



# DUCS 2.0: exploring new frontiers in research

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Research and Innovation Division,  
Universiti Teknologi MARA (UiTM) Selangor,  
Puncak Alam Campus

# **DUCS 2.0 : EXPLORING NEW FRONTIERS IN RESEARCH**

**UNIVERSITI TEKNOLOGI MARA SELANGOR,  
PUNCAK ALAM CAMPUS**  
Research and Innovation Division

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*“...extends its highest appreciation and gratitude to the Senior Management of UiTM Selangor Branch, as well as all Units and Divisions within UiTM Selangor, for their contributions toward the success of this publication.”*

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## FOREWORD

We begin by expressing our utmost gratitude to Allah SWT, whose blessings and grace have enabled the successful publication of this book.

Our heartfelt appreciation goes to the Rector of Universiti Teknologi MARA (UiTM) Cawangan Selangor, Professor Dr. Ahmad Taufek Abdul Rahman, for his unwavering support and trust in the realisation of this publication. We also extend our deepest thanks to the Deputy Rector (Research and Innovation), UiTM Selangor, Professor Ir. Ts. Dr. Mohamad Hafiz Mamat and former Deputy Rector (Research and Innovation), UiTM Selangor, Professor Ts. Dr. Asmah Awal, whose vision and encouragement served as a catalyst for this writing endeavour.

This book would not have been possible without the dedication and contributions of the authors; comprising researchers across various disciplines, the Research and Innovation Division, the editorial team, and the leadership of UiTM Selangor.

More than just a compilation of scholarly writings, this publication reflects the vibrant spirit of knowledge, creativity, and innovation thriving within the university's academic ecosystem. We hope it will serve as a valuable reference and a source of inspiration for readers, while contributing to the advancement of knowledge and technology.

Finally, we wish to convey our sincerest appreciation to all who have supported this endeavour, whether directly or indirectly. May this book be a meaningful contribution to the academic community and society at large.

Happy reading.

### **Editorial Board**

# Message from the Rector



---

Assalamualaikum Warahmatullahi Wabarakatuh and warm greetings.

All praise and gratitude be to Allah SWT for His abundant blessings and guidance, through which this book has been successfully compiled and published for the benefit of readers. This publication is a testament to the dedication, perseverance, and collaborative spirit of our researchers alongside the leadership of the Research and Innovation Division(BPI), UiTM Selangor.

I am immensely proud and would like to extend my highest appreciation to all parties who have contributed to the success of this publication. This book is not merely a collection of scholarly works, but also a reflection of the intellectual vigour, creativity, and innovation that continue to flourish within the academic ecosystem of UiTM Selangor.

This initiative by BPI, UiTM Selangor, aims to provide a platform for engagement and knowledge-sharing among researchers from various fields of expertise. The primary objectives are to foster research collaboration, strengthen grant proposal writing, and stimulate high-impact publications in targeted research areas. The publication of high-quality research outcomes through this effort is hoped to elevate the expertise and visibility of our researchers at both national and international levels.

In line with UiTM's aspirations to strengthen its position as a leading university, we are also advancing the agenda of Reset, Recover, and Restore to ensure the sustainability of UiTM Selangor's strategic plan towards realising a more competitive, realistic, and meaningful Research Campus.

I would also like to express my sincere appreciation to the entire editorial committee for their hard work, dedication, and commitment, which have enabled this book to be published successfully. May all these efforts be blessed and rewarded by Allah SWT.

In closing, I wish you an insightful reading experience. May this book bring immense benefit to its readers and serve as a source of inspiration to continue empowering a culture of research and innovation at UiTM.

*Wassalamu 'alaikum Warahmatullahi Wabarakatuh.*

**Professor Dr. Ahmad Taufek Abdul Rahman**  
*Rector, UiTM Cawangan Selangor*

## Message from the Deputy Rector



In the Name of Allah, the Most Gracious, the Most Merciful

*Assalamualaikum Warahmatullahi Wabarakatuh and warm greetings.*

First and foremost, I express my highest gratitude to Allah SWT, and send peace and salutations upon the beloved Prophet Muhammad SAW, for the abundant blessings, guidance, and grace bestowed upon us all.

With His permission and divine guidance, this book has been successfully completed and published for readers' benefit. On this meaningful occasion, I wish to extend my heartfelt appreciation and congratulations to the entire editorial team for their tireless efforts and unwavering dedication in ensuring the successful realisation of this publication.

This book compiles research papers from diverse fields of knowledge, contributed by researchers from UiTM Selangor. It is our hope that this research compilation will serve as a valuable and impactful reference for both the academic community and the nation.

I also sincerely hope that this book will provide significant benefits and serve as a source of inspiration for researchers, particularly within UiTM Selangor, to continue strengthening the culture of research, scholarly writing, and knowledge sharing in a sustainable manner.

In conclusion, I once again convey my deepest appreciation and gratitude to all who have contributed their ideas, time, and effort to make this publication a success. May all the sacrifices and dedication be blessed and rewarded by Allah SWT.

*Wassalamu 'alaikum Warahmatullahi Wabarakatuh.*

**Professor Ir. Ts. Dr. Mohamad Hafiz Mamat**  
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## **COLLEGE OF BUILT ENVIRONMENT**

# THE ROLE OF LOCAL AUTHORITIES IN MALAYSIA TOWARD SAFE CITIES INITIATIVE

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## ABSTRACT

Local authorities in Malaysia are facing mounting challenges in managing and maintaining urban areas. City life is complex due to the interactions of people in crowded areas. The performance of local authorities greatly influences the public's impression of the entire governance system, and safe delivery is a key metric for gauging a developed nation's success. The role of local authorities in the Safe Cities initiative is crucial for ensuring the safety and well-being of residents. Local authorities play a significant role in implementing, managing, and overseeing various aspects of creating a safe and secure urban environment. Various strategies and signs have been implemented to ensure safety. It is crucial to understand the role of LAs and how they represent safety initiatives, as reflected in the Safe Cities index. Therefore, in this study, three (3) local authorities (LAs) at central zone were chosen as the case study and stated as CS1, CS2 and CS3. A qualitative methodology using semi-structured interviews was conducted to achieve both objectives. The aim of this paper is to have an overall view of safe city implementation conducted and to what extent the core business of each LA aligned with the five (5) key domains of safe city: personal (physical), infrastructure, digital, health and environment security. Besides, it identifies which domain captures the most dominant among the departments within the local authority level. Besides, it identifies which domain captures the most dominant among the departments within the local authority level. This study reveals that only about half of the departments in the case studies were aligned with the task of creating safe city initiatives. It was implemented in 11 out of 22 departments to address objective one. The local authority council commonly utilises the domain of digital security among its various departments to address the second objective. The research findings provide crucial new information for establishing appropriate benchmarks for safe cities to be delivered at all council levels. The findings from this study hold significant importance, serving as a guiding light for other local authorities (LAs) seeking suitable benchmarks in their pursuit of a safer city paradigm. It's evident that the approach adopted by these authorities extends beyond crime prevention within the physical realm, encompassing multiple facets across safe city domains. This collective effort underscores the progress of LAs in Malaysia's central zone, demonstrating advancement not solely within specific departments but across the board. The forthcoming study explores diverse initiatives and strategies that promise to curtail operational costs while enhancing community life quality—a pivotal exploration. Ultimately, this approach can be extrapolated to municipalities and districts nationwide by tailoring adjustments to suit specific local contexts, fostering widespread implementation and positive impact throughout Malaysia.

**Keyword:** Local Authorities, Safe City, City Council.

## INTRODUCTION

It is estimated that the population of Malaysia will increase to 41.5 million by 2040, from 28.6 million in 2010 [1]. Additionally, a further increase of 40 million is expected by 2050. Urbanization is an ongoing process in Malaysia, which means that urban living and urbanism are crucial aspects of Malaysian society [2].

Densely populated cities no longer provide adequate protection for the well-being of urban society, as people flock there in search of employment to meet their diverse needs. This has resulted in inadequate amenities, leading to flooding and poor living arrangements in certain areas, which have generated a range of social problems, including crime. Typically, crime is the primary indicator of safety

performance. Nevertheless, even though the majority of studies exclusively discuss safe cities in connection to crime reduction [6][7][8], casualties from other problems like inadequate traffic management and vehicle accidents should also need to be taken into account to reflect safety [5]. While creating a safe community inside a city may entail multiple layers of stakeholders, the primary objective of public management in urban areas has been emphasised as providing a range of solutions related to safety and enhancing the quality of urban places [9]. Nonetheless, interested and impacted parties raised the matter of LAs' performance [10]. Thus, it is essential to comprehend the responsibilities and obligations of LAs.

Therefore, the study examined the function of local administrations (LAs) in the organisational structure of the city council by comparing workstreams within the council to better understand their contributions to the successful implementation of the safe city strategy. The study was conducted using a straightforward mapping exercise that involved the duties and responsibilities of the chosen city councils toward the five (5) safe city index domains: physical, infrastructure, health, digital, and environment security. This conceptual study was then developed as a result of the mapping. All levels of city councils are expected to gravitate towards the Safe City strategy.

### ***The Fundamentals of Safe City.***

A safe city indicates different perspectives among people. A safe city has no widely agreed-upon definition. As such, the idea of a safe city differs from nation to nation and city to city. A widely recognised definition of a safe and secure city is one that is livable, sustainable, inclusive, tolerant, and technologically advanced [11]. Governments, mayors, and legislators face their greatest task in ensuring the safety and security of their citizens. A dependable option, Safe City offers a range of integrated operational services for an incredibly intricate operational chain and efficient deployment, both at the local level within a municipality and via integration into a unified federal framework [12].

### ***Safe City Index***

Four (4) primary domains of the Safe City Index are digital, infrastructural, health, and personal. Environmental security was added to the Safe City Index in 2021 as the fifth major domain [16]. Because of this modification, the index now goes beyond the conventional urban safety box and aligns with the shifts in perception brought about by COVID-19. For the 2021 Safe City Index, more than 51 indicators were gathered, as mentioned in Table 1

**Table 1: Safe City Index**

Digital Security	Infrastructure Security	Health Security	Personal Security	Environmental Security
Privacy policy Citizen awareness of digital threats Secure smart cities Cybersecurity preparedness Public-private partnerships Percentage with internet access Secure internet servers Risk of attacks IT infrastructure risk Percentage of computers infected from online attacks.	Enforcement of transport safety Pedestrian friendliness Disaster management/business continuity plan Water infrastructure Hazard monitoring Road traffic deaths Deaths from climate-related disasters Transport infrastructure: Air transport facilities Transport infrastructure: Road network Transport infrastructure: Rail network Power network Institutional capacity and access to resources Catastrophe insurance Disaster-risk informed development Percentage living in slums Percentage of homeless population	Universal healthcare coverage Availability of public healthcare Availability of private healthcare Availability of OTC drugs Quality of private healthcare provision Quality of public healthcare provision No. of beds per 1,000 No. of doctors per 1,000 Access to safe and quality food Policy on substance abuse /drug use Pandemic preparedness Mental health Emergency services in the city Life expectancy years Infant mortality	Use of data-driven techniques for crime Gun regulation and enforcement Threat of terrorism Threat of military conflict Threat of civil unrest Police personnel per capita Prosecution personnel per capita Professional judges or Magistrate personnel per capita Expenditure on social security Laws on domestic violence Laws on sexual harassment	Sustainability masterplan Incentives for renewable energy Green economy initiatives Waste management Sustainable energy Rate of water stress Air quality levels Urban forest cover Waste generation

Source: Hino et al. (2021).

### ***Local Governments in Malaysia***

According to Malaysia's Constitution, state governments have exclusive jurisdiction over local governments, except those in federal territory. They have the power to oversee, organise, and carry out delegated tasks in a limited region [17]. All societal facilities that are being charted under Act 171 Sections 5(1) (Malaysia, 1976a) and 6(1) of the Town and Country Planning Act 1976, Act 172 [18] (Laws of Malaysia, 2006), which grants authority for development control [19], and Sections 101 and 102 of the Local Government Act 1976 serve this purpose. The term "local authorities" (Pihak Berkuasa

Tempatan, or PBT) is typically used to refer to local governments divided into city, municipal, and district councils. Table 2 shows that there are currently 152 Local Authorities in Malaysia.

**Table 2: Local Authorities in Malaysia**

Types of Local Governments in Malaysia	Numbers
Cities	19
Municipalities	40
Districts	92
Special Local Councils	1
<b>Total</b>	<b>152</b>

Source: Adopted from Local Government Department, Ministry of Housing and Local Governments (2022)

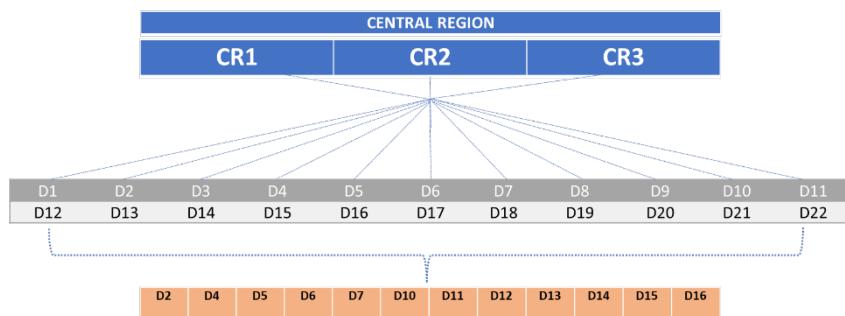
## MATERIAL AND METHOD

The first step is to review the local authorities' understanding of their roles and tasks in the organisation's workstream. Three (3) local authorities, namely CS1, CS2, and CS3, were selected due to their location, population, and economic condition, and they were among the prominent LA contributors to safe city initiatives.

The second stage involved a simple mapping exercise to explore how LAs are working to fulfil the safe city index based on the first finding. It is a descriptive exploratory study using primary and secondary data. Interview sessions were conducted with officers in the organization working in related fields. Three respondents were selected in this study. The study aims to indicate the specific area within the local authority management contribution regarding the safe city approach.

**Table 3: Representative Respondents of City Council and Administrative Unit**

Case Study	Respondent	Scope Of Task	Working Duration with LAs
CR1	R1	Deputy Director of Town Planning Officer Sustainable Development	More than 18 years
CR2	R2	Senior Officer of Town Planning Sustainable Development	More than 10 years
CR3	R3	Deputy Director of Town Planning Officer Sustainable Development	More than 20 years



Note:

CR = Local Authority – City Council

D1 – D22 = Management Unit in City Council

## RESULTS AND DISCUSSION

This section analyzes the multifaceted aspects of creating and sustaining safe cities. It delves into the complex interplay between various workstreams that collectively contribute to the overall safety framework within urban environments.

This study involved representatives from three city councils in the central zone of Selangor, who were selected to represent the other 19 city councils across Malaysia's 14 states. Within CS1, CS2, and CS3, there are 22 departments. The study utilised a socio-legal approach involving library-based research and interviews with senior officers from the three local authorities (LAs).

According to this study, only 12 departments have aligned more than 50% with the various safe city domains. These departments are D2, D4, D5, D6, D7, D10, D11, D12, D13, D14, and D15, as presented in table 4. It also indicates that most of the departments in the local authority did not address any of the safe city domains, such as Digital, Infrastructural, Health, Personal, and Environmental Security. Nevertheless, the remaining departments, including D1, D3, D8, D9, D16, D17, and D22, have still been contributing to the community, but to a lesser extent than the first 12 departments, as they have addressed their tasks toward safe city indicators minimally.

The Safe City initiatives carried out by 11 departments (D2, D3, D5, D6, D7, D9, D10, D11, and D12) reflect significant progress towards the five domains listed in the Safe City Index, which contribute 40% towards a safer city. While most departments focus on a specific domain, it is noteworthy that some departments, such as D5, D10, and D11, work simultaneously on multiple domains. The organisation seems to have made significant strides towards digitisation, which could result from the COVID-19 pandemic that forced changes to maintain productivity.

**Table 4: City Council's Work Scope and Departmental Unit**

Code	Department /Unit	Scope of Work	Representative Officer			Safe City Indicators	Domain
			CS1	CS2	C S3		
D2	Corporate Department and Strategic Management Unit/ Sector of Corporate and Strategic Management	Responding and responding to issues arising in the mass media.	/	/	/	Secure Smart Cities	Digital Security
		Preparation and coordination of information on the mass media	/	/	/		
		Coordinating the flow of public complaints process and call centre management	/	/	/		
		Carry out monitoring at the location of complaints periodically.	/	/	/		
D4	Department of Information Technology Unit	Planning, developing and implementing the use of ICT	/	/	/	Privacy policy Citizen awareness of digital threats	Digital Security
		Providing the latest ICT facilities to employees and to the citizens of LA.	/	/	/		
		Provide exposure and culturalization of ICT	/	/	/		
D5	Department of Development Planning	Planning development within the area of LA toward sustainable development	/	/	/	Sustainability masterplan	Physical Security
		Prepare and monitor Structural Plans and Local Plans Check the policies provided to be improved and updated occasionally.	/	/	/	Use of data-driven techniques for crime	Environment Security
		Process the application for permission to plan the layout/standing of the building.	/	/	/	Sustainability masterplan	Infrastructure Security
		Coordination and enforcement of authorized and unauthorised properties	/	/	/		
		Coordinate planning standards and guidelines.	/	/	/		
		Supporting applications to charge land conditions, lot mergers, and government land applications	/	/	/		
		Support license application, development plans	/	/	/		
		Monitor the development of low-cost houses.	/	/	/		

		Geography Information System (GIS)	/	/		Secure smart cities Hazard monitoring.	Infrastructure Security
D6	Engineering Department	Responsible for reviewing, approving and infrastructure plans for the new and existing development areas	/	/	/	Enforcement of transport safety	Infrastructure Security
		Process and issue earthwork permits	/	/	/	Pedestrian friendliness	
		plan, manage coordinate and maintain infrastructure facilities drain, flood repair works and projects	/	/	/	Disaster management	
		Monitor, supervise and maintain slopes from landslides	/	/	/		

D7	Department of Health and Environmental Services	Controlling and monitoring business premises, industry, workshops, kindergartens, nurseries, dogs	/	/	/	Quality of public healthcare provision	Health Security
		Enforcement, monitoring and inspection on food premises and public building	/	/	/	Access to safe and quality food	
		Disease control using dengue fever control, abandoned (land and house) and cemetery management	/	/	/	Quality of public healthcare provision	
		Nuisance animal control	/	/	/		
D10	Building Control Department	Processing and approving plans for additional new buildings and amendments to existing buildings	/	/	/	Percentage with internet access	Digital Security
		CCC application	/	/	/		
		Designing and supervising special projects of the Council such as stalls, halls, 'food-court' and others	/	/	/	Use of data-driven techniques for crime	Physical Security
		Process and approve equivalent permits for construction/temporary buildings permits	/	/	/	Sustainability masterplan	Environment Security
		Monitor, inspect and enforce the law among illegal construction projects	/	/	/		
D11	Society/Community Development Department	Ensure programs and activities organized by the Department are implemented efficiently and effectively	/	/	/	Community based patrolling	Environment Security
		Ensure the 24 zones and Resident Representative Council implements the program planned	/	/	/	Level of police engagement	Physical Security
		Providing library services to the community to cultivate a knowledgeable society	/	/	/	Community based patrolling	Environment Security
		Organize sports and youth programs for the community in the LA territory to inculcate spirit of racial	/	/	/		
D12	Department of Enforcement	Implement the enforcement of laws and regulations	/	/	/	Sustainability masterplan	Environment Security
		Operation of a 24-hour to receive, monitor and provide preliminary enforcement services for emergencies	/	/	/	Secure smart cities	Digital Security
		Providing and providing rescue assistance services in the event of disasters and floods	/	/	/	Hazard monitoring	Infrastructure Security
		Controlling and taking care of the property of the Council	/	/	/	Level of police engagement	
		Integrated enforcement in technical actions (Task Force)	/	/	/		

		Enforcement of wrong parking which gazetted as Towing Zones	/	/	/		
D13	Landscape Department	Landscape project planning and management	/	/	/	Sustainability masterplan	Physical Security
		Park maintenance and landscape maintenance programs on a contractual and 'in-house' basis	/	/	/	Waste management	Environment Security
		Manage the supply of plant material and nursery activities	/	/	/		
D14	Licensing Department		/	/	/		Physical Security
D15	Department of Solid Waste Management & Public Cleaning/ Environment		/	/	/	Waste management	Environment Security

**Table 5: City Council Division Enhancing Safe City Initiatives**

Code	Department	Safe City Indicators					Domain
		Digital Security	Information Security	Infrastructure Security	Physical Security	Environmental Security	
D2	Corporate Department and Strategic Management Unit/ Sector of Corporate and Strategic Management	/					3
D4	Department of Information Technology Unit	/					3
D5	Department of Development Planning	/	/		/		1
D6	Engineering Department		/				3
D7	Department of Health and Environmental Services			/			3
D10	Building Control Department	/					3
D11	Society/Community Development Department				/	/	2
D12	Department of Enforcement	/	/				2
D3	Landscape Department					/	3
D14	Licensing Department	/					3
D15	Department of Solid Waste Management & Public Cleaning/ Environment					/	3
		6	3	3	2	3	

According to Table 5, the Safe City domain that was most highly used was Digital Security. The Department of Development Planning had the safest city domains, including Digital security, infrastructure security, and physical security.

This finding shows that the Department of Development Planning emerged as the primary hub for various Safe City domains, with Digital Security being the most extensively utilised. This department notably covered a spectrum of domains crucial to Safe City initiatives, encompassing Digital Security, Infrastructure Security, and Physical Security.

## CONCLUSION

The study results are very important as they help other local authorities (LAs) identify the right benchmarks to use in their work towards a safe city approach. The approach taken by LAs is not only related to the physical domain, which focuses on preventing crime, but it also contributes towards other

elements of the safe city domains. This collective approach within the organisation helps to show that LAs located in the central zone of Malaysia are not only progressing through one specific department, but through all. The next study will explore various initiatives and strategies that can have a great impact in minimizing operation costs, while still improving the quality of life within the community. Eventually, a similar approach can be implemented in other municipalities and districts throughout Malaysia by making certain adjustments that are tailored to the local context.

## REFERENCES

- [1] Embong, A. (2011). Urbanisation and Urban Life in Peninsular Malaysia. academic, 23-39. 040023-608 October 2023 15:41:47
- [2] Marshall, W. & Garrick, N. (2010). Street network types and road safety: A study of 24 California
- [3] Malek , J., & Ibrahim , M. (2015). Bandar Selamat dan Keselamatan Komuniti Bandar Selamat. Journal of Social Science and Humanities, 97-117
- [4] Davies, G.H. What Are the World's Safest Cities? Available online: <https://www.movehub.com/blog/worlds-safest-cities/> (Last updated on 20 Feb 2020 accessed on 7 November 2020)
- [5] Lacinák, M., & Ristvej, J. (2017). Smart City, Safety and Security. TRANSCOM 2017, 522 – 527
- [6] Aris Anuar, A. Bookhar, S., & Aziz, N. (2012). The Effectiveness of Safe City Program as Safety Basic in Tourism Industry: Case Study in Putrajaya. Social and Behavioral Sciences, 477-485.
- [7] Sidhu, A.M. (2005). The Rise of Crime in Malaysia – An academic and statistical analysis. Journal of the Kuala Lumpur Royal Police College, no.4, pp.1-28.
- [8] Wereda , W., Moch , N., & Wachulak, A. (2022, 1). The importance of stakeholders in managing a safe city. Sustainability (Switzerland), 14(1).
- [9] Hamdan & Norudin (2010) Customers' Satisfaction towards Counter Service of Local Authority in Terengganu, Malaysia in Asian Social Science (v6) p 197
- [10] Vitalij, F., Robnik, A., & Alexey, T. (2012). "Safe City"-an Open and Reliable Solution for a Safe and Smart City.
- [11] Shamsuddin, S., Azim, N., & Hussin, B. (2013). Safe City Concept and Crime Prevention Through Environmental Design (CPTED) for Urban Sustainability in Malaysian Cities. Retrieved from <http://TuEngr.com/ATEAShttp://TuEngr.com/ATEAS/V02/223-245.pdf>
- [12] Ceccato, V., & Lukyte, N. (2011). Safety and Sustainability in a city in transition: The case of Vilnius Lithuania. Cities, 83-94.
- [13] Al-Ghiyadh, Mohammed Abdul-Kadhum, & Al-Khafaji, Saba J. Neamah. (2021). The Role of Urban Planning and Urban Design on Safe Cities. IOP Conference Series: Materials Science and Engineering
- [14] Hino, K., Professor, A., Léon, E., Oni, T., Health Physician, U., Singham, G., Professor, A. (2021). Safe Cities Index 2021 New expectations demand a new coherence: <http://pqi.stats.gov.my/result.php?token=69fa6eecc9ee2be312df1edb7dd5ddb1>
- [15] Kamarudin, N., Noordin, n., Zakaria, Z., & Mustaffa, J. (2011). The future challenges of local
- [16] Abdul Khalid, S. N. (2010). Improving the service delivery: A case study of the local authority in Malaysia. Global Business Review, 11(1), 65–77
- [17] Azman, Farida, Dayang, (2009) The Mediating Effect of Empowerment in the Relationship between Transformational Leadership and Service Quality in International Journal of Business and Management (v4) p 3-5 cities. Urban Design International, 133-147
- [18] Department of Statistics, Malaysia. (2020, 11 February Tuesday). Retrieved from Time series population
- [19] Ministry of Home Affairs India. (2021). Safe City Indicators.
- [20] Laws of Malaysia. (2006). Town And Country Planning Act 1976. Local

# Augmented Reality (AR) for Deaf and Hard of Hearing (DHH) for Animation

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## ABSTRACT:

Augmented Reality (AR) technology in education faces a significant gap, especially for deaf and hard-of-hearing (DHH) students. Research has shown the vast growing technologies for AR in many sectors; however, implementing the technologies towards education for DHH students is still lacking in Malaysia. This study aims to provide a rationale and justification for using AR technologies for DHH students for animation. Based on a literature review, five important keys drive the research questions. For the context of this paper, the five considerable keys are AR as a teaching aid (1), the importance of Art and Design (2), and social stigma (3). These primary keys are to support and justify this research. An interview was conducted with teachers who teach DHH students to further help the three primary keys. An interview with the AR developer was also conducted for this research. The study developed an AR with animation based on the interview and record-keeping. The results show that implementing this technology will significantly impact DHH students, especially in the Art and Design field. When exploring and using the AR Application, DHH students feel awkward. They are not used to using the AR application in their class. Regardless they all enjoy using it as it will have vast potential and possibility. As technology grows, DHH Students will have one step ahead of others. Worth mentioning the social stigma among them and how future research would continue and diminish the social stigma.

**Keywords:** Augmented Reality, Deaf, Hearing disabled, literature review, animation.

## INTRODUCTION

Augmented Reality (AR) technology in education develops learners to engage in authentic exploration in the real world, and virtual objects such as typography, images, and videos are vital features for learners to explore the surroundings of the natural world (Wu, Lee, Chang, & Liang, 2013). AR as an enhanced reality has fascinating features for educational approaches. And they could extend their attributes to any wide range of possibilities when the system connects to other types of technologies (Wu, Lee, Chang, & Liang, 2013). However, deaf and Hard of Hearing (DHH) students cannot absorb learning typically; this is because of their physical and mental disabilities, and they require individual attention and exceptional help from parents and teachers in their learning process (T. Perera, S. D. Wijerathne, M. Wijesooriya, Dharmarathne, & Weerasinghe, 2012).

Although AR is an emerging and growing technology in education environments (Johnson, Levine, & Stone, 2010), the available studies in Malaysia are still inadequate; there is a very minimum implementation of AR for DHH students in Malaysia. They used AR mainly as a marketing tool (Ng & Ramasamy, 2018) and lacked DHH for Animation. For the context of this paper, the researcher refers to *DHH for Animation* as using AR technology to teach DHH students Animation.

While previous studies have investigated AR for DHH students (Zainuddin, Zaman, & Ahmad, 2010), they focused more on science subjects. A systematic analysis of the AR benefits of DHH for Animation is yet to be accomplished (Wu, Lee, Chang, & Liang, 2013). Previous research does not consider the relation between AR and DHH for Animation. To close this research gap and the potential of AR for DHH students, the researcher presents two research questions:

1. *Why using AR Applications for DHH students is relevant?*
2. *Why are Art and Design subjects such as animation important to DHH students?*

To answer these questions, the researcher conducted Content Analysis through the literature review and sorted it into three primary keys to support the research questions. The researcher also interviewed DHH teachers and AR experts to support and justify the five essential keys.

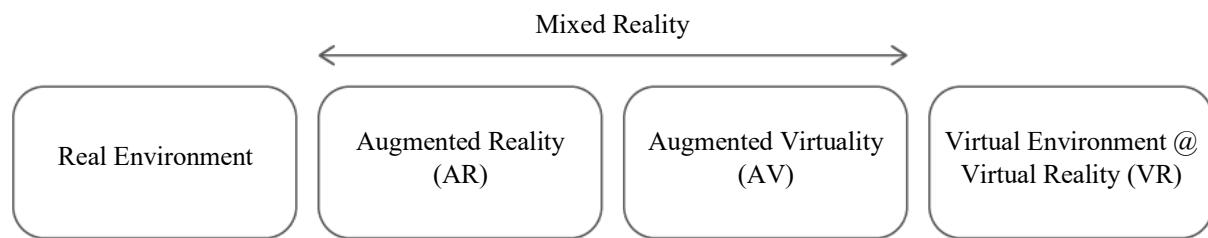
This paper proceeds as follows. Section 2 introduces the AR application and use of AR among DHH students. Section 3 is mostly presenting points and data to complement and support the two

research questions. The researcher discusses the findings in section 5. The topic paper ends with a conclusion for research and practice in section 6.

### ***Augmented Reality in General Educational Environments***

#### ***The Introductory of Augmented Reality***

AR was introduced decades ago in 1962, from retail to education to manufacturing (Gandolf, 2018). AR has exploded to \$108 (RM486) billion in revenues by 2021, and it's still considered the origin of the future of computing (Blackeye VR Limited, 2017). The term AR was suggested in 1990 by Boeing researcher Tom Caudell. AR and VR have been tied by bridging "mixed reality" concepts. According to Boyajian 2017, AR has overshadowed Virtual Reality (VR) functions since AR offers more practical daily use cases (Boyajian, 2017). Augmented Virtuality (AV) represents a method by which the virtual reality environment can be enriched with information from the natural world to connect the virtual to the real world. France is one of the leading countries in exposing and nurturing students to AR. In 2015, the government released an updated curriculum for students to integrate AR into their studies (klaspad, 2017). The government recognizes that using immersive AR technology in the public school system provides all students with the keys to understanding the contemporary technical environment and acting skills (klaspad, 2017). Many AR apps are available for the user in the Google Play Store or Apple Store worldwide. All apps comprise many features of their own, from daily tasks to education. AR is vital as Teaching Aid in today's growing technology world (Johnson, Levine, & Stone, 2010).



**Fig. 1 Reality-Virtuality Continuum (Milgram, Takemura, Utsumi, & Kishino, 1994)**

AR can be interpreted as a *view of a physical world environment whose elements are integrated with computer-generated sensory input* (Freina & Ott, 2015). The aim is to see and experience the natural world mixed with various virtual objects without losing the sense of reality (Persefoni & Tsinakos, 2015).

### **Augmented Reality for Deaf and Hard of Hearing Students**

According to Sudana, Aristamy, and Wirdiani (2016), creating a AR 3D application for Android Device helps the typical student learn sign language to communicate with DHH students. They urge more researchers to apply AR features for the application of education, aimed at the broader scope of the DHH. Currently, there are many Augmented Reality applications created for the DHH. However, most applications were designed for communication and focused on sign languages (Chang, 2018).

Research regarding AR in supporting DHH students in mainstream schools has increased by numbers in the European country. The exceptional teachers positively endorsed the experience of AR technology in real-world settings, serving the needs of special education students and potentially contributing to a more inclusive classroom environment (Loannou & Constantinou, 2018). Although recent studies exist on AR for DHH students in Malaysia (Zainuddin, Zaman, & Ahmad, 2010), the studies focus more on science subjects. However, it is crucial to highlight AR helps visualize the approach toward DHH students. Because there are visual learners (Zainuddin, Zaman, & Ahmad, 2010), they will be able to grasp more content through AR, which was beneficial to them. Furthermore, it is worth mentioning how essential to have the empirical study of Art and Design subjects on DHH students since Saxena and Jain (2013) reveal that social intelligence in the Art and Design stream is better than in the Science stream (Saxena & Jain, 2013).

## METHOD

### *Interviews*

The researcher employed structured interviews with teachers who teach DHH students. The interview was based on the research question and to get the ground rules of the current state of their teaching. This interview is to support and justify the previous section. And to identify the support of technologies among DHH students in class. The finding's accordance with the following set of themes.

1. *Art and Design Subjects as elective courses among deaf students.*
2. *Learning Module through AR and VR technologies.*
3. *Teaching deaf students.*

In the first theme, the researcher asks three sets of questions regarding Art and Design subjects. Based on the answer, art and design subjects have a firm foundation among deaf students. This will amplify the needs and essentials of the Art and Design stream subject. Furthermore, Saxena and Jain, 2013 mention that social intelligence in the Art and Design stream is better than in the Science stream (Saxena & Jain, 2013). The researcher focused on using technology in class and AR and VR technologies as teaching aid in the second theme. Results of interviews with teachers found that technology is necessary for class. However, the use of AR and VR technologies is still far-fetched. The teachers themselves may not be familiar with the help of the AR technologies among deaf students in class; they only encounter the AR technologies with other implementations in a non-learning environment. This amplifies Sudana, Aristamy, and Wirdiani (2016), urging more researchers to apply augmented reality features to apply learning/education aimed at the broader scope of the DHH students. On the last theme, this set of questions highlights some problems that teachers face when teaching deaf students. To summarise, they are some limitations when using sign language. Teachers will come out with their sign language through graphic demos and tutorials.

The researcher employed structured interviews with AR experts who develop AR applications. The interview was based on the research question. The interview finds out the limitation when developing a brand-new application and the importance of this technology used in the education environment—the finding's accordance with the following theme.

1. *Limitations when developing or starting a brand new application*

This theme is to find out the overall limitation when developing an AR app. And supporting the use of AR is relevant and practical for DHH students. In referring to the use of VR, even though today's mobile smartphones are capable of running high computational graphics, a fully immersive experience can only be achieved with an HMD device with a larger field of vision (FOV) and robust interactivity with the joystick or hand gestures, such as the Oculus Quest 2. And again, supporting the use of AR is more relevant than VR among DHH students in a current education setting. Less hassle and more convenient to set up.

### *Record keeping*

### *Augmented reality as a teaching aid*

One of the keys to supporting AR as a teaching aid is its improved development of spatial abilities. Previous studies mention that results support the hypothesis and suggest that AR has some potential to aid the learning of 3D concepts effectively. (Diegmann, Schmidt-Kraepelin, Eynden, & Basten, 2015). With the help of AR, students can acquire a new level of spatial abilities. Students have also been satisfied and motivated when physical interaction is identified as a driver of enhancing emotional engagement (Diegmann, Schmidt-Kraepelin, Eynden, & Basten, 2015).

### *The importance of Art and Design*

Art and design curriculum should be available to many students, including special needs students such as deaf and hard of hearing. All students have their potential, some greater than others. If we guide them in the right direction and recognize, educate and nourish them, the potential risk will decrease, and promise will flourish. (Hartman, 2007) Hartman believes deaf education is continually changing ways to instruct deaf and hard-of-hearing students. And there will always have an improvement in deaf education, especially in the art curriculum. The development of extensive art education for deaf students is essential. It will improve the art vocational skills of deaf students, form their healthy personalities, enhance their future employment competitiveness and achieve their professional goals in the future (Lan, 2018).

### ***Social stigma***

According to the press statement by the Human Rights Commission of Malaysia (SUHAKAM), in 2020, people with disabilities such as blind and deaf in Malaysia still face difficulties in various common aspects. The most frequent barriers are attitudinal, communication, physical, policy, programmatic, social, and transportation—this leads to a lack of resources to feed and develop technologies for DHH education. The existence of deaf individuals influences the economy in most developing countries. This occurs because deaf children are not receiving adequate schooling (World Health Organization, 2021). Compared to regular individuals, most deaf individuals have a low percentage of academic credentials. As a result, it is critical to improve learning opportunities, occupational skills, and awareness within the deaf population to assist them in succeeding in school on an equal footing. Hence the Augmented Reality technology was selected, and acting as a tool to help them would impact visual learners like them.

### ***Prototype development***

The researcher has developed a prototype based on the previous study and interviews with both teachers and AR experts. The outcome of the prototype development is a three-dimensional, immersive learning environment for DHH students. The design aims to enable the students to learn, interact, and feel like they are in the physical world. The design outcome is a 3D Animation, immersive learning environment for DHH students. The researchers chose one of the introductory interior design chapters for this prototype. These chapters cover the fundamentals of becoming an interior designer and expose them to basic furniture. The content includes deaf interpretation by Dr. Sharmizi. The researchers are using WebAR for this prototype. WebAR is a platform where users don't have to download any application, and the content is rendered through their browser on the phone. The figure below shows the screenshot of the prototype.



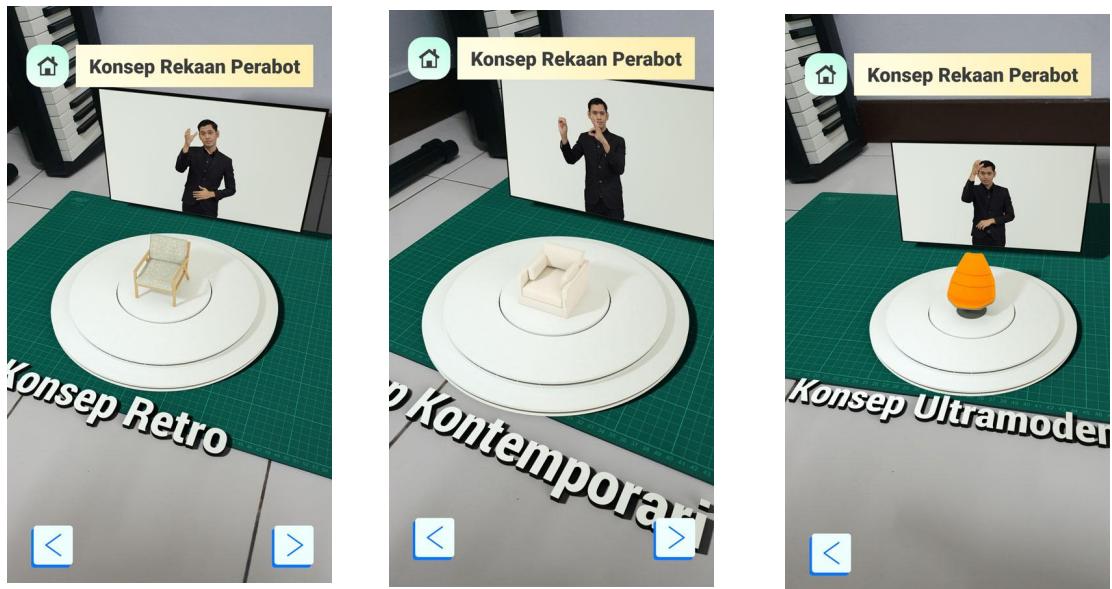
Figure 4: Animation 3, the furniture 1 is raised, along with Deaf interpretation.



Figure 5: Animation 4, the furniture 1 is set, along with Deaf interpretation.



Figure 6: Furniture 2 is set, along with Deaf interpretation.



### Testing

Non-formal testing was conducted virtually. The researcher managed to get three DHH students through the teachers. The WebAR prototype link is given to the teachers, then passed to the students. The students were guided to explore the WebAR prototype by the teacher to understand what it is. Then the teacher facilitated the students to explore the prototype and came up with their reviews on the prototype. The researcher has created a quick and straightforward brief survey to make it easier for the student's review and give feedback.

## RESULT

Based on the prototype that has been created, the researcher used it to enhance the learning environment of deaf students through AR. The researcher leveraged this prototype as a tool to create a platform that will facilitate the interaction between teachers and students. With the help of AR, the researcher provided more visual materials to improve the understanding of sign language, along with using animation for the content. The researcher leveraged AR to create a platform where teachers and deaf students can interact. Deaf students, when exploring the prototype, feel awkward as the prototype is branded for educational purposes; this indicates the use of Augmented Reality in their regular class is still new. Deaf students need to become accustomed to the new concept and become comfortable with AR usage for educational purposes. This is to ensure that they can productively utilize the technology in the future. Regardless they all enjoy using AR technology. It sparks their interest and piques their curiosity. The AR technology has the potential to be an integral part of the teaching-learning process. The fact that the DHH students enjoy using the technology indicates that the AR world could be a vital tool to engage them in the learning process.

## DISCUSSION

The result shows a vast gap between education and technology among DHH students, especially AR technology. It is also essential to highlight the importance of art and design subjects for DHH students, as emphasized by previous research and confirmed by teacher respondents. These results build on existing evidence from Parton, Hancock, & Dawson (2010). When digital and real-world events are combined, it will create immersive learning opportunities for students. The previous research also shows the alignment result with the current study is on the right track. The results' generalizability is restricted by theoretical progress and justification from literature review and interview. It is beyond the scope of study to create an extensive scale prototype pilot test among deaf students during the current pandemic. However, the result is heavily suggested and verifies the importance of AR technologies and their possibilities. This leads to further research to establish a pilot test and prototype.

## CONCLUSION

Based on the analysis and the research findings, the literature review, which highlights five significant points, justifies the research questions. In addition, all respondents are interested and highly agreed on utilizing AR for DHH students. In addition, respondents from teachers showed an interest in AR technology and its learning styles for DHH students. Therefore, it will have significant potential and relevance in providing effective learning for students and teachers. And the importance of this research is to narrow the gap between education and technology for DHH students. The press statement by the Human Rights Commission of Malaysia (SUHAKAM) in 2020 states that persons with disabilities such as blind and deaf in Malaysia still face difficulties in various common aspects. The most frequent barriers are attitudinal, communication, physical, policy, programmatic, social, and transportation. This research is one step closer to creating a benchmark for deaf students, creating competitiveness in their future careers with regular students.

## REFERENCES

Blackeye VR Limited. (2017). *Virtual Gets Real*. New Zealand: NZVRARA Inc.

Boyajian, L. (2017, March 22). *New opportunities for augmented reality*. Retrieved from THE REALITY OF AUGMENTED REALITY: <https://www.networkworld.com/article/3184071/new-opportunities-for-augmented-reality.html>

Bronack, S. C. (2011). The Role of Immersive Media in Online Education. *The Journal of Continuing Higher Education*, 113-117.

Chang, T. D. (2018). *The studies on loose hand gesture recognition*. 桃園市中壢區 [Zhongli District, Taoyuan City].

Farhan, W., & Passi, K. (2016). E-learning User Interface For Visual and Hearing Impaired. *Proceedings of the International Conference on e-Learning, e-Business, Enterprise Information Systems, and e-Government* (pp. 10-16). Sudbury: CSREA Press.

Freina, L., & Ott, M. (2015). A literature review on immersive virtual reality in education: state of the art and perspectives. *The international scientific conference eLearning and software for education*, 10-1007.

Gandolf, E. (2018). Virtual Reality and Augmented Reality. *Handbook of Research on K-12 Online and Blending Learning*, 545-561.

Hartman, L. (2007). Modified art curriculum for deaf students with secondary. *Rochester Institute of Technology*, 74.

Jabar, A. R., Noh@Seth, N., Jambari, H., Pairan, M., Mohd Ahyan, N., & Lokman, N. (2020). Exploring the Potential of Augmented Reality Teaching. *Proceedings of the 2020 11th International Conference on E-Education, E-Business, E-Management, and E-Learning*, 54-58.

Johnson, L., Levine, R., & Stone, S. (2010). *The 2010 Horizon Report*. Austin, Texas: The New Media Consortium.

klaspad. (2017, November 8). *Augmented reality in education*. Retrieved from Introduction | KLASPAD: <https://www.klaspad.com/blog/?p=113>

Lan, F. (2018). The Role of Art Education in the Improvement of Employment Competitiveness of Deaf College Students. *2nd International Conference on Art Studies: Science, Experience, Education* (pp. 879-883). Atlantis Press.

Loannou, A., & Constantinou, V. (2018). Augmented Reality Supporting Deaf Students in Mainstream Schools: Two Case Studies of Practical Utility of the Technology. *Interactive Mobile Communication Technologies and Learning*, 387--396.

Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1994). Augmented Reality: A class of displays on the reality-virtuality continuum. *Telemanipulator and Telepresence Technologies*, 282-292.

Ng, C. C., & Ramasamy, C. (2018). Augmented Reality Marketing in Malaysia. *Future Scenarios*, 224.

Parton, B. S., Hancock, R., & Dawson, J. (2010). Augmented Reality for Deaf Students: Can Mobile. *Human-Computer Interaction*, 309-312.

Persefoni, K., & Tsinakos, A. (2015). Use of Augmented Reality in terms of creativity in School learning. *Make2Learn@ICEC*, 45-53.

Saxena, D., & Jain, D. K. (2013). Social Intelligence of Undergraduate Students In Relation To Their Gender and Subject Stream. *Journal of Research & Method in Education*, 1-4.

Sudana, A., Aristamy, I., & Wirdiani, N. A. (2016). Augmented Reality Application of Sign Language for Deaf People in Android Based on Smartphone. *International Journal of Software Engineering and Its Applications*, 139-150.

T. Perera, N., S. D. Wijerathne, I., M. Wijesooriya, M., Dharmarathne, A., & Weerasinghe, A. (2012). ICT based education for students with special educational needs in Sri Lanka. *International Conference on Advances in ICT for Emerging Regions*, 156-164.

Tasneem Khan, Kevin Johnston, & Jacques Ophoff. (2019). The Impact of an Augmented Reality Application on Learning Motivation of Students. *Advances in Human-Computer Interaction*, 14.

Tkachuk, V., Yechkalo, Y., & Markova, O. (2017). Augmented reality in education of students with special educational needs. *5th Workshop on Cloud Technologies in Education* (pp. 66-71). Ukraine: CEUR-WS.

World Health Organization. (2021, April 1). *Deafness and hearing loss*. Retrieved from World Health Organization: <https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss>

Wu, H.-K., Lee, S. W.-Y., Chang, H.-Y., & Liang, J.-C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers & Education*, 41-49.

Yahya-Isa, S. (2004). *Against All Odds*. Penang: Forda Printing Sdn. Bhd.

Zainuddin, N. M., Zaman, H. B., & Ahmad, A. (2010). Developing Augmented Reality book for deaf in science: The determining factors. *2010 International Symposium on Information Technology*, 1-4.

SUHAKAM. (2020, December 3). Press Statement No. 37 of 2020 ("International Day of Persons with Disabilities 2020") [Press release]. <https://suhakam.org.my/2020/12/press-statement-no-37-of-2020-international-day-of-persons-with-disabilities-2020/>

**COLLEGE OF CREATIVE ART**

# IMAGE REPRESENTATIVE WITH HOLOGRAPHIC TECHNIQUE AS AN ALTERNATIVE READING METHOD FOR DYSLEXIC

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## ABSTRACT

This research strives to address the unique obstacles experienced by dyslexic children in their reading process by proposing an alternate teaching method employing image representation with holographic techniques. Dyslexia, a condition marked by neurobiological impairments, frequently impedes an affected individual's ability to analyze the alphabet and efficiently process textual information, particularly in reading. Due to the unique educational requirements of dyslexic children, which diverge from those of typically developing children, there is a clear imperative for developing targeted instructional resources designed to address their specific impairments. Therefore, this study presents an alternate pedagogical methodology to assist children with dyslexia, acknowledging the pressing nature of the issue. The study employs a purposive sampling method to select participants from the Persatuan Dyslexia Malaysia (PDM) in the Klang Valley, Malaysia, focusing on children aged 6 to 9. Utilizing a descriptive research methodology, the study applies qualitative methodology to collect detailed insights. The methodology applied encompasses direct observations of children with dyslexia and interviews with the teachers actively engaged in their educational processes. The research results highlight the efficacy of a reading methodology that integrates image representation with holographic approaches, indicating that dyslexic children readily embrace this unique approach. Moreover, the findings of this study make a substantial contribution to the provision of dyslexic children with an educational experience that is both valuable and engaging while also being in line with current educational practices. Introducing this alternative reading method elicits enthusiasm among dyslexic children, cultivating a favorable disposition towards literacy within the educational setting. The holographic technique effectively attracts the attention of dyslexic children and offers a multisensory approach that caters to their distinct learning preferences. As a result, it is recommended that teachers who are responsible for instructing dyslexic children adapt their instructional approaches in order to address the distinct difficulties associated with dyslexia, hence fostering an inclusive and efficient educational setting. This study supports implementing innovative methods and highlights the significance of teacher training and knowledge in effectively integrating new approaches into conventional education. In summary, the research highlights the significance of considering the distinct requirements of children with dyslexia and adapting instructional approaches to optimize their educational encounters. The suggested alternative reading method, which integrates image representation and holographic approaches, presents itself as a potentially fruitful route for enhancing student involvement and enhancing reading proficiency in children with dyslexia. This study provides valuable contributions to the special education field and promotes a more inclusive and dynamic instructional approach for dyslexic children in the context of Malaysian education. It highlights the importance of ongoing exploration and integration of innovative techniques to enhance the learning experience of dyslexic children.

**Keywords:** Dyslexia, Dyslexic Children, Teaching Aids, Image Representative, Holographic Technique

## INTRODUCTION

Dyslexia, a specific learning disability, presents unique challenges in reading, writing, and language processing. Individuals with dyslexia often experience letter reversals—confusing 'b' with 'd' or 'n' with 'u—as well as difficulties in associating letters with sounds, following directions, and maintaining focus. These challenges significantly impact their ability to process and retain information effectively, often leading to frustration and diminished self-esteem. Studies (Vicari et al., 2005; Shaywitz, 2003; Berninger et al., 2008) highlight that dyslexia are unrelated to visual or auditory impairments but stems from neurological differences that influence cognitive functioning.

In Malaysia, dyslexia are categorized as a Specific Learning Disability (SLD). It is estimated that 5% of Malaysian school children are dyslexic (New Straits Times, 2009), necessitating targeted intervention programs. Despite the provisions of the Compulsory Education Policy (2003) aimed at ensuring equal opportunities for all students, dyslexic children often face unmet educational needs. These gaps in support underline the necessity of developing and implementing specialized teaching methodologies. This research introduces image representation with holographic techniques as a potential solution, aiming to address these gaps by providing an engaging and effective learning tool tailored to the specific challenges faced by dyslexic learners.

### **Objectives**

This research seeks to:

1. Examine the current practices in teaching reading to dyslexic children, with a focus on understanding their limitations and identifying opportunities for improvement. This includes analyzing the methods employed by educators and evaluating their effectiveness in addressing the unique challenges of dyslexia.
2. Develop and assess an innovative image representation technique utilizing holography to create 3D effects. This approach aims to enhance engagement, foster curiosity, and improve reading comprehension among dyslexic children. By leveraging technology, the research seeks to introduce a multisensory experience that aligns with the cognitive preferences of dyslexic learners.

These objectives are designed to align with broader educational goals, ensuring that the proposed intervention not only addresses immediate challenges but also contributes to the long-term inclusion and empowerment of dyslexic students in educational settings.

### **Problem Statement**

From preliminary research conducted, it is identified that dyslexia children are facing difficulties and lack of focus in learning particularly in reading. Learning styles are defined as an individual's preferences for acquiring and using information when learning (Herod, 2002). Subsequently, the definition demonstrates that a distinctive individual has a diverse learning style. There are three basic types of learning styles that are very simple and efficient for children namely visual, auditory, and kinesthetic (Beatrice, 1994). Besides, as dyslexic children are easily losing their focus, therefore attention must be given to identify how well the reading method by using the image representative with holographic technique to enhance the reading style for dyslexic children. Previous research was conducted by Fadilahwati et al., (2009) revealed that dyslexic children needed to be motivated and engaged well in learning by using multimedia components such as animation, audio, graphics, and text. It is believed that one of the recommended interventions should involve strategies, activities, and support from the environment to spark the interest of the dyslexic children in reading (Mohd. Sharani Ahmad, 2004). Such educational intervention proves by Nor Hasbiah (2007) who reported that the implementation of multimedia learning methods can motivate dyslexic children to learn better. In overcoming learning problems in students, an effective learning strategy is much needed. Hence, this research is proposing the image representative with holographic technique to attract the attention of the children and at the same time, able to increase the reading capabilities among them.

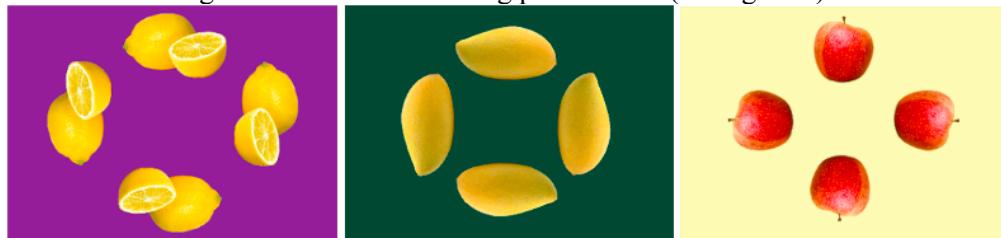
## **MATERIAL AND METHOD**

The Dick & Carey Model (2009) was employed to develop a systematic teaching approach using holographic techniques. This framework integrates cognitive and behavioral elements to create an effective learning system tailored to dyslexic students. Its ten interconnected components provide a structured approach, ensuring the intervention is both systematic and adaptable to the needs of its users. This model is referred to because it includes the cognitive and behaviouristic elements that emphasize the user's response to the stimulus presented. It also represents a thorough and systematic process when creating an ideal learning design system to overcome learning problems. The ten interconnected components contained in this model are the main steps in the development process of the proposed teaching with the holographic technique.

This research is to enhance the reading ability of dyslexic children in a classroom by using image representatives with holographic techniques as visual aids. This study implies qualitative

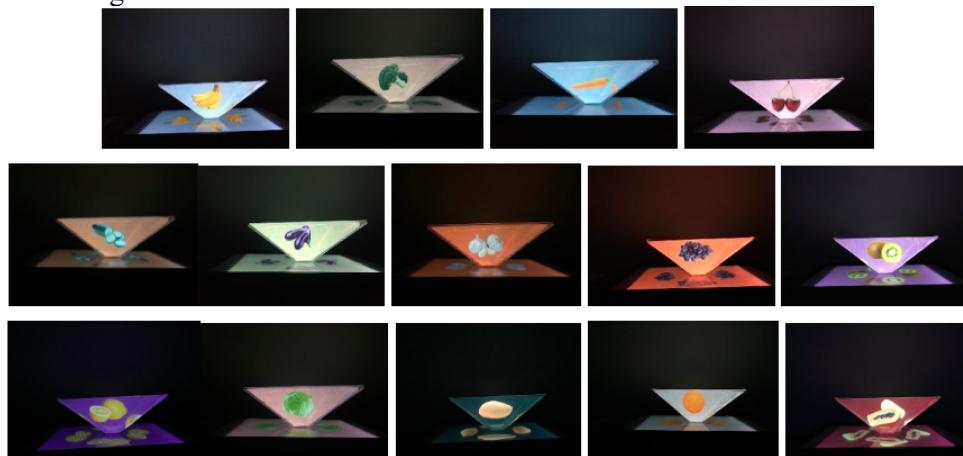
methods, including face-to-face interviews with five (5) PDM teachers and observational studies, were used to gather data. Interviews explored the current teaching practices and the perceived effectiveness of visual aids. According to Oppenheim (2000) and Smith (2015), the basic principle of qualitative interviewing is to formulate a scaffold within respondents that can express their understanding in their way. The interview conducted mainly concentrating on the learning style of the dyslexic children, for example, the significance of visual guides used in the classroom. Meanwhile, the final interview was focused primarily on issues that emerged, what helped or hindered the coordinated effort, and what benefits they can get from the research. The researcher transcribed each interview and added additional notes for interpretation. The findings of the interviews were additionally useful in the planning of the pre and post-test assignments.

Questions were designed to elicit detailed responses about the challenges and opportunities in teaching dyslexic children. Observations were conducted with 75 dyslexic children, later narrowed to 43 participants based on specific inclusion criteria. The selection criteria ensured that the participants represented a diverse range of abilities and learning preferences. (see figure 1).



**Figure 1: Pre-test involving visual about understanding colours on still images.**

Then, a set of tests comprising of visual representative with holographic technique (figure 2) were given afterward. After screening, the observation was conducted four times with the number of children reduced to 43 involving 4 different age groups (6, 7, 8, and 9 years old). During the observation, all activities carried out were recorded. The inclusion criteria for this group sample include; (i) able to see visually and (ii) generate creative imagination about the picture represented and able to maintain the received message.



**Figure from 2: Image representative with holographic technique to create 3D effect for pre and post-test session**

The treatment was implemented by using a set of flashcards displaying the actual image of fruits to assist the children in identifying the object. With a realistic image, the message is clearer and easier for the children to understand, and they could name the fruits without having any troubles. As dyslexic children are more attracted to bright colours or pastel colours, therefore by using the colourful image representative with holographic technique, has supported them to enhance their reading skills. Finally, a post-test with similar images as the pre-test was conducted to test the children's ability in recognizing what has been shown to them during the pre-test session. The children's response was analysed for an amendment to reach the final version of the activities and which took about one month to be completed.

## FINDINGS AND ARGUMENTS

The face-to-face interview that was conducted with 5 teachers at PDM showed that teachers were still using a conventional method of teaching style for the dyslexia children. This is due to limited resources in Malaysia. The teachers used; (i) cycle motor teaching method, (ii) one to one between teacher and dyslexic children, (iii) black and white illustration, and (iv) no graphical nor visual aids. In addition to this, some dyslexic children were easily losing focus, could not stay still for too long and are not attracted to the conventional method of learning styles. The results in table 1 is showing the results of the research conducted.

Table 1: The results of students participated in the research

Age groups (Years old)	Number of dyslexic children	Ability to identify 3D object	
		Able	Not Able
6	20	20	0
7	12	11	1
8	5	5	0
9	6	4	1

Reference: Nik Nor Azidah et al., (2020)

The finding shows that almost all children could identify the 3D objects regardless of age groups. The children who were not able to identify the 3D images were found to have severe dyslexia problem. Based on the data presented, dyslexic children have enjoyed the session conducted. Even though the session took place in a short period, the results are convincing as the image representative with the holographic technique has gained the interest of the dyslexic children in their reading session. Hence, this method is suitable to become an alternative to the reading method and to be used in the future. In terms of learning style, the outcomes from teachers' interviews impressively offered that learning style was affected by teaching materials. At the end of the interview, the teachers informed that there were no interactive visual aids provided for these dyslexic children in their learning method. With the image representative and holographic technique provided, the children were very excited to learn they had enjoyed the lesson conducted as they are able to differentiate the shapes and colours easily.

## CONCLUSIONS

This approach successfully fosters engagement, improves reading skills, and creates an interactive learning environment. By addressing the unique challenges faced by dyslexic learners, the study provides a foundation for developing more inclusive educational practices. The findings emphasize the importance of leveraging technology to create tailored interventions that align with the cognitive preferences of diverse learners.

Future research should explore scalability, long-term impacts, and integration with broader educational frameworks. Additionally, further studies could investigate the applicability of holographic techniques in other areas of learning and among different student demographics. By addressing the specific needs of dyslexic learners, this study contributes to the development of inclusive and innovative educational practices, paving the way for a more equitable and effective education system.

## REFERENCES

Beachem, N. (2007). The potential of multimedia to enhance learning for students with dyslexia? Retrieved from <http://www.skillsforaccess.org.uk/articles.php?id=150>

Beatrice, J.A. (1994). Learning to study through critical thinking? Retrieved from <http://www.uu.edu/programs/tesl/ElementarySchool/learningstylesinventory.htm>

Douglas, S. (2008). What it means to be a visual learner. Retrieved from [http://www.education.com/magazine/Ed\\_Could\\_You\\_Write\\_Down](http://www.education.com/magazine/Ed_Could_You_Write_Down)

Fadilahwati Abdul Rahman & Ronaldi Saleh (2009) "New Technology Approcah (D-Mic) for Dyslexia Learning Style". Proceedings: Regional Conference on Special Need Education, University of Malaya, 20-22 July 2009.

Gross, M., & Voegeli, C. (2007). A multimedia framework for effective language training. Journal of Computers and Graphics, 31, 761-777. doi: 10.1016/j.cag.2007.09.001

Herod, L. (2002). Adult learning: From theory to practice. Retrieved from <http://www.nald.ca/adultlearningcourse/glossary.htm>

Heymans, Y. (2007). Dyslexia. Retrieved from <http://www.etni.org.il/>

Irlen, H. (1991). Reading by colors. Overcoming dyslexia and other reading disabilities through the Irlen method. Garden City Park, New York: Avery Publishing.

Rainger, R. (2003). A dyslexic perspective on e-content accessibility. York, UK: JISC TechDis.

Sandro F., Sara B., Luca R., Massimo M., Simone G. Andrea F., (2015). "Shall We Play a Game?": Improving Reading Through Action Video Games in Developmental Dyslexia. Development Dyslexia (T Wydell, Section Editor) <http://doi.10.1007/s40474-015-0064-4>

Shaywitz, S. (2003). Overcoming dyslexia: A new and complete science-based program for reading problems at any level. New York, NY: Alfred A. Knopf.

# REVIEW OF THE EXPLORING SPATIAL VISUALISATION AND GENDER AMONG 3D COMPUTER ANIMATION UNDERGRADUATES

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## Abstract

The performance of multimedia undergraduates in 3D computer animation may be impacted by their deficiencies in spatial visualisation. It is possible to see spatial visualisation as a distinct intelligence that differentiates it from other types, such as verbal and reasoning abilities. Creating a 3D animation required complex visualisation work, which most students found challenging. Students who cannot finish the task due to inadequate spatial visualisation skills will not be able to pass the 3D computer animation course. This study investigates the relationship between undergraduates' performance in 3D computer animation, gender, and spatial visualisation. The first stage of the research was to examine the literature related to spatial visualisation, gender differences and computer animation skills among undergraduate students.

**Keywords:** Computer Animation, Spatial Visualisation, Multimedia, 3D Animation

## INTRODUCTION

The growth of the animation sector in Malaysia has created several professional prospects for 3D animators, resulting in a more discerning approach by recruiters throughout the hiring process. Additionally, gender has emerged as a criterion for employment. This study examines spatial visualisation, focusing on students' proficiency in multimedia courses through literature that explicitly investigates the potential correlation between spatial visualisation skills and performance in 3D computer animation among male and female students

The expansion of Malaysia's animation sector has significantly increased professional opportunities for 3D animators, leading to more stringent and selective recruitment processes. Gender, as a demographic factor, has increasingly influenced employment criteria within the industry. Furthermore, the research examines demographic variables, highlighting the critical influence of gender on students' achievements and industry readiness. According to statistics, the field of 3D animation is predominantly male, both globally and in Malaysia. In Malaysia, approximately 66.7% of animators are male, while 33.3% are female. Globally, the gender gap is more pronounced. For instance, in the United States, women held only 20% of creative roles in animation as of 2019. Despite women comprising over 70% of animation and art school students, they occupy just 34% of creative jobs in the industry (Ugap, et. al., 2023).

By exploring the male-dominated nature of the animation field, this study aims to identify the underlying factors affecting career trajectories for 3D animators in Malaysia and to propose strategies for promoting greater inclusivity within the profession.

### *Spatial Visualisation Among Multimedia Undergraduates and Gender Differences*

An individual engaged in design, particularly in the 3D discipline, must possess creativity and innovation to convey visual elements effectively. Additionally, they should have a vivid imagination to translate 2D items into their 3D counterparts and vice versa. Lohman (1988) defined spatial visualisation as the cognitive capacity to understand and mentally manipulate objects and movements within a three-dimensional space. Lowrie (2002) argues that modern civilisation progressively depends on visual stimuli as technological advancements blur the distinction between real-life settings and two-dimensional representations of three-dimensional space.

In addition, as Gutierrez (1996) stated, 3D animation students need perceptual constancy. This data refers to their ability to acknowledge that specific characteristics of an object, such as size, colour,

texture, or position, remain consistent regardless of orientation changes. They must maintain clarity and avoid confusion when perceiving things or images from different angles. Imagination is crucial in the process of creating and designing a 3D model. Dynamic visualisation, as defined by Presmeg (1986), refers to the cognitive ability to analyse and comprehend the fundamental characteristics of figures that are in motion, shrinking, or rotating, whether they are displayed on a screen or imagined mentally (Harel & Sowder, 1998; Presmeg, 1986). Workman and Lee (2004) argue that employing suitable strategies can successfully enhance students' problem-solving skills in design and foster their spatial visualisation abilities. By utilising 3D software, students can improve their spatial visualisation abilities. In addition, Sorby and Baartmans (2003) noted that including multimedia in the workbook benefited the student's development and improved their three-dimensional spatial skills.

Previous studies indicate differences in spatial ability between boys and girls (Battista, 1990; Ben-Chaim, Lappan, & Houang, 1988; McGuinness, 1993; Voyer et al., 1995). This phenomenon is evident in spatial visualisation (Mayer & Massa, 2003). Various explanatory factors have been proposed to account for the disparity in spatial ability between boys and girls, acknowledging the influence of learner-related factors (cognitive variables) and environmental factors (such as the activities in which boys and girls participate in their daily lives). Regarding characteristics associated with learners, much emphasis has been placed on how boys and girls encode and process information, known as cognitive style (Arnup, et al., 2013; Kozhevnikov, 2007; Mayer & Massa, 2003).

Michael T. Battista (1990) proposed that while males and females had discrepancies in spatial visualisation and their performance in high school geometry, they did not display differences in logical reasoning aptitude or their utilisation of geometric problem-solving approaches. The disparities in spatial skill levels between males and females can be attributed to either the influence of a male sex hormone (Hier & Crowley, 1982) or the predominant role of environmental factors (Fennema & Sherman, 1977). This is because males typically seek a technique or approach involving spatial awareness and directional strategies, while females rely on signs and route directions (Lawton, 1994; Geary, 1998). The results of this study align with the findings of Koenig et al., (1990), which suggest that women tend to excel in perceiving the exact location of objects. Still, men are proficient in understanding the distance and direction between objects.

## MATERIAL AND METHOD

This study employs content analysis to systematically investigate the literature on spatial visualisation, gender disparities, and proficiency in 3D computer animation among undergraduate students. Content analysis offers a rigorous framework for identifying, categorising, and quantifying thematic patterns within the selected body of literature, enabling a structured examination of prevailing trends and gaps (Stinson, 2021). The analytical process was grounded in a pre-established thematic framework derived from an initial scoping review of key studies, encompassing themes such as levels of spatial visualisation aptitude, gender-based performance differences, and their implications for academic and practical outcomes in 3D computer animation. The data coding process involved assigning numerical values to recurring patterns, enabling statistical evaluation of the frequency and distribution of themes across the selected works.

To ensure a comprehensive and multidisciplinary perspective, the literature search was conducted across five prominent academic databases: Google Scholar, Elsevier, PubMed, IEEE Xplore, and Springer. A systematic search strategy was employed using predefined keywords and Boolean operators, including "spatial visualisation," "gender disparities," "3D computer animation," "undergraduate students," and "performance analysis." The inclusion criteria required that studies be peer-reviewed, published between 2010 and 2023, and explicitly address at least one of the primary themes. Exclusion criteria included non-scholarly publications, studies unrelated to multimedia education or animation, and works lacking empirical evidence.

A multistep screening process was implemented to ensure methodological rigour. Initially, duplicate entries were removed to avoid redundancy. Abstracts of the remaining articles were screened for relevance to the research themes, followed by a full-text review of studies meeting the inclusion criteria. Furthermore, methodological approaches and reported outcomes were systematically categorised to provide insights into the research landscape.

This approach ensures a robust and systematic literature evaluation, offering valuable insights into the relationship between spatial visualisation, gender disparities, and academic performance in 3D

computer animation. By employing a transparent and replicable methodology, the study aims to contribute a nuanced understanding of the factors influencing proficiency in this field while identifying areas for future research.

## RESULTS AND DISCUSSION

A comprehensive literature review establishes a strong correlation between spatial aptitude and academic performance in 3D computer animation courses. Students with advanced spatial visualisation skills consistently demonstrate superior proficiency in mastering the complex cognitive tasks associated with 3D animation, such as spatial transformations, object manipulation, and scene composition. Conversely, a considerable proportion of multimedia undergraduates face challenges in executing these advanced spatial tasks, underscoring the need for pedagogical strategies tailored to varying levels of spatial proficiency.

Integrating spatial ability assessments alongside gender-based analyses offers educators an evidence-based approach to designing targeted instructional interventions. For example, developing specialised training modules or supplementary materials could enhance spatial visualisation capabilities among students with lower aptitude, thereby bridging performance gaps. While gender differences in performance have been observed, the mechanisms driving these disparities remain ambiguous, necessitating further investigation to inform more inclusive educational practices. This study underscores the importance of embedding cognitive and demographic considerations into the design of multimedia curricula to enhance academic outcomes. The findings are constrained by the need for larger, more diverse samples and further exploration of the longitudinal development of spatial skills through targeted training.

## CONCLUSION

Results revealed that students with high spatial aptitude will probably outperform those with low spatial talent in the 3D computer animation course. With spatial visualisation, students could find it much easier to understand the many activities required for a 3D computer animation performance. Few undergraduates studying multimedia have the skills to tackle the complex visualisation tasks involved in 3D computer animation, a demanding course that includes spatial tasks. Teachers can use spatial ability, gender, and 3D computer animation performance as predictors to help them create the best instructional materials for pupils with varying degrees of spatial visualisation proficiency. Future research should also focus on translating these insights into practical applications within industry settings to foster inclusivity and support the equitable development of 3D animation talent.

## REFERENCES

A Battista, M. T. (1990) Spatial Visualisation and Gender Differences in High School Geometry. *Journal for Research in Mathematics Education*.

Christou, C., Jones, K., Pitta-Pantazi, D., Pittalis, M., Mousoulides, N., Matos, J.F., Sendova, E., Zachariades, T., & Boytchev, P. (2007), Developing Student Spatial Ability with 3D Software Applications. *Paper presented at the 5th Congress of the European Society for Research in Mathematics Education (CERME), Larnaca, Cyprus, 22-26 Feb 2007*.

Daniel B. Hier, M. D, and William F. Crowley, Jr. M. D, Spatial Ability in Androgen-Deficient Men (1982), *The New England Journal of Medicine*, 306:1202-1205, DOI: 10.1056/NEJM198205203062003.

F. Mokhtar, S. Che Din (2013) Spatial Ability Test as A Predictor to Assess Students 3D Computer Animation Academic Performance Among University Undergraduates in Malaysia, *Iceri2013 Proceedings, Pp. 4024-4032*.

Gutierrez. S. Klein, (1996) Cognitive System-Principles of Leveling and Sharpening: Individual Differences in Visual Time- Error Assimilation Effects, *Journal of Psychology*, 37, 105-122

Judith Gluck and Sylvia Fitting, (2003) Spatial Strategy Selection: Interesting Incremental Information, *International Journal of Testing*, Volume 3, Issue 3 [https://doi.org/10.1207/S15327574IJT0303\\_7](https://doi.org/10.1207/S15327574IJT0303_7)

Harel, G., and Sowder, L. (1998), Student Proof Schemes Result from Exploratory Studies, in A. Schoenfeld, J. Kaput and E. Dubinsky (eds.), *Research in Collegiate Mathematics III* (pp. 234-282). American Mathematical Society.

I. M. Smith (1964) Spatial Ability: Its Educational and Social Significance, *San Diego, CA: Robert R. Knapp.*

J. Pellegrino, D. Alderton, and V. Shute, (1984) Understanding Spatial Ability, *Educational Psychologist*. 19(3):239-53.

Kamis, Arasinah & Mohamed, Suriani & Hanapi, Zaliza & Ghani, Che & Che Kob, Che & Jamaluddin, Rahimah. (2016). Fashion and clothing instrument for Malaysian fashion lecturers: An analysis of the instructors' competency scale. GEOGRAFIA OnlineTM Malaysian Journal of Society and Space 35 Themed issue on technological, vocational, and educational empowerment of Malaysia's human resource. 12. 35-45.

Kamaluzzaman, M. S. ., Che Din, S. ., Shamsuddin, N. A. A. ., & Chen, X. . (2023). Persuasive Technologies in using Social Media to Influence Behaviour Change in Malaysia. *Journal of ASIAN Behavioural Studies*, 8(24), 39–52. <https://doi.org/10.21834/jabs.v8i24.422>.

Khoza, L. S., & Workman, J. E. (2009) Effects of Culture and Training on Perceptual Learning Style and Spatial Task Performance in Apparel Design. *Clothing & Textiles Research Journal*, 25(1), 62-79. DOI: 10.1177/0887302X07309635.

Lohman, D. (1988), Spatial Abilities as Traits, Processes, and Knowledge, in R. J. Sternberg (ed.), *Advances in the psychology of human intelligence* (Vol. 4). Hillsdale, NJ: LEA.

Lowrie, T. (2002). The Influence of Visual and Spatial Reasoning in Interpreting Simulated 3D Worlds, *International Journal of Computers in Mathematical Learning*, 7(3), 301-318.

Mayer, R. E., & Massa, L. J. (2003), Three Facets of Visual and Verbal Learners: Cognitive Ability, Cognitive Style, and Learning Preference. *Journal of Educational Psychology*, 95(4), 833–846. <https://doi.org/10.1037/0022-0663.95.4.833>

Michael T. Battista, Spatial Visualization and Gender Differences in High School Geometry, *Journal for Research in Mathematics Education*, Vol. 21, No. 1 (Jan. 1990), pp. 47-60.

Mokhtar, H.S, A million clicks for Lee's parodies, News Straits Times Online, 22 August 2016, viewed 9 August 2018 <[https://www.nst.com.my/news/2016/08/167404/million-clicks-lees- parodies](https://www.nst.com.my/news/2016/08/167404/million-clicks-lees-parodies)>

Presmeg, N.: 1986), Visualisation and Mathematical Giftedness, *Educational Studies in Mathematics*, 17, 297- 311.

Ramful A., Lowrie T. (2016) Spatial Visualisation and Cognitive Style: How Do Gender Differences Play Out?

Sarah A. Burnett, David M. Lane, Lewis M. Dratt (1979) Spatial Visualisation and Sex Differences in Quantitative Ability.

**COLLEGE OF COMPUTING, INFOMATICS AND MEDIA**

# EMANCIPATE SOCIAL MEDIA PLATFORM IN INVIGORATING GREEN TECHNOLOGY INITIATIVE FOR LIBRARY SUSTAINABLE COMMUNITIES

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## ABSTRACT

When it comes to implementing green innovation strategies, libraries are cautious to do so unless those techniques offer immediate cost benefits. This is because of the perceived risk involved in making investments for the short term with the goal of achieving long-term advantages, which is in contrast to the emphasis placed on short-term quarterly returns in corporate settings. The goal of fully implementing environmentally friendly methods across the entirety of the product life cycle is a valuable endeavour because of the potential for growth that it gives to people who are looking for excitement. The absence of a comprehensive framework that incorporates social media in order to promote the significance of environmentally friendly technology in libraries is the reason for this situation. The purpose of this research is to provide a structural framework that makes use of social media in order to improve the green technology library project. The framework that has been developed will raise the people in the library community's knowledge of the importance of environmental sustainability. The aspects of green library for environment sustainability were obtained from the reviewing articles indicating resources, environmental, material, educational and management as well as factors to implement of the green library; Energy, education and management. This study will establish green library practices to benefit the environment, whether explicitly stated or not, to improve human well-being. Humans are clearly harming the ecosystem. Libraries, as public institutions that improve society, should protect the environment. This research can alert the community to our situation and empower them to change. Libraries realise that their eco-friendly building can educate the public. Libraries are centered on improving humanity; hence sustainability is important. Green libraries often provide environmental education programmes to demonstrate how their architecture and operations reflect these ideas. The significance of this cannot be overstated because society is an essential element of the concept of sustainability. It is important to ensure that library patrons have access to materials while also preserving their health in an atmosphere that is sustainable. There were a variety of recommendations regarding the implementation of a green library towards the environment world. One of these recommendations was to implement a wide expectation building development practices and procedures.

**Keywords:** Aspects, Factors, Green Technology, Library, Sustainability

## INTRODUCTION

Green libraries protect the environment and its natural systems and resources. Natural resource protection, carbon-neutral living, and community service are Green Library goals. This assignment encourages practical and environmentally responsible living and strives to preserve the world's resources for future generations. It improved library operations and taught the community about environmental issues. Libraries' prominent position allows them to model sustainable solutions for the community. Green environmentalism is active in libraries. The green architecture trend presents special challenges for libraries. Books must be secured from extreme temperatures, dampness, sunlight, termites, fungus, rodents, and dishonest readers. Heavy books and many readers on the floor complicate things. Building structure and design must accommodate book, reader, and technological growth. Binks (2014) advises examining the components to evaluate if the library can become a green library. Progress requires factors. Information literacy and teaching can turn a standard library into a green library, according to Kamińska et al. (2021). Sustainable resource quality and trash management assist the environment in this green library. A green library, often called a sustainable library, delivers high-quality services that benefit the environment, according to Khalid et al. (2021). Guest speakers on water-wise gardening, composting, recycling, energy efficiency, and green cleaning are needed to introduce and promote library sustainability programming. The green construction trend includes green libraries.

Libraries must safeguard books from sunlight, moisture, and temperature changes (Verticchio et al., 2021). Green design relies on sunlight to reduce artificial lighting. Book weight is another difficulty at the library. Sustainable design generally elevates flooring to improve airflow, but shelving can be too heavy. Many designers have addressed this issue by specializing in the library. Libraries should be flexible enough to handle space and wiring extensions. Library buildings are long-term community investments. Thus, architects must design for the future and last a century or more. This study will examine green library components and environmental impact. Green library procedures benefit the environment, resource management, and trash disposal, according to Beutelspacher et al (2020). In another study, Laukkanen et al (2022) said a green library, or sustainable library, provides high-quality services that benefit the environment. This article examines eco-friendly library practices for environmental sustainability. Services and their influences on green library implementation will be examined in this paper. For service effect, we focus on resources, environmental, materials, educational, and management. These factors drive green library implementation in the environmental domain. Energy, education, and management drive green library implementation. The rest of this paper follows this structure. Literature review is in Section 2. Section 3 proposes a framework. The final section contains conclusions.

## MATERIALS AND METHOD

The framework of this investigation was derived from existing literature. Table 1 below shows there are five variables were obtained from the reviewing articles that indicate **resources**, **environmental**, **material**, **educational** and **management**. In general, the most variable found is assigned by the materials construction in implementation of green library. The table clearly stated various type of variables that can be used by green library services based on external and internal environmental issues and awareness.

Table 1: Implementation Aspects of Green Library for Environment Sustainability

Author	Resources	Environmental	Material	Educational	Management
Malode (2014)	/		/		
Meher & Parabhoi (2017)	/		/		
Shah; Kumar & Shah (2015)		/			
Hauke & Werner (2013)					/
Cardoso & Machado (2015)	/			/	
Sotak & Karpinski (2014)		/	/		
Bayley (2014)			/	/	
Blinks et al (2014)					/

Table 2 shows the study that discuss about the factor to implement the green library. There have three factors to implement of green library; **Energy**, **education** and **management** Under the factor of energy there have three authors argue about the energy. Each of them has different view related to energy. Whereby there have three authors argue about the factor of education. For the last factor is management, there have only two authors discuss about an education from the previous study.

Table 2: Factors to Implement of the Green Library

Authors	Energy	Education	Management
Kurbanoglu & Boustany (2016)		/	
Kumar (2012)		/	/
Meher & Parabhoi (2017)	/		
Hauke & Werner (2013)			/
Binks et al (2014)	/	/	

## FINDINGS

The implementation of a green library to strengthen environmental sustainability needs to be addressed on two aspects such as elements of implementing and aspects of implementing. In Figure 1, we present a study framework based on two variables; factors and aspects to show the relationships for green library technology implementation. At this stage of this research, we consider the two variables are crucial in order for the library to implement green technology.

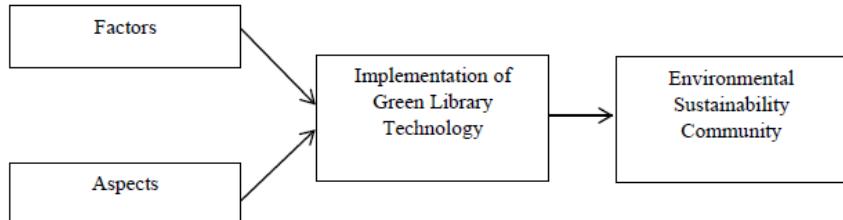


Figure 1: The Relationship Elements for Green Library Technology Implementation

In Figure 2, we suggest that the application of social media to support the element toward the implementation of green library technology that can assist the process to identify the factors and values toward the implementation of green technology for environmental sustainability.

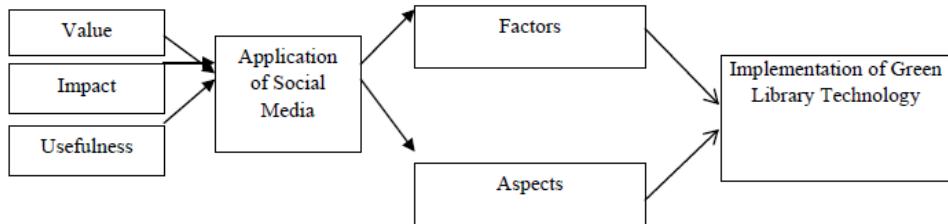


Figure 2: Using Social Media Application to Support the Element Toward the Implementation of Green Library Technology

In the proposed framework, we denote **Value** of social media is important because **Value** relies user understanding of social media in sharing the information of green technology using social media platform. We denote **Impact** of social media relies the effective of using social media to promote green technology in library. Library need to understand the implementation of social media that could impact the effectiveness of promoting green library. The **Usefulness** of social media indicates the implementation of social media that benefit the usage of social media platform to promote green library. The three aspects of social media are proposed to empower the usage of social media as a main platform to promote green library initiative for library sustainability community. The proposed framework implies the propositional logic as,  $SM = V_{value} + I_{Impact} + U_{usefulness}$  where social media (SM) implies the aspect of Value, Impact and Usefulness. Therefore, we denote the implication as,  $SM (V_{value} I_{Impact} U_{usefulness})$ , In Figure.2, we understand that each social media consists of  $V_{value} + I_{Impact} + U_{usefulness}$ . This implies each relationship as  $M (V_{value})$ , which indicate social media has value toward green library endowment.

$SM (V_{value}^1 \dots, V_{value}^n)$ , where  $SM \rightarrow (\neg V_{value})$  is implies if it has value on green library initiative. We indicate social media has impact toward green library endowment  $SM (I_{Impact})$ ,  $SM (I_{Impact}^1 \dots, I_{Impact}^n)$  where  $SM \rightarrow (\neg I_{Impact})$  is implies if it has impact on green library initiative. Lastly, we indicate social media is useful toward green library endowment  $SM (U_{usefulness})$ ,  $SM (U_{usefulness}^1 \dots, U_{usefulness}^n)$ , where  $SM \rightarrow (\neg U_{usefulness})$  is implies if it is useful on green library initiative. The framework indicates the relationship between social media platform and green technology (GT) initiative as  $SM (Value (Impact (Usefulness))) = GT (Library (Sustainability))$ . The relationship implies on the implementation of social media to empower green technology initiative for library sustainability community. The three variables; value, impact and

usefulness indicate on important of social media as a main platform to promote green technology initiative.

## CONCLUSION

This study will help establish green library practices to benefit the environment, whether explicitly mentioned or not, in order to enhance the well-being of humanity. There is no longer any serious doubt that humans are inflicting damage to the ecosystem. Libraries, being public institutions dedicated to the improvement of society, should ensure they do not harm the environment. This research can help educate the community about our current condition and empower them to create change. Libraries are realizing that their environmentally-friendly building provides a significant chance to educate the public. Libraries are increasingly focusing on enhancing the human condition and sustainability will need to be a key focus. Green libraries frequently provide programmes on environmental education, illustrating how these concepts are incorporated into their architectural design and operations.

## REFERENCES

Ayu, A. R., & Abrizah, A. (2011). Do you Facebook? Usage and applications of Facebook page among academic libraries in Malaysia. *The International Information & Library Review*, 43(4), 239-249.

Bayley, P. (2014). Developing Sustainable Agriculture and Community. *Libraries Strategy*, 1- 24.

Beutelspacher, L., & Meschede, C. (2020). Libraries as promoters of environmental sustainability: Collections, tools and events. *IFLA journal*, 46(4), 347-358.

Binks, L., Braithwaite, E., Hogarth, L., Logan, A., & Wilson, S. (2014). Tomorrow's green public library. *The Australian Library Journal*, 63(4), 301-312.

Burkhardt, A. (2010). Social media: A guide for college and university libraries. *College and Research Libraries News*, 70(1), 10-24.

Cardoso, N. B., & Machado, E. C. (2015). Sustainable and Green Libraries in Brazil: Guidelines for Local Governments, 1-13.

Charmigo, L., & Barnett-Ellis, P. (2007). Checking out Facebook.com: The impact of a digital trend on academic libraries. *Information Technology and Libraries*, 26(1), 23-34.

Chu, M., & Nalani-Meulemans, Y. (2008). The problems and potential of Myspace and Facebook usage in academic libraries. *Internet Reference Services Quarterly*, 13(1), 69-85.

Hauke, P., & Werner, K. U. (2013). Going green as a marketing tool for libraries: environmentally sustainable management practices, 1-12.

Kamińska, A. M., Opaliński, Ł., & Wycislik, Ł. (2021). The landscapes of sustainability in the library and information science: Systematic literature review. *Sustainability*, 14(1), 441.

Khalid, A., Malik, G. F., & Mahmood, K. (2021). Sustainable development challenges in libraries: A systematic literature review (2000–2020). *The Journal of academic librarianship*, 47(3), 102347.

# ADVANCING ARCHIVAL AWARENESS IN HIGHER EDUCATION INSTITUTIONS (HEIs) OF MALAYSIA: EXPLORING ARCHIVAL EDUCATION PROGRAMS THROUGH COLLABORATIVE PARTNERSHIP

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## ABSTRACT

In recent years, there has been a growing recognition of the importance of archival awareness within the higher education landscape. The aim of this study is to delve into the implementation of educational archives programs facilitated through collaborative partnerships between the National Archives of Malaysia and Higher Education Institutions (HEIs) across the nation. This initiative is strategically designed to bolster archival awareness, particularly within the realm of professional education and training. By enlightening the breadth of opportunities inherent in such collaborations, this study serves as a beacon for fostering synergistic relationships between the National Archives of Malaysia and both public and private HEIs in Malaysia. Furthermore, it serves as a benchmarking tool for archival institutions, fostering heightened visibility and understanding within the archival domain. The primary objective of this study is to examine the educational archives program facilitated through collaborative partnerships between the National Archives of Malaysia and HEIs in Malaysia. Specifically, the focus is on how this collaboration serves as an initiative to heighten archival awareness within the context of professional education and training. Additionally, this study aims to explore the diverse array of opportunities inherent in the partnership collaboration between the National Archives of Malaysia and HEIs in Malaysia. This exploration seeks to uncover the potential avenues for collaboration and mutual benefit, shedding light on the mutual relationship between the two entities.

**Keywords:** Archives, Higher Education Institutions, Educational Archives, Skills Training, Partnership

## INTRODUCTION

The growing support of HEIs in archival services has become significant to their future development especially in the context of professional education and training. Moreover, there is an increasing acknowledgment of the significance of diversity, equity, and inclusion in archival education. The HEIs as a center of academic excellence relies heavily on strategic cooperation with the industry in the development of teaching and learning curricula that are relevant to industry needs. The collaboration between universities and industry can generate rich and relevant educational content, fostering lifelong education (Bjursell, C., & Ramsten, A. C., 2020) and can enhance educational outcomes and align academic programs with industry needs (Perkmann, M., & Walsh, K., 2021). This will enhance the availability of local graduates. An active collaborative partnership between the archival institution and HEIs is critical for knowledge exchange, enhancing practical knowledge, boosting the level of graduate employability and strengthening the research and development activities.

For many HEIs, there are many opportunities to form a strategic archival learning collaboration and archives institutions are essential instigator and facilitators for collaborations. The positive relationship of this collaboration has led to mutually beneficial for both archival institutions and HEIs which may include knowledge exchange, public engagement, skills, and innovation development, career prospects and also experiences enhancement. Furthermore, this collaborative endeavor contributes to lifelong learning and community development, fostering partnerships in diverse cultural and economic initiatives. It enables universal access to information, preserves heritage materials, expands outreach to new audiences, and enhances core services, thereby propelling forward the collective mission of education and cultural preservation.

Acknowledging the growing demand for records and archives personnel within the industry, the National Archives of Malaysia has assumed the role of an advisory committee to numerous Higher Education Institutions (HEIs) across Malaysia. Recognized as a pivotal professional entity with a profound impact on higher education within the realm of archives and records management, the National Archives of Malaysia has strategically positioned itself to cultivate awareness across various facets within the higher education landscape. By spearheading initiatives aimed at fostering awareness, this agency is dedicated to nurturing a cadre of exceptional human capital capable of contributing to the global discourse.

In response to the growing industry demand of records and archives personnel, the National Archives of Malaysia has become an advisory committee to most HEIs in Malaysia. As known to all, the National Archives of Malaysia is a professional body that has a natural bias to directly related archival, historical, or conservation-focused disciplines. The range of potential partner academic disciplines with the National Archives of Malaysia can be overwhelming. A result of this is that innovative and exciting collaborative projects with records and archives disciplines can be focused as it may open more significant opportunities for more effective and efficient usage of archival services and materials as well as the development of new possibilities and capabilities. However, the study of educational archives programs through partnership collaborations between HEIs and the National Archives of Malaysia is still unknown and to date, limited study and there are no empirical studies found by research.

Despite the evident potential for collaboration, empirical studies examining educational archives programs through partnership collaborations between HEIs and the National Archives of Malaysia remain sparse and largely unexplored. This underscores the need for further research to elucidate the nuances and impacts of such collaborative endeavors, paving the way for informed decision-making and the advancement of archival education within the higher education field.

## **MATERIAL AND METHOD**

This study adopts a qualitative approach, incorporating literature review, document analysis, and in-depth interviews with top management and senior archivists from National Archives of Malaysia and lecturers from HEIs across Malaysia. Situational analysis and unstructured face to face interviews with five respondents from the headquarters of the National Archives of Malaysia and five respondents from different HEIs were carried out to explore the archival learning activities through their collaborative partnership which emphasizes on the scope of types of educational archives programs, benefits and outcomes of the collaboration. All the information provided by the interviewees would be treated in strict confidence. The interviews ranged between 20 and 40 minutes and were audio recorded. Analysis of the qualitative data obtained through this intensive interview was done by coding the answers and marking discernible patterns and themes in answers. Therefore, all the interviewees' views and comments are described anonymously. The data collected are analyzed thematically to identify common patterns and opportunities in the implementation of educational archives programs through collaborative partnerships. Moreover, document analysis was employed to mitigate some of the ethical issues commonly associated with other qualitative methods (Khan, S. S., & Khan, H. R., 2020) and to glean valuable insights for summarizing this study. By examining a range of documents including the National Archives of Malaysia bulletin, policies, and standards, it became evident that National Archives of Malaysia has undertaken numerous initiatives to bolster its operations and enhance the quality of services provided to its users.

## **RESULTS AND DISCUSSION**

The findings of this study reveal overwhelmingly positive outcomes stemming from the educational archives program established through collaborative partnerships between the National Archives of Malaysia and HEIs. These collaborative endeavors not only ensure the sustained viability of both entities but also bolster the credibility of academic subjects offered, given the National Archives of Malaysia's pivotal role and the HEIs' vested interest in its perspectives. Numerous educational archives programs have been successfully executed, signaling the effectiveness of these collaborative activities. Interviewees express confidence in the potential of such strong collaborative partnerships to facilitate the implementation of further educational archives programs. At the forefront of elevating the

National Archives of Malaysia's prominence within the realm of higher education, the agency has seamlessly fostered enriching partnerships and orchestrated numerous educational archival programs in collaboration with no less than ten Higher Educational Institutions (HEIs). Notably, five of these partnerships have evolved into strategic alliances bound by the mutual respect delineated in Memorandums of Understanding (MoUs). Prominent among these esteemed institutions are Universiti Kebangsaan Malaysia (UKM), Universiti Teknologi MARA (UiTM), Universiti Utara Malaysia (UUM), Universiti Pendidikan Sultan Idris (UPSI), and Kolej Universiti Islam Melaka (KUIM). The National Archives of Malaysia underscores the significance of these collaborations, which span across both public and private HEIs, encompassing research and development initiatives, student placement programs for industry training, consultancy projects, training sessions, seminars, and the pursuit of archival administration objectives. Through these synergistic partnerships, the National Archives of Malaysia continues to uphold its commitment to advancing knowledge dissemination, fostering academic excellence, and preserving the nation's rich historical heritage.

The findings collected from the in-depth interviews illuminated an understanding of the collaborative activities undertaken with HEIs. Interviewees described a specific array of educational archives programs, showcasing a focused spectrum of initiatives (Refer Table 1). This comprehensive of collaborative endeavors underscores the multifaceted approach adopted in enriching archival learning experiences within the academic sphere.

**Table 1: National Archives of Malaysia collaborative activities with HEIs**

Educational archives programs	1	2	3	4	5
The Archives Consumerism Clinic		✓		✓	✓
File Description Program		✓			
Audiovisual Records and Archives Mini Training Program		✓			
Thematic Finding Aids Project		✓			
Oral History Project	✓	✓		✓	✓
Seminar and Training series	✓	✓	✓	✓	✓
Research and Development Project	✓	✓	✓	✓	
Student Placement Program				✓	✓

Moreover, the study identifies a multitude of benefits arising from this collaboration, including enhanced relationships between the archival and higher education industries, heightened visibility of archival institutions among young people, and knowledge exchange through seminars and training series. Interviewees stress the importance of meticulous planning for collaborative activities to ensure optimal outcomes for both parties involved. The growing demand for archival learning activities underscores the necessity for implementing collaborative programs, particularly spurred by the success of initiatives like the File Description Program, which has fostered substantial collaboration among various HEIs. The findings highlight the diverse range of collaborative partnership activities between National Archives of Malaysia and HEIs. The collaborative partnership between the National Archives of Malaysia and Higher Education Institutions (HEIs) has generated numerous opportunities that have proven beneficial to both entities, extending beyond merely raising awareness about the importance of archives. Qualitative findings underscore the existence of several opportunities stemming from this partnership (Refer Table 2).

**Table 2: The opportunities of collaborative partnerships between National Archives and HEIs**

The opportunities	1	2	3	4	5	6	7	8	9	10
Knowledge exchange	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Audience development						✓	✓	✓	✓	✓
Student engagement	✓	✓	✓	✓		✓	✓			
Transfer of technology		✓				✓	✓			✓
Enhanced student experiences	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Archival promotion and access		✓			✓	✓	✓	✓	✓	✓
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These opportunities highlight the substantial roles played by the National Archives of Malaysia and HEIs in elevating archival awareness, enriching the education system through enhanced teaching and learning activities, and fostering interactive relations between them.

## CONCLUSION

This study enriches the literature by offering insights into an educational archives program that can be implemented through collaborative partnerships between HEIs and archival institutions. The program is designed to enhance archival awareness, particularly within teaching and learning activities, while better equipping future archivists with the necessary teaching skills. This, in turn, contributes to the advancement of educational practices in the field. Collaborative partnerships between the National Archives of Malaysia and HEIs hold immense potential for enhancing archival awareness and education within the Malaysian higher education landscape. By fostering collaboration, resource sharing, and capacity building, these partnerships contribute to the preservation of cultural heritage, the advancement of academic research, and the promotion of lifelong learning. In addition, this collaboration has underscored the pivotal roles played by the National Archives of Malaysia and HEIs in elevating archival awareness, enhancing the education system through enriched teaching and learning activities, and fostering interactive relations between them. It emphasizes the necessity for both industry and academia to make sustained investments, cultivate understanding, and adapt at various organizational levels to establish a successful relationship (Kunttu, L., & Neuvo, Y., 2019). Future research should continue to explore innovative strategies and best practices for integrating archival education into higher education curricula, thereby ensuring the sustainability and relevance of archival awareness initiatives in the digital age.

## REFERENCES

Bjursell, C., & Ramsten, A.-C. (2020). University-industry collaboration to support lifelong education. *INTED Proceedings*, 1, 6059–6068. <https://doi.org/10.21125/inted.2020.1641>

Khan, S. S., & Khan, H. R. (2020). *The role of document analysis in qualitative research: A systematic review*. *Qualitative Research Journal*, 20(2), 126-139.

Kunttu, L., & Neuvo, Y. (2019). Balancing learning and knowledge protection in university-industry collaborations. *The Learning Organization*, 26(2), 190–204. <https://doi.org/10.1108/tlo-06-2018-0103>

Valiente Bermejo, M., Eynian, M., Malmskold, L., & Scotti, A. (2021). University-Industry Collaboration in curriculum design and delivery: A model and its application in manufacturing engineering courses. *Industry and Higher Education*, 36(5), 615–622. <https://doi.org/10.1177/09504222211064204>

# EXPLORING ISSUES AND CHALLENGES IN OPEN AND DISTANCE LEARNING (ODL): FRAMEWORK TO MITIGATE DROPOUT RISK AMONG UiTM STUDENTS

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## ABSTRACT

This research study aims to explore the factors that contribute to the dropout risk in an Open and Distance Learning (ODL) setting and, thus, develop a framework to mitigate this risk, particularly among Universiti Teknologi MARA (UiTM) students. As such, research objective one investigates the factors that contribute to the dropout risk in the ODL setting. Through qualitative interviews, this study has gathered in-depth insights into the personal, academic, socio-economic, and institutional factors that influence dropout decisions. Research objective two focuses on developing a framework to mitigate dropout risk among UiTM students in the ODL setting. Building upon the findings from research objective one, the framework was designed to address the identified factors and provide practical approaches to enhance student motivation and support. The findings of this research will contribute to the existing literature on dropout risk in ODL settings, providing insights into the unique challenges faced by UiTM students. The developed framework will serve as a practical tool for UiTM and other institutions to implement strategies aimed at reducing dropout rates and improving student retention in ODL programs. Ultimately, this study seeks to enhance the overall learning experience and success of UiTM students in the ODL environment.

**Keywords:** Student Dropout, Open and Distance Learning, Higher Education, Information Management.

## INTRODUCTION

The adoption of Open and Distance Learning (ODL) as a response to the pandemic has illuminated both the potential and challenges of remote learning. Malaysia's diverse educational landscape has navigated the shift to ODL with varying degrees of success [1]. Despite its promise, ODL's adoption has revealed issues such as limited digital infrastructure, connectivity gaps, and varying degrees of preparedness among students, all of which contribute to student attrition [2]. Hence, raises the urgency to understand the rate of attrition during ODL within the Malaysian higher education context. Particularly, Universiti Teknologi MARA (UiTM) as a leading Malaysian institution, has embraced ODL to ensure educational continuity during the pandemic. As UiTM transitioned to remote learning, the unique challenges faced by its students became apparent. The sudden shift to ODL platforms prompted by the pandemic exposed students to challenges related to digital literacy, access to technology, and the absence of physical interactions. Understanding the experiences of UiTM students within the ODL framework and the factors influencing attrition rates is essential for developing targeted interventions.

ODL introduces a flexible educational opportunity that offers students the freedom to study from anywhere and at any time over the Internet. Nevertheless, shifting the constraints of a conventional lesson structure and promoting an independent learning mode can be a “double-edged sword” for students. On one hand, it presents enormous chances to improve traditional education, however, it can also present a significant obstacle to the pedagogical application of online education. ODL necessitates that students have a high degree of autonomy and responsibility in choosing their courses of study. To finish learning assignments and consequently reach the associated learning goals, students must be able to manage their study time throughout the allocated learning periods.

However, the aim could not reach every student and some of them might fail to complete their study due to many reasons. Higher education institutions continue to face a substantial and expensive problem with student attrition, also known as student dropout. Universities and students both suffer

from attrition. Failure to complete a degree will hinder students' efforts to improve their socioeconomic standing, but for universities, attrition results in a significant financial loss and harms their reputation because this performance is crucial to how the institution will allocate funding for its current and graduate students [3]. Therefore, a qualitative study is needed to understand the reasons behind those learners' decision to leave their studies, to allow for a better understanding of students' behaviours and factors contributing to the early dropout risk, particularly in open and distance learning environments [4].

## METHOD

The study utilized a semi-structured interview approach to collect data from 15 former students of Universiti Teknologi MARA, who had dropped out of their studies. Participants were purposively selected based on their availability and willingness to share their experiences. The sample included individuals who had dropped out from UiTM within the past few years during the COVID-19 pandemic in Malaysia which resulted in the Movement Control Order in the year 2020, representing various programs, disciplines, and levels of study. The interviews were conducted from early August to late November 2022, based on the availability and scheduling preferences of the participants. The interviews were carried out via video conferencing with applications such as Google Meet or Zoom Meetings, depending on the preferences of the participants. A semi-structured interview guide was developed for the study, which included open-ended questions and prompts to explore the participants' reasons for dropping out, their experiences during their online studies at home, and their perceptions of the factors that contributed to their decision to discontinue their studies.

In addition, the interview guide was designed to allow for flexibility and in-depth exploration of the research topic. The interviews lasted for an average duration of 30 minutes to 1 hour and 30 minutes, depending on the responses and engagement of the participants. Before the interviews, the participants were provided with information about the background, purpose and nature of the study, and their informed consent was obtained. The interviews were audio-recorded with the participant's permission, and detailed notes were taken during the interviews to capture important points and observations. For data analysis, NVivo 12 was used to analyze the data [5]. The recorded interviews were transcribed verbatim, and the data were analyzed using thematic analysis. Themes and patterns were identified from the interview data, and the findings were interpreted in light of the research questions and study objectives. The study followed ethical guidelines for research involving human participants, including obtaining informed consent, ensuring confidentiality and privacy, and maintaining the anonymity of the participants. The study received ethical approval from the UiTM ethics review board.

## RESULTS AND DISCUSSION

Table 1 highlights factors that contributed to the dropout risk in an ODL setting. Data from the 15 respondents are presented in descending order from highest to lowest of which factors reported by respondents in causing student attrition. The factors are: (i) Self-Regulation Factor - students frequently struggle with poor self-organization because they lack the drive to pursue self-directed learning. This dependence on instructor direction stems from the conventional face-to-face classroom environment. It emphasizes the necessity for students to take greater responsibility for their learning and self-regulate their study habits, as relying solely on instructors is insufficient, (ii) Personal Factor - this study found that when students first switched to ODL, they frequently went through a type of "culture shock" and lacked the prerequisite training for this new way of learning. Students were commonly burdened by personal obligations and distractions while at home. Moreover, ODL also tended to reduce students' interest in their studies because there was no personal connection between them and their teachers, (iii) Teaching Quality Factor - the study found that 14 out of 15 respondents shared their concerns and frustrations regarding the teaching quality during ODL classes. Their feedback shed light on various aspects of teaching that they found lacking or problematic, including lecturer teaching styles, feedback responses from lecturers, and overall engagement with students. One of the primary concerns expressed by the students was related to the teaching styles employed by the lecturers in the ODL setting. The students craved more interactive sessions that would foster meaningful exchanges of ideas and allow for clarifications on complex topics. The lack of real-time interaction and dialogue with their lecturers

created a sense of detachment and hindered their ability to fully grasp and apply the course content, (iv) Environmental Factor - the introduction of ODL brought to light the significant influence of geographical location on the Internet speed, resulting in slower connections in rural areas compared to urban counterparts. This discrepancy in Internet speed made it difficult for students to learn. Slower internet users had the option of seeing class recordings later, but this made it more difficult for them to participate in real-time discussions. Additionally, in instances where presentations are involved, this might affect students' academic achievement.

**Table 1: Results of Qualitative Study**

Factors	Times referenced	Percentage
1. Self-regulation	59	23.0%
2. Personal	53	20.7%
3. Teaching Quality	41	16.0%
4. Environmental	38	14.8%
5. Emotional	21	8.2%
6. Financial	20	7.8%
7. Communication	13	5.1%
8. Technological	11	4.3%

In addition, (v) Emotional Factor - this study found that the shift to remote learning from home has resulted in a notable absence of connections with peers, replacing all in-person interactions with screens and text messages. This circumstance frequently causes feelings of isolation while studying or working together on group projects. ODL presents difficulties for instructors as well because it makes it difficult to build emotional connections with students, (vi) Financial Factor - the sudden shift to remote education requires access to computers, laptops, tablets, or smartphones, as well as a stable internet connection. These additional expenses put a financial strain on many families, especially those who were already facing economic challenges. Moreover, the cost of online learning varies across different courses. Some courses required students to purchase specific software, access online platforms, or subscribe to digital resources, which further added to the financial burden, (vii) Communication Factor - this study discovered that eight respondents reported that their lecturers experienced problems with their internet connection during online classes. These issues ranged from intermittent connectivity to complete disconnection. As a result, students faced disruptions, lagging, and even complete interruptions in their learning sessions. Such internet-related problems hindered the flow of the class, affected real-time interaction, and impeded the delivery of course content, (viii) Technological Factor - the respondents highlighted the specific hardware requirements they lacked, including earphones, microphones, laptops, phones, and reliable internet connection. These hardware limitations have impacted their ability to effectively communicate, complete assignments, and ensure a smooth learning experience in ODL. For active involvement, teamwork, and engagement in online discussions, good audio quality is essential.

In summary, this study identified the following recommendations to reduce the risk of dropout among undergraduate students: (i) Prioritize Teaching Quality by recognizing that teaching quality emerged as a crucial factor in student attrition, institutions should focus on improving the quality of online instruction. This includes training instructors in effective online teaching methods, providing them with the necessary tools and resources, and promoting engagement and interaction in virtual classrooms, (ii) Enhance Self-Regulation Skills by giving the significant role of self-regulation in ODL, institutions should invest in programs and resources aimed at developing students' self-regulation skills. Providing guidance on time management, goal setting, and study strategies can empower students to take greater responsibility for their learning, (iii) Supportive Learning Environment by creating a supportive online learning environment that minimizes distractions and fosters concentration. This can include providing students with guidelines for setting up productive study spaces at home and encouraging them to minimize interruptions during online classes, (iv) Accessible to Technology by addressing the digital divide by ensuring that all students have access to the necessary technology and internet connectivity for ODL. Institutions can explore options for providing devices and affordable internet access to students who need them, (v) Regular Revision Practice by encouraging students to adopt regular and thorough revision practices. Promoting the importance of reviewing course materials

can help students consolidate knowledge, identify areas of weakness, and prepare effectively for assessments, (vi) Engagement and Interaction by implementing strategies to enhance student engagement and interaction in the online learning environment. This can involve incorporating collaborative activities, group discussions, and peer-to-peer interactions to create a sense of community and reduce feelings of isolation, (vii) Mental Health Support by recognizing the potential mental health challenges faced by students in ODL, especially in light of isolation and distractions. Provide access to counselling services and resources to support student's emotional well-being, (viii) Flexibility and Communication by offering flexibility in course schedules and communication channels to accommodate students' diverse needs and circumstances. Ensure that instructors are accessible and responsive to students' inquiries, particularly during off-class hours, and (ix) Monitoring and Intervention by implementing a system for monitoring students' progress and identifying those at risk of attrition early in their ODL journey. Provide timely interventions, such as academic advising or tutoring, to support struggling students. Hence, implementation of these recommendations will help students adapt to the challenges of online learning and maximize their growth potential.

## CONCLUSION

In sum, this research has shed light on the multi-layered factors contributing to student attrition in the realm of ODL. Through a systematic examination of these factors, critical areas have been identified that demand attention to enhance student retention and success in ODL settings. The findings underscore the paramount importance of self-regulation skills among ODL students. To mitigate attrition, educational institutions need to put a high priority on programs that help students become more goal-oriented, time-efficient, and disciplined—all of which are critical for success in an online learning environment.

## REFERENCES

- [1] Abdullah, Z. & Mohamad, S.M.N.H.(2022). Engaging and Empowering Malaysian Students Through Open and Distance Learning in the Post-COVID Era. *Front. Educ.* 7:853796. doi 10.3389/feduc.2022.853796
- [2] Izham, M. A. A. N. I., Anuar, N., & Khairuddin, I. E. (2022). Factors that Contribute to Students' Attrition in Open and Distance Learning (ODL) Environment: A systematic review. *Environment-Behaviour Proceedings Journal*, 7(SI10), 103-109.
- [3] Smith, J., & Stirling, A. (2020). Environmental distractions and their impact on student engagement during online distance learning. *Journal of Online Learning Research*, 25(2), 123-140.
- [4] Uzir, N. A. A., Khairuddin, I. E., Zaini, M. K., & Izzuddin Izham, M. A. A. N. (2021, November). Towards a Conceptual Framework to Mitigate Dropout Risk in Open and Distance Learning (ODL) in Higher Education Institutions. In *International Conference on Business and Technology* (pp. 907-914). Cham: Springer International Publishing.
- [5] QSR International Pty Ltd. (2018). What is NVivo? Retrieved from <https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/about/nvivo>.

# ENHANCING PUBLIC LIBRARY SERVICES: A FOCUS ON THERAPEUTIC LANDSCAPE QUALITY IN MALAYSIAN PUBLIC LIBRARIES

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## ABSTRACT

The Public libraries in Malaysia are evolving into vital community hubs, offering access to information and social connections while supporting mental health and well-being. This research investigates the quality of therapeutic landscapes within Malaysian public libraries using a mixed-methods approach. It explores user perceptions of therapeutic environments and aims to develop strategies for enhancing these spaces. By integrating qualitative insights and quantitative assessments, the study seeks to understand the impact of therapeutic landscapes on user satisfaction and the overall library experience. Findings are expected to inform library management practices and contribute to societal well-being.

**Keywords:** Therapeutic landscapes, Well-being, Library therapeutic landscape, Library therapeutic landscape quality, Library therapeutic satisfaction, public libraries,

## INTRODUCTION

In Malaysia, public libraries are becoming community hubs, providing access to information, fostering social connections, and supporting mental health and wellbeing. This research aims to evaluate and enhance the therapeutic landscape quality within these spaces through a mixed-methods approach, integrating qualitative insights and quantitative assessments. The study focuses on understanding user perceptions of therapeutic landscapes, including natural and built environments, social environments, and spiritual environments, and developing strategies for improvement. The research methodology employed is a sequential mixed-methods approach, combining qualitative and quantitative techniques to provide a comprehensive understanding of public library therapeutic landscapes. Qualitative methods were used to gather contextual insights, while quantitative data collection techniques were used to quantify user perceptions of therapeutic landscape quality and its relationship with overall library satisfaction. The study seeks to develop a comprehensive quality measurement system tailored to public library settings. Surveys and structured questionnaires were administered to users, gathering data on their experiences, preferences, and perceived benefits of library engagement. The findings are anticipated to provide actionable insights for library management, foster improved user experiences, and contribute to societal well-being. Demographic factors such as age, gender, and socioeconomic status were found to influence perceptions of therapeutic landscape quality, emphasizing the need for tailored interventions to meet diverse user needs. In conclusion, this research provides valuable insights into the design, management, and enhancement of therapeutic landscapes within Malaysian public libraries, emphasizing the importance of creating supportive, inclusive, and engaging environments for accessing information and promoting mental health and wellbeing.

The Malaysian government has been dedicated to addressing socio-economic disparities and advancing the nation's knowledge in social, cultural, educational, and economic aspects since the 1990s. Public libraries are recognised as integral components of community life, serving as catalysts for societal transformation and individual empowerment (Zakaria et al., 2011). This study emphasises the pivotal role of public libraries in fostering social wellbeing and positions them as key providers of therapeutic landscapes aimed at nurturing the future wellbeing of the populace. Public libraries have long been recognised for their transformative impact on society, enhancing the quality of people's lives by providing access to knowledge, resources, and cultural enrichment (Brewster, 2014; Zakaria et al., 2011). However, with mounting pressures and pervasive feelings of stress and depression (World Health Organization, 2017; Malaysian National Library, 2006), there is a pressing need for proactive

interventions to support mental health and well-being. The concept of therapeutic landscapes emerges as a promising solution, offering a holistic approach to planning and developing library environments conducive to healing and restoration. This research seeks to elucidate best practices for leveraging public libraries as therapeutic landscapes, focusing on the incorporation of therapeutic elements within library environments that can improve users' overall well-being. It is based on Gesler's (1998) therapeutic landscape theory and builds upon Brewster's (2014) thematic categorization of public libraries as restorative and relaxing environments. The research aims to go beyond qualitative assessments by incorporating quantitative measures to evaluate the impact of therapeutic landscapes on user satisfaction. This was achieved through a survey-based research design involving 474 respondents, with data analyzed using descriptive statistics, factor analysis, and multiple regression to assess relationships between Library Therapeutic Landscape Quality (LTLQ) dimensions and user satisfaction. By embracing the idea of therapeutic landscapes, public libraries can become essential community hubs, enabling people to live healthier, more satisfying lives and supporting societal progress.

## MATERIAL AND METHOD

This study focuses on the relationship between library therapeutic landscape quality and library services and facilities in Malaysian public libraries. The research paradigm is a pragmatic (sequential mixed method) approach, using both qualitative and quantitative methods. A discussion, interview, focus group session, and identification of the research problem came after a preliminary approach to identifying the components and dimensions of library therapeutic landscape criteria. Quantitative data was obtained to understand the views of library management and staff on how public libraries can contribute as a therapeutic landscape. The project aims to inspire satisfaction using library therapeutic landscape quality as a motivator towards well-being. However, there is a significant lack of data supporting this idea. To fill this gap, a four-tiered approach was taken: survey construction based on existing literature, exploratory study, survey and pilot testing, and running reliability and validity tests on the data. A literature review was conducted to identify categories of quality and the questions associated with each category. Three categories for therapeutic landscape quality were decided upon due to the original theory of therapeutic landscape. Four questions were generated for each item, with pre-testing carried out to identify any problems related to questions, format, style, terms, fonts, etc. The instrument was then submitted to experts for content validity review. To ensure the usefulness of the results, the assessment tool was tested for different forms of validity and reliability. Questions were designed to assess expectation and perception, with a diversity of questions to increase content validity. The questions were sorted based on response type, such as word response, pick one answer, or five-point Likert scales, and analysed using descriptive statistical techniques. The questions were arranged into "my expectation" and "my perception," which both contain all the questions in different orders and categories.

## RESULTS AND DISCUSSION

The research study aimed to identify the dimensions of a therapeutic landscape in a public library setting using a qualitative approach. It involved a literature review, semi-structured interviews, and focus group discussions with library professionals and users. The dependent variable was library therapeutic satisfaction, measured in terms of library user satisfaction. The independent variables were based on the therapeutic landscape theory by Gesler (1992), the service quality (ServQUAL) theory by Parasuraman, Zeithaml, and Berry (1988), and library quality (LibQUAL) by the Association of Research Libraries. The independent variables consisted of three dimensions: library natural/built environment, library social environment, and library spiritual environment. The findings of this study highlight the significant role of Library Therapeutic Landscape Quality (LTLQ) in enhancing user satisfaction. The dimensions of the natural/built environment, social environment, and spiritual environment were all positively correlated with therapeutic satisfaction, with the social environment showing the strongest influence ( $\beta=0.27$ ,  $p<0.05$ ). The small difference between what users expect and what they think about libraries shows that they meet or go beyond what users want. This is shown by the high mean scores for the natural/built environment ( $4.36 \pm 0.39$ ), the social environment ( $4.04 \pm 0.38$ ), and the spiritual environment ( $4.01 \pm 0.59$ ). These findings reinforce libraries' role as spaces of

restoration and well-being, emphasizing the importance of integrating therapeutic principles, such as strategic use of physical spaces, inclusive social interactions, and symbolic elements. These results align with previous research on therapeutic landscapes and provide a framework for further exploration in diverse library settings.

## CONCLUSION

The study has sought to explore and define the dimensions and elements of the library therapeutic landscape (LTL) within Malaysian public libraries. Drawing from the foundational work of Gesler (1992), the researcher aimed to extend the understanding of LTL, particularly in the context of Malaysia, where little prior research exists on this topic. An extensive literature review revealed that while studies in the West have explored the concept of libraries as therapeutic landscapes, Malaysia has not conducted any such investigations. Moreover, there is a dearth of research discussing the model of library therapeutic landscape quality. Library Therapeutic Landscape Quality (LTLQ) emerges as a crucial criterion for library branding and the development of public libraries in Malaysia. Given the country's status as a developing nation, prioritizing LTLQ library services, facilities, and collections is imperative. Recognizing the significance of LTLQ not only enhances user experiences but also contributes to the broader economic prosperity of the nation. As Malaysia transitions toward a service-oriented economy characterized by rapid technological advancements, the importance of meeting user expectations and perceptions becomes increasingly vital. This necessitates a shift from traditional library service paradigms to ones measured by LTLQ, ensuring libraries remain relevant and competitive in the evolving landscape. Integrating the concept of therapeutic landscapes into library service frameworks can enhance service performance and overall library quality, ultimately contributing to the creation of a more robust and competitive society. By emphasizing culture and fostering healthy environments, public libraries can serve as crucial components for advancing societal development. Furthermore, this study can aid the government in promoting mental health awareness, particularly through public library services. The findings underscore the profound influence of affective therapeutic landscape experiences within libraries, reinforcing the importance of prioritizing LTLQ in library management and service provision. In conclusion, this research explores the concept of the therapeutic library landscape in Malaysian public libraries, emphasizing the importance of prioritizing its quality in library management practices. It emphasizes the need for further exploration and integration of LTLQ principles in library service frameworks to enhance user experiences and contribute to societal well-being. The findings underscore the profound influence of therapeutic landscape experiences within libraries and the need for further exploration and integration of these principles.

## REFERENCES

Brewster, L. (2020). Library support for student mental health and well-being in the UK: Before and during the COVID-19 pandemic. *The Journal of Academic Librarianship*, 46(6), 102256. <https://doi.org/10.1016/j.acalib.2020.102256>

Brewster, L. (2014). The public library as therapeutic landscape: A qualitative case study. *Health & Place*, 26, 94–99.

Gesler, W. M. (1992). Therapeutic landscapes: Medical issues in light of the new cultural geography. *Social Science & Medicine*, 34(7), 735–746. [https://doi.org/10.1016/0277-9536\(92\)90360-3](https://doi.org/10.1016/0277-9536(92)90360-3)

Jiang, S. (2014). Therapeutic landscapes and healing gardens: A review of Chinese literature in relation to the studies in western countries. *Frontiers of Architectural Research*, 3(2), 141–153.

Motealleh et al. (2015). Investigating the significance of landscape in designing library by emphasizing the enhancement of learning. *HBRC Journal*. <https://doi.org/10.1016/j.hbrcj.2014.12.007>

Zakaria, Z., Hussin, Z. H., Noordin, N., Sawal, M. Z. H. M., & Ahmad Alhady, S. M. A. S. (2011). Service quality dimensions in public library: Northern area experienced. *Journal of Social Sciences*, 7, 265–270

Gesler, W. M. (1998). Bath's reputation as a healing place. In R. A. Kearns & W. M. Gesler (Eds.), *Putting Health into Place* (pp. 17–35). Syracuse: Syracuse University Press.

World Health Organization. (2017). Depression and other common mental disorders: Global health estimates. Geneva: World Health Organization.

Malaysian National Library. (2006). The reading profile of Malaysians. Unpublished research by the Malaysian National Library, Kuala Lumpur.

# DIGITAL PRESERVATION STRATEGY FOR FUTURE SUSTAINABILITY OF MALAYSIA'S ORAL HISTORY COLLECTIONS

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## ABSTRACT

The diverse file formats and rapid technological advancements present significant issues for Archives, Libraries, research institutes, and allied organizations in maintaining the accessibility and usage of materials in the long term. The research aims to explore experts' perspectives on digital preservation strategies for oral history collections. A purposive sampling approach is employed. The panel of experts will be chosen through a peer survey rather than a random selection from a population. This pilot study is being done to assess the possibility of a full-scale investigation of the digital preservation of Malaysia's oral history collection. The research aims to investigate several variables: (1) the Expert Panel's experience and knowledge of oral history and digital preservation; (2) the technology utilized for digital preservation; (3) platforms, formats, and mediums of oral history collections; (4) allocation of funding for digital preservation initiatives; (5) short-term and long-term strategies; and (6) existing policies regarding the treatment and digital preservation of such collections. The pilot project was conducted with four (4) custodians of the Oral History Collections selected around Malaysia. The pilot study's findings are analyzed based on several variables: (1) the Expert Panel's expertise in oral history and digital preservation; (2) the technology utilized for digital preservation; (3) the platform, formats, and medium of oral history collections; (4) allocation of funding for digital preservation projects; (5) short-term and long-term strategies; and (6) current policies regarding the treatment and digital preservation of such collections.

**Keywords:** oral history, digital preservation strategy, cultural heritage, Malaysian's oral history collection,

## INTRODUCTION

In Malaysia, the topic of digital preservation, which is a significant challenge in many parts of the world, has not been addressed according to a prior study by Zuraidah et al (2010). The increasing accumulation of digital resources necessitates not only accessible and efficient transmission but also, crucially, the long-term preservation of these items for the benefit of future generations. The study primarily focuses on oral history collections, which make a substantial contribution to the resources stored in Archives, Libraries, and similar organisations. To ensure the sustainability of collections for future generations, it is important to develop and implement strategies that facilitate the transition from analogue to digital formats, as most collections are currently in analogue form but becoming more accessible in digital audio format. Digital preservation is all the different methods that are needed to keep digital things safe for a long time especially in managing information in the digital age (Ahmad, et al., 2024). Merely safeguarding electronic records is inadequate if the emphasis is solely on the tangible storage devices. It should focus on ensuring continued access to the information within the records. Preserving electronic records involves adapting to ongoing technical advancements to provide long-term access to the records. Oral history collections in Malaysia are in danger due to the decay of analogue sound carriers and the progress of digital recordings. (Irwin, 2016). Technological advancements are impacting the Oral History collections, and access to them may diminish due to the declining market support for analogue audio technology. Advancements in audio technology have resulted in the creation of various new audio formats and devices available on both discs and tapes. Due to the outdated nature of vintage playback technology and the absence of coordinated efforts in managing and preserving these collections, there is a pressing requirement for a digital preservation plan for oral history recordings. This study aims to examine the future sustainability of oral history collections in Malaysia.

## MATERIAL AND METHOD

The findings and results of this study concluded into three important parts according to the criterion 1) expert panel, 2) technology and platforms and 3) funding, strategy and established policy as tabulated in Table 1.

**Table 1 Discussion Summary according to the criterion of this study**

Criterion	Summary
<b>Expert panel</b>	The institutions have numerous oral history collections, but its expert panel is ineligible for the study due to limited knowledge in the field and digital preservation. The individuals in charge of administering the collections only have experience in handling the collection. Additionally, the responsibility was assigned to a clerk instead of an officer with oral history and digital preservation expertise.
<b>Technology and Platforms</b>	The institution does not implement digital preservation programmes, and all collections are stored on audio cassettes that can only be utilised with analogue cassette players. No modern technology was used because the digital preservation initiative is not implemented.
<b>Funding, Strategy and Established Policy</b>	The oral history collection Institutional culture and heritage were organised and administered similarly to library items. Unfortunately, the institutions are not disclosing the number of oral history collections. As digital preservation strategies were not entirely executed, no cash was granted for collection preservation. Not all oral history recordings were transcribed to preserve knowledge in a systematic fashion. The lack of a developing strategy and set policy for digital preservation projects is evident.

The result of discussion on short-term and long-term strategies; and existing policies regarding the treatment and digital preservation of OH collections are tabulated in Table 2.

**Table 2 Discussion summary on the strategies and policy on this study**

List of respondents	Result					
	Preservation Strategies		Policy Document			
	Short term Preservation	Long-term Preservation	AES22-1997 (r2008)	AES28-1997 (r2008)	AES38-2000 (r2005)	AES41-2009 (r2005)
Panel A	/	/	/			
Panel B	/	/				
Panel C	/					
Panel D	/		/			

Based on the result presented in Table 2, it is found that all of the respondents have strategized short-term preservation, and only Panels A and B have strategized long-term preservation measurement. Hence, only Panel A and D has complied the policy AES22-1997 (r2008). It shows the need for more awareness of digital preservation among all the custodians of oral history collection in the selected organizations.

## CONCLUSION

A preservation plan provides a way to preserve and access current and archive electronic records for as long as needed. A preservation plan is necessary to ensure long-term preservation of

electronic documents, which are more easily manipulated and altered, resulting in decreased faith in their dependability and validity. Therefore, the preservation plan should guarantee the accessibility of electronic record information. Most oral history recordings are analogue, although digital audio is becoming more prevalent. Libraries and archives must not only store and provide access to resources, but also ensure their long-term preservation. Proper preservation is essential for future retrieval and access, requiring a seamless transfer between analogue and digital environments.

## REFERENCES

AES22-1997 (r2008): AES recommended practice for audio preservation and restoration — Storage and handling — Storage of polyester-base magnetic tape. <http://www.aes.org/publications/standards/>

AES28-1997 (r2008): AES standard for audio preservation and restoration — Method for estimating life expectancy of compact discs (CD-ROM), based on effects of temperature and relative humidity (includes Amendment 1- 2001). <http://www.aes.org/publications/standards/>

AES38-2000 (r2005): AES standard for audio preservation and restoration — Life expectancy of information stored in recordable compact disc systems — Method for estimating, based on effects of temperature and relative humidity. <http://www.aes.org/publications/standards/>

AES41-2009 (r2005): AES standard for digital audio — Recoding data set for audio bitrate reduction. <http://www.aes.org/publications/standards/>

Ahmad, R., & Rafiq, M. (2024). Digital preservation practices for information resources in university libraries of Pakistan. *Online Information Review*, 48(4), 725-745.

Ashenfelder, M (2013). Doug Boyd and the Power of Digital Oral History in the 21st Century, Library of Congress from <https://blogs.loc.gov/thesignal/2013/01/doug-boyd-and-the-power-of-digital-oral-history-in-the-21st-century/>

Cunningham, S. (2012). The preservation of analog oral history collections through digitization. In D. Boyd, S. Cohen, B. Rakert, & D. Rehberger (Eds.), *Oral history in the digital age*. Institute of Library and Museum Services. Retrieved from <http://ohda.matrix.msu.edu/2012/06/preservation-of-analog-collections-through-digitization/>

Delbecq, A., Van de Ven, A., & Gustafson, D. (1975). *Group techniques for program planning: A guide to nominal group and Delphi processes*. Glenview, IL: Scott-Foresman.

Gould, S, and Varlamoff, M.T. (2000, October). Digital Disappearances — Archiving Electronic Records, UNESCO Courier. Retrieved February 20, 2009, from [http://www.findarticles.com/articles/mi\\_m1310](http://www.findarticles.com/articles/mi_m1310)

Irwin, K., (2016). Moving Forward: Enhancing Preservation of and Access to Oral Histories at UNLV University Libraries, *Provenance, Journal of the Society of Georgia Archivists*, 34:1 from <http://digitalcommons.kennesaw.edu/provenance/vol34/iss1/12>

Lang, T. (1998). An overview of four futures methodologies. From <http://www.soc.hawaii.edu/future/j7/LANG.html>

Ludwig, B. (1997). Predicting the future: Have you considered using the Delphi Methodology? *Journal of Extension*. 35 (5). from <http://www.joe.org/joe/1997october/tt2.html>

Zuraidah Abd. Manaf & Aliza Ismail (2010). Malaysian Cultural Heritage at Risk? A Case Study of Digitization Projects, *Library Review*, 59(2), p.107-116

# MODELLING BUSINESS CONTINUITY AND RECORDS MANAGEMENT IN DIGITAL ENVIRONMENT

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## ABSTRACT

Small and medium-sized enterprises (SMEs) play a pivotal role in national economies, employing nearly two-thirds of the labour force and contributing significantly to government income. Selangor, a thriving economic landscape with the highest number of establishments among Malaysian states, relies predominantly on SMEs. The strategic location of Selangor at the heart of Peninsular Malaysia has attracted numerous SMEs, making it crucial to understand and enhance their business continuity and records management practices. To address this, a qualitative multiple case study was conducted, focusing on SMEs in Selangor. The study aimed to evaluate the comprehensiveness of business continuity management, assess business continuity plans (BCPs) for records management, and explore the implications of non-compliance with BCPs for SMEs. The research utilized document reviews and interviews with SME business owners and continuity managers, explicitly focusing on managerial-level respondents in the records and information system department. Findings underscored the importance of identifying vital records within SMEs, such as active contracts, financial records, and personal customer information. Regular updates to BCPs were highlighted as crucial to align with organizational changes. The study revealed diverse approaches to records management, with some SMEs designating division managers as custodians and others involving management, records committees, and imaging specialists. Integrating stakeholder perspectives was identified as a critical factor in developing comprehensive BCPs. Discrepancies were observed in including records in BCPs, emphasizing the need for a standardized understanding. An organized BCP was deemed essential, with SMEs emphasizing the significance of recovery plans, regular audits, and discussions with top management. In conclusion, the research findings emphasize the need for SMEs in Selangor to evaluate and integrate their BCPs and records management practices to enhance overall resilience. The study contributes practical insights for improving business continuity and records management efforts, providing valuable guidance on identifying vital records, engaging stakeholders, specifying roles, and maintaining organized BCPs. The results offer SMEs in Selangor an opportunity to strengthen their readiness and resilience for business continuity by customizing strategies effectively.

**Keywords:** Business continuity plans (BCPs), records management practices, small and medium-sized enterprises (SMEs), integration of BCPs and records management and vital records.

## INTRODUCTION

Small and medium-sized enterprises (SMEs) are responsible for employing nearly two-thirds of the labor force in the country. They contribute to the government's income through income taxation, and households benefit from taxes, profits, and salaries. Thailand, Malaysia, and the Philippines are emerging countries that rely on SMEs for economic development, as per the World Bank's classification of countries (Mintah, Gabir, Aloo and Ofori (2022)). These nations are also vulnerable to various natural disasters that affect all businesses, including SMEs. In December 2021, the worst flood disaster affected around 50,000 SMEs in several districts in Selangor. These SMEs experienced losses such as damage to their premises, machinery, business records, and information, destruction of raw materials, and final products due to water inundation. This led to the expected closure of their operations (Auzzir, Haigh, and Amaratunga, 2018). To survive and expand, SMEs must maintain accurate records.

According to the latest report on business establishments by the Department of Statistics Malaysia, Selangor has the highest number of establishments among all states in Malaysia as of 2019. This indicates that the state's economic landscape is thriving, mainly driven by SMEs. Most of the businesses in Selangor are SMEs, which significantly contribute to the state's economy. The state's strategic location is one of the main reasons for its success in attracting SMEs. Selangor is located at the heart of Peninsular Malaysia, acting as a natural gateway to the rest of the country. A study needs

to be conducted to investigate the records management aspects of Small and Medium Enterprises (SMEs) business continuity management practices. This study aims to evaluate the comprehensiveness of business continuity management and assess their business continuity plans for records management aspects. Additionally, the study will assess the implications of non-compliance with a business continuity plan for SMEs. The outcome of this study will contribute to the comprehensive framework of business continuity planning and the records management aspects by SMEs.

## **MATERIAL AND METHOD**

The research conducted in this study used a qualitative approach with multiple case study designs. This approach can be replicated in other research settings focusing on different institutions. According to Creswell (1998), any research question containing 'how' or 'what' falls under the category of qualitative research. This confirms the qualitative approach used in this study. Yin (2003) expressed his concerns about single-case designs, as they limit the scope of study and may not provide the most potent analytical conclusions. Yin also stressed that analytical conclusions drawn from two or more cases independently would be more effective than those from a single case study. Therefore, the multiple case study approach provided a rich and maximized depth of information, resulting in more transferable findings.

This study aimed to investigate the extent to which Small and Medium Enterprises (SMEs) practice business continuity management. The study collected data through document reviews and interviews with SME business owners and business continuity managers. The study also explored whether records management was integrated into business continuity plans or worked in isolation and how implementing a business continuity plan could benefit SMEs. The study focused on SMEs in Selangor, and data were collected from managerial-level respondents in the records and information system department. SMEs outside the Selangor area were excluded, and respondents below the managerial level were not selected for an interview. The findings from these cases led to creating a comprehensive framework for business continuity planning that incorporates records management.

Data were collected through document reviews and semi-structured interviews with five SMEs' managerial-level participants from records and information systems departments, each company participating in this research named C1 to C5. These transcriptions were coded, and thematic analysis focused on integrating records management into BCP practices, the current effectiveness of approaches, and the challenges identified. Through cross-case analysis, the methods used by the five firms were compared. Triangulation enhanced credibility, as insights were cross-verified between interviews and documents.

## **RESULTS AND DISCUSSION**

This study highlights the critical importance of identifying vital records within SMEs as a fundamental element for ensuring the smooth functioning of business operations. Vital records, encompassing active contracts, financial records, employee data, and personal and confidential customer information, are essential for prioritising their management, storage, and protection. The diverse approaches revealed through interviews with SMEs (C1 to C5) highlight the necessity for tailored strategies in identifying and handling vital records. Regular updates to business continuity plans (BCPs) are emphasised as crucial, aligning with technological, staff, and facility changes. This practice ensures that BCPs remain relevant and effective in evolving organisational dynamics, a perspective supported by existing literature.

The preservation of vital records necessitates clear roles and responsibilities within an organisation. Various SMEs adopt different approaches, designating division managers as custodians in some cases (C1 and C4), while others involve management, records committees, and imaging specialists (C2 and C3). Stakeholder involvement is critical in developing a comprehensive BCP, with diverse perspectives and expertise contributing to a tailored approach that effectively addresses potential risks and threats.

A notable finding is the varying perspectives on including records in business continuity plans. While some SMEs (e.g., C2) do not have specific BCPs for records, others (e.g., C1) stress the importance of including records detailing corporate events, audit trails, and financial activities. This

discrepancy underscores the need for a standardised understanding of what constitutes vital records and their role in ensuring accountability and facilitating financial management.

The study emphasises that an organised business continuity plan is essential for maintaining business operations during unexpected events. SMEs stress the significance of recovery plans, including identifying vital records, establishing recovery sites, and approval by management. Regular audits and discussions with top management are highlighted as crucial elements to ensure these plans' ongoing validity and effectiveness. The business recovery plan team, responsible for administrative functions, facilities, logistics, user support, computer backup, restoration, and other critical areas, plays a pivotal role in executing the plan.

In conclusion, the research findings emphasise the need for SMEs in Selangor to evaluate and integrate their business continuity plans and records management practices. This integration is crucial for enhancing overall resilience in the face of disruptions. The study contributes to a better understanding of SMEs' preparedness and provides practical insights for improving business continuity and records management efforts. Identifying vital records, engaging stakeholders, specifying roles, and maintaining organised business continuity plans serve as valuable guidance for SMEs seeking to strengthen their resilience strategies.

## **CONCLUSION**

In summary, this study emphasizes the importance of including records management in the business continuity plans of small and medium-sized enterprises (SMEs) in Selangor. It suggests that SMEs evaluate their current level of integration and seek advice from experts in records management and business continuity planning to customize their strategies effectively. The results of the study offer valuable information to SMEs in Selangor, helping them improve their readiness and resilience for business continuity by integrating records management, identifying crucial records, involving stakeholders, utilizing expertise, communicating effectively, and collaborating with relevant agencies.

## **REFERENCES**

Auzzir, Z., Haigh, R., & Amaratunga, D. (2018). Impacts of Disaster to SMEs in Malaysia. *Procedia Engineering*, 212, 1131-1138. doi:<https://doi.org/10.1016/j.proeng.2018.01.146>.

Creswell, J. W. (1998). *Qualitative Inquiry and Research Design-Choosing Among Five Traditions*. London: SAGE Publications

Mintah, C., Gabir, M., Aloo, F., & Ofori, E. K. (2022). Do business records management affect business growth?. *Plos one*, 17(3), e0264135.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). Sage Publications.

# ONLINE INFORMATION CREDIBILITY AMONG TEENAGERS IN MALAYSIA

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## ABSTRACT

Information plays a significant role in delivering society's input, ideas, and opinions. However, the rise of fake information has led towards misinformation in society. Current global issues regarding the COVID-19 outbreak include various kinds of fake news and inaccurate information that have been spread widely. Therefore, this study would like to explore the evaluation criterion of online information by assessing the youth information behaviour toward the credibility of online information among teenagers in Malaysia. The Radical Change Theory has been adopted in the development of a conceptual framework in the process of identifying the variable's relationship with online information credibility among teenagers. A quantitative approach was selected to assess the credibility of online information among teenagers. The findings show a positive relationship between youth information behaviour that consists of three principles: interactivity, connectivity and access and online information credibility, which contains accuracy, authority, objectivity, currency, and coverage. Individuals with high information credibility will carefully choose and select the information content on the website. Through the findings, the teenager is aware of the significance of choosing the right information; however, the teenager should be extra cautious about fake news, which makes it difficult to know the right and wrong information. The possible collaboration with the Ministry of Education in achieving the quality of education by enhancing the understanding of teenagers in evaluating online information in the future is in line with the Strategic Plan 2024-2030, Ministry of Education for the Strategic Pillar No 1 (Increase Access and Quality of Education)

**Keywords:** Information science, Information Credibility, Teenager, Interactivity, Connectivity, Accessibility

## INTRODUCTION

Generation Z and Generation Alpha are the teenage categories that will commonly and easily be manipulated by online information in the media. Social networking sites such as Facebook, X (previously known as Twitter), Instagram and TikTok are the platforms commonly used by this generation to create, share and delete online information. This has been supported by Hussin, Azli, and Samsudin (2019), who state that users use social networking sites (SNS) to share their ideas, personal messages, information, and other content, such as pictures and videos. However, this generation does not hesitate to use the information without confirming the sources of the information. Teenagers' awareness of assessing the credibility of information is low. This has been supported by a Stanford researcher who found out that students have trouble judging the credibility of information (Donald, 2016). Without confirmation from reliable sources, teenagers think the information they disseminate is right. According to Anderson (2017), teenagers are tech-savvy compared to their parents. However, when it comes to identifying fake news, they seem as confused as other generations. The same research has also been conducted, and the findings show that 31% of kids 10 to 18 years old have shared online information and later found out that the information is fake or inaccurate (Figueiraa & Oliveira, 2017). Other research by Sharma, Kaushal, and Joshi (2023) mentions that social media users cannot filter trustworthy information due to the enormous size of information; thus, the role of information support from the government is significant. Teenagers are much more curious than adults and want more attention on social media when they spread such kind of information.

These generations should possess the skill of searching for or seeking online information on whatever platform exists in digital media. According to Mohd Razilan Abdul Kadir, Nurul Ilyia Sabeela Johari and Norhayati Hussin (2018), teenagers should develop skills in information management and usage of information tools as well as databases that will lead them to search for information accurately related to their study. These issues and problems lead teenagers or youth to create, use and disseminate

wrong information. Therefore, this study would identify and explore the evaluation criterion for online information by assessing the youth information behaviour toward the credibility of online information among teenagers in Malaysia. It is significantly important to educate this generation in evaluating the right information. This has been supported by Hassan et al. (2020), who state that the government agency gives full support in educating society to become information literate through Media and Information Literacy Programs that have been implemented by library institutions nationwide. One of the initiatives that the Malaysian government has introduced is the In4Skill program for rural communities. This kind of program should be expanded to include Sabah and Sarawak so that Malaysia can shape the information society in 2030.

## **LITERATURE REVIEW**

### ***Teenagers***

According to Merriam-Webster Dictionary (2024), teenagers refer to individuals who are between 13 and 19 years old. During the teenage years, the behaviour and personality of this group are usually energetic, curious, and adventurous. Teenagers curious will seek more information, especially on the internet or social media. However, teenagers have also been exposed to fake information and misinformation, making them gather the wrong information online. Rodríguez-Hidalgo et al. (2023) state that teenagers have mastered Information, Communication and Telecommunication (ICT). However, they need skill and media literacy training to use the information and avoid fake news effectively. Teenagers usually do not hesitate to use the information without confirming the sources of the information. The awareness of teenagers in assessing the credibility of information is low. According to Schroeder (2021), imposter URLs and syndicated news will confuse the students in misevaluating the credibility of online news. Without confirmation from reliable sources, teenagers think the information they disseminate is correct. According to Anderson (2017), teenagers are tech-savvy compared to their parents; however, when it comes to identifying fake news, they seem as confused as other generations. This has also been mentioned by Dumitru (2020), who states that most teenagers cannot distinguish between fake and trusted information within online environments. Teenagers should develop skills in information management and using information tools as well as databases that will lead them to search for information that is related to their study. The skill and knowledge on assessing the credibility of information among teenagers should increase by providing training focused on evaluating the credibility of information.

### ***Credibility***

Credibility is generally defined as the believability of information. People judge credibility based on many different constructs, such as accuracy, objectivity, timeliness, and reliability, and rely on cues such as source credibility, social prominence, and domain knowledge. Besides that, credible information is called believable information (Fogg et al., 2001; Tseng & Fogg, 1999), and it is a person's perception of the truth of a piece of information (Eisend, 2006). Self (1996) also stated that this concept was based on Aristotle's argument that persuasion was based on fitting the message to the audience's needs in the linear model of speaker-message-audience. In sum, different researchers employed different definitions of credibility. This definition helps to demonstrate that credibility is a complex, interdependent, and multidimensional concept (Burgoon et al., 1981).

### ***Evaluation Criterion on Online Information Credibility***

Previous literature identifies five criteria that users should employ in their assessments of Internet-based information: accuracy, authority, objectivity, currency, and coverage or scope (see Brandt, 1996; Smith, 1997; Alexander & Tate, 1999; Scholz-Crane, 1998; Fritch & Cromwell, 2001; Meola, 2004). Accuracy refers to the degree to which a Web site is free from errors, whether the information can be verified offline, and the reliability of the information on the site. The website's authority may be assessed by noting who authored the site, whether contact information is provided for that person or organization, the author's credentials, qualifications, and affiliations, and whether a trusted source recommends the Website. Objectivity involves identifying the site's purpose and whether the information provided is fact or opinion. Currency refers to whether the information is up to date. Coverage refers to the comprehensiveness or depth of the information provided on the site. These

recommendations require a range of activities on the part of users, from simple visual inspection of a Web site to more laborious information verification and triangulation efforts.

### ***Radical Change Theory***

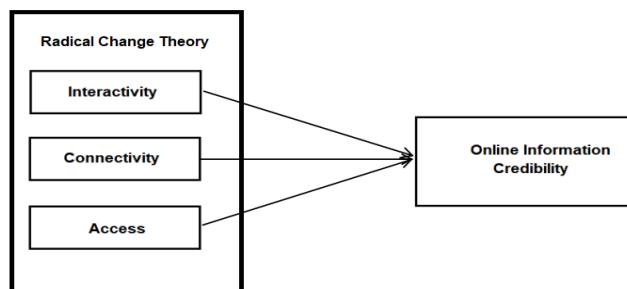
The theory of Radical Change proposes that three digital age principles—Interactivity, Connectivity, and Access—explain changes in youth information resources and behaviors in the digital age (Dresang, 2005). A typology with three types of changes, each with indicators, operationalizes the theory for the identification/ explanation of changes in information resources. The theory, however, has been applied to the information behaviour of youth without such a typology. Therefore, the proposed study seeks to further develop the theory by establishing a typology (or model) and accompanying variables that address young people's (a) cognitive status, (b) identify/value negotiation and information creation, and (c) social interaction during their interaction with information (Koh, 2010). The Radical Change theory with a new model from the proposed study will help understand youth information-related activities and their interrelationships, not just studies of individual tasks or search sessions isolated from the context.

### ***Online Information Credibility***

The credibility of online information should be examined so that the teenager will never disseminate and share the wrong information. Previous studies have examined the credibility of information based on the criteria that have been mentioned (i.e., accuracy, authority, objectivity, currency, and coverage) to gauge the credibility of the information they find online. Respondents were asked to indicate how often they performed nine behaviors (consisting of how often they ch) and see if the information is up-to-date (currency), consider whether the views represented on a site are facts or opinions (objectivity), consider the author's goals/objectives for posting the information (objectivity), check to see that the information is complete and comprehensive (coverage), seek out other sources to validate the information on a site (accuracy), check to see who the author of the web site is (authority), verify the author's qualifications or credentials (authority), check to see whether the contact information for the author or organization is provided on the site (authority), and look for an official "stamp of approval" or a recommendation from someone they know (authority). The findings from a previous study by Metzger and Flanagin show the user's information behaviour in identifying the credibility of online information. This study will adopt that component to examine the evaluation criterion in assessing credible online information.

### ***Proposed Conceptual Model***

In this study, the proposed model has been constructed based on the Radical Change Theory by Dresang and Koh (2009) and the criteria of online information credibility. Radical Change Theory explains changes in information resources and human information behavior towards the current digital age. There are three dimensions to Radical Change Theory: interactivity, connectivity and access. The criteria of online information credibility include authority, accuracy, currency, objectivity, and coverage.



**Figure 1: Figure Header**

## **RESEARCH METHODOLOGY**

The methodology used in the work project must be clearly stated and described in sufficient detail or with sufficient references. The quantitative research approach has been selected to explore the credibility of online information by identifying the evaluation criteria for online information as well as

evaluating existing guidelines of information behaviour toward credibility assessment among teenagers in Malaysia. The quantitative research approach deals with numerical data that could be converted into numbers (Sheard, 2018). In this research, the respondents are youths in Puncak Alam and Puncak Perdana. More than 400 questionnaires have been distributed online among teenagers in this area. However, only 265 questionnaires have been returned. An online survey was used to collect data. The questionnaire was divided into five sections: demographic, online information credibility, interactivity, connectivity, and access.

The data analysis of the quantitative study used Statistical Packages of Social Science (SPSS) version 25. It is used to create, clean, and analyze the data set. The analysis of the study is divided into two stages. Descriptive statistics is used to compare the mean within the variable, while inferential statistics is shown to test the reliability and validity of the instrument. An independent sample T-Test was also conducted to determine whether there was a significant difference between the Mean of the two groups. While assessing the relationship, the researcher conducted the Pearson Correlation Coefficient test to identify positive and negative within the variables.

## **RESULTS AND DISCUSSION**

Through this study, there is a positive relationship between youth information behaviour that consists of three principles: interactivity, connectivity and access and online information credibility that contains accuracy, authority, objectivity, currency, and coverage. Individuals with high information credibility will carefully choose and select the information content on the website. The finding shows that the interactivity of the sources influences the credibility of online information on the website. This has been supported by Kim (2012), who states that interactivity can be important in studying online source credibility. Interactivity is a unique aspect of credibility study. A different study found that the interactivity of the application is also a predictor of credibility in social media (Johnson & Kaye, 2016). So, this study shows that the interactivity sources of information influence the credibility of online information sources. Even though the study has different scenarios, it proves that the interactivity of either system or application has influenced the credibility of the information towards human behavior.

Connectivity also influences teenagers' behavior in searching for credible information. The findings show that low internet connectivity will disrupt teenagers in searching for credible online information to complete their tasks. The connectivity of the internet influences teenagers to search for credible information. A good internet infrastructure can assist teenagers in getting the correct information. Based on Internet Society (2017), no strategy for the Internet for education can succeed without adequate infrastructure and access to resources. It is good enough to access credible online information as long they have a good internet connection, either via WIFI, 3G, or 4G (Britland, 2013). So, connectivity is necessary to provide teenagers with credible, authentic and reliable online information.

Access to online information is essential to credible online information among teenagers. Based on UNICEF (2017), providing all children, especially teenagers, affordable access to high-quality resources is necessary. Chhachhar et al. (2014) state that the availability of the Internet and its access in schools, colleges, universities, and even houses also created various problems related to teenagers nowadays being close to the Internet. Donald (2016) states that based on a study by Standford University reported that the challenge of accessing online resources is people's difficulty accessing authentic online information. This study has assessed teenagers in urban areas, so the findings show that teenagers do not have significant difficulties in this matter. However, further study should be conducted on access to credible online information in rural communities. The result may differ because some rural areas do not have good internet infrastructure.

## **CONCLUSION**

In conclusion, this study has examined the evaluation criterion of online information by assessing the youth information behavior toward the credibility of online information among teenagers in Malaysia. The findings show that all youth information behaviour has a positive relationship with the credibility of online information. This is a teenager's positive behaviour in assessing the credibility of online information in their daily life. However, with the emergence of various websites and platforms, we should be careful with teenagers when taking online information from digital and online

platforms. Besides that, future research should expand by conducting a comparative study of teenage information behavior towards online information credibility in different ethnic groups, which can also be conducted for further study. This is because the interesting finding will clearly show which ethnic will have positive information behavior towards credible online information.

## REFERENCES

- [1] Alexander, J.E., & Tate, M.A. (1999). *Web wisdom: How to evaluate and create information quality on the Web*. Hillsdale, NJ: Erlbaum.
- [2] Anderson, J. (2017). Even social media-savvy teens can't spot a fake news story. Quartz website. Retrieved Feb 2024, from: <https://qz.com/927543/even-social-media-savvy-teens-cant-spot-a-fake-news-story>
- [3] Brandt, D. S. (1996). Evaluating information on the Internet. *Computers in Libraries*, 16, 44-46.
- [4] Britland, M. (2013). What is the future of technology in education?. *The Guardian*. Retrieved April 2020, from: <https://www.theguardian.com/teacher-network/teacher-blog/2013/jun/19/technology-future-education-cloud-social-learning>
- [5] Burgoon, M., Burgoon, J. K., and Wilkinson, M. (1981). *Newspaper Image and Evaluation*. *Journalism quarterly*, 58(3), 411-433.
- [6] Chhachhar, A. R., Qureshi, B., Maher, Z. A., & Ahmed, S. (2014). Influence of Internet Websites on Children Study. *Journal of American Science*, 10(5), 40-45.
- [7] Dumitru, E. (2020). Testing Children and Adolescents' Ability to Identify Fake News: A Combined Design of Quasi-Experiment and Group Discussions. *Societies*. <https://doi.org/10.3390/SOC10030071>.
- [8] Donald, B. (2016). Stanford researchers find students have trouble judging the credibility of information online. Graduate School of Education. Retrieved April 2020, from: <https://ed.stanford.edu/news/stanford-researchers-find-students-have-trouble-judging-credibility-information-online>
- [9] Dresang, E. T. (2005). Radical Change. In *Theories of Information Behavior*, K. E. Fisher, S. Erdelez, and L. McKechnie, Eds. *Information Today*, Medford, New Jersey, 398-302.
- [10] Dresang, E. T., & Koh, K. (2009). Radical change theory, youth information behavior, and school libraries. *Library Trends*, 58(1), 26-50.
- [11] Eisend, M., (2006). "Source Credibility Dimensions in Marketing Communication – A Generalized Solution". *Journal of Empirical Generalizations in Marketing Science*, 10(1), 1-33
- [12] Figueiraa, A. & Oliveira, L. (2017). The current state of fake news: challenges and opportunities. *Procedia Computer Science*, 121 (2017), pp817-825.
- [13] Fogg, B.J., Marshall, J., Laraki, O., Osipovich, A., Varma, C., Fang, N., Paul, J., Rangnekar, A., Shon, J., Swani, P. and Treinen, M. (2001), "What makes web sites credible? A report on a large quantitative study", *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, Seattle, Washington, USA, March 31-April 4, pp. 61-8.
- [14] Fritch, J. W., & Cromwell, R. L. (2001). Evaluating Internet resources: Identity, affiliation, and cognitive authority in a networked world. *Journal of the American Society for Information Science and Technology*, 52(6), 499-507.
- [15] Hassan, Z., Hussin, N., Hashim, H., & Tokiran, N. S. M. (2020). Information Seeking in Knowledge Society: Choose Right from Wrong. *International Journal of Asian Social Science*, 10(3), 151-158.
- [16] Internet Society (2017). Internet Access and Education: Key considerations for policy makers. Retrieved April 2020, from: <https://www.internetsociety.org/resources/doc/2017/internet-access-and-education/>
- [17] Johnson, T. J., & Kaye, B. K. (2016). Some like it lots: The influence of interactivity and reliance on credibility. *Computers in Human Behavior*, 61, 136-145
- [18] Kim, D. (2012). Interacting is believing? Examining bottom-up credibility of blogs among politically interested Internet users. *Journal of Computer-Mediated Communication*, 17(4), 422-435.
- [19] Koh, K. (2011). Proposing a Theoretical Framework for Digital Age Youth Information Behavior Building upon Radical Change Theory. ERIC. Dissertation. ISBN-978-1-1249-8247-2. Retrieved April 2020, <https://eric.ed.gov/?id=ED534815>

[20] Merriam-Webster Dictionary (2024). Teenagers. Retrieved from January 2025, from: <https://www.merriam-webster.com/dictionary/teenager>

[21] Meola, M. (2004). Chucking the checklist: A contextual approach to teaching undergraduates Web-site evaluation. *Libraries and the Academy*, 4(3), 331–344

[22] Metzger, M.J and Flanagin, A.J (2013). “Credibility and trust of information in online environments: the use of cognitive heuristics. *Journal of Pragmatics*, 59; p:210-220.

[23] Metzger, M.J., Flanagin, A.J., Eyal, K., Lemus, D., & McCann, R. (2003). Bringing the concept of credibility into the 21st century: Integrating perspectives on source, message, and media credibility in the contemporary media environment. *Communication Yearbook*, 27, 293–335.

[24] Metzger, M.J., Flanagin, A.J., Eyal, K., Lemus, D., & McCann, R. (2003). Bringing the concept of credibility into the 21st century: Integrating perspectives on source, message, and media credibility in the contemporary media environment. *Communication Yearbook*, 27, 293–335.

[25] Mohd Razilan Abdul Kadir, Nurul Iylia Sabeela Johari, Norhayati Hussin (2018). Information Needs and Information Seeking Behaviour: A Case Study on Students in Private University Library. *International Journal of Academic Research in Progressive Education and Development*, 7(3), 226–235.

[26] Norhayati Hussin, Nurul Nabila Azli, Ahmad Zam Hariro (2019). Information Disclosure in Social Media among Teenagers. *International Journal of Recent Technology and Engineering (IJRTE)* ISSN: 2277-3878, Volume-8, Issue-3S, October 2019.

[27] Rodríguez-Hidalgo, C., Rivera-Rogel, D., Flandoli, A., Tapia, R., & Vargas, L. (2023). Teens facing fake news. Media literacy needs in the classroom. 2023 18th Iberian Conference on Information Systems and Technologies (CISTI), 1-7. <https://doi.org/10.23919/CISTI58278.2023.10211591>.

[28] Schroeder, S. (2021). Incoming Undergraduate Students Struggle to Accurately Evaluate Legitimacy of Online News. *Evidence Based Library and Information Practice*. <https://doi.org/10.18438/EBLIP29854>.

[29] Scholz-Crane, A. (1998). Evaluating the future: A preliminary study of the process of how undergraduate students evaluate Web sources. *Reference Services Review*, 26(3/4), 53–60.

[30] Self, C. S. (1996). Credibility. In M. Salwen & D. Stacks (Eds.), *An integrated approach to communication theory and research* (pp. 421–441). Mahwah, NJ: Lawrence Erlbaum Associates

[31] Sharma, M., Kaushal, D., & Joshi, S. (2023). Adverse effect of social media on generation Z user's behavior: Government information support as a moderating variable. *Journal of Retailing and Consumer Services*, 72, 103256

[32] Sheard, J. (2018). Quantitative data analysis. Retrieved February 2024, from Research Methods (Second Edition) <https://www.sciencedirect.com/science/article/abs/pii/B9780081022207000182n>.

[33] Smith, A.G. (1997). Testing the surf: Criteria for evaluating Internet information resources. *The Public-Access Computer Systems Review*, 8. Retrieved April 2020, from <http://www.aut.ac.nz/depts/commstud/theorysmith.htm>.

[34] Tseng, S., & Fogg, B. J. (1999). Credibility and computing technology. *Communications of the ACM*, 42(5), 39–44.

[35] UNICEF (2017). Children in Digital World. Retrieved April 2020, from: [https://www.unicef.org/publications/files/SOWC\\_2017\\_ENG\\_WEB.pdf](https://www.unicef.org/publications/files/SOWC_2017_ENG_WEB.pdf)

# INFORMATION LITERACY SKILLS AMONG UNDERGRADUATE'S STUDENTS

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## ABSTRACT

Delivery of information literacy instruction to students is becoming progressively more significant due to the proliferation of electronic resources and the increased usage of the net as an information source. Information literacy has also become more and more significant in the contemporary environment of rapid technical change and proliferating information resources. However, the escalating complexity of this environment, individuals are faced with diverse, abundant information choices: in their academic studies: in the workplace, and in their personal lives. Therefore, this study purposes to identify information literacy skills in enhancing the learning process among undergraduate students in university. Information Literacy skills will assist the undergraduate's student in learning process to become advanced and efficient in using the right online resources in digital platforms. The quantitative research approach has been adopted in assessing the Information Literacy Skills (ILS) among undergraduate students for their learning process. The findings of this study revealed that majority of the students highlighted that information literacy skills are significantly important to them because their learning process has been systematically, efficient and advanced when using the right digital tools. The undergraduate student could also determine the right information resources that can be used in improving their learning process. Through these findings, this study has already contributed to the government agency especially in education in identified the level of ILS of undergraduate students nowadays.

**Keywords:** Library and Information Management, Information literacy, information literacy skills, learning process, undergraduate students.

## INTRODUCTION

This study is to identify information literacy skills among undergraduate students, as it is one of the important elements in the learning process. Information literacy skills are one of the crucial factors to all students across curriculum. The university plays an essential role in enhancing the learning process of the university, especially in teaching and learning. However, the university student also should improve their own skill and knowledge so that can adopt the current curriculum that maybe adopt the artificial intelligence, robotic and virtual reality elements in their teaching and learning. Other than that, the university student also should know the right and credible information to receive, disseminate, use and share and apply that information for their assignment that has been given by the lecturer. With the advance of technology, information and technology are related with one another so the university student should have capabilities and abilities to recognize the information needed by them and how to locate, evaluate and use them effectively. Thus, the university student should possess a set of abilities requiring individuals to recognize when information is needed and can locate, evaluate, and effectively use the needed information. This kind of ability is known as information literacy. These abilities already have certain skills that assist the undergraduate's student in their learning process in university.

Therefore, this study would like to identify information literacy skills in enhancing the learning process among undergraduate students in university. Information Literacy skills will assist the undergraduate's student in learning process to become advanced and efficient in using the right online resources in digital platforms. It is essential to universities identify the right skills of information literacy so that they could apply and utilized those skills in learning process. Besides that, the process of learning and teaching will become smoother when the undergraduate's student could apply those skills and

knowledge during the studies in the university. This study could also contribute to the government agency especially in education in identified the level of ILS of undergraduate students nowadays.

## **LITERATURE REVIEW**

Information literacy skills are one of the crucial factors to all students across the world. Swann (1985 & 1987) identifies that those who are uncertain about their skills tend to pursue information that is dependable with their views of themselves and interpret uncertain information in a manner that consistent with these views. Baro (2011) highlights that information is presented in unfiltered formats, raising questions about its authenticity, validity, and reliability. Doyle (1994) defines information literacy skills as a set of abilities required to access, evaluate, and use information from a variety of sources. Flywel & Jorosi (2018) mention that students are encountered with various and plentiful information selections in their academic studies. Therefore, information literacy skills among students are vital to ensure that they are able to filter the information retrieved before deciding whether to use or not to use it. Besides seeking for information from the printed sources that available in the libraries and information centres, students are also able to get their information needs from the non-printed sources like online databases, electronic journals, e-books and many other sources available these days (Hassan et al, 2020). Bawden (2001) views information literacy skills as related to “computer literacy, internet literacy, digital literacy and media literacy”. In the 21st century, students live in technology, and media-suffused situation and they are obligatory to seek plenty of information and integrate information sharing with the whole world (Partnership for 21st Century Skills, 2009).

Tang and Tseng (2013) highlight that, to ensure the students are able to succeed in the online learning environment, they must obtain critical thinking and decision-making skills, as well as the capability in evaluating information - to find out which information is correct and truthful. They added that online trainers create courses to involve students in self-regulated learning and to nurture students' skill to confirm their own learning progress. Before that, Zhang, Li, Duan and Wu (2001) in their study discover that distance learning self-efficacy, self-regulated learning skills, and information literacy skills are significant analysts of learners' general achievements in distance learning. According to Kurbanoglu, Akkoyunlu and Umay (2006), students will readily commence and effortlessly resolve their information searching complications if they are poised about their information literacy skills.

On the other hand, Oware (2010) says, information literacy skills have developed around the world as necessary skills for the 21st century. Baro and Kebob (2012) believe that this is caused by the swift progression in information and communication technologies globally. At the same time, Flywel & Jorosi (2018) mention that the active use of information by students has become essential. As informed by Lau (2006), information has turned out to be a factor that allows students at all levels to attain better results in their academic responsibility and even at work after graduation. He added that contemporary information overload entails the students to authenticate and evaluate information to prove its reliability. Ojedokun (2007) mentions, when students own suitable information literacy skills, their self-assurance and capability to work individually is enriched since they can critically think, understand the information well and make conversant decisions. Wema (2006) and Chu, Yeung & Chu (2012) say, it is vital for universities to certify that all students attain information literacy skills by participating in information literacy education into their curriculum.

## **RESEARCH METHODOLOGY**

This study has adopted the quantitative research approach in identified the information literacy skill among the undergraduate students in university. According to Coghlan and Bryan-Miller (2014), quantitative research is the dominant research framework within the social science where it is a set of strategies, technique and assumption used to study physiology, social and economic processes through the exploration of numeric patterns. Thus, it is suitable approach in exploring and identified the information literacy skill among undergraduate study within the university. This study involves a descriptive survey research design. The population of this study covered undergraduate students from twenty-six (26) faculties and academic centers all around Universiti Teknologi MARA (UiTM) Selangor. The number of respondents that participated in this

study is 165 undergraduate students. The instrument covered information literacy skills as well as information resources. The Statistical Package for Social Science (SPSS) software already been used to analyze the data based on the objectives of this study.

## FINDINGS AND DISCUSSION

### ***Demographic of Respondents***

The number of respondents who participated in this study is 165 undergraduate students within the UiTM Selangor Branch. The data show that the number of male and female are forty-two (42) male meanwhile, one hundred twenty-three (123) of female. The undergraduate student come from various faculty and college in UiTM Selangor Branch. The segmentation of respondents as following:

**Table 1: Number of respondents from various faculties within UiTM Selangor Branch**

Faculty	Frequency	Percent	Valid Percent	Cumulative Percent
Faculty of Medicine	3	1.8	1.8	1.8
Faculty of Architecture, Planning & Surveying	2	1.2	1.2	3.0
Faculty of Film, Theater & Animation	1	.6	.6	3.6
Faculty of Education	1	.6	.6	4.2
Faculty of Accountancy	12	7.3	7.3	11.5
Faculty of Hotel & Tourism Management	1	.6	.6	12.1
Faculty of Information Management	145	87.9	87.9	100.0
Total	165	100.0	100.0	

### ***Identify the characteristics of information literacy skills among undergraduate students***

This study is conducted to identify the characteristics of information literacy skills in enhancing the learning process among undergraduate students. The data analysis described the mean scores in identifying each construct of information literacy skills characteristics in enhancing undergraduate students learning process. The findings found that many students understand the meaning of information literacy skills with the ILS (mean = 3.79, S. D. = .649) based on the score obtained. Majority of the students highlighted that information literacy skills are important to them with the ILS (mean = 4.18, S. D. = .656). Besides that, all the respondents responded that information literacy skills should be obtained by all undergraduate students to enhance their learning process with the ILS (mean = 4.22, S. D. = .647). In other words, most of the undergraduate students agreed that information literacy skills are very useful in enhancing their learning process.

On the other hands, undergraduate students know the kinds of information literacy skills in searching for information they need. The ILS for this statement is (mean = 3.84, S. D. = .692). While for undergraduate students' knowledge about how to seek for the information themselves, the result is (mean = 3.98, S. D. = .662). This showed that not all undergraduate students have enough knowledge on information literacy skills. Besides that, majority undergraduate students agreed that information literacy skill is important to them in managing their information searching. The finding was (mean = 4.14, S. D. = .680).

It is found that, having information literacy skills could help undergraduate students in doing their daily tasks, e.g.: their learning process. The finding shows the information literacy skills for this question with (mean = 4.19, S. D. = .630). Majority respondents agreed that, undergraduate students' information literacy skills could solve their information seeking problem easily in their learning process. The findings for this statement are (mean = 4.13, S. D. = .677). While (mean = 4.04, S. D. = .643) findings were found for undergraduate information literacy skills could help them in formulating questions based on their information needs in their learning process questions.

On the other hand, the findings for the question related to the information literacy skills could help the undergraduate students in identifying potential sources of information in their learning process has found the (mean = 4.02, S. D. = .639). While the other question on information literacy skills could help undergraduate students in developing their successful search strategies in their learning process found the result of (mean = 4.06, S. D. = .622). The findings of (mean = 4.07, S. D. = .655) is for the question on information literacy skills could help the undergraduate students in developing their successful search strategies in their learning process.

The findings also show that, undergraduate students' information literacy skills could help them in evaluating information sources they found in their learning process. The findings were (mean = 4.05, S. D. = .656). It is also shows that, undergraduate students' information literacy skills could help them in organizing information for practical applications in their learning process with the (mean = 4.09, S. D. = .688). While, for the question related to the undergraduate students' information literacy skills could help them in integrating new information from sources into an existing body of knowledge with the findings of (mean = 4.08, S. D. = .666).

Regarding the undergraduate student's information literacy skills could help them in using information sources in their critical thinking with the results of (mean = 4.08, S. D. = .629). On the other hand, respondents responded that their information literacy skills could help them in using information sources in their problem solving with the findings of (mean = 4.07, S. D. = .700). While they agreed that their information literacy skills could enhance their learning process with the (mean = 4.13, S. D. = .667).

Based on the above table, the undergraduate student's information literacy skills could help them to understand more in their learning process with the (mean = 4.12, S. D. = .670). It is found that, the undergraduate students' information literacy skills could help them in becoming more efficient in their learning process. It is also discovered that the undergraduate students' information literacy skills could help them in becoming more advance in their learning process with (mean = 4.10, S. D. = .686). While for their information literacy skills could help them in improving their grades in their studies shows (mean = 4.11, S. D. = .672).

### ***Examine the relationship between information literacy skills and learning process among undergraduate students***

To test the relationship between the variables, the factor that researchers consider in determining the significance of hypothesis is the P-Value. Thus, for the relationship between two hypotheses to be considered significant and not just merely random, therefore, the P-Value must be less than 0.05. Based on the data analyses above, it shows that the information skills and electronics resources have a significant relationship as the P-value that was reported is less than 0.05. The significant value is .000 and it is a very strong significant (Sekaran & Bougie, 2016).

## **CONCLUSION**

Information literacy has also become more and more significant in the contemporary environment of rapid technological change and proliferating information resources. Because of the escalating complexity of this environment, individuals are faced with diverse, abundant information choices: in their academic studies: in the workplace, and in their personal lives (Anafo and Filson, 2014). In addition, information is available through multiple media, including graphical, aural, and textual, and these pose new challenges for individuals in evaluating and seeing it. The uncertain quality and expanding quantity of information pose large challenges for society (Ashoor, 2005). Hence, it is crucial for the undergraduate students bear at least good information literacy in enhancing their learning process throughout their fields at the universities.

## **REFERENCES**

Baro, E. E. (2011). A survey of information literacy education in library schools in Africa. *Library Review*, 60(3), 202-217.

Bawden, D. (2001). Information and digital literacies: a review of concepts. *Journal of documentation*, 57(2), 218-259.

Chu, C., Yeung, A., & Chu, S. (2012). Assessment of Students' Information Literacy: A Case Study of a Secondary Schools in Hong Kong. *CITE Research Symposium*. University of Hong Kong.

Coghlan, D., Brydon-Miller, M. (2014). *The SAGE encyclopedia of action research* (Vols. 1-2). London,: SAGE Publications Ltd doi: 10.4135/9781446294406

Flywel, D., & Jorosi, B. N. (2018). Information Literacy Skills Among the Undergraduate Students at the University of Livingstonia, Malawi. *International Journal of Library and Information Services (IJLIS)*, 7(2), 43-56.

Hassan, Z., Hussin, N., Hashim, H., & Tokiran, N. S. M. (2020). Information Seeking in Knowledge Society: Choose Right from Wrong. *International Journal of Asian Social Science*, 10(3), 151-158.

Kurbanoglu, S. S., Akkoyunlu, B., & Umay, A. (2006). Developing the information literacy self-efficacy scale. *Journal of Documentation*, 62(6), 730-743.

Lau, J. (2006). Guidelines on Information Literacy for Lifelong. International Federation of Library Association and Institutions. Retrieved December 11, 2017 from <http://www.ifla.org/files/assets/information-literacy/publications/ifla-guidelines-en.pdf>

Ojedokun, A. A. (2007). Information Literacy for Tertiary Education Students in Africa. Ibadan: Third World Information Services Limited.

Oware, D. W. (2010). Graduate Students' Views on Information Literacy (Master's thesis, Høgskolen i Oslo. Avdeling for journalistikk, bibliotek-og informasjonsvitenskap).

Partnership for 21st Century Skills (2009). Partnership for 21st Century Skills Professional development for the 21st century Retrieved September 25, 2012, from [http://www.p21.org/documents/P21\\_Framework.pdf](http://www.p21.org/documents/P21_Framework.pdf) (2009).

Swann (1985). W.B. Swann. The self as architect of social reality. B.R. Schlenker (Ed.), *The self and social life*, McGraw-Hill, New York (1985), pp. 100-125.

Swann (1987). W.B. Swann. Identify negotiation: Where two roads meet. *Journal of Personality and Social Psychology*, 53 (1987), pp. 1038-1051.

Sekaran, U., & Bougie, R. (2016). *Research Methods for Business: A Skill Building Approach*. John Wiley and Sons.

Wema, E. (2006). Developing Information Literacy Programmes for Public University Libraries in Tanzania: A Case Study of the University of Dar eslaam [Ph.D. Thesis]. Loughborough University.

Zhang, J., Li, F., Duan, C. & Wu, G. (2001). Research on self-efficacy of distance learning and its influence to learners' attainments. C.H. Lee (Ed.), *Proceedings of the International Conference on Computers in Education (ICCE)/SchoolNet 2001*, Incheon National University of Education, Incheon, South Korea (2001), pp. 1510-1517.

## **FACULTY OF MEDICINE**

# THE EFFECTS OF PERSISTENT ORGANIC POLLUTANT DIOXIN ON REVERSE CHOLESTEROL TRANSPORT PATHWAY OF HDL IN DIFFERENTIATED 3T3-L1 ADIPOCYTES

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## ABSTRACT

Cardiovascular disease (CVD) the leading cause of mortality globally occurs primarily due to coronary artery disease caused by hypertension, diabetes and dyslipidemia. In addition to the above-mentioned risk factors, persistent organic pollutants (POPs) which include dioxin also play a role in CVD. They are transported by lipoproteins and accumulate in adipose tissue with low-density lipoprotein (LDL) found to be the main transporter of lipid-soluble POPs. However, very-LDL (VLDL) and high-density lipoprotein (HDL) have also been associated with lipid-soluble POPs in humans. An in-vitro study looking at the effects of dioxin in reverse cholesterol transport (RCT) of high-density lipoprotein cholesterol (HDL-c), an anti-atherogenesis pathway was undertaken to further understand it's mechanism of action. **MATERIALS AND METHOD:** 3T3-L1 preadipocytes were differentiated into mature adipocytes according to manufacturer instructions. A cholesterol efflux capacity assay was performed using mature adipocytes loaded with fluorescence-labelled cholesterol and treated with dioxin concentrations of 1,10,30 nm and dioxin 30 nm together with rosiglitazone (0.005  $\mu$ mol/ml). The movement of labelled cholesterol from the cells to the acceptor (HDL) was quantified with the intensity of fluorescence-labelled cholesterol measured at 485 nm excitation and 523 nm emission. **RESULTS AND DISCUSSION:** The percentage of cholesterol efflux using dioxin concentrations of 1 and 10 nm and HDL was lower than that of HDL alone. However, the highest Dioxin concentration (30 nm) showed comparable results with HDL after a 4 hours efflux incubation period. Dioxin together with rosiglitazone and HDL showed unexpected results with a lower percentage of cholesterol efflux. This shows that Dioxin and rosiglitazone did not significantly increase the ability of HDL to promote cholesterol efflux in mature adipocytes as it should function. **CONCLUSION:** These findings suggest that dose of Dioxin exposure, to some degree, influences cholesterol efflux which warrants further exploration.

**Keywords:** Persistent Organic Pollutant Dioxin; Reverse Cholesterol Transport; HDL, Cardiovascular disease; Cholesterol efflux

## INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of mortality globally with 17.9 million people dying annually from CVD in 2019 (WHO). CVD occurs primarily due to atherosclerosis which is triggered by hypertension, diabetes and dyslipidemia (1,2). Recently, it has been shown that persistent organic pollutants (POPs), which include Dioxin, influence metabolic diseases that increase the risk of atherosclerosis. POPs are transported by lipoproteins and accumulated in adipose tissue with low-density lipoprotein (LDL) found to be the main transporter of lipid-soluble POPs (3). Human can be exposed to Dioxin through the consumption of contaminated food, water, air and skin absorption. Very-low-density lipoprotein (VLDL) and high-density lipoprotein (HDL) have also been associated with lipid-soluble POPs in humans (4,5). However, the effect of Dioxin on cholesterol transporters is not established and hence investigated in this study.

Cholesterol efflux is the process by which excess cholesterol is removed from cells, primarily through a class of proteins called ATP-binding cassette transporters (ABCA1 and ABCG1) and high-

density lipoprotein (HDL) particles, often referred to as “good cholesterol”. This process is essential for preventing them accumulation of cholesterol in cells and by extension, the development of atherosclerosis (6,7,8).

Dioxin is a group of toxic chemical compounds that can have a wide range of adverse effects on human health. While much of the research on dioxin has focused on its carcinogenic properties and impact on the endocrine system, it can also affect various aspects of lipid metabolism, including cholesterol transporters. Cholesterol transporters are essential for regulating cholesterol levels in the body, and disruptions in their function can lead to various cardiovascular and metabolic problems (6). Dioxin primarily exerts its effects on cholesterol transporters through its influence on gene expression.

It is important to note that the effects of dioxin on cholesterol transporters are complex and can vary depending on factors such as the dose and duration of exposure, as well as individual genetic susceptibility. Additionally, the health consequences of dioxin exposure extend beyond cholesterol transporters to include a wide range of adverse effects on the cardiovascular system, immune system, and overall health. Reducing exposure to dioxin and other environmental toxins is an important step in minimizing these health risks.

## MATERIALS AND METHODS

3T3-L1 preadipocytes were cultured into adipocytes according to manufacturer instructions. Fully differentiated 3T3-L1 adipocytes (Day 15) were then cultured with a treatment medium containing DMEM, 10% FBS, and 1% penicillin/streptomycin antibiotic to proceed with the next experiment. Cells were maintained at 37°C in a humidified 5% CO<sub>2</sub> incubator.

Lipid content was measured using a commercially available kit (AdipoRed Assay Reagent). Test experiments were done on undifferentiated 3T3-L1 preadipocytes, differentiated 3T3-L1 adipocytes on day 9, and fully mature 3T3-L1 adipocytes on day 15 to see the progress of lipid accumulation in the cells. For qualification test, the adipocytes (Day 9) and the matured adipocytes (Day 15) was tested for the presence of lipid contents by staining the cells with AdipoRedTM assay reagents. For quantification assay, lipid content was measured by AdipoRedTM assay, cells were washed with PBS and 100 µL of PBS was added to the wells. AdipoRed reagent (30µL) was added to each well. After 10 min, the fluorimeter and fluorescence were measured with an excitation wavelength of 485 nm and emission wavelength of 572 nm.

For the MTS assay (Cell Proliferation, Colometric, Abcam, UK), on day-15, the adipocytes cell was cultured in the treatment medium containing various concentration of dioxin (0.1nM, 1nM, 10nM, 30nM and 60nM) and cells were incubated in 37°C incubator, 5% CO<sub>2</sub> for 24 hours, 48 hours and 72 hours. Cells with adipocytes medium were served as control meanwhile, cells treated with 0.5ul toluene in 100ul medium were served as vehicle control. After 24 hours, 48 hours and 72 hours incubation, 10ul MTS was added into each well and returned to the incubator for 3 hours. The plate was shaken and absorbance was measured at 490 nm using a microplate reader (Perkin Elmer Victor X5 2030) to determine the formazan concentration, which is proportional to the number of viable cells.

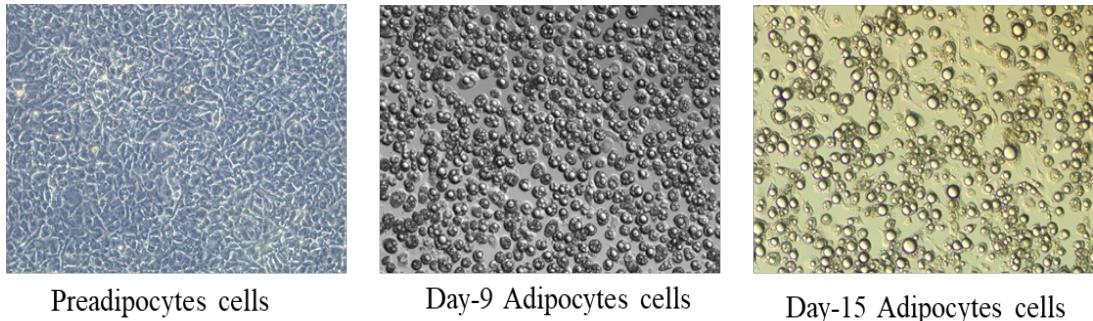
For the quantitative measurement of cholesterol efflux assay (Cholesterol Efflux Assay Kit, Abcam, UK, Cell-based), after mature adipocytes ready, they were loaded with fluorescence-labelled cholesterol, labelling medium for 1-hour incubation, followed by an equilibrium process, in which cells were incubated in equilibration medium to equilibrate the labelled cholesterol among all intracellular cholesterol pools for 24 hours. After that, the cells were treated with dioxin (1, 10 & 30 nm) and dioxin (30 nm) together with rosiglitazone (0.005 µmol/ml) then incubated with cholesterol acceptors and the movement of labelled cholesterol from cells to the acceptor was quantified. The capability HDL (100 µg/ml) to take up labelled cholesterol was determined after 4h of efflux incubation period. TNF-Alpha (10 ng/ml) was used as a positive control while toluene as vehicle control. The intensity of fluorescence-labelled cholesterol was measured at 485 nm excitation and 523 nm emission.

All experiments were conducted at least in triplicate, and the data are expressed as the mean ± standard error of mean (SEM). Statistical analysis was performed using one-way ANOVA, followed by Tukey post hoc test for multiple comparisons. A p-value of less than 0.05 was regarded as statistically significant for differences between groups.

## RESULTS AND DISCUSSION

### 3T3-L1 Cell culture and treatment

3T3-L1 preadipocytes was cultured into full adipocytes according to the manufacturer instruction. Briefly, preadipocytes 3T3-L1 was cultured in 3T3-L1 Preadipocyte medium until confluent. Following this, cells were induced for differentiation by culturing in the 3T3-L1 differentiation medium for 3 days until fully differentiated. The fully differentiated 3T3-L1 adipocytes was cultured in the 3T3-L1 Adipocyte medium until matured (15 days). Based on Figure 1, the differentiation of 3T3-L1 from preadipocytes to mature adipocytes took 15 days after growth in the differentiation medium.



**Figure 1: Cells images with 10x magnification. The differentiation of 3T3-L1 from preadipocytes to mature adipocytes took 15 days after growth in the differentiation medium.**

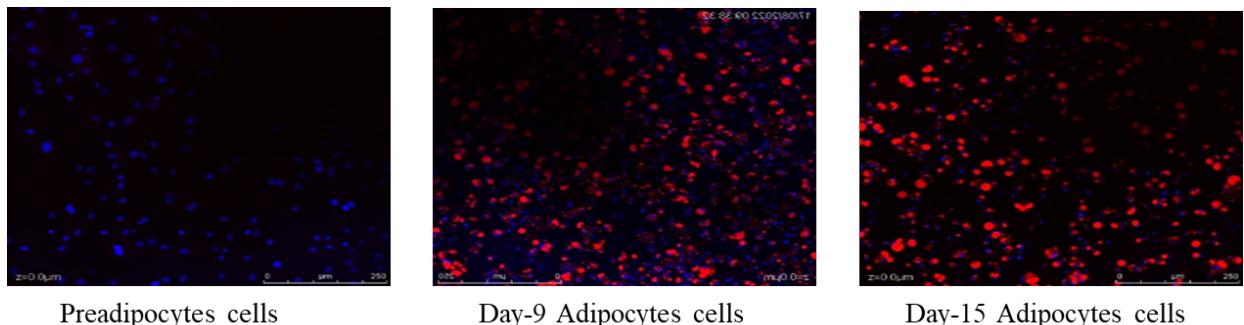
Mature adipocytes and pre-adipocytes are two different phases of fat cell development that differ significantly in structure, function, and appearance. In term of shape and size, pre-adipocytes are undifferentiated cells that have a fibroblast-like shape and relatively smaller and have a more elongated or spindle-shaped appearance.

On day 9, the cells are in an intermediate stage, transitioning from pre-adipocytes toward mature adipocytes. They are smaller in size, with an elongated or fibroblastic shape, and have a high nuclear-to-cytoplasmic ratio. There are few lipid droplets, as the cells have not yet accumulated significant fat. The cells are actively undergoing differentiation and preparing for the transition to mature adipocytes.

By day 15, mature adipocytes are larger and more spherical. Adipocyte development is characterized by lipid accumulation, and as the cell stores energy as fat, its shape becomes rounder compare to day 9. The cells have a distinct appearance with a centrally located, flattened nucleus pushed to the periphery by the large lipid vacuole.

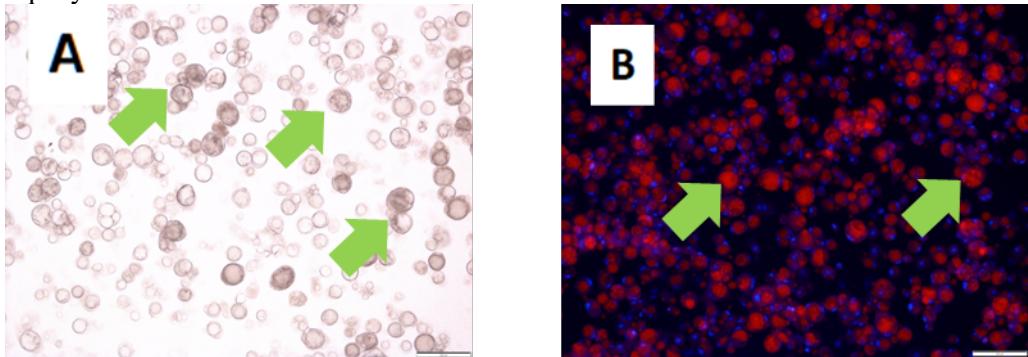
### Qualification of lipid content by AdipoRedTM assay

High secretion of lipid droplets is one of the potent characteristics of mature adipocytes. This can be observed within the incubation period of preadipocytes to mature adipocytes.



**Figure 2: Image of Adipored (red) and nuclues staining (blue) indicating accumulation of lipids in Adipocyte cells. Images were taken by Confocal Laser Scanning Microscope and observed under 20x objective.**

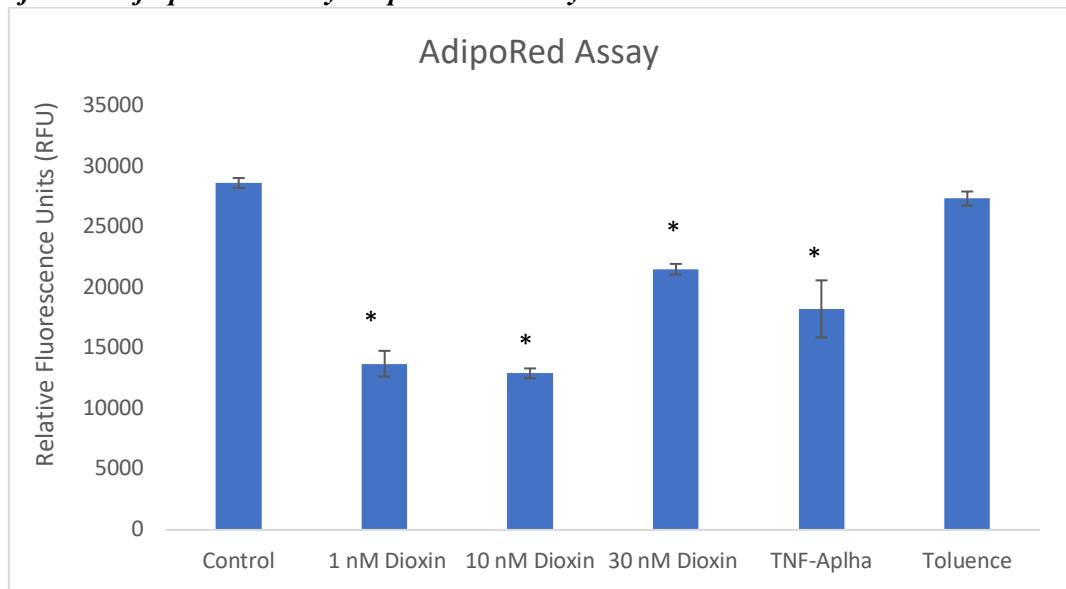
In pre-adipocytes, the nucleus is centrally located and occupies a significant portion of the cell. The cell is more metabolically active, with processes related to cell division, signaling, and differentiation. In mature adipocytes, the nucleus is flattened and displaced to the periphery of the cell due to the large lipid droplet. The nucleus in mature adipocytes is less metabolically active compared to pre-adipocytes.



**Figure 3: Cells images with 10x magnification. A: Bright field and B: Fluorescence. Cells were stained with Adipored reagent(red) and DAPI for nucleus (blue). Arrows are the lipid droplets.**

This figure showed mature adipocytes day 15 with different technique of imaging. The rounder shapes are larger and more spherical, filled with large lipid droplets containing triglycerides. Intracellular triglyceride accumulation is frequently utilized as a measure of adipocyte development. The lipid droplets keep getting bigger and more numerous.

#### ***Quantification of lipid content by AdipoRedTM assay***

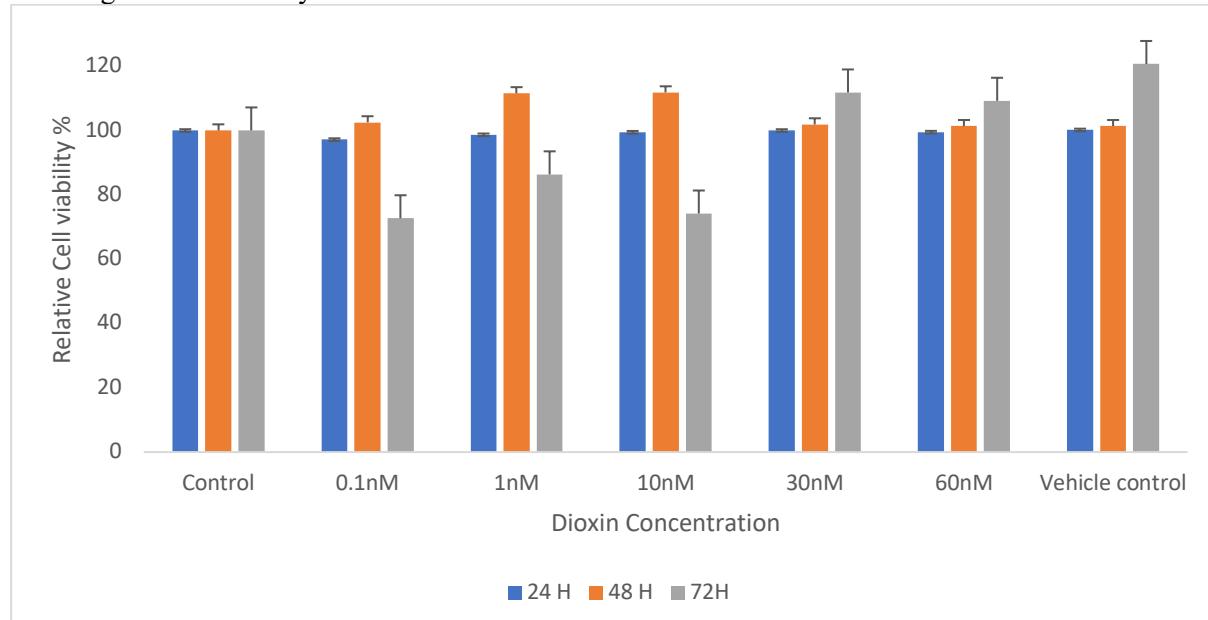


**Figure 4: 3T3-L1 cells were induced to differentiate in the presence of dioxin with 1, 10 and 3 nm, TNF $\alpha$ , toluene and no inhibitor. Lipid accumulation was assayed after 15 days mature adipocytes. Data are expressed as Mean + SEM (n=5), \*p<0.05 versus control group.**

Based on the result above, there are no significant different between and within each group. The accumulation of lipid droplets of dioxin treated with 1,10 and 30 nm of Dioxin representing significant reduction compared to the control. Same goes to TNF-alpha which acts as positive control. This suggests that Dioxin at this concentration decreases or reducing lipid accumulation. The lipid content increases to 21,549 at 30 nM Dioxin, indicating a reversal of the dose-dependent effect at higher concentrations. This could be because of toxicity changing the metabolism of lipids or a compensatory cellular response. TNF-Alpha showed the lipid content with 18,273, lower than the control but higher than the effects seen with Dioxin (1 nM and 10 nM). TNF-alpha seems to suppress lipid accumulation, although not as strongly as Dioxin. While toluene showed the lipid content which is close to the control level. This suggests that Toluene has little to no effect on lipid accumulation.

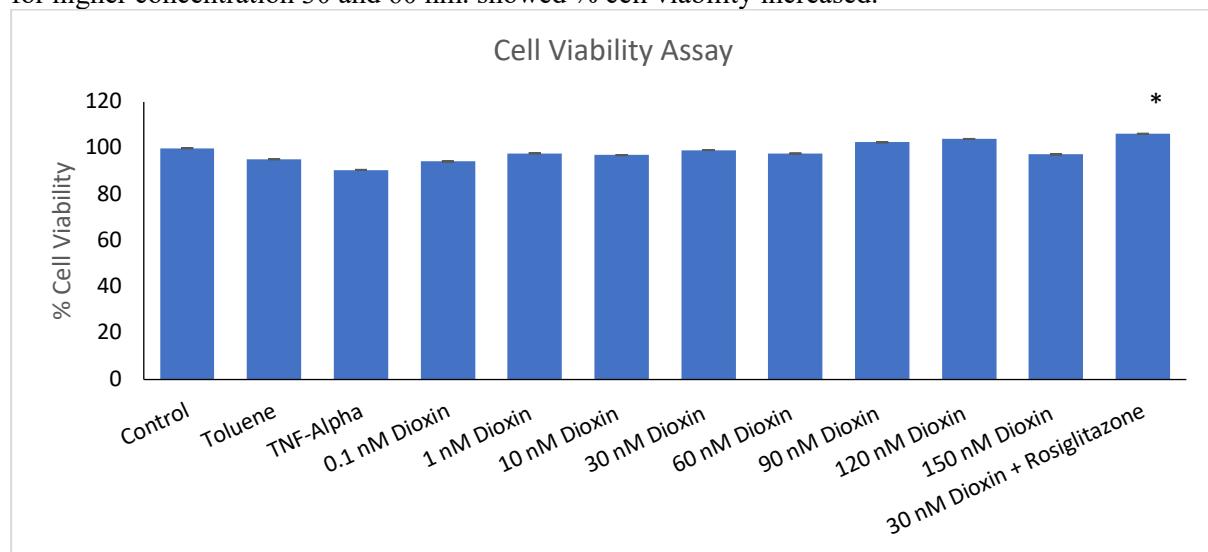
### MTS Cell Viability Assay

MTS assay (3-(4,5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulfophenyl)-2H-tetrazolium assay) is a commonly used colorimetric assay for assessing cell viability, proliferation, and cytotoxicity in biological experiments. For this assay cell were exposure to dioxin which was detected using MTS Assay Kit with different concentration of dioxin and times. This assay aims to reveal the effect of the dioxin in different concentration and incubation time on cell proliferation and cytotoxicity, affecting the cell viability.



**Figure 5: Cell viability assay of 3T3-L1 cells exposed to different concentrations of dioxin (0.1 nM to 150 nM) with different time incubation.**

Based on the results above, viability assay of 3T3-L1 cells exposed to different concentrations of dioxin (0.1 nM to 150 nM) for 24 hours, 48 hours and 72 hours incubation showed no toxicity effect. However, dioxin with concentration of 0.1, 1 and 10Nm showed significantly decrease after 72h while for higher concentration 30 and 60 nm. showed % cell viability increased.



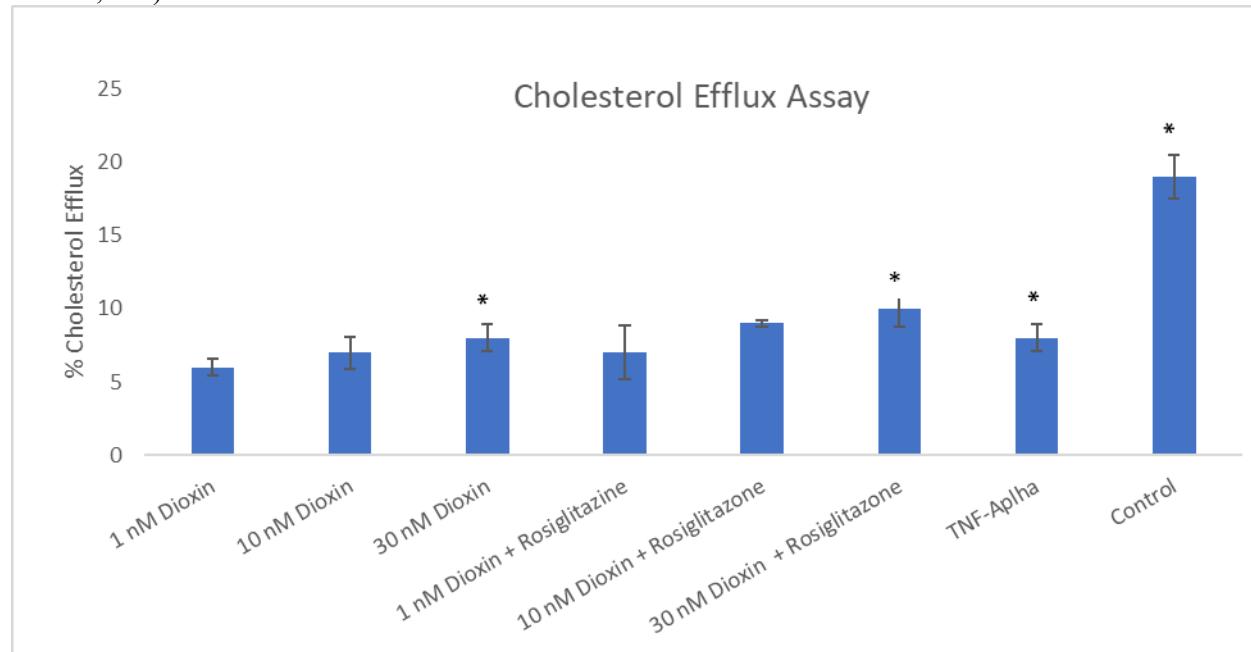
**Figure 6: Cell viability assay of 3T3-L1 cells exposed to different concentrations of dioxin (0.1 nM to 150 nM). Graph represent average cell viability (mean SEM values, n=5, \*p<0.05 versus control group).**

From the result above, concentration of dioxin with 0.1 nM - 30 nM showed viability remains fairly stable with no strong indication of toxicity at these doses. While dioxin with 60 nM - 120 nM gave results with viability exceeds 100% which suggesting potential stimulatory effects at higher doses.

However, dioxin with concentration 150 nM showed viability decreased may due to that extremely high doses might lose the stimulatory effect or begin to introduce toxicity. The combination treatment with Rosiglitazone at 30 nM Dioxin shows the highest viability at 106.23%, suggesting a potential protective or enhancing effect from this drug.

#### **Cholesterol Efflux Assay**

The movement of labelled cholesterol from the cells to the acceptor (HDL) as control group treated with 1,10,30 nM of Dioxin and dioxin 1, 10 and 30 nM together with Rosiglitazone (0.005  $\mu$ mol/ml) plus HDL for each treatment were quantified with Cholesterol Efflux Assay Kit (Cell-based, Abcam, UK) at 485 nm excitation and 523 nm emission.



**Figure 7: Cholesterol Efflux Assay was quantified in cells exposed to 1,10,30 nM of Dioxin and Dioxin 1, 10 and 30 nM together with Rosiglitazone (0.005  $\mu$ mol/ml) plus HDL for each treatment. Graph represent % cholesterol efflux (mean SEM values), n=4, \*p<0.05 versus control group.**

3T3-L1 cells were treated with differentiation concentration of dioxin, dioxin together with rosiglitazone, HDL as acceptors (Control) for cholesterol while TNF-Alpha served as a positive control. The percentage of cholesterol efflux using dioxin concentrations of 1, 10 & 30 nM and increased within 4-hour efflux incubation time. Among the dioxin groups, concentrations 30 nm showed the highest percentage of cholesterol efflux followed by 10 nm and 1 nm. However, the highest Dioxin concentration (30 nM) showed with significantly different compared to control and TNF-Alpha after 4 hours efflux incubation period. Treatment dioxin together with rosiglitazone showed higher percentage of cholesterol efflux compared dioxin alone. Dioxin 30 nm together with rosiglitazone showed significantly different compared to control and TNF-Alpha after 4 hours efflux incubation period. All other groups did not show any significant differences.

Rosiglitazone acts as a peroxisome proliferator-activated receptor gamma (PPAR- $\gamma$ ) agonist, which regulates genes involved in glucose and lipid metabolism. Its effect or may induce on cholesterol efflux. This is primarily mediated by the enhanced activity of ATP-binding cassette (ABC) transporters, such as ABCA1, which play a crucial role in the efflux of cholesterol to HDL particles. It is also suggested that rosiglitazone can alter the lipid composition of HDL particles. This change might improve the function of HDL in cholesterol efflux, even if the total HDL cholesterol levels are not significantly altered. Based on the trend, looks like incubation of 1, 10 and 30 nm dioxin with Rosiglitazone have a higher trend in increasing cholesterol efflux compared to Dioxin alone. However, comparisons involving "Dioxin plus Rosi" groups did not show significant differences. This suggests the effects of "Rosi" treatment are not dramatically different at these levels.

## CONCLUSION

Dioxin at 1, 10 and 30 nm had lower cholesterol efflux compared HDL alone. Interestingly, incubation of dioxin with Rosiglitazone exhibits higher trend of cholesterol efflux capacity however not as potent as HDL alone. Therefore, it can be postulated that PPAR gamma pathway is responsible for the mechanism of dioxin inhibiting cholesterol efflux capacity in 3T3 L1 adipocytes.

## REFERENCES

- [1]. [https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-\(cvds\)](https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds))
- [2]. Alice Dupont Juhl and Daniel Wüstner (2022). Pathways and Mechanisms of Cellular Cholesterol Efflux—Insight From Imaging. *Front. Cell Dev. Biol.*, 01 March 2022 Sec. Membrane Traffic Volume 10 - 2022 | <https://doi.org/10.3389/fcell.2022.834408>
- [3]. WHO estimates of the global burden of foodborne diseases: foodborne disease burden epidemiology reference group 2007-2015. I. World Health Organization. ISBN 978 92 4 156516 5
- [4]. WHO (2002). Polychlorinated dibenzodioxins, polychlorinated dibenzofurans, and coplanar polychlorinated biphenyls. In: Safety evaluation of certain food additives and contaminants. Geneva, World Health Organization (WHO Food Additives Series, No. 48; <http://www.inchem.org/documents/jecfa/jecmono/v48je20.htm>).
- [5]. Cave, E. & Crowther, N.J. (2019). The Use of 3T3-L1 Murine Preadipocytes as a Model of Adipogenesis. In: Guest, P. (eds) Pre-Clinical Models. Methods in Molecular Biology, vol 1916. Humana Press, New York, NY. [https://doi.org/10.1007/978-1-4939-8994-2\\_25](https://doi.org/10.1007/978-1-4939-8994-2_25)
- [6]. Jie Luo, Hongyuan Yang & Bao-Liang Song (2020). Mechanisms and regulation of cholesterol homeostasis. *Nature Reviews Molecular Cell Biology* volume 21, pages225–245
- [7]. Krause BR & Hartman AD. (1984). Adipose tissue and cholesterol metabolism. *Lipid Res*; 25:97-110.
- [8]. Zhang, Y., Mc Gillicuddy, F.C., Hinkle, C.C., O'Neill, S., Glick, J.M., Rothblat, G.H. & Reilly, M.P. (2010). Adipocyte modulation of high-density lipoprotein cholesterol. *Circulation*, 121(11): 1347. <http://doi.org/10.1161/CIRCULATIONAHA.109.897330>.
- [9]. Saha, S., Graessler, J., Schwarz, P.E., Goettsch, C., Bornstein, S.R. & Kopprasch, S. 2012. Modified high-density lipoprotein modulates aldosterone release through scavenger receptors via extracellular signal-regulated kinase and janus kinase-dependent pathways. *Molecular and Cellular Biochemistry*, 366(1-2): 1-10. <https://doi.org/10.1007/s11010-012-1274-2>
- [10]. Rizzatti, V., Boschi, F., Pedrotti, M., Zaico, E., Sbarbati, A. & Zamboni, M. 2013. Lipid droplets characterization in adipocyte differentiated 3T3-L1 cells: size and optical density distribution. *European Journal of Histochemistry*, 57(3): 24. <http://doi.org/10.4081/ejh.2013.e24>.
- [11]. Niemelä, S., Miettinen, S., Sarkkanen, J.R., & Ashammakhi, N. 2008. Adipose tissue and adipocyte differentiation: molecular and cellular aspects and tissue engineering applications. *Topics in Tissue Engineering*, 4(1): 26.
- [12]. William P. C. & Jaswinder K. S. 2015. TNF- $\alpha$  and adipocyte biology. *Federation of European Biochemical Societies*, 582(1): 117–131. doi: 10.1016/j.febslet.2007.11.051.
- [13]. Özlem Sultan Aslantürk Submitted: 16 May 2017 Reviewed: 24 October 2017 Published: 20 December 2017 DOI: 10.5772/intechopen.71923 FROM THE EDITED VOLUME Genotoxicity - A Predictable Risk to Our Actual World

# ELUCIDATING THE ASSOCIATION OF *TMPRSS6* rs855791, rs5756504 AND rs4820268 POLYMORPHISM AND IRON DEFICIENCY IN OBESE ADULTS IN MALAYSIA

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## ABSTRACT

Obesity is becoming a social burden in Malaysia, and there is emerging evidence that obesity increase the risk of iron deficiency (ID) and iron deficiency anaemia (IDA). Polymorphisms such as single nucleotide polymorphisms (SNPs) in the *transmembrane protease serine 6 (TMPRSS6)* gene resulted in elevated hepcidin levels, which cause iron-refractory iron deficiency anaemia (IRIDA). Aside from IRIDA, previous studies have shown that there was significant association between the *TMPRSS6* SNPs with haematological and biochemical parameters related to ID with or without anaemia in different clinical settings such as celiac disease and chronic kidney diseases. Unfortunately, limited study in identifying a possible relationship between *TMPRSS6* SNPs and ID among obesity reported in Malaysia. However, the underlying mechanisms impacting iron metabolism dysregulation in this population is unknown. Therefore, this study aimed to identify the *TMPRSS6* SNPs (rs855791, rs5756504 and rs4820268) that influence low blood and body iron status parameters in overweight and obese subjects with ID/IDA. Also, to elucidate the association between the identified SNPs with the haematological and biochemical parameters. A total of 62 overweight/obese patients were recruited from the Primary Care Medicine clinic at Pusat Pakar Perubatan UiTM, Sungai Buloh, Selangor. Anthropometric measurements (weight, height, BMI, waist, and hip circumference) were taken. Blood samples were collected to analyse the full blood count and iron profiles. The concentrations of serum hepcidin, IL-6, leptin and sTfR were measured. Genomic DNA was extracted to be used on identifying the SNPs located on the *TMPRSS6* gene via rhAmp SNP genotyping assay (qRT-PCR). SPSS software was used to analyse the correlation between the identified SNPs, haematological and biochemical parameters among the studied group via Pearson correlation analysis, and One-way ANOVA. Approximately, 51.6% of overweight/obese subjects were iron deficient (case) and 48.4% were non-iron deficient (control). Significant low levels of haematological (haemoglobin, Hct, MCV, MCH and MCHC), iron profiles (SI, TS and SF), and biochemical (hepcidin and leptin) parameters were observed in the case group compared to the controls. In contrast, significant high levels of sTfR and TIBC were observed among the case compared to the controls. Genotyping analysis showed that rs855791 exhibits significant association with the incidence of ID and allele A was identified as the risk allele which significantly associated with low levels of haemoglobin, Hct, MCHC, SI, TS and hepcidin. No significant association were observed between rs4820268 and rs5756504 with the ID status. Meanwhile, among the iron deficient group, A/A carriers of rs855791 showed significantly associated with low levels of Hct and hepcidin. For rs5756504, among the case group, G/G carriers were significantly associated with low levels of hepcidin and leptin. No significant association was observed between rs4820268 with the studied parameters in both groups. To our knowledge, this is the recent findings on the *TMPRSS6* gene polymorphisms in relation to ID among overweight/obese adults. Future studies on a larger sample size are warranted to further discover the functional structure of *TMPRSS6* protein (MT-2) which was associated with the identified SNPs that caused ID/IDA to provide better insight on the SNP associated iron regulatory gene and disease management among overweight /obese populations.

**Keywords:** Iron deficiency, anaemia, transmembrane protease serine 6 gene, overweight, obesity

## INTRODUCTION

The global prevalence of overweight and obesity is increasing due to rising national affluence, dietary changes, and fast food industries [1]. Malaysia has the highest overweight and obesity prevalence among Asian nations, with 30.4% and 19.7% among the adults, respectively [2]. Obesity increases the risk of chronic diseases like diabetes, osteoarthritis, cancer, and major vascular disorders. Iron deficiency (ID) is linked to excess body weight, with lower iron concentrations and decreased levels of ferritin, haemoglobin, and saturated transferrin [3]–[7].

Obesity is linked to low iron status in the obese population due to poor dietary practices, low physical activity, and increased iron need. Obesity is also known as a low-grade inflammatory condition and the low iron status observed within this population can be explained by the inflammatory state, causing the level of hepcidin to be elevated. Hepcidin is a protein that is directly responsible for reducing iron absorption in the gut through its down-regulatory effect on ferroportin, the main iron exporter found in the cell membrane of duodenal enterocytes, which absorb iron from the food, and macrophages, which recycle iron from the senescent erythrocytes [6]. Furthermore, hepcidin level in the liver can be influenced by several systemic factors, including changes in the body's iron reserves, inflammation, hypoxia, and the rate of erythropoiesis, as well as the availability of regulatory messenger molecules such matriptase-2 (MT-2) [8].

Matriptase-2 commonly expressed in the liver and function as a negative regulator of hepcidin expression. In addition, *transmembrane protease serine 6 (TMPRSS6)* gene located on the chromosome 22 is responsible for the expression of MT-2 protein which was believed to regulate the hepcidin expression during the increase body iron level. For instance, *TMPRSS6* normally modifies or cleaves hemojuvelin (HJV) proteins that function as the hepcidin-activating pathway in the hepatocytes which then followed by inhibition of hepcidin expression during iron deficiency condition. Despite that, due to the polymorphisms such as single nucleotide polymorphisms (SNPs) arising in the *TMPRSS6* gene, these SNPs affect the catalytic activity domain of MT-2 and, thus, causing the MT-2 protein are unable to suppress the hepcidin expression, causing a high level of hepcidin in the circulation. Hence, leading to anaemia and to the extent leading to ID [9].

The common ID condition observed with the association between elevated hepcidin levels and *TMPRSS6* SNPs such as rs855791 and rs4820268, were seen among individuals with iron-refractory iron

deficiency anaemia (IRIDA) [10]. Recently, relationship between common SNPs (rs855791 and rs4820268) were also observed among end-stage renal failure and chronic kidney disease patients with IDA [11], [12]. Despite of differences in genetic and medical backgrounds, findings from previous studies have proved that commonly reported SNPs (rs855791 and rs4820268) are not only associated with chronic diseases but also associated with low haemoglobin, mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), serum iron (SI), serum ferritin (SF), and transferrin saturation (TS) observed among ID/IDA individuals without comorbidities [10], [13], [14]. SNP of rs5756504 also exhibited similar association with the other two common SNPs [15]. This showed that not only chronic diseases associated patients could possess ID/IDA, normal individuals with ID/IDA history also can be affected. Moreover, genome wide association study (GWAS) revealed that these SNPs commonly associated with Asian populations followed by the Caucasian [16]. Although the definitive statistics of the prevalence of genetic variants of IDA are scarce, however it is estimated that iron-genetic diseases such as IRIDA, celiac disease, and chronic kidney disease might contributed less than 1% of all instances of IDA seen in clinical practice [17].

As condition of ID/IDA were observed among the overweight and obese individuals specifically among the adults, in this recent study predicted that overweight and obese individuals might be affected by the presence of these SNPs which affecting the body iron level leading to ID/IDA. Therefore, in this study aims to identify the *TMPRSS6* SNPs (rs855791, rs4820268 and rs5756504) and elucidating the association between the identified SNPs with haematological parameters, iron profiles and biochemical parameters. Findings from this study may drive Malaysian future genetic association studies that seek to pinpoint genetic risk factors for iron insufficiency particular to the obesity community and, ultimately, to assist in developing population-specific iron supplementation strategies.

## MATERIAL AND METHOD

A total of 62 overweight/obese adults were recruited according to the exclusion and inclusion criteria from the Primary Care Medicine Clinic in Pusat Pakar Perubatan UiTM (PPPUiTM). All subjects were subjected to measure the anthropometric measurements (BMI, weight, height, WC, hip and waist to hip ratio). Thirty-two of the subjects were classified as case group whereas 30 subjects were classified as control group. Ethics approval was obtained from the UiTM Research Ethics Committee. Next, 10 mL of fresh blood were collected into two EDTA tube and one SST tube (specifically for the serum) by the respective phlebotomist during the appointment and were used for the full blood count, iron profiles and biochemical analysis. As for the biochemical analysis, serum hepcidin, IL-6, leptin and soluble transferrin receptor were analysed using the ELISA kit assays.

Meanwhile, the second tube of blood is then used to extract the genomic DNA of all subjects using the genomic DNA extraction kit and were run for the genotyping analysis using the rhAmp SNP genotyping assay via the quantitative real-time PCR. Once genotyped, allelic discrimination plot of all the tested SNPs (rs855791, rs5756504 and rs4820268) were analysed automatically. All the assays were run in duplicate. All the collected data and measurements were analysed using the SPSS software version 26 via the student *t*-test, Pearson correlation and One-way ANOVA to identify the association between the rs855791, rs5756504 and rs4820268 with the studied parameters and ID/IDA status.

## RESULTS AND DISCUSSION

In this study we found that only rs855791 has the significant relationship between the incidence of ID/IDA ( $P < 0.05$ ). Meanwhile no other significant association between rs5756504 and rs4820268 with the incidence of ID/IDA. This recent finding is supported by previous studies in which other researchers also found that rs855791 is strongly associated with the low iron status [10], [14]. Furthermore, the A/A carriers of rs855791 also significantly associated with the low levels of haematocrit (Hct) and hepcidin. Previous studies also found that A/A carriers is commonly associated with the low haematological parameters such as low haemoglobin, Hct, MCV and MCH [16]. Interestingly, we found that rs5756504 seems to be the protective variants as this SNP specifically the G/G carriers among the case group were associated with low levels of hepcidin and leptin. Different populations have different effect of the SNP on the levels of haematological, iron profiles and biochemical parameters. Also, different populations have different susceptibility rate of *TMPRSS6* SNP with ID/IDA status. This recent finding can be the reference for the future studies that is warranted with a bigger sample size among overweight/obese populations in Malaysia as the prevalence of obesity is rising nowadays and more obese individuals were associated with low iron status. This need to be done to assist the Ministry of Health curbs and develop the best intervention to slow down the rate of non-communicable diseases like ID and IDA.

## REFERENCES

- [1] N. B. Ali *et al.*, “Overweight and obesity among urban women with iron deficiency anaemia in Bangladesh,” *Matern. Child Nutr.*, vol. 17, no. 2, pp. 1–10, 2021, doi: 10.1111/mcn.13102.
- [2] S. S. Ganapathy *et al.*, “National Health and Morbidity Survey (NHMS) 2019: NCDs - Non-Communicable Diseases: Risk Factors and other Health Problems,” Institute for Public Health, National Institutes of Health (NIH), Ministry of Health, Malaysia, 2019. [Online]. Available: <http://www.iku.gov.my/nhms-2019>
- [3] B. J. Wenzel, H. B. Stults, and J. Mayer, “Hypoferræmia in Obese Adolescents,” *Lancet*, vol. 280, no. 7251, pp. 327–328, 1962, doi: 10.1016/S0140-6736(62)90110-1.
- [4] C. C. Seltzer and J. Mayer, “Serum Iron and Iron Binding Capacity in Adolescents,” vol. 27, no. 4, pp. 2081–2088, 1963, doi: 10.1249/MSS.0b013e31821d4a82.
- [5] S. Mohd-Sidik, R. Lekhradj, and C. N. Foo, “Prevalence, associated factors and psychological determinants of obesity among adults in Selangor, Malaysia,” *Int. J. Environ. Res. Public Health*, vol. 18, no. 3, pp. 1–17, 2021, doi: 10.3390/ijerph18030868.
- [6] H. Stankowiak-Kulpa, A. Kargulewicz, A. Styszyński, E. Swora-Cwynar, and M. Grzymisławski, “Iron status in obese women,” *Ann. Agric. Environ. Med.*, vol. 24, no. 4, pp. 587–591, 2017, doi: 10.5604/12321966.1232092.

[7] E. Emam, M. . Hamed, D. Fouad, and R. Abd-Allah, “The abnormal iron homeostasis among Egyptian obese children and adolescents: relation to inflammation of obesity,” *Egypt. J. Haematol.*, vol. 43, no. 3, p. 97, 2018, doi: 10.4103/ejh.ejh\_52\_17.

[8] H. Lokuge *et al.*, “TMPRSS6 rs855791 is associated with iron deficiency in a cohort of Sri Lankan pregnant women,” *Egypt. J. Med. Hum. Genet.*, vol. 23, no. December, pp. 1–10, 2022, doi: 10.1186/s43042-022-00377-8.

[9] K. E. Finberg *et al.*, “Mutations in TMPRSS6 cause iron-refractory iron deficiency anemia (IRIDA),” *Nat Genet*, vol. 40, no. 5, pp. 569–571, 2008, doi: 10.1038/ng.130.

[10] M. Elmahdy, H. Elhakeem, F. Gaber, and F. Mourad, “TMPRSS6 Gene Polymorphism and Serum Hepcidin in Iron Deficiency Anemia,” *Egypt. J. Hosp. Med.*, vol. 73, no. 7, pp. 7090–7103, 2018, doi: 10.12816/ejhm.2018.17507.

[11] V. Dopsaj *et al.*, “Associations of common variants in HFE and TMPRSS6 genes with hepcidin-25 and iron status parameters in patients with end-stage renal disease,” *Dis. Markers*, vol. 2019, no. Id, pp. 1–10, 2019, doi: 10.1155/2019/4864370.

[12] A. M. Nalado *et al.*, “TMPRSS6 rs855791 polymorphism and susceptibility to iron deficiency anaemia in non-dialysis chronic kidney disease patients in South Africa.,” *Int. J. Mol. Epidemiol. Genet.*, vol. 10, no. 1, pp. 1–9, 2019.

[13] L. H. Al-Jamea *et al.*, “Genetic analysis of TMPRSS6 gene in Saudi female patients with iron deficiency anemia,” *Hematol. Oncol. Stem Cell Ther.*, vol. 14, no. 1, pp. 41–50, 2021, doi: 10.1016/j.hemonc.2020.04.007.

[14] O. Al-Amer *et al.*, “Study the association of transmembrane serine protease 6 gene polymorphisms with iron deficiency status in Saudi Arabia,” *Gene*, vol. 751, p. 144767, 2020, doi: 10.1016/j.gene.2020.144767.

[15] T. Seiki *et al.*, “Association of genetic polymorphisms with erythrocyte traits: Verification of SNPs reported in a previous GWAS in a Japanese population,” *Gene*, vol. 642, no. October 2017, pp. 172–177, 2018, doi: 10.1016/j.gene.2017.11.031.

[16] J. C. Chambers *et al.*, “Genome-wide association study identifies variants in TMPRSS6 associated with hemoglobin levels,” *Nat Genet*, vol. 41, no. 11, pp. 1170–1172, 2009, doi: 10.1038/ng.462.

[17] M. D. Cappellini, K. M. Musallam, and A. T. Taher, “Iron deficiency anaemia revisited,” *J. Intern. Med.*, vol. 287, no. 2, pp. 153–170, 2020, doi: 10.1111/joim.13004.

# EFFECT OF BONE MORPHOGENETIC PROTEIN 2 (BMP-2) ON THE EXPRESSION OF MESENCHYMAL STEM CELLS AND CANCER STEM CELL SURFACE MARKERS

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## ABSTRACT

Mesenchymal stem cells (MSCs) are recognized for promoting cancer cell proliferation, angiogenesis, and metastasis. Modification of tumour microenvironment (TME) is attributable to the cancer stem cell (CSC) population recruiting and activating specific cell types such as MSCs. Bone morphogenetic protein-2 (BMP-2) has a modulatory role towards TME via cytokines action, which may affect MSCs differentiation into CSCs. However, the cellular molecular mechanism involved remains elusive. Therefore, this study aims to investigate the expression of CSC population in the human umbilical mesenchymal stem cell (hUCMSC) that was treated with BMP-2. The hUCMSC were cultured in Dulbecco's Modified Eagle Medium F-12 (DMEM/F-12), 10% foetal bovine serum (FBS) and 1% penicillin-streptomycin at 37°C in a humidified incubator of 5% CO<sub>2</sub>. The stem cell properties were analysed via flowcytometry analysis of stem cell surface markers; CD105, CD90, CD73, and CD34. Prior to treatment of the hUCMSC, cytotoxicity analysis of BMP-2 was carried out with different concentrations of 0.05, 0.10, 0.15, 0.20, 0.25, 0.30 µg/ml incubated for 8, 16 and 24 hours. Post-treated hUCMSC was analysed for the expression of cancer stem cell surface marker CD133. Flow cytometry result showed high expression levels of both positive and negative stem cell markers; CD105+, CD90+, CD73+ and CD34-, indicating presence of stem cell populations in the hUCMSC. Meanwhile, treatment with 0.05 µg/mL of BMP-2 for 24 hours presented the highest number of viable cells at 80%, hence was used for treatment of the hUCMSC. Unfortunately, expression of CD133 was absent in the BMP-2 post-treated hUCMSC, indicating lack of CSC differentiation. In conclusion, although BMP-2 was ineffective towards CSC progression, its role towards stem cell differentiation into CSC remains elusive since results of this current study are still preliminary, and thus require further investigations.

**Keywords:** Mesenchymal stem cells, osteosarcoma, cancer stem cells, bone morphogenetic protein, stem cell markers

## INTRODUCTION

Osteosarcoma (OS) is a primary malignant bone tumour with a worldwide incidence of 3.4 per million people per year [1]. It is the third-most common cancer in adolescence with 5.6 cases per million children under the age of 15 reported. Osteosarcoma is most often found in the long bones especially on the legs, but sometimes also on the arms. Despite rigorous therapy, a considerable number of children with sarcoma have tumour relapse and metastasis, with survival rates of only 20% [2]. Cancer stem cell (CSCs) hypothesis may account for osteosarcoma therapy failures and tumour relapse. CSCs are rare immortal cells within a tumour that can both self-renew by dividing and give rise to many cell types that constitute the tumour and can therefore form a secondary tumour. Their characteristics are similar to both stem cells and cancer cells but due to their asymmetrical cell division and alteration in gene regulations they can be easily distinguished from the normal stem cells.

Correspondingly, the tumour environment plays a major role in cancer malignancy. The interaction of CSCs with the cellular components of the tumour environment might establish a new metastasis site. Extracellular matrix (ECM) is a major structural component of the tumour micro-environment that consists of a network of biochemically discrete components, including fibrous proteins, glycoproteins, proteoglycans, and polysaccharides [3]. There is suggestive evidence that ECM proteins produce biochemical signals with the cooperation of growth factors and promote a physical and biochemical habitat for CSCs to regulate proliferation, self-renewal, and differentiation that can promote metastasis and progression of cancer to an advanced stage [4]. Given the various limitations

existing in osteosarcoma treatment, a deeper insight on CSC-cytoskeletal and CSC-ECM interactions will be essential in developing more effective therapeutic strategies to target and eradicate CSCs. Some of the molecular mechanisms associated with cancer progression could be elucidated by using the cancer-iPSC model. The production of iPSC via stem cell reprogramming that involves pluripotency associated genes can be done to further understand the cellular behaviour of the reprogrammed cells which exhibits dynamic changes during the different stages of reprogramming [5].

Previous findings reported the role of BMP-2 in the regulation of osteoblastic MSCs differentiation. However, it has been postulated that upregulation of MSCs differentiation was the origin of cancer stem cells (CSCs), which promote the invasiveness of osteoblastic cancer cells particularly the highly metastatic osteosarcoma (OS). Nonetheless, the mechanism involved remains unclear due to the unique but vast stemness properties of the MSCs as well as the OS-CSCs, also attributable to complex interaction with the extracellular matrix (ECM) of the cytoskeletal network. Thus, investigation of how BMP-2 exert its effect during differentiation of both stem cells through reprogramming strategy will be paramount to the elucidation of the signal transduction cascades responsible for OS metastasis. Therefore, this study aims to determine the potency of stem cells surface markers affected by BMP-2 activity towards MSC differentiation and proliferation of osteosarcoma cells.

## MATERIALS AND METHOD

The experimental procedure commenced with cell isolation and culture of the cells (MSCs and MG63) followed by phenotypic potency characterisation of the stem cells surface markers, after treatment with the BMP-2.

### *Cell culture*

The human osteosarcoma cell line (MG-63) (CRL-1427 ATCC, USA) was cultured in Hams' F12 medium Dulbecco's Modified Eagles Medium supplemented with 2.5mM L-glutamine, 10% fetal bovine serum (FBS) (TICO Europe, Netherlands), and 1% Penicillin-Streptomycin Mixed Solution (Nacalai Tesque, Japan). The human umbilical cord-derived mesenchymal stem cells (HUCMSCs) were supplied by our collaborator, NiSCELL (Petaling Jaya, Selangor) which was maintained in Hams' F12 Dulbecco's Modified Eagles Medium supplemented with 10% FBS and 1% Penicillin-Streptomycin Mixed Solution (Nacalai Tesque, Japan). Both cells were cultured in T-25 flasks and maintained in a humidified incubator with presence of 5% CO<sub>2</sub>. The cells were detached with trypsin/EDTA (Nacalai Tesque, Japan) and re-plated subsequently.

### *Cell morphology analysis*

Both HUCMSCs and MG-63 cells were cultured in 2-well chamber slides at  $0.5 \times 10^6$  cells/well for morphology comparison. After 24 hours of incubation, the slide proceeded with staining. Firstly, medium was removed from the slide and washed with PBS for 3 minutes. Then, the slide was fixed by placing 1 mL of absolute ethanol on the slide and incubated for 6 minutes. After that, the ethanol was removed, washed with PBS and air dried in a biological hood until the slide was completely dried. Next, 1 mL of haematoxylin was added onto the slide and left incubated at room temperature for 40 minutes. After that, the slide was rinsed briefly with small amounts of tap water. Then, 1 mL of eosin was added to the slide and incubated for 30 minutes at room temperature. The slide was rinsed again with a small amount of tap water and dehydrated with 95% ethanol for 30 seconds and 100% ethanol for another 30 seconds. Finally, one small drop of mounting medium was added to the slide and covered with a coverslip. The slide was viewed under the inverted microscope.

### *Treatment of MSC and MG63 with BMP-2*

Cytotoxicity analysis of BMP-2 against the cells preceded the treatment procedure using MTS assay. Firstly, the cells were seeded at  $1 \times 10^6$  cell/ well in a 96 well plate. After 24-hour incubation, 20  $\mu$ L of MTS solution was added to each well under minimal light exposure. The plate was immediately wrapped with aluminium foil, before being incubated at 37°C in a CO<sub>2</sub> incubator for 2 hours. The optical density was measured using VictorTM X5 Multilabel Plate Reader at 490 nm. The optimum non-toxic dose of BMP-2 was then used to treat the cells for 8-, 16- and 24-hour incubation time.

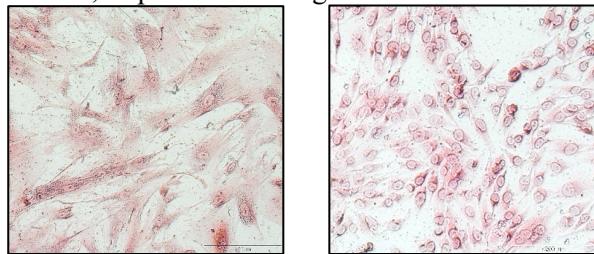
### Stem cells phenotypic analysis via flowcytometry

The MSCs and MG63 cells were trypsinised and resuspended with phosphate buffered saline (PBS). In each sample,  $5 \times 10^5$  MSCs in 50  $\mu\text{l}$  of PBS was incubated with 2.5  $\mu\text{l}$  of fluorescein isothiocyanate (FITC) or phycoerythrin (PE) conjugated antibodies against human antibodies, PE-CD34, FITC-CD45, FITC CD-90, PE-CD105, PE-CD34 and PE-CD73 antibodies (BD Biosciences, USA) for 30 min at  $4^\circ$  in the dark. After washing with PBS, the cells were fixed with paraformaldehyde in PBS. At least 10,000 labelled cells were acquired and analysed using BD FACS Via Flowcytometry System (BD biosciences, USA).

## RESULTS AND DISCUSSION

### Morphological assessment of MSC and MG63

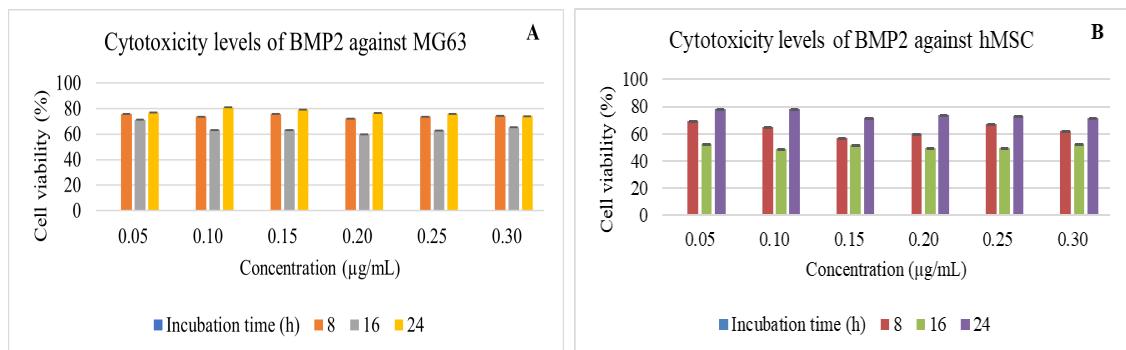
The morphological features of undifferentiated MSCs were distinctive from MG-63. The MSCs presented with spindle-shaped of several cell processes, while MG63 appeared as oval-shaped cells with large and round tumor nuclei, as presented in Figure 1.



**Figure 1. Haematoxylin and Eosin Staining of HUCMSCs and MG-63 (40x magnification)**

### Cytotoxicity of BMP-2 concentration towards MG63 and MSC via MTS assay

Treatment with BMP-2 at concentration of 0.05  $\mu\text{g/mL}$  has the least effect on the cells with 80% of cell viability at all incubation times. Figure 2 illustrated the percentage of cell viability for MG63 and MSC cells at their respective post-incubation time. According to Tian et al., 2019, BMP-2 regulates the progression, and the growth of tumour as demonstrated in vitro from their experiment, hence the increasing number of cells can be seen. All values are represented as means  $\pm$  standard deviation of two replicates from two independent experiments.

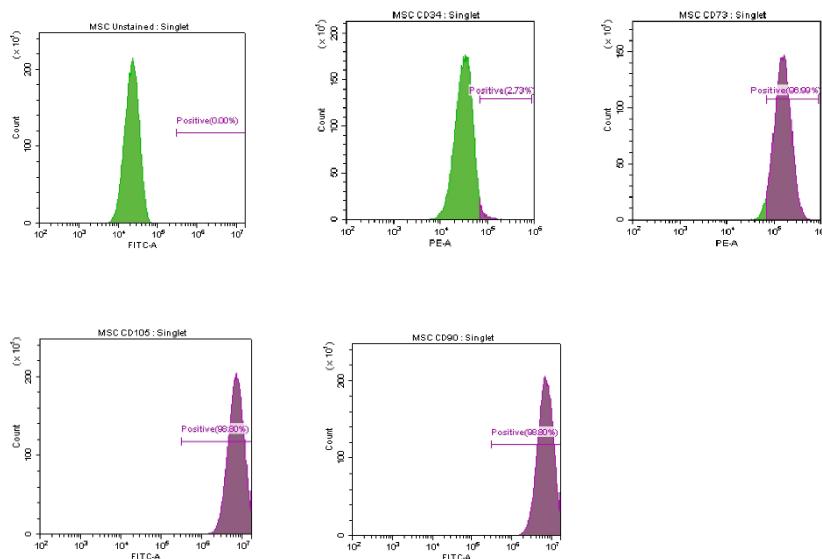


**Figure 2. Cytotoxicity of BMP2 in MG63 and MSC at different incubation time**

### Expression of stem cell surface markers via flowcytometry analysis

Through self-renewal and differentiation, a subpopulation of OS-CSCs is reported to cause resistance, recurrence, and metastasis of bone cancer, but the truth is still unknown. Previous research has reportedly suggested that MSCs may be the cell of origin for a number of sarcomas, but more research is needed to clarify through the study of OS-CSCs biology. Mesenchymal stem cells (MSC) have a high self-renewal capacity, multipotency with osteogenic, chondrogenic, and adipogenic potentials and immunomodulatory properties, making them an appealing tool for research and clinical application [6]. In 2006, the International Society for Cellular Therapy introduced a series of markers and cellular characteristics due to the lack of a single biomarker for MSC [7]. Here, we used flowcytometry as a method to characterize the MSCs to determine the potential biological traits of OS-CSCs by analysing the expression of a characteristic set of surface markers, such as cluster of

differentiation CD73, CD90, and CD105, while lacking expression of CD34. Over 95% of MSCs samples expressed positive marker which are CD73, CD90, and CD105 while less than 3% of cells expressed the negative marker, CD34. The result suggests that the cells fulfil the phenotypically defined MSCs.



**Figure 3. Representative flow cytometry profile. (A) Unstained MSC, (B) CD34, (C) CD73, (D) CD105 and (E) CD90. Green plots represent the negative control, while purple plots represent the surface marker antibody-stained cells. PE, phycoerythrin; FITC, fluorescein isothiocyanate**

## CONCLUSION

In conclusion, although BMP-2 was ineffective towards CSC progression, its role towards stem cell differentiation into CSC remains elusive since these results so far are still preliminary. Efforts are currently ongoing towards a reprogramming approach to determine the regulatory mechanism of BMP-2 towards osteosarcoma stem cells dedifferentiation.

## REFERENCES

- [1] Mirabello, L., Troisi, R. J., & Savage, S. A. (2009). International osteosarcoma incidence patterns in children and adolescents, middle-ages and elderly persons. *International Journal of Cancer*, 125(1), 229–234. <https://doi.org/10.1002/ijc.24320>
- [2] O’Kane, G. M., Cadoo, K. A., Walsh, E. M., Emerson, R., Dervan, P., O’Keane, C., Hurson, B., O’Toole, G., Dudeney, S., Kavanagh, E., Eustace, S., & Carney, D. N. (2015). Perioperative chemotherapy in the treatment of osteosarcoma: a 26-year single institution review. *Clinical Sarcoma Research*, 5, 17. <https://doi.org/10.1186/s13569-015-0032-0>
- [3] Jieqing Zhu, Gaofeng Xiong, Christine Trinkle and Ren Xu (2014). Integrated extracellular matrix signalling in mammary gland development and breast cancer progression. *Histology and Histopathology*, 29(9), 1083-1092. <https://doi.org/10.14670/HH-29.1083>
- [4] Smaldone, S., Clayton, N. P., del Solar, M., Pascual, G., Cheng, S. H., Wentworth, B. M., Schaffler, M. B., & Ramirez, F. (2015). Fibrillin-1 Regulates Skeletal Stem Cell Differentiation by Modulating TGF- $\beta$  Activity Within the Marrow Niche. *Journal of Bone and Mineral Research*, 31(1), 86–97. <https://doi.org/10.1002/jbmr.2598>
- [5] Takahashi, K., & Yamanaka, S. (2006). Induction of Pluripotent Stem Cells from Mouse Embryonic and Adult Fibroblast Cultures by Defined Factors. *Cell*, 126(4), 663–676. <https://doi.org/10.1016/j.cell.2006.07.024>
- [6] Mushahary, D., Spittler, A., Kasper, C., Weber, V., & Charwat, V. (2017). Isolation, cultivation, and characterization of human mesenchymal stem cells. *Cytometry Part A*, 93(1), 19–31. <https://doi.org/10.1002/cyto.a.23242>

[7] Dominici, M., Katarina Le Blanc, Mueller, I., Ineke Slaper-Cortenbach, Marini, F. C., Krause, D. S., Deans, R., Keating, A., Prockop, D. J., & Horwitz, E. M. (2006). Minimal criteria for defining multipotent mesenchymal stromal cells. The International Society for Cellular Therapy position statement. *Cytotherapy*, 8(4), 315–317. <https://doi.org/10.1080/14653240600855905>

# ANTIBODY RESPONSE TO BOOSTER DOSES OF HEPATITIS B VACCINE IN MEDICAL STUDENTS VACCINATED IN INFANCY

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## ABSTRACT

(This study investigates the antibody response to booster doses of the hepatitis B vaccine in medical students vaccinated during infancy. Hepatitis B vaccination has been part of Malaysia's National Immunisation Programme since 1989, with no routine post-vaccination antibody measurements. This study aimed to evaluate antibody levels and the response to booster doses in individuals who completed the primary vaccination series in infancy but no longer had protective antibody levels (anti-HBs <10 mIU/ml). A descriptive prospective study was conducted on medical students from Universiti Teknologi MARA. Participants with written proof of completing the three-dose primary series were included. Antibody levels were measured at baseline, seven days after the first booster dose, 28 days after the second dose, six months after the third dose, and one-month post-final booster. The recombinant hepatitis B vaccine Euvax B, containing 20 µg of hepatitis B surface antigen with an aluminium hydroxide adjuvant, was used. Anti-HBs levels were measured using an electrochemiluminescent immunoassay (COBAS E411 analyser). Of 152 participants, 19.08% had baseline protective antibody levels ( $\geq 10$  mIU/ml). Fifty-six students with evidence of prior vaccination were eligible for the study, and 37 completed the full protocol. At seven days post-first dose, 8/37 (21.62%) achieved protective antibody levels, rising to 31/37 (83.78%) by 28 days and 37/37 (100%) by six months. The findings indicated a robust anamnestic response in most participants, with a single booster dose restoring protective antibody levels in 83.78%. The study highlights the waning of hepatitis B antibodies 19–20 years post-primary immunisation. Although protective levels persisted in 19% of young adults, most participants responded to a single booster dose, reaffirming the effectiveness of the vaccination program. The results support booster vaccination for healthcare workers to ensure adequate protection against hepatitis B.

**Keywords:** hepatitis b vaccine, booster, antibody response

## INTRODUCTION

Hepatitis B vaccination has been included in the Malaysian infancy vaccination schedule since 1989. Post-vaccination antibody measurements are not recommended after routine vaccination in infancy, and non-responders were not identified. Healthcare workers are considered at high risk of being infected with hepatitis B through work-related injuries and are recommended to prevent infection through vaccination if they do not have protective levels of antibodies. Antibody levels measured years after primary immunisation will be low due to natural waning. We conducted this study to determine the antibody levels after one, two and three doses of hepatitis booster vaccine in individuals who have completed primary vaccination in infancy.

## MATERIAL AND METHOD

We performed a descriptive prospective study to determine the effect of booster hepatitis B vaccines by measuring the hepatitis B surface antibody levels after booster vaccination on a group of medical students who had completed three doses of primary vaccination in infancy, but no longer had protective levels of antibody for hepatitis B surface antigen (anti-HBs <10 mIU/ml).

As proof of hepatitis B vaccination, we accepted childhood immunisation records that included an immunisation book or card provided by government or private institutions with the dates and doses of vaccines given as part of the Malaysian National Immunisation Programme. To qualify for the study, the participant needed to have written evidence of three doses of hepatitis vaccines given at 0-, 1- and 6-months intervals.

Antibody levels were measured at 0 (before the first dose), ~7 days after the first dose, ~28 days (before the second dose), ~ 6 months (before the third dose) and one month after the last dose of vaccine. Levels equal to and above 10mIU/ml were considered protective. Levels measured at seven days and one month after the first booster dose were considered an anamnestic response to primary immunisation in infancy.

The vaccine used for the booster vaccination programme was Euvax B, manufactured by LG Chem Ltd, and is a WHO prequalified vaccine. It is a recombinant hepatitis B vaccine with 20 micrograms of hepatitis B surface antigen combined with an aluminium hydroxide adjuvant.

Blood analysis for AntiHBs was done by electrochemiluminescent immunoassay using the COBAS E411 analyser.

## RESULTS AND DISCUSSION

As part of a medical student hepatitis B vaccination drive, 152 second-year students from the Faculty of Medicine, Universiti Teknologi MARA, consented to participate in the study. They were screened for baseline hepatitis B surface antibodies before vaccination, and 29/152 (19.08 %) had anti-HBs  $\geq 10$  mIU/ml.

Only 56 participants were able to provide written evidence of completion of the three-dose hepatitis B vaccination series. 11/56 already had an anti-HBs  $\geq 10$  mIU/ml at baseline, and seven were excluded because they were unable to complete the study.

**Table 1: Antibody response to booster vaccinations**

Test (~)	Numbers that achieved anti-HBs $\geq 10$ mIU/ml (N=37)
7 days	8
28 days	31
6 months	37
7 months	37

Healthcare workers are at increased risk of being infected by blood-borne viruses, including Hepatitis B, in the line of their work. Unlike other blood-borne viruses like HIV and hepatitis C, an efficacious vaccine exists for hepatitis B that is 90-95% effective at preventing infection in adults.<sup>1</sup> Malaysia, as part of its National Immunisation Programme, has included hepatitis B vaccination in the childhood schedule since 1989. As a result, the majority of children would have already received three doses of hepatitis B vaccination before entering school.<sup>2</sup>

Considering the current age of our participants and the age at hepatitis b vaccination, it would have been 19-20 years (mean age 19 years) after primary immunisation. Antibody levels at this stage would have been expected to wane below protective, even detectable levels. The persistence of protective levels of antibodies was seen in 19% of our study participants. This may also reflect exposure to hepatitis b prior to testing.

Anamnestic response sufficient to provide protective levels of antibodies was seen in the majority of our participants (83.78 %) one month after the first booster vaccine, and the remaining participants only required a second dose to achieve protective levels. Because we had not measured antibody levels at two months, it was unclear whether this would have occurred anyway without a second booster vaccine dose.

## **CONCLUSION**

The persistence of protective levels of antibodies for hepatitis B is only seen in a minority (19 %) of young adults 20 years after the primary hepatitis b vaccination series. However, anamnestic response after a single booster was able to reach protective levels of antibodies in the majority of participants (83.78 %). The second dose of vaccine at one month was sufficient to achieve protective levels of antibodies in the remainder.

## **REFERENCES**

Palmovi, I. D., Cmjakovic-Palmovic J. (2022). Vaccination against hepatitis B. Results of the analysis of 2000 population members in Croatia. *Eur J Epidemiol.* 1994;10:541–547.

Malaysia Ministry of Health, The Malaysian National Immunisation Programme. (<http://www.myhealth.gov.my/en/immunisation-schedule/>) . Accessed 3rd of November 2022.

# QUALITATIVE STUDY: EXPLORATION OF BLOOD DONATION AWARENESS AMONG NON-BLOOD DONORS

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## ABSTRACT

Donating blood is a humanitarian act with lifesaving implications. Blood transfusion saves lives and helps recover many patients, as every blood component is beneficial. The general public is urged to respond to the call of blood banks to donate blood to enable them to maintain a continuous supply of blood for the vital use of patients nationwide. This study explores the level of blood donation awareness amongst non-donors and the factors that hinder them from voluntarily donating blood. Four focus group discussions (FGD) were conducted among non-blood donors. The discussions were held in separate, closed rooms. All of the sessions were recorded with the participants' permission. The discussions were conducted in the local language, and the verbatim was later translated into English. Most non-donor participants professed an awareness of the importance of donating blood to save an ill person. However, those with daily work commitments do not voluntarily donate blood mainly due to the lack of donation, such as it causing weakness and a variety of health problems. Fear is also a common factor stated by the participants, including fear of the needle, fear of blood, or a general fear of the whole blood donation process. Concerning creating awareness, some participants recommended using short films/videos or advertisements that could stir an emotional reaction. Other hindering factors are related to the common myths, fears and superstitions about blood on voluntary blood donation campaigns that were very limited. Findings indicate a need for comprehensive strategies to address these barriers and promote voluntary blood donation.

**Keywords:** awareness; blood donation; blood bank; focus group discussion

## INTRODUCTION

Blood transfusion is a fundamental medical procedure that saves millions of lives annually. It is vital in treating life-threatening conditions, enhancing the quality of life for critically ill patients, and supporting complex medical and surgical interventions. Additionally, blood transfusions play a critical role in maternal and child healthcare, where they are often needed during childbirth complications, and during human-induced disasters, where they are crucial for treating injuries and shock. These lifesaving benefits highlight the increasing need for a sufficient, quality blood supply for clinical treatments.

Many countries, including Malaysia, are grappling with the urgent challenge of meeting the escalating demand for quality blood supplies. According to the United Kingdom Blood Services and Norfolk (2013), approximately 80% of blood transfusions are performed to address low haemoglobin (Hb) levels rather than active bleeding [1]. Research by Jain and Gupta (2012) found that 29.6% of individuals would only donate blood to assist family members or friends in need [2]. In 2015, Malaysia's National Blood Centre anticipated that over 10% of Malaysians would donate blood, but only 2.2% reported doing so. The Malaysian Director General of Health (2010) noted that only two in 1000 eligible donors (2:1000) in Malaysia donated blood, creating a pressing challenge for blood bank services to maintain a safe and sufficient supply [3].

Despite widespread blood donation campaigns, participation remains low due to limited public understanding [4-6]. Fear and lack of self-awareness are significant factors influencing an individual's decision to donate blood. Awareness is often heightened through personal experiences, such as a family member requiring a blood transfusion [7]. Bilal et al. (2015) reported that 83.7% of individuals would donate blood only if a family member, relative, or friend needed a transfusion, indicating that awareness is often situation-specific and limited to personal connections [8].

Voluntary donors differ from non-donors in demographics, altruism, intention, anxiety, and perception [9]. Further studies are necessary to determine if these findings apply to non-donors in other

countries. Understanding the reasons healthy, eligible individuals refuse to donate blood is not just important; it's crucial to addressing this issue. This research is a significant step towards that understanding.

This study delves into the barriers to blood donation among eligible non-donors, particularly when family members are critically ill. The findings aim to illuminate the issue and inspire strategies that can significantly increase blood donor participation. Our goal is to surpass the 10% national target set by Malaysia's National Blood Centre, and this study's insights can pave the way for a brighter future in blood donation.

## MATERIAL AND METHOD

This qualitative study was conducted among caregivers of intensive care unit patients at a public hospital in Sabah, Malaysia. Participants were healthy caregivers eligible to donate blood but with no prior donation history. Four focus group discussions (FGDs) were conducted with 11 participants, each lasting 15 to 30 minutes in a comfortable hospital setting. The discussions were guided by a moderator using a semi-structured format, with consistent questions across all groups (Table 1). Participants were selected through purposive sampling until thematic saturation was achieved. Informed consent was obtained prior to participation.

**Table 1: Interview Topics**

Topic	Questions
Awareness	Have you heard about blood donation? What are your views on it?
Knowledge	What are the criteria for donating blood? Why is blood donation important?
Barriers	What prevents you from donating blood?
Suggestions	What would motivate you to donate blood?

Interviews were recorded in the local language, transcribed verbatim, and translated into English. Data analysis followed three steps:

- Transcription and Validation:** Verbatim transcripts were reviewed by participants to ensure accuracy and reliability.
- Coding and Indexing:** Transcripts were coded systematically (e.g., FG1-L for male participants in the first group) to facilitate analysis.
- Thematic Analysis:** Data were analysed through repeated readings to identify themes and sub-themes related to blood donation awareness, barriers, and suggestions.

This study was approved by the National Medical Research Register (NMRR) and the Ethics Committee of Universiti Teknologi MARA (UiTM) Selangor.

## RESULTS AND DISCUSSION

**Participant Demographics** A total of 11 participants were interviewed, comprising six females (54%) and five males (45%). Four participants (36%) had tertiary education, and seven (63%) worked in the private sector. Age distribution showed six participants (54%) aged 18-29 years and five (45%) aged 30-40 years (Table 2).

**Table 2: Demographic data of participants**

Category	FGD 1	FGD 2	FGD 3	FGD 4	Total
Age (years)					

18-29	2	2	1	1	6 (54%)
30-40	1	1	1	2	5 (45%)
<b>Education background</b>					
Primary school	1	0	1	0	2 (19%)
Secondary school	1	2	0	2	5 (45%)
Diploma/degree	1	1	1	1	4 (36%)
<b>Work sector</b>					
Private sector	2	1	1	3	7 (63%)
Government sector	0	1	0	0	1 (9%)

**Blood Donation Awareness** Most participants (10 out of 11) were aware of the importance of blood donation, often learning about it during secondary school or hospital visits. They acknowledged blood donation as a noble act that helps save lives and promotes good moral values. Example responses included: “Donating blood is good for saving the lives of others” (FG2/P).

**Knowledge of Blood Donation** Participants demonstrated limited knowledge of eligibility criteria. They understood basic requirements, such as being healthy and chronic disease-free, but lacked comprehensive awareness. A participant stated: “Blood donors must be healthy, 18 years or older, and free of harmful diseases” (FG2/L).

**Barriers to Blood Donation** Three main barriers emerged:

1. **Fear:** Participants expressed fear of needles, blood, or health repercussions. For instance, “I’m afraid of needles” (FG1/L).
2. **Lack of Desire:** Many people lacked motivation to donate despite recognizing its importance. For example, “I’ve never felt the need to donate blood” (FG1/P).
3. **Time Constraints:** Busy schedules hindered participation. Example: “I’m too busy with work commitments” (FG4/P).

**Suggestions for Improvement** Participants suggested enhancing blood donation campaigns to focus on emotional appeals and accessibility. Specific recommendations included workplace blood drives, targeting government employees, and mobile units for rural areas. One participant noted: “Future campaigns should emphasize patient suffering to create awareness” (FG2/P).

**Discussion** Participants recognized the importance of blood donation but faced significant barriers. Fear was the most common deterrent, consistent with previous studies [10-11]. Limited knowledge about eligibility criteria also contributed, as supported by Shakeri et al. (2012) [5]. Emotional and logistical factors influenced participation, such as proximity and timing of donation drives. Addressing these barriers through targeted education, emotional engagement, and improved accessibility could increase donor rates. This aligns with findings by Pereira et al. (2016) and Umakanth et al. (2015), emphasizing the need for strategic communication and outreach efforts [4,12].

## CONCLUSION

Addressing barriers such as fear, lack of desire, and logistical challenges is crucial for increasing blood donation rates. Effective strategies include emotional engagement in campaigns, workplace-based donation drives, and enhanced public education on eligibility and benefits. Future studies should expand to diverse demographics and incorporate quantitative assessments to develop tailored interventions. Collaborative efforts between government and private sectors are essential to ensure a sustainable blood supply.

## REFERENCES

[1] United Kingdom Blood Services., & Norfolk, D. (2013). Handbook of transfusion medicine. Stationery Office.

[2] Jain, R., & Gupta, G. (2012). Family/friend donors are not true voluntary donors. *Asian Journal of Transfusion Science*, 6(1), 29–31.

[3] National Blood Bank: Enough, but we always need more | Malaysia | Malay Mail Online. (n.d.). Retrieved May 30, 2017, from <http://www.themalaymailonline.com/malaysia/article/national-blood-bank-enough-but-we-always-need-more> factors of blood donation.

[4] Pereira, J.R., Sousa, C.V., Matos, E.B, Rezende, L.B.O., Bueno, N.X.,& Dias, A.M. (2016). To donate or not donate, that is the question: an analysis of the critical.

[5] Shakeri, M. T., Vafaee, A., Esmaeily, H., Shafiei, N., Bazargani, R., & Khayamy, M. (2012). The causes for lack of interest to blood donation in eligible individuals, mashhad, northeastern iran. *Iranian Red Crescent Medical Journal*, 14(1), 37–40.

[6] Joshi, D., & Meakin, R. (2017). Views and attitudes towards blood donation: a qualitative investigation of Indian non-donors living in England. *BMJ open*, 7(10), e018279. <https://doi.org/10.1136/bmjopen-2017-018279>

[7] Lim, M. L., Thock, S. H., Andrew, K.G.T. & Gwee, S.L. (2018). Determinants of blood donation status in Malaysia: profiling the non-donors, occasional donors and regular donors. *Kajian Maysia*, 36(1), 43-62

[8] Bilal, M., Haseeb, A., Zahid, I., Lashkerwala, S. S., Saeeduddin, et al. (2015). Knowledge, attitudes and perceptions among non blood donor female health care professionals. *Global Journal of Health Science*, 8(4), 203–11.

[9] McVittie, C., Harris, L., & Tiliopoulos, N. (2006). "I intend to donate but ...": Non-donors' views of blood donation in the UK. *Psychology, Health & Medicine*, 11(1), 1–6.

[10] Wevers, A., Wigboldus, D. H. J., de Kort, W. L. A. M., van Baaren, R., & Veldhuizen, I. J. T. (2014). Characteristics of donors who do or do not return to give blood and barriers to their return. *Blood Transfusion Trasfusione Del Sangue*, 12 Suppl 1(Suppl 1), s37-43.

[11] Bantayehu, D. (2015). knowledge, attitude, and practice of voluntary blood donation and associated factors among health care providers in addis ababa health facilities,Ethiopia. *Occupational Medicine & Health Affairs*, 3(4).

[12] Umakanth, S., Thasian, Rita, I., Selvaraj, KG., Dolly, D., Joy, J.M. &Sukesh, C.N. (2015). A qualitative study of identifying factors which contribute and non-contribute to voluntary blood donation through focus group discussions among blood donors and non-blood donors. *International Journal of Emergency Mental Health and Human Resilience*, 17(1), 337-340

# REGULATION OF AIRWAY REMODELING AND OXIDATIVE STRESS IN OVALBUMIN-INDUCED ALLERGIC ASTHMA PREGNANT MOUSE

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## ABSTRACT

Oxidative stress (OS) is involved in the pathogenesis of allergic asthma and airway remodeling. Among pregnant mothers, the prevalence of allergic asthma is climbing. At present, data of the imaging in bronchial lumen area of allergen-induced pregnant asthma mouse model using micro-computer tomography (CT) as a modality is less reported. This study determined the effects of 100 $\mu$ g/200 $\mu$ L ovalbumin (OVA) on airway remodeling in pregnant mouse model. Eighteen (18) female BALB/c mice aged 4-5 weeks old and weighed 20-25g were divided equally into sham (G1), PBS (G2) and 100 $\mu$ g/200 $\mu$ L OVA (G3). Animals were subjected to airway sensitization (intraperitoneal injection, i.p), airway challenge (nasal instillation, n.i), and superovulation with gonadotrophins before being mated with fertile males at 1:1 ratio. At the end of the treatment, asthma was stimulated by methacholine. Animals were then euthanized on Day 10 post coitum. The serum was subjected to inflammatory biomarkers (IL5 & IL13), F2 isoprostane, total antioxidant capacity (TAC) and pregnancy hormonal (progesterone P<sub>4</sub> & estrogen E<sub>2</sub>) assays. Animals were also subjected to micro-CT and hematoxylin&eosin (H&E) to determine the lumen area. Reduced bronchial lumen area ( $p<0.05$ ) consistent with increased bronchial wall thickness ( $p<0.001$ ) was noted in the treated group. Serum interleukin (IL)-5, IL-13, and 8-isoprostane were remarkably higher in the treated animals respectively ( $p<0.001$ ,  $p<0.05$ , and  $p<0.05$ ). In contrast, serum TAC, P<sub>4</sub>, and E<sub>2</sub> were reduced in the treated compared to control animals ( $p<0.001$ ,  $p<0.001$ , and  $p<0.001$ ). Dose of 100  $\mu$ g/200  $\mu$ L OVA had induced maternal allergic airway inflammation, OS, and initiated airway remodeling in this model. The inappropriate balance of pregnancy hormone levels was indicative of possible poor implantation, placentation, fetal growth impairment, and reduced pregnancy outcome. Micro-CT modalities are preferred to be used as the result is remarkable in comparison with the H&E approach.

**Keywords:** allergic asthma, tocotrienol rich fraction, airway remodeling, oxidative stress, micro-CT.

## INTRODUCTION

Asthma is a respiratory disorder affecting almost 13% of pregnant women worldwide (Bonham et al., 2018). In Malaysia alone, the fatality rate associated with asthma was 0.91 % of the total deaths (WHO., 2017). Allergic asthma inflammation is characterized by the recruitment of inflammatory cells, cytokines, and chemokines (Ayakannu et al., 2019). Activation of T-helper type 2 (Th2) related cytokines and interleukins (ILs) play essential roles in the exacerbation of asthma (Gurgone et al., 2020). OS on the other hand is a condition of homeostasis imbalance, characterized by raised levels of reactive oxygen species (ROS) and depleted levels of total antioxidant capacity (TAC). Appropriate sex steroid hormone levels are essential during the gestation period. Progesterone (P<sub>4</sub>) and estrogen (E<sub>2</sub>) are secreted by both ovary and placenta during pregnancy. Both hormones are reported to play significant roles in allergic diseases.

Recent study has illustrated the effects of OVA; an allergen derived from egg albumin that mimics acute asthma, on the structural changes of the airway in male mice (Paik et al., 2014). On embryonic growth, OVA-induced maternal asthma has promoted preimplantation embryonic cell death via increased cell fragmentation and zona pellucida damage (Wafriy et al., 2021). While the evidence linking asthma and pregnancy management has been highlighted (Meakin et al., 2020; Strub et al., 2016), at present, little information correlates OS as the responsible mechanism in the presentation of

airway remodeling in pregnant asthmatic animal model. The effects of allergen induced asthmatic conditions on pregnancy hormone concentrations, specifically P4 and E2 are also less described.

This study examined OVA as an allergen that induces allergic asthma, on airway remodelling in pregnant mice using micro-computed tomography (micro-CT) and hematoxylin and eosin (H&E) as the modality. The role of inflammatory-OS response and pregnancy hormones behind airway remodelling in this model was also determined.

## MATERIALS AND METHOD

Eighteen (18) female BALB/c mice aged 4-5 weeks old and weighed 20-25g were divided into sham (G1), PBS (G2) and 100 $\mu$ g/200 $\mu$ L OVA (G3). Animals were subjected to airway sensitization (intraperitoneal injection, i.p), airway challenge (nasal instillation, n.i), and superovulation with gonadotrophins before being mated with fertile males at 1:1 ratio. Pregnancy was confirmed via copulatory plug, swabbing and visual inspection. At the end of the treatment, asthma was stimulated by methacholine. Animals were then euthanized on Day 10 post coitum. Following whole blood collection through cardiac puncture, the serum was subjected to inflammatory biomarkers (IL5 & IL13), F2 isoprostan, total antioxidant capacity (TAC) and pregnancy hormonal (progesterone P4 & estrogen E2) assays. Animals were also subjected to micro-CT and hematoxylin&eosin (H&E) to determine the lumen area (UiTM CARE 319/2020).

One-way analysis of variance ANOVA was applied for data associated with biochemical analysis and quantitative results of micro-CT and H&E followed by Tukey's test between all groups. Pearson correlation coefficient was used to determine the concordance between micro-CT and H&E results. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) version 25.0.0.0. A p-value of  $<0.05$  was considered statistically significant.

## RESULTS AND DISCUSSION

Results showed reduction in the total bronchial lumen area (at 4th and 5th proximal branches and total combination) assessed under micro-computed tomography in the challenged compared to control animals ( $0.1255 \pm 0.0612$  vs  $0.2513 \pm 0.0832$ ,  $** = p < 0.001$ ). For H&E, there was a significant reduction in the bronchial lumen areas (4th and 5th proximal branches, and total combination) in 100  $\mu$ g/200  $\mu$ L OVA compared to PBS groups, ( $0.0564 \pm 0.0050$  vs  $0.1723 \pm 0.0265$ ,  $p < 0.001$ ).

There was a raise in serum IL-13 in the treated animals ( $19.5162 \pm 1.9595$  (OVA) vs  $9.7535 \pm 2.8114$  (PBS),  $* = p < 0.05$ ). Concurrently, serum IL-15 was also significantly increased ( $105.3470 \pm 0.7162$  (OVA) vs  $41.8987 \pm 2.0849$  (PBS),  $** = p < 0.001$ ). Similarly, serum 8-isoPS was notably higher ( $28.7533 \pm 27.4463$  (OVA) vs  $6.8000 \pm 2.4658$  (PBS),  $* = p < 0.05$ ) accompanied by decreased TAC ( $5.5483 \pm 3.6382$  (OVA) vs  $26.9283 \pm 8.3903$  (PBS),  $* = p < 0.001$ ). A decline in both serum P4 ( $276.6267 \pm 19.7106$  (OVA) vs  $354.1600 \pm 9.1481$  (PBS),  $* = p < 0.001$ ) and E2 ( $117.8365 \pm 0.6736$  (OVA) vs  $147.1697 \pm 0.4549$  (PBS),  $* = p < 0.001$ ) were also recorded in the treated against control groups.

In our findings, the following observations were noted: 1) the treated animals showed thicker airway walls but narrower airway lumens compared to control 2) thicker airway walls and narrower airway lumens were related to increased inflammatory-OS response and also airway remodelling. This may have subsequently led to missing daughter branches, and ultimately resulted in airway obstruction (via airway wall remodelling or airway collapse). Similarly, H&E staining showed reduced lumen area accompanied by increased bronchial wall thickness in the treated animals compared to control. Changes in the thickness might be due to the increased mucus secretion by goblet cells that eventually causes the smooth muscle and epithelial cells to become hyperplasia.

Our results suggest increased proliferation in the immune cells subtypes in the lungs of OVA treated mice as part of the inflammatory signalling pathway and call cascade initiation. This may contribute to the exhibition of allergic lung inflammation via increased IL-13 and IL-5, respectively. We postulate that the upregulated IL-5, IL-13, and 8-isoPS will subsequently affect maternal lung function and fatal growth. We suggest that 100  $\mu$ g/200  $\mu$ l OVA caused increased release of OS mediators resulting in compensated lumen area in our study model. Reduced serum TAC levels may also necessitate further inflammatory processes at the injury site.

We thus postulate that while normal circulating E2 and P4 may reduce maternal asthmatic conditions, decreased circulating or inappropriate E2 & P4 levels may promote asthma exacerbation, ultimately leading to various pregnancy complications and undesired pregnancy outcomes. Further studies are required to interrogate the pathophysiological processes that drive lumen narrowing over the gestational duration and their effects on the course of allergic asthma. The fluctuations of progesterone and estrogen during pregnancy, their association with maternal asthma pathogenesis, and fetal growth in the allergic airway model also warrant further elucidation.

**TABLE, IMAGE AND FIGURE**

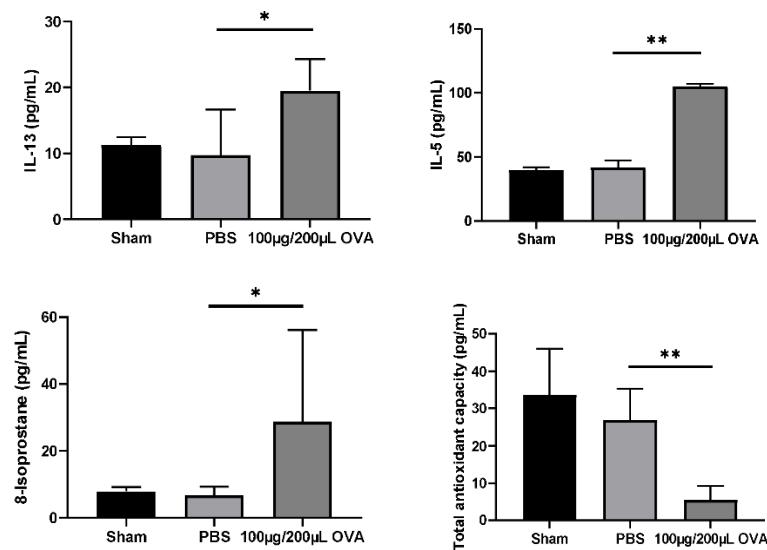
**Table 1. Bronchial lumen area across all groups. Data represented as mean  $\pm$  SD**

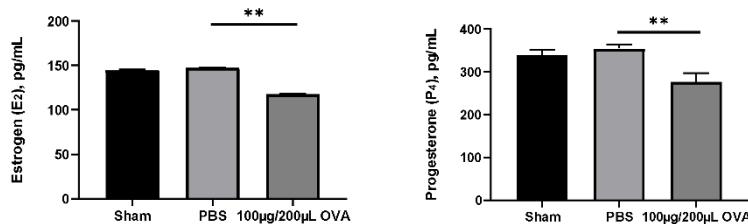
	RL4	RL5	LL4	LL5
<b>PBS</b>	0.303 $\pm$ 0.0918 <sup>a</sup>	0.2643 $\pm$ 0.1041 <sup>a</sup>	0.2315 $\pm$ 0.0485 <sup>a</sup>	0.2063 $\pm$ 0.0627 <sup>a</sup>
<b>100 <math>\mu</math>g/200 <math>\mu</math>L OVA</b>	0.1280 $\pm$ 0.045 <sup>b</sup>	0.1145 $\pm$ 0.0545 <sup>b</sup>	0.1398 $\pm$ 0.0874 <sup>b</sup>	0.1197 $\pm$ 0.0645 <sup>b</sup>

a,b = p<0.001



**Figure 1. Micro-CT images of bronchial lumen area between A) Sham, B) PBS, and C) 100  $\mu$ g/200  $\mu$ L OVA groups (R = right lung; L = left lung) (300-700 BMP)**





**Figure 2 . Serum A) IL-13, B) IL-5, C) 8-isoPS, D) TAC, E) pregnancy hormones P<sub>4</sub> and F) E<sub>2</sub>. (\* = p<0.05 and \*\* = p<0.001).**

## CONCLUSION

Results demonstrated that 100 µg/200 µL OVA reduces airway lumen area and increased bronchial lumen wall thickness in pregnant allergic asthma model. This effect may be related to increased airway inflammation leading to cellular responses and airway remodeling via the OS mechanism, and imbalance in pregnancy hormone levels.

## REFERENCES

- [1] Bonham, C. A., Patterson, K. C., & Strek, M. E. (2018). Asthma Outcomes and Management During Pregnancy. *Chest*, 153(2), 515-527. doi:10.1016/j.chest.2017.08.029
- [2] World Health Organization (2017). Asthma in Malaysia. Retrieved June 13, 2020, from <https://www.worldlifeexpectancy.com/malaysia-asthma>
- [3] Ayakannu, R., Abdullah, N., Radhakrishnan, A. K., Lechimi Raj, V., & Liam, C. (2019). Relationship between various cytokines implicated in asthma. *Human Immunology*, 80(9), 755-763. <https://doi.org/10.1016/j.humimm.2019.04.018>
- [4] Gurgone, D., McShane, L., McSharry, C., Guzik, T. J., & Maffia, P. (2020). Cytokines at the Interplay Between Asthma and Atherosclerosis?. *Frontiers in pharmacology*, 11, 166. <https://doi.org/10.3389/fphar.2020.00166>
- [5] Paik, S., Kim, W., Park, J., Park, C., & Jin, G. (2014). A Quantitative Study of Airway Changes on Micro-CT in a Mouse Asthma Model: Comparison With Histopathological Findings. *Allergy, Asthma & Immunology Research*, 6(1), 75. doi:10.4168/aaair.2014.6.1.75
- [6] Wafriy, C. I., Kamsani, Y. S., Nor-Ashikin, M. N., Nasir, N. A., & Hanafiah, M. (2021). Ovalbumin causes impairment of preimplantation embryonic growth in asthma-induced mice. *Journal of Reproductive Immunology*, 143, 103240. doi:10.1016/j.jri.2020.103240
- [7] Meakin, A. S., Saif, Z., Seedat, N., & Clifton, V. L. (2020). The impact of maternal asthma during pregnancy on fetal growth and development: A review. *Expert Review of Respiratory Medicine*, 14(12), 1207-1216. doi:10.1080/17476348.2020.1814148

# REVEALING EFFECTIVE ADULTICIDES FOR OUTDOOR DENGUE VECTOR CONTROL AT SELANGOR HOT SPRINGS

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## ABSTRACT

The susceptibility levels of an outdoor dengue vector; *Aedes albopictus* adult populations from four hot springs in Selangor, Malaysia towards two organochlorine, two organophosphate, two carbamate and eight pyrethroid adulticides were determined in this study. *Aedes albopictus* adult populations from selected hot springs were exposed to each adulticide for an hour following the procedures of adult bioassays outlined by the World Health Organization (WHO). The mortalities throughout the exposure period and at 24 h post-exposure to each adulticide were noted. The *Ae. albopictus* laboratory strain which represented the reference strain was fully susceptible towards all tested adulticides, except for the exposure to pyrethroid permethrin 0.25% and bifenthrin 0.2%. As for the field adult populations of *Ae. albopictus*, various levels of resistance against organochlorine DDT 4% and dieldrin 4%; organophosphate fenitrothion 1%; carbamate propoxur 0.1% and bendiocarb 0.1%; as well as pyrethroid permethrin 0.25%, alpha-cypermethrin 0.05% and bifenthrin 0.2% were exhibited. Complete mortalities were recorded at 24 h post-treatment among all *Ae. albopictus* adult populations from hot springs that were exposed to organophosphate pirimiphos-methyl 0.25% as well as pyrethroid permethrin 0.75%, deltamethrin 0.05%, lambda-cyhalothrin 0.05%, cyfluthrin 0.15% and etofenprox 0.5% which suggested that these adulticides are potentially effective in controlling *Ae. albopictus* populations at selected hot springs if needed in the near future. Despite zero case of mosquito-borne infection reported at selected hot springs so far, more studies on the mosquito densities at these hot springs and continuous monitoring of insecticide susceptibility among mosquito vectors from these hot springs are still vital so that effective future vector control strategies for these hot springs could be planned ahead.

**Keywords:** Adulticides, Dengue, Hot springs, Selangor, Malaysia.

## INTRODUCTION

Dengue is a mosquito-borne infection that is endemic in tropical and subtropical climates. Dengue is transmitted by *Aedes aegypti* and *Ae. albopictus* (Kobayashi *et al.*, 2023). The incidence of dengue has been greatly increasing worldwide with significant morbidity and mortality. In Malaysia, for the year of 2023, until 4<sup>th</sup> November 2023, a total of 100,936 dengue cases with 78 deaths has been reported (Ministry of Health Malaysia, 2023).

As the development of the dengue vaccine is still ongoing, the spread of dengue infection is managed through the control of mosquito vectors. The World Health Organization (WHO) has recommended various vector control strategies comprising the environmental, mechanical, biological and chemical control methods (World Health Organization, 2012). Among all vector control methods suggested, the chemical control using insecticides remains the most selected control approach due to their quick actions and less costly. Nevertheless, frequent and massive application of insecticides lead to the development of insecticide resistance among mosquito vectors which eventually causes failures in the vector control activities conducted. Hence, it is important to clarify the susceptibility status of mosquito vectors from the target sites before the selection of insecticides to be used in the vector control operations is made.

Hot springs are natural geothermal water spots which are also a public attraction especially for illness treatment and relaxation. Besides human residential areas, recreational areas like hot springs are also at risk of mosquito-borne infection transmission due to the high human traffic and conducive ecology for mosquito vectors. Dense vegetation that surrounds most hot springs are idyllic resting and breeding sites for mosquitoes including the outdoor dengue vector; *Ae. albopictus* (Samson *et al.*, 2013). Thus, there is a need to formulate effective vector surveillance and control methods for hot springs in order to prevent the occurrence of any mosquito-borne infection including dengue. This study was carried out with the aim to determine the susceptibility status of the outdoor dengue vector; *Ae. albopictus* from selected hot springs in Selangor, Malaysia, against various public health insecticides. Four *Ae. albopictus* adult populations from Selayang (SEL), Hulu Tamu Batang Kali (HTBK), Kuala Kubu Bharu (KKB) and Kerling (KERL) hot springs in Selangor, Malaysia were exposed to different adulticides via the WHO adult bioassays which covered four insecticide classes, namely organochlorines, organophosphates, carbamates and pyrethroids.

## MATERIALS AND METHODS

### 2.1 Study localities

Four hot springs in Selangor, Malaysia have been selected for this study, namely Selayang (SEL) hot spring in Gombak district, as well as Hulu Tamu Batang Kali (HTBK), Kuala Kubu Bharu (KKB), and Kerling (KERL) hot springs in Hulu Selangor district.

### 2.2 Samples of *Aedes albopictus*

Samples of an outdoor dengue vector; *Aedes albopictus*, were collected at each study locality via the ovitrapping technique. Ovitrap containing hay infusion water for the mosquito egg-laying were placed at the study localities for five days. All mosquito immatures found in the ovitraps were nurtured to adult stage in the insectarium. Only *Ae. albopictus* adults were maintained while other mosquito species were discarded.

Other than the field populations of *Ae. albopictus*, the laboratory strain of the same species (F80) was also utilized as a reference strain in this study. All *Ae. albopictus* colonies were nurtured in the same manner in the insectarium. *Aedes albopictus* female adults aged 3-5 days old were employed in this study.

### 2.3 Adulticides

Fourteen adulticides from four insecticide classes were tested in this study: organochlorine dichlorodiphenyltrichloroethane (DDT) 4%, and dieldrin 4%, organophosphate fenitrothion 1% and pirimiphos-methyl 0.25%; carbamate propoxur 0.1% and bendiocarb 0.1%; and pyrethroid permethrin 0.25% and 0.75%, deltamethrin 0.05%, lambda-cyhalothrin 0.05%, cyfluthrin 0.15%, etofenprox 0.5%, alpha-cypermethrin 0.05% and bifenthrin 0.2%. All adulticides used were in the form of impregnated papers, bought from the WHO Collaborating Centre, Vector Control Research Unit (VCRU), Universiti Sains Malaysia, Penang, Malaysia.

### 2.4 Adult bioassays

The adult bioassays were conducted following the World Health Organization guidelines (2016). Twenty-five healthy sugar-fed *Ae. albopictus* female adults aged 3-5 days old were exposed to each adulticide impregnated paper in the exposure tube for 1 h. A total of four replicates per population were utilized in the adult bioassay. Two control tubes, each containing either the olive oil-impregnated paper (as an organochlorine and carbamate control) or the silicone oil-impregnated paper (as a

pyrethroid control), and similar number of sugar-fed female mosquitoes were also prepared and run. The mortality rates of mosquitoes were noted for every minute throughout the exposure time and at 24 h post-treatment.

## 2.5 Analysis of data

The mortality results of each population at 24 h post-treatment of all adulticides were converted into mortality percentages. Based on these mortality percentages, the susceptibility status of each *Ae. albopictus* population against all tested adulticides were then classified following the World Health Organization guidelines (2016): A 98-100% mortality showed susceptibility to the tested adulticide; 90-97% mortality revealed possible resistance against the tested adulticide which later had been confirmed by additional adult bioassays conducted; and <90% mortality signified confirmed resistance against the tested adulticide among the respective *Ae. albopictus* population.

## RESULTS AND DISCUSSION

At 24 h post-exposure, full susceptibility was demonstrated among *Ae. albopictus* laboratory strain towards almost all organochlorine, organophosphate, carbamate and pyrethroid adulticides, except for permethrin 0.25% (51.00%) and bifenthrin 0.2% (67.00%) exposures (Table 1). Full susceptibility was also observed among all four hot springs populations of *Ae. albopictus* towards organophosphate pirimiphos-methyl 0.25% and also pyrethroid permethrin 0.75%, deltamethrin 0.05%, lambda-cyhalothrin 0.05%, cyfluthrin 0.15% and etofenprox 0.5%. Possible resistance was displayed among all hot spring's populations against organochlorine DDT 4% (82.00 – 96.00%) and dieldrin 4% (93.00 – 100.00%) as well as carbamate propoxur 0.1% (83.00 – 95.00%). All hot springs populations exhibited confirmed resistance against organophosphate fenitrothion 1% (63.00 – 79.00%) and carbamate bendiocarb 0.1% (58.00 – 77.00%). *Aedes albopictus* adult populations from SEL, HTBK and KKB hot springs showed possible resistance against pyrethroid permethrin 0.25%, whereas, KERL hot spring population displayed confirmed resistance against the same adulticide. *Aedes albopictus* populations from HTBK, KKB and KERL hot springs were susceptible to pyrethroid alpha-cypermethrin 0.05% while possible resistance was displayed among *Ae. albopictus* population from SEL hot spring against the same pyrethroid. In contrast, full susceptibility towards bifenthrin 0.2% was demonstrated only among *Ae. albopictus* population from SEL hot spring while confirmed resistance was observed among other hot springs populations against bifenthrin 0.2%.

Among four insecticide classes tested in this study, the utilization of organochlorines in both agriculture and public health sectors has been banned worldwide including in Malaysia since the 1970s due to their persistent presence in the environment (Sharip *et al.*, 2017). However, resistance against organochlorines were detected among nearly all hot springs populations of *Ae. albopictus* tested in this study, suggesting that organochlorine elements were still persisted in these hot spring's environments.

On the other hand, organophosphates like fenitrothion, pirimiphos-methyl, malathion, fenthion and temephos have been used in the space treatment for dengue control activities in Malaysia (Ong, 2016). Pirimiphos-methyl is the recommended organophosphate adulticide to be applied at all hot springs if needed in the future based on the full susceptibility towards pirimiphos-methyl observed among *Ae. albopictus* hot springs populations.

Meanwhile, the utilization of carbamate adulticides in the selected hot springs should be carefully considered, monitored and rotated with adulticides from other insecticide classes due to the resistance development detected among *Ae. albopictus* populations from these hot springs against both carbamate propoxur and bendiocarb. The use of carbamate propoxur and bendiocarb in the local mosquito control activities are unknown. However, propoxur was formerly used as an active ingredient in the household aerosol locally before it was replaced by pyrethroids in 1990s (Low *et al.*, 2013).

In addition, the application of pyrethroid permethrin, deltamethrin, lambda-cyhalothrin, cyfluthrin and etofenprox in the future vector control activities at selected hot springs are also recommended based on the full susceptibility demonstrated among *Ae. albopictus* adult populations from these localities. In fact, some of these pyrethroids have been applied by the Ministry of Health Malaysia in their vector control programmes (Ong, 2016). Pyrethroid alpha-cypermethrin and bifenthrin could also be utilized in several hot springs selected but their effectiveness against *Ae. albopictus* population would require some time to be evidenced.

In general, all four selected hot springs are supported with common facilities like concrete benches surrounding the hot springs, resting huts and the lavatories. KERL hot spring is located marginally far from any human residential areas and surrounded by denser vegetation than other selected hot springs. On the other hand, SEL, HTBK and KKB hot springs are situated nearer to human residential areas which indirectly increase the chance of getting the insecticide exposure from the vector control activities conducted in the residential areas towards the hot spring's mosquitoes. The presence of human visitors, mosquito vectors as well as physical facilities and vegetation that could serve as prospective mosquito resting and breeding habitats at the hot springs are important factors that could mediate the transmission of mosquito-borne infections at these localities. Hence, it is crucial to continuously monitor the density and susceptibility of the mosquito vectors from the hot springs against insecticides so that effective mosquito control strategies could be planned and conducted at these hot springs when needed in the near future.

**Table 1: Mortality Percentage at 24 h Post-Treatment for Five Populations of *Aedes albopictus* Female Adults Against Organochlorine, Organophosphate, Carbamate and Pyrethroid Adulticides.**

Insecticide class	Populations	24 h mortality (%)				
		Laboratory strain (Reference)	Selayang hot spring (SEL)	Hulu Tamu Batang Kali hot spring (HTBK)	Kuala Kubu Bharu hot spring (KKB)	Kerling hot spring (KERL)
Adulticides						
Organochlorines	DDT 4%	<sup>S</sup> 100.00 ± 0.00	<sup>M</sup> 91.00 ± 4.12	<sup>R</sup> 87.00 ± 5.74	<sup>R</sup> 82.00 ± 5.77	<sup>M</sup> 96.00 ± 2.83
	Dieldrin 4%	<sup>S</sup> 100.00 ± 0.00	<sup>M</sup> 93.00 ± 1.00	<sup>S</sup> 99.00 ± 1.00	<sup>M</sup> 97.00 ± 1.91	<sup>S</sup> 100.00 ± 0.00
Organophosphates	Fenitrothion 1%	<sup>S</sup> 100.00 ± 0.00	<sup>R</sup> 74.00 ± 8.08	<sup>R</sup> 66.00 ± 10.13	<sup>R</sup> 63.00 ± 4.43	<sup>R</sup> 79.00 ± 4.73
	Pirimiphos-methyl 0.25%	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00
Carbamates	Propoxur 0.1%	<sup>S</sup> 100.00 ± 0.00	<sup>M</sup> 92.00 ± 2.83	<sup>M</sup> 90.00 ± 3.46	<sup>R</sup> 83.00 ± 3.00	<sup>M</sup> 95.00 ± 3.00
	Bendiocarb 0.1%	<sup>S</sup> 100.00 ± 0.00	<sup>R</sup> 58.00 ± 3.46	<sup>R</sup> 74.00 ± 3.46	<sup>R</sup> 69.00 ± 6.61	<sup>R</sup> 77.00 ± 5.26
Pyrethroids	Permethrin 0.25%	<sup>R</sup> 51.00 ± 1.91	<sup>M</sup> 96.00 ± 2.31	<sup>M</sup> 90.00 ± 1.15	<sup>M</sup> 91.00 ± 1.91	<sup>R</sup> 83.00 ± 5.74
	Permethrin 0.75%	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00
	Deltamethrin 0.05%	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00
	Lambda-cyhalothrin 0.05%	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00
	Cyfluthrin 0.15%	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00
	Etofenprox 0.5%	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00
	Alpha-cypermethrin 0.05%	<sup>S</sup> 99.00 ± 1.00	<sup>M</sup> 97.00 ± 1.91	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 100.00 ± 0.00	<sup>S</sup> 99.00 ± 0.49
	Bifenthrin 0.2%	<sup>R</sup> 67.00 ± 7.55	<sup>S</sup> 100.00 ± 0.00	<sup>R</sup> 90.00 ± 3.46	<sup>R</sup> 86.00 ± 2.58	<sup>R</sup> 97.00 ± 3.00

Percent mortality after 24 h (%) = Mean of mortality percentage of adult mosquitoes ± standard error (S.E.).

S = susceptible, M = possible resistance, R = confirmed resistance, as determined by WHO (2016).

## CONCLUSION

In essence, findings of this study indicate organophosphate pirimiphos-methyl as well as pyrethroid permethrin, deltamethrin, lambda-cyhalothrin, cyfluthrin and etofenprox as potential adulticides to be applied at all four selected hot springs. Even though there is no case of mosquito-borne infection reported at these hot springs so far, more research on the mosquito density and insecticide susceptibility status among mosquito vectors from hot springs should be carried out following the

current popularity of these hot springs among local and foreign visitors so that the occurrence of any mosquito-borne infection at these hot springs could be prevented.

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## REFERENCES

Kobayashi, D., Kai, I., Faizah, A. N., Moi, M. L., Tajima, S., Takasaki, T., Sasaki, T. & Isawa, H. (2023). Comparative analysis of the susceptibility of *Aedes aegypti* and Japanese *Aedes albopictus* to all dengue virus serotypes. *Tropical Medicine and Health*, 51, 61.

Low, V. L., Chen, C. D., Lee, H. L., Tan, T. K., Chen, C. F., Leong, C. S., Lim, Y. A. L., Lim, P. E., Norma-Rashid, Y. & Sofian-Azirun, M. (2013). Enzymatic characterization of insecticide resistance mechanisms in field populations of Malaysian *Culex quinquefasciatus* Say (Diptera: Culicidae). *PLoS ONE*, 8(11), e79928.

Ministry of Health Malaysia. (2023). Situasi Semasa Demam Denggi Di Malaysia: Minggu Epidemiologi 44 (29 Oktober – 4 November 2023). *Kenyataan Media Kementerian Kesihatan Malaysia*. 10<sup>th</sup> November 2023. (Unpublished data).

Ong, S. Q. (2016). Dengue vector control in Malaysia: A review for current and alternative strategies. *Sains Malaysiana*, 45(5), 777-785.

Samson, D. M., Qualls, W. A., Roque, D., Naranjo, D. P., Alimi, T., Arheart, K. L., Muller, G. C., Beier, J. C., Xue, R. -D. (2013). Resting and energy reserves of *Aedes albopictus* collected in common landscaping vegetation in St. Augustine, Florida. *Journal of the American Mosquito Control Association*, 29(3), 231-236.

Sharip, Z., Hashim, N., & Suratman, S. (2017). Occurrence of organochlorine pesticides in a tropical lake basin. *Environmental Monitoring and Assessment*, 189, 560.

World Health Organization. (2012). *Handbook for Integrated Vector Management*. Geneva, Switzerland: WHO Press.

World Health Organization. (2016). *Monitoring and managing insecticide resistance in Aedes mosquito populations. Interim guidance for entomologists* (WHO/ZIKV/VC/16.1). Geneva, Switzerland: World Health Organization.

## **FACULTY OF DENTISTRY**

# DOMESTIC WATER PURIFICATION SYSTEMS AND FLUORIDE CONCENTRATION OF HOME WATER SUPPLY

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## ABSTRACT

The addition of fluoride into the public water supply through regulated and adjusted means, also known as community water fluoridation, has shown to be a very effective public health measure to prevent tooth decay. However, the widespread use of water purifiers to filter the tap water supply, questions have been raised as to whether the fluoride concentration in public water supply has been affected by the water purifier systems that are widely available in today's market. Objective: To determine the effect of various types of domestic water purifier systems on the fluoride concentration in home water supply. Methods: A total of 100 water samples collected from 25 water purifier systems were included in this study. Results: Reverse osmosis purifier systems showed significant reduction in fluoride concentration at point of use ( $P=.027$ ). Activated carbon combination water purifier systems showed varying levels of fluoride concentrations at point of use. There was a significant increase in fluoride for the carbon mechanical plus calcium sulphite filter ( $P=.01$ ) and for the carbon sediment plus nano filter ( $P=.02$ ) but reduced fluoride concentration for the carbon ceramic and carbon fiber water purifier systems. Conclusions: This study showed that carbon-based water purifier systems may increase or reduced fluoride concentration in water. However, continuous use of water purifiers using reverse osmosis technology can reduce the amount of fluoride and this may give negative implications on oral health.

**Keywords:** water purifier system, fluoride concentration, home water supply.

## INTRODUCTION

### *Water Fluoridation*

The use of fluoride is one of the most effective preventive strategy in oral health by making teeth more resistant to the action of acids and slowing the occurrence of tooth decay<sup>1,2</sup>. Fluoridation of public water supply in controlled concentration is one of the safest and effective methods to deliver fluoride to the population and to remove the barriers of inequality<sup>3,4</sup>. Studies have also shown that it is more cost effective to fluoridate the water supply than to treat carious teeth. The American Dental Association stated that for most American cities, every \$1 invested in water fluoridation saves \$38 in dental treatment costs<sup>4</sup>.

The water fluoridation programme in Malaysia was approved by the government in 1972 to support its caries-protective effects with due considerations given to its safety, efficiency and cost effectiveness<sup>5</sup>. The National Guidelines for Safe Drinking Water has cited a range of 0.4 – 0.6 ppm fluoride as the implementation range for water fluoridation in Malaysia<sup>5</sup>. Since its inception, dental caries status has improved especially among children. The National Oral Health Survey of 12-year-old schoolchildren in 2017 showed reduced prevalence of dental caries from 60.9% in 1997 to 33.3% in 2017 with reduced decayed, missing and filled teeth (DMFT) of 1.9 to 0.78 respectively<sup>6</sup>.

### *Domestic water purification systems*

Water purifier systems (WPS) are used in many households basically to remove pollutants from the tap water with the help of physical barriers, chemical processes or biological processes. According to Bee B.L (2005), the popular types of WPS used in the Malaysian market are activated carbon filter, membrane filter, reverse osmosis, distillation, ultraviolet light unit and the combination unit<sup>10</sup>. Carbon filtration systems use activated charcoal as filtering medium to filter chlorine-based chemicals, pesticides and industrial solvents. Reverse osmosis filtration works where untreated water flows through fine filter membrane at pressure so that water passes through, but the contaminants remain

behind<sup>9</sup>. Membrane filters such as ceramic and nano filter used to filter larger and undesirable molecules such as virus, bacteria, salt and metal<sup>11</sup>. The improved water purifier systems (WPS) available in the market nowadays not only remove contaminants, but also heavy ions, chlorine and bad odour and this has posed a question as to whether the fluoride that has been added to the water supply is also being filtered. The objective of this study was to determine the effect of various domestic water purifier systems (WPS) commonly used today in Malaysian households on the fluoride concentration in the water supply.

## METHODOLOGY

### *Water samples*

100 water samples were collected from twenty-five different households in the Klang Valley of Selangor, Malaysia over a period of six months. Water samples taken at the household tap before entering the water purifier is designated as water at 'point of entry' (POE) and water that is collected after it has passed through the water purifier is designated as 'point of use' (POU). The water samples were collected in plastic bottles (Polyethylene) and two sets of water samples were taken from each water purifier, each set consists of water samples at POE and POU thus giving a total of four water samples per water purifier. All water samples collected were taken to the laboratory within 24 hours and analysed for fluoride content within the next 12 hours to avoid any contaminations<sup>28</sup>. A Fluoride Low Range Portable Photometer was used to measure the amount of fluoride in the water samples. Twenty-five percent of water samples taken from randomly chosen water purifiers were reanalysed for reliability. The Cronbach's alpha was 0.766 indicating acceptable reliability of the measurements.

### *Data management and statistical analysis*

Data was analysed using SPSS version 26 software. Three of the water purifiers were reverse osmosis and twenty WPS were activated carbon in combination with other methods of filter cartridges and data were grouped according to combinations based on the manufacturers' details of each water purifier's mode, type and technology. Based on these, there were the carbon + mechanical + calcium sulphite (CMCS) group, the carbon + sediment + nano (CSN) group, the carbon + fiber (CF) group, the carbon + ceramic (CC) and the carbon + others (CO) group. The other two water purifiers use mechanical technology and is named as 'other' WPS. Wilcoxon Signed-Rank test was used to compare the fluoride concentrations of drinking water before passing (POE) and after passing (POU) through the various WPS. Paired t test was used to analyse the fluoride concentrations of the water samples at POE and POU levels in each carbon group while the Kruskal Wallis test was used to compare the fluoride concentrations between the various carbon combination WPS. All analysis were computed to within 95% confidence interval.

## RESULT

Water samples collected from the reverse osmosis purifier systems showed a significant reduction of fluoride concentration by 67.3% ( $P=.027$ ) while for the others (mechanical) showed a 5.9% reduction in fluoride at the POU. (Table 1). Data analysis from the twenty-carbon combination WPS showed an overall significant increase in fluoride concentration at the point of use ( $P=.003$ ). (Table 1).

Further data analysis was done for water samples within each carbon combination groups and results are shown in Table 2. The CMCS WPS which consists of carbon combination with mechanical and calcium sulphite filters showed a significant mean increase of 0.08 mg/L (23.6%) in fluoride concentration ( $P=.011$ ) at POU level. The CSN WPS which consists of carbon combination with sediment and nano filter also showed significant increase in fluoride concentration at the POU level with mean increase of 0.024 mg/L (5.5%) of fluoride concentration ( $P=.02$ ). There was also an increase in the fluoride concentration at the POU level for the carbon combination with other filters (CO). The mean increase was 0.048 mg/L or 13% in fluoride concentration at the POU level. However, this increase is not significant ( $P=.09$ ). The WPS which consist of carbon combination with ceramic filter (CC) showed a decrease fluoride concentration of 0.02 mg/L (5.3%) in fluoride concentration while the carbon combination with fiber filter (CF) showed a decrease of 0.015 mg/L (4.6%) fluoride concentration at the POU level. But the decrease for both water purifiers is not significant ( $p>.05$ ).

## DISCUSSION

Activated carbon (AC) is widely used in water purifier systems and in this study three groups of carbon combination WPS (CMCS, CSN and CO) showed increase in fluoride concentration at the POU but slight reduction in fluoride concentration for CF and CC carbon combination WPS. In his study Konno et al (2008) showed that activated-carbon filters had a low absorptive capacity for fluoride ions<sup>14</sup>. Loh et al also stated that a standard carbon filter does not remove fluoride but with combinations of other filtration systems may contribute to either removal or some addition of fluoride in water after passing through water filtration devices<sup>7</sup>.

This study showed that some activated carbon WPS that used combinations with other filter cartridges such as mechanical, calcium sulphite, sediment and nano filters may contribute to an increase in fluoride content at the POU but the mean fluoride concentration at POU recorded was still within the permissible range<sup>5</sup>. The increase of fluoride could possibly be that fluoride is collected from the sediments or there is mineral addition from any of the cartridges in the combination to the water before reaching the POU. The effectiveness of carbon filters to filter fluoride has been discussed by Bee<sup>10</sup> whereby the physical and chemical properties, contaminant, water temperature, ph. and exposure time play a role in the effectiveness of activated carbon as water filters and therefore require regular maintenance for effective removal of impurities and contaminants.

Findings from the National Oral Health Survey of Adults (NOHSA) 2010 showed that an estimated 42% of Malaysian households have water filters<sup>21</sup>. A recent technical report in 2018<sup>9</sup> and a study by Nur Shahirah et al<sup>22</sup> stated the most used domestic water purification system is the reverse osmosis technology due to their performance efficiency and low electric consumption. The high reduction in fluoride concentration at POU for the reverse osmosis WPS in this study was similar to other studies and this reaffirmed that reverse osmosis water purifiers reduced fluoride levels in drinking water by as much as 80-90%<sup>7,13,17,23</sup>.

The 2018 Annual Report of the Ministry of Health Malaysia had reported that an estimated 74.1% of the Malaysia population received fluoridated water from the addition of fluoride at the water treatment plants (WTPs). 60% of the WTPs in this country are privatized and the fluoridation is carried out by the private sectors while the government funded the fluoridation of public water supply for WTPs operated by the government<sup>24</sup>. A substantial amount of money has been spent to fluoridate the public water supply in efforts to improve the oral health status of the Malaysian population and to reduce any oral health inequalities among the population. However, the use of reverse osmosis as the preferred WPS meant that it is a waste of government and private sector's resources as fluoride that is added to the water is not being utilized to its potential.

This study has shown that the types of WPS used in different households have an effect on the fluoride content of the drinking water and may have health implications in the long term. The past national oral health surveys have reported reduced prevalence of dental caries among the preschool children which showed a reduction from 87.1% in 1995 to 71.3% in 2015<sup>25</sup> while among the adults, there was decrease in caries prevalence from 94.6% in 1990 to 88.9% in 2010<sup>21</sup>. This decrease is largely attributed to the government's effort to provide water fluoridation and therefore there is a need for water fluoridation to continue. However, households which uses the reverse osmosis technology can deprive their family members of the benefits of fluoride. Household that uses water purification systems with activated carbon or carbon combinations, even though there may be an increase of fluoride at POU, the increase is still within the range permissible while for other carbon combination systems that showed a decrease at the POU, the decrease of between 4% – 5% may not affect the benefits that water fluoridation could offer. A very recent study has also shown that reverse osmosis systems resulted in very low fluoride concentration. Further studies need to be carried out to investigate the increase in fluoride concentration in these WPS.

## CONCLUSION

The use of water filter that removes fluoride completely contradicts the government's efforts in implementing public water fluoridation for primary prevention of caries. With available scientific evidence, efforts should be made to create awareness of reduction of optimal fluoride levels in drinking

water by reverse osmosis to the consumers. This study also showed that water filtration devices that used carbon filters in combinations with other filtration systems may preserved the fluoride content.

**Table 1: Analysed data for general POE and POU of carbon combination, reverse osmosis and others**

Type of water filtration system	Mean Fl Concentration (mg/L)		% Mean difference (POE-POU)	P value
	POE	POU		
Carbon	0.385	0.419	8.9% (0.034)	.003
Reverse Osmosis	0.413	0.135	67.3% (0.278)	.027
Others (mechanical)	0.465	0.440	5.9% (0.028)	>0.05

**Table 2: Analysed data between carbon combination groups.**

Carbon groups	POE		POU		% Mean difference (POE-POU) Mg/L	P Value	
	No of water samples at each end point	Mean Mg/L	SD	Mean Mg/L	SD		
1. Carbon + mechanical + calcium sulphite	8	0.365	0.09	0.4513	0.07	23.6% (0.086)	.011
2. Carbon + sediment + nano	14	0.4343	0.12	0.4586	0.11	13.0% (0.024)	.020
3. Carbon + ceramic	4	0.375	0.10	0.355	0.17	5.3% (0.02)	.47
4. Carbon + fiber	4	0.325	0.05	0.31	0.01	4.6% (0.015)	.47
5. Carbon + others	10	0.361	0.08	0.4090	0.15	13.0% (0.048)	.09

## REFERENCES

- [1] Shaharuddin MS, Kamil YM, Ismail YM, Firuz RM, Aizat IS, Yunus AM. Fluoride concentration in Malaysian drinking water. American-Eurasian J Agric Environ Sci. 2009;6(4):417-20.
- [2] The American Academy of Pediatric Dentistry: Best Practices Fluoride Therapy, The Reference Manual of Pediatric Dentistry, Latest Revision 2018, 262-265.
- [3] McDonagh MS, Whiting PF, Wilson PM et al. Systematic review of water fluoridation. BMJ. 2000; 321(7265):855-859.
- [4] American Dental Association, Executive Summary, Fluoridation Facts, 2005
- [5] Malaysian Dental Council 2009. Position Document: Use of Fluorides in Malaysia, MOH / K / GIG /19.2010 (GU).
- [6] Institute for Public Health, National Institutes of Health (NIH), Ministry of Health Malaysia. The National Health and Morbidity Survey 2017: National Oral Health Survey of Schoolchildren 2017, Volume II: Oral Health Status of 12-year-old Schoolchildren, MOH/S/IKU/68.17(RR).
- [7] Loh KH, Yaacob H, Andan H, Omar S, Jamaludin M. A Study of The Effect of Home Water Filtration Systems on Fluoride Content of Drinking Water in Johor. Malaysian Dental Journal 2011; 33(2):8-13.
- [8] Sweetman MJ, May S, Mebberson N, Pendleton P, Vasilev K, Plush SE, Hayball JD. Activated Carbon, Carbon Nanotubes and Graphene: Materials and Composites for Advanced Water Purification. C — Journal of Carbon Research. 2017; 3(2):18.
- [9] Malaysia Water Purifiers Market, By Mode (POU & POE), By Type (Under Sink, Counter Top, Faucet Mount, etc.), By Technology (RO, UF, UV, Media, NF), By Region, Competition, Forecast

& Opportunities, 2025, TechSci Research. 2018, Available at: <https://www.techsciresearch.com/report/malaysia-water-purifiers-market/2303.html> . Accessed March 24, 2020

[10] Law Bee Bee, The Usage of Domestic Water Filtration Systems in Malaysia. University of Southern Queensland Faculty of Engineering and Surveying. Dissertation, Oct 2005.

[11] Chris Woodford, How water filters work. Available at <https://www.explainthatstuff.com/howwaterfilterswork.html>. Accessed March 26,2020

The Basics of Common Water Filter Technologies. Available at . <http://filterbutler.com/blog/the-basics-of-common-water-filter-technologies/> Accessed April 15, 2020

[12] Khairnar MR, Jain VM, Wadgave U, Dhole RI, Patil SJ, Chopade SR. Effect of different reverse osmosis water filters on fluoride content of drinking water. J Indian Assoc Public Health Dent 2018;16:165-8.

[13] Konno, Hideki & Yaegaki, Ken & Tanaka, Tomoko & Sato, Tsutomu & Itai, Kazuyoshi & Imai et al, (2008). Neither hollow-fibre membrane filters nor activated-charcoal filters remove fluoride from fluoridated tap water. Journal (Canadian Dental Association). 74. 443.

[14] Buzalaf, Marília & Levy, Flávia & Rodrigues, Maria & De Magalhães Bastos, José. (2003). Effect of domestic water filters on water fluoride content and level of the public water supply in Bauru, Brazil. Journal of dentistry for children (Chicago, Ill.). 70. 226-30.

[15] Eftekhar B., Skinik M., Shamohammadi M., Ghaffaripour J., Nilchian F. The Effectiveness of Home Water Purification Systems on the Amount of Fluoride in Drinking Water. J Dent Shiraz Univ Med Sci., 2015 September; 16(3 Suppl): 278-281

[16] Michael D. Brown, Gerald Aaron. The effect of point-of-use water conditioning systems on community fluoridated water. Pediatr Dent 1991 Jan-feb;13(1):35-8

[17] Lambert-Beer's Law available at [https://en.wikipedia.org/wiki/Beer%20%93Lambert\\_law](https://en.wikipedia.org/wiki/Beer%20%93Lambert_law). Accessed March 20, 2020.

[18] Enagic Innovative Water Technology available at <https://www.enagiccomparison.com/?c=product>. Accessed January 4, 2020.

[19] Cuckoo Products/ Water Purifiers available at <https://www.cuckoo.com.my/products/water-purifiers/iris-top>. Accessed January 4, 2020.

[20] Oral Health Division, Ministry of Health Malaysia. National Oral Health Survey of Adults 2010 (NOHSA 2010). November 2013.

[21] Nur Shahirah Abd Rahim and Norzila Othman 2019 IOP Conf. Ser.: Mater. Sci. Eng. 601 012011.

[22] Prabhakar, Attiguppe & Raju, O & Kurthukoti, Ameet & Dev, Vishwas. (2008). The effect of water purification systems on fluoride content of drinking water. Journal of the Indian Society of Pedodontics and Preventive Dentistry. 26. 6-11. 10.4103/0970-4388.40314.

[23] Annual Report 2018. Oral Health Programme, Ministry of Health Malaysia; MOH/K/GIG/10.2019(GU)

[24] Che Salleh, Natifah, and Savithri Vengadasalam. National Oral Health Survey of Preschool Children 2015 (NOHPS 2015), Vol. I: Oral Health Status and Caries Treatment Needs of 5-year-old Children. The Oral Health Division, Ministry of Health Malaysia, 2017.

[25] Olga, K.I. & Jankulovska, Mira & Mijoska, Aneta & Zabokova Bilbilova, Efka & Pavlevska, M. & Todorovska, G.. (2017). Ultrastructural changes of the initial lesion at early childhood caries. Journal of International Dental and Medical Research. 10. 36-41.

[26] Bilyschuk, Liubov & Keniuk, Andrii & Goncharuk-Khomyn, M. & Yavuz, Izzet. (2019). Association Between Saliva Quantity and Content Parameters with Caries Intensity Levels: A Cross-Sectional Study Among Subcarpathian Children. Pesquisa Brasileira em Odontopediatria e Clínica Integrada. 19. 1-10. 10.4034/PBOCI.2019.191.121.

[27] AR Prabhakar, OS Raju, AJ Kurthukoti, TD Vishwas. The effect of water purification systems on fluoride content of drinking water. J Indian Soc Pedod Prev Dent. 2008; 26(1):6–11.

[28] Loai Wadea Hazzazi et al. Tap water filtration and purification usage and their impact on the concentrations of fluoride and other minerals – A community-based study, Journal of Dentistry, Volume 150, 2024, 105377, ISSN 0300-5712, (<https://www.sciencedirect.com/science/article/pii/S0300571224005475>)

# A RANDOMIZED CROSS-OVER TRIAL OF BEHAVIOUR GUIDANCE TECHNIQUES ON CHILDREN WITH SPECIAL NEEDS DURING DENTAL TREATMENT: THE CAREGIVERS' PERCEIVED MANNERISMS

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## ABSTRACT

Due to their challenging behaviour, the dental practitioner needs to implement a feasible behaviour guidance technique in delivering safe and effective dental care to children with special needs. This study evaluates the impact of Papoose Board (PB) usage on the attitude of carers and the association between their education level, monthly household income, and previous dental experience. Next, the acceptance, consent, and concern regarding utilising a combination of basic behaviour guidance techniques (CBBGT) and Papoose Board (PB) for their children will be compared. Ninety children with special needs were recruited to get dental care with two behaviour-guiding exposures successively in the order of A-B/B-A design. CBBGT as exposure A and PB as exposure B. Caregivers are to complete a questionnaire before and after the exposure. Eight-eight caregivers with children between 2 and 15 completed the sequence. A total of 98.9% of the children were found to have neurodevelopmental abnormalities and disorders. Twenty-seven carers expressed significant anxiety when the CBBGT was applied to their children, and fourteen carers felt the same way about PB. The Wilcoxon sign rank test, on the other hand, demonstrated that carers' scores on approval and permission for both procedures were inconsequential. However, after watching the placement of their children, caregivers' views towards the use of PB dramatically improved. In conclusion, the caregivers exhibited comparable acceptance, consent, and worry about using PB. Additionally, they demonstrated improved attitudes following a detailed explanation and real-time observation of PB utilisation during their children's dental treatment.

**Keywords:** Attitude, children with special needs, passive immobilisation

## INTRODUCTION

When dealing with patients who have special needs, it can be challenging to manage their behaviour because of fear, anxiety, communication problems, and a lack of understanding of dental care, which increases the likelihood that they may engage in rebellious behaviours. Even though patients with special needs receive dental care comparable to that provided to healthy patients, they frequently encounter obstacles while attempting to receive routine dental care in a conventional dental setting. Therefore, different methods for behaviour advice may be required. Passive immobilisation could be advantageous for people with insufficient conventional behaviour counselling. Full-body passive

Immobilisation devices, such as the Papoose Board (PB), are designed to prevent infants from striving by splinting them to a rigid board. This is done to prevent the youngster from moving around.[1]

On the other hand, using these mechanical restraining devices in paediatric dentistry has sparked debate and controversy among dental practitioners and parents. Employing passive immobilisation devices was considered a non-friendly conduct comparable to using a tight jacket. This behaviour provoked problematic ethical evaluations while the general dentist did individual assessments. [2,3]

## MATERIAL AND METHOD

Randomised cross-over research involved two dental appointments within two months. The software (G\*Power 3.1) calculated the sample size with a medium effect size and a 20% dropout rate. Ninety carers brought their special needs children to the Pediatric Special Care Dentistry Clinic for dental treatment. The research assistant used sequentially numbered, opaque, sealed envelopes for allocation concealment in essential randomisation. Standard oral examination, basic behaviour instructions (e.g., tell-show-do), and treatment goals were discussed during the initial appointment. Carers were given a participant sheet with research details and commitment requirements. Carers had the option to participate or not. After the agreement, written consent was sought. Patients had two sequential exposures over two visits. Following the A-B/B-A exposure series, the treatment order was randomised. Exposure A (CBBGT) involves tell-show-do (TSD), distraction (Dis), or positive reinforcement (PR), while Exposure B involves passive immobilisation utilising a PB

The bilingual questionnaire has two parts: demographics and carer acceptance, consent, worry, and attitude. In part one, sociodemographic data, including carer age, gender, race, education, household income, dental experience, and disability type, were collected. In section two, the carer answered three Paryab et al. [4] questions about using a PB and CBBGT. The surveys assessed carers' agreement, assent, and worry about each treatment using a 5-point Likert scale.

Following Exposure B intervention, carers were asked six additional questions about the child's attitude towards PB use before and after the device was applied. Further questions were modified by Hill et al. [5]. The questionnaire was translated into English-Bahasa Malaysia for cultural and language compatibility. Content and face validation were used to ensure questionnaire relevance. The scale-level content validity index (S-CVI/Ave = 0.93) was constructed using the average approach to assess questionnaire item relevance and panel expert consensus. Data analysis was conducted using IBM SPSS (Version 28.0, IBM Knowledge Centre, New York, USA), with a P-value < 0.05 indicating statistical significance. The carers' acceptance, worry, consent, and attitude were analysed per question. Pairwise median and IQR comparisons were analysed using the Wilcoxon Sign rank Test. Logistic regression examined the relationship between carers' positive attitudes, education, monthly income, and dental experience.

## RESULTS AND DISCUSSION

Fifty-five of the respondents, eight young parents, 35 middle-aged parents, and 12 older parents, were recruited. The data consist of 25 males and 30 females. Of oral health care awareness and knowledge, 43.6% of the respondents had received treatment in the dental clinic, while 9.1% never had treatment before. 21 parents lack oral home care practices, and only three have adequate ones. A one-way ANOVA test revealed a significant difference between behaviour management technique (BMT) and age ( $p=0.001$ ). Further analysis using the post-hoc Bonferroni test suggested that all possible pairs of mean age were significantly different. We observed that those with middle-aged parents had higher mean compared to others. A significant linear correlation exists between a child who received treatment and active restraint with  $p=0.01$ . A significant linear correlation exists between a child who received treatment and TSD with  $p=0.022$  (Table 2). The vital difference in mean for each behavioural management technique acceptance was set at ( $p>0.05$ ). A pairwise comparison with confidence interval adjustment was performed. The result showed that there were significant differences in the comparison of certain BMTs.

Parental acceptability of passive immobilisation procedures was often low among healthy children. A study on children with exceptional needs found that communicative behaviour direction and protective stabilisation were more accepted than other techniques [6,7]

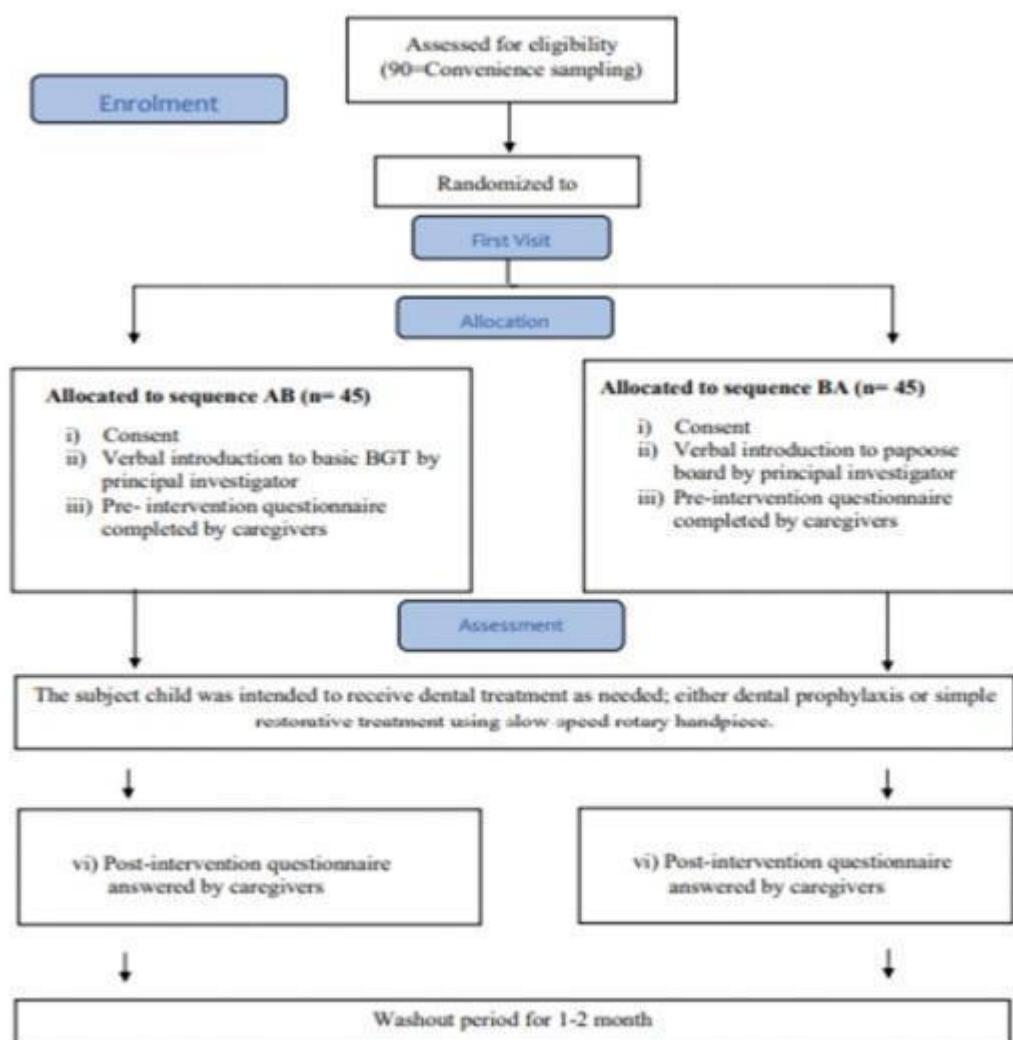
Caregivers in our study strongly agreed on the acceptance and consent for both approaches, supporting our findings. Compared to essential behaviour guidance, carers showed less concern for their child's treatment, believing passive immobilisation techniques effectively manage unwanted physical movements in patients with physical, mental, and psychological disabilities, particularly those with complex behaviour and limited communication.[8]

Educating carers on behaviour guidelines before treatment is crucial for children's dental care. Positive verbal information increased parents' approval of the proposed dental therapy.[9]

By providing comprehensive information, parents may make informed decisions about their child's dental care, reducing situational anxiety. The study recommends introducing the carer verbally, visually, and physically before using the PB. Participants can touch and feel the board compartment and Velcro material to better grasp the device's indications, dangers, and benefits. Providing carers with additional information about passive immobilisation techniques may increase their support.[10]

Previous studies ranked parental preferences for various behaviour management approaches, including audiotape, written, and images of other children, with varying results. This study compares basic BGT and PB for their child. [11,12] The individualistic aspects of the recipient should be considered when selecting behaviour control approaches for dental care. A detailed explanation of passive immobilisation increased carers' acceptance of special needs children during dental care.

## TABLE, IMAGE, AND FIGURE



## CONCLUSION

The evaluated carers showed the same level of acceptance, consent, and worry regarding the use of PB and CBBGT. Furthermore, their attitudes improved after receiving a detailed explanation and real-time observation of the use of PB during their children's dental treatment.

## REFERENCES

[1] Shanti M. Exploit restraints in managing Maladaptive behaviors. Asian Pac J Health Sci 2014;1:354-61.

- [2] Ilha MC, Feldens CA, Razera J, Vivian AG, de Rosa Barros Coelho EM, Kramer PF. Protective stabilization in pediatric dentistry: A qualitative study on the perceptions of mothers, psychologists, and pediatric dentists. *Int J Paediatr Dent* 2021;31:647-56.
- [3] Aarvik RS, Agdal ML, Svendsen EJ. Restraint in paediatric dentistry: A qualitative study to explore perspectives among public, non-specialist dentists in Norway. *Acta Odontol Scand* 2021;79:443-50.
- [4] Paryab M, Afshar H, Mohammadi R. Informing parents about the pharmacological and invasive behavior management techniques used in pediatric dentistry. *J Dent Res Dent Clin Dent Prospects* 2014;8:95-100
- [5] Betz CL, Baer MT, Poulsen M, Vahanvaty U, Bare M, Haddad Y, et al. Secondary analysis of primary and preventive services accessed and perceived service barriers by children with developmental disabilities and their families. *Issues Compr Pediatr Nurs* 2004;27:83-106.
- [6] Martinez Mier EA, Walsh CR, Farah CC, Vinson LA, Soto-Rojas AE, Jones JE. Acceptance of behavior guidance techniques used in pediatric dentistry by parents from diverse backgrounds. *Clin Pediatr (Phila)* 2019;58:977-84
- [7] Castro AM, Espinosa RC, Pereira CA, Castro TC, Santos MA, Santos DR, et al. Behavior guidance techniques used in dental care for patients with special needs: Acceptance of parents. *Pesqui Bras Odontopediatria Clin Integr* 2016;16:113-121.
- [8] American Academy of Pediatric Dentistry. Behavior guidance for the pediatric dental patient The Reference Manual of Pediatric Dentistry. Chicago, IL: American Academy of Pediatric Dentistry; 2021. p. 306-24.
- [9] Kupietzky A, Ram D. Effects of a positive verbal presentation on parental acceptance of passive medical stabilization for the dental treatment of young children. *Pediatr Dent* 2005;27:380-4.
- [10] Hill B, Fadavi S, LeHew CW, Rada R. Effect of caregiver's race and ethnicity on acceptance of passive immobilization for their child's dental treatment. *J Dent Child (Chic)* 2019;86:3-9.
- [11] Al Zoubi L, Schmoeckel J, Mustafa Ali M, Splieth CH. Parental acceptance of advanced behaviour management techniques in paediatric dentistry in families with different cultural background. *Eur Arch Paediatr Dent* 2021;22:707-13.
- [12] Thirunavakarasu R, Sudhan M, Ramakrishnan M. Parental acceptance towards behavioural management techniques in pediatric dentistry. *J Res Med Dent Sci* 2021;9:308-13.

# **MALAYSIAN PARENTAL KNOWLEDGE, ACCEPTANCE AND PERCEPTION OF BEHAVIOUR MANAGEMENT FOR THEIR PRESCHOOL CHILDREN DENTAL TREATMENT.**

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## **ABSTRACT**

Optimum behaviour management by dentist during dental care are very essential to enhance the treatment adherence. This study is to evaluate parents' knowledge, acceptance and perceptions towards passive restraint, active restraint, parents' separation, voice-control, tell-show-do, conscious sedation, and general anaesthesia on their child during dental treatment as one of behaviour management techniques in dentistry. 32-item questionnaires constructed with seven set videos of selected behavior management techniques were developed and validated. Data were analysed using SPSS version 22. Fifty-five parents were recruited. The sample consists of parents with children aged 3 – 5 years old. 98% of the parents are married, and 2% are single. Most of the parents are degree holders. 42% of parents said they assist their children in tooth brushing and imply good oral home care practice. More than half of the parents are substantially aware of oral care, as 60% of parents bring their children to the dentist. Tell-Show-Do (TSD) is the most accepted technique by parents in dental treatment. The least accepted is General Anaesthesia. In conclusion, the parental knowledge and perception of suggested behaviour management techniques are above average. Proper explanation and clarification of the method will improve acceptance and lessen the parents' concern about their children's dental treatment.

**Keywords:** Tell-show-do, preschool children, dental treatment, behaviour.

## **INTRODUCTION**

The foundation for children to practise dentistry is built on the ability to guide them through their dental experience. Although some children are relaxed and cooperative in the dental treatment environment, some demonstrate disruptive behaviours that make treatment more difficult. According to Wright (1975), children can be generally classified in one of three ways: cooperative, lacking the cooperative ability or potentially cooperative (1). Dental treatment for children usually requires behavioural management techniques (BMTs). Behavioural dentistry is an interdisciplinary science that develops a dental practitioner's understanding of the interpersonal social force influencing a patient's behaviour. This ability is a prerequisite to providing their immediate dental needs. Treating the patient and not just the tooth should be operative with all patients but is essential with a child patient. The objectives of behaviour management are to reduce anxiety and fear in children, gain an understanding of the parental attitude and establish better dentist-parent communication, parent education and childcare (2). To accomplish the treatment, dentists use various techniques to manage, modify, and shape undesirable behaviours into more appropriate behaviours to achieve high-quality, comprehensive care. Managing uncooperative children is an integral part of pediatric dentistry, and the dentist must occasionally rely on other BMTs as alternatives or adjuncts to communicative management (2).

Basic behaviour guidance includes tell-show-do, voice control, direct observation, pre-visit imagination, distraction, and parents' separation. Meanwhile, advanced behaviour guidance includes protective stabilisation, sedation, and general anaesthesia (2). Conversely, The European Academy of Pediatric Dentistry divided BMTs into pharmacological and non-pharmacological behaviour management (2, 3). Behaviour management techniques cannot be evaluated individually for validity but must be assessed within the context of the child's total dental experience.

## MATERIAL AND METHOD

Through a convenient sample, this study was conducted in the Faculty of Dentistry and Faculty of Medicine Universiti Teknologi MARA and Hospital Sungai Buloh, Ministry of Health. The sample size was calculated using the Explanatory Factor Analysis (EFA). The inclusion criteria include parents who can read and understand the language of conduct, parents with preschooler age group children (3 – 5 years old), and their children who must be fit and healthy but show uncooperative or disruptive behaviour toward dental treatment. The exclusion criteria are parents with children with any kind of special needs condition. Ten (10) patients were recruited as pilot-study.

### *Vignettes development.*

Seven types of BMTs were chosen which are passive restraint, active restraint, parent separation, voice control, tell-show-do, conscious sedation, and general anaesthesia. Every vignette was prepared according to an actual situation in a dental office before dental treatment. Each vignette takes about 1.5 minutes to 2 minutes. The language is English with Bahasa Malaysia subtitles to maximise content comprehension.

### *Questionnaire construction.*

32-item questionnaires were constructed in four domains: demographic, knowledge, perception, and acceptance. The acceptance domains were assessed using these questions:

- i. Do you think this technique is effective?
- ii. Would you permit us to use the technique for your child?
- iii. Are you worried about your child's treatment?

A 100mm horizontal visual analogue scale (H-VAS) is used to assess the acceptance of each BMT. This straight line ranked from the left end as "totally disagree" and far right as "totally agree". Respondents are advised to place a vertical line anywhere on the horizontal scale that represents their acceptance of the BMTs using the formulated questions.

### *Data Analysis*

Analysis of data included tabulation of frequency distributions for sociodemographic information obtained. All the statistical analysis was done with the SPSS version 25 software program, and the **a priori level for acceptance of statistical significance was set at  $P \leq 0.05$ .** To compare the level of acceptability, the mean rating for each of the seven behaviour management techniques was determined using Pairwise Comparison. Descriptive statistics were calculated for all the demographics. The mean gender level of the subjects was compared using an independent T-test. The age, ethnicity, marital status, level of education, occupation and income were analysed using one-way ANOVA. The correlation between the 7 BMT with oral home care practices, children who had received treatment before and the awareness of oral care was analysed using Pearson Correlation. Bonferroni was used to compare the two domains.

## RESULTS AND DISCUSSION

Fifty-five of the respondents, eight young parents, 35 middle-aged parents, and 12 older age parents, were recruited. The data consist of 25 males and 30 females. Regarding oral health care awareness and knowledge, 43.6% of the respondents had received treatment in the dental clinic, while 9.1% had never had treatment. 21 parents lack oral home care practices, while only three have adequate ones. A one-way ANOVA test revealed a significant difference between BMT and age ( $p=0.001$ ). Further analysis using the post-hoc Bonferroni test suggested that all possible pairs of mean age were significantly different. We observed that those with middle-aged parents had higher mean compared to others. A significant linear correlation exists between a child who received treatment and active restraint with  $p=0.01$ . A significant linear correlation exists between a child who received treatment and TSD with  $p=0.022$  (Table 2). The vital difference in mean for each behavioural management technique acceptance was set at ( $p>0.05$ ). A pairwise comparison with confidence interval adjustment was performed.

A balanced number of respondents between sexes where the female has five respondents more compared to male. This may be due to mothers being more aware of their children's behaviour than fathers, as agreed in a paper by Grietens et al., 2003 (4). 43.6% of the total respondents know the need for their children to get dental treatment. Meanwhile, 9.1% of the respondents lack awareness of taking their child for dental treatment. Parents' knowledge highlighted the optimum time to brush their children's teeth, bringing children regularly for dental visits and children's dental pain experience and reasons. Kaur 2009 found that parents are more interested in children's diet, snacking, and brushing habits, with a subsequent complaint of children eating sugary snacks and inadequate oral hygiene practices (5).

General anaesthesia is the least accepted technique as it implies medication, and the need for hospital management is seen as intimidating by most of the respondents. This technique is also considered the last resort and unnecessary for dental treatment. Other authors have emphasised that general anaesthesia is the alternative management after another method has failed (6, 7, 8). Different studies by Oliver et al. proved that restraint techniques, including active and passive, follow general anaesthesia as the least accepted technique (8).

There was a statistically significant relationship between the age and the tell-show-do technique ( $p=0.001$ ). Middle-aged parents agree more about tell-show-do techniques to imply to their children. Adequate exposure to the method, sufficient explanation and demonstration, and practice of the procedure to the child are considered factors for acceptance of BMTs. Following the pairwise comparison, there were also statistically significant differences between the tell-show-do technique with parent's separation, passive restraint, active restraint, conscious sedation, and general anaesthesia. Most dentists in Malaysia use these two techniques at their best during dental treatment, making the parents believe and trust that these techniques suit their children.

#### TABLE, IMAGE, AND FIGURE

Table 1: Rating means for all BMT

Techniques	Mean
Tell-show-do	23.598
Voice control	21.564
Parents separation	20.304
Conscious sedation	20.146
Passive restraint	19.257
Active restraint	19.246
General anaesthesia	17.004

Variable	BMT	N	Acceptance Mean (SD)	P-value
Receiving Treatment	Active Restrain	55	19.25 (17.38 , 21.10)	0.01
	Tell-Show-Do	55	23.6 (22.44 , 24.7)	0.022

Table 2: The relationship between significant methods with a child that had received treatment.

BMT	N	Mean Difference	P-Value
Tell-show-do	Parents separation	55 4.341 (0.654, 8.028)	0.009
	Passive restraint	55 3.295 (0.065, 6.524)	0.041
	Conscious sedation	55 3.452 (0.216, 6.688)	0.027
	Active restraint	55 4.352 (1.213, 7.490)	0.001
	General Anaesthesia	55 6.595 (3.049, 10.140)	0.000
	Voice control	55 0.012 (0.0597, 8.525)	0.012

Table 3: Correlations between behavioural management techniques

## CONCLUSION

The least aggressive techniques are more acceptable, and parents reported a significant preference for them over the pharmacological technique and restraint. The most accepted method is tell-show-do, and the least accepted technique is general anaesthesia.

## REFERENCES

- [1]. Kiran S, Bhatt R, Patel M, Shah N. Pattern and Knowledge of Wright's Modification of Frankl's Behavior Rating Scale Followed among Postgraduate Students of Pediatric Dentistry in Ahmedabad City-A Survey. *Advances In Human Biology*. 2015 Apr 30;5(1):39-42.
- [2]. American Academy of Pediatric Dentistry Council on Clinical Affairs. Guideline on behavior guidance for the pediatric dental patient. *Pediatric dentistry*. 2008;30(7 Suppl):125.
- [3] Roberts JF, Curzon ME, Koch G, Martens LC. Review: behaviour management techniques paediatric dentistry. *Eur Arch Paediatr* Aug;11(4):166-74.
- [4]. Hellinckx W. Journal of Psychopathology and Behavioral Assessment; Comparison of Mothers', Fathers' and Teachers' Reports on Problem Behavior in 5 to 6-year-old Children. June 2004 Vol. 26, No. 2, (137-146)
- [5]. 27. Kaur B. Indian Journal of Dental Research; Evaluation of oral health awareness in parents of preschool children. 2009 20;4 (463-465)
- [6]. Wright GZ: Behavior Management in Dentistry for Children. Philadelphia; WB Saunders Co, 1975
- [7]. Chambers DW: Managing the anxieties in young dental patients. *J Dent Child* 27:363-74, 1970
- [8]. Oliver K., Manton D. J. *Journal of Dentistry for Children; Contemporary Behavior Management Techniques in Clinical Pediatric Dentistry: Out with the Old and in with the New?* March 27, 2014 82:1 (22-28).

## **FACULTY OF PHARMACY**

# ENHANCED ORAL DELIVERY OF GRISEOFULVIN: ROLE OF SOLUBILISING AGENTS AS PERMEATION ENHANCER

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## ABSTRACT

The Griseofulvin, a Class II drug under the Biopharmaceutics Classification System (BCS), is characterized by low solubility and high permeability, which often results in poor bioavailability. This study investigated the use of various solubilizing agents, including propylene glycol, Transcutol® P, Tween 80, 2-hydroxypropyl  $\beta$ -cyclodextrin (2HP- $\beta$ -CyD), polyethylene glycol (PEG) 400, Labrasol, and hydrogenated castor oil-60 (HCO), to enhance the solubility and pharmacokinetic profile of griseofulvin following oral administration in rats. Among the solubilisers tested, 10% (v/v) Transcutol® P significantly ( $p < 0.05$ ) improved oral absorption, increasing the bioavailability of griseofulvin by 1.8-fold compared to the griseofulvin solution. Other solubilizing agents, however, showed no significant effect on absorption. These findings underscore the potential of Transcutol® P as an effective enhancer for the oral delivery of poorly soluble drugs such as griseofulvin.

**Keywords:** Griseofulvin, pharmacokinetics, BCS Class II, Transcutol® P, solubilising agents.

## INTRODUCTION

Advancements in pharmaceutical chemistry, coupled with our ever-growing understanding of human physiology, have led to the development of novel and efficacious drug candidates. Nevertheless, many of these candidates exhibit poor aqueous solubility, which causes variability in drug absorption profiles and limits bioavailability (1). To address this issue, formulators often employ various strategies to enhance the solubility of these drug candidates, such as the use of solubilising agents or alternative formulation approaches.

Among these strategies, the use of solubilising agents represents a simple yet effective method to improve drug solubility, ultimately enhancing oral bioavailability. A wide range of solubilising agents is available for improving the solubility of poorly soluble drugs. These include (1) water-soluble complexation carriers such as cyclodextrins, (2) water-soluble organic (co)solvents (e.g., PEG 400, propylene glycol), and (3) surfactants (e.g., Tween 80, Labrasol, HCO-60, Transcutol® P). In this study, we utilised 10% (v/v or w/v) of a range of solubilising agents to improve the solubility and pharmacokinetic profile of griseofulvin following oral administration in rats.

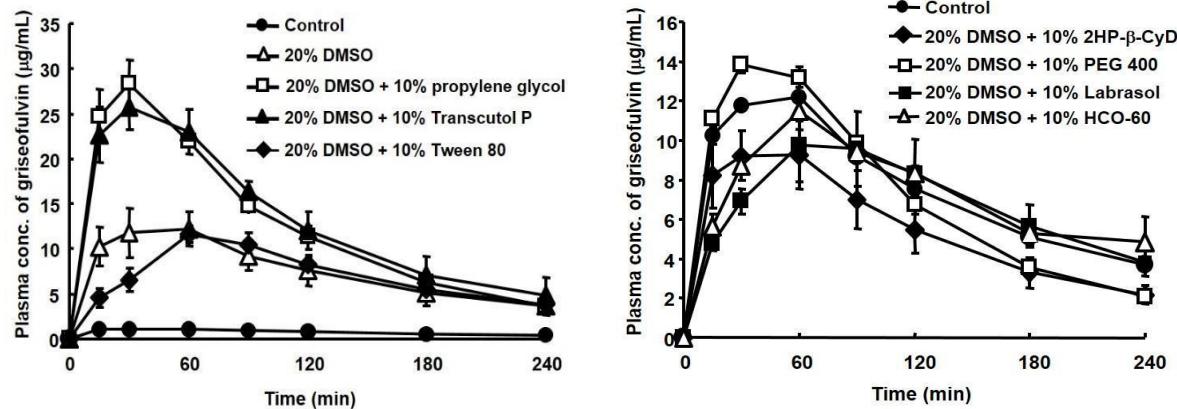
## MATERIALS AND METHODS

Griseofulvin suspension was prepared as the control group using Hepes-Tris buffer (pH 7.4). Other formulations included griseofulvin dissolved in 20% (v/v) DMSO (0.5 mg/mL) or griseofulvin (0.5 mg/mL) solubilised with 10% (w/v or v/v) solubilising agents, such as propylene glycol, Transcutol® P, Tween 80, 2-hydroxypropyl  $\beta$ -cyclodextrin (2HP- $\beta$ -CyD), polyethylene glycol (PEG) 400, Labrasol, or hydrogenated castor oil-60 (HCO).

For the pharmacokinetic study, rats were fasted overnight prior to the experiment. Griseofulvin solutions (6.25 mg/kg body weight), with or without 10% (v/v) solubilising agents, were administered orally via gavage (2,3). Blood samples were collected at predetermined intervals from the jugular vein into heparinised syringes over 240 minutes to measure drug concentrations using HPLC. The area under the curve (AUC) was calculated using the trapezoidal method from time zero to the final sampling point, characterising the pharmacokinetic profile. methodology that has been used in the work project must be clearly stated and described in sufficient detail or with sufficient references.

## RESULTS AND DISCUSSION

The effects of several solubilising agents on the intestinal absorption of griseofulvin are shown in Figure 1 and Table 1.



**Figure 1: Plasma concentration-time profiles of griseofulvin (6.25 mg/kg) in the presence and absence of 10% (v/v, w/v) solubilising agents after oral administration. The results are expressed as the mean  $\pm$  S.E. of at least 3 experiments.**

**Table 1: The effect of solubilising agents on the pharmacokinetic parameters of griseofulvin (6.25 mg/kg) after oral administration.**

	C <sub>max</sub> (µg/mL)	T <sub>max</sub> (min)	AUC <sub>0-240</sub> (µg/mL·min)	F (%)
Control	1.15 $\pm$ 0.1	25.0 $\pm$ 5.0	176.3 $\pm$ 9.3	1.3
20% (v/v) DMSO	14.1 $\pm$ 2.0	45.0 $\pm$ 6.7	1816.4 $\pm$ 349.8*	13.6
20% (v/v) DMSO + 10% (v/v) Propylene glycol	28.4 $\pm$ 2.6	30.0 $\pm$ 0.0	3105.5 $\pm$ 74.9** <sup>,N.S.</sup>	23.2
20% (v/v) DMSO + 10% (v/v) Transcutol® P	26.9 $\pm$ 2.2	25.0 $\pm$ 5.0	3203.0 $\pm$ 469.7** <sup>,#</sup>	24.0
20% (v/v) DMSO + 10% (v/v) Tween 80	11.8 $\pm$ 0.9	60.0 $\pm$ 12.0	1693.8 $\pm$ 182.6 <sup>,N.S.</sup>	12.7
20% (v/v) DMSO + 10% (w/v) 2HP-β-CyD	9.5 $\pm$ 1.5	50.0 $\pm$ 10.0	1326.5 $\pm$ 258.8 <sup>,N.S.</sup>	10.0
20% (v/v) DMSO + 10% (v/v) PEG 400	13.9 $\pm$ 0.4	40.0 $\pm$ 10.0	1747.8 $\pm$ 82.6 <sup>,N.S.</sup>	13.1
20% (v/v) DMSO + 10% (v/v) Labrasol	10.4 $\pm$ 2.1	70.0 $\pm$ 10.0	1634.3 $\pm$ 280.5 <sup>,N.S.</sup>	12.2
20% (v/v) DMSO + 10% (v/v) HCO-60	11.5 $\pm$ 0.9	60.0 $\pm$ 0.0	1744.0 $\pm$ 67.6 <sup>,N.S.</sup>	13.1

Results are expressed as the mean  $\pm$  S.E. of at least 3 experiments. \*P<0.05, \*\*P<0.01, compared with the control. #P<0.05 compared with 20% (v/v) DMSO, N.S. indicates no significant difference compared with 20% (v/v) DMSO.

As shown in Figure 1, the absorption of griseofulvin (6.25 mg/kg) in the control group was low throughout the experiment. However, intestinal absorption of griseofulvin was significantly enhanced by 10.5-fold when dissolved in 20% (v/v) DMSO (Table 1). DMSO is reported to be inert towards other chemicals, easily penetrates cell membranes without causing irreversible damage, and has been widely used due to its large solubilisation capacity and low toxicity (4). Moreover, our study demonstrated that 10% (v/v) Transcutol® P further enhanced the intestinal absorption of griseofulvin, as shown by the AUC value of 3203.0  $\pm$  469.7, compared to the griseofulvin solution, which had an AUC of 1816.4  $\pm$  349.8. Additionally, the presence of 10% (v/v) propylene glycol in the formulation appeared to increase the pharmacokinetic profile of griseofulvin, albeit insignificantly. In contrast, the other solubilising agents did not significantly affect the intestinal absorption of griseofulvin compared to the griseofulvin

solution in 20% (v/v) DMSO. It is worth noting that, in our preliminary studies, all these solubilising agents at the concentrations used did not cause any membrane damage to the intestinal epithelium (5).

## CONCLUSION

Transcutol® P at a concentration of 10% (v/v) significantly ( $p<0.05$ ) enhanced the pharmacokinetic profile of griseofulvin following oral administration in rats. Therefore, the addition of Transcutol® P has been shown to act as an effective enhancer in the oral delivery of griseofulvin. In contrast, other solubilising agents did not significantly affect the absorption profile of griseofulvin.

## REFERENCES

- [1]. Fink C, Sun D, Wagner K, Schneider M, Bauer H, Dolgos H, et al. Evaluating the role of solubility in oral absorption of poorly water-soluble drugs using physiologically-based pharmacokinetic modeling. *Clin Pharmacol Ther* [Internet]. 2020;107(3):650–61. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7158207/>
- [2]. Anuar N, Sabri AH, Bustami Effendi TJ, Hamid KA. Development and characterisation of ibuprofen-loaded nanoemulsion with enhanced oral bioavailability. *Helijon* [Internet]. 2020;6(April):e04570. Available from: <https://doi.org/10.1016/j.heliyon.2020.e04570>
- [3]. Jaafar MHM, Hamid KA. Chitosan-coated Alginate nanoparticles enhanced absorption profile of Insulin via oral administration. *Curr Drug Deliv*. 2019;16(7):672–86.
- [4]. Capriotti K, Capriotti JA. Dimethyl sulfoxide: History, chemistry, and clinical utility in dermatology. *J Clin Aesthet Dermatol* [Internet]. 2012;5(9):24–6. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3460663/>
- [5]. Hamid KA, Katsumi H, Sakane T, Yamamoto A. The effects of common solubilizing agents on the intestinal membrane barrier functions and membrane toxicity in rats. *Int J Pharm*. 2009;379(1–2):100–8

# CLOTRIMAZOLE FILM-FORMING GEL FOR TOPICAL TREATMENT OF DERMATOPHYTOSIS: A POTENTIAL APPROACH FOR IMPROVED PERMEATION AND PROLONG SKIN DEPOSITION

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## ABSTRACT

Cutaneous fungal infections pose a pressing global health concern, necessitating innovative approaches to improve the efficacy of current topical antifungal preparations. Current formulations often contribute to instances of drug resistance and treatment failure, primarily due to issues such as poor persistent contact at the treatment site, easy removal after application, and insufficient drug permeability across the stratum corneum (SC). This study focuses on the formulation and evaluation of a groundbreaking clotrimazole film-forming gel (Clotrimazole-FFG) designed to address these challenges and improve drug permeation and deposition. The clotrimazole-FFG were formulated using methacrylate copolymers, polyethylene glycol 400, and ethanol as diluent. The optimised formulation was subjected to test of drug permeation across the stratum corneum and drug deposition study. *Ex vivo* skin permeation and deposition studies revealed that clotrimazole-FFG exhibited threefold increase in skin permeation and higher clotrimazole deposition in the stratum corneum ( $312.22 \pm 37.91 \mu\text{g}/\text{cm}^2$ ) and epidermis layer ( $164.18 \pm 13.47 \mu\text{g}/\text{cm}^2$ ) compared to a proprietary drug ( $182.33 \pm 35.61 \mu\text{g}/\text{cm}^2$  and  $65.73 \pm 42.19 \mu\text{g}/\text{cm}^2$ , respectively). This enhanced performance can be attributed to the occlusion effect, resulting in superior drug permeation across the SC and retention at the viable epidermis. Clotrimazole-FFG emerges as a valuable addition to the armamentarium of antifungal treatments, offering improved efficacy and addressing critical issues associated with existing formulations.

**Keywords:** Dermatophytosis, film-forming gel (FFG), clotrimazole, antifungal drug, topical application.

## INTRODUCTION

Dermatophytosis, affecting over 20% of the global population (Nussipov et al. 2017), is a prevalent skin infection, particularly rampant in tropical regions (Jain and Sharma 2017; Mustaffa et al. 2023; Ramamuthie et al. 2015). Although not life threatening, it contributes significantly to the worldwide burden of years lived with disability (YLDs), surpassing conditions like diabetes mellitus and migraines (Karimkhani et al. 2017). This mycotic infection poses a substantial risk, particularly to immunocompromised individuals, those with chronic illnesses, and the elderly (Moubasher, Abdel-Sater, and Soliman 2017).

In the realm of cutaneous infections, topical drugs remain the primary treatment modality (Na et al. 2020). Local effects attained in a topical drug delivery system are superior over oral treatment. The effectiveness of topical antimicrobial therapy hinges on a drug's ability to penetrate the stratum corneum (SC) and follicular keratin while maintaining sustained presence at the infection site (Rapalli et al. 2020). The skin, namely the stratum corneum (SC), poses a significant barrier to the penetration of drugs (Na et al. 2020; Zhu et al. 2020). Recent studies highlight that, despite displaying excellent *in vitro* activity, antifungals often demonstrate a limited ability to penetrate the SC in skin models (Zhu et al. 2020). A compromised ability to retain drugs at the infection site can lead to diminished efficacy and the emergence of drug resistance (Khurana, Sardana, and Chowdhary 2019; Moubasher, Abdel-Sater, and Soliman 2017). Evidence of resistance to common dermatophytosis treatments, including terbinafine, fluconazole, and griseofulvin, (Ayukekpong, Ntemgwa, and Atabe 2017; Hay 2018; Rather et al. 2017) underscores the consequences of factors such as non-adherence to prescribed regimens, repetitive use of antifungal drugs, reabsorption or washout of drugs from the skin, and failure to reach the SC (Hay 2018; Rather et al. 2017). Higher rates of treatment failures (40–60%) and relapse incidents

(22.2% after 3 years) prompt inquiries into the effectiveness of current antimicrobial preparations, with potential implications for morbidity and mortality (Jimenez-Garcia et al. 2020). Existing topical anti-infective formulations, available as ointments, creams, gels, lotions, and shampoos, exhibit specific limitations, including inadequate and persistent contact with the treatment site, suboptimal drug permeability, and compromised patient compliance due to their messy, sticky nature, unattractive appearance, and interference with daily activities (Monica, Jordi, and Francisco 2020).

Addressing these challenges, film-forming dermal and transdermal drug delivery systems have gained attention (Mustaffa et al. 2021; Yang et al. 2020). Film-forming gels, in particular, present a unique attribute of transitioning from a non-solid solution during storage to a film in-situ upon application. This transition induces drug supersaturation and enhances skin hydration, resulting in improved drug flux across the SC. However, existing film-forming systems have their drawbacks, including prolonged film formation time and sub-optimal bioavailability (Liu et al. 2014; Thapa et al. 2017; Tokuda et al. 2018). Therefore, there is a pressing need to develop formulations that consider both consumer preferences and formulation characteristics.

This study aims to overcome the limitations of conventional topical formulations by developing a film-forming clotrimazole gel for the treatment of dermatophytosis. We hypothesise that the proposed formulation will yield a thin, transparent, non-sticky, and flexible film with a rapid drying time of less than 1 minute. We anticipate that this formulation will exhibit superior drug permeation across the SC, offering a promising avenue for enhancing the efficacy of topical treatments for cutaneous fungal infections.

## MATERIAL AND METHOD

### Materials

The film-forming gels were prepared using methacrylate copolymer (Evonik Röhm GmbH, Darmstadt, Germany) of Eudragit L100; hydroxypropyl methylcellulose (HPMC, Merck Milipore, USA); polyethylene glycol 400 (PEG400, Merck Milipore, USA), ethanol (Thermo Fischer Scientific, USA) and clotrimazole (USP convention, USA). Deionised water was obtained using a Milli-Q system from Millipore. The proprietary drug Canesten® (1% clotrimazole cream, Bayer, Germany) was used for positive control. Acetonitrile and tetrahydrofuran HPLC grade (Thermo Fischer Scientific, USA) were used for HPLC assays. *Trichophyton rubrum* (ATCC-10218), sabouraud dextrose agar (SDA, Life Technologies, USA), RPMI 1640 with glutamine (Life Technologies, USA), and cocktails of ketamine, xylazine, tiletamine and zolazepam (Virbac, France) were used for an *in-vivo* animal study.

### Formulation

The clotrimazole-FFG was formulated according to Mustaffa et al., 2021 but with slight modifications. The best formulation that attributes i.e., low viscosity, fast drying (less than 1 min), forms a non-sticky, transparent, and detachable was subjected to tests of *in-vitro* drug permeation and drug retention analysis. The formulation was stored in an amber bottle at room temperature until further use.

### Animals

The present study was approved by the Committee on Animal Research and Ethics (CARE) of UiTM (UiTM Care: No 367/2022). Male Sprague Dawley (SD) rats (n=12) weighing 150–300 g was obtained from LAFAM, Faculty of Pharmacy, UiTM. All the animals were housed in individually ventilated cages (IVC, Modular Animal Caging Systems, Alternative Design, Manufacturing & Supply, Inc., Siloam Springs, Arkansas, USA) at 10% negative pressure with respect to a room that had a natural light-dark cycle (12 h each). Corn cobs (Bed-O' Corbs ¼) were used as bedding material and changed weekly or as and when required. All rats had access to food (Gold Coin Feed Mills, Penang, Malaysia) and water *ad libitum*.

### Drug permeation and drug deposition analysis

Permeation analysis utilised 12 pieces of hairless abdominal skin of SD rats (Anwar, Ramadon, and Ardi 2018). The animals were sacrificed by overdose inhalation of diethyl ether. Subsequently, the dorsal hair was removed using a 0.1 mm animal hair clipper, moving from tail to head. The skin's dermal portion was meticulously wiped with a wet cotton swab soaked in isopropanol (3 to 4 times) to eliminate any adhering fat, and a thorough examination ensured the absence of surface irregularities such as

fissures or small holes. The prepared skin samples were affixed to the receptor chamber of the Franz Diffusion Cell (PermeGear, USA), exposing a cross-sectional area of  $3.14\text{ cm}^2$  (2 cm in diameter) to the test compound. The receptor phase consisted of PBS (pH 5.5, 5 ml), with the temperature maintained at  $32 \pm 0.5\text{ }^\circ\text{C}$  through a circulating water jacket, and agitation facilitated by a magnetic stir bar. Receptor fluid was withdrawn at 6 time points (1 h, 2 h, 4 h, 6 h, 12 h, and 24 h), immediately replaced with an equal volume of fresh diluents. All samples underwent filtration using a  $0.45\text{ }\mu\text{m}$  nylon filter and subsequent analysis by HPLC. The assay was conducted in triplicates at three distinct sites on the skin samples.

At the end of the experiment, the skin was wiped twice with cotton gauze to remove residual formulation. The tape disks were applied and removed with pincers, underwent 13 repetitions with gentle pressure to ensure optimal skin contact. To prevent potential contamination by drug residue, the initial tape-strip was discarded, and subsequent tapes were grouped into threes, subjected to overnight shaking with 5.0 ml of PBS, and the mixture was filtered and quantified using RP-HPLC. Drug permeation and retention were determined using the Area Under Curve (AUC) method, compared with calibration plots generated with pure compounds. The drug permeation profile of clotrimazole in each formulation was established over 24 h, plotting the cumulative amount of drug permeated against time.

#### Statistical analysis

The results were presented as mean  $\pm$  standard deviation of the mean (S.D.). Analysis of variance (ANOVA) test with Duncan's post-hoc test was used to analyse and compare between the group data, with  $p < 0.05$  as the limit of significance.

## RESULTS AND DISCUSSION

Overcoming the formidable permeation barrier of the stratum corneum (SC), which constrains drug transport, represents a critical challenge in cutaneous drug delivery. The primary objective in evaluating the efficacy of topical antifungal medications is achieving drug penetration across the SC into the viable epidermis at concentrations conducive to therapeutic effects. In this study, the clotrimazole-FFG demonstrated a significant ( $p < 0.001$ ) 3-fold increase in drug permeation across the SC at 24 h ( $1279.22 \pm 82.77\text{ }\mu\text{g/cm}^2$ , Figure 1A) compared to the proprietary drug, Canesten® ( $475.8 \pm 36.27\text{ }\mu\text{g/cm}^2$ ). Furthermore, clotrimazole-FFG exhibited significant ( $p < 0.001$ ) 1.7-fold and 2.5-fold higher clotrimazole deposition in the stratum corneum ( $312.22 \pm 37.91\text{ }\mu\text{g/cm}^2$ , Figure 1B) and epidermidis layer ( $164.18 \pm 13.47\text{ }\mu\text{g/cm}^2$ ) of the skin than Canesten® ( $182.33 \pm 35.61\text{ }\mu\text{g/cm}^2$  and  $65.73 \pm 42.19\text{ }\mu\text{g/cm}^2$ , respectively).

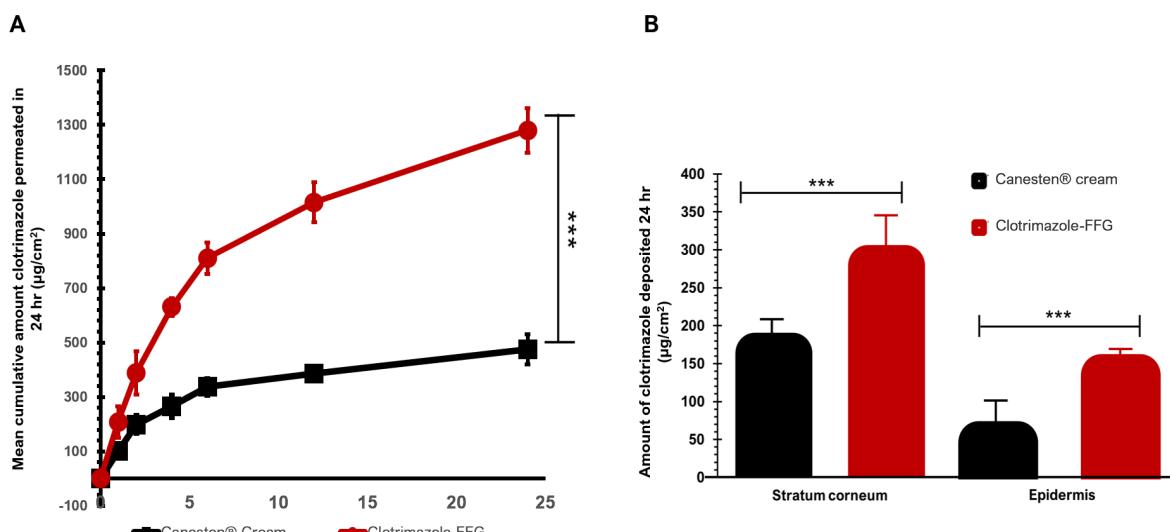


Figure 1: Dermato-pharmacokinetic profile of clotrimazole. (A)

*Ex vivo* skin permeation profiles of Carnesten® cream, and clotrimazole- FFG. Values are represented as mean $\pm$ SD ( $n=3$ ). \*\*\* $p < 0.001$  vs Carnesten® cream. (B) *Ex vivo* skin deposition of

Carnesten® cream, and clotrimazole- FFG. Values are represented as mean $\pm$ SD (n=3). \*\*\*p < 0.001 vs Carnesten® cream.

Eudragit L100 in the formulation exhibits ionic interactions and hydrogen bonding with PEG400, playing a crucial role in stabilizing the amorphous state of drugs to prevent crystallization. The amorphous state, being thermodynamically metastable compared to the crystalline state, enhances drug release and permeation (Banerjee et al. 2014; Morales et al. 2014). In our study, the use of 70% (v/v) ethanol, evaporating rapidly within 1 minute, differs from previous studies with less volatile solvents prone to re-crystallization (Reid et al. 2013). Studies by Anwar *et al.* and Ahad *et al.* highlighted that ethanol significantly improves drug flux across the stratum corneum (SC) compared to other solvents (Ahad et al. 2015; Anwar, Ramadon, and Ardi 2018). The transient supersaturation of the drug before application, associated with high thermodynamic activity, promotes cutaneous drug delivery by increasing flux and deposition at the stratum corneum and epidermis layer. Ethanol also serves as a penetration enhancer by disrupting the intercellular lipid packing, facilitating drug diffusivity across the SC (Thapa et al. 2017). Given ethanol's impact on SC solvency and barrier properties, it is expected to contribute to the deposition of clotrimazole (Reid et al. 2013). The combined effects of ethanol and PEG400 enhance clotrimazole solubility in the formulation, resulting in a higher drug deposition at the upper skin layer (Anwar, Ramadon, and Ardi 2018). The film-forming gel's efficacy in delivering and retaining clotrimazole at target sites suggests the potential for sustaining therapeutic concentrations over an extended period. These findings underscore the superior drug permeation and deposition capabilities of clotrimazole-FFG, indicating its potential as an effective topical antifungal formulation.

## CONCLUSION

Clotrimazole-FFG presents an impressive achievement, demonstrating a threefold increase in drug permeation across the SC and over a 1.5-fold enhancement in drug retention at the targeted skin layers compared to the proprietary drug Canesten®. These findings showed that this novel formulation demonstrates significant advancements in overcoming the challenges associated with cutaneous antifungal drug delivery. Building upon these promising results, future investigations should delve into the long-term efficacy, safety, and patient acceptance of Clotrimazole-FFG. These endeavors will contribute to establishing Clotrimazole-FFG as a robust and patient-friendly solution for cutaneous antifungal therapy.

## REFERENCES

Ahad, Abdul et al. 2015. "Systemic Delivery of  $\beta$ -Blockers via Transdermal Route for Hypertension." *Saudi Pharmaceutical Journal* 23(6): 587–602.

Anwar, Effionora, Delly Ramadon, and Ghina Ardi. 2018. "Novel Transethosome Containing Green Tea (*Camellia Sinensis* L. Kuntze) Leaf Extract for Enhanced Skin Delivery of Epigallocatechin Gallate: Formulation and in Vitro Penetration Test." *International Journal of Applied Pharmaceutics* 10: 299.

Ayukekpong, James A, Michel Ntemgwa, and Andrew N Atabe. 2017. "The Threat of Antimicrobial Resistance in Developing Countries: Causes and Control Strategies." *Antimicrobial Resistance & Infection Control* 6(1): 47.

Banerjee, Subham et al. 2014. "Aspect of Adhesives in Transdermal Drug Delivery Systems." *International Journal of Adhesion and Adhesives* 50: 70–84.

Hay, Roderick. 2018. "Therapy of Skin, Hair and Nail Fungal Infections." *Journal of fungi (Basel, Switzerland)* 4(3).

Jain, Neetu, and Meenakshi Sharma. 2017. "Screening of *Thymus Vulgaris* Essential Oil against Fungi Causing Dermatophytosis in Human Beings." *International Journal of Pharmacy and Pharmaceutical Sciences* 9: 236.

Jimenez-Garcia, Lesly et al. 2020. "Efficacy of Topical Clotrimazole vs. Topical Tolnaftate in the Treatment of Otomycosis. A Randomized Controlled Clinical Trial." *Brazilian journal of otorhinolaryngology* 86(3): 300–307.

Karimkhani, Chante et al. 2017. "Global Skin Disease Morbidity and Mortality: An Update From the Global Burden of Disease Study 2013." *JAMA dermatology* 153(5): 406–12.

Khurana, Ananta, Kabir Sardana, and Anuradha Chowdhary. 2019. "Antifungal Resistance in Dermatophytes: Recent Trends and Therapeutic Implications." *Fungal Genetics and Biology* 132: 103255.

Liu, Ximing et al. 2014. "Design of Transparent Film-Forming Hydrogels of Tolterodine and Their Effects on Stratum Corneum." *International Journal of Pharmaceutics* 471(1): 322–31.

Monica, Labella-Lorite, Gonzalez Jordi, and Fernandez-Campos Francisco. 2020. "In Situ Bioadhesive Film-Forming System for Topical Delivery of Mometasone Furoate: Characterization and Biopharmaceutical Properties." *Journal of Drug Delivery Science and Technology* 59: 101852.

Morales, Javier O., Siyuan Huang, Robert O. Williams, and Jason T. McConville. 2014. "Films Loaded with Insulin-Coated Nanoparticles (ICNP) as Potential Platforms for Peptide Buccal Delivery." *Colloids and Surfaces B: Biointerfaces* 122: 38–45.

Moubasher, A H, M A Abdel-Sater, and Z Soliman. 2017. "Incidence and Biodiversity of Yeasts, Dermatophytes and Non-Dermatophytes in Superficial Skin Infections in Assiut, Egypt." *Journal de Mycologie Médicale* 27(2): 166–79.

Mustaffa, M F et al. 2021. "In-Situ Film-Forming Solution for Topical Application of Terbinafine Hcl: Biopharmaceutical Evaluation and in Vivo Antifungal Performance Using Animal Model." *International Journal of Applied Pharmaceutics* 13(6): 98–105. <https://doi.org/10.22159/ijap.2021v13i6.42589>.

Mustaffa, M F, W.A.N.A. Raman, N Husain, and H A Hamid. 2023. "Hydrogen Sulphide Ameliorates the Toxic Effect of Clotrimazole Against Trichophyton Rubrum." *Malaysian Journal of Medicine and Health Sciences* 19: 59–64. <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85180588707&doi=10.47836%2Fmjmhs.19.5.10&partnerID=40&md5=281aaf14fd4896e06c01f5c44b213252>.

Na, Young-Guk et al. 2020. "Development and Evaluation of a Film-Forming System Hybridized with Econazole-Loaded Nanostructured Lipid Carriers for Enhanced Antifungal Activity against Dermatophytes." *Acta Biomaterialia* 101: 507–18.

Nussipov, Yerlan et al. 2017. "Clinical and Epidemiological Features of Dermatophyte Infections in Almaty, Kazakhstan." *Open access Macedonian journal of medical sciences* 5(4): 409–13.

Ramamuthie, Ghaneshwari, Rohit Verma, Jamuna Rani, and Ankur Barua. 2015. "Awareness of Risk Factors for Skin Infections and Its Impact on Quality of Life among Adults in a Malaysian City: A Cross-Sectional Study." *Tropical Journal of Pharmaceutical Research* 14: 1319–26.

Rapalli, Vamshi Krishna et al. 2020. "Insights of Lyotropic Liquid Crystals in Topical Drug Delivery for Targeting Various Skin Disorders." *Journal of Molecular Liquids* 315: 113771. <https://www.sciencedirect.com/science/article/pii/S0167732220322546>.

Rather, Irfan A, Byung-Chun Kim, Vivek K Bajpai, and Yong-Ha Park. 2017. "Self-Medication and Antibiotic Resistance: Crisis, Current Challenges, and Prevention." *Saudi Journal of Biological Sciences* 24(4): 808—812.

Reid, Monica L et al. 2013. "Topical Corticosteroid Delivery into Human Skin Using Hydrofluoroalkane Metered Dose Aerosol Sprays." *International Journal of Pharmaceutics* 452(1): 157–65.

Thapa, Raj Kumar et al. 2017. "Therapeutic Effects of a Novel DA5505 Formulation on a Guinea Pig Model of Tinea Pedis." *Dermatologica Sinica* 35(2): 59–65.

Tokuda, Takahiro et al. 2018. "Use of the Wound, Ischemia, Foot Infection Classification System in Hemodialysis Patients after Endovascular Treatment for Critical Limb Ischemia." *Journal of Vascular Surgery* 67(6): 1762–68. <https://www.sciencedirect.com/science/article/pii/S074152141732493X>.

Yang, Fengdie et al. 2020. "Co-Delivery of Terbinafine Hydrochloride and Urea with an in Situ Film-Forming System for Nail Targeting Treatment." *International Journal of Pharmaceutics* 585: 119497.

Zhu, Jieyu et al. 2020. "Applications and Delivery Mechanisms of Hyaluronic Acid Used for Topical/Transdermal Delivery – A Review." *International Journal of Pharmaceutics* 578: 119127.

# **PERSICARIA MINOR (BIOKESUM®) AMELIORATES COGNITIVE DYSFUNCTION IN CHRONIC CEREBRAL HYPOPERFUSION-INDUCED RATS**

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## **ABSTRACT**

Vascular dementia (VaD) is the second most common cause of dementia, succeeding over Alzheimer's disease (AD) in the elderly, and is expected to double every 10-15 years. Chronic cerebral hypoperfusion (CCH) resulting from diverse cerebral vascular pathologies is a major cause of VaD. However, effective therapeutic approaches to cure VaD are still missing. The latest trends are seeing a shift in consumer preference to natural therapy for health and wellness with a high degree of convenience. *Persicaria minor*, commonly referred to as 'Kesum' in Malaysia is known for its potent antioxidant, anti-inflammation, anti-acetylcholinesterase, and cognitive-enhancing effects, which are beneficial in preventing aging and oxidative stress-related disease. However, the behavioral effect of *P. minor* in enhancing cognitive functions, especially following ischemic conditions, remains unknown. The present study evaluates the neuroprotective effects of a standardised aqueous extract of *P. minor* (Biokesum®) in CCH-induced rats. A permanent bilateral occlusion of common carotid artery (PBOCCA) surgery was performed to develop the CCH model in rats. The effects of *P. minor* (100, 200, and 300 mg/kg; orally) on motor and cognitive functions were evaluated using a series of behavioral tests. The behavioral assessment results have demonstrated that *P. minor* improves both short- and long-term recognition and spatial memories without affecting the motor functions of the PBOCCA rats. The present findings suggest the potential of *P. minor* in enhancing cognitive deterioration in CCH-induced rats.

**Keywords:** Vascular dementia, PBOCCA. Chronic cerebral hypoperfusion, cognition, *Persicaria minor*

## **INTRODUCTION**

Vascular dementia (VaD), which is characterized by a progressive decline in cognition and behavior, is the second most common cause of dementia in the elderly, succeeding over Alzheimer's disease (AD) [1]. Chronic cerebral hypoperfusion (CCH) resulting from diverse cerebral vascular pathologies is a critical mechanism in developing vascular cognitive impairment and dementia. Advanced age and cardiovascular risk factors such as obesity, diabetes, hypercholesterolemia, arteriosclerosis, and smoking may affect the cerebral vascular system, resulting in moderate hypoperfusion and ischemic brain injuries, which lead to a progressive decline in cognitive and memory functions [2]. Although existing therapeutic agents such as memantine, galantamine, donepezil, and rivastigmine have achieved significant therapeutic advances in dementia, they are limited in the clinical application's safety and effectiveness. In searching for protective ways of CCH-induced cognitive dysfunction, much attention has been focused on the potential of natural antioxidants to attenuate neuronal injury, thus preventing vascular cognitive impairment and dementia.

*Persicaria minor* (*P. minor*) which is commonly known as 'kesum' in Malaysia, is an aromatic plant that belongs to the family Polygonaceae. It is extensively used as a spice and flavoring ingredient in culinary dishes or even consumed as a salad. *P. minor* has attracted particular attention as a nutraceutical because of its widespread health benefits. Traditionally, *P. minor* leaf decoctions are used to treat indigestion as a postnatal tonic and are applied to the scalp to treat dandruff [3]. Scientific reports have shown numerous biological activities of *P. minor*, including antioxidant, antimicrobial, anti-fungal, anti-inflammatory, anti-hyperlipidemia, antiproliferative, gastric cytoprotective activity, anti-hyperuricemic and neuroprotective effects, which were attributed to the presence of various phytoconstituents such as flavonoids, flavones, catechin, epicatechin gallate and terpenoids [4,5,6,7]. It

has also been reported to be rich in vitamins such as carotenes, retinol equivalents and vitamin C,  $\alpha$ -tocopherol, and minerals such as calcium, phosphorus, iron, sodium, potassium, magnesium, copper and zinc, which are all major contributors to human nutrition [8]. Meanwhile, *P. minor* extract has shown superior antioxidant activity compared to other popular herbs such as 'pegaga', 'ulam raja', and curry leaves [3]. *P. minor* has also been reported to inhibit acetylcholinesterase, which is an enzyme that metabolizes acetylcholine, a neurotransmitter related to learning and memory in the brain [6]. The potent antioxidant and anti-acetylcholinesterase properties of *P. minor* may be attributed to its potential to prevent aging and other oxidative stress-related diseases [7]. To date, several studies have reported the ability of *P. minor* extract to improve learning and memory in scopolamine-induced cognitive impairment in rodents [9]. However, these studies are insufficient to provide evidence-based use of the plant as a potential therapeutic agent for treating VaD.

Therefore, the present study was designed to explore the neuroprotective effects of chronic 14-day administration of aqueous *P. minor* extract on improving cognitive deficits in rats induced by CCH. In this study, a widely accepted model of CCH induced by permanent bilateral occlusion of common carotid arteries (PBOCCA) in rats was used. PBOCCA is a classic and frequently used approach to imitate CCH in rats.

## MATERIAL AND METHOD

### *Animals*

Seven-week-old male Sprague Dawley (SD) rats (200–250 g) were obtained from the Laboratory Animal Facility and Management (LAFAM), Faculty of Pharmacy, UiTM Puncak Alam, Malaysia. They were housed in five rats per cage and kept in the animal transit room for a week for acclimatization before the animals were subjected to surgery. The animal room was maintained at a constant temperature ( $\pm 24$  °C) with a 12-hour of light-dark cycle (light on at 7 am). Food and water were given ad libitum. All experimental procedures in this study have been reviewed and approved by the Animal Ethics Committee, Universiti Teknologi MARA (Ref. No.: UiTM CARE 3/2021/(340/2021).

### *Induction of CCH*

CCH was induced in rats by permanent bilateral occlusion of the common carotid arteries (PBOCCA), as described previously [10]. Briefly, rats were anaesthetised with an intraperitoneal (i.p) injection of ketamine hydrochloride (70 mg/kg) and xylazine hydrochloride (20 mg/kg). Forty rats were randomly chosen for PBOCCA surgery. The common carotid arteries were exposed through a small ventral midline incision, isolated from the surrounding carotid sheath and the vagus nerves, and permanently doubly ligated with 6/0 surgical silk suture. The skin incision was closed, and the rats were kept in an air-conditioned room at 25 °C. The sham-operated rats ( $n = 8$ ) were subjected to the same surgical procedure, except that the common carotid arteries were not occluded.

### *Plant materials*

The standardized aqueous extract of *P. minor* (BioKesum®) leaves powder was obtained from Biotropics Malaysia Berhad (Batch No. KE200302). The extract contains bioactive compounds, which include quercetin-3-glucuronide (more than 0.45%), quercitrin (more than 0.15%), and total phenolic content (more than 100 mg GAE/gdE). A certificate of analysis was provided by Phytex Biotech Sdn. Bhd.

### *Treatment conditions*

The rats were randomly divided into five treatment groups two weeks after surgery. Group 1: Sham rats received vehicle (distilled water) ( $n = 8$ ), Group 2: PBOCCA rats received vehicle ( $n = 8$ ), and Group 3, 4, 5 treated with *P. minor* extracts at doses 100, 200, or 300 mg/kg, respectively. The extracts and distilled water were administered to the rats via oral gavage.

### *Behavioral assessments*

After 14 days of treatment, behavioral tests, including the open-field test, novel object recognition task, and Morris's water maze task were conducted to assess the animals' motor, learning, and memory functions. The motor function and exploratory behaviors of animals were measured using the open field test (OFT). The novel object recognition (NOR) test was conducted to assess short-term

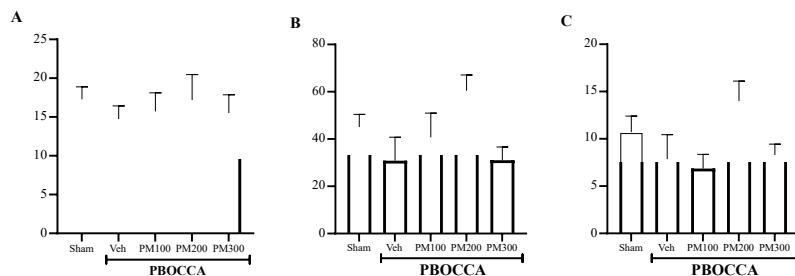
and long-term recognition memory. The Morris water maze (MWM) task was used to evaluate the spatial learning and reference memory of the rats as previously described [10].

## RESULTS AND DISCUSSION

### *P. minor* does not affect locomotor activities and anxiety-like behavior in PBOCCA rats

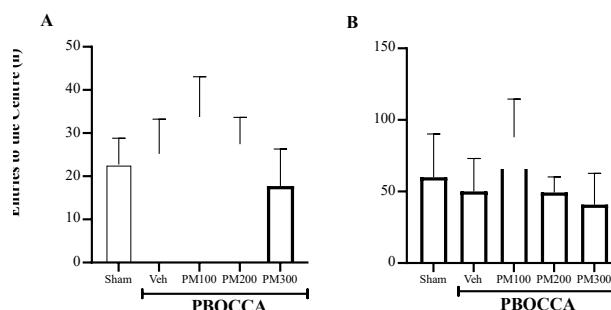
The effects of *P. minor* on motor activity and exploratory behavior were measured using the open-field test. The treatments have no significant impact on the spontaneous locomotor and exploratory activities of the PBOCCA rats (Figure 1).

Expression of anxiety-related behavior in the open field test is related to the anxiety of open space and was indexed by the animal's reluctance to venture into the central zone. A greater time spent, as well as a higher number of entries into the central zone, indicate a decrease in state anxiety. However, there was no significant difference in the number of entries and time spent in the central zone among all groups (Figure 2).



**Figure 1: Effect of *P. minor* extract on (A) total distance traveled, (B) rearing activities, and (C) grooming activities of the PBOCCA rats in the open-field test. Statistical analysis using one-way ANOVA did not reveal significant group differences in the spontaneous locomotor and exploratory activity. Data are expressed as the mean $\pm$ SEM (n=6-7).**

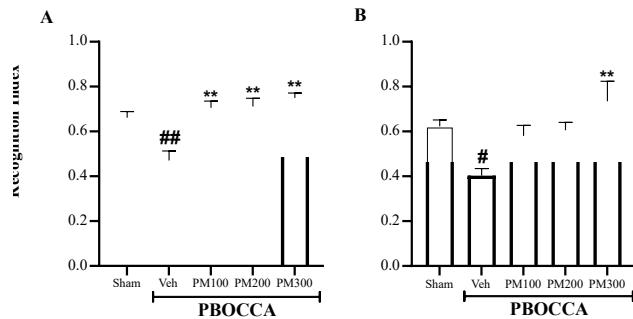
ANOVA did not reveal significant group differences in the spontaneous locomotor and exploratory activity. Data are expressed as the mean $\pm$ SEM (n=6-7).



**Figure 2: Effect of *P. minor* extract on anxiety-like behavior. (A) no. of entries to the center and (B) duration at the center. There is no significant difference among the groups analysed by one-way ANOVA. Data are expressed as the mean $\pm$ SEM (n=6-7/group).**

### *P. minor* improves recognition memory deficits in PBOCCA rats

Figure 3 shows the effect of *P. minor* on short- and long-term recognition memories in the PBOCCA rats, presented by the recognition index (RI). PBOCCA rats exhibited a significantly lower RI value than sham-operated rats during both the short- ( $p=0.0026$ ) and long-term ( $p=0.0401$ ) test phases, respectively (Fig. 3A). Sham-operated rats with intact short- and long-term recognition memory spend more time exploring a novel object than a familiar object. PBOCCA rats did not recognise previously explored objects and spent almost equal time exploring familiar and novel objects during the short and long test phases. This indicates that CCH induces impairment of both short- and long-term recognition memory in rats. During the short-term phase, PBOCCA rats treated with *P. minor* (100, 200, and 300 mg/kg) exhibited significant ( $p < 0.01$ ) higher RI values as compared to PBOCCA rats treated with a vehicle, which indicates the treatment with *P. minor* (100, 200, and 300 mg/kg) improve short-term recognition memory in PBOCCA rats. Meanwhile, during the long-term test phase, only the PBOCCA rats treated with 300 mg/kg of *P. minor* showed significant ( $p < 0.01$ ) higher RI than PBOCCA rats treated with vehicle (Fig. 3B).

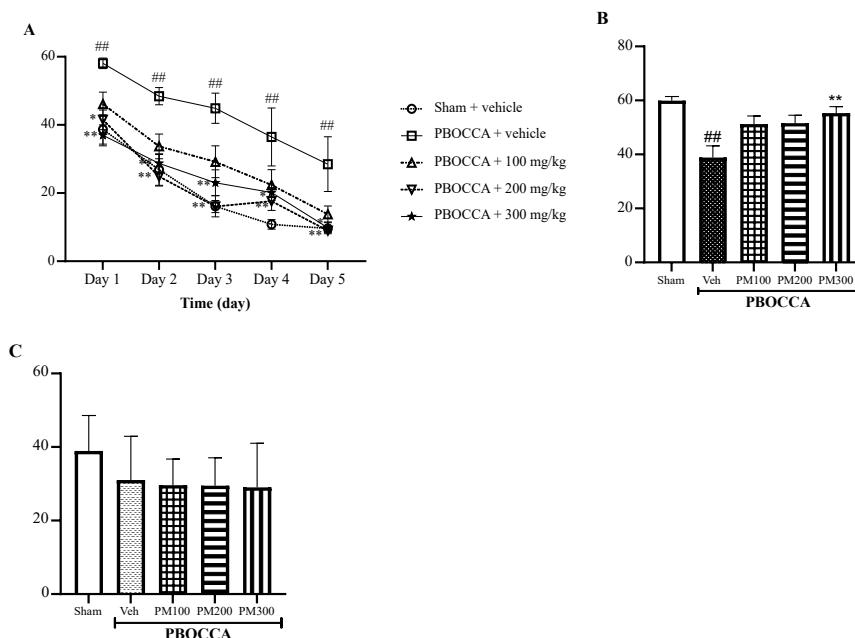


**Figure 3: Effect of *P. minor* aqueous extract on (A) short-term and (B) long-term recognition memory in PBOCCA rats. Data are expressed as the mean±SEM (n = 6-7). The graph was statistically analysed by one-way ANOVA followed by Bonferroni post hoc test. # p < 0.05 vs. sham group; ## p < 0.01 vs. sham group; \*\* p < 0.01 vs. PBOCCA + vehicle group.**

#### *P. minor* attenuates spatial reference and learning memory deficits in PBOCCA rats

The ability of *P. minor* to attenuate spatial learning and reference memory deficit in PBOCCA rats was assessed via the MWM task. During acquisition, a two-way repeated measures ANOVA analysis revealed significant treatment effect ( $F_{4,26} = 11.82$ ,  $p < 0.0001$ ), test day effect ( $F_{4,104} = 77.92$ ,  $p < 0.0001$ ), as well as significant treatment x test day effect ( $F_{16,104} = 0.81$ ,  $p = 0.6688$ ) (Fig. 4A). The escape latencies during five days of training were significantly increased in the PBOCCA rats received vehicle (PBOCCA + vehicle) in comparison with the sham group. *P. minor* extract (200 and 300 mg/kg) treatment for 14 days significantly improved the spatial learning impairment in PBOCCA rats. This was evident by the significant reduction ( $p < 0.05$ ) in the escape latencies starting from day 1 to day 5 (200 mg/kg) and from day 2 to day 5 (300 mg/kg) as compared to sham. However, treatment with a lower dose of *P. minor* (100 mg/kg) did not show an apparent difference ( $p > 0.05$ ) as compared with that of the sham group across five days of training.

Retrieval of spatial memory was explicitly tested with the probe trial performed 24 h after the last day of the training trial. As shown in Fig. 4B, CCH rats induced by PBOCCA spent less time in the target quadrant as compared to the sham group ( $p < 0.05$ ). PBOCCA rats treated with 300 mg/kg of *P. minor* extract spent significantly ( $p < 0.05$ ) more time in the target quadrant compared to the PBOCCA + vehicle group. In addition, the visible platform trials in the water maze task did not reveal any significant difference ( $p > 0.05$ ) in escape latency among the groups (Fig. 4C). This implies that the group differences during the acquisition and probe trial were not due to visual deficits.



**Figure 4: Effect of *P. minor* on spatial reference learning deficits in PBOCCA rats. (A) Escape latency time during acquisition (Day 1-5). Data are expressed as the mean±SEM (n=6-7), analysed by two-way ANOVA followed by the Bonferroni post hoc test. (B) Percentage time spent in the target quadrant during the probe trial. (C) Escape latency time with a visible platform. Data are expressed as the mean±SEM (n=6-8), analysed by one-way ANOVA followed by Bonferroni post hoc test. ## p < 0.01 vs. sham group; \* p< 0.05 vs. PBOCCA + vehicle group; \*\* p < 0.01 vs. PBOCCA group.**

## CONCLUSION

The findings demonstrated an improving effect of *P. minor* extract on memory in the CCH rat model, suggesting that *P. minor* extract could be a potential treatment for vascular dementia and Alzheimer's disease patients as well as a preventive healthcare measure in preventing the rapid decline of cognitive function associated with aging.

## REFERENCES

- [1] Smith, E. E. (2017). Clinical presentations and epidemiology of vascular dementia. *Clinical Science*, 131(11), 1059–1068. <https://doi.org/10.1042/CS20160607>
- [2] Nichols, E., Steinmetz, J. D., Vollset, S. E., Fukutaki, K., Chalek, J., Abd-Allah, F., Abdoli, A., Abualhasan, A., Abu-Gharbieh, E., Akram, T. T., Al Hamad, H., Alahdab, F., Alanezi, F. M., Alipour, V., Almustanyir, S., Amu, H., Ansari, I., Arabloo, J., Ashraf, T., ... Vos, T. (2022). Estimation of the global prevalence of dementia in 2019 and forecasted prevalence in 2050: an analysis for the Global Burden of Disease Study 2019. *The Lancet Public Health*, 7(2), e105–e125. [https://doi.org/10.1016/S2468-2667\(21\)00249-8](https://doi.org/10.1016/S2468-2667(21)00249-8)
- [3] Huda-Faujan, N., Noriham, A., Norrakiah, A. S., & Babji, A. S. (2007). Antioxidative activities of water extracts of some Malaysian herbs. *ASEAN Food Journal*, 14(1), 61–68.
- [4] Asanai, M. F., Haron, N., Camalxaman, S. N., Mohamed, E., & Rambely, A. S. (2020). A review on medicinal benefits of *Persicaria minor*. *Healthscope: The Official Research Book of Faculty of Health Sciences, UiTM*, 3(2), 44–50. <https://healthscopefsk.com/index.php/research/article/view/132>
- [5] Chinnappan, S. M., George, A., Choudhary, Y. K., Godavarthi, A., Teng, C.-L., & Jin, W. H. (2022). In vitro and In vivo Investigations on Anti-Hyperuricemic Activity of Commercial Preparations of *Persicaria minor* (Biokesum®) and *Eurycoma longifolia* (Physta®). *Current Traditional Medicine*, 9(5). <https://doi.org/10.2174/2215083809666221213142127>
- [6] George, A., Ng, C. P., O'Callaghan, M., Jensen, G. S., & Wong, H. J. (2014). In vitro and ex-vivo cellular antioxidant protection and cognitive-enhancing effects of an extract of *Polygonum minus* Huds (LineminusTM) demonstrated in a Barnes Maze animal model for memory and learning. *BMC Complementary and Alternative Medicine*, 14, 1–10. <https://doi.org/10.1186/1472-6882-14-161>
- [7] Vikram, P., Chiruvella, K. K., Ripain, I. H. A., & Arifullah, M. (2014). A recent review on phytochemical constituents and medicinal properties of kesum (*Polygonum minus* Huds.). *Asian Pacific Journal of Tropical Biomedicine*, 4(6), 430–435. <https://doi.org/10.12980/APJTB.4.2014C1255>
- [8] Christopher, P., Parasuraman, S., Christina, J., Asmawi, M. Z., & Vikneswaran, M. (2015). Review on *Polygonum minus*. Huds, a commonly used food additive in Southeast Asia. *Pharmacognosy Research*, 7(1), 1–6. <https://doi.org/10.4103/0974-8490.147125>
- [9] Christopher, P. V., Muthuraman, A., Zhang, L. S., Jordon, K. S. Y., & Jonathan, K. H. H. (2021). Effect of Methanol Extract of *Polygonum minus* on Neuropathic Pain and Cognitive Dysfunction in Rats Parayil. *International Journal of Nutrition, Pharmacology, Neurological Diseases |*, 8, 154–162. <https://doi.org/10.4103/ijnpnd.ijnpnd>
- [10] Hazalin, N. A. M. N., Liao, P., & Hassan, Z. (2020). TRPM4 inhibition improves spatial memory impairment and hippocampal long-term potentiation deficit in chronic cerebral hypoperfused rats. *Behavioural Brain Research*, 393(June), 112781. <https://doi.org/10.1016/j.bbr.2020.112781>

# PSYCHOSOCIAL BARRIERS TO MEDICATION ADHERENCE AMONG OLDER ADULTS LIVING IN CARE HOMES.

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## ABSTRACT

Medication adherence is important to achieve a better therapeutic outcome, especially in older adults. This study aims to assess medication adherence and its psychosocial barrier among older adults living in care homes. This study aims to identify psychosocial factors which affect the adherence level in older adults. The objectives of this study were to determine the level of medication adherence among older adults living in care homes and to identify the association of psychosocial factors with medication adherence among older adults living in care homes.

**Methods:** A study was conducted in 27 care homes in Klang Valley. A validated questionnaire was used and consisted of three parts: demographic, psychosocial factors and assessment of adherence level. The study only includes those aged 65 years and above, able to speak and hear clearly and taking at least one medication for chronic illness. The interview took 20 minutes per respondent. Data were analysed using the Chi-square and Pearson correlation test to determine the association and correlation between psychosocial factors and adherence level. The p-value is set to  $<0.05$  to indicate the data are statistically significant.

**Results:** A total number of 258 older adults were interviewed and more than half (59.7%) of them were identified as having a low risk of medication non-adherence. There was a statistically significant correlation between receiving enough explanation about the medication ( $P=0.030$ ) and trust in the physician ( $P=0.018$ ) with medication adherence. Respondents who received more information on medication dispensed and had a higher trust in physicians were correlated with a lower risk of medication non-adherence.

**Conclusion:** Older adults who received more explanation about medication and had higher trust in their physician were more likely to become adherent to prescribed medicines than those who received little information and had low trust in their physician.

**Keywords:** medication adherence, psychosocial, barriers, care homes, older adults

## INTRODUCTION

Care home residents are mainly older adults with multiple diseases and multiple medications. Good medication adherence is vital to achieving optimal therapeutic outcomes and the potential to reduce healthcare costs [1]. Although there is research to assess medication adherence among older adults in various developed countries, little is known about medication adherence among older adults in Malaysia, particularly those living in care homes. The primary objectives of this study were to determine the level of medication adherence among elderly people living in nursing homes and to identify the association of psychosocial factors with medication adherence among elderly people living in nursing homes. The information collected in this research will assist the healthcare provider in developing a strategy to improve the level of medication adherence in an older population in the future.

## MATERIAL AND METHOD

A cross-sectional study was conducted at 27 government and non-governmental organisation care homes in Klang Valley, Malaysia. Residents 65 years of age and older, taking at least one prescribed medication and able to speak clearly and with no hearing difficulties were included. Those who do not understand English or Malay, or are diagnosed with dementia were excluded.

The questionnaire consists of demographic information, psychosocial factors and an assessment of adherence level. A pilot study was run to determine the reliability and validity of the instrument used in this research, and this data was not included in the final result. Cronbach's alpha was measured to determine the reliability and consistency of the instruments which 0.70 or higher is considered acceptable and a value of 0.60 or higher is marginally acceptable [2]. Cronbach's alpha for this study

was 0.736. Psychosocial factors were divided into two sections. Section one is three items on healthcare provider factors. The score was measured by a 3-point scale [3]. Section two covered the level of patient's trust in the physician. This scale consists of 11 items and the participant's responses ranged from 1(strongly disagree) to 5(strongly agree). Medication Safety Alert Tool for Elderly (MeSATE) is used to predict the adherence level. This tool is a validated and reliable instrument that predicts intentional non-adherence in older adults aged 65 years or more. The instrument consists of four domains with 17 items to determine non-adherence. The four domains include disease factors, socioeconomic factors, treatment factors, and psychosocial factors. The scoring depended on the total score obtained; a total score of 80% or above means the patient is at high risk of medication non-adherence. Scoring between 40% to 80% is considered moderate risk and 40% or below is considered low risk of non-adherence to medication [4].

All the collected data were entered into Excel and transferred to SPSS. Data were analysed using IBM SPSS statistical package version 25 using descriptive and inferential statistics. Descriptive statistics for each variable were calculated as the percentage and mean  $\pm$  standard deviation. Pearson correlation and Chi-square test were used to determine the association and correlation between psychosocial factors and medication adherence. The level of medication adherence was determined by using the MeSATE tool and was characterised as the dependent variable and the participant's characteristics as an independent variable. A p-value of  $<0.05$  indicates the data are statistically significant.

## RESULTS AND DISCUSSION

Table 2 demonstrates the association between psychosocial factors with the risk of medication non-adherence. Most of the respondents (79.9%, n=188) were satisfied with the counselling conducted by the healthcare provider. Besides, the majority of the respondents (79.1%, n=204) had a good relationship with their healthcare provider. Most respondents agreed that they received enough explanation about the medication taken (87.2%, n=225). In addition, more than two-thirds (67.8%, n=175) had moderate trust towards their physician.

More than half of respondents (89.0%, n=137) had a low risk of medication non-adherence when they received enough explanation about the medication ( $p=0.030$ ). Respondents had a greater trust in their physician (6.0%, n=9) was correlated with a lower risk of getting non-adherent to the medication ( $p=0.018$ ).

Pearson's correlation was calculated to determine the correlation between two variables. Results indicated that an increase in information about medication dispensed ( $r=-0.094$ ,  $p=0.030$ ) and increased trust in the physician ( $r=-0.103$ ,  $p=0.018$ ) were statistically significant but weakly correlated with a decreased risk of medication non-adherence.

## TABLE, IMAGE AND FIGURE

Table 2: The association between psychosocial factors with the risk of medication non-adherence (n=258).

Variables	Total participant s (n, %)	Non-adherence level (n, %)			$\chi^2$ , P
		Low risk	Moderate risk	High risk	
Satisfaction with patient counselling					
Dissatisfied	3 (1.2)	1 (0.7)	2 (1.9)	0	1.392
Neutral	67 (26.0)	38 (25.2)	29 (27.4)	0	<sup>a</sup> ,
Satisfied	188 (72.9)	115 (74.7)	72 (69.9)	1 (100)	0.846
Patient-pharmacist relationship and communication					
	3 (1.2)	2 (1.3)	1 (0.9)	0	

Poor	51 (19.8)	27 (17.9)	24 (22.6)	0	1.209
Neutral	204 (79.1)	125 (81.2)	78 (75.7)	1 (100)	<sup>a</sup> , 0.877
Good					
Variables	Total participant s (n, %)	Non-adherence level (n, %)			r, P
		Low risk	Moderate risk	High risk	
Explanation of medication					
None	0	0	0	0	-
A little	33 (12.8)	17 (11.3)	16 (15.1)	0	0.094
Enough	225 (87.2)	137 (89.0)	87 (84.5)	1 (100)	<sup>b</sup> , 0.030
Trust in physician					
11-40 (Low)	71 (27.5)	41 (27.2)	29 (27.4)	1 (100)	
41-45 (Moderately low)	113 (43.8)	66 (43.7)	47 (44.3)	0	-
46-52 (Moderately high)	62 (24.0)	38 (24.7)	24 (23.3)	0	0.103
53-55 (High)	12 (4.7)	9 (6.0)	3 (2.8)	0	<sup>b</sup> , 0.018

<sup>a</sup> Chi-square test <sup>b</sup> Pearson correlation

Based on our study, the majority of the respondents demonstrated a low risk of becoming non-adherent to the medication. In our study, an elderly patient who received enough explanation about the medication they were taking and had a greater trust in the physician was significantly correlated with a better adherence level. Similarly, in the previous study by Jin et al [3], stated that a better explanation about medication is associated with a better adherence level. Similarly, a study reported that patient with higher trust in their physician had better adherence to the medication they were taking [5]. Identically, in the previous study, residents with greater trust in their healthcare provider were more likely to become more adherent to medication regimen compared to those with low trust in their physicians [6].

Previous studies demonstrated that proper counselling between patients and healthcare providers and having a good relationship and good communication between patients and healthcare providers resulted in good medication adherence [7]. Similarly, better medication adherence can be achieved if patients have a strong belief of their medications and good understanding of their disease [8]. Therefore, receiving a proper explanation about medication and having greater trust in the physician may lead to better adherence levels in elderly people.

## CONCLUSION

Older adults who received more explanation about their medication and had higher trust in their physician were more likely to become adherent to prescribed medicines than those who received little information and had low trust in their physician.

## REFERENCES

Walsh, C. A., Cahir, C., Tecklenborg, S., Byrne, C., Culbertson, M. A., & Bennett, K. E. (2019). The association between medication non-adherence and adverse health outcomes in ageing populations: A systematic review and meta-analysis. *British Journal of Clinical Pharmacology*, 85(11), 2464–2478. <https://doi.org/10.1111/bcp.14075>

Taber, K. S. (2018). The use of cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48(6), 1273–1296. <https://doi.org/10.1007/s11165-016-9602-2>

Jin, H., Kim, Y., & Rhie, S. (2016). Factors affecting medication adherence in elderly people. *Patient Preference and Adherence*, 10, 2117–2125. <https://doi.org/10.2147/ppa.s118121>

Fahrni ML, Dali AF, Muda MR, Thiyyagu K, Usir E.(2017). MeSATE: Medication Safety Alert Tool for Elderly.

Thom, D. H., Ribisl, K. M., Stewart, A. L., & Luke, D. A. (1999). Further validation and reliability testing of the trust in physician scale. *Medical Care*, 37(5), 510–517. <https://doi.org/10.1097/00005650-199905000-00010>

Abel, W. M., & Efird, J. T. (2013). The association between trust in health care providers and medication adherence among black women with hypertension. *Frontiers in Public Health*, 1. <https://doi.org/10.3389/fpubh.2013.00066>

Kwame, A., & Petrucci, P. M. (2021). A literature-based study of patient-centered care and communication in nurse-patient interactions: barriers, facilitators, and the way forward. *BMC Nursing*, 20(1). <https://doi.org/10.1186/s12912-021-00684-2>

Alhabib, M. Y., Alhazmi, T. S., Alsaad, S. M., AlQahtani, A. S., & Alnafisah, A. A. (2022). Medication adherence among geriatric patients with chronic diseases in Riyadh, Saudi Arabia. *Patient Preference and Adherence*, 16, 2021–2030. <https://doi.org/10.2147/ppa.s363082>

# STRUCTURAL ALTERATIONS IN LIVER ENDOTHELIUM OF RATS WITH DEXAMETHASONE-INDUCED INSULIN RESISTANCE

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## ABSTRACT

Liver sinusoidal endothelial cells (LSECs) are perforated with transcellular fenestrations that provide unimpeded access of substrates between sinusoidal blood and hepatocytes. Defenestration refers to the loss of fenestration number and/or decreasing in fenestration diameter which can alter metabolic homeostasis. Insulin resistance has been reported to promote fat accumulation in the liver leading to fatty liver disease. However, the effect of insulin resistance specifically on fenestrations is yet to be investigated. This study was conducted to observe changes in fenestrations of LSEC in response to insulin resistance. Adult male Sprague-Dawley rats were divided into two groups (n=8) where the control group received 0.9% NaCl and the treatment group received dexamethasone injection (1mg/kg) i.p once daily for ten days. At day 11, all rats were anaesthetised using ketamine/xylazine followed by cardiac puncture. Rats were dissected and livers were perfusion-fixed for electron microscopy. Fenestrations were examined using a Quanta FEG450 Scanning electron microscope at 15000x magnification. Ten random images per sample were taken for fenestrations diameter and porosity analysis using ImageJ software. Data was analysed using SPSS version 23.0. Results showed that dexamethasone has induced insulin resistance by a significant reduction of body weight (D=276.84±7.87 vs C=393.84±12.47g; p=0.00), increased fasting blood glucose (D=5.57 ±1.30 vs C=3.97±0.55mg/dl; p=0.02) and higher HOMA-IR value (D=1.37±0.52 vs C=0.85±0.22; p=0.00) in treatment group compared to the control. Analysis of the liver images has shown that insulin resistance causes defenestration of LSEC where there is a significant decrease in fenestration frequency (D=3.202±1.16 vs C=2.656±1.044; p=0.04) and endothelial porosity (D=2.17±0.74 vs C=1.77±0.9; p=0.049) but not fenestration diameter. In conclusion, this finding shows that insulin resistance can affect the integrity of liver endothelium specifically on fenestration frequency and liver porosity which will consequently lead to serious implications on liver function as the main site for metabolism.

**Keywords:** Insulin resistance, dexamethasone, liver endothelium, fenestrations, electron microscopy.

## INTRODUCTION

The liver plays a major role in the glucose homeostasis regulation, which is tightly regulated by insulin. Liver sinusoidal endothelial cells (LSEC) are perforated with transcellular fenestrations that provide permeability and access of substrates between sinusoidal blood and hepatocytes. During ageing and in liver diseases, LSECs undergo structural changes ranging from decreased fenestration number (defenestration) and/or diameter known as capillarisation (1). Insulin resistance is defined as the inability of tissues to respond to normal circulating levels of insulin and has been reported to promote non-alcoholic fatty liver disease (NAFLD) (2). However, the association between insulin resistance and fenestrations is yet to be investigated. Hence, this study aimed to analyse changes in fenestrations of LSEC in rat model models of insulin resistance. We hypothesised that LSEC ultrastructure is a contributing factor towards the clinical manifestations of insulin resistance.

## MATERIAL AND METHOD

Adult male Sprague-Dawley rats were divided into two groups where the control group (n=8) received 0.9% NaCl and the treatment group (n=8) received dexamethasone injection (1mg/kg) i.p once daily for ten days (3). Body weight and fasting blood glucose were recorded daily. At day 11, all rats were sacrificed using ketamine/xylazine followed by cardiac puncture. Rats were dissected and livers were perfusion-fixed for electron microscopy. Fenestrations were examined using a Quanta FEG450 Scanning electron microscope at 15000x magnification. Ten random images per sample were taken for

fenestration frequency, diameter and liver porosity analysis using ImageJ software (4). All data were analysed using SPSS Version 23.0. Values for measurements were presented as mean  $\pm$  SD.

## RESULTS AND DISCUSSION

Dexamethasone has caused a significant decreasing daily body weight starting at day 3 of treatment and subsequently mean body weight changes compared to control (5.38 vs -22.92%) throughout the experiment. There is no significant difference in liver-to-body-weight ratio although the treated liver showed a higher value as compared to the control. Fasting plasma insulin concentrations were significantly elevated in the treatment group compared to control (Figure 1A). As hyperinsulinemia occurs, the homeostatic model assessment index for insulin resistance (HOMA-IR), calculated from the fasting glucose-insulin product, was significantly increased by more than two-fold in the treatment group, indicating insulin resistance (Figure 1B). Dexamethasone harms pancreatic beta cell function by reducing insulin receptor sensitivity, leading to decreased glucose uptake, tissue starvation, proteolysis and consequently weight reduction (3).

The liver endothelium observed via SEM showed a normal fenestration morphology in control rats (Figure 2A) while a marked defenestration is present in insulin resistance rats (Figure 2B). Quantification analysis of LSECs fenestrations showed a significant decrease in fenestration frequency and liver porosity, but not fenestration diameter for the insulin resistance liver (Table I). Although the mechanism of defenestration is still under investigation, these liver alterations are probably due to the dexamethasone effect on the mitochondrial energy production at the LSEC that causes depletion of ATP that is needed to support the cytoskeleton rings for the maintenance of fenestrae patency (5).

## TABLE, IMAGE AND FIGURE

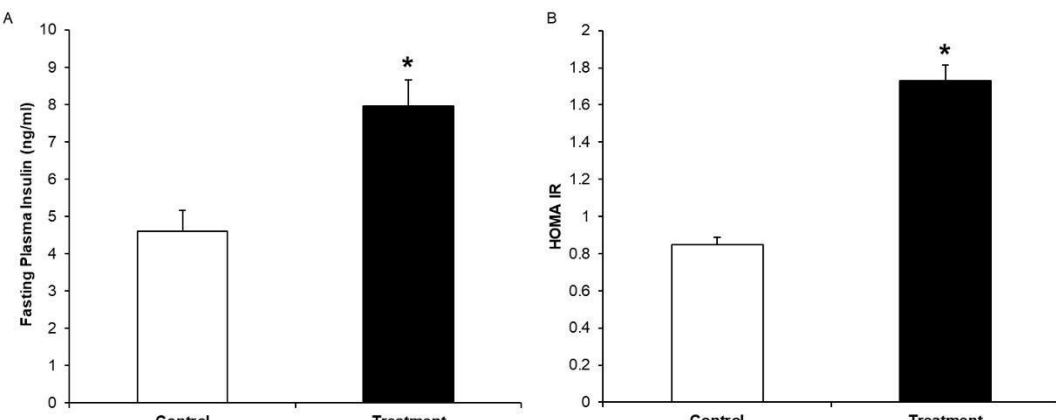


Fig. 1: Insulin resistance parameters in control and treatment group. (A) Fasting plasma insulin levels, (B) HOMA-IR. \*significant at  $p<0.05$

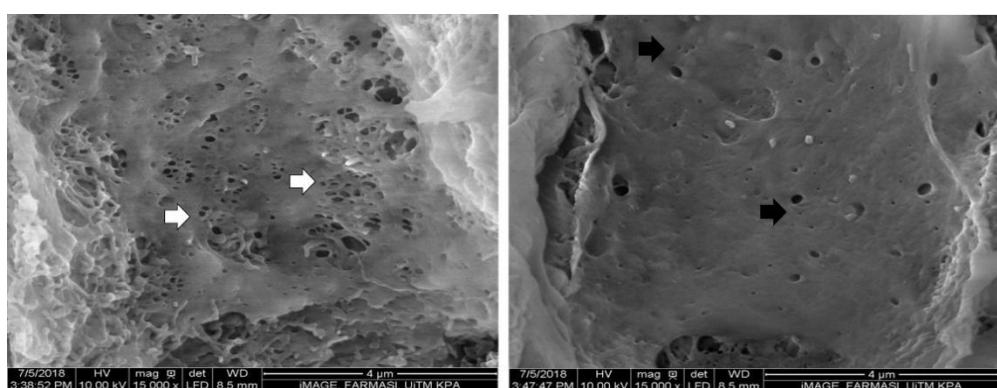


Fig. 2: Representative scanning electron micrograph of liver sinusoids. (A) Control liver showing fenestrations clustered into sieve plates (white arrows), (B) Marked defenestration (black arrows) is observed in insulin resistance rats (Mag 15000x)

Table 1: Quantification analysis of LSEC fenestrations

	Control (n=6)	Treatment (n=6)
Frequency	$3.21 \pm 1.2$	$2.65 \pm 1.0^*$

Diameter	0.08 ± 0.1	0.07 ± 0.2
Porosity	2.17 ± 0.7	1.77 ± 0.9*

## CONCLUSION

Insulin resistance has the ability to affect the integrity of liver endothelium specifically on fenestration frequency and liver porosity. These findings affirm the important role of liver ultrastructure in hepatic metabolic processes and highlight the LSECs as potential therapeutic targets for metabolic diseases such as diabetes and metabolic syndrome.

## REFERENCES

- [1]. Cogger VC, Hunt NJ, Le Couteur DG. Fenestrations in the Liver Sinusoidal Endothelial Cell. In: The Liver [Internet]. 2020. p. 435–43. Available from: <https://doi.org/10.1002/9781119436812.ch35>
- [2]. Lee SH, Park SY, Choi CS. Insulin Resistance: From Mechanisms to Therapeutic Strategies. *Diabetes Metab J.* 2022;46(1):15–37.
- [3]. Martínez BB, Pereira ACC, Muzetti JH, Telles F de P, Mundim FGL, Teixeira MA. Experimental model of glucocorticoid-induced insulin resistance. *Acta Cir Bras.* 2016 Oct;31(10):645–9.
- [4]. Mohamad M, Mitchell SJ, Wu LE, White MY, Cordwell SJ, Mach J, et al. Ultrastructure of the liver microcirculation influences hepatic and systemic insulin activity and provides a mechanism for age-related insulin resistance. *Aging Cell [Internet].* 2016 Aug 1;15(4):706–15. Available from: <https://doi.org/10.1111/acel.12481>
- [5]. Zapotoczny B, Braet F, Kus E, Ginda-Mäkelä K, Klejevskaia B, Campagna R, et al. Actin-spectrin scaffold supports open fenestrae in liver sinusoidal endothelial cells. *Traffic.* 2019 Dec;20(12):932–42.

**FACULTY OF HEALTH SCIENCE**

# RELATIONSHIP OF FATIGUE SEVERITY WITH PAIN LEVEL, OBESITY INDICES AND FUNCTIONAL PERFORMANCES IN WOMEN WITH KNEE OSTEOARTHRITIS

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## ABSTRACT

Knee osteoarthritis (KOA) is a common condition among women with obesity, affecting their musculoskeletal system. The pain experienced in KOA can hinder daily activities, leading to fatigue and reduced motivation to engage in meaningful tasks. This study aimed to explore the relationship between pain levels, obesity indicators, functional performance, and fatigue severity in women with KOA. This cross-sectional study recruited women aged 40 to 65 diagnosed with unilateral KOA and referred for physiotherapy management. Measurements included fatigue severity using the Fatigue Severity Scale, pain intensity using the Numerical Rating Scale, and obesity indicators such as body mass index (BMI), body fat percentage, and waist circumference. Functional performance was assessed through handgrip strength, the 5 Times Sit-to-Stand Test, the Timed Up and Go Test, the 6-Minute Walk Test and quality of life (QoL) using the WOMAC questionnaire. A total of 96 women (mean age = 54.76 years, SD = 5.54) participated in the study, with an average fatigue severity score of 34.51 (SD = 14.03). Participants with lower fatigue levels experienced less intense pain, lower body fat, and better QoL. Simple linear regression showed significant associations between fatigue severity and pain intensity ( $\beta = 4.089$ ,  $p < 0.001$ ), body fat percentage ( $\beta = 0.825$ ,  $p < 0.001$ ), and QoL ( $\beta = 0.304$ ,  $p < 0.001$ ). Pain management targeted weight reduction, and personalized exercise programs are essential in addressing fatigue in women with KOA. Further research with larger samples is recommended to better understand the dynamic relationship between pain, obesity, and fatigue.

**Keywords:** Functional performance, knee osteoarthritis, obesity, pain, quality of life

## INTRODUCTION

Knee osteoarthritis (KOA) is a joint disease that tends to affect older individuals, with a higher occurrence, in women compared to men. This is due to differences in body structure, movement patterns and hormonal influences. Around 18% of women experience KOA while 9.6% of men are affected [1,2]. In women with KOA, the disease often progresses to stages and causes more intense pain compared to men [3].

The main symptom of KOA is pain, which significantly limits activities such as walking, getting up from a seated position, doing household chores, climbing stairs and maintaining an upright sitting posture [4-6]. This limitation can lead to reduced activity and increased feelings of tiredness or lack of energy known as fatigue [7]. Interestingly, 40% of individuals with osteoarthritis report experiencing lower levels of fatigue that greatly disrupt their social life and everyday activities [8,9].

Understanding the factors that contribute to fatigue in women with KOA is crucial due to its impact on their quality of life (QoL). However, current literature on this matter primarily focuses on the relationship between pain and fatigue as well as their combined effect, on physical activity. This gap, in knowledge, makes it unclear how other potential factors contribute to fatigue in women with KOA [9].

Strategies for managing KOA include educating patients encouraging exercise and promoting weight loss. These strategies aim to alleviate pain and improve exercise tolerance [10]. However aside from understanding the relationship between pain and fatigue, there is a lack of research on how obesity indicators (such as body mass index, percentage of body fat, waist circumference) and functional abilities (such as strength, balance or mobility, exercise capacity and QoL) are related to the levels of fatigue in women with KOA.

The objective of this study is to bridge this knowledge gap by examining the relationship between the severity of fatigue and various factors such as pain level, obesity indicators and functional abilities in women diagnosed with KOA. The findings from this study are expected to offer insights for practice by improving the management and treatment approaches, for KOA specifically in women.

## MATERIAL AND METHOD

The protocol for this study received ethical approval from the Research Ethics Committee of Universiti Teknologi MARA (UiTM) [Approval no. 600 IRMI (5/1/6)]. This cross-sectional study was specifically designed for women who have been diagnosed with knee osteoarthritis (KOA) and referred for physiotherapy. To be included in the study participants needed to meet criteria such as; having a diagnosis of KOA in one knee, being between 40 and 65 years old, being fluent in either Malay or English and received a referral from a medical professional. Individuals who had undergone knee arthroplasty were pregnant, had limitations in knee motion or deformities due to KOA, had surgeries or had other major medical conditions like rheumatic diseases, cardiovascular problems or neurological issues were excluded from the study.

The Fatigue Severity Scale (FSS) is a questionnaire that participants completed on their own. It consists of nine items that measure how fatigue impacts motivation, and physical functioning and interferes with work, family life and social life. The questionnaire uses a seven-point Likert scale where participants rate their agreement level ranging from disagree (1) to strongly agree (7). The total scores on the FSS range, from 9 to 63 indicating increasing severity of fatigue. The Fatigue Severity Scale (FSS) is well known for its ability to accurately and consistently assess levels of fatigue [11,12].

To determine the intensity of pain, we used a Numerical Rating Scale (NRS) which has been established as an effective tool that ranges from 0 (no pain), to 10 (the worst imaginable pain). Participants were asked to choose the number on the scale that best represented their level of pain in their affected knee. This scale has proven to be highly reliable as evidenced by its test reliability and intra-class correlation coefficients [13].

To calculate participants' body mass index (BMI) ( $\text{kg}/\text{m}^2$ ), we measured their body weight (kg) and height (m) using the TANITA weighing scale and SECA Model Body meter, respectively.

For measuring body percentage, we utilized the TANITA (Bielectrical Impedance Analysis) (BIA) machine. Participants stood on footpads while holding handles on the BIA platform. This method provides efficient analysis of body composition with results in less, than 30 seconds.

To assess obesity and its associated health risks we measured the waist circumference (diameter between the ribs and iliac crest) using an elastic cloth tape with an accuracy of 0.5 cm.

For evaluating the upper limb strength (handgrip), we used the Jammar Analogue Hand Dynamometer. Participants were instructed to squeeze the dynamometer as hard as they could. Each hand's grip strength was assessed three times with a minute of rest in between attempts. We recorded the average of all measurements, where higher values indicate handgrip strength [14,15].

To measure the lower limb strength, we conducted the Five Times Sit to Stand Test (5STS). During this test, participants were timed as they stood up and sat down five times consecutively without using their legs against the chair and with arms folded. The faster completion time reflects the stronger the limb strength.

We employed the Time Up and Go Test (TUG) to assess balance performance. This test involved standing up from a chair, walking three meters, turning around and then sitting down. The time taken to complete this task was measured using a stopwatch. It is worth noting that this test has demonstrated reliability, among raters [16,17].

The 6-Minute Walk Test (6MWT) is a type of exercise test that evaluates how far a person can walk and their exercise capacity, over a period of time. It follows the guidelines provided by the American Thoracic Society. The test has shown good test-retest reliability among patients with KOA [18-20].

The Western Ontario McMaster University Osteoarthritis Index (WOMAC) is a questionnaire designed to assess the QoL or health status of patients with hip or knee osteoarthritis. It measures pain, stiffness and physical functions with scores indicating severe symptoms. The WOMAC is well known for its reliability and validity in evaluating the severity of KOA [21].

During the recruitment phase, potential participants were approached at a physiotherapy clinic. They were given information about the study's purpose and procedures. Eligibility was determined

based on criteria and informed consent was obtained before proceeding with data collection. Participants completed all measurements except, for the 6MWT, which was conducted on either the second or third day based on participant preference. To prevent fatigue, we strategically organized the sequence of tests starting with less demanding assessments. The principal researcher securely stored all the data and remained the only person to have access to the data.

We used SPSS version 26 to analyze the data setting a significance level at  $p < 0.05$ . Descriptive statistics were employed to present the means and standard deviations. To determine differences between participants with levels of fatigue we conducted a t-test analysis. Additionally, we examined the relationships between fatigue severity and the related variables using Pearson correlation analysis. By conducting regression analysis, we identified predictors of fatigue severity. We calculated a sample size of 96 to ensure an effect size and sufficient power for regression analysis. The Durbin-Watson value confirmed independent errors assumption and variation inflation factors indicated no multicollinearity among the variables [22, 23].

## RESULTS AND DISCUSSION

### *Participants Characteristics*

Ninety-six women (mean age=54.76, SD=5.54) with KOA participated in this study. Table 1 illustrates the measurement characteristics, revealing significant differences in pain level, body fat percentage, and QoL between low and high fatigue levels. Those with low fatigue reported lower pain levels, lower body fat percentages, and better QoL.

**Table 1. Participants' characteristics (N=96)**

Variables	Fatigue Severity Mean (SD)			<i>p</i> -value
	ALL (N=96)	Low (n=47)	High Severity (n=49)	
Age (years)	55.70 (6.90)	54.98 (6.75)	54.39 (7.04)	0.320
Height (m)	1.55 (0.53)	1.56 (5.32)	1.54 (5.25)	0.170
Bodyweight (kg)	70.16 (12.13)	68.91 (11.74)	71.35 (2.49)	0.327
BMI (kg/m <sup>2</sup> )	29.14 (5.00)	28.34 (4.95)	29.90 (4.99)	0.128
Fat %	40.04 (6.41)	38.07 (6.06)	41.93 (6.23)	0.003**
WC (cm)	94.62 (11.11)	94.27 (10.85)	94.96 (11.45)	0.761
Pain level	2.63 (1.51)	2.11 (1.13)	3.12 (1.67)	0.001**
Fatigue	34.51 (14.03)	22.32 (7.24)	46.20 (7.60)	<0.001**
UL strength (kg)	18.83 (5.09)	18.29 (5.87)	19.35 (4.20)	0.309
LL strength (s)	13.11 (5.64)	13.06 (4.81)	13.15 (6.38)	0.940
Mobility (s)	11.65 (2.98)	11.21 (2.36)	12.08 (3.45)	0.158
ES (m)	304.54 (56.38)	307.68 (57.73)	301.54 (55.49)	0.596
QoL	23.65 (18.16)	13.58 (10.96)	28.34 (19.01)	0.002**

Note: t-test significant at \* $p < 0.05$  and \*\* $p < 0.01$ ; SD – Standard Deviation

The Pearson correlation analysis revealed associations between fatigue severity and various factors in women diagnosed with knee osteoarthritis (KOA). Pain level demonstrated a strong positive correlation with fatigue severity ( $r = 0.467$ ,  $p < 0.001$ ), indicating that higher pain levels were associated with increased fatigue. Additionally, body fat percentage ( $r = 0.375$ ,  $p < 0.001$ ) exhibited a positive correlation, suggesting that higher fat percentages were linked to elevated fatigue levels. QoL also displayed a strong positive correlation with fatigue severity ( $r = 0.459$ ,  $p < 0.001$ ), indicating that diminished QoL was associated with higher levels of fatigue. These findings suggest the significant influence of pain, body fat percentage, and QoL on fatigue severity in individuals with KOA. Simple linear regression (Table 2) revealed that pain level, fat %, and QoL are significantly associated with fatigue severity. However, after controlling for pain level, only fat % remained to be significantly associated with fatigue severity.

**Table 2. Crude and Adjusted (pain level) Simple Linear Regressions of Fatigue Level**

Variable	SLR <sup>a</sup>			SLR <sup>b</sup>		
	$\beta^c$	s.e.	p-value	$\beta^d$	s.e.	p-value
Age	0.34	0.21	0.108	0.05	0.20	0.795
Pain level	4.09	0.80	<0.001**			
Body mass index	0.34	0.29	0.244	0.17	0.26	0.520
Fat %	0.82	0.21	<0.001**	0.58	0.20	0.005**
Waist circumference	-0.02	0.13	0.858	-0.09	0.12	0.433
Upper limb strength	0.15	0.28	0.607	0.27	0.25	0.283
Lower limb strength	-0.07	0.26	0.786	-0.27	0.23	0.236
Mobility	0.95	0.48	0.050	0.22	0.46	0.625
Exercise capacity	-0.02	0.03	0.419	-0.01	0.02	0.768
Quality of life	0.30	0.07	<0.001**	0.15	0.09	0.084

SLR<sup>a</sup>: Simple linear regression; SLR<sup>b</sup>: Simple linear regression adjusted for pain level; s.e.: Standard error;  $\beta^c$ : Crude regression coefficient;  $\beta^d$ : Adjusted regression coefficient;

The regression coefficient is significant at  $p<0.001**$

This research aimed to explore the relationship between the severity of fatigue and several factors, including pain level, obesity indices (BMI, body fat percentage, waist circumference) and functional performances (upper and lower limb strength, balance, exercise capacity and QoL) in women diagnosed with knee osteoarthritis (KOA). The results indicated that the average fatigue level was 34.51 (SD 14.03) which falls between high fatigue levels. About 51% of the participants experienced high levels of fatigue. These findings are consistent with studies suggesting that chronic pain can have an impact on physical activity leading to increased feelings of fatigue [24].

The study also emphasized an association between pain level and fatigue severity. Pain was found to interact with body measurements and functional abilities about fatigue. In addition, the current study's findings also observed that pain limits daily activities and mobility while potentially instigating fear of movement resulting in reduced physical activity. This lack of activity can further weaken muscles and intensify the sensation of pain since weaker muscles may struggle to bear knee load [25,26]. It should be noted that chronic pain increases energy expenditure during walking which often leads individuals to adopt energy-conserving strategies [27,28]. These findings suggest that timing exercises after taking pain medication or splitting exercise sessions could be beneficial. Additionally, recommending weight-bearing exercises such as swimming or static cycling may help reduce stress on the joints.

Among the measures of obesity, participants with fatigue showed a notably higher body fat percentage, which was significantly linked to the severity of fatigue. It is important to note that all obesity indices had values exceeding thresholds indicating a trend towards excessive body weight or obesity among the participants. This is a known risk factor for knee osteoarthritis (KOA) [29]. A study suggested that increased total body fat could increase the risk of cartilage defects potentially leading to pain and limited physical activity [30].

Regarding functional performances, even though there were no significant differences in all measures except for QoL, we noticed that participants with a higher fatigue level also presented with a lower mean in all measures of functional performance than those with a lower fatigue level. In terms of functional performance measures, even though there were no significant differences in all measures except for QoL, it was noted that those with a higher fatigue level also presented with a lower mean in all measures of functional performance than those with a lower fatigue level. Interestingly participants with higher fatigue levels showed better upper limb strength, which may compensate for declining lower limb functions. The walking patterns of patients with KOA may be altered due to painful knees resulting in increased energy expenditure and reduced habitual gait speed. This could explain the decrease in balance and exercise capacity [28]. Arthritic pain can affect quadriceps strength influencing gait patterns and leading to lower gait speed, prolonged support times and an extended duration to complete the five times sit to stand test [31,32]. The interaction, between these variables could result in a lower QoL as indicated by the WOMAC scores in participants experiencing more severe fatigue.

This study had limitations. The sample size was determined for 80% power, which might have affected the significance of the findings related to predicting fatigue severity for variables. We did not measure the duration of KOA, which could potentially impact fatigue due to prolonged inactivity. Nevertheless, this study provides insights into the factors that influence fatigue in KOA. It highlights

the importance of research in developing intervention guidelines to promote long-term adherence to physical activity.

## CONCLUSION

In summary, the results of this study indicate that the severity of fatigue is likely to be associated with pain levels, body fat percentage and QoL. On the other hand, it is worth noting that addressing obesity indices should be a priority for intervention since most participants exhibited high levels of obesity indices. Future studies should consider a larger sample size and examine how the duration of KOA influences these factors. Additionally, a longitudinal study would offer insights into how pain severity affects fatigue as the disease progresses. These findings have implications for healthcare professionals and physiotherapists who should prioritize pain management, weight management and modifications to exercise and physical activity.

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## ETHICS APPROVAL AND INFORMED CONSENT

The study was conducted by the Declaration of Helsinki and approved by the Research Ethics Committee of Universiti Teknologi MARA (Approval number: 600-IRMI (5/1/6).

## CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

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## REFERENCES

- [1] Hunter, D. J., & Bierma-Zeinstra, S. (2019). Osteoarthritis. *The Lancet*, 393, 1745-1759.
- [2] Valdes, A. M., & Stocks, J. (2018). Osteoarthritis and ageing. *European Journal of Rheumatology*, 3, 116-123.
- [3] Hame, S. L., & Alexander, R. A. (2013). Knee osteoarthritis in women. *Current Reviews in Musculoskeletal Medicine*, 6, 182-187.
- [4] Baert, I. A., Meeus, M., Mahmoudian, A., Luyten, F. P., Nijs, J., & Verschueren, S. M. (2017). Do psychosocial factors predict muscle strength, pain, or physical performance in patients with knee osteoarthritis? *Journal of Clinical Rheumatology*, 23, 308-316.
- [5] Lespasio, M. J., Piuzzi, N. S., Husni, M. E., Muschler, G. F., Guarino, A. J., & Mont, M. A. (2017). Knee osteoarthritis: a primer. *The Permanente Journal*, 21, 16-183.
- [6] Nawito, Z. O., El-Azkalany, G. S., & El-Sayad, M. (2018). Nottingham health profile assessment of health-related quality of life in primary knee osteoarthritis patients: Relation to clinical features and radiologic score. *Egyptian Rheumatology*, 40, 265-268.
- [7] Rose, D. M., Seidler, A., Nübling, M., Latza, U., Brähler, E., Klein, E. M., et al. (2017). Associations of fatigue to work-related stress, mental and physical health in an employed community sample. *BMC Psychiatry*, 17, 1-8.
- [8] Murphy, S. L., Alexander, N. B., Levoska, M., & Smith, D. M. (2013). Relationship between fatigue and subsequent physical activity among older adults with symptomatic osteoarthritis. *Arthritis Care & Research*, 65, 1617-1624.
- [9] Murphy, S. L., Niemiec, S. S., Lyden, A. K., & Kratz, A. L. (2016). Pain, fatigue, and physical activity in osteoarthritis: the moderating effects of pain-and fatigue-related activity interference. *Archives of Physical Medicine and Rehabilitation*, 97(Suppl), S201-S209.

[10] Katz, J. N., Arant, K. R., & Loeser, R. F. (2021). Diagnosis and treatment of hip and knee osteoarthritis: A Review. *JAMA*, 325, 568-578.

[11] Cross, M., Lapsley, H., Barcenilla, A., Brooks, P., & March, L. (2008). Association Between Measures of Fatigue and Health-Related Quality of Life in Rheumatoid Arthritis and Osteoarthritis. *Patient*, 1, 97-104.

[12] Amtmann, D., Bamer, A. M., Noonan, V., Lang, N., Kim, J., & Cook, K. F. (2012). Comparison of the psychometric properties of two fatigue scales in multiple sclerosis. *Rehabilitation Psychology*, 57, 159-166.

[13] Alghadir, A. H., Anwer, S., Iqbal, A., & Iqbal, Z. A. (2018). Test-retest reliability, validity, and minimum detectable change of visual analog, numerical rating, and verbal rating scales for measurement of osteoarthritic knee pain. *Journal of Pain Research*, 11, 851-856.

[14] Roberts, H. C., Denison, H. J., Martin, H. J., Patel, H. P., Syddall, H., Cooper, C., et al. (2011). A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. *Age and Ageing*, 40, 423-429.

[15] Wolinsky, F. D., Miller, D. K., Andresen, E. M., Malmstrom, T. K., & Miller, J. P. (2005). Reproducibility of physical performance and physiologic assessments. *Journal of Aging and Health*, 17, 111-124.

[16] Steffen, T. M., Hacker, T. A., & Mollinger, L. (2002). Age-and gender-related test performance in community-dwelling elderly people: Six-Minute Walk Test, Berg Balance Scale, Timed Up & Go Test, and gait speeds. *Physical Therapy*, 82, 128-137.

[17] Hafsteinsdóttir, T. B., Rensink, M., & Schuurmans, M. (2014). Clinimetric properties of the Timed Up and Go Test for patients with stroke: a systematic review. *Topics in Stroke Rehabilitation*, 21, 197-210.

[18] Bennell, K., Dobson, F., & Hinman, R. (2011). Measures of physical performance assessments: Self-Paced walk test (SPWT), stair climb test (SCT), Six-Minute walk test (6MWT), chair stand test (CST), timed up & go (TUG), sock test, lift and carry test (LCT), and car task. *Arthritis Care & Research*, 63(Suppl), S350-S370.

[19] ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories. (2002). ATS statement: guidelines for the six-minute walk test. *American Journal of Respiratory and Critical Care Medicine*, 166, 111-117.

[20] Ateef, M., Kulandaivelan, S., & Tahseen, S. (2016). Test-retest reliability and correlates of 6-minute walk test in patients with primary osteoarthritis of knees. *Indian Journal of Rheumatology*, 11, 192-196.

[21] Salaffi, F., Leardini, G., Canesi, B., Mannoni, A., Fioravanti, A., Caporali, R., et al. (2003). Reliability and validity of the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index in Italian patients with osteoarthritis of the knee. *Osteoarthritis and Cartilage*, 11, 551-560.

[22] Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G\*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, 41, 1149-1160.

[23] Rehman, A. S., & Mamoon, D. (2018). Does new public management practices lead to effective public welfare responses in Pakistan. *Turkish Economic Review*, 5, 150-173.

[24] Fawole, H. O., Dell'Isola, A., Steultjens, M. P., Riskowski, J. L., & Chastin, S. F. (2020). Temporal associations between physical activity, mental activity and fatigue dimensions in knee osteoarthritis: an exploratory intensive longitudinal study. *Fatigue: Biomedicine, Health & Behavior*, 8, 32-48.

[25] Alikari, V., Sachlas, A., Gitrakou, S., Stathoulis, J., Fradelos, E., Theofilou, P., et al. (2017). Fatigue in arthritis: a multidimensional phenomenon with impact on quality of life. *InGeNeDis*, 2016, 243-256.

[26] Luc-Harkey, B. A., Safran-Norton, C. E., Mandl, L. A., Katz, J. N., & Losina, E. (2018). Associations among knee muscle strength, structural damage, and pain and mobility in individuals with osteoarthritis and symptomatic meniscal tear. *BMC Musculoskeletal Disorders*, 19, 258.

[27] Coyle, P. C., Schrack, J. A., & Hicks, G. E. (2018). Pain energy model of mobility limitation in the older adult. *Pain Medicine*, 19, 1559-1569.

- [28] Foucher, K. C., Aydemir, B., & Huang, C. H. (2021). Walking energetics and fatigue are associated with physical activity in people with knee osteoarthritis. *Clinical Biomechanics*, 88, 105427.
- [29] Weiss, E. (2014). Knee osteoarthritis, body mass index and pain: data from the Osteoarthritis Initiative. *Rheumatology*, 53, 2095-2099.
- [30] Kulkarni, K., Karssiens, T., Kumar, V., & Pandit, H. (2016). Obesity and osteoarthritis. *Maturitas*, 89, 22-28.
- [31] Spinoso, D. H., Bellei, N. C., Marques, N. R., & Navega, M. T. (2019). Quadriceps muscle weakness influences the gait pattern in women with knee osteoarthritis. *Advances in Rheumatology*, 58, 26.
- [32] Kim, D., Park, G., Kuo, L. T., & Park, W. (2018). The effects of pain on quadriceps strength, joint proprioception and dynamic balance among women aged 65 to 75 years with knee osteoarthritis. *BMC Geriatrics*, 18, 1-6.

## **FACULTY OF HOTEL AND TOURISM MANAGEMENT**

# THE INFLUENCE OF SOCIAL COMMERCE ON CONSUMER DECISION MAKING: A CASE STUDY OF PERISHABLE PASTRY PRODUCTS

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## ABSTRACT

This study examines the relationship between social commerce adoption determinants, perceived trust, and purchase behavior among pastry product consumers. Data from 409 consumers were collected via an online survey and analyzed using Partial Least Square-Structural Equation Modeling (PLS-SEM). The findings reveal that consumers perceive social commerce as effortless, engaging, enjoyable, trustworthy, simple to use, and time-saving, motivating them to purchase pastry products through social commerce platforms. The study offers insights for social commerce researchers and marketers, particularly regarding perishable products. It contributes to the understanding of technology acceptance theory by elucidating the determinants of social commerce adoption among consumers in the pastry products domain.

**Keywords:** Social commerce, Pastry products, Technology adoption, Purchase behavior

## INTRODUCTION

In today's fiercely competitive business environment, sustaining and improving business practices presents an ongoing challenge. Entrepreneurs are continually seeking innovative strategies to enhance sales and engage with consumers in a crowded marketplace. Social media platforms have emerged as essential tools for entrepreneurs, facilitating direct marketing of products and services and driving the adoption of integrated online marketing communication platforms. Recent research underscores the effectiveness of online platforms as rapid avenues for business expansion, particularly with the rise of social commerce, which has revolutionized online marketing (Pantano et al., 2018; Srivastava & Sharma, 2013).

The emergence of social commerce arises from the rapid expansion of social networking sites (SNSs), introducing a novel form of electronic commerce (Al-Adwan & Kokash, 2019). Social commerce platforms leverage the capabilities of social media by extending consumers' shopping experiences beyond traditional e-commerce boundaries (Cutshall et al., 2020). These platforms enable consumers to engage in various purchasing activities, including comparison, curation, and sharing of products and services across online and offline marketplaces (Hettiarachchi et al., 2018; Maia et al., 2018). The term "social commerce" encapsulates the influence of social media on digital commerce endeavors (Valerio et al., 2019). According to Yadav et al. (2013), social commerce encompasses activities related to self-esteem, purchasing, usage, and repurchasing facilitated through technology platforms within social media networks. Other scholars define social commerce as a commerce activity leveraging social media platforms to bridge offline and online environments (Al-Adwan & Kokash, 2019). Additionally, researchers use various terms interchangeably, such as social shopping, collaborative commerce, and social media marketing (Han et al., 2018).

Social commerce, facilitated by various social media platforms, has not only transformed business operations but has also triggered significant shifts in consumer behavior during online shopping experiences. The widespread presence of social media has cemented social commerce as a global trend, enabling consumers to make instant purchases and access products and services beyond their geographical boundaries. Particularly noteworthy is its impact on small home-based entrepreneurs, providing them with business opportunities previously inaccessible through traditional retail channels. Despite the promise of social commerce, challenges persist, especially concerning consumer acceptance and trust in this relatively new concept. Trust, along with attributes such as security, safety, privacy,

and reputation, plays a critical role in fostering consumer acceptance and usage of social commerce (Liu et al., 2018). However, there is still a lack of validation regarding trust as a significant predictor of social commerce acceptance, highlighting the urgent need for empirical research, particularly in niche business sectors like the pastry industry.

The pastry industry, acknowledged as a vital global commodity, offers an attractive avenue for business growth. However, budget constraints and a lack of familiarity with electronic commerce have hindered its full utilization of online platforms for sales and promotion. Nevertheless, recent advancements in electronic commerce and social media have encouraged pastry entrepreneurs to explore online business platforms, attracted by their minimal initial investment requirements (Roesler, 2019). Social commerce has gained popularity among entrepreneurs in the perishable food product sector, particularly small and medium-sized businesses, enabling them to establish new brands and interact with consumers. Despite its potential, empirical research on consumer acceptance and usage of social commerce, especially concerning pastry products, remains limited. Addressing this gap is crucial, as understanding consumer behaviour towards social commerce can significantly benefit the Malaysian pastry products industry and overall economic growth.

Therefore, this study aims to investigate consumer acceptance and usage of social commerce in purchasing online pastry products. By examining the relationship between trust and other influencing factors, the study seeks to provide valuable insights for pastry entrepreneurs, enhancing their comprehension of social commerce's operational dynamics and competitive edge. Ultimately, this research strives to bridge the existing gap in empirical research and contribute to a deeper understanding of social commerce in the Malaysian context.

## **MATERIAL AND METHOD**

The study aimed to establish evidence regarding cause-and-effect relationships outlined in the research framework. Therefore, a causal research design was employed. Non-probability sampling, specifically the purposive sampling method, was adopted. Sample size calculation using GPower software suggested a minimum of 133 respondents, with the study targeting 400 responses to accommodate potential incomplete feedback (Wai et al., 2019). A total of 43 instruments were utilized, sourced from previous research (Palau-Saumell et al., 2019; Venkatesh et al., 2003), employing seven-point Likert scales for refined response options. The survey underwent pre-testing to gather expert panel feedback on questionnaire credibility, clarity, user-friendliness, and measurement accuracy. Pilot testing confirmed satisfactory reliability, with values exceeding 0.90, indicating excellent scale accuracy. Hypothesis testing employed Partial Least Squares-Structural Equation Modeling (PLS-SEM) via SmartPLS version 3.3.1 software. PLS-SEM, chosen for its suitability in verifying theoretical causal models and predictive ability, has been widely used across social science studies, including tourism and hospitality management.

## **RESULTS AND DISCUSSION**

The first step in testing the reflective measurement model involves examining indicator reliability. It is recommended that indicator loadings exceed 0.70, indicating that the construct explains more than 50% of the indicator's variance (Hair et al., 2019). In this study, indicator loadings ranged from 0.706 to 1, surpassing the recommended threshold. The second step is to assess internal consistency, measured through composite reliability (CR) and Cronbach's alpha. Both measures should exceed 0.70 (Hair et al., 2019). The CR values ranged from 0.817 to 1, surpassing the recommended threshold. Convergent validity is evaluated through the Average Variance Extracted (AVE), with a desirable value of 0.50 or higher, indicating that the construct explains at least 50% of the variance in its indicators (Hair et al., 2019). The AVE in this study exceeded the permissible threshold of 0.50, indicating satisfactory convergent validity. The heterotrait-monotrait (HTMT) correlation ratio, recommended by Henseler et al. (2016) and Voorhees et al. (2016), was utilized to assess discriminant reliability. A more restrictive threshold value, such as 0.85, is recommended for constructs that are conceptually distinct. The HTMT result, with a value of one, demonstrates excellent discriminant validity between constructs, confirming the model's discriminative validity.

Structural Model Assessment to address bias issues, an assessment of the inner variance inflation factor (VIF) was conducted to ensure that no bias occurred due to correlation among

independent variables in the structural model. The VIF values ranged from 1.436 to 3.530, indicating no bias. Next, the assessment of structural model metrics included path coefficient ( $\beta$ ), coefficient of determination ( $R^2$ ), effect size ( $f^2$ ), and predictive relevance ( $Q^2$ ) (Cuong & Khoi, 2019; Hair et al., 2016). The hypotheses were tested based on the path coefficient ( $\beta$ ) and significance level (p-value) of the relationships between various constructs, including Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Condition, Hedonic Motivation, Price Value, Habit, Trust, Purchase Behavior, and Usage Behavior, at a 95% confidence interval (CI).

The findings of the hypotheses testing revealed several significant relationships. For instance, Performance Expectancy (PE) was found to significantly influence consumer Purchase Behaviour (PB) ( $\beta = 0.313$ ,  $p < 0.001$ ), supporting hypothesis H1. Similarly, Effort Expectancy (EE) positively influenced Purchase Behavior ( $\beta = 0.236$ ,  $p < 0.001$ ), confirming hypothesis H2. Social Influence (SI) was also found to have a significant positive influence on Purchase Behavior ( $\beta = 0.307$ ,  $p < 0.001$ ), supporting hypothesis H3. Additionally, Hedonic Motivation (HM) positively influenced Purchase Behavior ( $\beta = 0.127$ ,  $p = 0.007$ ), supporting hypothesis H5. However, some hypotheses were not supported. For instance, Social Commerce Facilitating Conditions (FC), Price Value (PV), and Habit (H) did not significantly influence Purchase Behavior. Nonetheless, Trust (T) was found to significantly influence both Purchase Behavior ( $\beta = 0.085$ ,  $p = 0.044$ ) and Usage Behavior ( $\beta = 0.113$ ,  $p = 0.014$ ), supporting hypotheses H9 and H10, respectively.

The effect size ( $f^2$ ) analysis indicated that constructs like Effort Expectancy, Hedonic Motivation, and Performance Expectancy had minimal impact on Purchase Behavior, whereas constructs like Social Influence had a substantial effect. The  $R^2$  values showed that the model could explain 72.2% of consumer Purchase Behavior and 46% of Usage Behavior variance. Finally, the predictive relevance ( $Q^2$ ) values for Purchase Behavior ( $Q^2 = 0.413$ ) and Usage Behavior ( $Q^2 = 0.451$ ) indicated a significant level of predictive ability for both constructs, surpassing the threshold limit.

Overall, these results suggest that the path model used in the study adequately measures the relationships between various constructs, providing valuable insights into consumer behavior in the context of social commerce adoption for pastry products.

## CONCLUSION

This study effectively investigated the behavior of pastry consumers within the domain of social commerce purchase behavior, identifying significant variables influencing their actions. The variables examined in this study each displayed distinct impacts, as evidenced by the significant readings of four key dimensions: performance expectancy, effort expectancy, social influence, and hedonic motivation. These dimensions consistently emerged as predictors or precursors of purchase behavior. Conversely, three dimensions -facilitating conditions, price value, and habit - did not demonstrate significant influence on purchase and usage behaviors. Of particular note, performance expectancy emerged as the most influential predictor of purchase behavior. Consumers perceive that they can enhance their productivity when using social commerce, leading to an expectation of improved performance in their purchasing tasks. Additionally, consumers are swayed by their social circles when making purchasing decisions on social commerce platforms.

Effort expectancy also plays a significant role, as consumers perceive the efficiency, ease-of-use, and time-saving features of social commerce platforms as reducing the effort required for purchasing pastry products compared to traditional shopping methods. Moreover, this study expanded upon the UTAUT2 model by incorporating the trust dimension, which proved to be a robust predictor of both purchase behavior and usage behavior. Trust, encompassing elements of perceived privacy and security, significantly influences consumers' decisions to engage with social commerce platforms. The findings of this study bear practical implications for pastry entrepreneurs, especially given the rapid adoption of social commerce accelerated by the Covid-19 pandemic. Understanding consumers' preferences and behaviors in the realm of social commerce can inform marketing strategies, reduce costs, and improve consumer trust, thereby enhancing purchasing opportunities. By leveraging the insights gained from this study, entrepreneurs can tailor their marketing approaches to better meet consumer needs and preferences, ultimately driving business success in the social commerce landscape.

## REFERENCES

Al-Adwan, A.S. and Kokash, H. (2019), "The driving forces of Facebook social commerce", *Journal of Theoretical and Applied Electronic Commerce Research*, Vol. 14 No. 2, doi: 10.4067/s0718-18762019000200103.

Cutshall, R., Changchit, C. and Pham, A. (2020), "Factors influencing consumers' participation in social commerce", *Journal of Computer Information Systems*, Vol. 62 No. 2, pp. 290-301, doi: 10.1080/08874417.2020.1802790.

Cuong, D.T. and Khoi, B.H. (2019), "The relationship between service quality, satisfaction, trust and customer loyalty a study of convenience stores in Vietnam", *Journal of Advanced Research in Dynamic and Control Systems*, Vol. 11, pp. 327-333.

Hair, J.F. Jr, Hult, G.T.M., Ringle, C. and Sarstedt, M. (2016), *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, Sage Publications, Thousand Oaks, CA.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019), "When to use and how to report the results of PLS-SEM", *European Business Review*, Vol. 31 No. 1, pp. 2-24.

Han, H., Xu, H. and Chen, H. (2018), "Social commerce: a systematic review and data synthesis", *Electronic Commerce Research and Applications*, Vol. 30, pp. 38-50, doi: 10.1016/j.elerap.2018.05.005.

Henseler, J., Sinkovics, R.B.J.R., Ringle, C.M. and Sarstedt, M. (2016), "Testing measurement invariance of composites using partial least squares", *International Marketing Review*, Vol. 33 No. 3, pp. 405-431.

Hettiarachchi, H.A.H., Wickramasinghe, C.N. and Ranathunga, S. (2018), "The influence of social commerce on consumer decisions", *The International Technology Management Review*, Vol. 7 No. 1, p. 47, doi: 10.2991/itmrv.7.1.5.

Liu, L., Lee, M.K.O., Liu, R. and Chen, J. (2018), "Trust transfer in social media brand communities: the role of consumer engagement", *International Journal of Information Management*, Vol. 41, pp. 1-13.

Maia, C., Lunardi, G., Longaray, A. and Munhoz, P. (2018), "Factors and characteristics that influence consumers' participation in social commerce", *Revista de Gestão*, Vol. 25 No. 2, pp. 194-211, doi: 10.1108/rege-03-2018-031.

Palau-Saumell, R., Forgas-Coll, S., Sanchez-Garcia, J. and Robres, E. (2019), "User acceptance of mobile apps for restaurants: an expanded and extended UTAUT2", *Sustainability*, Vol. 11 No. 4, p. 1210, doi: 10.3390/su11041210.

Pantano, E., Priporas, C.V. and Dennis, C. (2018), "A new approach to retailing for successful competition in the new smart scenario", *International Journal of Retail and Distribution Management*, Vol. 46 No. 3, pp. 264-282.

Roesler, N. (2019), *How Bakeries Can Align Retail and E-Commerce Sales Strategies*, Sosland Publishing Company, <https://www.bakingbusiness.com/articles/49151-howbakeries-can-align-retail-and-e-commerce>.

Srivastava, K. and Sharma, N.K. (2013), "Consumer attitude towards brand extension: a comparative study of fast-moving consumer goods, durable goods and services", *Journal of Indian Business Research*, Vol. 5 No. 3, pp. 177-197, doi: 10.1108/jibr-07-2012-0057

Wai, K., Dastane, O., Johari, Z. and Ismail, N.B. (2019), "Perceived risk factors affecting consumers' online shopping behaviour", *The Journal of Asian Finance, Economics and Business*, Vol. 6, No. 4, pp. 246-260.

Valerio, C., William, L. and Noemier, Q. (2019), "The impact of social media on e-commerce decision making process", *International Journal of Technology for Business (IJTB)*, Vol. 1 No. 1, pp. 1-9.

Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003), "User acceptance of information technology: toward a unified view", *MIS Quarterly*, pp. 425-478.

Voorhees, C.M., Brady, M.K., Calantone, R. and Ramirez, E. (2016), "Discriminant validity testing in marketing: an analysis, causes for concern, and proposed remedies", *Journal of the Academy of Marketing Science*, Vol. 44 No. 1, pp. 119-134.

Yadav, M.S., de Valck, K., Hennig-Thurau, T., Hoffman, D.L. and Spann, M. (2013), "Social commerce: a contingency framework for assessing marketing potential", *Journal of Interactive Marketing*, Vol. 27 No. 4, pp. 311-323, doi: 10.1016/j.intmar.2013.09.001.

# **SURVIVAL STRATEGIES AND FAMILY ROLES IN MICRO-FAMILY FOOD BUSINESSES DURING COVID-19 PANDEMIC IN SELANGOR**

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## **ABSTRACT:**

Micro-, small, and medium-sized businesses (MSMEs), especially micro-family food businesses (MFFBs), are essential to Malaysia's economy. The COVID-19 pandemic has, however, posed significant challenges for these businesses, particularly in the Klang Valley. This study explores the unique struggles faced by MFFBs and the innovative strategies they employed to survive and thrive during the crisis, emphasizing the role of family dynamics in shaping these strategies. Using a qualitative approach, the research includes semi-structured interviews with six MFFB owners, selected through purposive sampling. Thematic analysis of the data revealed 15 key themes. The first four themes highlight the challenges of revenue loss, financial instability, potential closures, and employee-related issues. The next seven themes focus on the strategies MFFBs implemented, including benevolence, commitment to food quality, adaptability, takeaway management, strategic planning, menu diversification, and technology integration. Additionally, four themes—reliance, task division, deference, and responsibility—underscore the influential role of family members in decision-making. The study reveals that the family unit is not only a support system but also a driving force behind innovation and strategic responses. These findings enhance the understanding of how MFFBs, supported by strong family ties, demonstrate resilience and adaptability in navigating the challenges posed by the pandemic, offering insights into the critical role of familial involvement in MSME sustainability.

**Keyword:** Business challenges, business strategies, COVID-19, family role, micro-family food business.

## **INTRODUCTION**

The global impact of the Coronavirus Disease (COVID-19) pandemic has affected various economic sectors, including the service sector, which contributes significantly to Malaysia's economy at 57.7%. The food and beverage (F&B) industry, integral to the economy, encountered unprecedented challenges during the pandemic, leading to closures of most food establishments during the Movement Control Order (MCO) in March 2020. This phenomenon not only impacted the overall economy but also affected small and medium-sized businesses (SMEs) globally, including the United States, Germany, Japan, Turkey, and Malaysia [1, 2]. In Malaysia, where micro-enterprises constitute 76.5% of all small and medium enterprise (SMEs), a significant portion of businesses, encountered challenges related to growth, succession, and continuity. Family businesses, facing unique concerns in leadership and long-term objectives, particularly in the hospitality and tourism industries, were susceptible to crises. The COVID-19 pandemic exacerbated vulnerabilities for micro-enterprises, leading to issues such as declining demand, financial losses, high employee turnover, and closure risks [3, 4].

In this context, micro-family food businesses (MFFBs) grapple with an existential dilemma, necessitating an in-depth exploration of their challenges, survival strategies, and the role of family dynamics. The research objective is to comprehensively understand these facets, offering insights to enhance MFFBs' resilience during crises and contribute to existing literature. Recognizing the need for more post-COVID-19 research, this study delves into challenges faced by micro-foodservice businesses in Selangor [5]. The study aims to comprehensively explore challenges, survival strategies, and the role of family dynamics in micro-family food businesses during the COVID-19 crisis, filling gaps in understanding the strategic practices used by MFFB owners in Malaysia. Despite attention to success criteria for small businesses, there is a notable lack of research on how SMEs, particularly family-owned businesses, navigate crises like the COVID-19 pandemic [6, 7].

The research provides insights into MFFBs' survival plans, contributing to our understanding of their role in the industry and economy. Identifying a playbook for MFFBs to develop operational

strategies during global economic crises lays the foundation for future research in the foodservice domain. Furthermore, it offers valuable insights for MFFB owners in addressing pandemic challenges, emphasizing the role of "family" and the potential influence of technology and innovation to remain competitive beyond the COVID-19 crisis. The subsequent sections detail the research methodology, findings, and identified themes. The paper concludes by summarizing the study findings, acknowledging limitations, and proposing future research directions.

## MATERIAL AND METHOD

This study employed a basic qualitative research approach to gather information regarding survival strategies and family roles of micro-family food businesses, aiming to restore their business direction. Qualitative research, employing interviews, is suitable for extracting in-depth perspectives [8]. Additionally, it is intriguing for researchers exploring how individuals perceive, construct their worldview, and attribute significance to their experiences. Consequently, this research design presents an excellent opportunity for the researcher to collect precise data regarding MFFB owners' beliefs and motivations for sustaining their business operations during the COVID-19 crisis with an in-depth one-on-one interview.

The purposive sampling technique was employed to delve deeply into the phenomenon, selecting MFFB owners based on specific criteria for information-rich examples of successful business strategies [9]. The study focused on the most developed areas of Malaysia, particularly Selangor on the west coast of Peninsular Malaysia, mainly in the Klang Valley region. The participants were selected based on the criteria: (1) having over five years of business experience, (2) family ownership or familial connections (spouse, siblings, or relatives), (3) operating within a food premise, and (4) being situated within the Klang Valley region of Selangor.

In the qualitative research methodology, in-depth interviews were conducted as the primary data collection method [10]. The MFFB owners were chosen as participants that suited with the study's scope. By using ten open-ended semi-structured questions, the researcher extracted responses from participants. Follow-up questions were employed for clarification. For data analysis, six-phase thematic analysis was employed, which includes familiarisation, initial code generation, theme search, theme review, theme definition, and report production, were applied to categorise data based on participants' responses [11].

## RESULTS AND DISCUSSION

In qualitative research, interviews conclude upon sufficient data collection. Despite arguments favouring a justifiable sample size of one, qualitative researchers typically choose a range of 3 to 50 individuals to account for potential data fluctuations [12]. The researcher adhered to the saturation principle, stating that no new codes emerged in the sixth interview. From the interviews, researchers analysed the transcripts resulting 15 emerging themes and categorised into 3 groups that aligned with the study objectives. The first 4 themes identified the challenges faced by the MFFB owners due to COVID-19, namely drop in revenue, unstable financial, business closure and issues of employee. The next 7 themes developed for the strategies adopted, which are benevolence, food quality, changes of business operation, takeaway orders, effective market research, menu variety and technology adoption. Another 4 themes interpreted the roles of family in MFFB; reliance, dividing tasks, deference and responsibility.

Based on the findings, all participants agreed that they are facing challenges such as sales decline, financial instability, potential closure, and employee issues, experienced these issues during the COVID-19 pandemic. Prolonged lockdowns, as noted by [3], had severe consequences for corporate survival, intensifying financial instability in the foodservice sector. The concerns about business survival, potentially leading to closures, participants expressed their fears of permanent closure during the second wave of COVID-19. The economic impact of COVID-19 in 2020 distressingly affected micro and small businesses in the F&B sector [5]. Closure of businesses resulted in substantial job losses, in line with studies by [13].

However, the MFFB owners employed strategies crucial for business sustainability despite the difficulties. The acts of benevolence towards customers, emphasizing kindness, were the key in business according to [14]. Prioritizing food quality, despite pandemic-induced price hikes is important to meet

the customer preferences and safety concerns, as noted by [15]. Entrepreneurial adaptability was evident as MFFB owners shifted concepts, introducing innovations like online-ready-to-eat meals [16]. Emphasizing takeaways and home delivery reflected the resilience of smaller foodservice enterprises during crises, ensuring business continuity during different MCO phases [3]. Technology adoption, including online platforms and contactless payment facilitates the safe and convenient transactions [13].

On the other hand, the study revealed that MFFB owners prioritise supporting family members as the basic needs and the motivational role of family support. Parents' role as essential models and support systems, motivating entrepreneurs. Effective task division, predominantly by parents, sustained MFFBs, correlating with positive business performance [17]. Emphasizing respect among family members, participants stressed the need for a balanced approach to family and professional responsibilities. [18] highlighted the importance of distinguishing these roles to manage stress. Trust and commitment within family roles had implications for business sustainability, emphasising a proper business management [19]. Concerns over future leadership transitions, focusing on reputation and legacy were acknowledged, with participants preferring family involvement due to trust, dependence, and shared responsibility [14].

## CONCLUSION

This study provides valuable insights for MFFBs to systematically handle and respond to future crises, contributing to continuous thriving from the insights and perceptions from MFFB owners about their challenges during COVID-19, adopted survival strategies, and the family's crucial roles in the business. Addressing a gap in existing literature, this study offers practical guidelines and survival strategies tailored specifically for MFFBs. The highlighted strategies are particularly beneficial for MFFB owners, providing practical applications for long-term feasibility and continuity. The identified playbook from this study serves as a guide for MFFB owners in implementing business operations strategies amid future global economic crises, contributing to a deeper understanding of the family's role in managing business strategies within the food industry. Future studies in related sectors are recommended to assess the instrument's applicability more broadly. This research could broaden its scope by examining the supply chain dynamics of MFFBs, emphasizing how disruptions and adaptations in the supply chain impact their operational strategies, family roles, and overall resilience in times of crises.

## REFERENCES

- [1] Kahveci, E. (2021). Surviving covid-19 and beyond: A conceptual framework for smes in crisis. *Business: Theory and Practice*, 22(1), 167–179. <https://doi.org/10.3846/btp.2021.13020>
- [2] Rani, N. S. A., Krishnan, K. S., Suradi, Z., & Juhdi, N. (2019). Identification of critical components of resilience during and after economic crises: the case of women food operators in Kuala Lumpur. *Asian Academy of Management Journal*, 24(Supp. 2), 111–126. <https://doi.org/10.21315/aamj2019.24.s2.8>
- [3] Piramanayagam, S., Dixit, S. K., & Seal, P. P. (2022). We are in survival mode: how family-owned small foodservice firms in India responded to the Covid-19 pandemic. *Journal of Family Business Management*, 12(3), 436-449. <https://doi.org/10.1108/JFBM-10-2021-0130>
- [4] Toanoglou, M., Chemli, S. & Valeri, M. (2021). The organisational impact of Covid-19 crisis on travel perceived risk across four continents. *Journal of Organizational Change Management*. <https://doi.org/10.1108/JOCM-12-2020-0369>
- [5] Abhari, S., Jalali, A., Jaafar, M., & Tajaddini, R. (2021). The impact of Covid-19 pandemic on small businesses in tourism and hospitality industry in Malaysia. *Journal of Research in Marketing and Entrepreneurship*, 24(1), 1-17. <https://doi.org/10.1108/JRME-07-2020-0091>
- [6] Sum, R. M., & Hamir, H. (2020). Risk Management of A Micro Enterprise: A Case Study On A Small Restaurant In Johor, Malaysia. *International Journal of Communication, Management and Humanities - AID Conference*, 85–93. <https://www.researchgate.net/publication/343601023>
- [7] Arcese, G., Valeri, M., Poponi, S., & Elmo, G.C. (2021). Innovative drivers for family business models in tourism. *Journal of Family Business Management*, 11(4), 402- 422. <https://doi.org/10.1108/JFBM-05-2020-0043>

[8] Kaushal, V., & Srivastava, S. (2021). Hospitality and tourism industry amid COVID19 pandemic: perspectives on challenges and learnings from India. *International Journal of Hospitality Management* 2021, 92(102707). <https://doi.org/10.1016/j.ijhm.2020.102707>

[9] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>

[10] Martino, L., Elvira, V., & Louzada, F. (2017). Effective sample size for importance sampling based on discrepancy measures. *Signal Processing*, 131, 386-401. <https://doi.org/10.1016/j.sigpro.2016.08.025>

[11] Shafi, M., Liu, J., & Ren, W. (2020). Impact of COVID-19 pandemic on micro, small, and medium-sized Enterprises operating in Pakistan. *Research in Globalization*, 2, 1–14. <https://doi.org/10.1016/j.resglo.2020.100018>

[12] Jamil, M., Fadzil, A. F. M., Waqar, A., & Yaacob, M. R. (2022). Exploring entrepreneurial qualities for the sustainability of family businesses in Pakistan. *Journal of Family Business Management. Advance online publication*. <https://doi.org/10.1108/JFBM-05-2022-0073>

[13] Nguyen, L., Gao, Z., Anderson, J. L., & Love, D. C. (2022). Consumers' willingness to pay for information transparency at casual and fine dining restaurants. *International Journal of Hospitality Management*, 100, 1-15, 103104. <https://doi.org/10.1016/j.ijhm.2021.103104>

[14] Leone, L. A., Fleischhacker, S., Anderson-Steeves, B., Harper, K., Winkler, M., Racine, E., Baquero, B., & Gittelsohn, J. (2020). Healthy Food Retail during the COVID-19 Pandemic: Challenges and Future Directions. *International Journal of Environmental Research and Public Health*, 17, 1-14, 7397. <http://dx.doi.org/10.3390/ijerph17207397>

[15] Rachmawati, E., Suliyanto and Suroso, A. (2020). Direct and indirect effect of entrepreneurial orientation, family involvement and gender on family business performance. *Journal of Family Business Management. Advance online publication*. <https://doi.org/10.1108/JFBM-07-2020-0064>

[16] McAdam, M., Clinton, E., & Dibrell, C. (2020). Navigation of the paradoxical landscape of the family business. *International Small Business Journal*, 38(3), 139-153. <https://doi.org/10.1177/0266242619898610>

[17] Camilleri, M. A., & Valeri, M. (2021). Thriving family businesses in tourism and hospitality: A systematic review and a synthesis of the relevant literature. *Journal of Family Business Management. Advance online publication*. <https://doi.org/10.1108/jfbm-10-2021-0133>

[18] Merriam, S. B. (2009). *Qualitative Research: A Guide to Design and Implementation - Revised and Expanded from Qualitative Research and Case Study Applications in Education* (2nd ed.). John Wiley & Sons, Inc.

[19] Tshwete, L. M. (2020). *Strategies for the Growth and Survival of Small-and Medium-Sized Businesses* [Doctoral dissertation, Walden University]. Walden Dissertations and Doctoral Studies. <https://scholarworks.waldenu.edu/dissertations>

# PRESERVATION OF INDIGENOUS CULTURE AND TRADITION THROUGH TOURISM: A STUDY ON MAH MERI COMMUNITY IN CAREY ISLAND, MALAYSIA

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## ABSTRACT

To support sustainable tourism practices in the Malaysian tourism context, this study is regarded as an exploratory study that focuses on the development of cultural tourism in the Mah Meri Community, which includes both tangible and intangible cultural heritage. The focus is on the identity, preservation of the cultural heritage, and promotion of cultural products of the Mah Meri Community, a local Orang Asli community on Carey Island in Selangor, Malaysia. The research's overarching goal is to investigate the factors in the preservation of the cultural features of the Mah Meri Community as a tourism product that can help in promoting the destinations to other people from different backgrounds, races, destinations, and customs. The qualitative data collection helped the researcher to holistically understand the community's cultural identity, characteristics, and resources in the form of cultural tourism products. However, the local community believes that their identity as a potential tourist draw is increasingly threatened due to a lack of natural resources and the government's attention.

**Keywords:** Indigenous people, Mah Meri Community, preservation, cultural heritage, identity

## INTRODUCTION

The indigenous community in Malaysia represents around 12% of the Malaysian population, and most of them reside in East Malaysia while the remaining are residing in Peninsular Malaysia. The indigenous community in Peninsular Malaysia are relatively small, representing only 0.5% (178,000) of the entire population of Malaysia. They can be categorized into three groups namely 1) Semang (Negrito), 2) Senoi and 3) Proto Malay (Aboriginal Malay). Each group has a different language, beliefs, living style, culture and ethnic. The geographical location also differentiates the indigenous people. For instance, those who reside near the coastal area are fishermen while those residing away from the coastal area are mainly farmers. [1,2,3]

Indigenous communities have rich culture and arts especially their wood carving. In general, indigenous communities are poor and it is one of the biggest challenges for the government to assist them. The study's goal is to disclose how to create a preservation strategy for threatened cultures, especially for Indigenous cultures that may soon disappear from the world. [4,5]

### *Mah Meri Community and Tourism*

Orang Asli is classified into three major groups: the Negrito, the Senoi, and the Proto Malay, who differ in language, lifestyle, homes, facial traits, and skin colour. The Negrito tribes include Kensi, Kintak, Jahai, Mendriq, Bateq, and Lanah. The tributes of Senoi are Temlar, Semai, Semoq Beri, Che Wong, Jah Hut, and Mah Meri. Temuan, Semelai, Jakun, Orang Kanaq, Orang Kuala, and Orang Seletar are the Proto Malay tribes. They are one of the Malaysian government's 18 Orang Asli groups. They belong to the Senoi subgroup.

The Mah Meri tribe is mostly concentrated along the coast of South Selangor, from Sungai Pelek to Pulau Carey. There is at least one Mah Meri community on the opposite side of the Klang River. Their forefathers are said to be linked with the entrance of Austro-Asian migrants involved with the introduction of fire-cutting agriculture and rice on the Malay Peninsula. Some Mah Meri and Senoi have intermarried with local Negrito tribes as a result of cultural interactions and trade. Most of the Mah Meri resides in tiny villages (kampungs) on the outskirts of neighbouring towns and on Pulau Carey, which contains five independent Mah Meri communities. [6,7,8]

Pulau Carey is in the Malaysian state of Selangor. The place is well-known for its two distinct features. The first is a thriving fish sector, and the second is an indigenous group known as the Mah Meri people, who are renowned for producing some of the world's best wooden masks in terms of cultural value. They are originally known as the Besisi, which means people with fish scales. The Mah Meri community/people is an ethnic group from Peninsular Malaysia's western region.

As time passes, the Mah Meri people become a tourist attraction for others. More and more tourists are flocking there to experience their way of life and learn more about the culture of Pulau Carey. Mah Meri is a highly prominent race in Malaysia; they represent a type of Malaysian culture, particularly in terms of Orang Asli (indigenous people). Many researchers and authors travel to Pulau Carey to experience and study their way of life. Even though Pulau Carey is not as well-known as Redang and Tioman Islands, Mah Meri's culture has aided the growth of cultural tourism on the island. Because of their mastery of traditional wood carving, the Mah Meri people of Pulau Carey are highly renowned across the world. They have now integrated into contemporary life while simultaneously working in adjacent plantations and farms. They do, however, preserve their distinct culture and way of life.

### **Culture Heritage**

Cultural heritage encompasses tangible and intangible assets passed down from one generation to another within a group or community. It includes tangible culture, intangible culture, and natural heritage. The Mah Meri tribe, for example, is known for their arts, language, tradition, ritual, and dance. Handicrafts, such as leaf origami, masks, and sculptures, are an important aspect of the global visitor experience. The Jah Hut and Mah Meri tribes are known for their figure and mask carvings, which showcase their artistic and abstract creativity. These sculptures reflect their life and are often used in ceremonial dances to worship their ancestors' spirits, known as "Moyang." The carvings are influenced by their spiritual beliefs and are often sold to foreigners and collectors. The Mah Meri people also use ancestor spirits to cure issues and fight against evil spirits. These carvings are recognized by UNESCO as part of the world's heritage and are sought after by international collectors. [9]

Mah Meri, a Malay Peninsula Austroasiatic language, is a member of the Southern Aslian branch of the Aslian languages. It is a language spoken by 3,675 speakers in a coastal setting on the shores of Negeri Sembilan and Selangor. Mah Meri is a forest dweller group with tribes and a language like Proto-Malay. The language has 30 consonants and 9 vowels, with two voice registers: register 1 with shorter durations, a clearer voice, and a lower pitch, and register 2 with looser, longer, and higher pitched vowels. However, the language is not written.[10]

The Mah Meri group has a unique method of healing disease through ritual, which is divided into four stages: *sembuang* ritual, *ancak*, *balai*, and *sampan*. The first stage involves a bamboo tray placed at the patient's foot, containing everyday necessities such as candles, rice, turmeric, coal, egg, betel leaf, areca nut, sugar, and salt. The shaman burns incense, sings incantations, and spreads '*pengebas*' on the patient's body to remove the diseases from within the body and transfer them to the *sembuang*. A 15 cm diameter *Ancak*, is stocked with everyday essentials and three *pulai* wood sculptures, *Moyang Subay*, *Moyang Jegus*, and *Moyang Langkay*, who act as the "Guardian of Sickness." The *Ancak* is then hanged from the tree where the patient is believed to have received the sickness.

Community participation is an essential feature of the Mah Meri culture, with members working together to construct dwellings using traditional materials and methods. The Mah Meri has a long history of singing, dance, and storytelling, which are transmitted through rituals and environmental conservation initiatives. The community has recognized the importance of preserving their artistic and performance traditions to increase national significance and gain government respect.

Preserving architectural legacy can reduce reliance on new materials for construction projects and reduce the energy used in production. This, in turn, generates jobs and economic growth for citizens. Preservation and restoration also generate skilled occupations, raising the value of surrounding properties and promoting community growth.

Intangible cultural assets, such as performance and craft, are passed down orally from generation to generation. The production of authentic traditional arts and crafts supports the indigenous people's economic and cultural vitality. To prevent imitation, the World Intellectual Property Organization (WIPO) recommends the introduction of domestic legislation.

Historic preservation is a residential development that preserves the beauty and worth of existing land. These buildings serve as architectural histories of who we are, reminding communities of our progress and providing significance for both the present and the future.

## **RESEARCH METHODOLOGY**

The interview was held at Kampung Sungai Bumbun, Carey Island. A total of 155 people had been including villagers who live in Kampung Sungai Bumbun, Carey Island. The Malay language was used. There were 2 categories of questions that had been asked. The first category was demographic. It includes gender, age, religion, marital status, family size, educational level, income level, and ownership. On the other hand, there were 3 categories that involve Cultural Programs and Initiatives for Section B. It includes Educational Programs, Culture- Art, Language, Ritual and Dance, Community Participation, Handicrafts, Mah Meri Cultural Village (MMCV) as well as the Sustainability of Indigenous Tourism. Challenges and Opportunities for Section C include Community Involvement, Government Policy, and Tourism Development. Preservation of Indigenous Culture and Tradition Through Tourism for Section D. The data had been analyzed using a program called. To respond to the research topic and evaluate the hypotheses, the researcher performed descriptive analysis, Cronbach alpha, and multiple linear regression. Researchers can generate descriptive statistics and do quantitative data analysis using SPSS. The demographics of the samples had been fully summarized using descriptive statistics. To quantify the internal consistency of a test or scale, the Cronbach alpha statistic had been utilized. The associations between the variables and the various constructs had been examined using multiple linear regression.

## **FINDINGS AND RESULTS**

The Descriptive Analysis shows that tourism can attract many people to Mah Meri Cultural Village, affecting the preservation of indigenous culture and customs. The village has been preserving sculptures and masks since 1951, providing an example for young sculptors. Visitors, students, and government officials visit weekly to learn about the village's culture and traditions.

The study supports the hypothesis that sustainability in indigenous tourism impacts the preservation of indigenous culture and tradition. Respondents strongly agree that ancestral heritage must be preserved for tourism, aiming for a better future and preserving mental and physical health. Social sustainability involves equitably treating all people and providing essential services.

The Descriptive Analysis shows that community engagement significantly impacts indigenous culture and tradition preservation through tourism. The literature study supports this hypothesis, stating that the community acts as a symbolic key to sustainable tourism. Parents and elder generations continue to teach their children and grandchildren, preserving their culture and heritage.

The study supports the hypothesis that government policy influences the preservation of indigenous culture and tradition through tourism. Most respondents agree that the tourism industry protects the Mah Meri community's natural environment. Malaysia's policy efforts, including the Ninth Malaysian Plan (2006-2010), promote tourism, craft sector growth, global market promotion, and heritage preservation, recognizing cultural, artistic, and heritage-related enterprises as economic expansion sources.

Tourism development in Mah Meri Community promotes positive environmental ethics, significantly impacting indigenous culture and customs. This growth benefits the community through cultural preservation, economic growth, and environmental protection. Fostering conservation efforts can conserve Mah Meri's natural resources and habitat.

## **DISCUSSION**

Tourism development on Carey Island, Malaysia, presents both obstacles and possibilities for the Mah Meri people. Challenges include loss of cultural identity, environmental damage, and economic inequity. The Mah Meri culture is distinct and precious, but growing exposure to visitors and other influences may result in cultural uniformity and the loss of indigenous traditions and beliefs. Increased tourism may result in environmental deterioration, such as abuse of natural resources, pollution, and habitat damage.

On the bright side, tourist growth can provide opportunities for the community, such as cultural preservation, economic development, and environmental conservation. Cultural preservation can be achieved by promoting Mah Meri culture and traditional customs and fostering cultural preservation and education through introducing masks and carving art to other countries. Tourism can also be an income source for the Mah Meri community, contributing to economic growth and poverty alleviation. Environmental conservation can result in the protection of Mah Meri's natural resources and habitat by raising awareness of environmental concerns and promoting sustainability.

## CONCLUSION

Enlightening visitors about the indigenous culture fosters solidarity and pride, allowing the Mah Meri people to retain their heritage through tourism. Tourism can be used to help preserve societies, cultures and natural environments by educating visitors to increase their awareness and appreciation for what makes a place special. In addition, tourism revenues, for example from entrance fee, donation and others, can be used to help finance preservation efforts.

## REFERENCES

- [1] Jabatan Kemajuan Orang Asli (JAKOA), Jabatan Hal Ehwal Orang Asli Report Of 2020, K.Lumpur.
- [2] Abdullah, J., Borhan, M. A. A., & Ahmad, C. B. (2015). Orang asli resettlement in urban environment at Bukit Lanjan, Selangor, Malaysia. *Procedia-Social and Behavioral Sciences*, 201, 71-79.
- [3] Isa, S. S., Zakaria, H. M., & Isa, S. S. (2016). From Cultural Activity to Cultural Tourism: A Case of Indigenous Community in Malaysia. In *Regional Conference on Science, Technology and Social Sciences (RCSTSS 2014)* (pp. 1009-1021). Springer, Singapore.
- [4] Roddin, R., Sidi, N. S., Hadi, M. A., & Yusof, Y. (2012). Poverty eradication through "prom-poor tourism" (PPT) approach among Orang Asli communities in Malaysia. In EDULEARN12 Proceedings (pp. 1175–1183).
- [5] Roddin, R., Yusof, Y., & Sidi, N. S. S. (2015). Factors that influence the success of Mah Meri tribe in the tourism sector. *Procedia-Social and Behavioral Sciences* 204, 335-342
- [6] Kunasekaran, P., Gill, S. S., Ramachandran, S., Shuib, A., Baum, T., & Affandi, S. H. M. (2017). Measuring Sustainable Indigenous Tourism Indicators: A Case of Mah Meri Ethnic Group in Carey Island, Malaysia. *Sustainability*, 9(7), 1256. <https://doi.org/10.3390/su9071256>
- [7] Suet Ching,C. *Mah Meri on Stage: Negotiating National Policies, Tourism and Modernization in Kampung Sungai Bumbun, Carey Island*. PhD theses. University of Hawaii, 2010 14-17
- [8] Nowak,S. *Marriage and Household: Besisi' Response to a Changing World*. PhD Dissertation. State University of New York at Buffalo, 1987
- [9] UNWTO (2004) Sustainable Tourism Development (online). Retrieved on 20 September 2023. Available at <http://sdt.unwto.org/en>.
- [10] Stevens, M., Kruspe, N. and Hajek, J. (2006) (PDF) Register in mah meri: A preliminary phonetic analysis - researchgate, Register in Mah Meri: A preliminary phonetic analysis. Available at: [https://www.researchgate.net/publication/228670106\\_Register\\_in\\_Mah\\_Meri\\_A\\_preliminary\\_phonetic\\_analysis](https://www.researchgate.net/publication/228670106_Register_in_Mah_Meri_A_preliminary_phonetic_analysis) (Accessed: April 9, 2023).

## **FACULTY OF BUSINESS AND MANAGEMENT**

# REBRANDING OF STREET MARKETS: A DESIGN DRIVEN APPROACH

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## ABSTRACT

The street market, including the night and farmers' market, is considered as a less formalized economic activity that operates as part of the coping strategies in communities caught by the domestic response to changes in the global economy. While it is considered as the bottom of the retail pyramid, studies on street markets have found quite a substantial number of advantages that strengthen human and social interactions. Low prices and the possibility of finding deals, and a melting pot for people's diversity and culture have become the street market essence. However, the liberation of sub-scale retail sector has somehow affected the consumer's acceptance of the market. Low prices and better-quality products are the retailers' competitive advantages, while cleanliness, prices do not standardize, and poor services are tarnishing the market's image. Therefore, it raises the question of how the street markets can regain their competitive advantage and survive in the industry, given the intense competition from the retailers. Malaysian NKEA was introduced to create a balance in equipping the street markets with the modernize transformation in its distribution and operation. In addition, recently TN50 was also launched to further transform and modernize the street market image. However, the action and the development related to the achievement are yet to be well strategized. Hence, it is critical to rebrand the street market into a modern and informative culture. To address the issue, we propose to develop a street market app that will boost users' experience and later improve their acceptance by using the design driven approach. As IT has become the lifestyle, it is vital that street markets remain savvy, even in digital form, and responsive to consumers' needs.

**Keywords:** street market, rebranding, open-air market, competitive advantage, retail market

## INTRODUCTION

Street markets, influenced by informal work and urban landscape, have expanded in Malaysia since the medieval period (Sinha & Choudhury, 2023). They attract tourists and are a cultural attraction due to their high value. Governments support microenterprises by establishing policies, regulations, and financial assistance (Wang & Xu, 2021). Street markets offer a variety of products, including accessories, food, and delicacies, at good bargaining prices. The concept of street markets in Malaysia is synonymous with lifestyle and culture, with local authentic food offerings in every city and village (Yuen May et al., 2021).

During Ramadhan, street markets in Malaysia offer a unique experience for food vendors, known as bazaar Ramadhan. However, the operation of these markets is challenging and requires extensive labor tasks. Vendors must prepare tents, set up electrical supplies, and pay a specific plot number based on space availability and product type. Local councils monitor licensing and activities. Street market food vending is common in Shah Alam, the capital city of Selangor, where food trucks replace traditional desk operations. The internet has also revolutionized food delivery, making it challenging for food vendors to succeed (Hassoun et al., 2023). The research aims to assess how individual, organizational, and environmental factors interact to affect the success of food street market vendors in today's digital lifestyle.

### Problem Statement

Malaysia, a vibrant tapestry of cultures and traditions, has long been synonymous with its bustling street markets. The street markets in Malaysia are not just places to shop for aromatic spices to the colorful display of local crafts and many other products or services offered, but also a cornerstone

of its informal economy (Squarzon, 2020). Traditional street markets in Malaysia are struggling to maintain their vitality and relevance in the face of rising competition, outdated practices, and a changing consumer landscape.

### ***Competition from Formal Retailers***

The most immediate threat comes from the relentless expansion of modern retail. Air-conditioned supermarkets, sprawling hypermarkets, and sleek shopping malls offer a sterile but alluring alternative to the often-chaotic street market. These establishments boast consistent pricing, predictable hours, standardized quality, and comfortable shopping experience and environments. They also often have sophisticated marketing strategies and loyalty programs that draw customers away from traditional markets. The convenience and perceived higher quality make it difficult for street markets to compete, especially with younger, more affordable consumers or customers (Sevtsuk, 2020).

### ***Cleanliness and Hygiene Issues***

One of the most persistent challenges for street markets in Malaysia and indeed many developing nations, is the issue of cleanliness. Overflowing bins, unsanitary food handling practices, and the present of pets can deter shoppers, particularly tourists and those comfortable to the hygiene standards of modern retail outlets. While some markets have attempted to improve their sanitation, a lack of consistent maintenance, adequate waste disposal facilities, and enforcement of regulations often challenge these efforts (Nijhawan et al., 2023). This is not just an appealing issue, but also a significant health concern.

### ***Lack of Standardization and Regulation***

Street market in Malaysia often operate in a largely decentralized manner unlike regulated retail spaces. This leads to a lack of uniformity in pricing, product quality, and even the way businesses are conducted. The absence of clear regulations and standardized operating procedures means that market vendors often lack the necessary training in business management, food safety, and customer service (Prevolšek et al., 2021). This inconsistency can make shopping at street markets unpredictable and at times frustrating for customers.

### ***Modernization Context***

Malaysia's vibrant street markets, known locally as 'pasar malam' and 'pasar tani' are integral to the nation's cultural and economic landscape. These bustling hubs offer affordable goods, local flavours, and a social gathering point for communities. However, in an era of rapid modernization and aspirations of Transformasi Nasional 50 (TN50), these traditional marketplaces face the challenge of adaptation. While efforts have been made to modernize them, progress has been slow, leaving a gap between the vision and reality. Malaysia's national transformation plan spanning 2020 – 2050 (TN50), aimed to build a future proof nation through sustainable and inclusive growth (Karim, 2021). Key elements relevant to street market modernization include economic empowerment, technological advancement, urban renewal and sustainability and community engagement. TN50 focused on empowering small businesses and fostering entrepreneurship, which directly applies to street vendors. Initiatives should aim to improve their income and business practices. Embracing digital platforms, e-commerce, and financial technology was a core aspect of TN50. This is relevant to enhancing payment systems, online marketing, and inventory management for street vendors. TN50 emphasized the development of livable and sustainable cities. This necessitates improving the infrastructure and hygiene of street markets, aligning them with urban development goals. Furthermore, TN50 stressed inclusive participation and preserving cultural heritage. Street markets, as community hubs, need to be modernized in a way that respects their cultural significance and involves the local communities.

### ***Research Objectives***

This study explores rebranding strategies through a design-driven approach. This involves looking at everything from physical infrastructure to brand identity. The rebranding elements include modernizing stalls, branding and signage, creating a thematic experience and improved infrastructure. Redesigning more aesthetically pleasing stalls improves the market's visual appeal and creates a more organized layout. This will lead to clearer and attractive signage to enhance navigation and communicate the unique offerings of each vendor. Besides, vendors should adopt themes or highlight specific local craft or food items to create a more immersive experience. Moreover, for infrastructure,

vendors should also upgrade their lighting, sanitation facilities, and waste management systems that will contribute to a more comfortable and hygienic environment. Digital solutions such as online presence using online platforms or social media profiles can expand reach and visibility. E-commerce options offer online ordering and delivery services that can attract a wider customer base. E-wallet and other forms of digital payment can create a seamless and convenient transaction process. In the era of data-driven applications, it will help to provide valuable insights into customer preferences and help vendors make informed business decisions.

A proposed mobile application has the potential to be a catalyst for significant transformation. It will serve as a connection between vendors and customers and streamlining various aspects of market operations. Providing tools for inventory management, digital payments, and access to market data, enabling better decision making and financial planning for the street market stakeholders. Besides, the apps can offer a seamless browsing experience, highlighting unique products, and fostering transparency in pricing and quality. Moreover, it will facilitate efficient logistics by reducing waste and promoting local, eco-friendly products.

### **RELATED WORK**

Malaysia's MSMEs contribute to national economic development by creating jobs, strengthening community ties, attracting expertise, and promoting stability. Street markets, a Southeast Asian lifestyle trademark, offer unique experiences and serve as business incubators for aspiring entrepreneurs (Lim, 2021). However, the city's authority is dissatisfied with the number of foreign traders, leading to a rebranding, uniform aprons, and a new zoning system. The emphasis on cleanliness and rubbish bin placements further enhances the industry's success.

Street markets, including night markets, flea markets, and farmers' markets, are less formalized economic activities that strengthen human and social interactions (Chen & Liu, 2019). They offer low prices, deals, and a melting pot for people's diversity and culture. Famous street and night markets include Chatuchak Weekend Market in Bangkok, Souks of Marrakesh in Marrakesh, Shilin Night Market in Taipei, and La Boqueria in Barcelona. Information technology is crucial for business sustainability and user experience enhancement (Gil-Gomez et al., 2020).

Street markets, the vibrant arteries of urban life, pulse with a unique energy. In Malaysia, these markets are more than just places to buy goods, they are cultural hubs, economic drivers, and social gathering spots. Malaysia street markets serve as vital engines for microentrepreneurs to test their products and reach their target audiences (Krishnan et al., 2020). Furthermore, they embody cultural traditions, passing down culinary secrets, craft techniques, and community bonds through generations.

The sustained success of Malaysia street markets pivots on the involved interaction between individual vendors and supportive government policies. Well-designed policies can empower vendors with access to loans, business training and infrastructure improvements, ultimately boosting their sales and ensuring the longevity of these markets (Taylor et al., 2022). This includes access to proper waste disposal systems, reliable electrical connections, and shaded spaces to enhance the overall shopping experience for customers.

However, while the economic and cultural contributions of street markets in Malaysia are well-documented, existing research often falls short in addressing the challenges they face in a rapidly evolving environment. Furthermore, research often lacks critical analysis of the limitation inherent in past studies related to lack of diversity in the perspectives considered such as online ordering and delivery services for street market vendors.

### **MATERIAL AND METHOD**

Action Research (AR) method was employed to answer the research objectives of the study. This research method is well suited in the area of information systems development. AR is a combination of action and research and committed to the production of new knowledge by seeking solutions or improvements to real life practical situations (McKay and Marshall, 2001). There are two stages involved in this proposed study namely diagnostic stage and therapeutic stage (Baskerville and Myers, 2004). The first stage involves a collaborative analysis of the problems by the researchers and the subjects of the research (local authority, customers and business operators). Semi structured interview and Focus Group Discussions (FGD) were conducted to determine the problems and issues related to the study from the perspectives of participants.

### ***Population and sample***

A set of criteria was established to guide the researchers during the selection process to ensure that those involved in the mini focus group study can represent the population. The criteria include (1) the vendors are considered successful in their business with more than one year experience; (2) they represent food vendors of street market in the local area; and (3) they have received various types of aid from certain agencies to run their business and sustain in the street market.

**Table 1: Respondents' Profile**

<b>Variables</b>	<b>Description</b>	<b>Frequency</b>	<b>Percentage</b>
Products	Food	6	60.0
	Beverages	2	40.0
Age	31-40 years old	3	37.5
	41-50 years old	2	25.0
	51-60 years old	2	25.0
	61-70 years old	1	12.5
Marital Status	Single	0	0.0
	Married	8	100.0
Business Experience	Less than 5 years	0	28.0
	5-10 years	6	75.0
	More than 10 years	2	25.0
Monthly Sales	Less than RM2500	3	37.5
	RM2500 - RM9000	3	37.5
	RM9001 - RM31000	2	25.0
Costs of Operation	Less than RM1000	2	25
	RM1000 - RM3000	3	37.5
	RM3001 - RM12000	3	37.5
Gross Monthly Income	Less than RM1800	2	25.0
	RM1800 - RM3800	3	37.5
	RM3801 - RM20000	2	25.0

	More than RM20000	1	12.5
Monthly Expenses	Less than RM700	2	25.0
	RM700 - RM2000	2	25.0
	RM2001 - RM3800	1	12.5
	More than RM3800	3	37.5
Number of Employee	0 employee	0	0.0
	1 employee	2	25.0
	2 employees	4	50.0
	3 employees	1	12.5
	4 employees	1	12.5

## **RESULTS AND DISCUSSION**

As stated in Figure 1, the main factors contributing to the success of street market food vendors are dominated by individual factors either within control or beyond control. The first factor that is important to assist street market food and beverages vendors in achieving their business success is an individual factor mainly focusing on attitude. Attitude can be in the form of hardworking, smile, deep interest, survival instinct, focus and mentality. According to Correia & Kozak (2016), attitudes are also related to values, beliefs intentions, and behaviours, as in the case of counterfeiters. They did research focuses on personal attitudes, and as such the model presented hypothesizes that attitude towards street markets influences tourists' satisfaction and their intentions regarding repeat visitation or

recommending the experience of shopping in street markets to others. A study done by Trafialek et al. (2017) revealed that vendors had poor attitude levels. Thus, it is important to ensure the attitudes of vendors are the major factor contributing to business success. The finding is consistent with Soon (2019) stated that a number of factors could affect the ranking results inclusive of food handlers' knowledge and attitude, food safety training and education, and consumer's demands. Why is this individual factor important? The answer lies in the nature of business itself. It is possible that street food vendors were aware of the food safety news and consumers demand stricter food safety inspections from the local authorities. The unfortunate incident may have increased food handlers' awareness and attitudes towards food hygiene and safety (Soon, 2019). Several studies have been conducted to measure the level of vendors attitude towards food businesses such as in Turkey (Trafialek et al., 2017), Uganda and Kenya ((Muyanja, Nayiga, Brenda, & Nasinyama, 2011).

Skills that can be divided into communication and digital marketing skills is the second critical factor perceived by the food vendors of street market in Malaysia that contribute to business success. A study by Gatere (2016), through training women street vendors have acquired the relevant business management skills. They found that women lacked simple entrepreneurial skills such as auditing, accounting, marketing, planning and public relations. As a result, the respective institutions should organize training forums for women street vendors aiming at equipping them with the right credit and business management skills. Another study by Pletnev and Barkhatov (2016) found that all seven factors selected for the survey appeared to be quite important: financial resources, technological resources, entrepreneurial skills, government support, marketing strategy, business planning quality, and access to information contribute the business success factors for small-medium enterprises (SMEs) in the national economy of Pakistan. Therefore, entrepreneurial skills is important and considered as the skills that are pre-requisite for effective business operation guaranteeing some positive outcome (Gatere, 2016).

Operation such as running business every day, joint event, early preparation and enough workforce ranked as the second success factor in which categorized as important and within control of organizational factor. Another organization factor in the same category includes information management (brainstorming, cooperation, financial management, marketing techniques and prices comparison), machinery and other facilities for easy food and beverages management and resources available. This finding is supported by a study done by Lee et al., (2011) introducing a multilevel perspective of individual and organizational factors influencing business creation intentions. The findings of this study offer a number of opportunities for future research to advance our knowledge of the individual and organizational factors that predict IT professionals' intentions to start businesses. Aware of the business environment, transportation, location, technology and networking ranked as the third important factor contributing to the business success grouped under environmental factor. This finding was also reported by (Fernando, Chiappetta Jabbour, & Wah, 2019) who also found that environmental factors play an important role in chievingg business success.

Government support, which include the finance (repayment, funding and loans) and courses provided ranked as the fourth factor contributing to the business success. The findings is consistent with Long, Looijen and Blok (2018) and Muyanja et. al., (2011) which reported that support from government is crucial in sustaining business model innovation and economic effect. Financing can be in the form of low-interest loans, government grants, financial incentives, financial support from agencies such as TEKUN, MARA and other financial grants available in the country. Every business requires funding in terms of capital, premise, staffing, system and infrastructure investment to start off and to expand their business. Most private financial institutions rely on track records to award loans to businesses but for a new business venture, not having a favorable track record to award loans. For courses, encouragement by the government through local community programmes such as DuitNow, eRezeki and eUsahawan in Malaysia supported by MDEC for example can open up the opportunity for street market vendors in getting more demand via online platform for the food and beverages and at the same time increase their revenues.

### ***Malaysian Street Market Survival***

Malaysian street market survives as they preserve tradition crafts, culinary practices and social interactions that are vital to Malaysia's cultural identity and hub. Moreover, street markets in Malaysia provide livelihoods for countless individuals and families that often serving as entry points to

entrepreneurship for marginalized communities. Besides, the street market also draws for visitors eager to experience the authentic flavors and atmosphere of Malaysia. They foster community bonds and offer a space for social interaction that is gradually disappearing in modern urban life.

Several initiatives have been launched to modernize the Malaysian street markets attempting to align with TN50 involving the upgrades of infrastructure. Some markets have received basic infrastructure improvements like covered stalls, proper drainage, and waste management systems. This aims to create a more conducive and hygienic environment. More efforts have been made to encourage the use of e-wallets and other digital payment methods, reducing reliance on cash and promoting financial inclusivity. Workshops and training sessions have been introduced to equip vendors with basic business skills, hygiene practices and digital literacy. Some initiatives have focused on creating online platforms for vendors to sell their products, expanding their reach beyond the physical market. Besides, more organized market management effort has been made to formalize market operations, introduce licensing systems, and establish better management practices.

Even though many initiatives have been considered and launched, modernization of Malaysian street markets has not reached its full potential several factors contribute to this slow progress includes lack of comprehensive integration, limited funding and resources, resistance to change, inadequate digital infrastructure and weak community engagement. A comprehensive plan with clear goals, timelines and assigned responsibilities across government agencies is crucial. Funds should be allocated not just for infrastructure but also for vendor training, digital literacy programs, sustainable waste management and community engagement for long-term impact.

Within Control		Beyond Control	
Important	Not Important	Important	Not Important
<b>Individual (Rank #1)</b> 1. Attitude 2. Entrepreneur skills	<b>Individual</b> 1. Online business encouragement 2. Lifelong learning	<b>Individual</b> 1. Learn from mistakes 2. Learn from experience 3. Family conditions 4. Technology advancement (online business) 5. Health condition	<b>Individual</b> 1. Awards 2. Age
<b>Organizational (Rank #2)</b> 1. Operation 2. Information management 3. Machinery and other facilities for easy F&B management 4. Resources available	<b>Environmental</b> 1. Product improvement (innovation) 2. Product quality	<b>Environmental</b> 1. Accounting systems 2. Taxation 3. Provision of courses and seminars (training and development) 4. Competition 5. Weather 6. Family support	<b>Environmental</b> 1. License issuance 2. Motivation 3. Support from peers and neighbors
<b>Environmental (Rank #3)</b> 1. Aware of the business environment 2. Transportation 3. Location 4. Technology 5. Networking	<b>Organizational</b> 1. Business partner sharing	<b>Organizational</b> 1. Sales 2. Profit 3. Capital 4. Resources supplies	<b>Organizational</b> 1. Audit and classification
<b>Government Support (Rank #4)</b> 1. Finance 2. Courses	<b>Government Support</b> 1. Compound 2. Price control	<b>Government Support</b> 1. Business guidelines/ regulation (government policy) 2. Financial assistance 3. Training assistance & facilities	<b>Government Support</b> 1. Government subsidies 2. Political changes 3. Government support 4. License issuance by Local Municipal

Figure 1: Summary of business success factors as perceived by the respondents.

### Malaysian Street Market Unique Context

#### Rapid Urbanization

The rapid growth of Malaysian cities has led to the displacement of traditional markets, often replaced by high-rise buildings and commercial developments. This reduces the physical space available for markets and disrupts the established ecosystem of vendors and customers.

#### Cultural Shift

Malaysia's growing middle class is increasingly influenced by Western consumer culture, often favouring the convenience and perceived modernity of formal retail over the traditional experience of street markets.

#### Government Policies

While the government has, at times, made efforts to support local markets, a lack of consistent, targeted policies and enforcement often challenge these initiatives. A focus on attracting foreign investors and promoting large scale retail has in many ways, inadvertently downgraded traditional street markets.

## ***Sustainable Future of Street Markets via Digital Solutions***

Malaysia's street market can retain their cultural significance while adapting to the demands of a modern world. The integration of policies that support the modernization of street markets by invest in infrastructure upgrades and digital integration tools help to attract wider audiences.

## **CONCLUSION**

Taken as a whole, the findings are consistent with (Lee et al., 2011) assertion that individual-level factors predict the processes of new venture development. This study is meant to explore the factors that contribute to business success based on the mini focus group study approach. The findings discovered that individual factors are the most important factors followed by organization factors as the second important factor and government supports and environment factors respectively. This exploratory research aimed at gaining insights into the motivations of selected food street market vendors in Malaysia, their perceptions about the success factors. The future of Malaysian street markets is not predetermined. With strategic interventions and support, the street market can not only survive but thrive. Government should invest in targeting funding for improved infrastructure, sanitation facilities, and vendor training programs. Vendors also need to take the initiative to join business mentorship and training in modern business practices that will also lead to access to microloans. Without consumers or customers, businesses would not survive. Community involvement and engagement is important in the planning and management of markets, ensuring the street market remains relevant and reflective of local needs. All vendors also should embrace innovative technologies that provide solutions such as online platforms for market vendors and digital payment systems. Moreover, focusing on the unique cultural aspects of each market to attract tourists seeking authentic experience. Malaysia should ensure that all stakeholders continue to play a vital role in the nation's vibrant and diverse landscape. It is not just about saving a retail format but about safeguarding a vital part of Malaysia's heritage and collective identity.

## **REFERENCES**

Baskerville, R., & Myers, M. D. (2004). Special issue on action research in information systems: Making IS research relevant to practice: Foreword. *Mis Quarterly*, 329-335.

Chen, Y., & Liu, C. Y. (2019). Self-employed migrants and their entrepreneurial space in megacities: A Beijing farmers' market. *Habitat International*, 83, 125-134.

De Bruin, A., & Dupuis, A. (2000). The dynamics of New Zealand's largest street market; the Otara flea market. *International journal of sociology and social policy*, 20(1/2), 52-73.

Gil-Gomez, H., Guerola-Navarro, V., Oltra-Badenes, R., & Lozano-Quilis, J. A. (2020). Customer relationship management: digital transformation and sustainable business model innovation. *Economic research-Ekonomska istraživanja*, 33(1), 2733-2750.

Hassoun, A., Aït-Kaddour, A., Abu-Mahfouz, A. M., Rathod, N. B., Bader, F., Barba, F. J., Biancolillo, A., Cropotova, J., Galanakis, C. M., & Jambrak, A. R. (2023). The fourth industrial revolution in the food industry—Part I: Industry 4.0 technologies. *Critical Reviews in Food Science and Nutrition*, 63(23), 6547-6563.

Jones, P., Simmons, G., Packham, G., Beynon-Davies, P., & Pickernell, D. (2014). An exploration of the attitudes and strategic responses of sole-proprietor micro-enterprises in adopting information and communication technology. *International Small Business Journal*, 32(3), 285-306.

Kamal, M. (2015). Developing a sustainability network for information technology adoption and use in micro-enterprises. *Journal of the Midwest Association for Information Systems*, 1, 21-32.

Karim, A. (2021). The Politics of Visioning and Coalition Building in Malaysia: A Futures Studies Approach. Penerbit USM.

Kassim, E. S., Othman, A. K. and Zamzuri, N. H. (2016). Strategies for Sustainable Social Commerce: The Roles of Customer Focus, Innovative Business Model, Legality and Trust, *Information Journal*, 19 (7B), 2907-2912

Krishnan, S. N., Ganesh, L. S., & Rajendran, C. (2020). Characterizing and Distinguishing 'Innovative Start-ups' Among Micro, Small and Medium Enterprises (MSME). *Journal of New Business Ventures*, 1(1-2), 125-156. <https://doi.org/10.1177/2632962x20964418>

Lim, T. W. (2021). East Asian Entrepreneurs: A Study of State Role, Education and Mindsets. World Scientific.

Markovitch, S., & Willmott, P. (2014). Accelerating the digitization of business processes. *McKinsey & Company*, New York.

McKay, J., & Marshall, P. (2001). The dual imperatives of action research. *Information Technology & People*, 14(1), 46-59.

Minoo, T., & Charles, S. (2003). Economic development and micro-enterprises in rural communities: Are there gender differences?. *The Journal of Business and Economic Development*, 9 (1), 26-41.

New Strait times, June 17, 2014, 'Improved' TTDI night market opens. Available at <https://www.nst.com.my/news/2015/09/improved-ttdi-night-market-opens>.

Nijhawan, A., Budge, S., Reddy, O., Bartram, J., & Howard, G. (2023). Environmental hygiene in outdoor food markets in Africa: a scoping review. *Journal of Water, Sanitation and Hygiene for Development*, 13(4), 276-288.

Ogara, S. O., Koh, C. E., & Prybutok, V. R. (2014). Investigating factors affecting social presence and user satisfaction with mobile instant messaging. *Computers in Human Behavior*, 36, 453-459.

Petrescu, M., & Bhatli, D. (2013). Consumer behavior in flea markets and marketing to the Bottom of the Pyramid. *Journal of Management Research*, 13(1), 55.

Prevolšek, V., Ovca, A., & Jevšnik, M. (2021). Fulfilment of technical and hygienic requirements among street food vendors in Slovenia. *British Food Journal*, 123(13), 105-123.

Salleh, F., Yaakub, N., Yunus, K., Ghani, M. A., & Sulong, W. K. W. (2012). Factors Influencing the Night Market Traders' Performance in Malaysia. *International Journal of Business and Management*, 7(14), 32.

Sevtsuk, A. (2020). *Street commerce: Creating vibrant urban sidewalks*. University of Pennsylvania Press.

Sinha, M., & Choudhury, D. (2023). Redevelopment And Linkage Of Urban Public Markets: The Case Of Silchar Town, India. *Urbanism. Architecture. Constructions/Urbanism. Arhitectura. Constructii*, 14(2).

Squarezon, C. (2020). Taking the Street Out of Street Food: the Singapore Case 1. In.

Taylor, M., González, S., Waley, P., & Wilkinson, R. (2022). Developing markets as community hubs for inclusive economies: a best practice handbook for market operators.

Wang, H., & Xu, H. (2021). Research on Financing Difficulties and Countermeasures of Small and Micro-Enterprises in China: An Analysis Based on COVID-19. 2020 3rd International Seminar on Education Research and Social Science (ISERSS 2020),

Yuen May, R. Y., Aziz, K. A., Latif, R. A., Abdul Latip, M. S., Kwan, T. C., & Abdul Kadir, M. A. (2021). The Success Factors Affecting Street Food Stalls for Gastronomic Tourism Competitiveness: A Case of Petaling Jaya Old Town. *International Journal of Early Childhood Special Education*, 13(1).

# INTERNAL AND EXTERNAL BARRIERS TO EFFECTIVE SUPPLY CHAIN MANAGEMENT IMPLEMENTATION IN MALAYSIAN MANUFACTURING COMPANIES: A PRIORITY LIST BASED ON VARYING DEMOGRAPHIC PERSPECTIVES

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## ABSTRACT

Identifying and prioritizing internal and external barriers to supply chain management (SCM) is crucial, especially in a developing country context like Malaysia, where challenges often stem from limited awareness and unclear objectives within the supply chain network. This study thus aims to compare the ranking of various demographic groups in relation to the internal and external barriers experienced by Malaysian manufacturing companies, a topic that has received minimal attention. The identified lists of internal and external barriers are prioritised using the Analytic Hierarchy Process (AHP) from ten respondents with wide-ranging experience in SCM. The ranking of the respondents from different races, age groups, education levels, employment types, work experience, and designations suggests significant variations between these groups in terms of the ranking of internal and external barriers. The findings of this research provide significant information to company managers who desire to implement SCM in a multi-cultural setting such as Malaysia. The onus is on these managers to be cautious in developing a strategic plan for its effective SCM implementation and also in designing programs to overcome SCM obstacles.

**Keywords:** internal barriers, external barriers, supply chain management, Analytic Hierarchy Process, demographic perspectives

## INTRODUCTION

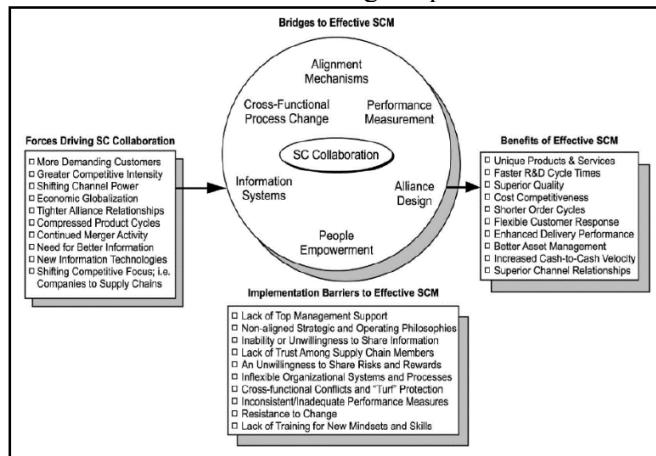
The concept of Supply Chain Management (SCM) combines the forward flow of materials and the backward flow of information (Monzouri, Ab Rahman, & Arshad, 2011). It is also typified by such activities as the flow of materials, information, products, and funds from supplier to manufacturer, to distributor, to retailer, and ultimately to the end users (Ferguson, 2000; Ali et al., 2012). Smooth implementation of SCM is required to ensure that the production process is effective, and this has provided the impetus for organisations to invest more in their Supply Chain (SC) (Manzouri et al., 2010; Mentzer, 2000). The many benefits of SCM include a reduction in inventory, improved sharing of information, increased mutual trust among supply chain partners, reduction of product life cycle, and increased customer satisfaction (Lee et al., 2011; Lee et al., 2014). Yet SCM implementation can be challenging and costly (Huo et al., 2017; Gorane & Kant, 2015; Monzouri, 2011; Manzouri, 2010; Meehan, & Muir, 2008). To fully achieve the benefits of SCM, organisations have to address these challenges and overcome both intra and inter organisational barriers that are often encountered (Gorane & Kant, 2015).

Intra-organisational SCM barriers are internal challenges such as lack of top management support, employee empowerment and training, financial resources, information technology and infrastructure. Conversely, inter organisational are external barriers ranging from an unwillingness to share critical information, lack of collaboration between SC partners, lack of information sharing, and mistrust among SC partners (Adhikari, 2010; Subrahmanyam & Rajashekhar, 2009; Asad Sadi, & Al-Dubaisi, 2008). Most of the SCM literature to date has identified and provided useful explications of SCM barriers, but currently, limited studies have been carried out to rank or prioritised the barriers (Islam, & Anis, 2018). Specifically, very little is known about prioritising the barriers based on different demographic perspectives in a Malaysian context and identifying the most urgent barriers to be

addressed. This paper studies Malaysian manufacturing companies and specifically attempts to rank and prioritise the barriers to SCM implementation according to different demographic perspectives. The well-known decision-making tool, the Analytic Hierarchy Process (AHP), is used for this purpose.

### **Supply Chain Management**

In order to allow a detailed analysis of SCM implementation, Palmer and Shah (2016) developed a comprehensive framework for SCM implementation that breaks down the process into four stages, as illustrated in Figure 1. The diagram shows that SCM implementation comprises strategic management initiatives and the factors that drive its implementation, such as customer demand, competition, economics and technology, performance outcomes, and the barriers disrupting the implementation of SCM. These barriers include a lack of top management support, unwillingness to share information, and reluctance to share risks among SC partners.



**Figure 1: A framework for SCM implementation (Palmer & Shah, 2016)**

### **Barriers to SCM**

This section will discuss the classification of the various internal and external barriers that prevent companies from implementing effective SCM (Meehan & Muir, 2008). To achieve optimal benefits, managers and business owners must understand and manage the barriers well so that the obstacles can be accurately and timely resolved (Ravi, et al., 2005). Internal SCM barriers stem from limited support from management, inadequate employee empowerment and training, insufficient funds, and an inferior information technology base. Additionally, problems between organisations and partners related to their refusal to share vital information, lack of trust and non-collaboration represent the external barriers to SCM (Adhikari, 2010; Subrahmanyam & Rajashekhar, 2009; Asad & Al-Dubaisi, 2008).

In the Malaysian context, Islam and Anis (2018) have carried out the barriers to SCM implementation in manufacturing companies. The barriers are shown in Table 1, in which the authors have categorised the barriers into internal and external.

**Table 1: Internal and External Barriers in Malaysian Manufacturing Companies**

<b>Internal Barriers</b>	<b>External Barriers</b>
<ul style="list-style-type: none"> <li>• Untrained workers</li> <li>• Poor communication between management and workers</li> <li>• Poor quality control</li> <li>• Machine breakdown</li> <li>• Wrong forecasts</li> <li>• Poor delivery system</li> <li>• Sloppy workers</li> <li>• Inefficient layout of the factory</li> <li>• No proper control of inventory</li> </ul>	<ul style="list-style-type: none"> <li>• Poor communication with suppliers</li> <li>• Late delivery</li> <li>• Unavailability of necessary raw materials</li> <li>• Fluctuation of product demand</li> <li>• Unreliable suppliers</li> <li>• Poor quality raw materials</li> <li>• Change in customer requirement</li> <li>• Raw materials price fluctuation</li> </ul>

	● Change of technology
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Source: Islam and Anis (2018).

The present study will utilise the barriers discovered by Islam and Anis (2018) to produce a ranking based on varying demographic perspectives.

## METHOD

This study employed the quantitative approach. Firstly, the internal and external barriers were identified through a literature review, specifically from Islam and Anis (2018). These barriers were then brought to and validated by expert academics and the relevant manufacturing industry practitioners involved in supply chain activities. Subsequently, these internal and external barriers were used to design the Analytics Hierarchy Process (AHP) survey questionnaire. The AHP data was obtained via structured interviews with five practitioners involved in supply chain activities and five expert academics in the area of SCM. These academics and practitioners were selected through a purposive sampling technique. The use of the purposive sampling technique is appropriate since the AHP requires opinions from experts possessing the necessary information.

## RESULTS AND DISCUSSION

Twelve respondents were contacted, and ten agreed to participate in the study (refer to Table 2). The majority, or 40 percent (4/10) of the respondents, are Malays as well as Indians, and 70 percent (7/10) are aged 51 and above. Most of 90 percent (9/10) of the respondents are either Master's degree or Ph.D. holders. Five or 50 percent of the respondents are attached to private organisations and possess 10 to 15 years or more than 15 years of working experience. As to their designation, Table 2 shows that 50 percent (5/10) of the respondents are academics in universities as well as manufacturing industry practitioners with practical experience in supply chain activities. It can be surmised that all the respondents are credible and have sufficient expertise in organisational supply chain management.

**Table 2: Demographic information of the respondents**

Demographic Profile	Frequency	Percentage
Gender		
● Male	9	90.00
● Female	1	10.00
Race		
● Malay	4	40.00
● Chinese	-	-
● Indian	4	40.00
● Others	2	20.00
Age Group		
● 21 – 30 years	-	-
● 31 – 40 years	-	-
● 41 – 50 years	3	30.00
● 51 year and above	7	70.00
Educational level		
● Certificate/Diploma	1	10.00
● Bachelors	-	-
● Master's	5	50.00
● PhD	4	40.00
Type of employment		
● Public sector	4	40.00
● Private sector	5	50.00
● Others	1	10.00
Working experience		
● 1 – 5 years	-	-

● 6 – 10 years	-	-
● 10 – 15 years	5	50.00
● 15 years and above	5	50.00
Designation		
● Supply-chain manager	1	10.00
● Senior estate manager	1	10.00
● Business consultant and trainers	2	20.00
● Environment and safety consultant	1	10.00
● University Professor/Associate Professor	5	50.00

Based on data in Table 2, the study intends to investigate the ranking of internal and external barriers assigned by different demographic groups, namely race, age, education level, employment type, working experience, and designation.

#### ***Analysis Based on Different Demographic Groups***

The findings are divided into two. Firstly, the ranking analysis is based on different demographic groups, namely race, age, education level, employment type, working experience, and designation. Secondly, the findings show the Rank Correlation Coefficient (RCC) results, evaluating the similarity of rankings assigned by the seven identified demographic groups as suggested by (Ho, 2008). The ranking assigned by the six groups and their corresponding priority values for internal and external barriers and the internal barrier and external barrier items are presented in Tables 3, 4, and 5, respectively (refer to Appendix 1). Data in Table 3 illustrates that all demographic groups, namely race, age, education level, employment type, working experience, and designation, show a fair amount of consensus in the ranking of internal and external barriers.

Overall, most of the demographic groups ranked the external barriers as the most important barriers compared to internal barriers, i.e., 1-2, respectively. Conversely, three demographic groups, i.e., race (others), education level (those with Master's degrees), and working experience (those possessing 15 years and more working experience), ranked internal barriers as the most important barriers as compared to external ones, i.e., 2-1. Tables 6, 7, and 8 (refer to Appendix 1) demonstrate the RCC in measuring the similarities in ranking assigned by the six demographic groups. Table 6 reveals significant similarities in the ranking of internal and external barriers by several demographic groups at a 1 percent significant level; specifically, the ranking assigned by the Malays – Indians (race), 31 to 40 years old – 41 to 50 years old (age), Certificate/Diploma – Others (education level), Public – Private, Public – Others, Private – Others (employment type) and Academic – Practitioner (designation).

Other demographic groups, on the other hand, showed a significantly different ranking for internal and external barriers, for instance, the ranking assigned by demographic groups of races (Malay – Others, Indian - Others), education level (Certificate/ Diploma – Master, Master – Others) and experience (10 to 15 years – 15 years and above). The ranking assigned by each demographic group for the internal barrier items is exhibited in Table 5. The following nine items were identified as the internal barriers to manufacturing supply chain activities: 1) untrained workers, 2) poor communication between management and workers, 3) poor quality control, 4) machine breakdowns, 5) inaccurate forecasts, 6) poor delivery systems, 7) sloppy workers, 8) inefficient layout, and 9) poor inventory control.

Table 5 reveals that the priority values and ranking differ for various demographic groups. Specifically, differences in the rankings were seen by demographic groups of races (Malay and Indian), education level (those with Certificates/ Diplomas and Master's degree as well as Certificates/ Diplomas and Other qualifications), the three employment types, i.e., Public, Private and Others and interestingly, the ranking by Academics and Practitioners (designation). The differences in ranking assigned by various demographic groups are supported by data in Table 8, which shows the RCC in measuring the similarities in ranking assigned by the six demographic groups in the present study. There are no significant similarities obtained between any demographic groups of races, age, education level, employment type, working experience, or designation, demonstrating that the ranking assigned by each

demographic group of races, age, education level, employment type, working experience, and designation are distinct.

The ranking of items for external barriers, namely 1) poor communication with suppliers, 2) late delivery, 3) unavailability of necessary raw materials, 4) fluctuation of product demand, 5) unreliable suppliers, 6) poor quality raw materials, 7) change in customer requirements 8) raw materials price fluctuation and 9) change in technology are presented in Table 5. Table 5 discloses that the ranking for external barrier items is different according to all demographic groups. Notably, divergent rankings were expressed by demographic groups of races (Indian and Others), education level (those who possess Certificates/ Diplomas and Master's degrees as well as Master's and Other qualifications), years of experience (those with 31 – 40 years and 41 to 50 years of working experience), employment type, especially for those attached to Public and Other organisations.

The RCC for items of external barriers is shown in Table 8. It was found that none of the RCC for the external barrier items was statistically significant for any combination of any demographic groups. Each demographic group, i.e., race, age, education level, employment type, working experience, and designation, has assigned different priorities for the external barrier items, indicating that each demographic group held differing perspectives in ranking the external barrier items.

## CONCLUSION

Limited empirical evidence is available on the barriers involved in SCM implementation in Malaysian manufacturing companies (Subrahmanya & Rajashekhar, 2009). Studies investigating the barriers to SCM implementation among related demographic groups involved in SCM implementation are even fewer. This study provides useful information to manufacturing companies on barriers to SCM implementation in a multi-cultural setting. This is carried out by obtaining the respondents' ranking of internal and external barriers to SCM implementation according to various demographic groups, i.e., race, age group, education level, employment type, work experience, and designation. The most striking result is that the RCCs for internal and external barriers were perfectly correlated at a 1 percent significant level.

In addition, most of the demographic groups assigned external barriers as most important compared to internal barriers for successful SCM implementation in Malaysian manufacturing companies. It is apparent that none of the RCCs were statistically significant for any combination of demographic groups for the nine internal and external barrier items. This means each demographic group, namely race, age, education level, employment type, work experience, and designation, has different priorities for the nine items. This study contributes to the literature, for without understanding these perspectives and evaluating their implications, SCM implementation in a specific multi-demographic and multi-cultural scenario runs the risk of inefficient management and loss of value.

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## REFERENCES

Adhikari, D. R. (2010). Human resource development (HRD) for performance management: The case of Nepalese organizations. *International Journal of Productivity and Performance Management*, 59(4), 306-324.

Ali, M., & Habib, M. M. (2012). Supply chain management of textile industry: A case study on Bangladesh. *International Journal of Supply Chain Management*, 1(2), 35.

Asad Sadi, M., & Al-Dubaisi, A. H. (2008). Barriers to organizational creativity: The marketing executives' perspective in Saudi Arabia. *Journal of Management Development*, 27(6), 574-599.

Ferguson, B. R. (2000). Implementing supply chain management. *Production and Inventory Management Journal*, 41, 64-67.

Gorane, S. J., & Kant, R. (2015). Modelling the SCM implementation barriers: An integrated ISM-fuzzy MICMAC approach. *Journal of Modelling in Management*, 10(2), 158-178.

Ho, W. (2008). Integrated analytic hierarchy process and its applications—A literature review. *European Journal of Operational Research*, 186(1), 211-228.

Huo, B., Wang, Q., Zhao, X., & Hua, Z. (2017). Barriers to third-party logistics integration: empirical evidence from China. *Industrial Management & Data Systems*, 117(8), 1738-1760.

Islam, R., & Anis, A. (2018). Prioritisation of Internal and External Barriers for Supply Chain Implementation in Manufacturing Companies: A Malaysian Perspective. *Multi-Criteria Methods and Techniques Applied to Supply Chain Management*, 33-55.

Lee, K. L., Mohamed Udin, Z., & Hassan, M. G. (2014). Global supply chain capabilities in Malaysian textile and apparel industry. *International Journal of Supply Chain Management (IJSCM)*, 3(2), 31-40.

Lee, Y. C., Chu, P. Y., & Tseng, H. L. (2011). Corporate performance of ICT-enabled business process re-engineering. *Industrial Management & Data Systems*, 111(5), 735-754.

Manzouri, M., Rahman, M. N. A., Arshad, H., & Ismail, A. R. (2010). Barriers of supply chain management implementation in manufacturing companies: a comparison between Iranian and Malaysian companies. *Journal of the Chinese Institute of Industrial Engineers*, 27(6), 456-472.

Meehan, J., & Muir, L. (2008). SCM in Merseyside SMEs: benefits and barriers. *The TQM Journal*, 20(3), 223-232.

Mentzer, J. T., Foggin, J. H., & Golicic, S. L. (2000). Collaboration: the enablers, impediments, and benefits. *Supply chain management review*, 4(4), 52-58.

Monzouri, M., Ab Rahman, M.N., & Arshad, H. (2011). Problematic issues in implementation of supply chain management in Iranian automotive industries. *International Conference on Environment Science and Engineering (IPCBEE)*, Singapore.

Palmer, V., & Shah, H.G. (2016) A literature review on supply chain management barriers in manufacturing organisation. *International Journal of Engineering Development and Research*, 4 (1), 26-42.

Ravi, V., Shankar, R., & Tiwari, M. K. (2005). Productivity improvement of a computer hardware supply chain. *International Journal of Productivity and Performance Management*, 54(4), 239-255.

Subrahmanyam Bhat, K., & Rajashekhar, J. (2009). An empirical study of barriers to TQM implementation in Indian industries. *The TQM Journal*, 21(3), 261-272.

## APPENDIX

### Appendix 1

Table 3: Priority value and ranking for internal and external barriers by various demographic groups

Barriers	RACES						AGE				EDUCATION LEVELS					
	Malay		Indian		Others		31 – 40 years		41 – 50 years		Certificate/diploma		Master		PhD	
	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank
Internal	0.4860	2	0.3898	2	0.6910	1	0.476	2	0.4855	2	0.1667	2	0.6607	1	0.4720	2
External	0.5140	1	0.6102	1	0.3090	2	0.5240	1	0.5145	1	0.8333	1	0.3393	2	0.5280	1

Barriers	TYPE OF EMPLOYMENT						EXPERIENCE				DESIGNATION			
	Public sector		Private sector		Others		10 – 15 years		15 years and above		Academic		Practitioners	
	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank
Internal	0.4886	2	0.4202	2	0.2	2	0.4039	2	0.5764	1	0.4909	2	0.4889	2
External	0.5114	1	0.5798	1	0.8	1	0.5961	1	0.4236	2	0.5091	1	0.5111	1

Table 4: Priority value and ranking for items of internal barrier by various demographic groups

Barriers	RACES						AGE			
	Malay		Indian		Others		31 – 40 years		41 – 50 years	
	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank
Untrained workers	0.1385	4	0.1060	4	0.1463	2	0.1219	3	0.1416	1

Poor communication mgt and workers	0.0537	9	0.2010	1	0.0647	8	0.1821	2	0.0774	9
Poor quality control	0.0631	8	0.1798	2	0.2543	1	0.2253	1	0.1141	5
Machine breakdowns	0.0792	7	0.0634	9	0.0656	7	0.0462	9	0.0678	8
Wrong forecasts	0.1521	2	0.0723	7	0.0967	5	0.0825	6	0.1220	4
Poor delivery system	0.1456	2	0.1013	5	0.0457	9	0.0976	5	0.1044	6
Sloopy workers	0.1549	1	0.1081	3	0.1283	3	0.1129	4	0.1399	2
Inefficient layout	0.1071	5	0.0671	8	0.0841	6	0.0613	8	0.1033	7
No proper control of inventory	0.1057	6	0.1009	6	0.1143	4	0.0704	7	0.1295	3

Barriers	EDUCATION LEVEL						TYPE OF EMPLOYMENT					
	Certificate/diploma		Master		PhD		Public sector		Private sector		Others	
	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank
Untrained workers	0.0494	6	0.1522	2	0.1438	3	0.2280	1	0.0995	6	0.0867	9
Poor communication mgt and workers	0.0141	9	0.1729	1	0.0777	7	0.0812	6	0.1077	5	0.1183	4
Poor quality control	0.0270	8	0.1227	4	0.1934	1	0.1286	4	0.1543	2	0.1004	6
Machine breakdowns	0.0758	4	0.0641	9	0.0486	9	0.0446	9	0.0644	9	0.1113	5
Wrong forecasts	0.2489	2	0.0836	7	0.1016	6	0.0687	8	0.1549	1	0.1215	3
Poor delivery system	0.3359	1	0.1097	5	0.0627	8	0.0774	7	0.1248	4	0.0984	7

Sloopy workers	0.1371	3	0.1311	3	0.1102	4	0.1403	3	0.1268	3	0.0953	8
Inefficient layout	0.0739	5	0.0718	8	0.1098	5	0.0829	5	0.0826	8	0.1342	1
No proper control of inventory	0.0379	7	0.0920	6	0.1522	2	0.1483	2	0.0852	7	0.1339	2

Barriers	EXPERIENCES				DESIGNATION			
	Malay		Indian		31 – 40 years		41 – 50 years	
	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank
Untrained workers	0.1219	3	0.1478	2	0.1809	1	0.1024	6
Poor communication mgt and workers	0.1084	5	0.0988	6	0.0816	7	0.1276	4
Poor quality control	0.1881	1	0.1006	5	0.1346	3	0.1338	2
Machine breakdowns	0.0588	9	0.0622	9	0.0586	9	0.0639	9
Wrong forecasts	0.1321	2	0.0853	7	0.0961	5	0.1271	5
Poor delivery system	0.0877	8	0.1339	3	0.0773	8	0.1443	1
Sloopy workers	0.1089	4	0.1597	1	0.1279	4	0.1313	3
Inefficient layout	0.0935	7	0.0801	8	0.0942	6	0.0897	7
No proper control of inventory	0.1007	6	0.1316	4	0.1488	2	0.0798	8

Table 5: Priority value and ranking for external barriers items by various demographic groups

Barriers	RACES						AGE			
	Malay		Indian		Others		31 – 40 years		41 – 50 years	
	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank
Sloopy workers	0.1371	3	0.1311	3	0.1102	4	0.1403	3	0.1268	3
Inefficient layout	0.0739	5	0.0718	8	0.1098	5	0.0829	5	0.0826	8
No proper control of inventory	0.0379	7	0.0920	6	0.1522	2	0.1483	2	0.0852	7

Poor communication with suppliers	0.0550	8	0.1021	3	0.0650	7	0.0878	5	0.0749	7
Late delivery	0.0600	7	0.2696	1	0.0452	8	0.2644	1	0.0735	8
Unavailability of necessary raw materials	0.1537	2	0.0652	7	0.0958	4	0.0480	9	0.1472	2
Fluctuations in product demand	0.0528	9	0.0627	8	0.0933	5	0.0696	7	0.0662	9
Unreliable suppliers	0.1484	3	0.0768	4	0.0340	9	0.0715	6	0.0991	6
Poor quality raw materials	0.2375	1	0.2012	2	0.1285	3	0.1713	2	0.2239	1
Change in customer requirements	0.0854	5	0.0762	6	0.3098	1	0.1075	4	0.1148	3
Raw materials price fluctuations	0.1280	4	0.0564	9	0.0855	6	0.0647	8	0.1044	4
Change in technology	0.0792	6	0.0898	4	0.1430	2	0.1152	3	0.0960	5

Barriers	EDUCATION LEVEL						TYPE OF EMPLOYMENT					
	Certificate/ diploma		Master		PhD		Public sector		Private sector		Others	
	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank
Poor communication with suppliers	0.0326	9	0.1053	4	0.0638	9	0.0532	9	0.0968	6	0.1609	2
Late delivery	0.0211	8	0.1814	2	0.0733	7	0.0687	8	0.1356	3	0.1326	3
Unavailability of necessary raw materials	0.3607	1	0.0623	8	0.1327	4	0.1580	2	0.0981	5	0.0322	9
Fluctuation of product demand	0.0554	7	0.0572	9	0.0758	6	0.0698	7	0.0691	9	0.0449	8
Unreliable suppliers	0.0593	6	0.1278	3	0.0639	8	0.1153	3	0.0721	8	0.1216	4
Poor quality raw materials	0.0948	4	0.2406	1	0.1850	1	0.2216	1	0.1774	1	0.2584	1
Change in customer requirements	0.1877	2	0.0701	7	0.1587	2	0.0876	6	0.1541	2	0.0886	5
Raw materials price fluctuations	0.0831	5	0.0836	5	0.0979	5	0.1181	4	0.0750	7	0.0841	6
Change in technology	0.1053	3	0.0717	6	0.1488	3	0.1078	5	0.1219	4	0.0767	7

Barriers	EXPERIENCES				DESIGNATION			
	Malay		Indian		31 – 40 years		41 – 50 years	
	Normalised	Rank	Normalised	Rank	Normalised	Rank	Normalised	Rank
Poor communication with suppliers	0.0773	7	0.0884	6	0.0699	8	0.0934	5
Late delivery	0.1510	2	0.0804	7	0.0714	7	0.1602	2
Unavailability of necessary raw materials	0.0756	8	0.1516	2	0.1535	2	0.0761	8
Fluctuations in product demand	0.0681	9	0.0683	9	0.0670	9	0.0667	9
Unreliable suppliers	0.0820	6	0.1078	3	0.1012	6	0.0859	6
Poor quality raw materials	0.1900	1	0.2375	1	0.2212	1	0.2006	1
Change in customer requirements	0.1352	4	0.0920	5	0.1063	3	0.1316	3
Raw materials price fluctuations	0.0846	5	0.1003	4	0.1038	5	0.0811	7
Change in technology	0.1362	3	0.0737	8	0.1057	4	0.1045	4

Table 6: RCC of ranking for internal and external barriers by various demographic groups

RCC	RACES			AGE	EDUCATION LEVELS		
	Malay - Indian	Malay - Others	Indian - Others		Certificate – master	Certificate - PhD	Master - PhD
	1 (0.01)*	-1 (0.01)*	-1 (0.01)*	31 to 40 years - 41 to 50 years	1.00 (0.01)*	-1.00 (0.01)*	1.00 (0.01)*

RCC	TYPE OF EMPLOYMENT			EXPERIENCE	DESIGNATION	
	Public-Private	Public-Others	Private-Others		Academic - Practitioners	
	1.00 (0.01)*	1.00 (0.01)*	1.00 (0.01)*	10 to15 years – 15 years and above	1.00 (0.01)*	
				-1.00 (0.001)*	1.00 (0.01)*	

Number in the (bracket) represents the *p* value of the correlation test

\*Significant at 0.01 percent

**Table 7: RCC of ranking for items in internal barrier by various demographic groups**

	RACES			AGE	EDUCATION LEVELS		
	Malay - Indian	Malay - Others	Indian - Others	31 to 40 years - 41 to 50 years	Certificate – master	Certificate - PhD	Master - PhD
RCC	-2.17 (0.576)	0.1 (0.798)	0.283 (0.460)	0.200 (0.606)	-0.433 (0.244)	-0.483 (0.187)	0.317 (0.406)

	TYPE OF EMPLOYMENT			EXPERIENCE	DESIGNATION		
	Public- Private	Public- Others	Private- Others	10 to15 years – 15 years and above	Academic - Practitioners		
	-0.017 (0.966)	-0.283 (0.460)	-0.283 (0.460)	0.317 (0.406)	-0.017 (0.966)		

Number in the (bracket) represents the *p* value of the correlation test

**Table 8: RCC of ranking for items in external barrier by various demographic groups**

	RACES			AGE	EDUCATION LEVELS		
	Malay - Indian	Malay - Others	Indian - Others	31 to 40 years - 41 to 50 years	Certificate – master	Certificate - PhD	Master - PhD
RCC	0.008 (0.983)	0.183 (0.637)	-2.09 (0.589)	-0.067 (0.865)	-0.383 (0.308)	0.800 (0.010)	-0.117 (0.765)

	TYPE OF EMPLOYMENT			EXPERIENCE	DESIGNATION		
	Public- Private	Public- Others	Private- Others	10 to15 years – 15 years and above	Academic - Practitioners		
	0.183 (0.637)	-0.117 (0.244)	0.433 (0.244)	0.183 (0.637)	0.383 (0.308)		

Number in the (bracket) represents the *p* value of the correlation test

# CORPORATE SOCIAL PERFORMANCE (CSP): AN EXPERIENCE OF BANK ISLAM MALAYSIA BERHAD

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## ABSTRACT

This research explores the sustainability of Islamic corporate social responsibilities (CSR) programs through the case study of bank Islam Malaysia berhad's sadaqa house platform. interviews with the key beneficiaries who are also the key informants for this study were selected based on their experiences when receiving the financial assistance. they revealed that focused csr initiatives led to enhanced satisfaction and quality of life. despite a small sample size, the study achieved its objectives due to the relevance of selected informants. this research contributes to understanding the impact and sustainability of CSR programs within financial institutions, particularly in emerging markets. bank Islam's experience offers a valuable benchmark for best practices.

**Keywords:** corporate social performance, Bank Islam, corporate social responsibilities, Sadaqa House, Islamic bank

## INTRODUCTION

Since CSR has been defined in a variety of ways over the years by prior literature, it is challenging to come to a consensus on a word that is widely understood since it can imply different things to different people [1]. [2] define CSR as a broad and all-encompassing term that encompasses a range of concerns related to corporate obligations. [3] endeavoured to consolidate the diverse interpretations of CSR found in prior literature into four essential elements: economic, legal, ethical, and philanthropic.

These four components encompass all of a corporation's responsibilities to society, which are practical and grounded in reality, considering both the humanitarian nature of a firm and its need to make profits. [4] propose that the Islamic financial institutions (IFIs) have achieved their CSR goals, as demonstrated by their study on a specific Islamic bank in Malaysia. They also argue that CSR is expanding in tandem with the IFIs' favourable financial performance. This is consistent with the results reported by [4] on the corporate social performance of *takaful* in Malaysia. [5] highlighted the significance of IFIs to deliberately synchronise their decisions and actions in order to be socially accountable for advancing the well-being of society.

This viewpoint is also supported by [6], who explained that IFIs should engage in CSR in both obligatory and recommended manners. The compulsory documents include: investment screening, prohibition of illicit earnings, customer management, recruitment of exceptional staff, and payment of *zakat*. [7] Dusuki (2011) contends that the ethical and social responsibilities outlined by Western scholars can be extended to Islamic banking due to the universal nature of the main themes, which align with Islamic teachings. These themes include environmental stewardship, human resource management, philanthropy, and human rights.

[8] suggest that Islamic banks use sustainable techniques in their implementation of CSR. According to their viewpoint, this should be founded on comprehensive Islamic principles and should be directed towards various socioeconomic factions. Hence, it is imperative for Islamic banks to consistently enhance their consciousness, transparency, and supervision in their CSR endeavours. [9] emphasise that CSR efforts will enhance the reputation of Islamic banks in Bangladesh.

This is because Islamic banks need to be perceived as going beyond only financial considerations. Similarly, [10] concur that the Islamic banks' implementation of CSR initiatives

contributes to the development of a favourable reputation, which in turn increases customer inclination to choose these banks.

This is supported by the findings of [9] study on Islamic banks in Bangladesh, which revealed a positive correlation between the execution of CSR activities and the profitability of the banks over a five-year period. The research conducted by [9] is challenged by [4], who discovered that the Islamic banks in their study consistently engaged in CSR initiatives even though experiencing a reduction in profits in some years (as seen by the researchers).

The CSR initiatives are financed either by *zakat*, which is the obligatory alms tax that Islamic banks are required to pay annually from their profits, or through funds provided by the shareholders as part of their operational costs [11,12].

## **MATERIAL AND METHOD**

The research used semi-structured interviews to balance focused questioning with the flexibility to explore topics as they emerged. This method allowed them to gather in-depth information about CSR initiatives from key Bank Islam Malaysia Berhad informants. Face-to-face interviews enabled researchers to observe nonverbal cues, enhancing data validity [13,14]. Interviews were conducted in either Malay or English based on participant preference.

Key informants were chosen for their expertise, availability, and interest in the research topic. The study interviewed three individuals from beneficiary institutions of the Sadaqa House CSR program. Though a small sample, this number allowed for rapport-building and data saturation, where all three informants provided consistent criteria [15]. This saturation point was important considering the study's external funding [16]. The selection of participants ensured a representative view of Sadaqa House beneficiaries. The key informants are:

Key informants, Universiti Teknologi Malaysia (UTM)  
Key informants 2, National Heart Institute Foundation (YIJN)  
Key informants 3, Sultanah Bahiah Foundation (YSB)

## **RESULTS AND DISCUSSION**

### ***Research Objective 1: Evaluate the long-term positive impact of Bank Islam Malaysia's CSR programs on beneficiary satisfaction.***

Key findings: Beneficiaries of the Bank Islam Malaysia CSR program appear to have entered into agreements voluntarily.

Supporting Evidences:

- Key informants 2 emphasize mutual agreement and transparency between YIJN and Sadaqa House. YIJN willingly provided patient information for funding decisions.
- Key informants 3 describe YSB's participation as voluntary with alternative funding sources available.
- Key informants 1 confirm that UTM was approached by Bank Islam and freely chose to accept the offered funds.

Overall: The text suggests that there's no evidence of coercion in the CSR program's implementation. Beneficiaries made informed choices to participate based on open communication about goals, processes, and funding uses.

### ***Research objective 2: Determine the long-term impact of the bank's CSR program on beneficiaries' well-being.***

Key findings: Bank Islam Malaysia CSR program has mixed effects on employability for beneficiaries.

Supporting Evidences:

- YSB: The program likely increases employability by creating job opportunities through small business support.

- IJN: The program has no direct impact on employability as it focuses on covering medical bills for children. Indigenous communities: The program's impact on employability is uncertain. While it improves quality of life through solar energy access, it doesn't directly create jobs.

Overall, the program appears to prioritize improving basic living standards and healthcare access, which could indirectly enhance future employment prospects for beneficiaries

## CONCLUSION

This analysis indicates that Bank Islam Malaysia's CSR activities have achieved sustainability via improved quality of life and happiness. The newly founded Sadaqa House has harnessed the knowledge and collaborative efforts of Bank Islam by providing a specialised platform for CSR initiatives. This has allowed the bank to prudently deploy funds for high-impact CSR initiatives and reduce spending on individual CSR events that lack consistency. It is imperative for other International Financial Institutions (IFIs) to evaluate their CSR initiatives in order to fulfil their dual obligations of being financially sustainable and socially accountable. This study has several limitations. Initially, the study just focuses on Bank Islam, which is inadequate to serve as a representative sample of all Islamic banks in Malaysia. However, the report effectively highlighted the achievement of Bank Islam in guaranteeing the sustainability of its CSR activities. Next, the key informants selected were only three. By having more key informants, more meaningful information can be captured. Nevertheless, the three key informants have been able to provide important insights on the impacts of CSR activities of Bank Islam through Sadaqa House platform which has contributed to the CSP of Bank Islam itself.

## REFERENCES

- [1] Marrewijk, M. V. (2003). Concepts and Definitions of CSR and Corporate Sustainability: Between Agency and Communion. *Journal of Business Ethics*, 44(2), 95-105.
- [2] Hillenbrand, C., & Money, K. (2007). Corporate Responsibility and Corporate Reputation: Two Separate Concepts or Two Sides of the Same Coin? *Corporate Reputation Review*, 10(4), 261-277.
- [3] Carroll, A. B. (1999). Corporate Social Responsibility: Evolution of a Definitional Construct. *Business and Society*, 38(3), 268-295
- [4] Muhamat, A. A., Jaafar, M. N., & Basri, M. F. (2017). Corporate Social Performance (CSP) Influences on Islamic Bank's Financial Performance. *Journal of International Business, Economics and Entrepreneurship (JIBE)*, 2(1), 11-16
- [5] Sairally, B. S. (2006). A Study on the Corporate Social Responsibility of Islamic Financial Institutions: Learning from the Experience of Socially Responsible Financial Institutions in the UK (Doctoral Dissertation, Loughborough University, Loughborough). Retrieved from <https://s3-eu-west-1.amazonaws.com/>
- [6] Farook, S., Hassan, M. K., & Lanis, R. (2011). Determinants of Corporate Social Responsibility Disclosure: The Case of Islamic Banks. *Journal of Islamic Accounting and Business Research*, 2(2), 114-141
- [7] Dusuki, A. W., & Bouheraoua, S. (2011). The framework of Maqasid al-Shari'ah and its implication for Islamic finance. *ICR Journal*, 2(2), 316-336.
- [8] Bella, V. D., & Al-Fayoumi, N. (2016). Perception of Stakeholders on Corporate Social Responsibility of Islamic Banks in Jordan. *EuroMed Journal of Business*, 11(1), 30-56.
- [9] Hossain, M. S. (2019). The Nexus between CSR Disclosure and Financial Performance: A Study on Islamic Sharia-based Banking Companies in Bangladesh. *Global Journal of Management And Business Research*, XIX, 13-27.
- [10] Mostafa, R. B., & ElSahn, F. (2016). Exploring the Mechanism of Consumer Responses to CSR Activities of Islamic Banks. *International Journal of Bank Marketing*, 34(6), 940-962.
- [11] Muhamat, A. A. (2020). Corporate Social Performance of Takaful Operators Handbook of Research on Theory and Practice of Global Islamic Finance (663-680). Retrieved from <https://www.academia.edu/download/85261342/viewtitlesample.pdf>
- [12] Muhamat, A. A., & McIver, R. (2019). Linking Governance Qualities and Stewardship Attributes: Findings from Malaysian Takaful Operators. *Journal of Islamic Accounting and Business*

Research, Retrieved from <https://www.emerald.com/insight/content/doi/10.1108/JIABR-04-2016-0048/full.html>.

- [13] Creswell, J. (2010). Qualitative Inquiry and Research Design: Choosing among Five Approaches, 2, Retrieved from <https://d1wqtxts1xzle7.cloudfront.net>
- [14] Salkind, N. J. (2010). Encyclopedia of Research Design, 1 (Ed.). Los Angeles: Sage.
- [15] Patton, M. Q. (2002). Two Decades of Developments in Qualitative Inquiry: A Personal, Experiential Perspective. *Qualitative Social Work*, 1(3), 261-283.
- [16] Blaikie, N., & Priest, J. (2019). Designing Social Research: The Logic of Anticipation. New York: John Wiley & Sons.

# NEGATIVE PAST EXPERIENCE, IMAGE INCONGRUENCE, CORPORATE WRONGDOING AND BRAND FORGIVENESS AMONG ISLAMIC BANKING CUSTOMERS

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## ABSTRACT

Research on the relationship between brand transgression and brand forgiveness is notably limited, especially in the context of Southeast Asian customers. Therefore, this study aims to contribute insights to existing literature by examining how brand transgression, represented by negative past experience, image incongruence, and corporate wrongdoing, influences brand forgiveness among Islamic banking customers in Malaysia. The increasing interest in negative brand relationships has prompted questions about their impact on brand forgiveness. Thus, this theoretical argument, lacking empirical evidence, requires statistical validation. This study utilized a non-probability purposive sampling technique to survey customers who had negative experiences with Islamic banking services in the Klang Valley area. Analysis of 211 usable responses included descriptive statistics, exploratory factor analysis, and multiple regression. The findings indicate that image incongruence and corporate wrongdoing significantly affect brand forgiveness, while negative past experiences do not. The paper also discusses research implications and suggestions for future studies.

**Keywords:** Brand Transgression, Negative Past Experience, Image Incongruence, Corporate Wrongdoing, Brand Forgiveness.

## INTRODUCTION

In an industry marked by intense competition, the Islamic banking sector faces a growing challenge in retaining customers following negative service incidents or transgressions. The assertion that the Islamic banking industry is experiencing rapid global expansion (Rama, 2017) underscores the critical importance of delivering exceptional service while minimizing transgressions. Despite garnering unprecedented recognition from both Muslim and non-Muslim clientele (Rama, 2017), there's no guarantee that service delivery will be entirely free from transgressions due to the subjective and intangible nature of the service. Moreover, with the Eleventh Malaysian Plan (RMK-11) aiming to elevate the Malaysian service industry, there's an urgent need for the Islamic banking sector to shift its approach towards delivering transgression-free service. Current marketing research trends have also begun focusing on negative brand relationships, including brand transgression, service failures, product harm crises, and double deviations. Thus, it's imperative to conduct empirical studies, particularly among banks offering Islamic banking services in Malaysia. Drawing on existing literature on negative brand relationships, this study investigates the impact of brand transgression on brand forgiveness, aiming to fill gaps identified by Fetscherin and Sampedro (2019) regarding the role of forgiveness post-transgression. This research will also contribute to the field by utilizing real customer experiences with Islamic banking services, unlike previous studies that predominantly employed experimental designs with vignettes and manipulations. Given the substantial evidence from financial literature suggesting that service failures or transgressions are key predictors of customer defection (Vyas & Raitani, 2014), the choice of the Islamic banking sector as the study context is particularly timely.

## METHODOLOGY

A total of 300 questionnaires were disseminated through the non-probability purposive sampling technique. This method, as described by Collins (2017) and Zikmund et al. (2012), is selected when specific characteristics are sought in the sample population. To ensure the inclusion of only

eligible participants, additional screening questions were administered. Consequently, only individuals who had encountered negative experiences with

Islamic banking services were considered for this study. Given the absence of a comprehensive list of such customers, probability sampling was not feasible. As of the data collection deadline, 211 questionnaires were deemed usable for preliminary and advanced analysis. However, 89 responses were excluded due to various issues such as missing data, outliers, suspicious responses, or lack of prior negative experiences with any Islamic banking services. Furthermore, a statistical method was employed to examine the potential influence of Common Method Variance (CMV). As recommended by Omar et al. (2021) and MacKenzie and Podsakoff (2012), Harman's single-factor test was conducted by inputting all measurement items into SPSS. The analysis revealed that the largest variance explained by any individual factor was 33.32%. Consequently, it is inferred that CMV did not significantly affect the results, as neither a single nor a general factor accounted for the majority of covariance.

## RESULTS AND DISCUSSION

The study yielded mixed results, highlighting the significant impact of image incongruence and corporate misconduct on brand forgiveness within Islamic banking services. Specifically, forgiveness from customers appears more likely when the perceived level of image incongruence and corporate wrongdoing is relatively low. This aligns with previous research by Fetscherin and Sampedro (2019), indicating that reduced image incongruence tends to foster greater forgiveness.

Moreover, the study indicates that brand forgiveness is influenced by the extent of corporate wrongdoing. In the context of Islamic banking services, lower levels of corporate misconduct correlate with higher levels of brand forgiveness. Despite the expectation that corporate wrongdoing would diminish customer satisfaction (Alnsour et al., 2021), the findings suggest that customers remain inclined to forgive, consistent with the observations of Fetscherin and Sampedro (2019).

The hypothesis concerning the impact of negative past experiences on brand forgiveness was not supported. However, while these results may appear inconclusive, it's important not to discount them, as they may offer valuable insights upon further analysis (Drotar, 2009; Hewitt et al., 2008). One potential explanation for the lack of significance could be the understanding that customers may not universally react to negative past experiences in the same manner, despite the common expectation of natural and justified negative reactions (Tsarenko & Tojib, 2015).

## CONCLUSION

This study contributes to the comprehension of negative brand relationships by examining the significant role of brand forgiveness in addressing brand transgressions among Islamic banking customers in Malaysia. The research demonstrates that brand forgiveness can be established by Islamic banking customers if the perceived level of image incongruence and corporate wrongdoing is not excessively severe. While the influence of negative past experiences on brand forgiveness was not found to be significant, its importance should not be disregarded in future studies, as indicated by Fetscherin and Sampedro (2019) in their research conducted among customers in the United States. In contrast to previous studies, this research provides a significant contribution by investigating the impact of brand transgressions on brand forgiveness among Islamic banking customers in Malaysia. To the best of the researchers' knowledge, there is a notable scarcity of research focusing on Islamic banking customers in the exploration of this forgiveness process.

## REFERENCES

Alnsour, I. A., Alnsour, I. R., & Alotoum, F. J. (2021). Enhancing customers' satisfaction using Loyalty rewards programs: Evidence from Jordanian Banks. *The Journal of Asian Finance, Economics and Business*, 8(11), 297-305.

Collins, M. (2017). Sampling decisions in educational research. BERA/SAGE.

Drotar, D. (2009). Editorial: How to write an effective results and discussion. *Journal of Pediatric Psychology*, 34(4), 339-343.

Fetscherin, M., & Sampedro, A. (2019). Brand forgiveness. *Journal of Product & Brand Management*, 28(5), 633-652. <https://doi.org/https://doi.org/10.1108/JPBM-04-2018-1845>

Hewitt, C. E., Mitchell, N., & Torgerson, D. J. (2008). Heed the data when results are not significant. *British Medical Journal*, 336(7634), 23-25.

MacKenzie, S. B., & Podsakoff, P. M. (2012). Common Method Bias in Marketing: Causes, Mechanisms, and Procedural Remedies. *Journal of Retailing*, 88(4), 542-555.

Omar, N. A., Abdullah, N. L., Zainol, Z., & Nazri, M. A. (2021). Consumers' responsiveness towards contaminated canned sardine in Malaysia: Does perceived severity matter? *Food Control*, 123, 107780.

Rama, A. (2017). An exploration of customers' switching behaviour in Islamic banking industry. *Journal of Islamic Monetary Economics and Finance*, 2(2), 251-286.

Tsarenko, Y., & Tojib, D. (2015). Consumers' forgiveness after brand transgression: The effect of the firm's corporate social responsibility and response. *Journal of Marketing Management*, 31(17-18), 1851-1877.

Vyas, V., & Raitani, S. (2014). Drivers of customers' switching behaviour in Indian banking industry. *International Journal of Bank Marketing*, 32(4), 321-342. <https://doi.org/https://doi.org/10.1108/IJBM->

Zikmund, W., Babin, B., Carr, J., & Griffin, M. (2012). *Business Research Methods*. Cengage Learning.

# EXAMINING THE EFFECT OF SOCIAL MEDIA CONTENT TYPES ON ENGAGEMENT BEHAVIOUR AMONG YOUTH

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## ABSTRACT

In the context of the contemporary global business environment, the role of social media has increased drastically especially among youth who have been shown to spend a great deal of time on social media. The purpose of this study is to explore the effect of the elements in social media contents (informational content, entertaining content, remunerative content, and relational content) on social media engagement behaviour and whether or not social media contents are connected to social media engagement behaviour. The study was also conducted to determine the highest category of social media contents that contributes to social media engagement behaviour among youth. The students from the Faculty of Communication and Media Studies Universiti Teknologi MARA (UiTM) Shah Alam, Malaysia were chosen as the sample for this study because of their familiarity with social media various platforms. Online self-completion questionnaire was used as the main instrument and the data received from the respondents was analyzed using the IBM Statistical Package for Social Science (SPSS) software version 26.0. Findings from the study revealed that informational content is the highest category of social media content that contributes to social media engagement behaviour among youth. The Pearson Correlation indicated that the relationships between social media contents and social media engagement behaviour are significant. Moreover, Multiple Linear Regression analysis shows that relational content is the strongest predictor of social media engagement behaviour among youth. The implications of these findings are discussed for researchers and practitioners.

**Keywords:** Social media, social media engagement behaviour, informational content, entertaining content, remunerative content, relational content

## INTRODUCTION

Social media has been acknowledged as significant instruments that enable big ranges of users to unite freely and readily exchange knowledge and communicate their ideas, feelings and opinions (Ahmed et al., 2019). A study by Go-globe (2015) revealed that social media users account for as much as 13.3 million or 45.5% of Malaysia's total inhabitants. As of January 2024, Malaysia had 28.68 million social media users which marks a significant increase from 2015 (Datareportal, 2024). The substantial growth underscores the expanding influence of social media in Malaysia over the past decade. From that amount, those aged 13 to 34 years old were Malaysia's largest social media users contributing up to 80.3 percent of Malaysia's 13.3 million social media users. Youth has also been identified as the age cohort that makes up the majority of online shoppers in many developed countries (Muda et al., 2016). Marketers are increasingly emphasizing engagement especially towards millennials on social media for campaigns purposes because millennials will dominate the consumption market on the Internet (Andersson & Arnvaller, 2017; Grau et al., 2019). With that being said, businesses who fail to engage with young people on social media platforms are being left behind (Goudie, 2018). Thus, the purpose of this study is to acquire a better understanding of youth engagement behaviour on social media so that businesses can utilize their social media content to facilitate the segmentation process and effectively reach out to the millennial generation. The Uses and Gratifications Theory (UGT) was applied in this study to explore social media users' motivation to engage with certain types of media content including informational content, entertaining content, remunerative content, and relational content. Therefore, by investigating social media engagement behaviour in the perspective of uses and gratifications theory, the effect and relationship of the elements in social media content on social media engagement behaviour can be determined in order to indicate how youth would react to social media contents.

### **Informational Content**

The informational content characterizes the degree to which posts on social media provide users with quick-witted and useful information (Laryea, 2017). Informational content can be described as the different types of information contained in the social media and is produced to exchange and disseminate thoughtful information that may be helpful to other users and influence information that may change or affirm an individual's views or stance on a particular problem (Egger, 2003; Wang, 2012).

*H1 There is a positive relationship between informational content and social media engagement behaviour among youth.*

### **Entertaining Content**

Dolan et al. (2019) describe the entertainment construct as the extent to which the online media is enjoyable and pleasant for media users. It motivates users to try out and participate in social network platforms and content to meet their entertainment, leisure or time-consuming needs (Videgren et al., 2018).

*H2 There is a positive relationship between entertaining content and social media engagement behaviour among youth.*

### **Remunerative Content**

Remunerative content refers to the extent to which the content of social media offers financial or incentive benefits (Dolan et al., 2019). It delivers economic benefits and gains attention using contests, coupons, and other offers in social media (Menon et al., 2019). Remunerative content also embraces the situations where people engage in social media use as they expect to gain some kind of rewards such as an economic incentive, job-related benefit or personal desires (Katsiadze, 2016).

*H3 There is a positive relationship between remunerative content and social media engagement behaviour among youth.*

### **Relational Content**

Relational content refers to the extent to which the content of social media meets the need for participation and personal communication of users and the willingness for social gains (Dolan et al., 2019). It refers to content that is person-focused, generated on social media to establish, sustain or develop personal relationships (Yang, 2017).

*H4 There is a positive relationship between relational content and social media engagement behaviour among youth.*

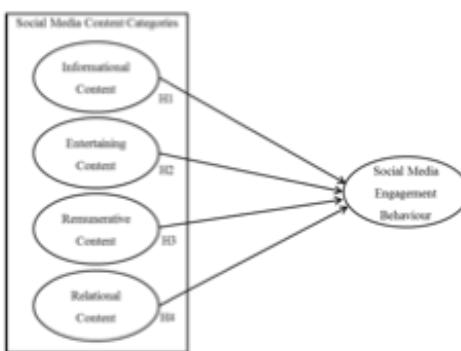


Figure 1: Conceptual Model of Social Media Content and Social Media Engagement Behaviour  
(Dolan et al., 2016)

## **MATERIAL AND METHOD**

The correlational study was used to study the relationship between social media content and social media engagement behaviour. The sampling frame for this study consists of students from the Faculty of Communication and Media Studies at UiTM Shah Alam, Selangor. The population of this study consist of 2,365 students from the faculty and the sampling method that was used to obtain the sample was convenience sampling. According to Krejcie and Morgan (1970) table for deciding the

sample size for a given population of 2,365 is 331. The online self-completion questionnaire was created and a total of 331 responses were received. However, only 329 responses were valid for analysis. The data that was collected in this study was analyzed using the Statistical Packages for Social Science (SPSS) version 26.0. Descriptive statistics were used to determine the highest category of social media content that contributes to social media engagement. Inferential statistics such as Pearson's correlation analysis and multiple regression analysis were also used to investigate the relationship between the variables and to study the effect of the elements in social media content on social media engagement behaviour among youth.

## RESULTS AND DISCUSSION

This study surveyed respondents, with 21.3% males and 78.7% females. The majority (64.1%) were aged 19-22, followed by 23-26 (31.9%) and 27-30 (2.7%) years old. Educational status showed 18.8% were pursuing a Diploma, 77.5% a Bachelor's Degree, 3.3% a Master's Degree, and 0.3% a PhD. Marital status indicated 1.5% were married, 98.5% single. 98.8% agreed social media is important for youth. Daily usage was high at 98.5%, with WhatsApp (97%) and Instagram (93.9%) being the most used platforms. Most (98.2%) browsed for entertainment, while 90.3% sought informational content, 86% for education, 49.8% for relational, and 18.2% for remunerative content.

### Normality Analysis

Acceptable skewness and kurtosis value are in the range of +/- 3 (Hair et al., 2010). Table 1 shows that all of the variables were normally distributed since the value of skewness and kurtosis for these variables is in the range of +/-3. Nonetheless, two outliers were removed to ensure normality in the data set.

Table 1: Normality Analysis

Variables	Skewness	Kurtosis
Informational Content	-.724	-.031
Entertaining Content	-.699	.925
Remunerative Content	-.202	.238
Relational Content	-.715	-.133
Social Media Engagement Behaviour	-.194	-.483

### Reliability Analysis

Table 2 indicates that the Cronbach's Alpha values. According to Sekaran & Bougie (2016), reliabilities less than 0.60 are considered to be poor, those in the 0.70 range, acceptable, and those over 0.80 good.

Table 2: Reliability Analysis

Variables	Cronbach's Alpha	No. of Items
Informational Content	0.819	5
Entertaining Content	0.803	4
Remunerative Content	0.884	4
Relational Content	0.709	4
Social Media Engagement Behaviour	0.827	7

### Descriptive Analysis

According to Table 3, of all the independent variable, the highest mean score for social media content is informational content with the mean of 4.4657 (SD=.48797) which is reckoned as the highest category of social media content that contributes to social media engagement behaviour among youth.

Table 3: Descriptive Statistics

Independent Variables	Minimum	Maximum	Mean	Std. Deviation
Informational Content	3.00	5.00	4.4657	.48797
Entertaining Content	1.00	5.00	4.1884	.66389
Remunerative Content	1.00	5.00	3.4605	.84867

Relational Content	2.50	5.00	4.4347	.53132
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### **Pearson's Correlation Analysis**

Table 4 indicates the relationship between social media content and social media engagement behaviour.

Table 4: Pearson's Correlation Analysis

	Informational	Entertaining	Remunerative	Relational	SMEB
Informational	Pearson Correlation	1	.394**	.360**	.453**
	Sig. (2-tailed)		.000	.000	.000
	N	329	329	329	329
Entertaining	Pearson Correlation	.394**	1	.323**	.303**
	Sig. (2-tailed)	.000		.000	.000
	N	329	329	329	329
Remunerative	Pearson Correlation	.360**	.323**	1	.322**
	Sig. (2-tailed)	.000	.000		.000
	N	329	329	329	329
Relational	Pearson Correlation	.453**	.303**	.322**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	329	329	329	329
SMEB	Pearson Correlation	.382**	.282**	.412**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	329	329	329	329

\*\*. Correlation is significant at the 0.01 level (2-tailed).

### **Multiple Regression Analysis**

According to Table 5, the adjusted R square of .295 implies that all of the independent variables explain 29.5% of the variance in a dependent variable while 70.5% of the variance in the dependent variable is not explained by the independent variables in this study.

Table 5 Multiple Regression Analysis (Model Summary)

Model	R	R Square	Adjusted R	Std. Error of the
			Adjusted R Square	Estimate
1	.551 <sup>a</sup>	.303	.295	.60679

a. Predictors: (Constant), Relational, Entertaining, Remunerative, Informational

Table 6 shows the result of the Multiple Regression Analysis (ANOVA) for the independent variables. The result indicated that it was statistically significant with F value of 35.294 (p<0.05).

Table 6 Multiple Regression Analysis (ANOVA)

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	51.979	4	12.995	35.294	.000 <sup>b</sup>
	Residual	119.294	324	.368		
	Total	171.273	328			

a. Dependent Variable: SMEB

b. Predictors: (Constant), Relational, Entertaining, Remunerative, Informational

Table 7 indicates that the p-value of informational content is 0.015 (1.5%) which is below the 5% significant level. Therefore, informational content is positively related to social media engagement behaviour. However, entertaining content is not related to the dependent variable since the p-value for entertaining content is 0.255 (25.5%) which is above the 5% significant level. Whereas both remunerative content and relational content have a p-value of 0.00 (0.00%) which lead these two variables to be related to social media engagement behaviour among youth. The result suggests that relational content is the largest beta coefficient with a beta value of 0.291 which makes it the strongest predictor to the social media engagement behaviour among youth. The second would be remunerative content with a beta value of 0.251 followed by informational content with a beta value of 0.136. The weakest predictor would be entertaining content with a beta value of 0.059.

Table 7 Multiple Regression Analysis (Coefficients<sup>a</sup>)

Model		Unstandardized		Standardized		
		B	Coefficients	Std. Error	Beta	t
1	(Constant)	.209	.355		.589	.556
	Informational	.202	.082	.136	2.449	.015
	Entertaining	.065	.057	.059	1.141	.255
	Remunerative	.213	.044	.251	4.859	.000
	Relational	.396	.073	.291	5.456	.000

a. Dependent Variable: SMEB

## CONCLUSION

The objective of this study was to investigate social media engagement behaviour among youth. The descriptive analysis indicates that informational content is the highest category of social media content that contributes to social media engagement behaviour. Moreover, Pearson's correlation analysis reveals that there is a positive relationship between the variables. The findings of this study indicate that social media content predicts social media engagement behaviour among youth with relational content as the most influential factor followed by remunerative content and informational content while entertaining content is the weakest predictor. This aligns with the findings of (Laryea, 2017), who highlighted that content fostering interpersonal connections significantly enhances user engagement on social media platforms. The strong influence of relational content also reflects the cultural tendencies among youth to prioritize connectivity and personal relationships, as highlighted in (Yang, 2017). However, the weak predictive power of entertaining content differs from previous findings by (Videgren et al., 2018), who suggested entertainment as a dominant factor in certain demographic or cultural contexts. This discrepancy could be attributed to differences in sample characteristics or the evolving preferences of youth towards more meaningful or value-driven interactions over purely entertainment-focused content. The results for remunerative and informational content are consistent with (Dolan et al., 2019; Laryea, 2017) who found that tangible incentives and informative posts significantly impact engagement behaviour. Future studies should explore the role of

mediators (e.g., trust and perceived value) or moderators (e.g., personality traits, platform algorithms) in the relationship between content types and engagement behaviour.

## REFERENCES

Ahmed, Y. A., Ahmad, M. N., Ahmad, N., & Zakaria, N. H. (2019). Social media for knowledge-sharing: A systematic literature review. *Telematics and Informatics*, 37, 72–112. <https://doi.org/10.1016/j.tele.2018.01.015>

Andersson, S., & Arnvaller, K. (2017). *Social Media: How to Interact with Millennials and Make Use of Self-Segmentation: A Case Study of Swedish Millennials' Behaviour on Facebook* [Luleå University of Technology]. <http://www.diva-portal.org/smash/get/diva2:1091070/FULLTEXT02.pdf>

Datareportal. (2024). *Digital 2024: Malaysia*. Retrieved from <https://datareportal.com/reports/digital-2024-malaysia>

Dolan, R., Conduit, J., Fahy, J., & Goodman, S. (2016). Social Media Engagement Behaviour: A Uses and Gratifications Perspective. *Journal of Strategic Marketing*, 24(3–4), 261–277. <https://doi.org/10.1080/0965254X.2015.1095222>

Dolan, R., Conduit, J., Frethey-Bentham, C., Fahy, J., & Goodman, S. (2019). Social media engagement behaviour: A framework for engaging customers through social media content. *European Journal of Marketing*, 53(10), 2213–2243. <https://doi.org/10.1108/EJM-03-2017-0182>

Egger, F. N. (2003). From Interactions to Transactions: Desgining the Trust Experience for Business-to-Consumer Electronic Commerce. In *Personal Relationships*. Technische Universiteit Eindhoven. <https://doi.org/10.6100/IR572640>

Go-globe. (2015, January 27). *Social Media Usage In Asia Pacific – Statistics And Trends*. <https://www.go-globe.com/blog/social-media-asia/>

Goudie, K. (2018, October 25). *Using Social Media to Reach Young People*. <https://thewhin.co/using-social-media-to-reach-young-people/>

Grau, S., Kleiser, S., & Bright, L. (2019). Exploring social media addiction among student Millennials. *Qualitative Market Research: An International Journal*, 22(2), 200–216. <https://doi.org/10.1108/QMR-02-2017-0058>

Hair, J., Black, W., Babin, B., & Anderson, R. (2010). *Multivariate Data Analysis: A Global Perspective* (7th ed.). Pearson Education Limited.

Laryea, R. (2017). *Drivers and Outcomes of Social Media Advertising Engagement: A Survey of University of Ghana Students* [University of Ghana]. <http://ugspace.ug.edu.gh/handle/123456789/23230>

Menon, R. G. V., Sigurdsson, V., Larsen, N. M., Fagerstrøm, A., Sørensen, H., Marteinsdottir, H. G., & Foxall, G. R. (2019). How to grow brand post engagement on Facebook and Twitter for airlines? An empirical investigation of design and content factors. *Journal of Air Transport Management*, 79, 9. <https://doi.org/10.1016/j.jairtraman.2019.05.002>

Muda, M., Mohd, R., & Hassan, S. (2016). Online Purchase Behaviour of Generation Y in Malaysia. *Procedia Economics and Finance*, 37, 292–298. [https://doi.org/10.1016/s2212-5671\(16\)30127-7](https://doi.org/10.1016/s2212-5671(16)30127-7)

Sekaran, U., & Bougie, R. (2016). *Research Methods for Business: A Skill-building Approach* (7th ed.). John Wiley & Sons.

Videgren, V., Jost Auf Der Stroth, A., & Mathieu, J.-P. (2018). *Users motivational drives to engage with athletes on social media Title: Users motivational drives to engage with athletes on social media*. <http://www.diva-portal.org/smash/get/diva2:1219098/FULLTEXT01.pdf>

Wang, H. (2012). Six P's of youth social media from a young consumer's perspective. *Young Consumers*, 13(3), 303–317. <https://doi.org/10.1108/17473611211261674>

Yang, J. (2017). Enacted Affordances of Social Media and Consumers' Response to Advertising [Michigan State University]. In *ProQuest LLC*. <http://search.proquest.com.ezaccess.library.uitm.edu.my/docview/1985053556?accountid=42518>

Yusop, F. D., & Sumari, M. (2013). The Use of Social Media Technologies among Malaysian Youth. *Procedia - Social and Behavioural Sciences*, 103, 1204–1209. <https://doi.org/10.1016/j.sbspro.2013.10.448>

## **FACULTY OF ACCOUNTANCY**

# **FINANCIAL MANAGEMENT BEHAVIOUR AMONG MALAYSIAN SMES OWNERS IN KUALA SELANGOR: SOME NEW INSIGHTS FROM A QUALITATIVE STUDY**

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## **ABSTRACT**

One of the critical elements for SMEs to continue improving their performance with a dynamic market in Malaysia is to practice prudent financial management. Therefore, this study aims to identify the owners' and firm characteristics and financial management practices among the SMEs owners in Kuala Selangor. The data was collected through an interview, and the results indicate the importance of ensuring all the available business resources are used efficiently and effectively to provide an optimum return. Findings from this study may be helpful to the Government and financial providers know the importance of educating the financial management knowledge among SMEs owners and understand the appropriate financial management tools adoption by SMEs owner in the sub-urban area in Selangor.

**Keywords:** Financial Knowledge, Financial Management, Inventory Management Practices, Behaviour, SMEs

## **INTRODUCTION**

Sound financial management may help in retaining the sustainability of the company. Hence, financial management is an important area in managing small and medium-sized enterprises (SMEs). Given that financial management is one of the critical aspects of a business's well-being and survival, the owner of the SMEs needs to be concerned about their firm's financial resources (Belás, Ključníkov, Vojtovič & Sobeková-Májková, 2015). Therefore, SME owners need to ensure that they have sufficient knowledge about financial management. This study aims to explore the financial management practices among the SMEs owners in Kuala Selangor.

### ***Literature Review***

Previous studies highlighted SME challenges from many dimensions but failed to address the reality gap that surrounds SMEs. Among the most discussed challenges are not limited to; lack of access to credit, training and development issue, government policy, marketing complexity, poor management skills, low awareness of ICT, culture barrier, and heavy regulatory burden (Khalique, Isa, Shaari & Ageel, 2011; Panigrahi, 2011; Chong, 2012). Many past studies have also been carried out to evaluate and analyse the importance of financial management. They have proven that sound financial management and good accounting practices are the best ways to remain profitable and solvent.

The study by Muneer, Abrar Ahmad and Ali (2017) provides some relevant findings on the relationship between financial management practices and the business performance of SMEs. Filbeck and Lee (2000) stated the relationship between liquidity and profitability, while Uyar (2009) shows significant positive correlations between working capital components with firm performance in Malaysia. Past evidence has been found that SMEs in Malaysia have many failures due to inadequate capital, inadequate institutional credit facilities, outdated technology, improper accounting techniques, inadequate sales, promotion competencies, and inattentiveness of small businesses (Salikin et al., 2014). These obstacles have resulted from inefficient business administration and, lack of experience in essential business functions, mainly accounting and finance. Several studies highlighted that poor accounting and financial management practices are factors contributing to the massive failure of SMEs in the short run.

## METHODOLOGY

This study employed the qualitative method. The interviewees are drawn from a population who were involved directly and had the experience on the phenomenon studied. Table 1 provides the details of the interviewees who participated in this study.

**Table 1: Demographic Result**

Demographic category		N	Percentage (%)
Nature of business	Services	4	67
	Manufacturing	2	33
	Constructions		
	Agriculture		
Size	Medium		
	Small	3	50
	Micro enterprises	3	50
Number of years business operated	Less than ten years	1	17
	More than ten years	4	66
	More than 20 years	1	17

The data obtained were digitally recorded by a voice recorder, and the verbatim transcripts were used to organize the data. The content analysis of the qualitative data was done by using Nvivo Version 11.

## FINDINGS

### *Factors Influencing the Financial Management Behaviour*

Most SME owners have viewed the financial performance assessment as an essential factor in evaluating the efficiency of a company.

*All respondents are absent sufficient knowledge about efficient financial management. Financial management knowledge helps the SMEs owner in making an excellent financial decision. The respondents need management knowledge such as cash activity, loan application, and inventory management (L1, L3).*

*I think an entrepreneur must know about financial management as it will help them manage their business better. I do not have sufficient knowledge about financial management. My parents taught me my understanding, who have been in this industry for a long time. I have been exposed to preparing accounts, applying and repaying bank, and other financial matters (L1, L3, L4, and L6).*

The poor financial management of owner-managers is the leading cause underlying the problems in SME financial management, and most respondents are aware of the basic knowledge of asset management and the importance of a proper inventory system.

*Financial knowledge is not just for acquiring a bank loan to finance the business. Still, it is more than that, such as practicing proper handling of account receivables and accounts payable and a sound inventory management system (L3, L4)*

Given the nature of business, a firm's characteristics also play a role in assessing the financial management behavior among SMEs' owners. The firm characteristics are an essential factor in determining how the SME owner is practicing their financial management.

*The business in manufacturing is more independent and relies on some financial management practices, especially asset management (practice a proper way of handling account receivables and account payable) and inventory management. The financial management practices must improve the performance of SMEs and give them a more competitive advantage to sustain and contribute to economic development (L1, L2).*

Besides knowing financial management, the owners are opined that business experience and risk appetite also might influence the financial management behavior and quantify the probability of actual process and results from the expected level.

*All respondents highlight that the knowledge of financial management and business experience are the main factors. The SME's owner must be willing to change the old way*

*of doing their business and adopt the optimal application and commitment towards financial management practices (L1, L2, L3).*

*Factors such as business experience, knowledge, risk appetite also might influence the financial management behavior of the SME owner in Malaysia (L2).*

Most owners have highlighted the relevant courses or training provided by several agencies such as Agrobank, MARA, and FAMA for SMEs. However, most owners do not frequently attend the course provided as they do not practically use such practices or financial management systems.

*Most of the SMEs are from small and microenterprise, generally small, and hire a few employees. Limited resources are among the factors that discourage adopting an excellent financial management practice. The main priority is to ensure early payment, as some suppliers need payment cash (L5, L6).*

### **Financial Management Methods Used**

Overall, most SME owners have practiced financial management methods at a minimum level. The SME's owner needs to identify and implement policies and procedures that will lead to and ensure that they meet the financial obligations and ensure the business will have enough working capital once and when needed. Lack of confidence when deciding the best financial management method or system is also a common scenario faced by SMEs in Kuala Selangor.

*The inventory system is still mainly conventional (manual checking). All transactions on a cash basis buy the inventory as needed. I issued receipts to customers and kept receipts from suppliers. Most SMEs maintain an adequate record of a cash register and cash book. (L3, L6).*

*Sometimes I am not happy and not sure about my decision in managing the business credits. I do not apply any comparative ratio analysis before making the decision (L5).*

## **CONCLUSION**

In conclusion, financial management is crucial for sustainable growth and stability. From a practical perspective, sound financial management will ensure the optimal allocation of financial resources to achieve organizational goals, facilitate investment in profitable projects and balance risk and return. Good financial management is related to effective liquidity management. Effective liquidity management will ensure sufficient liquidity for smooth day-to-day operations. Financial management literacy will positively affect SMEs' sustainability and will assist the owner in doing sound financial management practices that will boost their development and sustainability. Thus, it will help the business expand by identifying and mitigating financial risks, including market, credit, and operational risks. Its real-world implementations will continuously refine theoretical frameworks, driving the discipline forward. The outcome can also help develop theories for understanding and quantifying the relationship between risk and return and explore the interaction between corporate financial decisions and broader economic factors. Future research should investigate the factors influencing financial management among SME owners in Kuala Selangor using the quantitative method and the impact of financial management on SME performance sustainability in the long run.

## **REFERENCES**

Ahmed Sheikh, N. & Wang, Z. (2013). The impact of capital structure on performance: An empirical study of non-financial listed firms in Pakistan. *International Journal of Commerce and Management*, 23(4), 354-368. <https://doi.org/10.1108/IJCoMA-11-2011-0034>.

Abdul Rahman, N., Yaacob, Z. & Mat Radz, R. (2016). The challenges among Malaysian SME: a theoretical perspective. *World Journal of Social Sciences*, 6(3), 124 – 132.

Belás, J., Ključníkov, A., Vojtovič, S., & Sobeková-Májková, M. (2015). Approach of the SME entrepreneur's to financial risk management in relation to gender and level of education. *Economics and Sociology*, 8(4), 32-42. DOI:10.14254/2071-789X.2015/8-4/2.

Carey, P. J. (2015). External accountants' business advice and SME performance. *Pacific Accounting Review*, 27(2), 166-188. <https://doi.org/10.1108/PAR-04-2013-0020>.

Chong, W. Y. (2012). Critical success factors for small and medium enterprises: Perceptions of entrepreneurs in urban Malaysia. *Journal of Business and Policy Research*, 7(4), 204-215.

Dzomonda, O. & Fatoki, O. (2018). Evaluating the effects of owners' demographic characteristics on the financial management behaviour of rural entrepreneurs in South Africa. *Academy of Accounting and Financial Studies Journal*, 22(3), 1-11.

Filbeck, G., & Lee, S. (2000). Financial management techniques in family business, *Family Business Review*, 13(3), 201-216. <https://doi.org/10.1111/j.1741-6248.2000.00201>.

Inman, P. (2014). Funding for lending won't solve SMEs' problems, viewed 10 December 2014

Khaliq, M., Isa, A. H. M., Shaari, J. A. N. & Ageel, A. (2011). Challenges faced by the small and medium enterprises (SMEs) in Malaysia: An intellectual capital perspective. *International Journal of Current Research*, 33(6), 398-401.

Lucky, E. O., & Olusegun, A. I. (2012). Is small and medium enterprises (SMEs) an entrepreneurship?. *International Journal of Academic Research in Business and Social Science*, 2(1), 487-496.

Mohd Harif, M. A. A., Osman, H., & Hoe, C. H. (2010). Financial management practices: An in-depth study among the CEOs of small and medium enterprises (SMEs). *International Review of Business Research Paper*, 6(6), 13-35.

Muneer, S., Abrar Ahmad, R., & Ali, A. (2017). Impact of financial management practices on SMEs profitability with moderating role of agency cost. *Information management and Business Review*, 9(1), 23-30. <DOI:10.22610/imbr.v9i1.1593>

Panigrahi, A.K. (2011). Risk management in micro, small and medium enterprises (MSMEs) in India: A critical appraisal. *Asia Pacific Journal of Marketing & Management Review*, 1(4), 59-72.

Rathnasiri, U. A. H. A. (2015). The financial practices of small and medium enterprises in Sri Lanka. *Global Journal of Contemporary Research in Accounting, Auditing and Business Ethics (GJCRA)*, 1(2), 374-399.

Salikin, N., Ab Wahab, N., & Muhammad, I. (2014). Strengths and weaknesses among Malaysian SMEs: Financial management perspectives. *Procedia - Social and Behavioral Sciences*, 129, 334 – 340. <https://doi.org/10.1016/j.sbspro.2014.03.685>

Smit, Y., & Watkins, J. A. (2012). A literature review of small and medium enterprises (SME) risk management practices in South Africa. *African Journal of Business Management*, 6(21), 6234-6330. <DOI: 10.5897/AJBM11.2709>

Turyahewa, A., Sunday, A., & Ssekajugo, D. (2013). Financial management practices and business performance of small and medium enterprises in Western Uganda. *African Journal of Business Management*, 7(38), 3875-3885. <DOI: 10.5897/AJBM2013.6899>

Uyar, A. (2009). The relationship of cash conversion cycle with firm size and profitability: An empirical investigation in Turkey. *International Research Journal of Finance and Economics*, 24, 186-193.

# UNDERSTANDING SMALL AND MEDIUM ENTERPRISES (SMEs) LOAN APPLICATIONS: COMPREHENSIVE ANALYSIS FROM SMEs AND LOAN PROVIDERS

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## ABSTRACT

This comprehensive study investigates the financing landscape for small and medium enterprises (SMEs) from both the perspectives of loan providers and SMEs themselves. It employs a multifaceted approach to provide a holistic understanding of the factors influencing SMEs' financing decisions and shedding light on the crucial criteria that financial institutions consider when evaluating loan applications. This study utilized interviews with financial institutions to outline crucial loan approval criteria, emphasizing collateral, applicants' characteristics, and business plans. Simultaneously, this study recognizes that financing remains a significant hurdle to the growth of SMEs which include the challenges, risks, and sustainability factors influencing SMEs' decisions in seeking external financing. Notably, it highlights challenges such as accounting knowledge and fluctuating demand, which expose SMEs to various risks like liquidity and technological risks, and subsequently explores sustainability concerns in the dynamic economic context of Malaysia, with the aim of bridging the information gap and empowering SMEs to enhance their financing prospects.

**Keywords:** SME, Financing, Collateral, Challenges, Risk, Sustainability

## INTRODUCTION

The small and medium enterprises (SMEs) in Malaysia make up 97.2% of all business establishments. In 2020, there was 1,151,399 SMEs in the country, with Selangor and Wilayah Persekutuan Kuala Lumpur having the highest concentrations. These SMEs contributed significantly to Malaysia's GDP, accounting for 38.2% in 2020. However, SMEs face challenges, particularly in accessing external financing [1]. The government has introduced various programs and support to help SMEs grow, but their reliance on internally generated funds remains a limitation. Despite various government programmes aimed at supporting SMEs, a significant percentage of them face financial difficulties and fail within their initial years of operation. Previous studies highlighted the financial difficulties include high capital costs, lack of access to credit, labour shortages, insufficient funds, and a weakening local currency, all which impact sales [2],[3].

### *The Significance of Small and Medium Enterprises (SMEs)*

In today's rapidly evolving world, SMEs play a significant role in both developed and developing economies, contributing to employment and industrial productivity [4]. In Malaysia, SMEs are a critical component of the economy, accounting for approximately, 18.6% of total exports, and 66% of total employment [5]. SMEs are becoming global growth engines due to their capacity for innovation and adaptability in response to changing economic conditions [6]. Their smaller size allows them to be more flexible and quicker to innovate, giving them a competitive advantage [7].

The development of SMEs is crucial for linking sub-urban and rural areas with more structured urban SMEs in Malaysia. This contributes to balanced growth and shared prosperity, especially through micro-enterprises that make up the majority of SMEs. It also helps with poverty alleviation and the fair distribution of wealth across regions. SMEs in Malaysia have been supported by the government through various schemes and programs, such as financing gateways, outreach initiatives, and capacity-building efforts [8]. However, for SMEs to expand into the global market, they need access to working capital, information about foreign business opportunities, global market analysis, and the ability to reach potential clients worldwide [9].

### ***Challenges and Opportunities in SME Financing***

The external financing for SMEs is very important for them to compete in a competitive market. However, the information asymmetry between loan applicants and providers can create a financing gap, hence, hindering SMEs' optimal growth [10]. SMEs lack knowledge of banking information, while financial institutions have limited information about SMEs, making it uncertain whether SMEs can repay loans [11]. SMEs are considered riskier due to this uncertainty [12]. Financial institutions may need time to gather information before making lending decisions, and this information asymmetry can lead to moral hazard [13], [14].

Collateral plays a significant role in credit agreements and can influence the credit rationing behaviour of financial institutions [15]. SMEs may have difficulty providing collateral due to their smaller asset size. However, offering collateral can increase the likelihood of obtaining credit even in uncertain situations [15]. Still, some SMEs may fear rejection or losing collateral if the market conditions are unfavourable [15]. Additionally, applicant characteristics, such as age and education, can affect credit constraints. Younger firms may face more significant information asymmetry, making it harder for them to establish trust with financial institutions [15]. The quality of management and the ability to build a positive image are crucial for creditworthiness [16]. Providing a clear and concise business plan, including information on collateral and applicant characteristics, can assist financial institutions in making lending decisions [15]. Business plans should outline the vision and management strategy to achieve business objectives.

On the other hand, proper financial management is also paramount for SMEs' growth and sustainability. Many SMEs rely on bank loans for financing, but new businesses often face rejections due to stricter financial policies in the wake of the global financial crisis [17]. It is a critical role of SMEs in the Malaysian economy to understand their challenges in obtaining financing, and the need for effective financial management. Therefore, the objectives of this study are twofold; (i) to explore the loan application experiences of SME owners in Kuala Selangor which include challenges, risks and sustainability; and (ii) to explore loan applications from the perspective of loan providers to determine success criteria.

## **MATERIAL AND METHOD**

This study comprises of two distinct data collection methods in order to fulfil the two objectives of this study. Firstly, to achieve research objective one, this study focuses on SME owners in Kuala Selangor, Malaysia. This study used random sampling and selected this location due to a research grant aimed at benefiting the community there. This study employed a qualitative approach and conducted structured interviews with seven SME owners, including four in the services sector and three in manufacturing. These sectors were chosen because they are significant contributors to Malaysia's SME economic activities and involve substantial investments in fixed assets. All SMEs in the study were registered with SME Corporation of Malaysia. We provided interview questions in advance to five respondents, with hand-delivery and a digital messaging applications for distribution. Each face-to-face interview lasted approximately 30 minutes and covered topics related to loan applications by SME owners, focusing on challenges, risks, and sustainability. The interviews took place at the SMEs' shops and were recorded in written form since the questions were pre-prepared, and this data was analyzed to explore information related to the three key aspects of the study: challenges, risks, and sustainability.

Secondly, research objective two is to explore the loan application process for SMEs from the perspective of loan providers. To fulfil this objective, interviews with representatives from two different banks were conducted. The interview questions were designed to address key aspects of the study, including collateral, applicants' characteristics, and business plans. The interviews took place at the banks' premises and were recorded through hand-written notes. Each interview lasts about thirty minutes, and the collected data is analyzed to examine information related to the three units of analysis: collateral, applicants' characteristics, and business plan.

## **RESULTS AND DISCUSSION**

### ***Loan Application Experiences of SME Owners***

From interviews conducted with SME owners in Kuala Selangor, financing challenges are primarily related to a lack of business knowledge and insufficient working capital. These challenges significantly impact the capital structure of SMEs, making it challenging to secure external loans. These challenges can be grouped into three, namely, knowledge, fluctuating demand, and sensitivity of cash flows. SME owners in the study possess some business knowledge and have taken relevant courses but opt not to hire qualified accountants or auditors to manage financial matters. This decision is often driven by the cost associated with hiring external professionals and concerns about information asymmetry, which may lead to loan application rejections. SMEs in Kuala Selangor face inconsistent demand for their products and services. Seasonal variations and university students' absence during breaks can result in lower sales. To address this challenge, SMEs need to maintain sufficient cash reserves to cover expenses during low-demand periods. Many SMEs, both in the study and reported by SME Corporation in Malaysia, struggle with cash flow and liquidity issues. Some SMEs prioritize their focus on available cash over submitting loan applications. Financing challenges persist even beyond the initial start-up phase, as SMEs face higher credit constraints compared to larger firms due to their unique nature of operations.

Furthermore, the risks faced by SME owners include interest rate and liquidity, potentially hindering external loan applications and sustainability. SMEs heavily reliant on external financing through loans may face interest rate fluctuations, impacting their monthly commitments to financial institutions. This uncertainty discourages four out of seven SME owners in Kuala Selangor from pursuing loan applications due to the variable interest rates, preferring fixed-rate loans with less risk. Liquidity risk, potentially leading to bankruptcy, can impose substantial indirect costs, including personal collateral and self-esteem loss for SME owners. Factors contributing to SMEs bankruptcy include lack of knowledge, debt accessibility issues, and economic conditions. To mitigate these risks, SME owners must maintain adequate cash reserves to support their operations, as they face greater vulnerability during economic crises. As a result, many respondents in the study avoid external loan applications to minimize bankruptcy and liquidity risks. Despite the potential benefits of e-business and technological advancements for SMEs, challenges arise regarding their adoption, implementation costs, and the need to identify individuals capable of operating technology. Some SMEs in Kuala Selangor face difficulties coping with e-business and digitalization, focusing on premises sustainability and daily cash operations. Failure to embrace these technologies may pose a risk, as competitors who do so could capture more revenue, given the evolving nature of technology adoption in the region.

In dynamic economies, innovation is crucial for SMEs survival. To thrive, SMEs must leverage available opportunities, foster creativity, and secure adequate funding for production and growth. To assess sustainability issues among SMEs in Kuala Selangor, interviews with respondents focused on their approaches to product and process innovation in comparison to competitors over the past years. Three respondents disclosed that they had not undertaken any product or process innovation in the past 12 months due to financial difficulties and a focus on cash flow. Respondents expressed uncertainty about fluctuating product demand and acknowledged a lack of innovation in their own businesses. Finance plays a crucial role in SMEs as it affects growth and impacts various key challenges they face. Survival is fundamental for sustainability, and economic crises can hinder a company's innovative capacity, subsequently influencing expansion and growth. In uncertain economic conditions, SMEs in less developed areas may rely on internal funding sources to ensure survival and, if possible, expansion.

### ***Loan Applications from the Perspective of Loan Providers***

From interviews conducted with loan providers, factors that influence the approval of loan applications by SMEs are collateral, applicant characteristics, and business plans. Collateral, such as assets or deposits, is often required by banks for loan approval. However, some banks offer loans without collateral, instead charging a percentage of the deposit as security. Different types of SME financing may have varying collateral requirements.

The characteristics of loan applicants play a significant role in the approval process. The applicant's personal characteristics and credit history are assessed during eligibility evaluation. Credit history, in particular, is a crucial factor in determining loan approval. A clean credit history, reflecting responsible repayment of debts, is vital for loan approval. Applicants are advised to maintain a smooth credit history and manage their cash flow effectively. The age of both the SME owner and the business

itself can impact loan approval. Most applicants fall within the middle-age range. Additionally, businesses typically need to be in operation for at least a few years to be eligible for loans. The sector in which an SME operates is considered in loan applications. While the services sector is dominant, there is no restriction on the type of business that can apply for loans. Business location can influence the sector's relevance.

Having a well-prepared business plan is crucial for applying for external financing. Small businesses may not always have comprehensive business plans, relying on family loans instead. Some banks may assist in preparing the necessary paperwork for loan applications. In summary, SMEs seeking loans should pay attention to their credit history, ensure they meet age and business operation criteria, and consider providing a clear and convincing business plan. The need for collateral varies, and some banks may assist with paperwork preparation. Additionally, the type of business and its location are factors that banks may consider during the approval process.

## CONCLUSION

This study finds valuable insights into loan applications by SME owners in the District of Kuala Selangor. Most respondents do not seek loans from financial institutions, primarily due to a desire to avoid monthly payment commitments. Instead, they prefer to self-finance or seek funds from sources other than banks. Additionally, the majority of these respondents are new entrants in their respective industries, operating for less than five years. This suggests that SME owners prioritize stabilizing their businesses for about a decade before considering expansion and loan applications. Their focus during the initial ten years is on prudent financial management to sustain their enterprises. The prospect of obtaining loans presents inherent risks and challenges for them. In addition, this study also investigates bank loan applications by SMEs, particularly on the factors that influence the success of the applications. This is done by conducting interviews with two bank representatives.

Nevertheless, there are certain limitations to this study. Firstly, the sample is limited to SMEs in the District of Kuala Selangor. A comparative study involving SMEs from other regions could yield interesting insights. Secondly, the study's findings may not be generalizable due to its location-specific nature. A more comprehensive approach involving a wider range of respondents across various sectors could enhance the explanatory results. Thirdly, to gain deeper insights into varying bank loan requirements, a larger sample size for interviews would be more relevant.

Overall, this study contributes to the limited literature on SMEs loan applications in Malaysia, enhancing our understanding of bank loan requirements for SMEs and shedding light on the loan application behaviour of SME owners in Malaysia. It provides a deeper understanding of the factors influencing loan applications among SME owners.

## REFERENCES

- [1] Steinerowska-Streb, I., & Steiner, A. (2014). An analysis of external finance availability on SMEs' decision making: A case study of the emerging market of Poland. *Thunderbird International Business Review*, 56(4), 373-386.
- [2] Beck, T. H. (2007). Financing constraints of SMEs in developing countries: Evidence, determinants and solutions. *Financing innovation-oriented businesses to promote entrepreneurship*.
- [3] Czarnitzki, D. (2006). Research and development in small and medium-sized enterprises: The role of financial constraints and public funding. *Scottish journal of political economy*, 53(3), 335-357.
- [4] Khalil, M. A. T., Dominic P, D. D., Hassan, M. F., & Mushtaq, A. (2011). An in-depth analysis of ecosystems & blueprint of digital business ecosystem (DBE) framework for Malaysian SMEs. *Computer Science Journal*, 1(1), 65-78.
- [5] Economic Census (2016). Profile of SMEs, Department of Statistics, Malaysia.
- [6] Gherghina, S. C., Botezatu, M. A., Hosszu, A., & Simionescu, L. N. (2020). Small and medium-sized enterprises (SMEs): The engine of economic growth through investments and innovation. *Sustainability*, 12(1), 347.
- [7] Qian, G., & Li, L. (2003). Profitability of small-and medium-sized enterprises in high-tech industries: the case of the biotechnology industry. *Strategic management journal*, 24(9), 881-887.
- [8] SME Corp Malaysia (2019). Report on Contribution of SME in 2016. Retrieved on 1 Feb 2019 from <http://www.smecorp.gov.my/index.php/en/policies/2015-12-21-09-09- 49/sme-statistics>.

[9] Abe, M., Troilo, M., & Batsaikhan, O. (2015). Financing small and medium enterprises in Asia and the Pacific. *Journal of Entrepreneurship and Public Policy*, 4(1), 2-32.

[10] Ramlee, S., & Berma, B. (2013). Financing gap in Malaysian small-medium enterprises: A supply-side perspective. *South African Journal of Economic and Management Sciences*, 16(5), 115-126.

[11] Song, H., Yu, K., & Lu, Q. (2018). Financial service providers and banks' role in helping SMEs to access finance. *International Journal of Physical Distribution & Logistics Management*, 48(1), 69-92.

[12] Berger, A. N., & Udell, G. F. (2006). A more complete conceptual framework for SME finance. *Journal of Banking & Finance*, 30(11), 2945-2966

[13] Yan, J., Yu, W., & Zhao, J. L. (2015). How signaling and search costs affect information asymmetry in P2P lending: the economics of big data. *Financial Innovation*, 1(1), 19.

[14] Sufi, A. (2007). Information asymmetry and financing arrangements: Evidence from syndicated loans. *The Journal of Finance*, 62(2), 629-668.

[15] Hoque, M.Z., Sultana N. & Thalil, T. (2016). Credit rationing's determinants of Small and Medium Enterprises (SMEs) in Chittagong, Bangladesh. *Journal of Global Entrepreneurship Research*, 6 (1), 1-23.

[16] Del Bello, A. (2016). Credit rating and intangible assets: a preliminary inquiry into current practices. In *Visualising intangibles: Measuring and reporting in the knowledge economy* (pp. 165-190). Routledge.

[17] Wehinger, G. (2014). SMEs and the credit crunch: Current financing difficulties, policy measures and a review of literature. *OECD Journal: Financial market trends*, 2013(2), 115-148.

# **DIGITAL FINANCIAL LITERACY AND FINANCIAL BEHAVIOUR: THE CASE OF UNIVERSITY STUDENTS**

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## **ABSTRACT**

COVID-19 has changed the way financial transactions are carried out, from physical transactions to digital or online transactions. Hence, there is an increase in the use of digital financial goods and services. Among the highest users is the younger population, which coincidentally has weak financial management skills or financial behaviour. This is because the number of bankruptcy cases among the younger population in Malaysia has escalated. Therefore, a new concept of financial literacy from a digital perspective, which is digital financial literacy (DFL), has emerged. This study examines the level of DFL among university students, the factors that affect DFL, and the impact of DFL on students' financial behavior. This study collected data from 183 Malaysian university students and utilised SmartPLS for data analysis using partial least squares (PLS) modelling. The result indicated that digital financial knowledge is lacking, including awareness of risk related to digital financial transactions among the students compared to the other DFL elements. Additionally, financial literacy and usage of social media positively impacted DFL, and DFL does not boost a sound financial behavior among university students. This study highlights the importance of DFL in the financial literacy body of knowledge and the significance of utilizing social media for DFL education.

**Keywords:** Digital financial literacy (DFL), financial literacy, financial behavior, university students

## **INTRODUCTION**

The COVID-19 pandemic has considerably impacted the adoption of technology across various domains, including financial transaction (Al-Maroof et al., 2020; Puriwat & Tripopsakul, 2021), by accelerating the transition to online financial transactions due to the necessity for physical isolation. The utilisation of digital financial services has increased (Mansour, 2021), particularly among individuals aged 18–44 (Gomes, 2022), who are also reported to have the highest bankruptcy rates in Malaysia, with 36,173 cases recorded from 2017 to 2021 (Malaysian Department of Insolvency, 2021). This raises concerns regarding the influence of digital financial literacy (DFL) on financial behaviour, as personal bankruptcies are exacerbated by poor financial management and the convenience of digital transactions. Consequently, it is imperative to investigate the levels of DFL and their determinants within this demographic. The objective of this study is to examine the level of DFL among university students, factors that affect their DFL, and whether DFL results in sound financial behaviour. 183 students in Selangor, Malaysia, were selected as a sample for the study.

## **MATERIAL AND METHOD**

The questionnaire was distributed online using Survey Monkey. There are four sections of the questionnaires. The first section comprises of questions related to the demographic information about the respondents. The second section collects information related to respondents' DFL. The questions were adapted from Setiawan et al. (2020), comprised of three dimensions discussed in past studies (Lyons & Kass-Hanna, 2021; Morgan et al., 2019; Tony & Desai, 2020). The three dimensions are knowledge, practical know-how, and self-defence. The third section extracts information related to factors that could affect DFL and also financial behavior, such as financial literacy, programme level, parental influence, peers' influence, and also social media influence. The factors are chosen based on the Theory of Planned behaviour of Ajzen (1991). The last section measures the students' financial behaviour based on items suggested by Perry and Morris (2005) and Dew and Xiao (2011). This study utilises SmartPLS 3.3.3 (Ringle et al., 2015) as the statistical tool to assess both the measurement and structural models using the Partial Least Squares Structural Equation Modelling (PLS-SEM) method.

## RESULTS AND DISCUSSION

The first objective of this study is to examine the level of DFL among university students. Three dimensions of DFL, which are knowledge, practical know-how, and self-defence, have been asked. The result indicated that the respondents had a high total digital financial literacy (DFL) score of 4.55, showing excellent knowledge of digital financial services. The score is higher than that of the DFL reported by Setiawan et al. (2020) in Indonesia, which is 2.986. The high score can be attributed to the COVID-19 pandemic, which has led to a shift in various transactions to online platforms, necessitating the adoption of digital skills by young people in conducting financial transactions. Looking at individual dimensions, digital financial knowledge and awareness of risk related to digital financial transactions among the students scored lower than other DFL elements with a mean score of 4.33. However, they have extensive experience (4.65) with digital payments via mobile or internet banking and e-wallets. Their experience with fund transfers through these sites was slightly greater (4.66). More importantly, students are aware of the significance of securing personal information and PINs (4.76).

For the second objective, this study aims at identifying the factors that could affect DFL. The  $R^2$  for the model was 0.192. Based on the results, financial literacy ( $\beta = 0.275$ ,  $p < 0.01$ ) and social media ( $\beta = 0.218$ ,  $p < 0.01$ ) have a significant positive effect on a student's DFL. The result indicated that a student who possesses a strong financial foundation exhibits greater confidence when utilising digital financial products and services. Therefore, it is critical that students acquire enhanced understanding and proficiency in digital financial products and services. Furthermore, in addition to creating effective self-protection mechanisms while utilising digital financial products and services, a good foundation in financial literacy will educate students on the risks associated with their use.

Because of the COVID-19 outbreak, people are talking to each other online instead of in person. Because of this, there has been a big rise in the use of social media to connect with others. Al-Maroof et al. (2020) say that the effort to beat COVID-19 has led to more use of technology. This is because many students use social media a lot, which has helped them learn basic digital skills like how to set a password for an account, which has improved their DFL. Students can improve their online financial skills by visiting sites or following accounts that deal with money and the economy. Based on the study's findings, social media is a useful tool for learning DFL, which is in line with the Social Learning Theory.

The last objective of the study is to identify the role of DFL in influencing a student's financial behaviour. The  $R^2$  for this model is 0.533. The study found that rather than having a beneficial impact, DFL actually has a significant detrimental influence on students' financial behaviour ( $\beta = -0.144$ ,  $p < 0.05$ ). In contrast with the findings by Setiawan et al. (2020) and Rahayu et al. (2022), this study suggests that students who possess a high level of digital financial literacy are more likely to exhibit undesirable financial behaviour. This could be the result of a correlation between high DFL and students' overconfidence in their digital literacy, which in turn increases the likelihood that they will indulge in risky financial behaviour.

## CONCLUSION

In the post-COVID-19 era, it is imperative to utilise digital financial products and services. Due to concerns regarding COVID-19 and social distancing, consumers favour online transactions. The high incidence of bankruptcy among the younger population in Malaysia is indicative of poor financial behaviour. Therefore, this study investigates a novel financial literacy concept known as digital financial literacy (DFL). The students' digital financial literacy was satisfactory on average. However, it is important to take into account the lack of knowledge and risk awareness regarding digital financial transactions. The DFL of a student is significantly predicted by financial literacy and social media usage. Policymakers should acknowledge the significance of DFL and employ social media to improve financial literacy among the younger generation. As evidenced by a substantial adverse effect, a high level of digital financial literacy may deter a good financial behaviour, contrary to expectations.

## REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. <https://doi.org/10.1080/10410236.2018.1493416>

Al-Maroof, R. S., Salloum, S. A., Hassanien, A. E., & Shaalan, K. (2020). Fear from COVID-19 and technology adoption: the impact of Google Meet during Coronavirus pandemic. *Interactive Learning Environments*, 0(0), 1–16. <https://doi.org/10.1080/10494820.2020.1830121>

Dew, J., & Xiao, J. J. (2011). The financial management behavior scale: Development and validation. *Journal of Financial Counseling and Planning*, 22(1), 43–59.

Gomes, V. (2022). E-Wallet: Digital payments pivotal to Malaysia's financial services industry. *The Edge Markets*, 1–7. <https://www.theedgemarkets.com/article/ewallet-digital-payments-pivotal-malaysias-financial-services-industry>

Lyons, A. C., & Kass-Hanna, J. (2021). A methodological overview to defining and measuring “digital” financial literacy. *Financial Planning Review*, 4(April), 1–19. <https://doi.org/10.1002/cfp2.1113>

Malaysian Department of Insolvency. (2021). *Statistik Kebankrapan 2021*. <https://www.mdi.gov.my/index.php/legislation/bankruptcy/1828-bankruptcy-statistic-202>

Mansour, H. (2022). How successful countries are in promoting digital transactions during COVID-19. *Journal of Economic Studies*, 49(3), 435–452. <https://doi.org/10.1108/JES-10-2020-0489>

Morgan, P. J., Huang, B., & Trinh, L. Q. (2019). *The Need to Promote Digital Financial Literacy for the Digital Age*.

Perry, V. G., & Morris, M. D. (2005). Who is in control? the role of self-perception, knowledge, and income in explaining consumer financial behavior. *Journal of Consumer Affairs*, 39(2), 299–313. <https://doi.org/10.1111/j.1745-6606.2005.00016.x>

Puriwat, W., & Tripopsakul, S. (2021). Understanding food delivery mobile application technology adoption: A utaut model integrating perceived fear of covid-19. *Emerging Science Journal*, 5(Special issue), 94–104. <https://doi.org/10.28991/esj-2021-SPER-08>

Rahayu, R., Ali, S., Aulia, A., & Hidayah, R. (2022). The current digital financial literacy and financial behavior in Indonesian millennial generation. *Journal of Accounting and Investment*, 23(1), 78–94. <https://doi.org/10.18196/jai.v23i1.13205>

Ringle, C. M., Wende, S., & Becker, J.-M. (2015). SmartPLS 3. In *Boenningstedt: SmartPLS GmbH*.

Setiawan, M., Effendi, N., Santoso, T., Dewi, V. I., & Sapulette, M. S. (2020). Digital financial literacy, current behavior of saving and spending and its future foresight. *Economics of Innovation and New Technology*, 0(0), 1–19. <https://doi.org/10.1080/10438599.2020.1799142>

Tony, N., & Desai, K. (2020). Impact of digital financial literacy on digital financial inclusion. *International Journal of Scientific & Technology Research*, 9(01), 1911–1915.

# INVESTIGATING OPERATIONAL RISK CHALLENGES FACED BY MICRO ENTERPRISE IN MALAYSIA

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## ABSTRACT

Micro and small enterprises have emerged as a pivotal driving force behind Malaysia's economic growth, contributing significantly to its overall economic prosperity. In the contemporary landscape of the digital economy, effectively navigating the multifaceted challenges that beset these enterprises is of paramount importance to ensure their sustained survival and success in the competitive economic environment. Understanding these risks and addressing them appropriately is essential to safeguard the long-term prospects of micro and small enterprises. This research endeavours to shed light on the diverse challenges associated with managing potential operational risks within the context of micro and small enterprises situated in Kuala Selangor, Selangor, Malaysia. In-depth interviews were conducted with a carefully selected group of business owners operating within the geographical confines of Kuala Selangor. The insights and data gathered from these interviews provide a comprehensive perspective on the challenges faced by these enterprising individuals, as well as their perceptions of operational risk occurrences within the contemporary business environment. Furthermore, this study also takes cognizance of its own limitations and offers valuable recommendations for future research directions in this domain. By exploring the nuances of managing operational risks in micro and small enterprises, this research seeks to contribute to a deeper understanding of the intricate economic landscape in Malaysia and provide insights that can inform policy, strategy, and best practices for the benefit of these crucial economic contributors.

**Keywords:** Operational Risk, Micro and Small Enterprises, Entrepreneur

## INTRODUCTION

The economic landscape of Malaysia has experienced significant challenges due to internal political instability and what some consider as unfavorable government policies. These factors have not only increased the cost of living but have also prompted a shift in consumer behavior, as people adapt their spending habits to cope with these economic hardships. This shifting landscape has put a strain on the survival of micro and small enterprises (MSEs), which heavily depend on stable economic conditions. Consequently, there has been a growing discourse among academics, industry professionals, and regulatory bodies about how to effectively manage the difficulties and risks associated with this changing economic environment. Business decisions in such conditions are increasingly influenced by the ability to foresee and mitigate impending risks, yet it is surprising that only a limited number of previous research efforts have delved into this crucial subject matter (Saghaian et al., 2022). In 2016, Malaysia boasted an impressive number of small and medium enterprises (SMEs), encompassing a wide array of sectors. Among these, Micro Enterprises (MEs) held a prominent position, accounting for 76.5% of the total SMEs, with 693,670 businesses. As these MSEs play a pivotal role in driving the economy and are often the cornerstone for many families, it is crucial to understand and address the potential risks that may affect their operations. The Malaysian government, through agencies like SME Corporation, has prioritized the improvement of income for rural and local communities, in alignment with the goals outlined in the 11<sup>th</sup> Malaysia Plan, aimed at elevating the living standards of bottom-tier households (referred to as B40) toward achieving middle-class status. MSEs are viewed as a promising avenue for creating business opportunities for family members and enhancing their quality of life. Previous research has pinpointed several potential risks that can impact MSEs, spanning product-related, marketing, human resources, suppliers, economic, and technological domains. Hence, it is essential for business owners to proactively assess the operational risks that might manifest in their ventures, which would not only benefit their own enterprises but also support organizations like SME Corporation, Amanah Ikhtiar Malaysia (AIM), Tabung Ekonomi Kumpulan Usaha Niaga (TEKUN

Nasional), or Perbadanan Usahawan Nasional Berhad (PUNB) in their efforts to provide comprehensive support.

A paramount challenge for many MSEs lies in their ability to assess specific risks at each stage of their business life cycle. This evaluation is instrumental as it enables them to identify priority areas for improvement (Ismail Albalushi et al., 2022). Over time, it has become evident that decisions often hinge on the perceived causes of actions, even if the actual risks have not been fully acknowledged. Even those risks with low probabilities of occurrence must be considered in the decision-making process. In essence, avoiding risk is not a guarantee for business survival in a competitive environment, as a previous study suggests that the ability to analyze rivals' strategies and business risks is critical for the survival of MSEs in such an intensely competitive landscape (Jamak, Salleh, Sivapalan & Abdullah, 2011). In light of these challenges, this study seeks to explore the hurdles faced by MSEs in Kuala Selangor, Selangor, as they strive to minimize the occurrences of operational risks that could threaten their business survival. The research endeavors to provide a deeper understanding of the challenges confronting micro and small businesses and to identify the factors contributing to perceived operational risks and how they can be minimized to prevent losses. This study aims to shed light on the practices of risk management among micro and small business owners, ultimately helping them navigate and mitigate the impacts of risks that could hinder their business's longevity and success.

## LITERATURE REVIEW

### *Operational Risk and Business Survivability*

In the context of micro-enterprises in Malaysia, there has been substantial discourse within professional and regulatory circles concerning the management of business risk. Despite the fact that the ability to detect and anticipate significant risk-related events can profoundly influence business decisions, there is a limited body of previous research that delves into risk management strategies aimed at ensuring the survival of small and medium-sized enterprises. Solomon, Solomon, Norton, and Joseph (2000) offer a definition of risk as the uncertainty associated with potential gains and losses, presenting risk information from both positive and negative perspectives (ICAEW, 2000). ICAEW (2000) goes on to elaborate on operational risks as events that disrupt operations, rendering them inefficient and ineffective in executing the firm's business model and meeting quality, cost, and time performance objectives (Naude & Chiweshe, 2017). In another study, risk is defined as disturbances in operational events that lead to deviations from expected performance, resulting in unfavorable consequences and losses (Crovini et al., 2021). Generally, risks can be categorized into three groups: operational, occupational, and economic. These risks may have interconnected adverse effects on routine operations, potentially causing decreased productivity, losses in production quality, asset depletion, elevated risks related to human capital issues such as employee health, safety, and well-being, financial penalties, compensation claims, and damage to the firm's reputation (Crovini et al., 2021). Previous empirical studies also indicate that intense competition, lack of customers, and deficiencies in management, sales, and marketing skills can significantly impede the overall business systems and processes (Jamak et al., 2011).

### *Factors Contributing to Business Success*

The success of businesses is closely tied to entrepreneurs' ability to overcome challenges at every stage of the business life cycle (Dewa, Matope, Van Der Merwe, & Nyanga, 2014). Scholars have explored various factors that contribute to the success or failure of SMEs. Entrepreneurial competence, the use of IT technology, and financial resources have all been identified as major determinants of business success (Mohamad Radzi, Mohd Nor, & Mohezar Ali, 2017). Additionally, three owner-related characteristics, business background, and business practices have been recognized as crucial elements for the survival of micro and small enterprises (Jamak et al., 2011; Usama & Yusoff, 2019). Business survival can be influenced by the general characteristics of business owners, including gender, age, and education, as well as their motives, such as risk tolerance, desire for independence, and employment status. Competencies, such as industry-specific skills and general business management, also play a vital role (Saghaian, Mohammadi & Mohammadi, 2022).

Furthermore, the business background encompasses factors like the age of the business, its size, industry/sector, and location, while business characteristics involve the execution of daily operations, innovation, technology adoption, market orientation, and sources of finance (Che Omar & Nor Azmi,

2015). The motivation behind an individual's decision to start and sustain a business can be driven by either opportunity or necessity (Nasiri & Hamelin, 2018; Papadaki & Chami, 2002). Various reasons underpin the choice to become an entrepreneur, dependent on the individual's initial objectives and aspirations in the realm of business (Mabhungu & Van Der Poll, 2017). The opportunity or "pull" factor relates to resource exploitation, such as expertise, business innovation, and self-realization, whereas the necessity or "push" factor is associated with personal forces like unemployment, preference for work flexibility, or the compulsion to meet the cost of living (Nasiri & Hamelin, 2018). Therefore, the motivations and factors driving individuals to become business owners are of paramount importance, as they shape how entrepreneurs perceive the challenges within their businesses. These challenges can be viewed as either opportunities or threats depending on entrepreneurs' perceptions of their impacts.

## RESEARCH METHODOLOGY

The research participants were carefully selected from the Kuala Selangor district, a significant area in the state of Selangor, which ranks as the second-largest district in the region but exhibits lower economic performance compared to smaller districts within the same state. This choice was informed by statistical data from SME Corp, which highlighted Selangor's dominance in terms of SME registration in Malaysia, at 19.8%, surpassing the Federal Territory of Kuala Lumpur (14.7%) and Johor (10.8%). Despite this, the Kuala Selangor district was ranked eighth out of nine districts, with a total cumulative investment of only RM3,702.6 million reported from 1987 to 2016. The study engaged seven respondents, each representing three distinct types of businesses: education services, trading, and food production. These individuals willingly participated in in-depth semi-structured interviews conducted in the Malay language, reflecting the local environment. The primary aim of the research was to comprehensively explore the personal experiences of entrepreneurs as they navigate challenges and disruptions in their respective businesses. The interview questions were meticulously crafted around four key themes: the business profile, understanding of operational risks, challenges associated with managing operational risks, and the assessment of operational risk factors to mitigate adverse effects on business sustainability. Each interview session spanned approximately 40 minutes to one hour and was carried out at the premises of the respective businesses. These sessions were recorded, and the pertinent information was subsequently manually transcribed to align with the research's objectives. Data analysis was conducted through an extensive review of relevant literature sources, focusing on extracting and presenting information directly related to the study's objectives.

## RESULTS AND DISCUSSION

The initial section of the interviews unveiled its results in Table 1, which focused on gathering essential business profile details that shed light on the background of both entrepreneurs and their respective enterprises. This section made no distinction between these two components. Among the participants, three were male, while four were female. When it came to the duration of business operations, two establishments had been running for a period spanning 5 to 10 years, whereas the remaining five could be categorized as relatively new startups since their operations had not exceeded 5 years. In terms of workforce size, all of these businesses could be classified as either micro or small enterprises, as their staff number did not surpass 20 individuals. Out of the seven businesses under investigation, only three were able to generate a monthly sales income exceeding RM20,000. Consequently, these specific criteria established their credibility as respondents, given their significance in determining business survival, as highlighted by Che Omar and Nor Azmi (2015).

Table 1: Business Profile

Item	Frequency	Percent
Gender		
Male	3	42.8
Female	4	57.2
Sector		

Services	2	28.6
Food & Beverages	1	14.3
Education services	3	42.8
Trading	1	14.3
<b>Number of Employees</b>		
Nil	2	28.6
0 to 5	3	42.8
6 to 20	2	28.6
<b>Monthly Sales Income</b>		
Less than RM5,000	1	14.3
Less than RM10,000	2	28.6
Less than RM20,000	2	28.6
More than RM20,000	2	28.6

### ***Operating Risk: Definition, Comprehension, and Consequences***

Each participant in this study held varying perspectives on operating risks and their impact on their businesses. These participants are identified as “E1” through “E7.” A majority of them failed to recognize that business operations, regardless of their scale, are susceptible to operating risks by their very nature. In general, they encountered disruptions in both their routine and non-routine operations (Ismail, Md Yusoff, Ab Samad & Ahmad, 2020). However, they did not perceive these disruptions as risks to their businesses, primarily because most of them associated the term ‘risk’ with a negative connotation. Their understanding of risks was limited, not recognizing that risks can have either a positive or negative connotation, depending on one’s perspective. All respondents also agreed that perceived risks could be either positive or negative, and their significance depended on their initial intentions when establishing their businesses and their ability to navigate these risks over the next five years.

### ***Challenges in Managing Operational Risk in Micro and Small Businesses***

Accordingly, all respondents indicated that they began their businesses for various reasons. Eighty-five percent of them stated that the push factor compelled them to start their businesses (Jamak et al., 2011; Ismail et al., 2020). They acknowledged that these decision-driving factors would influence their future life planning. Most respondents perceived the challenges they encountered in managing operational risks positively. They identified human capital issues, such as employee and owner health problems, as a key risk factor contributing to business challenges. They also were asked how they perceived themselves as entrepreneurs when confronting these challenges. Interestingly, most respondents portrayed themselves as risk-takers, displaying the courage to explore new ideas, seek new markets, and adopt innovative marketing methods. They demonstrated a strong understanding of product/service gaps and were unafraid of failure in their ventures (Ismail et al., 2020). This indicates their ability to effectively manage these challenges, even though most of them could be classified as young entrepreneurs with less than five years of experience in their businesses.

### ***Assessing Operational Risk Factors to Minimize Impacts***

During interviews, respondents mentioned various actions they had taken to minimize or mitigate the impacts of risks on their business operations. These questions elicited detailed responses from the respondents, demonstrating their ability to take appropriate actions when faced with unexpected events in their businesses. Despite the absence of specific risk assessment procedures and designated personnel, they equipped themselves with knowledge about their businesses. They could grasp critical situations, assess the consequences of unforeseen risk events, and consider customer preferences and regulatory requirements to ensure the continued relevance of their businesses (Jamak et al., 2011).

## CONCLUSION

This research delves into the realm of micro and small enterprises in the Kuala Selangor district of Selangor, Malaysia, seeking to illuminate the rich tapestry of experiences of business owners who embarked on their entrepreneurial journeys within the past decade. Through a carefully curated selection process, we engaged with these individuals, aiming to extract valuable insights into the myriad operational risks that permeate their business landscapes. Despite their diminutive size, micro and small enterprises harbor tremendous growth potential, presenting a formidable opportunity to bolster the Malaysian economy. Thus, the paramount objective of this study is to fathom the business owners' perspectives regarding the impetus behind their enterprises, their nuanced perceptions of the operational hazards that loom, and the multifaceted challenges entailed in effectively managing and evaluating these risks. Micro and small enterprise proprietors are often viewed as daring risk-takers, their foray into the business landscape exemplifying their willingness to confront challenges head-on. Despite being seasoned entrepreneurs, they exhibit an unwavering commitment to embracing risk as an integral part of decision-making, essential for ensuring the survival and flourishing of their ventures amidst cutthroat competition. Crucially, a noteworthy subset of these entrepreneurs has undertaken proactive measures to identify and evaluate the latent risks within their operations, thereby enabling them to implement safeguards to mitigate the adverse impacts of unforeseen events. In light of these findings, it is apparent that future investigations should be conducted on a larger scale, with a quantitative methodology poised to offer more comprehensive insights. Moreover, to delve deeper into the intricate web of factors that influence the management and assessment of risks, a more detailed examination is warranted. The current qualitative approach, while insightful, may fall short in encapsulating the diverse perspectives and experiences within the broader population. Additionally, a profiling of business owners is a promising avenue to explore, allowing for a more thorough examination of whether personality differences constitute a determinative factor in the growth of MSEs within Malaysia.

## REFERENCES

Che Omar, M. Z. C., & Nor Azmi, N. M. (2015). Factors Affecting the Success of Bumiputera Entrepreneurs in Small and Medium Enterprises ( SMEs ) in Malaysia. *International Journal of Management Science and Business Administration*, 1(9), 40–45.

Crovini, C., Ossola, G., & Britzelmaier, B. (2021). How to reconsider risk management in SMEs? An advanced, reasoned and organised literature review. *European Management Journal*, 39(1), 118–134.

Dewa, M. T., Matope, S., Van Der Merwe, A. F., & Nyanga, L. (2014). An Empirical Analysis of Operational Disturbances and Their Impact on Business Performance in Manufacturing Firms : Case Tooling Industry South Africa. In 26th SAIIE conference (pp. 1–16).

ICAEW. (2000). No Surprises: The case for better risk reporting.

Ismail Albalushi, K., & Naqshbandi, M. M. (2022). Factors Affecting Success and Survival of Small and Medium Enterprises in the Middle East. *Knowledge*, 2(3), 525–538.

Ismail, R. F., Yusoff, N. M., Ab Samad, N. H., & Ahmad, E. M. (2020) Assessing Operating Risk Impacts on Business Operation from the Micro and Small Entrepreneurs' Perspective. *International Journal of Innovation, Creativity and Change*, 13(3), 1262 – 1280.

Jamak, A. B. S. A., Salleh, R., Sivapalan, S., & Abdullah, A. (2011). Entrepreneurial challenges confronting micro enterprise of Malaysian Malays. *International Journal of Economics and Management Engineering*, 5(11), 1432–1437.

Mabhungu, I., & Van Der Poll, B. (2017). A Review of Critical Success Factors Which Drives the Performance of Micro, Small and Medium Enterprises. *International Journal of Business and Management*, 12(6), 151.

Mohamad Radzi, K., Mohd Nor, M. N., & Mohezar Ali, S. (2017). The Impact of Internal Factors on Small Business Success: A Case of Small Enterprises under the FELDA Scheme. *Asian Academy of Management Journal*, 22(1), 27–55.

Nasiri, N., & Hamelin, N. (2018). Entrepreneurship driven by opportunity and necessity: Effects of educations, gender and occupation in MENA. *Asian Journal of Business Research*, 8(2), 57–71.

Naude, M. J., & Chiweshe, N. (2017). A proposed operational risk management framework for small and medium enterprises. *South African Journal of Economic and Management Sciences*, 20(1), 1–10.

Papadaki, E., & Chami, B. (2002). Growth Determinants of Micro-Businesses in Canada. *Small Business Policy Branch Industry Canada*.

Saghaian, S., Mohammadi, H., & Mohammadi, M. (2022). Factors Affecting Success of Entrepreneurship in Agribusinesses: Evidence from the City of Mashhad, Iran. *Sustainability*, 14(13), 7700.

Solomon, J. F., Solomon, A., Norton, S. D., & Joseph, N. L. (2000). A Conceptual Framework For Corporate Risk Disclosure Emerging From The Agenda For Corporate Governance Reform. *British Accounting Review*, 32, 447–478. <https://doi.org/10.1006/bare.2000.0145>

Usama, K. M., & Yusoff, W. F. (2019). The impact of financial literacy on business performance. *International Journal of Research and Innovation in Social Science*, 3(10), 84-91.

## **FACULTY OF EDUCATION**

# DOUBLE DISASTER: EXPLORING POST-TRAUMATIC EXPERIENCES AMONG STUDENTS

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## ABSTRAC

The years 2020 and 2021 witnessed how the world had to deal with the unprecedented educational circumstance prompted by a global pandemic. The swift change to online learning was stressful and taxing in many ways, for both students and teachers, affecting their physical and mental health. Combating the spread of Covid-19 is aggravated by various natural disasters in several countries, including Malaysia. In the aftermath of a disaster, physical impacts such as the destruction of infrastructure and human casualties are easily noticeable. Yet there are often many psychological impacts present too such as anxiety, shock, sleeplessness and uncertainties concerning the future. With the combination of pandemic and natural disasters, the distress caused by these successive events may have become a hindrance to students' deep involvement in learning. Therefore, this study seeks to explore the difficulties faced by individuals affected by a combination of a global pandemic and natural disasters. Employing a quantitative approach through an online survey, 409 participants were selected from stratified random sampling. In addition, quantitative data gathered through a questionnaire were analysed using descriptive statistics. Findings indicate that the dual disasters increased stress levels, leading to heightened academic, behavioural, and financial pressures on students. The findings of this study will be instrumental in formulating strategic measures that best complement the needs of students during a double disaster, particularly in addressing the psychological impact towards this vulnerable group.

**Keywords:** global pandemic, natural disasters, Covid-19, post-traumatic events, teaching and learning

## INTRODUCTION

The closure of schools and educational institutions due to the Covid-19 pandemic presented challenges to teaching and learning processes, prompting schools to implement unprecedented measures to sustain the education system (Chiu, Lin, & Lonka, 2021). During the pandemic, some individuals faced an additional crisis attributed to climate change. Termed "double disaster," these humanitarian emergencies involve a combination of pandemics, natural disasters, and man-made crises, posing significant challenges to the well-being of individuals and communities (Cueto & Agaton, 2021). Additionally, the rise in absenteeism and dropouts due to Covid-19 is a notable concern. In Malaysia, Education Minister Radzi Jidin reported a slight increase in dropout rates among primary and secondary level learners since the onset of the Covid-19 pandemic, indicating a 0.01 percent rise from the previous year (Hazim, 2020).

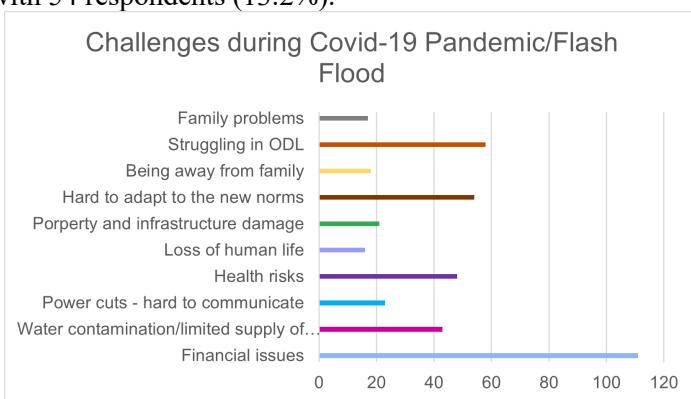
The Covid-19 pandemic has significantly impacted teaching and learning processes. The sudden transition from traditional classrooms to remote learning has been a formidable challenge for institutions globally, particularly in engaging students and motivating their participation in online lessons (Xhaferri & Xhaferri, 2022). The online learning environment, reliant on intrinsic motivation, curiosity, and self-regulation to foster classroom engagement, demands learners to be more intrinsically motivated (Martens, Gulikers, & Bastiaens, 2004). However, the aggregated stress and anxiety from the pandemic can easily demotivate learners in the virtual classroom (Pekrun et al., as cited in Chiu, Lin, & Lonka, 2021). As a result, it hampers the learning process. This study aims to address the challenges faced by students who experienced double disaster.

## MATERIAL AND METHOD

This study adopted the quantitative methodology by using an online survey. The questionnaire encompassed demographic details, open-ended questions pertaining to the challenges faced by the respondents during the double disaster. There are a total of 409 respondents who took part in this study. These respondents were selected using stratified sampling. Data were collected and analysed using the Statistical Package for Social Sciences (SPSS) Version 28 to answer the research question in this study. A descriptive analysis was conducted to examine the challenges experienced by respondents during the double disaster.

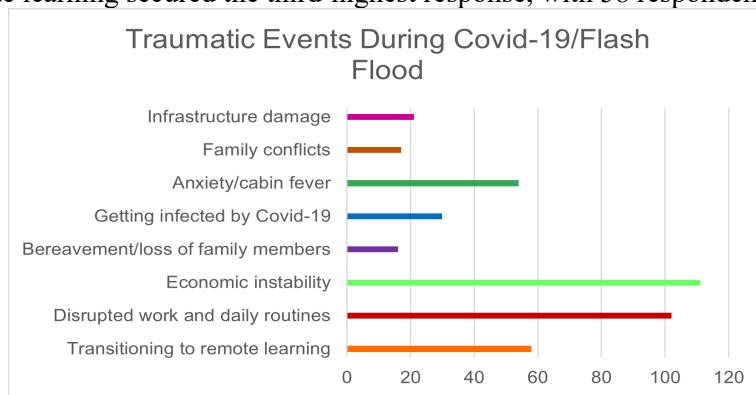
## RESULTS AND DISCUSSION

Figure 1 displays the results for Question 1, revealing 10 emerging themes. Financial issues emerged as the most frequently mentioned theme, with 111 responses (27.13%). Online Distance Learning (ODL) struggles closely followed, garnering 58 respondents (14.18%), and transitioning to new norms ranked third with 54 respondents (13.2%).



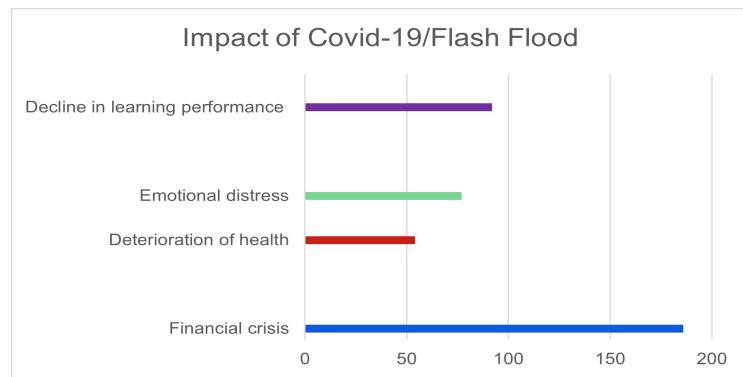
**Fig 1.** Challenges Faced by Students during COVID-19 Pandemic/Flash Flood

For Question 2, 7 emerging themes were identified. Economic instability topped the list with 111 responses (27.14%), indicating the most experienced traumatic event. Disruption of work and daily routines due to the global pandemic and flash flood closely followed, with 102 respondents (24.93%). Transitioning to remote learning secured the third-highest response, with 58 respondents (14.18%).



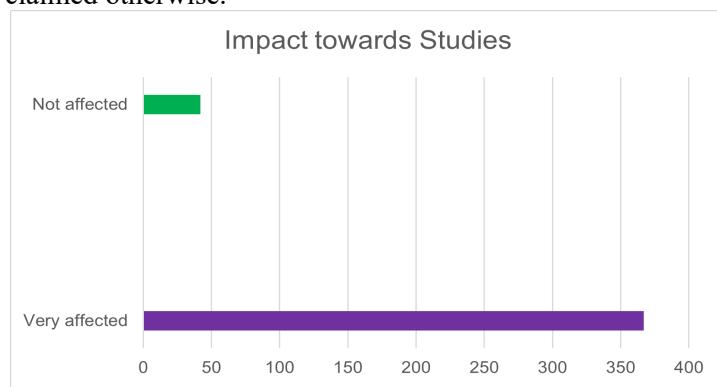
**Fig 2.** Traumatic Events during COVID-19/Flash Flood

Figure 3 illustrates the responses for Question 3, with 186 respondents (45.5%) indicating a significant impact on their finances due to the Covid-19 pandemic and flash flood. Additionally, 92 respondents (22.5%) reported a decline in learning performance following these events. Emotional distress and deterioration of health gathered 77 respondents (18.8%) and 54 respondents (13.2%), respectively.



**Fig 3.** Impact of COVID-19/Flash Flood

Question 4 aimed to assess the impact of the double disaster on respondents' studies. Figure 4 depicts that 367 respondents (89.7%) agreed that their studies were highly affected, while the remaining 42 respondents (10.3%) claimed otherwise.



**Fig 4.** Impact of Traumatic Events towards Studies

It is evident that the abrupt transition from traditional classrooms to remote learning posed significant challenges for the majority of students. Encouraging student engagement and participation in online lessons proved to be difficult due to the intrinsic motivation required in the online learning environment (Xhaferri & Xhaferri, 2022). A study by Othman, Sulaiman, Mohd Najib, and Wan Ismail (2022) highlighted issues such as reduced concentration, poor internet connectivity, and difficulty comprehending online content among Diploma in Pharmacy students at a local university. Some students reported poor exam results, indicating a decline in learning performance attributed to the challenges posed by the Covid-19 outbreak and flash floods.

Jafar et al., (2022) also found that deteriorating focus on studying and students' inability to adapt to e-learning were major challenges faced by higher education students in Malaysia during the implementation of online learning. The reduced focus may be linked to the sudden social isolation imposed during the pandemic, leading to cognitive inactivity and cognitive decline (Shankar et al., 2013). Students also reported losing motivation to continue their education and experiencing emotional distress, with the lack of social interactions contributing to poorer physical and mental health (Hawley & Cacioppo, 2010). These findings align with a study done by Leal Filho, Wall, Rayman-Bacchus, Pritchard, Lovren, Farinha, Petrovic, and Balogun (2021), who noted that anxiety, amplified by social isolation and the shift to online learning, resulted in mental health consequences. The limitations on social interactions during the pandemic have intensified anxiety and depression among individuals perceiving themselves as vulnerable to Covid-19, compounded by factors such as financial constraints, social isolation, and the inability to leave their homes (Ibrahim & Alexcius, 2022).

Disrupted daily routines emerged as another major challenge, disrupting academic activities and demotivating students due to the lack of social interactions (Leal Filho et al., 2021). Economic instability, exacerbated by the dual crises of the global pandemic and flash floods, particularly affected vulnerable groups already experiencing poverty and relying on financial or humanitarian support (Nordling, 2020). Respondents reported cutting expenses due to financial anxiety induced by the Covid-

19 pandemic. Natural disasters and healthcare crises typically influence consumer behavior, including herd mentality, panic buying, or changes in discretionary spending (Loxton et al., as cited in Trkulja & Tadic, 2021).

## CONCLUSION

It is crucial to acknowledge that the impact of the COVID-19 pandemic and the flash flood has diverse effects on students, impacting them physically, emotionally, and financially. This research offers a perspective on the difficulties students encounter during these crises. Given the ongoing challenges posed by COVID-19 and natural disasters, it becomes imperative for nations to prioritize the protection of the most vulnerable group, shielding them from the negative repercussions of both crises. In addition, the government should promote strategies to help individuals detach from the overwhelming emotional distress caused by eco-anxiety. Over the past few years, the use of asynchronous technologies has witnessed growth in various healthcare settings, and this trend has now expanded to mental healthcare (Yellowlees & Shore, 2018). The increasing adoption of asynchronous tools makes it more accessible for people to seek mental support. Since the results indicated a significant disruption in the students' learning process due to the double disaster, future studies could delve into exploring the potential consequences of these shocks on the overall quality of education across various levels

## . REFERENCES

Chiu, T. K., Lin, T.-J., & Lonka, K. (2021). Motivating Online Learning: The Challenges of COVID-19. *Asia-Pacific Edu Res*, 187-190.

Clayton, S., Manning, C., Krygsman, K., & Speiser, M. (2017). *Mental Health and Our Changing Climate: Impacts, Implications, and Guidance*. Washington D.C.: Americal Psychological Association and ecoAmerica.

Cueto, L. J., & Agaton, C. B. (2021). Pandemic and Typhoon: Positive Impacts of a Double Disaster on Mental Health of Female Students in the Philippines. *Behavioral Sciences*, 11, 64, 1-12.

De Mello MT, Lemos Vde A, Antunes HK, Bittencourt L, Santos-Silva R, Tufik S. (2013). Relationship between physical activity and depression and anxiety symptoms: a population study. *J Affect Disord*. Jul;149(1-3):241-6. doi: 10.1016/j.jad.2013.01.035.

Goodwin, E., Kraft, K. (2022). Mental health and spiritual well-being in humanitarian crises: the role of faith communities providing spiritual and psychosocial support during the COVID-19 pandemic. *Int J Humanitarian Action* 7. <https://doi.org/10.1186/s41018-022-00127-w>

Hakim, A. (2020, May 8). Retrieved from TRP: <https://www.therakyatpost.com/news/malaysia/2020/05/08/malaysias-unemployment-rate-jump-to-decade-record-high-amid-pandemic/>

Ibrahim, W. N., & Alexcius, N. (2022). Anxiety and Depression among University Students during the COVID-19 Pandemic: A Cross-sectional Study. *Asian Journal of University Education (AJUE)*, 170-179.

Kearney, M., Schuck, S., Fergusson, J. et al. (2022). Effective practices during emergency school lockdowns: shared experiences of four Australian schools. *Aust. Educ. Res.* <https://doi.org/10.1007/s13384-022-00588-3>

Louise C. Hawkley, John T. Cacioppo. (2010) Loneliness Matters: A Theoretical and Empirical Review of Consequences and Mechanisms, *Annals of Behavioral Medicine*, Volume 40, Issue 2, Pages 218–227, <https://doi.org/10.1007/s12160-010-9210-8>

Lucero-Pisno, D., Bernardino, G., Camua, A., Lin, X., & Adebisi, Y. (2020). Philippines braces for the typhoon season amidst COVID-19. *Lancet Reg. Health West. Pac.*

Martens, R., Gulikers, J., & Bastiaens, T. (2004). The Impact of Intrinsic Motivation on E-Learning in Authentic Computer Tasks. *Journal of Computer Assisted Learning*, 368-376.

Nordling, M. L. (2020). *Double Trouble: An analysis of the UNDRR's inclusion of vulnerable groups in dual crises following natural*. DiVA.

Olmedo-Cifuentes, I.;& Martínez-León, I.(2022). University dropout intention: analysis during covid-19. *Journal of Management and Business Education*, 5(2), 97-117. <https://doi.org/10.35564/jmbe.2022.0007>

Othman, M. I., Sulaiman, S., Mohd Najib, M. N., & Wan Ismail, W. N. (2022). Forced Online and Distance Learning during COVID-19 Pandemic: Students' Perceptions and Experiences . *Asian Journal of University Education (AJUE)*, 894-905.

Panu, P. (2020). Anxiety and the Ecological Crisis: An Analysis of Eco Anxiety and Climate Anxiety. *MDPI*, 1-20.

Papouli, E., Chatzifotiou, S., & Tsairidis, C. (2020). The use of digital technology at home during the COVID-19 outbreak: Views of social work students in Greece. *Social Work Education*, 39(8), 1107-1115.

Sparks, S. D. (2021, May 24). Retrieved from Education Week: <https://www.edweek.org/leadership/helping-students-bounce-back-from-a-disrupted-year-strategies-for-schools/2021/05>

Trkulja, I., & Tadic, L. (2021). *Financial anxiety and saving intentions during the Covid-19 crisis: A comparison between Sweden and Serbia*. DiVA.

Ward, M. E., & Shelley, K. (2008). Hurricane Katrina's impact on students and staff members in the schools of Mississippi. *Journal of Education for Students Placed at Risk*, vol. 13, 335-353.

Xhaferri, B., & Xhaferri, G. (2022). Motivation in Online Learning During COVID-19 Pandemic: A Case Study of SEEU in North Macedonia. *Proceedings on Engineering Sciences*, 157-166.

Yellowlees P, Shore J. (2018). Telepsychiatry and health technologies: a guide for mental health professionals. APPI Press. Washington DC.

# **UNDERSTANDING AND PREVENTING JUVENILE DELINQUENCY: A QUALITATIVE EXPLORATION OF RISK AND PROTECTIVE FACTORS AMONG MALAYSIAN ADOLESCENTS**

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## **ABSTRACT**

Juvenile delinquency, characterised by unlawful actions committed by individuals under 18, raises considerable societal concerns, necessitating insights into its causes and preventive strategies. This study investigates the leading risk factors associated with delinquency among Malaysian adolescents, employing semi-structured interviews with two probation officers. Thematic analysis revealed family instability, lack of parental support, peer pressure, living environment, education gaps, and delinquents' attitudes as influential factors. The implications extend to understanding, risk identification, and program development for prevention, intervention, and rehabilitation. Furthermore, beyond investigating the causes, this research delves into the intricate dynamics of protective factors influencing Malaysian youth in criminal activities. Drawing from the experiences of the probation officers, the study identified that family, schools, and society at large emerge as pivotal deterrents, playing crucial roles in steering juveniles away from criminal behaviours. This comprehensive exploration aims to deepen our understanding of the multifaceted factors influencing adolescent criminal behaviour, providing valuable insights for the development and enhancement of targeted prevention strategies for juvenile delinquency in Malaysia.

**Keyword:** Juvenile delinquency, Adolescent offenders, Malaysian youth, Risk factors, Protective factors

## **INTRODUCTION**

Wrongful conduct and criminal acts, particularly those committed by juveniles or adolescents, remain a pervasive concern globally. In the specific context of this study, juvenile delinquency refers to the commission of illegal or wrongful acts by individuals under 18 (Nasimah, 2013). The spectrum of crimes associated with juvenile delinquency encompasses various offences, including burglary, larceny, armed robbery, alcohol-related offences, drug offences, sexual offences, vandalism, assault, harassment, loitering, and gangsterism. These offences carry legal consequences, ranging from probation for less severe crimes to incarceration for more severe infractions (Nasimah, 2013).

The implications of juvenile delinquency extend beyond the immediate legal ramifications, reaching into societal, parental, and educational realms. Recognising the gravity of the issue, particularly in the Malaysian context, where understanding the contributing factors is paramount, this study delves into the primary influences on juvenile delinquency among Malaysian adolescents. By examining both the risk and protective elements associated with criminal activities, the research aims to provide comprehensive insights that can inform effective prevention and intervention efforts.

Understanding the intricacies of juvenile delinquency involves a nuanced exploration of risk and protective factors. Risk factors are characteristics or conditions that increase the probability of an individual engaging in delinquent behaviour compared to their peers in the general population. Recent research has identified family conflict and dysfunction, as well as neglect and maltreatment, as primary predictors of juvenile delinquency. Conversely, higher academic achievement and strong, positive parental relationships serve as protective factors against delinquency among at-risk youth. Interventions that have shown efficacy in reducing recidivism include family-based approaches, particularly family therapy, and community-based programs. These findings underscore the complexity of identifying and mitigating risk factors in juvenile delinquency (Aazami et al., 2023).

Concurrently, protective factors act as buffers that mitigate the impact of exposure to risk factors, leading to a reduced incidence of problematic behaviour. Recent studies have identified key

protective factors, such as supportive family environments and positive peer relationships, which enhance resilience among at-risk youth. These factors operate through mechanisms like reducing exposure to risk, fostering self-esteem and self-efficacy, and creating opportunities for positive development. This framework underscores the critical importance of identifying and strengthening both risk and protective factors to effectively address juvenile delinquency (Aazami et al., 2023).

In delving into the primary influences on juvenile delinquency among Malaysian adolescents, this study aims to provide a comprehensive understanding that can inform effective prevention and intervention efforts, fostering a safer and more supportive environment for the youth.

## METHOD

A qualitative research approach was employed to investigate juvenile delinquency among Malaysian adolescents. Semi-structured interviews, a fundamental component of the basic qualitative approach, were conducted with two probation officers who have firsthand experience with adolescents in court proceedings. Using probation officers as key informants provided valuable insights into the practical and legal dimensions of juvenile delinquency. Thematic analysis was applied to the interview data to distil essential findings and uncover patterns related to family dynamics, peer influence, socio-economic factors, and educational disparities. The data collection process adhered to an interview protocol sanctioned by the university's ethics committee, ensuring that respondents were informed of the study's objectives, and their identities were kept anonymous throughout the research. Pseudonyms were assigned during data analysis to further safeguard informant identities. Below are the demographic profiles of the respondents.

**Table 1 Demographic Profile of the Respondents**

<b>Name (pseudonym)</b>	<u>Masran</u>	Eliza
<b>Age</b>	45	39
<b>Gender</b>	Male	Female
<b>Experience as a probation officer</b>	4 years (2018 – 2021)	11 years (2010 – 2021)

## RESULTS AND DISCUSSION

Thematic analysis of the semi-structured interviews revealed six overarching themes that contribute significantly to juvenile delinquency among Malaysian adolescents: family instability, lack of parental support, peer pressure, incondusive living environments, gaps in education and awareness, and the delinquents' attitudes toward unlawful behaviours. The study highlights the delicate balance between these factors, indicating that elements perceived as protective, such as family and societal support, can also turn into risk factors under certain circumstances. To ensure reliability and validity, inter-coder reliability was achieved by having two independent researchers code the transcripts, resolving discrepancies through consensus. Thematic validity was strengthened through member checking, where participants confirmed the accuracy of the themes, and expert validation, where findings were reviewed by specialists in juvenile delinquency. These measures ensured the trustworthiness of the data and interpretations, despite relying on a single instrument.

### ***Risk Factors:***

**Family Environment:** The insights provided by the informants underscore the significant influence of family environments on adolescent delinquency, particularly in the Malaysian context. The majority of adolescents engaged in delinquent activities hailed from incondusive family environments, often characterized by low income. Eliza highlighted that families earning less than RM2000 per month, with the breadwinner frequently self-employed and facing financial distress, were more susceptible to challenges. The struggle to meet basic needs amid financial and life pressures left parents with limited capacity to provide essential attention, guidance, and care for their children. This deficiency in parenting was identified as a key factor contributing to delinquency. The absence of adequate parental supervision, whether through neglect, overindulgence, or inattentiveness, created a void that allowed adolescents to act impulsively, engage in unlawful acts as a form of rebellion or emotional expression, or seek attention. The scarcity of basic needs and the desire for more resources or attention emerged as driving factors for adolescents' involvement in criminal activities, as evidenced by previous research

(Khuda, 2019). The informants concurred on the prevalent types of crimes among these adolescents, including possession of stolen goods, drug-related offences (commonly involving methamphetamine or 'syabu'), sexual assault, reckless motorcycle riding, and involvement in physical altercations. This underscores the diverse range of delinquent behaviours stemming from family-related challenges.

**Academic Performance:** Another prominent theme in the data is the link between poor academic performance and juvenile delinquency. Both informants noted a pervasive lack of interest in schools or learning among delinquents, with many only completing primary or lower secondary education. This disinterest often led to school dropout, expulsion, or removal from the education system by parents. Eliza also emphasized that some parents of delinquents had low academic achievements, highlighting the intergenerational nature of educational challenges. This finding aligns with research indicating that low academic performance and weak school engagement are significant predictors of juvenile delinquency. For instance, Boabeng et al. (2022) found that children become delinquent due to various reasons, including financial hardship, negative influences in their lives, and low academic achievement.

**Peer Influence:** The theme of peer influence emerged as a significant factor contributing to juvenile delinquency. Adolescents, grappling with inconducive family environments and poor academic achievement, turned to peers for relief and acknowledgement. Both informants highlighted that these peers often shared similar familial and educational backgrounds and were already involved in delinquent activities. The choice of peers, while possibly a poor judgment by adolescents, was driven by the allure of reputation and acceptance gained through criminal activities. This illusion of fun and enjoyment in anti-social behaviour, as well as the perception of gaining attention, belonging, and respect, attracted adolescents to engage in delinquency. These findings align with previous research highlighting being a gang member as fulfilling specific needs, such as status, belonging, protection, and respect (Bellair & McNulty, 2009; Papachristos, 2009; Ortega-Campos et al., 2016). Gangs were also identified as substitute families, providing security and love missing from their biological families (Jackson & Knepper, 2013).

**Individual Attributes and Personality:** The final theme points to individual attributes and personality as contributors to juvenile delinquency. Previous research linking impulsivity, aggressive behaviour, and low conscientiousness to increased anti-social behaviour in adolescents resonates with the observations made by the informants. Eliza noted tendencies among some adolescents to be impulsive and prioritise personal desires, such as independence, freedom, and earning money. This impulsivity often led them to rebel against parental guidance and engage in anti-social behaviours, including potentially criminal activities. Awareness creation and providing avenues for adolescents to express themselves and reflect on their needs and desires could prove beneficial.

#### **Protective Factors:**

**Family Environment:** The informants emphasised that adolescents in positive family environments and higher-income households tend to be less susceptible to delinquent behaviour. In supportive families, parents actively engage with their children, providing the necessary attention, guidance, and care. Adolescents living in conducive environments with personal space and a stable family structure are less inclined to spend excessive time outside the home engaging in risky behaviour. Maintaining a strong family unit, either through intact marriages or supportive single-parent households, acts as a protective factor against delinquency (Demuth & Brown, 2004, as cited in Masood & Ali, 2019; McCurley & Sydney, 2004). Both participants underscored the significance of positive parenting, indicating that effective parenting prevents rebellious behaviour and delinquency, offering an outlet for adolescents' emotional needs without resorting to criminal activities. Therefore, fostering a supportive family environment serves as a protective risk against juvenile delinquency.

**Peer Influence:** Conversely, positive peer influence emerges as a protective risk against delinquency. According to social learning theory, adolescents who associate with peers adhering to societal norms are less likely to engage in criminal behaviour (Barnasco et al., 2013; Osgood & Anderson, 2004). Both participants highlighted that adolescents who choose friends with positive influences are likelier to avoid engaging in delinquent activities. The importance of positive peer associations is reinforced by the idea that belonging to groups or clubs within the community can satisfy adolescents' needs for prestige, belonging, and respect without resorting to criminal behaviour (Bellair & McNulty, 2009; Papachristos, 2009; Ortega-Campos et al., 2016; Jackson & Knepper, 2013).

Therefore, cultivating positive peer relationships acts as a protective risk, steering adolescents away from delinquency.

**Community:** The community, including schools, teachers, neighbours, and society, plays a pivotal role in influencing adolescents positively and preventing delinquent behaviour. Both participants stressed the importance of schools in identifying and supporting at-risk students, making education engaging and motivating to deter them from criminal activities. Community figures, such as Agensi Dadah Kebangsaan, can contribute to prevention by conducting awareness programs about the consequences of drugs. Moreover, positive role models in authority figures and the availability of preventive, developmental, and intervention programs act as protective risks against at-risk behaviours among teenagers. By fostering a sense of belonging, care, and support in the community, adolescents are less likely to engage in delinquent behaviour. Thus, a supportive community environment serves as a protective risk against juvenile delinquency.

## CONCLUSION

In conclusion, this study has provided comprehensive insights into the intricate dynamics of juvenile delinquency within the Malaysian context. Identifying risk and protective factors underscores the nuanced nature of the issue, emphasising the necessity for targeted and multifaceted interventions. The pivotal roles played by family, schools, and broader societal influences highlight the need for a holistic approach to effectively prevent, intervene, and rehabilitate juvenile offenders. This research contributes significantly to a deeper understanding of juvenile delinquency, paving the way for the development of robust strategies aimed at enhancing the well-being and prospects of Malaysian adolescents entangled in criminal activities. As we move forward, further exploration in this field can uncover new dimensions, fostering continuous improvement in strategies to address juvenile delinquency and bolster the positive development of our youth.

## REFERENCES

Aazami, A., Valek, R., Ponce, A. N., & Zare, H. (2023). Risk and protective factors and interventions for reducing juvenile delinquency: A systematic review. *Social Sciences*, 12(9), 474. <https://doi.org/10.3390/socsci12090474>

Bellair, P. E., & McNulty, T. L. (2009). Gang membership, drug selling, and violence in neighborhood context. *Justice Quarterly*, 26(4), 644–669. <https://doi.org/10.1080/07418820902763080>

Bernasco, W., Ruiter, S., Bruinsma, G. J. N., Pauwels, L. J. R., & Weerman, F. M. (2013). Situational causes of offending: A fixed-effects analysis of space-time budget data. *Criminology*, 51(4), 895–926. <https://doi.org/10.1111/1745-9125.12026>

Boabeng, J. E., Yao, D. W. J., Owusu-Addo, A., & Odum, J. K. (n.d.). A review on juvenile delinquency and academic performance of students. *International Journal of Multidisciplinary Studies and Innovative Research*. <http://doi.org/10.53075/Ijmsirq4364654764753>

Herrenkohl, T. L., Hawkins, J. D., Chung, I., Hill, K. G., & Battin-Pearson, S. (2001). School and community risk factors and interventions. In R. Loeber & D. P. Farrington (Eds.), *Child delinquents: Development, intervention, and service needs* (pp. 211–246). Thousand Oaks, CA: Sage Publications.

Jackson, M. S., & Knepper, P. (2003). *Delinquency and justice: A cultural perspective*. Boston: Allyn and Bacon.

Khuda, K. (2019). Juvenile delinquency, its causes and justice system in Bangladesh: A critical analysis. *Journal of South Asian Studies*, 7(3), 109–118. <https://doi.org/10.33687/jsas.007.03.3097>

Maasod, S., & Ali, S. M. (2019). Role of family, neighbourhood and peers in development of delinquent behavior in adolescents. *Peshawar Journal of Psychology and Behavioral Sciences (PJPBS)*, 4(2), 171–192.

McCurley, C., & Snyder, H. (2004). *Risk, protection, and family structure*. Pittsburgh, PA: National Center for Juvenile Justice.

Nasimah, H. (2013). Juvenile delinquencies in Malaysia: Legal provisions & prospects for reforms. Retrieved from <http://www.childjustice.org/index.php/component/edocman/?task=document.viewdoc&id=90&Itemid=469>

Ortega-Campos, E., García-García, J., Gil-Fenoy, M. J., & Zaldívar-Basurto, F. (2016). Identifying risk and protective factors in recidivist juvenile offenders: A decision tree approach. *PLOS ONE*, 11(9), e0160423. <https://doi.org/10.1371/journal.pone.0160423>

Osgood, D. W., & Anderson, A. L. (2004). Unstructured socializing and rates of delinquency. *Criminology*, 42(3), 519–549. <https://doi.org/10.1111/j.1745-9125.2004.tb00528.x>

Papachristos, A. V. (2009). Murder by structure: Dominance relations and the social structure of gang homicide. *American Journal of Sociology*, 115(1), 74–128. <https://doi.org/10.1086/599247>

# UNVEILING MOTIVATIONAL DYNAMICS: A CASE STUDY OF YOUNG ADULT LEARNERS

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## ABSTRACT

This study aims to delve into the motivational factors influencing learning among young adult learners in selected schools in Kuala Selangor, Malaysia. Utilizing a qualitative approach, four focus group discussions were conducted through semi-structured interviews with participants selected based on their exposure to motivational sessions organized by the researchers. Thematic analysis was employed to distil key insights from the gathered data, revealing six overarching themes. The identified themes encompass the reasons for attending school, the cultivation of interest in schooling, manifestations of disinterest in schooling, preferences for specific subjects, deliberate efforts to enhance academic performance, and the multifaceted factors contributing to academic achievement. Notably, the findings underscore that while teachers and peer influences can serve as motivating factors driving learners to attend school, these same factors may also pose challenges that impact overall success or failure. Given the transitional phase of young adult learners, characterized by ongoing cognitive development and physiological changes, educators and policymakers are urged to take a proactive stance. Specifically, interventions should be designed to foster motivation among young adult learners, especially those at risk of discontinuing their secondary education. This study emphasizes the nuanced interplay of motivational factors in the educational journey of young adults, urging a comprehensive and tailored approach to support their academic endeavours.

**Keyword:** Motivation, Young adult learners, Learning motivation, educational psychology, Student engagement

## INTRODUCTION

Motivation is marked by a profound enthusiasm within an individual that propels them toward achieving success. According to Bandura (1997), this concept evolves from individual learning activities and experiences influenced by various situations. In the context of learning, scholars such as Ormrod (2000) and Boström and Bostedt (2020) argue that motivation significantly influences learners by directing behaviour toward specific goals. For instance, the pursuit of good grades in high school has been linked to positive outcomes in higher education, fostering increased confidence, better academic preparedness, a deeper appreciation of success, and enhanced coping skills. Understanding motivation is pivotal in constructing an effective learning process. Learner motivation is a complex interplay of factors determining various behaviours (Reeve, 1996; Singh et al., 2002; Chan & Norlizah, 2017; Boström & Bostedt, 2020). It is described as self-generated spirit directing behaviour toward specific objectives (Zimmerman, 2008). Bandura's triadic theory further elucidates that social cognition forms the basis of self-regulated learning, influencing learning through personal, environmental, and behavioural factors (Bandura, 1986), all of which are reflected in learner motivation.

Highly motivated learners, as asserted by Chan and Norlizah (2017), strive for high academic performance and adeptly overcome challenges. School-based research consistently indicates that learner motivation significantly affects academic performance (Al-Khatib, 2010; Amraia et al., 2011; Brophy, 2010; Shamshuddin, 2008; Chan & Norlizah, 2017; Boström & Bostedt, 2020; Wong & Wong, 2019; Mazuin et al., 2021). For example, Al Khatib (2010) found that strong motivational beliefs correlate with increased academic merits.

Furthermore, studies in the Malaysian context, such as those by Mazuin et al. (2021) and Amraia et al. (2011), underscore the positive impact of learner motivation on various aspects, including achievement, recognition, peer relationships, and relationships with educators. Boström and Bostedt's (2020) quantitative study also revealed the influence of teaching strategies and parental support on

learner motivation. Sharifah Muzlia's (2015) investigation into motivational forces identified six constructs, including future time reference, achievement need, learning goals, self-efficacy, self-determination, and expectancy values. These constructs, rooted in humanistic and cognitive perspectives, were predicted to work synergistically to drive learners toward success. Chan and Norlizah (2017) emphasized learners' motivation in science learning, revealing a correlation between motivation levels and science subject grades.

However, despite extensive research on motivation and academic achievement, previous studies primarily focus on specific subjects like English, Science, and Mathematics among young adult learners. There is a noticeable gap in the literature regarding Malaysian young adult learners' motivation towards schooling. Thus, this study aims to explore the factors influencing young adult learners' motivation in the Malaysian context.

## MATERIAL AND METHOD

The study employed a qualitative research design, focusing on young adult learners aged 13 to 17 in secondary schools located in Kuala Selangor, Selangor, Malaysia. Semi-structured interviews were conducted via Google Meet, offering flexibility during the sessions to delve deeper into the study's context (Robson, 2002). The interview protocol, developed by the researchers, guided data collection. For participant selection, purposive sampling was utilized, targeting individuals who had attended the researchers' motivational sessions. This approach, as outlined by Patton (2002), aimed to select information-rich cases that could illuminate the research question. A total of 23 participants, distributed among four focus groups consisting of five to seven learners each, were selected based on these criteria. Thematic analysis was employed to scrutinize the interview data. The researchers transcribed interactions verbatim, then analysed and coded participants' responses to derive meaningful themes. Ethical considerations were paramount. The researchers ensured clarity on the interviews' purpose and guaranteed participant anonymity throughout the process. Names were replaced with codes in the interview reports, as illustrated in Table 1. These measures upheld ethical standards and safeguarded the confidentiality of the participants.

**Table 1. Details of Participants of the Study (by code name)**

Code Name	Gender	Age
RPMS	Male	15
RPSZ	Female	15
RPSS	Female	17
RPNM	Female	17
RPAS	Female	13
DHA	Female	16
DHF	Male	16
DHAM	Female	16
DHY	Male	16
DHAZ	Male	16
DHH	Male	16
TJH	Female	15
TJS	Male	15
TJA	Female	16
TJAN	Female	16
TJAM	Female	17
TJSHD	Female	16
RMA	Female	15
RMAT	Female	17
RMAI	Male	16
RMAF	Male	16
RMS	Female	16
RMATH	Female	15

## RESULTS AND DISCUSSION

The analysis revealed distinct themes that encapsulate the essence of the study, including 'reasons for coming to school,' 'interest in schooling,' 'disinterest in schooling,' 'subjects of interest,' 'effort to increase academic performance,' and 'factors contributing to academic achievement.' In the subsequent section, we will delve into a detailed exploration of each theme to provide a comprehensive understanding of the findings.

**Reasons for Attending School:** In the post-pandemic era, physical attendance at traditional schools faces challenges as external activities like online gaming compete for students' attention. School absenteeism reasons were explored through interviews, revealing categories such as 'seeking knowledge,' 'inspiring others,' 'socialization,' 'responsibilities,' 'self-improvement,' and 'pursuing ambition.' Participants, including RPNM, RPAS, and TJA, see school as an opportunity to increase knowledge, while RMA values the insights gained about travel. RPAS notably views attending school as a chance to inspire others. Socialization, a hidden curriculum element, is emphasized by participants like DHAM. School attendance reasons can be categorized into intrinsic and extrinsic motivations, with intrinsic motivations enduring based on genuine liking for tasks, as defined by Santrock (2018).

**Interest in Schooling:** The subsequent finding delves into factors that kindle learners' interest in attending school. Sub-themes such as 'nice teachers,' 'friends,' 'conducive learning environment,' and 'facilities' emerged. Teachers often emerge as a potent motivating factor, influenced by their teaching methods, behaviour, or overall demeanour. Participants like RPSZ emphasized the opportunity to meet more friends at school than in their local neighbourhoods, underlining the social aspect of learning. The school environment, coupled with facilities like laboratories, further contributed to students' positive perception of school.

**Disinterest in Coming to School:** Conversely, there were findings outlining reasons why learners avoided school, revealing sub-themes such as 'teachers,' 'friends,' 'excessive homework,' and 'food.' Teacher and friend dynamics emerged as demotivating factors, with some learners experiencing scolding or unsupportive friendships. Excessive homework was identified as a source of concern, impacting learners' energy and time. Surprisingly, the monotony of food offerings in the school canteen also contributed to disinterest.

**Subjects of Interest:** This sub-theme delves into subjects that captivate learners' interest. Despite a mandated curriculum covering diverse subjects, young adult learners expressed preferences for certain subjects. Participants highlighted subjects such as History, Al Quran and Sunnah, Technology, English, and Mathematics. For instance, DHY valued History for its lessons in learning from past experiences, while DHA emphasized the international communication aspect of learning English.

**Effort to Increase Academic Performance:** Examining the efforts invested by students to enhance academic performance revealed sub-themes like 'doing homework,' 'revisions,' 'mind mapping,' 'asking teachers,' 'focusing in class,' 'learning in a group,' 'time division,' and 'extra classes.' Participants highlighted the significance of homework completion, revision through self-study and online resources, and collaborative learning methods. Strategies like note-taking, mind mapping, and seeking clarification from teachers were emphasized, underscoring the multifaceted approach to academic improvement.

**Factors Contributing to Academic Achievement:** This sub-theme explores factors contributing to learners' academic achievement, including 'friends,' 'teachers,' 'family,' 'self,' and 'co-curricular activities.' Participants acknowledged the pivotal role of teachers, supportive family environments, and peer relationships in their academic success. Interestingly, some participants recognized self-motivation and involvement in co-curricular activities as factors contributing to their academic achievements.

In summary, the findings provide a nuanced understanding of the motivations, interests, and challenges young adult learners face in the context of schooling, shedding light on the complex interplay of intrinsic and extrinsic factors influencing their educational journey.

## CONCLUSION

Motivation, a driving force in individuals' lives, shapes various aspects from routine activities to complex pursuits like education and career choices. Explored through theories such as Maslow's Hierarchy and behavioural motivation, this research focuses on learner motivation, utilizing interviews

and thematic analysis. Themes emerge, including reasons for attending school, interest/disinterest, academic effort, and factors affecting achievement. Despite challenges like bullying and uninspiring environments, young learners recognize school's importance as a knowledge source and a bridge to future success. Intrinsic and extrinsic motivations, influenced by factors like teachers and facilities, play a role but can also hinder success. As learners mature, school management must address these factors for a positive environment, as motivation significantly impacts decisions for tertiary education. Intrinsic and extrinsic motivation can shape learning outcomes, influencing learners to excel and pursue higher education aligned with future goals. Motivation is crucial in connecting the learning process with young learners' future needs, propelling them toward academic excellence and career aspirations. In summary, this study highlights factors influencing student motivation, underscoring the importance of addressing these for a positive learning environment.

## REFERENCES

Ainol Madziah, Z., & Isarji, S. (2009). Motivation to learn a foreign language in Malaysia. *GEMA Online Journal of Language Studies*, 9(2), 73–87.

Al Khatib, S. A. (2010). Meta-cognitive self-regulated learning and motivational beliefs as predictors of college students' performance. *International Journal for Research in Education*, 14(1), 31–55.

Amraia, K., Motlagh, S. E., Zalani, H. A., & Parhon, H. (2011). The relationship between academic motivation and academic achievement of students. *Procedia Social and Behavioral Sciences*, 15, 399–402.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Boström, L., & Bostedt, G. (2020). What motivates students to study in upper secondary school? A study on students' perspective on study motivation in four different study programs in Sweden. *International Journal of Teaching and Education*, 8(2).

Brophy, J. E. (2010). *Motivating students to learn*. New York, NY: Routledge.

Chan, Y. L., & Norlizah, C. H. (2017). Students' motivation towards science learning and students' science achievement. *International Journal of Academic Research in Progressive Education and Development*, 6(4).

Hasan, A., Imran, A., Muhammad Aslam, K., & Kasyif, H. (2010). A study of university students' motivation and its relationship with their academic performance. *International Journal of Business and Management*.

Mazuin, M. H., Narehan, H., Nur Athirah, S., Aida, S. O., Sharrifah, A., Rozilah, A. A., Afiza, A. M., & Nor Fazalina, S. (2020). Moderating effects of student motivation on the relationship between learning styles and student engagement. *Asian Journal of University Education*, 16(2), 93–103.

Ormrod, J. E. (2000). *Educational psychology* (3rd ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Asian Journal of University Education, 18(2), 476.

Reeve, J. (1996). *Motivating others: Nurturing inner motivational resources*. Needham Heights, MA: Allyn & Bacon.

Robson, C. (2002). *Real world research: A resource for social scientists and practitioner-researchers*. Oxford, UK: Blackwell Publishers.

Santrock, J. W. (2018). *Educational psychology* (6th ed.). New York, NY: McGraw-Hill Education.

Shamshuddin, S. (2008). *Values and academic achievement*. New York, NY: Discovery Publishing House.

Sharifah Muzlia, S. M. (2015). Model of motivational forces influencing academic achievement among secondary school students through the mediation of flow. *Unpublished doctoral thesis*. Universiti Putra Malaysia.

Singh, K., Granville, M., & Dika, S. (2002). Mathematics and science achievement: Effects of motivation, interest, and academic engagements. *The Journal of Educational Research*, 95(6), 323–332.

**I-PPERFORM**

# EXPLORING THE FEASIBILITY OF THE ASTHMA SELF-MANAGEMENT BOOKLET TO EMPOWER ADULTS WITH ASTHMA AMONG FAMILY MEDICINE PHYSICIANS

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**Keywords:** Asthma, Self-management, Asthma Action Plan, Asthma diary

## INTRODUCTION

The development of a user-centered healthcare intervention tool would require feasibility testing to evaluate the acceptability, usability, strengths, and weaknesses of the tool. Feasibility testing evaluates the intervention's potential for success; therefore, exploring the user's experience, acceptability, opinion, and motivation is an important factor in the evaluation process [1]. To ensure that the Asthma Self-Management Booklet© is acceptable and useful to physicians in managing adults with asthma, there is a need to systematically evaluate the feasibility of these tools in supporting and empowering self-management of their patient's asthma symptoms [2]. Therefore, the objectives of this project are to explore the feasibility of the Asthma Self-Management Booklet© in empowering patients in asthma self-management and to refine the booklet based on the feasibility assessment findings. A qualitative research design using focus group methodology will be employed to explore the acceptability, usability, strengths, and weaknesses of the Asthma Self-Management Booklet©.

## MATERIAL AND METHOD

A purposive sampling strategy is used to generate a heterogeneous group that captures the perspectives of Primary Care Physicians (PCP) with varied experiences. A sample size of 2 focus group discussions (FGD) consisting of 5 participants in each group is estimated to achieve saturation of themes and to generate sufficient feedback to refine the booklet [3]. Focus group sessions will employ semi-structured interview guides based on the Knowledge to Action framework [4] developed by team members with knowledge translation and qualitative research expertise [5]. The face and content validity of the Asthma Self-Management Booklet© will be assessed by team members and will be refined as needed. All focus group interviews are digitally audio-recorded and field notes are kept. The responses from the FGD were transcribed verbatim, coded and analyzed thematically. Atlas.ti version 8 was used for data management.

## RESULTS AND DISCUSSION

Ten family medicine physicians participated in two FGDs between December 2018 to April 2019. Most were females (n=8, 80%) and postgraduate trainees (n=8, 80%). Three themes were found: user experience; perceived appropriateness and intent to continue use. For user experience, participants expressed convenience as the booklet facilitates assessment of symptom control using asthma control test (ACT) scoring and asthma diary. However, the book is under-utilized by patients due to a lack of awareness of self-monitoring. Participants found the booklet useful for monitoring symptoms, and an essential and relevant resource for asthma. However, lack of training affects its usage among physicians. Participants expressed that having a supportive system in the clinics and the involvement of nurses would help in the continued usage of the booklet.

## CONCLUSION

The Asthma Self-Management Booklet is acceptable amongst family medicine physicians. However, the uptake and its continued usage can be improved via patient awareness, physician training and support from the nurses.

## REFERENCES

- [1] Yu CH, Parsons J, Mamdani M, Lebovic G, Shah BR, Bhattacharyya O, Laupacis A, Straus SE. Designing and evaluating a web-based self-management site for patients with type 2 diabetes - systematic website development and study protocol. *BMC Medical Informatics and Decision Making*. 2012; **12**:57. DOI: [10.1186/1472-6947-12-57](https://doi.org/10.1186/1472-6947-12-57).
- [2] Creswell JW. Research design: Qualitative, quantitative, and mixed methods approach. 2009 (3<sup>rd</sup> ed.), Thousand Oaks, CA: Sage Publications.
- [3] Kuzel AJ. Sampling in qualitative inquiry. Doing Qualitative Research. Edited by: Crabtree B, Miller W. 1999, London: Sage Publications, 33-45. 2.
- [4] Graham ID, Logan J, Harrison MB, Straus SE, Tetroe J, Caswell W. Lost in knowledge translation: time for a map? *J Contin Educ Health Prof*. 2006; **26**: 13-24. 10.1002/chp.47.
- [5] Madriz E. Focus groups in feminist research. *Handbook of Qualitative Research*. Edited by: Denzin NK, Lincoln YS. 2000, Thousand Oaks: Sage Publications, 835-50. 2.

**IPROMISE**

# IN VITRO ANTI-PROLIFERATIVE AND ANTOXIDANT ACTIVITIES OF CHLOROFORM EXTRACT OF *CHRISTIA VESPERTILIONIS* ON MCF 7 AND MDA-MB-231 BREAST CANCER CELLS

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## ABSTRACT

Cancer continues to be a formidable adversary in global public health, exacting a devastating toll on millions of lives each year. Among the most prevalent forms of cancer, breast cancer stands out as a significant contributor to mortality rates worldwide. Despite considerable advancements in medical science and the development of various treatment modalities such as chemotherapy and radiotherapy, these interventions often bring about debilitating side effects, ranging from nausea and fatigue to hair loss. Consequently, there has been a growing interest in exploring alternative and complementary therapies, including herbal medicines, for their potential anticancer properties. One such herbal remedy under investigation is *Christia vespertilionis* (L.f.) Bakh. F, commonly referred to as "Daun Rerama" or "Butterfly wing" in Malaysia due to the shape of its leaves. Traditionally, *C. vespertilionis* has been used to treat various ailments, including tuberculosis, snakebites, bronchitis, and muscle weakness, among others. Recent scientific studies have delved into the pharmacological properties of *C. vespertilionis*, revealing its potential as an anticancer agent. The present study aimed to investigate the cytotoxic properties of *C. vespertilionis* extract against breast cancer cell lines, particularly estrogen receptor-positive (MCF7) and estrogen receptor-negative (MDA-MB-231) cells. Additionally, the study sought to explore the antioxidant properties of the extract, considering the crucial role of oxidative stress in cancer development and progression. The research methodology involved the extraction of *C. vespertilionis* leaves using chloroform, followed by phytochemical screening to identify bioactive compounds present in the extract. Flavonoids and saponin were among the compounds detected, indicating the potential pharmacological significance of the plant. Further analysis quantified the total phenolic and flavonoid contents of the extract, providing insights into its antioxidant capacity. Subsequently, the antiproliferative effects of the *C. vespertilionis* extract were evaluated using the MTT assay, a widely used method for assessing cell viability and proliferation. The results revealed a concentration-dependent cytotoxic effect of the extract on both MCF7 and MDA-MB-231 breast cancer cell lines, with decreasing IC<sub>50</sub> values observed over time. While the potency of the extract was lower compared to the standard anticancer drug tamoxifen, the findings underscored the potential of *C. vespertilionis* as a natural therapeutic agent against breast cancer. Overall, the study sheds light on the promising anticancer properties of *C. vespertilionis* and highlights the need for further research to elucidate its mechanisms of action and potential clinical applications. Additionally, the findings contribute to the growing body of evidence supporting the use of herbal medicines as adjunctive or alternative therapies in cancer treatment, emphasizing the importance of exploring nature's pharmacopeia in the fight against cancer.

**Keywords:** Anti-proliferative, antioxidant, MCF 7, MDA-MB-231, *Christia vespertilionis*

## INTRODUCTION

Cancer is a leading cause of death globally and was responsible for 10 million deaths in year 2020. The most frequent cancer types in year 2020 in term of new cases of cancer were breast cancer (2.26 million cases), lung cancer (2.21 million cases), colon and rectum (1.41 million cases), skin (1.20 million cases) and stomach (1.09 million cases) [1]. Among 2.3 million women diagnose with breast cancer in year 2020, 685,000 were deaths globally. In Malaysia, as reported by The Global Cancer Observatory, a total number of 8 418 new breast cancer cases were diagnosed in the year 2020., of which 3 503 were reported deaths due to breast cancer [2].

Nowadays, there are many types of cancer treatment like chemotherapy, radiotherapy, cryosurgery and many more. Although all these treatments aim to kill the cancer cells, they also have their own side effects like nausea and vomiting, fatigue, sleep disorder, delirium and hair loss. Other than that, alopecia or hair loss from areas of the body is a common side effect of chemotherapies used in the treatment of breast cancer [3].

One of the herbs that was believed to possess anticancer activity and is currently under investigating in our laboratory is *Christia vespertilionis* (L.f.) Bakh. F belongs to the family of Fabaceae). Among Malaysian, this herbs commonly known as “Daun Rerama” or “Butterfly wing” due to the shaped of it leaf [4]. Generally, the whole plant has traditionally used to treat tuberculosis and snake bites. Besides that, the decoction of the leaves also has been used to treat bronchitis, colds muscle weakness, inflamed tonsils and to improve blood circulation [5,6,7].

Several scientific studies have been carried out on different part of *C vespertilionis* (L.f.) Bakh. Based on the recent study, the leaves of *C. vespertilionis* were shown to exhibit anti-malarial, anti-inflammatory, anti-proliferative and anti-cancer against various cancer types [8,9,10]. Apart from that, the plant was also reported to contain a variety of phytocompounds including polyphenols, alkaloids, and terpenoids which may be constituents that are responsible for the antioxidant and anti-cancer activities (Osman et al., 2017).

However, there is yet any report regarding the cytotoxic properties of the different parts of the plant extract of *C. vespertilionis* specifically against breast cancer cell lines and their antioxidant properties. The present study, therefore, investigated the possible phytocompounds responsible toward the anti-cancer activities of *C. vespertilionis* through its antioxidant properties.

## MATERIAL AND METHOD

### *Source and Identification of Plant Material*

The leaves of *C. vespertilionis* were purchased from Guar Perahu Herbal Valley, Bukit Mertajam, Pulau Pinang, Malaysia in May 2018. The leaves sample was deposited in the herbarium of the Biodiversity Unit, Institute of Bioscience, Universiti Putra Malaysia with voucher no. SK3350/18.

### *Preparation of Plant Extract*

The dried leaves were ground into a powder and soaked in chloroform (Elite Advance Material, Malaysia) in the ratio of 1:20 (w/v) for 72 hours. After that, the supernatant was filtered using Whatman No. 1 filter paper. Then, the supernatant was evaporated using a rotary evaporator at 40°C under reduced pressure. This method was carried out according to Hisam et al., 2012 [11]. The crude dried chloroform extract obtained was kept in an ointment jar and store at 4°C until used.

### *Phytochemical Screening*

The phytochemical screening of the *C. vespertilionis* chloroform extract (CVCE) was carried out according to the method described by Hisam et. al., 2018 [12]. A stock concentration of 1% (w/v) of the extract were tested for the presence of tannins, alkaloids, triterpenoids, flavonoids, phenol, and alkaloids. The change of colors or the formation of precipitate was used as an indication of a positive response to these tests.

### *Total Phenolic and Flavonoids Content*

The total phenolic content was determined by Folin–Ciocalteu method. Briefly, 0.1 mL of sample (1 mg/mL) was diluted with distilled water (4.5 mL) and subsequently, Folin–Ciocalteu reagent (0.1 mL) was added with shaking for 3 min. A 2% (w/v) solution of sodium carbonate (0.3 mL) was added and the mixture was stirred and left to stand for 3 h. An aliquot of the mixture (200 µL) was transferred to a 96-well plate and the absorbance was measured at 760 nm against a blank using a microplate reader (BMG POLARstar Omega, Germany). The total phenolic content was expressed as µg of gallic acid equivalent per mg of the dry weight of the sample, using an equation obtained from the gallic acid standard curve.

Total flavonoid content was determined by the aluminum calorimetric method, using quercetin as the reference standard. Briefly, 150 µL of the test sample (0.3 mg/mL) was mixed with 150 µL of 2% (w/v) AlCl<sub>3</sub> in a 96-well plate. After 15 min of incubation at room temperature, the absorbance was measured at 435 nm by a microplate reader (BMG POLARstar Omega (BMG POLARstar Omega,

Germany). The content of the total flavonoids was expressed as  $\mu\text{g}$  of quercetin equivalent per mg of the dry weight of the sample, using an equation obtained from the quercetin standard curve.

### Cell Line

The cell line used in this study were estrogen receptor-positive breast cancer cells - MCF7 (ATCC no. HTB 22) and estrogen receptor-negative breast cancer cell - MDA-MB-231 (ATCC no. HTB 26) breast cancer cell line. It was obtained from Integrative Pharmacogenomics Institute (iPROMISE), Universiti Teknologi MARA. Both cells were maintained in Dulbecco's modified Eagle's medium (Biowest, France) supplemented with 10% FBS (Biowest, France) and 1% penicillin-streptomycin (Sigma-Aldrich, USA) at 37 °C in a humidified 5% CO<sub>2</sub> atmosphere.

### Antiproliferative Assay

The antiproliferative of the CVCE extract was determined using the 3-(4,5-dimethylthiazol-2-yl)- 2,5-diphenyltetrazolium bromide (MTT) assay. Exponentially growing cells were harvested, counted, and diluted with DMEM (Biowest, France). The cells ( $1 \times 10^5$  cell/ mL) were prepared and seeded (100  $\mu\text{L}$ ) into each well of a 96-well plate. The cells were cultured overnight before treatment with the extract. Cells were treated with extracts or Tamoxifen as a positive control at concentrations of 6.25, 12.5, 25, 50 and 100  $\mu\text{g}/\text{mL}$  for 24, 48 and 72 hours. At each time point, MTT (Sigma-Aldrich, USA) solution (5 mg/mL) was added to the cultured cells and incubated at 37 °C for 3 h. Crystallized MTT was dissolved in DMSO and the optical density was measured at 570 nm using a microplate reader (BMG POLARstar Omega, Germany). The percentages of viable cells were plotted against concentrations and the IC<sub>50</sub> values were determined. All experiments were performed in triplicate. The formula used Hisam et. al., 2018 [12] to calculate percentage of cell viability.

$$\text{Percentage of cell viability (\%)} = \frac{\text{OD sample (mean)}}{\text{OD control (mean)}} \times 100$$

## RESULTS AND DISCUSSION

### Phytochemical Screening of CVCE

As shown in table 1, the phytochemical screening of CVCE demonstrated the presence of flavonoids and saponin. However, tannins, triterpenoids, phenols, steroids, and alkaloids were not detected in the extract. This result is not in line with previous study that showed the present of alkaloids, triterpenes, fatty acids, phenols, alkanes and long chained alcohols [6]. This difference is due to the use of different solvents and the method of extraction. Based on the previous report, Flavonoids have been reported to possess antioxidant and anticancer activities [13]. Saponins, which are detected in the extract, were reported to induce an apoptosis response on cancer cells through the permeabilization of the mitochondrial membranes [14].

**Table 1: The phytochemical constituents of CVCE**

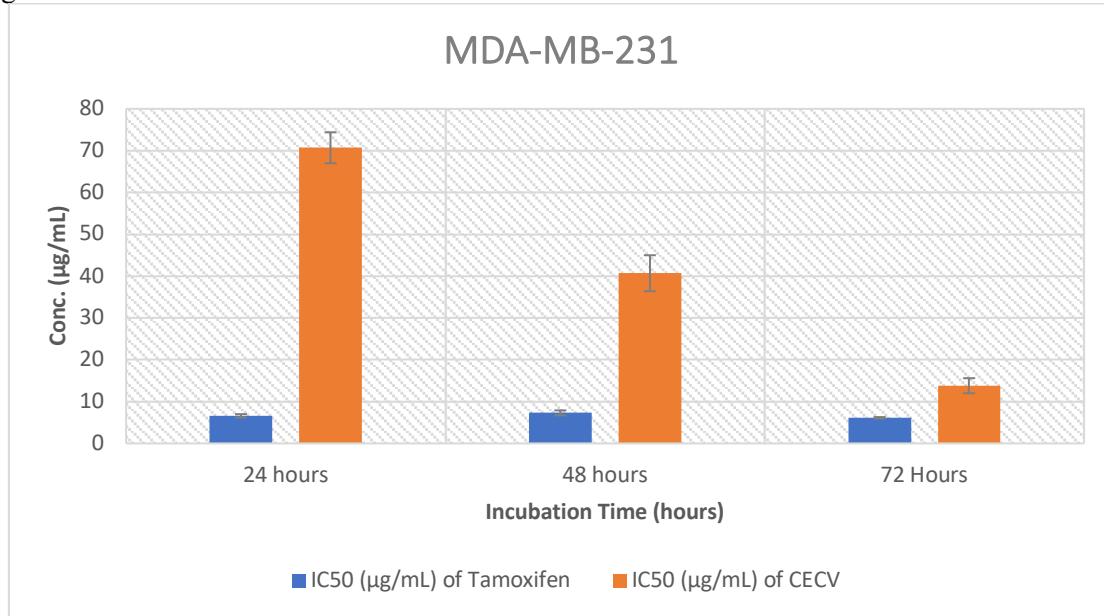
Test	Indicator
Tannins	-
Triterpenoids	-
Flavonoids	+
Saponin	+
Phenol	-
Steroids	-
Alkaloids	-

### Total Phenolic, Flavonoids Content and antioxidant activity of CVCE

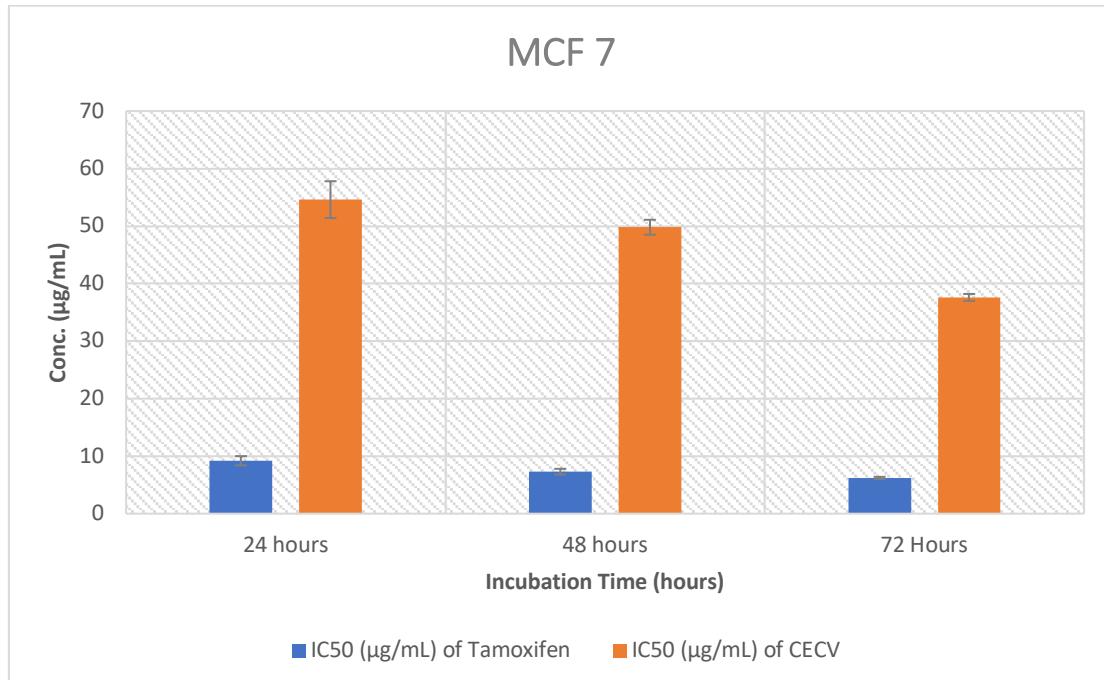
**Table 2: Total phenolics, flavonoids contents and antioxidant activities of CVCE.**

Total Phenolic ( $\mu\text{g}$ of gallic acid equivalent/ mg of extract $\pm$ SEM)	Total flavonoids ( $\mu\text{g}$ of quercetin equivalent/ mg of extract $\pm$ SEM)	FRAP value ( $\mu\text{g}$ Trolox/ $\mu\text{g}$ sample dry weight $\pm$ SEM)	IC50 of DPPH radical ( $\mu\text{g}/\text{mL}$ )
54.43 $\pm$ 1.49	24.91 24.91 $\pm$ 0.33	43.05 $\pm$ 0.76	54.75 $\pm$ 1.13

Based on Table 2, the total flavonoids and phenolic contents present in CVCE extract were  $24.91 \pm 0.33$   $\mu\text{g}$  quercetin equivalent/mg of extract and  $54.43 \pm 1.49$   $\mu\text{g}$  gallic acid equivalent/mg of extract, respectively. The concentrations of CVCE extract that reduced free radical DPPH to about 50% (IC50) is  $54.43 \pm 1.49$   $\mu\text{g}/\text{mL}$ . FRAP value was expressed as Trolox equivalents ( $\mu\text{g}$  Trolox/ $\mu\text{g}$  sample dry weight). The FRAP value of CVCE extract was found to be  $43.05 \pm 0.76$   $\mu\text{g}$  Trolox/ $\mu\text{g}$  sample dry weight.



**Figure 1: Inhibition concentration (IC50) value of CVCE extract on MDA-MB-231**



**Figure 2: Inhibition concentration (IC50) value of CVCE extract on MCF 7**

The cytotoxic effect of CVCE extract was assessed based on the minimum concentration of extract that giving at least 50% of the cancer cell survivability (IC50). Two human breast carcinoma cell lines which are estrogen receptor negative (ER-) MDA-MB-231 cells and estrogen receptor positive (ER+) MCF7 cell were used to determine the antiproliferative activity of CVCE extract. The survival

of the human breast-derived cells after treatment with the CVCE extract and tamoxifen after 24, 48 and 72 h were determined. The inhibition concentration (IC50) of CVCE against MDA-MB-231 and MCF7 cell lines are shown in Figures 1 and 2, respectively.

The antiproliferative profiles of the CVCE extracts against the MDA-MB 231 cancer cell lines are shown in [Fig. 1](#). The result show that the IC50 value of the extract was decrease against time form 24 h to 72 h with IC50 value of 70  $\mu\text{g}/\text{mL}$ , 40  $\mu\text{g}/\text{mL}$  and 15  $\mu\text{g}/\text{mL}$  respectively. The activity against MCF7 cancer cell lines also showed the same pattern which are the IC50 value of CVCE was decrease against time (24 h, 48 h and 72h) with the value 55  $\mu\text{g}/\text{mL}$ , 50  $\mu\text{g}/\text{mL}$  and 38  $\mu\text{g}/\text{mL}$ , respectively.

Comparison of IC50 was also performed between the CVCE extract and tamoxifen, a standard antitumor drug ([Figure 1 and 2](#)). Overall, tamoxifen was a more potent antiproliferative agent against both cancer cell lines compared with the CVCE extracts of the plant as indicated by its lower IC50 values.

## CONCLUSION

In conclusion, the findings of this study underscore the potential of *Christia vespertilionis* (L.f.) Bakh. F as a natural anticancer agent against breast cancer cell lines. The phytochemical screening revealed the presence of bioactive compounds, particularly flavonoids and saponin, suggesting the pharmacological significance of the plant. Moreover, the quantification of total phenolic and flavonoid contents provided insights into its antioxidant capacity, which may contribute to its anticancer effects by mitigating oxidative stress. The antiproliferative assays demonstrated a concentration-dependent cytotoxic effect of the *C. vespertilionis* extract on estrogen receptor-positive (MCF7) and estrogen receptor-negative (MDA-MB-231) breast cancer cells. While the extract exhibited promising cytotoxicity, its potency was lower compared to the standard drug tamoxifen. Nevertheless, the results support further investigation into the mechanisms of action underlying the anticancer properties of *C. vespertilionis* and its potential clinical applications.

## REFERENCES

- [1] Piñeros, M., Mery, L., Soerjomataram, I., Bray, F., & Steliarova-Foucher, E. (2021). Scaling up the surveillance of childhood cancer: a global roadmap. *JNCI: Journal of the National Cancer Institute*, 113(1), 9-15.
- [2] World Health Organization, International Agency for Research on Cancer, & World Health Organization. (2020). Global cancer observatory.
- [3] Lemieux, J., Maunsell, E., & Provencier, L. (2008). Chemotherapy-induced alopecia and effects on quality of life among women with breast cancer: a literature review. *Psycho-Oncology: Journal of the Psychological, Social and Behavioral Dimensions of Cancer*, 17(4), 317-328.
- [4] Murugesu, S., Perumal, V., Balan, T., Hamzan, N. A. S., Shahrim, N. S. S., Sharrizal, N. S. R., & Hin, L. W. (2020). A review on *Christia vespertilionis*: a new emerging medicinal plant. *FABAD Journal of Pharmaceutical Sciences*, 45(3), 269-277.
- [5] Bunawan, H. A. M. I. D. U. N., Bunawan, S. N., & Baharum, S. N. (2015). The red butterfly wing (*Christia vespertilionis*): A promising cancer cure in Malaysia. *International Journal of Pharmacy and Pharmaceutical Sciences*, 7(8), 5.
- [6] Dash, G. K. (2016). An appraisal of *Christia vespertilionis* (LF) bakh. F.: A promising medicinal plant. *Int. J. Pharmacogn. Phytochem. Res*, 8(6), 1037-1039.
- [7] Ariff, M. A. M., Tukiman, S., Razak, N. A. A., Osman, M. S., & Jaapar, J. (2019, November). Optimization of supercritical fluid extraction of Mariposa *Christia Vespertilionis* leaves towards antioxidant using response surface methodology. In *Journal of Physics: Conference Series* (Vol. 1349, No. 1, p. 012054). IOP Publishing.
- [8] Hofer, D., Schwach, G., Ghaffari Tabrizi-Wizsy, N., Sadjak, A., Sturm, S., Stuppner, H., & Pfragner, R. (2013). *Christia vespertilionis* plant extracts as novel antiproliferative agent against human neuroendocrine tumor cells. *Oncology reports*, 29(6), 2219-2226.
- [9] Upadhyay, H. C., Sisodia, B. S., Cheema, H. S., Agrawal, J., Pal, A., Darokar, M. P., & Srivastava, S. K. (2013). Novel antiplasmodial agents from *Christia vespertilionis*. *Natural product communications*, 8(11), 1934578X1300801123.

[10] Abd Latip, N., & Abd Mutalib, N. (2019). Synergistic interactions between Christia vespertilionis leaves extract and chemotherapy drug cyclophosphamide on WRL-68 cell line. *Asian Journal of Pharmaceutical Research and Development*, 7(3), 109-113.

[11] Hisam, E. E. A., Zakaria, Z. A., Mohtaruddin, N., Rofiee, M. S., Hamid, H. A., & Othman, F. (2012). Antiulcer activity of the chloroform extract of Bauhinia purpurea leaf. *Pharmaceutical Biology*, 50(12), 1498-1507.

[12] Hisam, E. E. A., Rofiee, M. S., KHALID, A., Jalaluddin, A. F., YUSOF, M. I. M., Idris, M. H., ... & Salleh, M. Z. (2018). Combined extract of Moringa oleifera and Centella asiatica modulates oxidative stress and senescence in hydrogen peroxide-induced human dermal fibroblasts. *Turkish Journal of Biology*, 42(1), 33-44.

[13] Vijayalakshmi, A., Kumar, P. R., Sakthi Priyadarsini, S., & Meenaxshi, C. (2013). In vitro antioxidant and anticancer activity of flavonoid fraction from the aerial parts of Cissus quadrangularis Linn. against human breast carcinoma cell lines. *Journal of Chemistry*.

[14] Elekofehinti, O. O., Iwaloye, O., Olawale, F., & Ariyo, E. O. (2021). Saponins in cancer treatment: Current progress and future prospects. *Pathophysiology*, 28(2), 250-272.

## REFERENCES

1. Piñeros, M., Mery, L., Soerjomataram, I., Bray, F., & Steliarova-Foucher, E. (2021). Scaling up the surveillance of childhood cancer: a global roadmap. *JNCI: Journal of the National Cancer Institute*, 113(1), 9-15.
2. World Health Organization, International Agency for Research on Cancer, & World Health Organization. (2020). Global cancer observatory.
3. Lemieux, J., Maunsell, E., & Provencher, L. (2008). Chemotherapy-induced alopecia and effects on quality of life among women with breast cancer: a literature review. *Psycho-Oncology: Journal of the Psychological, Social and Behavioral Dimensions of Cancer*, 17(4), 317-328.
4. Murugesu, S., Perumal, V., Balan, T., Hamzan, N. A. S., Shahrim, N. S. S., Sharrizal, N. S. R., & Hin, L. W. (2020). A review on Christia vespertilionis: a new emerging medicinal plant. *FABAD Journal of Pharmaceutical Sciences*, 45(3), 269-277.
5. Bunawan, H. A. M. I. D. U. N., Bunawan, S. N., & Baharum, S. N. (2015). The red butterfly wing (Christia vespertilionis): A promising cancer cure in Malaysia. *International Journal of Pharmacy and Pharmaceutical Sciences*, 7(8), 5.
6. Dash, G. K. (2016). An appraisal of Christia vespertilionis (LF) bakh. F.: A promising medicinal plant. *Int. J. Pharmacogn. Phytochem. Res*, 8(6), 1037-1039.
7. Ariff, M. A. M., Tukiman, S., Razak, N. A. A., Osman, M. S., & Jaapar, J. (2019, November). Optimization of supercritical fluid extraction of Mariposa Christia Vespertilionis leaves towards antioxidant using response surface methodology. In *Journal of Physics: Conference Series* (Vol. 1349, No. 1, p. 012054). IOP Publishing.
8. Hofer, D., Schwach, G., Ghaffari Tabrizi-Wizsy, N., Sadjak, A., Sturm, S., Stuppner, H., & Pfragner, R. (2013). Christia vespertilionis plant extracts as novel antiproliferative agent against human neuroendocrine tumor cells. *Oncology reports*, 29(6), 2219-2226.
9. Upadhyay, H. C., Sisodia, B. S., Cheema, H. S., Agrawal, J., Pal, A., Darokar, M. P., & Srivastava, S. K. (2013). Novel antiplasmoidal agents from Christia vespertilionis. *Natural product communications*, 8(11), 1934578X1300801123.
10. Abd Latip, N., & Abd Mutalib, N. (2019). Synergistic interactions between Christia vespertilionis leaves extract and chemotherapy drug cyclophosphamide on WRL-68 cell line. *Asian Journal of Pharmaceutical Research and Development*, 7(3), 109-113.
11. Hisam, E. E. A., Zakaria, Z. A., Mohtaruddin, N., Rofiee, M. S., Hamid, H. A., & Othman, F. (2012). Antiulcer activity of the chloroform extract of Bauhinia purpurea leaf. *Pharmaceutical Biology*, 50(12), 1498-1507.
12. Hisam, E. E. A., Rofiee, M. S., KHALID, A., Jalaluddin, A. F., YUSOF, M. I. M., Idris, M. H., ... & Salleh, M. Z. (2018). Combined extract of Moringa oleifera and Centella asiatica modulates oxidative stress and senescence in hydrogen peroxide-induced human dermal fibroblasts. *Turkish Journal of Biology*, 42(1), 33-44.

13. Vijayalakshmi, A., Kumar, P. R., Sakthi Priyadarsini, S., & Meenaxshi, C. (2013). In vitro antioxidant and anticancer activity of flavonoid fraction from the aerial parts of *Cissus quadrangularis* Linn. against human breast carcinoma cell lines. *Journal of Chemistry*.
14. Elekofehinti, O. O., Iwaloye, O., Olawale, F., & Ariyo, E. O. (2021). Saponins in cancer treatment: Current progress and future prospects. *Pathophysiology*, 28(2), 250-272.

# ACE2 POLYMORPHISM: THE HUMAN KEY FOR COVID-19 SEVERITY

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## ABSTRACT

COVID-19, caused by the novel coronavirus SARS-CoV-2, has rapidly evolved into a global pandemic, profoundly impacting public health, economies, and societies worldwide. The disease's variable clinical manifestations range from asymptomatic cases to severe respiratory distress, highlighting the critical need to understand the genetic underpinnings of COVID-19 susceptibility and severity. This study aims to investigate the association between *ACE2* gene polymorphisms and COVID-19 susceptibility and severity, providing insights that could be pivotal for developing targeted preventive and therapeutic strategies. *ACE2*, a transmembrane protein, is recognized as the primary entry point for SARS-CoV-2 into host cells. It is expressed in various tissues, including the lungs, heart, kidneys, and intestines, suggesting its central role in the multi-organ impact of the virus. Genetic variations in the *ACE2* gene have been implicated in influencing an individual's susceptibility to and severity of COVID-19. Such variations can affect *ACE2* expression levels or alter the protein's structure, potentially influencing the virus's ability to bind and enter cells. To elucidate these associations, we conducted a comprehensive genome mining analysis of 203 genomes from individuals diagnosed with COVID-19. Our analysis focused on identifying *ACE2* polymorphisms associated with the disease. We analyzed a comprehensive set of 22 genetic markers across 15 genes linked to COVID-19 susceptibility from existing literature. These markers were chosen based on their documented association with immune response, viral entry mechanisms, and inflammatory processes in viral infections. Individuals were stratified into one of seven risk categories based on their genetic profiles: "Moderately increased infection risk", "Moderately reduced infection risk", "Roughly average infection risk", "Slightly increased infection risk", "Slightly reduced infection risk", "Very slightly increased infection risk", and "Very slightly reduced infection risk". This stratification provides a nuanced understanding of individual variability in COVID-19 susceptibility, which could be critical for personalized risk assessment and management. We further explored the association between *ACE2* polymorphisms and COVID-19 severity. Our analysis extended to 42 genetic markers across 29 genes associated with COVID-19 severity, derived from available literature. These genes are involved in pathways like cytokine signaling, immune regulation, and cellular stress response, all of which are crucial in the pathogenesis of severe COVID-19. Among these markers, 12 (rs11385942, rs2082940, rs2248690, rs4444903, rs324420, rs1801274, rs4073, rs20541, rs2275913, rs832582, rs6721961, and rs3025039) were found to be present in at least 10% of the studied population and were associated with a higher risk of severe COVID-19 complications. Our findings suggest that *ACE2* gene polymorphisms play a significant role in determining COVID-19 susceptibility and severity. Individuals harboring specific *ACE2* genotypes may have an increased risk of developing COVID-19 and experiencing severe complications. This study underscores the importance of genetic factors in COVID-19 and opens avenues for personalized medicine approaches. The identification of high-risk genetic profiles can aid in early intervention strategies and tailored treatment plans, potentially improving patient outcomes. Furthermore, these findings have broader implications for public health policies and pandemic preparedness. Understanding genetic susceptibility can enhance screening strategies and inform vaccine distribution priorities. Additionally, our study lays the groundwork for future research exploring the interaction between *ACE2* polymorphisms and other genetic or environmental factors contributing to COVID-19 outcomes. In conclusion, this study provides compelling evidence of the role of *ACE2* gene polymorphisms in COVID-19 susceptibility and severity. By offering a more detailed genetic landscape of the disease, our research contributes significantly to the ongoing efforts to combat the COVID-19 pandemic through precision medicine and personalized healthcare strategies.

**Keywords:** Genome mining, COVID-19 severity, *ACE2* polymorphisms, precision health

## INTRODUCTION

The emergence of the COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, has posed an unprecedented global health crisis. The disease exhibits a wide spectrum of clinical manifestations, ranging from asymptomatic infections to severe respiratory distress and multi-organ failure. This variability in disease severity underscores the critical need to understand the genetic underpinnings of COVID-19 susceptibility and severity. The Angiotensin-Converting Enzyme 2 (ACE2) receptor serves as the primary entry point for SARS-CoV-2 into host cells. Expression of ACE2 is found in various tissues, including the lungs, heart, kidneys, and intestines, highlighting its potential role in the multi-organ effects of COVID-19. Genetic variations in the *ACE2* gene have been implicated in influencing an individual's susceptibility to and severity of COVID-19 [1]. These variations can alter *ACE2* expression levels or modify the protein's structure, potentially influencing the virus's ability to bind and enter cells [2]. To elucidate the associations between *ACE2* polymorphisms and COVID-19 outcomes, we conducted a comprehensive genome mining analysis of 203 genomes from individuals diagnosed with COVID-19. Our study aimed to identify *ACE2* polymorphisms associated with the disease and to assess their impact on COVID-19 susceptibility and severity.

## MATERIAL AND METHOD

To identify *ACE2* polymorphisms associated with COVID-19 susceptibility and severity, we conducted genome mining on 203 genomes from individuals diagnosed with COVID-19. Genome mining involves analyzing large-scale genomic data to identify genetic variants associated with specific traits or diseases. In our study, we focused on identifying *ACE2* polymorphisms, which are variations in the *ACE2* gene sequence.

### *Genome Mining Process*

- i. Data Acquisition: We obtained genome data for 203 individuals diagnosed with COVID-19 from the iPROMISE human genome database.
- ii. Genetic Marker Selection: We selected 22 genetic markers across 15 genes linked to COVID-19 susceptibility from existing literature. These markers were chosen based on their documented association with immune response, viral entry mechanisms, and inflammatory processes in viral infections.
- iii. Genotyping: We performed genotyping to determine the genetic variants present at each of the selected markers for each individual.
- iv. Risk Stratification: Based on their genetic profiles, individuals were stratified into one of seven risk categories: "Moderately increased infection risk", "Moderately reduced infection risk", "Roughly average infection risk", "Slightly increased infection risk", "Slightly reduced infection risk", "Very slightly increased infection risk", and "Very slightly reduced infection risk".
- v. Severity Analysis: We further analyzed the association between *ACE2* polymorphisms and COVID-19 severity. We examined 42 genetic markers across 29 genes associated with COVID-19 severity from available literature. Among these markers, 12 were found to be present in at least 10% of the studied population and were associated with a higher risk of severe COVID-19 complications.

## RESULTS AND DISCUSSION

Our genome mining analysis revealed significant associations between *ACE2* polymorphisms and COVID-19 susceptibility and severity. Individuals with specific *ACE2* genotypes exhibited a higher risk of developing COVID-19 and experiencing severe complications. These findings highlight the potential role of genetic factors in modulating an individual's response to SARS-CoV-2 infection.

### *Susceptibility Analysis*

The analysis of 22 genetic markers across 15 genes associated with COVID-19 susceptibility revealed a clear association between specific *ACE2* polymorphisms and an individual's risk of developing the disease. Individuals harboring certain *ACE2* genotypes were found to have a moderately increased or moderately reduced risk of COVID-19 infection compared to those with average infection

risk profiles. These findings suggest that genetic variations in the *ACE2* gene play a significant role in determining an individual's susceptibility to SARS-CoV-2 infection.

### Severity Analysis

Our analysis of 42 genetic markers across 29 genes associated with COVID-19 severity identified 12 markers that were significantly associated with an increased risk of severe COVID-19 complications. These markers are involved in pathways crucial for the pathogenesis of severe COVID-19, including cytokine signaling, immune regulation, and cellular stress response. The association between these markers and severe COVID-19 outcomes suggests that genetic factors play a substantial role in determining the severity of COVID-19 infection.

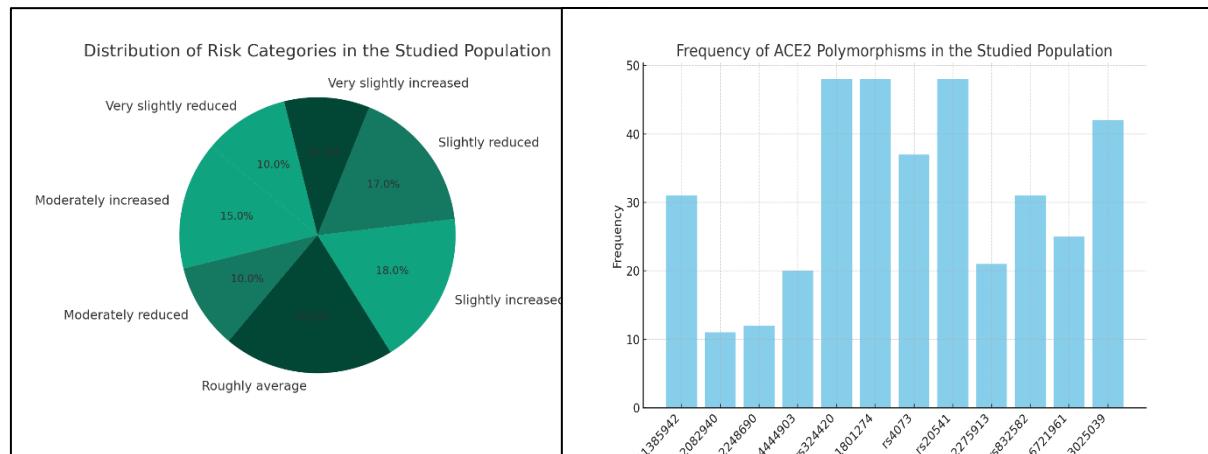
### Discussion

Our study provides compelling evidence of the role of *ACE2* gene polymorphisms in COVID-19 susceptibility and severity. These findings align with previous research demonstrating the association between genetic variations in *ACE2* and an individual's susceptibility to SARS-CoV-2 infection and the severity of COVID-19 outcomes [1,2].

The identification of specific *ACE2* polymorphisms associated with an increased risk of COVID-19 and severe complications has important implications for personalized medicine approaches. By understanding an individual's genetic predisposition to the disease, clinicians can tailor preventive measures, treatment strategies, and resource allocation. For instance, individuals with high-risk genetic profiles may benefit from enhanced infection control measures, early intervention strategies, and personalized treatment plans [3,4].

Moreover, our findings have broader implications for public health policies and pandemic preparedness. Understanding genetic susceptibility can inform screening strategies, vaccination campaigns, and resource allocation during pandemics [4,5]. Additionally, our study lays the groundwork for future research exploring the interaction between *ACE2* polymorphisms and other genetic or environmental factors contributing to COVID-19 outcomes [1,4,6-7].

### TABLE, IMAGE AND FIGURE



**Figure 1: Left:** A pie chart showing the distribution of the studied population across the seven risk categories. **Right:** A histogram displaying the frequency of specific *ACE2* polymorphisms within the studied population.

### CONCLUSION

Our study provides compelling evidence that genetic variations in the *ACE2* gene influence an individual's susceptibility to and severity of COVID-19. Understanding an individual's genetic predisposition can inform personalized preventive measures, treatment strategies, and resource allocation. Additionally, genetic susceptibility data can guide public health policies, such as screening guidelines and vaccination prioritization.

## ACKNOWLEDGEMENTS

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## REFERENCES

- [1] Möhlendick B, Schönfelder K, Breuckmann K, Elsner C, Babel N, Balfanz P, Dahl E, Dreher M, Fistera D, Herbstreit F, Hölzer B, Koch M, Kohnle M, Marx N, Risse J, Schmidt K, Skrzypczyk S, Sutharsan S, Taube C, Westhoff TH, Jöckel KH, Dittmer U, Siffert W, Kribben A. ACE2 polymorphism and susceptibility for SARS-CoV-2 infection and severity of COVID-19. *Pharmacogenet Genomics*. 2021 Oct 1;31(8):165-171. doi: 10.1097/FPC.0000000000000436. PMID: 34001841; PMCID: PMC8415730. Dean AG, Sullivan KM, Soe MM. OpenEpi: Open-Source Epidemiologic Statistics for Public Health, Version. [www.OpenEpi.com](http://www.OpenEpi.com), updated 2013/04/06, accessed 2020/04/24.
- [2] Ren W, Zhu Y, Lan J, Chen H, Wang Y, Shi H, Feng F, Chen DY, Close B, Zhao X, Wu J, Tian B, Yuan Z, Zhou D, Saeed M, Wang X, Zhang R, Ding Q. Susceptibilities of Human ACE2 Genetic Variants in Coronavirus Infection. *J Virol*. 2022 Jan 12;96(1):e0149221. doi: 10.1128/JVI.01492-21. Epub 2021 Oct 20. PMID: 34668773; PMCID: PMC8754202.
- [3] Saengsiwaritt W, Jittikoon J, Chaikledkaew U, Udomsinprasert W. Genetic polymorphisms of ACE1, ACE2, and TMPRSS2 associated with COVID-19 severity: A systematic review with meta-analysis. *Rev Med Virol*. 2022 Jul;32(4):e2323. doi: 10.1002/rmv.2323. Epub 2022 Jan 8. PMID: 34997794.
- [4] Chen F, Zhang Y, Li X, Li W, Liu X, Xue X. The Impact of ACE2 Polymorphisms on COVID-19 Disease: Susceptibility, Severity, and Therapy. *Front Cell Infect Microbiol*. 2021 Oct 22;11:753721. doi: 10.3389/fcimb.2021.753721. PMID: 34746028; PMCID: PMC8569405.
- [5] Redin C, Thorball CW, Fellay J. Host genomics of SARS-CoV-2 infection. *Eur J Hum Genet*. 2022 Aug;30(8):908-914. doi: 10.1038/s41431-022-01136-4. Epub 2022 Jun 30. PMID: 35768520; PMCID: PMC9244159.
- [6] Anastassopoulou, C., Gkizarioti, Z., Patrinos, G.P. et al. Human genetic factors associated with susceptibility to SARS-CoV-2 infection and COVID-19 disease severity. *Hum Genomics* 14, 40 (2020). <https://doi.org/10.1186/s40246-020-00290-4>
- [7] Zheng M. ACE2 and COVID-19 Susceptibility and Severity. *Aging Dis*. 2022 Apr 1;13(2):360-372. doi: 10.14336/AD.2021.0805. PMID: 35371596; PMCID: PMC8947832.

# DIFFERENTIAL PROTEIN EXPRESSIONS ASSOCIATED WITH DENTAL IMPLANT HEALING

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## ABSTRACT

**Purpose of the research-** Dental implants' topographical features are critical in regulating the healing process and, consequently, the production of proteins involved in multiple stages, from the initial inflammatory response to the following remodelling of the bone. Improved bone-to-implant contact and favourable cellular responses have been shown when a rough implant surface is present. But to get the appropriate level of roughness, additional procedures are usually required, which raises the total cost of dental implants. Using metal injection moulding technology, a porous dental implant composed of nickel titanium (NiTi) has been produced successfully. This novel method makes it unnecessary to make additional surface alterations, making it a more economical alternative. However, further research needs to be done to determine which protein expressions are associated with the faster healing of porous implants, as shown by an earlier study in an animal model. The objective of this investigation was to identify and compare the proteins that are produced during the healing process in dental implants, both with and without porous properties. **Methods-** The study comprised a total of fourteen participants, with seven participants receiving the NiTi dental implant and seven participants receiving the Mega Gen dental implant (control group). Saliva samples were obtained at three distinct time intervals: prior to implantation (T0), one-week post-implantation (T1), and eighteen weeks' post-implantation (T2). The proteins involved in bone regeneration were analyzed in saliva using liquid chromatography-mass spectrometry (LC-MS, Model 6520-Accurate Mass Q-TOF). **Results-** Gene ontology analysis revealed 15 proteins associated with osseointegration in the MegaGen group, detected at various time points (T0, T1, and T2). These proteins included Pancreatic alpha-amylase (T0, T1, T2), Fibronectin (T0), Putative POU domain, class 5, transcription factor 1B (T0), Titin (T0, T2), Cellular tumor antigen p53 (T1, T2), Neuroserpin (T1), Collagen alpha-3(VI) chain (T1), Dystonin (T1), Ubiquitin carboxyl-terminal hydrolase 19 (T1), basement membrane-specific heparan sulfate proteoglycan core protein (T2), EH domain-containing protein 1 (T2), myosin-11 (T2), TLR4 interactor with leucine-rich repeats (T2), Talin-1 (T2), and Thrombospondin-1 (T2). In the NiTi group, 7 proteins were identified, including Fibronectin at T0 and T2, Pancreatic alpha-amylase at T0, T1, and T2, Titin and Hepatocyte growth factor at T0, T1, and T2, Zinc finger and BTB domain-containing protein 40 at T1, Endothelin-1 at T2, and Fibrillin-2 at T2. **Conclusion-** The proteins associated with the MegaGen group offer a detailed elucidation of the osseointegration process, particularly during the phases of cell proliferation and bone remodelling. The proteins associated with the NiTi group may have a link not only to osseointegration but also to inflammation.

**Keywords:** Dental implants, bone healing, proteins, saliva, biomarkers.

## INTRODUCTION

Dental implants have been used to replace missing teeth since the 1960s. However, due to their unparalleled level of effectiveness and convenience, their use has become much more widespread in recent years, and it is estimated that one million dental implants are placed worldwide each year (1). This is because dental implants are now regarded as the gold standard in tooth replacement. The process of osseointegration, also known as bone to implant contact (BIC), is critical to the success of dental implants. This procedure starts with the surgical placement of the implant and continues through the healing process as well as the continuous loading of the implants while they are in use. Osseointegration is only considered successful if new bone forms on the implant's surface. During the contact osteogenesis process, osteogenic cells in various stages of differentiation are continuously recruited and migrating to the implant site.

The purpose of this study, which was part of a larger clinical trial on a novel porous Nickel Titanium dental implant, was to look into the impact of the implant's porous surface on the osseointegration process. It would be beneficial to identify the biomarkers involved in the osseointegration of this novel porous implant because research has shown that different surface characteristics can elicit different cellular responses (2,3,4). We anticipate seeing some differences in the biomarkers involved, particularly in the early stages of the healing process, because the animal study showed that this porous implant enhances osseointegration (5).

Homeostasis, granulation tissue production, and bone remodelling have all been shown to be critical components of the osseointegration process. These processes have the potential to initiate the production of cytokines that promote inflammation, inflammatory cell infiltration, osteogenic cell activation, and immune cell stimulation. As a result, each stage of the osseointegration process stimulates the release of healing-related factors that have yet to be fully identified and understood. These factors linked to the healing process have the potential to be used as clinical biomarkers. As a result, more molecular studies are needed to provide a clear explanation of the molecular mechanism underlying osseointegration.

## MATERIAL AND METHOD

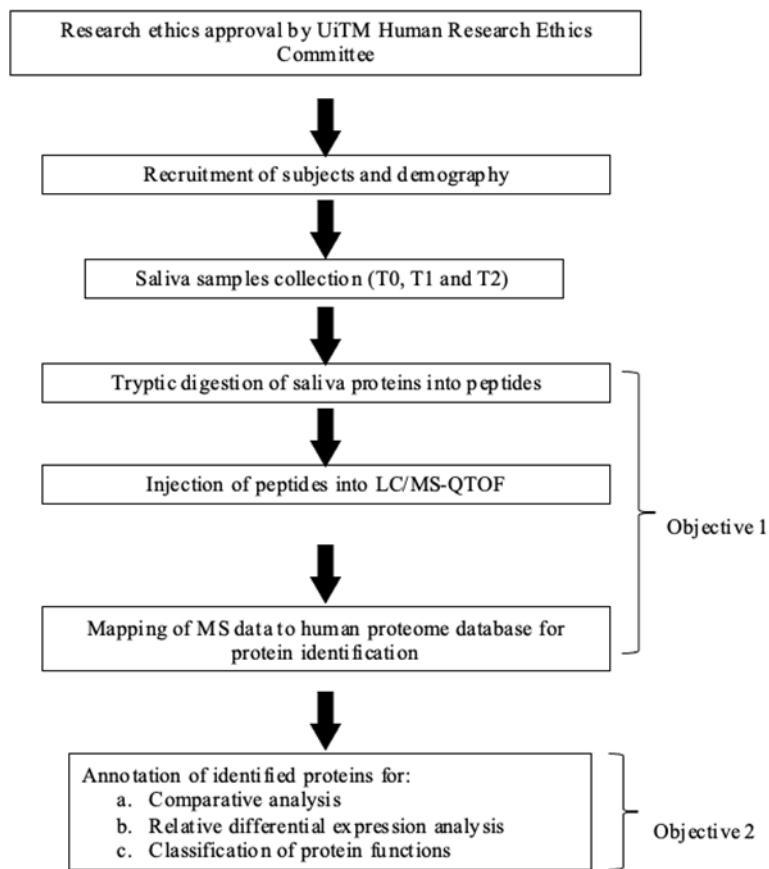


Figure 3.1: A flowchart summarizes the methodology used in this study.

Saliva samples were taken from participants in a parallel, single-blinded, superiority clinical trial (registered under ClinicalTrial.Gov (U.S. National Library of Medicine, ID:NCT04618055)) following ICH GCP, ISO 14155:2011 guidelines.

This study was conducted at the Faculty of Dentistry, Sungai Buloh and Integrative Pharmacogenomics Institute (iPromise), Puncak Alam Campus. 14 individuals received a single implant in the mandibular posterior region: 7 received porous NiTi and 7 received MegaGen Anyridge implants from February 2022 to April 2023.

Three saliva samples were taken before, one week after, and 18 weeks after implant installation. MegaGen was selected as the control group due to their recent entry into the implant market and the absence of comprehensive performance research. Moreover, MegaGen implants were notably affordable compared to other dental implants in Malaysia, and the NiTi implant manufacturers intended to provide their product at a comparable price to MegaGen implants.

Subject recruitment was open to individuals of both genders who are 18 years or older and have good dental hygiene. This study excludes individuals who are medically compromised, smokers, individuals with a history of drug abuse or alcoholism, individuals with severe periodontal disease, individuals who have had unsuccessful implant treatment, individuals undergoing chemotherapy or radiotherapy, and pregnant women.

## RESULTS AND DISCUSSION

### RESULT

As for the result, 42 saliva samples were collected for testing. The majority of the participants were Malay (85%), female (93%), and aged 44 to 64 years old, with a mean age of 52 years old. The demographic data for both groups were very similar.

#### Comparative Analysis of Peptide Profiles

Chromatograms show the relative concentration and intensity of peptides in porous and non-porous dental implants throughout time. These various chromatographic patterns may indicate different protein expression profiles or protein copy numbers across timepoints. T0 and T1 show that non-porous implant peptides are more abundant than porous implant peptides. This suggests different protein expression kinetics at these stages. The chromatograms show a significant increase in peptide abundance in the porous implant group compared to the non-porous implant group in T2. This change in peptide intensity may indicate a major change in protein expression or copy numbers during healing.

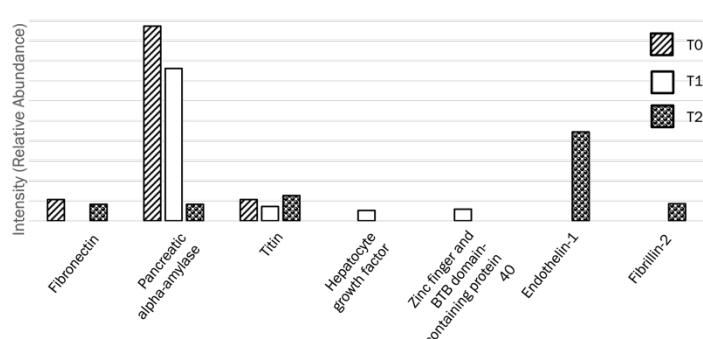
#### Protein Identification and Functional Annotation

This research discovered proteins, each with unique proteome profiles, highlighting the dynamic nature of protein expression during dental implant healing. In particular, 17 proteins were consistently expressed at all timepoints, but different protein combinations were coexpressed at different times. Using PANTHER webtools for protein classification revealed a key difference: MegaGen implant patients have a wider range of proteins involved in many biological processes than NiTi implant patients. This protein involvement discrepancy suggests different biological pathways. The SalivaDB database was used to compare the proteins. Of the proteins discovered, 13.21% proteins matched SalivaDB entries.

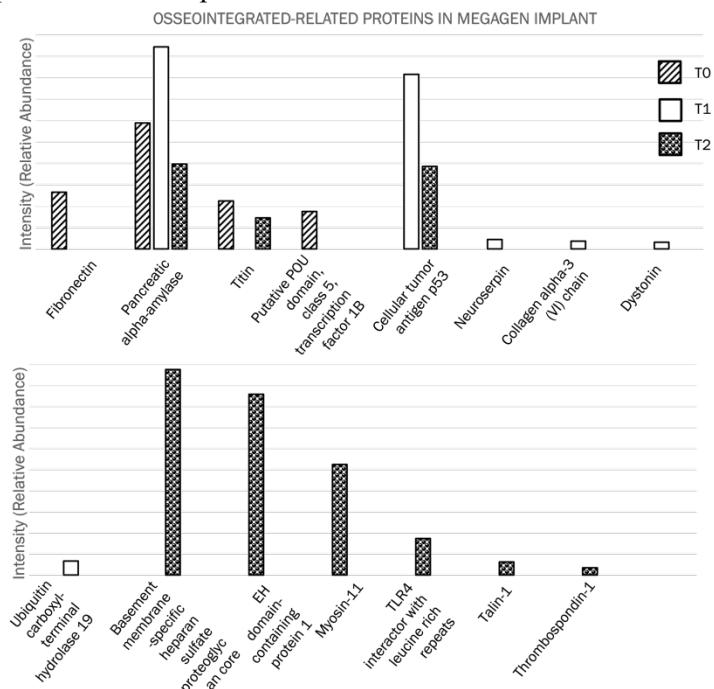
#### Protein Annotation: Comparative Analysis

MegaGen implants detected 8.14% salivary proteins, while NiTi implants found 6.30%. NiTi discovered 7 implant healing-related proteins after functional annotation, with the first 3 proteins also found in MegaGen. Different regulatory patterns defined these proteins. Fibronectin downregulated from T0 to T2, pancreatic alpha-amylase consistently downregulated, and Titin downregulated from T0 to T1 and upregulated from T1 to T2. Hepatocyte growth factor and Zinc finger and BTB domain-containing protein 40 were exclusively expressed at T1 in NiTi implants, while Endothelin-1 and Fibrillin-2 were expressed at T2.

IMPLANT-HEALING-RELATED PROTEINS IN NITI IMPLANT AT DIFFERENT TIME-POINTS



MegaGen discovered 15 osseointegration-associated proteins with diverse regulation patterns. Pancreatic alpha-amylase upregulated during T0 to T1 and downregulated during T1 to T2. Both fibronectin and Putative POU domain, class 5, transcription factor 1B were only expressed at T0. Cellular tumour antigen p53 downregulated from T1 to T2, while Titin consistently downregulated from T0 to T2. Neuroserpin, Collagen alpha-3(VI) chain, Dystonin, Ubiquitin carboxyl-terminal hydrolase 19 were exclusively expressed at T1 while Basement membrane-specific heparan sulfate proteoglycan core protein, EH domain-containing protein 1, Myosin-11, TLR4 interactor with leucine-rich repeats, Talin-1, Thrombospondin-1 were expressed at T2.



## DISCUSSION

This dental implantology study uses salivary proteomics to analyse osseointegration, a pioneering effort (6,7,8,9). This work tracks healing during osseointegration, unlike previous research that examined salivary proteome alterations at a single timepoint. T1 proteins reflect the inflammatory to proliferative phase, while T2 proteins show healing maturation. No other study has provided as complete and dynamic salivary proteome data for dental implant operations, which enhances our understanding of implant healing dynamics.

Several proteins showed unexpected patterns with NiTi implants. Pancreatic alpha-amylase was detectable at all three timepoints but decreased. This protein may affect bone repair and calcium binding. Throughout recovery, striated muscle structural protein titin was constantly found. Fibronectin, hepatocyte growth factor, zinc finger and BTB domain-containing protein 40, endothelin-1, and fibrillin-2 were also connected to bone healing but only found once. Cell adhesion, collagen binding, osteoblast development, bone mineralization, cell population proliferation, and bone trabecula creation are among their roles (10).

The salivary proteomes of participants who received MegaGen and NiTi implants differed significantly due to variations in implant surface material and osseointegration outcomes. The paucity of research on salivary proteins and MegaGen osseointegration renders comprehension challenging. Within the MegaGen group, there are variations in the levels of pancreatic alpha-amylase, which can potentially impact the process of bone repair and the binding of calcium (11). The levels of T0 and T2 titin decreased without a definitive correlation to bone regeneration. The levels of cellular tumour antigen p53 decreased from T1 to T2, potentially because it plays a role in inhibiting DNA synthesis following DNA damage. This decrease may not have an impact on bone repair. At T1, active bone healing resulted in the production of neuroserpin and collagen alpha-3(VI) chain. The proteins dystonin, ubiquitin carboxyl-terminal hydrolase 19, myosin-11, TLR4 interactor with leucine-rich

repeats, talin-1, and thrombospondin-1 were found only at T1 or T2, indicating that they play a role in the process of bone healing and osseointegration. Further investigation is required to ascertain their precise functions.

This study provides a database of MegaGen dental implant patients' saliva protein expressions during two critical healing periods. Future research could compare these protein profiles to those of other calcium-coated implants to gain a better understanding of the molecular mechanism that promotes osseointegration in calcium-coated implants. The atypical protein expressions observed in the NiTi group may suggest the presence of metal contamination resulting from surgical drills, which could potentially lead to complications in osseointegration. This study emphasizes the potential of saliva as a diagnostic tool for assessing the healing process of dental implants, which could have a significant impact on the field of dental implantology.

## CONCLUSION

We believe this is the first proteomics work to assess saliva proteins at several timepoints after dental implant therapy, especially with varied implant types. Protein profiles differ from pre-implant treatment (T0) to 1 week (T1) and 18 weeks (T2) after implant implantation. Surgical drill metal contamination may affect seven implant-healing proteins in NiTi implants. In MegaGen implants, 15 proteins were linked to osseointegration phases. The unique protein profiles of each implant group reveal their healing processes and lay the groundwork for future research. They enable clinical biomarker research and dental implant surface coating development to expedite implant healing.

## REFERENCES

- [1] Le Guehennec, L., Soueidan, A., Layrolle, P. & Amouriq, Y. 2007. Surface Treatments Of Titanium Dental Implants For Rapid Osseointegration. *Dental Materials*, 23, 844-854.
- [2] Dolanmaz, D., Saglam, M., Inan, O., Dundar, N., Alniacik, G., Gursoy Trak, B., . . . Hakki, S. S. (2015). Monitoring Bone Morphogenetic Protein-2 And -7, Soluble Receptor Activator Of Nuclear Factor-Kb Ligand And Osteoprotegerin Levels In The Peri-Implant Sulcular Fluid During The Osseointegration Of Hydrophilic-Modified Sandblasted Acid-Etched And Sandblasted Acid-Etched Surface Dental Implants. *J Periodontal Res*, 50(1), 62-73.
- [3] Lang, N. P., Salvi, G. E., Huynh-Ba, G., Ivanovski, S., Donos, N., & Bosshardt, D. D. (2011). Early Osseointegration To Hydrophilic And Hydrophobic Implant Surfaces In Humans. *Clin Oral Implants Res*, 22(4), 349-356.
- [4] Lee, J. S., Mitulović, G., Panahipour, L., & Gruber, R. (2020). Proteomic Analysis of Porcine-Derived Collagen Membrane and Matrix. *Materials (Basel, Switzerland)*, 13(22), 5187
- [5] Rahimi, S. N., Tengku Mohd Ariff, T. F., Kamar Affendi, N. H., & Ahmad, R. (2022). Surface Modifications Of Dental Implant And Its Clinical Performance: A Review. *Compendium Of Oral Science (Corals)*, 9(1), 52-66.
- [6] Araújo-Gomes, N., Romero-Gavilán, F., García-Arnáez, I. et al. Osseointegration mechanisms: a proteomic approach. *J Biol Inorg Chem* 23, 459–470 (2018).
- [7] Romero-Gavilán F, Gomes NC, Ródenas J, Sánchez A, Azkargorta M, Iloro I, Elortza F, García Arnáez I, Gurruchaga M, Goñi I, Suay J. Proteome analysis of human serum proteins adsorbed onto different titanium surfaces used in dental implants. *Biofouling*. 2017 Jan;33(1):98-111. doi: 10.1080/08927014.2016.1259414. PMID: 28005415.
- [8] Qian-Li Ma, Ling-Zhou Zhao, Rong-Rong Liu, Bo-Quan Jin, Wen Song, Ying Wang, Yu-Si Zhang, Li-Hua Chen, Yu-Mei Zhang. Improved implant osseointegration of a nanostructured titanium surface via mediation of macrophage polarization. *Biomaterials*. 2014 Volume 35, Issue 37, 9853-9867, <https://doi.org/10.1016/j.biomaterials.2014.08.025>.
- [9] Gittens RA, Olivares-Navarrete R, Schwartz Z, Boyan BD. Implant osseointegration and the role of microroughness and nanostructures: lessons for spine implants. *Acta Biomater*. 2014 Aug;10(8):3363-71. doi: 10.1016/j.actbio.2014.03.037. Epub 2014 Apr 8. PMID: 24721613; PMCID: PMC4103432.
- [10] Nakamura, T., Sakai, K., Nakamura, T., & Matsumoto, K. (2011). Hepatocyte growth factor twenty years on: Much more than a growth factor. *Journal of gastroenterology and hepatology*, 26 Suppl 1, 188–202. <https://doi.org/10.1111/j.1440-1746.2010.06549.x>

[11] Aubrun-Fillâtre, C., Monchau, F., & Hivart, P. (2016). Acrylic bone cement and starch: Botanical variety impact on curing parameters and degradability. *Materials science & engineering. C, Materials for biological applications*, 69, 1328–1334.

**AURINS**

# CHEMICAL COMPOSITIONS OF TAPA LEAVES (*PYCNARRHENA CAULIFLORA*): A NATURAL FOOD FLAVOR ENHANCER

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## ABSTRACT

The leaves of 'Pokok Tapa' or scientifically known as *Pycnarrhena cauliflora* (Menispermaceae) are used by Borneo communities as folkloric medicine and as a natural food flavour enhancer in their cooking. However, a thorough literature search revealed that not much scientific work has been done on the species. Thus, the aim of this study is to determine the chemical compositions of the plant's leaves through proximate analysis, phytochemical screening, and high-performance liquid chromatography (HPLC) profiling. The proximate analysis indicated that the dried leaves contain key nutritional components such as carbohydrate, crude fibre, total fat, and crude protein in the percentage of 78.5, 59.0, 2.7 and 8.2, respectively. The high protein content could contribute to the flavor enhancer potential of the leaves. Meanwhile, the phytochemical screening test on the methanolic leaf extract showed the presence of several classes of compounds which were alkaloids, terpenoids, and tannins. Among the classes of compounds that have been reported in the *Pycnarrhena* species were the alkaloids isoquinoline, bisbenzylisoquinoline and aporphine while none of the terpenoids or tannins. The HPLC profile obtained at 230 and 281 nm UV wavelengths indicate strong  $\pi\rightarrow\pi^*$  and  $n\rightarrow\pi^*$  electronic transitions of the moderate polarity alkaloids. These alkaloids might also contribute to the umami flavor of the plant's leaves. However, identification the alkaloids and free amino acid composition of the crude protein is necessary to support these findings.

**Keywords:** Borneo herb, *Pycnarrhena*, phytochemical, proximate analysis, HPLC.

## INTRODUCTION

*Pycnarrhena cauliflora* (Miers.) Diels. (Menispermaceae) is a liana species, thrives in tropical regions, particularly Borneo [1]. Known by various names such as 'pokok ajinomoto,' 'kiamis,' 'tapa,' 'tapa tahambia,' or 'tapa bohuang' in Sabah, and 'sengkubak' and 'kemangi imbo' in Indonesia, its usage varies among local ethnic groups [2]. Extensive literature search reveals that the prevalence traditional applications of *P. cauliflora* are more prominent in Kalimantan, Indonesia, and East Malaysia [3]. Beyond its role as a food enhancer and seasoning, the leaves of *P. cauliflora* have traditionally been employed to address diverse ailments, including eye irritation, headaches, fever, seizures, malaria, stomach bloating, and snakebites [4,5].

Besides that, the plant exhibits several biological activities, including cytotoxicity, antioxidant properties, antiparasitic effects, anticancer potential, and protein tenderizing attributes [6-10]. Despite screening for major phytochemical groups (alkaloids, flavonoids, tannins, terpenoids, steroids, saponins, and phenols), there are lack of reports on the chemistry of the plant. Nevertheless, recent GC-MS analysis of volatile constituents from its leaves revealed compounds such as  $\alpha$ -bergamotene,  $\beta$ -sesquiphellandrene,  $\alpha$ -cubebene, and sabinene, all belonging to the terpene class [11]. Thus, the aim of this study is to determine the chemical compositions of the plant's leaves through proximate analysis, phytochemical screening, and high-performance liquid chromatography (HPLC) profiling.

## MATERIAL AND METHOD

### **Plant Materials**

Dried *P. cauliflora* leaves were purchased online through E-commerce from Indonesian vendor. Then, the leaves were delivered to AuRIns, UiTM Puncak Alam for authentication.

### **Preparation of Extracts**

The sample (500 g) was cut into smaller fragment and pulverized using electrical grinder. The powder was extracted with 100 % MeOH at room temperature for 72 h and then filtered through Whatman No. 3 filter paper (Whatman, England). The filtrate was collected, and excess solvent was evaporated under reduced pressure using rotary evaporator at temperature between 40-45 °C yielding 20 g of the extract. The extract was stored in -4 °C prior to analysis.

### **Proximate Analysis**

The proximate analysis were determined on the pulverized sample according to the official analysis methods of the AOAC International [12]: total ash content by igniting a *ca.* 3–5 g test sample in a furnace at 550 °C until whitish or grayish ash obtained (923.03); moisture content by oven drying a *ca.* 2 g test sample at 100 °C to a constant weight (950.46); protein content by the Kjeltec Auto Analyzer (923.03); total fat content by petroleum ether extraction using a Soxhlet apparatus (991.36). The carbohydrate content was determined according to [13]: % Carbohydrates = 100 – (% Protein + % Fat + % Ash + % Moisture).

### **Phytochemical Tests**

The extract underwent qualitative phytochemical analyses following the procedures outlined by Azmi et al. [14]. The identification of alkaloids (Mayer's reagent), flavonoids (Shinoda Test), terpenoids (Salkowski Test), tannins (Ferric Chloride Test), and saponins (Froth Test) was carried out.

### **Chemical Profiling using High Performance Liquid Chromatography (HPLC)**

The profile of the extract was analysed by using DIONEX Ultimate 3000 HPLC system (ThermoFisher, USA). Separation was accomplished on a Phenomenex Luna ® 5 µm C18 (2) 100 Å (150 X 4.6 mm particle size) column. Mobile phase A was UPW and mobile phase B was HPLC grade MeCN. A constant flow rate of 1 mL/min was used and a mobile phase gradient was applied to achieve a good baseline separation: min 0; 10% B, min 25; 100% B, min 30, 100% B, min 33; 10% B, min 35; 10% B.

## **RESULTS AND DISCUSSION**

Tables 1 and 2 summarize the proximate analysis and phytochemical screening of *P. cauliflora* leaf extract. The proximate analysis (Table 1) revealed that the dehydrated leaves contain essential nutritional components, including carbohydrates (78.5%), crude fiber (59.0%), total fat (2.7%), and crude protein (8.2%). While, the phytochemical screening results (Table 2) indicated the presence of several compound classes, notably alkaloids, terpenoids, and tannins. Most alkaloids are biogenetically derived from amino acids such as glutamic acid, aspartic acid, phenylalanine, and tyrosine [15]. The combination of high protein and moderate alkaloid content suggests the potential presence of umami tastants in the leaves. Previous studies have also noted that the bitter taste of alkaloids may contribute to the umami flavor of certain foods [16].

Alkaloids such as isoquinoline, bisbenzylisoquinoline, and aporphine have been previously reported within the *Pycnarrhena* genus, while terpenoids and tannins remain undocumented [17]. To further investigate the chemical composition and structural complexity of *P. cauliflora* leaf extract, HPLC chemical profiling was performed. Guided by phytochemical analysis, which revealed a high concentration of alkaloids, two UV maxima wavelengths (230 nm and 281 nm) were selected for detection, focusing on this class of compounds.

The chromatograms (Figures 1 and 2) revealed consistent chemical profiles, with the major constituents eluting between 14 and 20 minutes, indicative of moderate polarity. These HPLC profiles confirmed the presence of alkaloids, with most peaks concentrated in the central region of the chromatograms. This observation aligns with the characteristic electronic transitions of  $\pi \rightarrow \pi^*$  and  $n \rightarrow \pi^*$  commonly associated with alkaloid compounds at 230 nm and 281 nm [15-18].

**Table 1: Proximate Analysis**

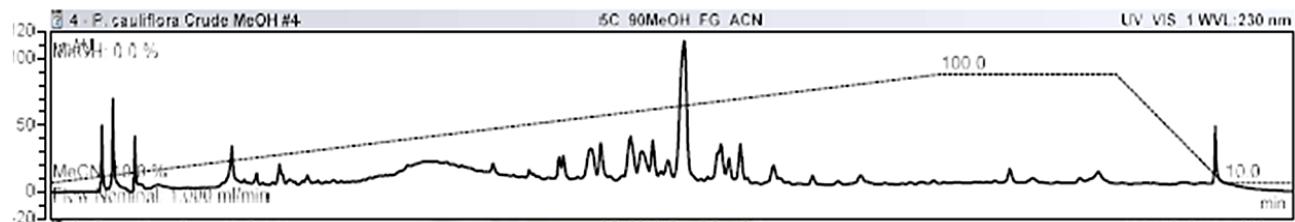
Components	Content
Total ash	3.0%
*Moisture	7.6%
Protein	8.2%
Total Fat	2.7%
Carbohydrate	78.5%
Crude fiber	59.0%

\*Moisture was presented based on wet mass; others were presented based on dry mass

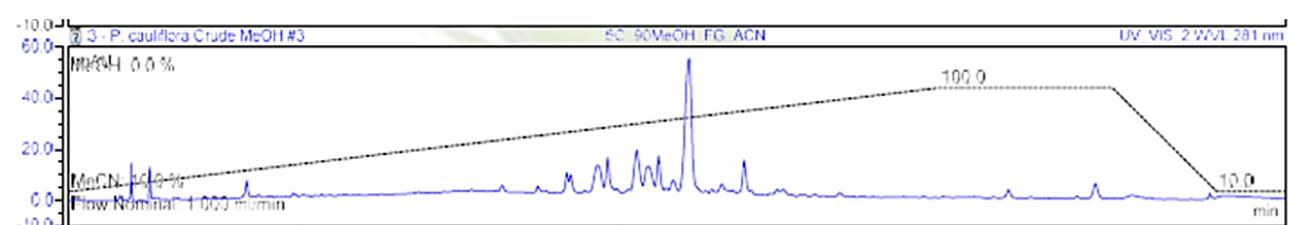
**Table 2: Phytochemical Tests**

Phytochemical constituents	Qualitative content
Alkaloid	++
Flavonoid	-
Terpenoid	+
Tannins	+
Saponins	-

\*Qualitative approximation scale: '+' trace, '++' moderate, '-' absent



**Figure 1: Chromatogram of the extract detected at 230 nm wavelength**



**Figure 2: Chromatogram of the extract detected at 281 nm wavelength**

## CONCLUSION

The chemicals content of *P. cauliflora* leaves were found to be protein, fat, carbohydrate, fiber, alkaloids, terpenoids, and tannins. High protein and moderate alkaloids contents could contribute to the flavor enhancer potential of the plant's leaves. Additional investigations are required to identify the specific alkaloids which give rise to the peaks in the chromatograms and to assess these alkaloids for their potential as flavor enhancers. Furthermore, there is a need for the identification of the free amino acid composition within the crude protein.

## REFERENCES

Hoot, S. B., Zautke, H., Harris, D. J., Crane, P. R., & Neves, S. S. (2009). Phylogenetic patterns in Menispermaceae based on multiple chloroplast sequence data. *Systematic Botany*, 34(1), 44-56.

Azman, M. F. S. N., Zainurin, N. A. Z., Azmi, A. S., Suleiman, M., Yeaw, N. S., & Salim, F. (2022). A review on the morphology, nutritional value, traditional uses, phytochemistry, and biological activities of *Pycnarrhena cauliflora* and its synonyms. *ASM Science Journal*, 17, 1-12.

Salim, F., Ismail, N. H., Ghani, N. A., Sidik, N. J., Tajuddin, A. M., & Khalil, A. K. B. (2022). Alkaloids and flavonoids compositions of traditional medicinal value plants from Imbak Canyon Conservation Area (ICCA). *Malaysian Journal of Chemistry*, 24(4), 110-106.

Rahayu, Y. D., Sutedjo, & Matius, P. (2007). Kajian potensi tumbuhan obat di kawasan Malinau Research Forest (MRF) Cifor Kabupaten Malinau Kalimantan Timur. *Journal Kehutanan*, 3(1), 87-101.

Santoso, E. A., & Utami, S. (2019). Inventory and biodiversity medicinal plants of dayak tomun society in lopus village Lamandau regency central Kalimantan. *Journal of Physics: Conference Series*, 1217(1).

Masriani M., Mustofa, M., & Jumina, J. (2013) *Pycnarrhena cauliflora* ethanolic extract induces apoptosis and cell cycle arrest in hela human cervical cancer cells. *International Journal of Research in Pharmaceutical and Biomedical Sciences*, 4, 1060–1068.

Purba, D. M., Wibowo, M. A., & Ardiningsih, P. (2014). Aktivitas antioksidan dan sitotoksik ekstrak metanol daun sengkubak (*Pycnarrhena cauliflora* Diels). *Jurnal Kimia Khatulistiwa*, 3(2).

Ramadani, A. P., Paloque, L., Belda, H., Tamhid, H. A., Masriani, Jumina, Augereau, J. M., Valentin, A., Wijayanti, M. A., Mustofa, & Benoit-Vical, F. (2018). Antiprotozoal properties of Indonesian medicinal plant extracts. *Journal of Herbal Medicine*, 11, 46–52.

Masriani, M., & Jumina, S. (2015) Aktivitas antioksidan dan penghambatan ekspresi 8-hidroksi deoksiguanosin (8-ohdg) isolat akar sengkubak [*Pycnarrhena cauliflora* (miers) diels] pada sel kanker payudara T47D. *Semirata*.

Noviyanti, T., & Ardiningsih, P. (2013). Pengaruh temperatur terhadap aktivitas enzim protease dari daun sansakng (*Pycnarrhena cauliflora* Diels). *Jurnal Kimia Khatulistiwa*, 1(1).

Puspita, D., & Wulandari, T. (2020). Analysis of bioactive compounds in kemangi imbo leaf (*Pycnarrhena cauliflora*) used as natural flavor. *Journal of Food Technology and Nutrition*.

AOAC (1999). Official methods of analysis of AOAC international (16th ed.). Association of the Official Analytical Chemists (AOAC) International.

Pomeranz, Y., & Meloan, C. E. (1987) Food analysis: Theory and practice (2<sup>nd</sup> ed.). An Aspen Publication.

Azmi, A. S., Amini, M. H., Azman, M. F. S. N., Salim, F., & Jawad, A. (2022). Antibacterial activity and phytochemical screening of *Erythrina fusca* Lour. leaf extract (Fabaceae). *Science Letters*, 16(1), 60-71.

Weber, C., & Opatz, T. (2019). Chapter one-bisbenzylisoquinoline alkaloids. *The alkaloids: chemistry and biology* 81, 1-114.

Carey, R. M., Kim, T., Cohen, N. A., Lee, R. J., & Nead K. T. (2022) Impact of sweet, umami, and bitter taste receptor (TAS1R and TAS2R) genomic and expression alterations in solid tumors on survival. *Scientific Reports*, 12, 8937.

Pelletier, S. W. (2000). *Alkaloids: Chemical & biological perspectives*. Chapter 1: The bisbenzylisoquinoline alkaloids- A tabular review. Elsevier, 14, 197-241.

Azman, M. F. S. N., Zakri, Z. H. M., Suleiman, M., Yeaw, N. S., Rasol, N. E., Afzan, A., Zainul, M. M., & Salim, F. (2024). Phytochemical identification of *Albertisia papuana* Becc. leaf methanolic extract through liquid chromatography tandem mass spectrometry data analysis. *Malaysian Journal of Chemistry* 26(1), 65-73.

# ***IN VITRO WOUND HEALING POTENTIAL OF MALAYSIAN TETRIGONA APICALIS PROPOLIS***

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## **ABSTRACT**

Stingless bee propolis, a natural resinous substance, has garnered scientific attention due to its rich array of bioactive compounds and traditional medicinal uses. While extensive studies have characterized the biological properties and therapeutic potential of propolis from various regions, limited research has been conducted on Malaysian stingless bee propolis. This study investigated the *in vitro* wound healing potential of the ethanolic extract of Malaysian *Tetrigona apicalis* propolis. Human epidermal keratinocyte (HaCaT) cells were used to assess cell viability, proliferation, and migration through 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) and scratch assays. Cell viability was determined after 24 h of treatment, while proliferation was measured at 48 and 72 h. The scratch assay assessed cell migration following 24 h of treatment at various extract concentrations. The results indicated that the ethanolic extract of *T. apicalis* did not exhibit cytotoxic effects on HaCaT cells at concentrations ranging from 7.81 and 125.00 µg/mL but caused a dose-dependent reduction in cell viability at higher concentrations of 250-1000 µg/mL. At 100 µg/mL, the extract significantly enhanced cell migration within 24 h compared to the positive control, allantoin. These findings highlight the enhanced cell migration within 24 h compared to the positive control, allantoin. These findings suggest that *T. apicalis* propolis possesses properties that may support wound healing. However, further studies are necessary to elucidate its mechanisms of action and evaluate its practical applications in wound care therapies.

**Keyword:** Stingless bee propolis, keratinocytes, proliferation, migration, wound healing.

## **INTRODUCTION**

Stingless bee propolis, renowned for its rich repertoire of bioactive constituents and longstanding traditional medicinal applications, has emerged as a subject of growing interest in recent scientific investigations [1,2]. Derived from diverse botanical sources and processed by stingless bees of various species, propolis exhibits a remarkable diversity in its chemical composition, reflecting the unique flora and environmental conditions of different geographical regions [2]. Numerous studies conducted worldwide have elucidated the multifaceted therapeutic properties of propolis, encompassing antioxidant, antimicrobial, anti-inflammatory, and immunomodulatory activities, among others [3]. These pharmacological effects have been attributed to the presence of phenolic compounds, flavonoids, terpenes, and other biologically active constituents present in propolis extracts [1]. The genus *Tetrigona*, comprising various species of stingless bees, is endemic to Malaysia and Southeast Asia [4]. Among these species, *Tetrigona apicalis* stands out for its unique propolis composition and medicinal properties [5]. Despite its potential therapeutic benefits, limited research has been conducted to evaluate the wound healing effects of Malaysian *T. apicalis* propolis.

Wound healing is a dynamic and intricate biological process orchestrated by a series of cellular and molecular events aimed at repairing damaged tissues and restoring their structural and functional integrity. This multifaceted process involves several overlapping phases, including hemostasis, inflammation, proliferation, and tissue remodeling, each governed by intricate signaling pathways and orchestrated by various cell types,

growth factors, cytokines, and extracellular matrix components [6]. Keratinocytes, the predominant cell type in the epidermis, contribute to wound closure by proliferating, migrating, and differentiating to form a protective barrier over the wound bed. These cells are essential for re-epithelialization, a critical

phase of wound healing that involves the restoration of the epidermal layer to seal the wound and prevent infection [7].

In recent years, there has been growing interest in exploring natural remedies with potential wound healing properties, driven by the recognition of the limitations and adverse effects associated with conventional therapies [8]. Natural products derived from plants, animals, and microorganisms have long been used in traditional medicine systems worldwide for the treatment of various ailments, including wounds and skin conditions [9]. Given these insights, this study aimed to assess the *in vitro* wound healing potential of the ethanolic extract of Malaysian *T. apicalis* propolis. The assessment included cytotoxicity, proliferation, and migration activities using human epidermal keratinocyte (HaCaT) cells as a model system. By elucidating the biological activities of Malaysian *T. apicalis* propolis extract, this research seeks to contribute to the understanding of its therapeutic potential and pave the way for future applications in wound healing therapies.

## MATERIAL AND METHODS

### *Collection of raw propolis*

Propolis produced by stingless bees *T. apicalis* was collected in December 2021 from local apiary of Belantara SR Enterprise, Hulu Bernam, Selangor (N 3° 40' 42.1818" E 10° 31' 14.5416"). The apiary site is predominantly surrounded by a diverse range of ornamental trees, notably from the *Myrtaceae*, *Fabaceae*, *Scrophulariaceae*, *Lythraceae*, *Elaeocarpaceae* families, in addition to fruit trees including *Moraceae*, *Anacardiaceae*, and *Sapindaceae* families. A voucher specimen documenting the identified stingless bee species was deposited at the Centre for Insect Systematic, Universiti Kebangsaan Malaysia with voucher accession number of CIS-TRI-2022-06.

### *Preparation of ethanolic extract*

The ethanolic extraction of propolis followed a method outlined by [10] with minor modifications. Briefly, the propolis samples (10 g) were ground into powder and dissolved in 100 mL of 70% ethanol (1:10 w/v ratio). After 48 hours of agitation at 25°C, the suspensions were filtered and evaporated under vacuum (995 hPa, 30°C). The concentrated extracts were frozen overnight, centrifuged to remove wax, freeze-dried, and stored at -20°C.

### *Cell culture and cell viability assay*

The human epidermal keratinocyte (HaCaT) cell line was obtained from the American Type Culture Collection (ATCC, Manassas, VA, USA). The cells were cultured in complete Dulbecco's modified Eagle medium (DMEM), supplemented with 10% fetal bovine serum and 1% penicillin-streptomycin, and maintained in a humidified incubator at 37°C with 5% carbon dioxide (CO<sub>2</sub>). Subculturing was performed when the cell density reached 80–95% confluence. Cells in all experiments were used between the 10<sup>th</sup> and 15<sup>th</sup> passages.

Cell viability was determined using a modified colorimetric MTT assay, which measures the mitochondrial reductase activity of viable cells. Cells grown in 96-well plates were treated with propolis extract at concentrations of 7.81, 15.63, 31.25, 62.50, 125.00, 250.00, 500, and 1000 µg/mL in the growth medium. After 24 h of incubation, MTT solution was added to the wells. Then all the solutions were removed and DMSO was added to dissolve the formazan crystals. The plates were incubated for 4 h and then read at 570 nm.

### *Cell migration assay*

HaCaT cell migration assays were conducted following the protocol outlined by [11]. Cells were seeded at a density of 1x10<sup>6</sup> cells per well in six-well plates and allowed to reach confluence. A scratch was then made across each well using a 200 µL pipette tip. Cells were subsequently treated with varying concentrations (12.50, 25.00, 50.00, and 100.00 µg/mL) of the extract, with 10.0 µg/mL allantoin serving as a positive control. Phase-contrast images were captured at 0, and 24 h post-wounding, and cell migration was quantified by measuring the remaining scratch wound area relative to the initial wound area using ImageJ software.

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### **Statistical analysis**

The data presented in this study represent the mean  $\pm$  standard deviation of at least three independent replicates. Statistical significance between groups was determined by One-Way ANOVA followed by Tukey's test for post hoc comparison. A p-value of less than 0.05 was considered statistically significant.

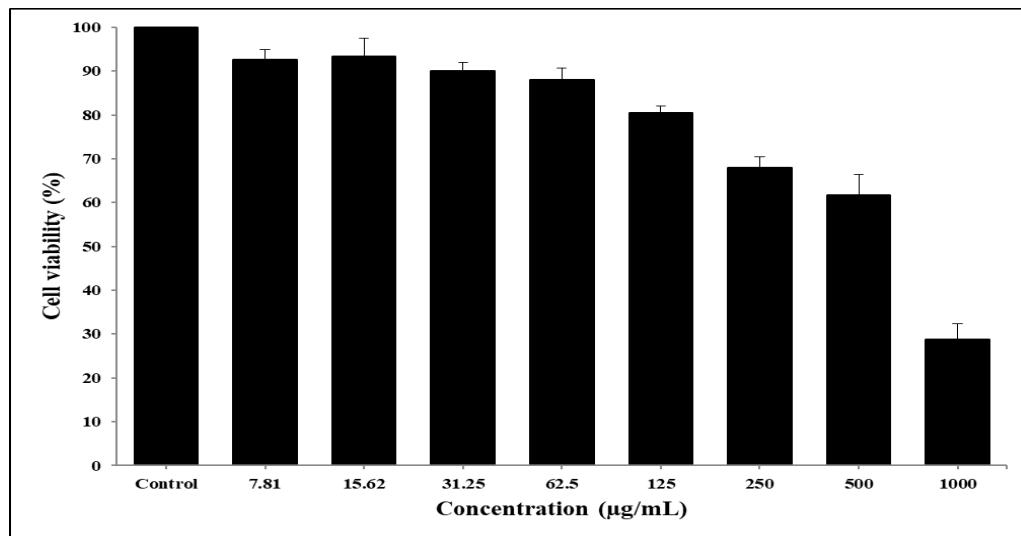
## **RESULTS AND DISCUSSION**

Figure 1 illustrates the viability of HaCaT cells following a 24-h treatment with varying concentrations of *T. apicalis* propolis extract. At lower concentrations (7.81–125.00  $\mu$ g/mL), no cytotoxic effects were observed, indicating that the extract was biocompatible within this range. However, at higher concentrations (250–1000  $\mu$ g/mL), cell viability decreased significantly in a dose-dependent manner, with a reduction exceeding 30%. This reduction may be attributed to the high levels of certain bioactive compounds in the propolis extract that at elevated concentrations, could exert cytotoxic effects. Based on these findings, concentrations between 12.5 and 100  $\mu$ g/mL were selected for subsequent proliferation and migration assays to ensure non-cytotoxic conditions.

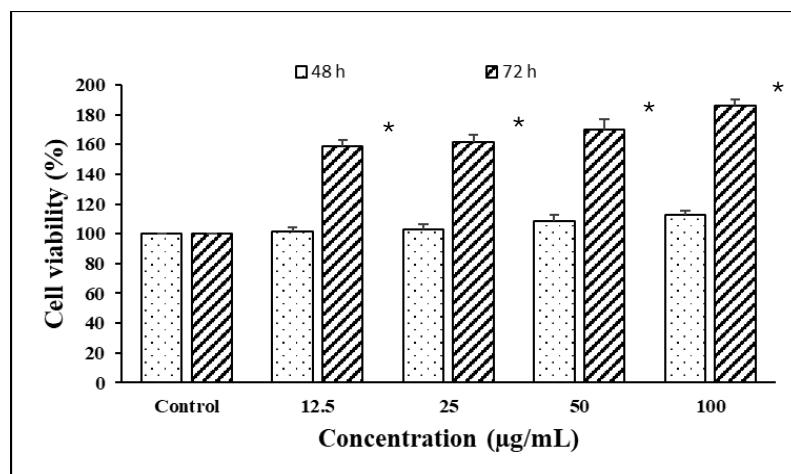
In the proliferation assay, the extract exhibited a stimulatory effect on cell viability over time, as shown in Figure 2. At all tested concentrations, a notable increase in cell viability was observed after 48 and 72 h of treatment compared to the control. This effect was more pronounced after 72 h, where concentrations of 12.5–100  $\mu$ g/mL resulted in a significant increase ( $p<0.05$ ) in proliferation, with rates ranging from  $158.76 \pm 0.11\%$  to  $185.92 \pm 0.15\%$ . The migration of HaCaT cells was evaluated using a scratch assay, which monitors the ability of cells to close a wound gap over time [11,12]. After 24-h of treatment, cells treated with 100  $\mu$ g/mL of the extract exhibited a significant ( $p<0.05$ ) increase in the percentage of wound closure, measuring  $96.65 \pm 3.01\%$ , compared to the control group ( $55.65 \pm 2.21\%$ ). Interestingly, there was no significant difference ( $p>0.05$ ) in the percentage of wound closure between the groups treated with allantoin ( $84.96 \pm 2.32\%$ ), serving as the positive control, and the group treated with the propolis extract at 100  $\mu$ g/mL ( $96.65 \pm 3.01\%$ ). These results are visually supported by the micrographs presented in Figure 3, which illustrate the progression of wound closure in each treatment group.

The present study suggests that *T. apicalis* propolis extract promotes wound closure in a dose-dependent manner by stimulating keratinocyte proliferation and migration. Keratinocytes are crucial during the epithelialization phase of wound healing, as they migrate and proliferate to restore the integrity of the wound surface [13]. Re-epithelialization, a key component of this phase, is a highly coordinated process involving keratinocyte migration from the wound margins, followed by their proliferation to cover the exposed wound bed [7]. The significant increase in cell migration observed with the extract treatment is consistent with previous studies highlighting the stimulatory effects of propolis on keratinocyte activity [14, 15]. The bioactive compounds in *T. apicalis* propolis, particularly flavonoids and phenolic acids, are likely responsible for these effects. These compounds have been widely recognized for their ability to enhance cellular activities, reduce oxidative stress, and support wound repair mechanisms through their antioxidant and anti-inflammatory properties [16, 17].

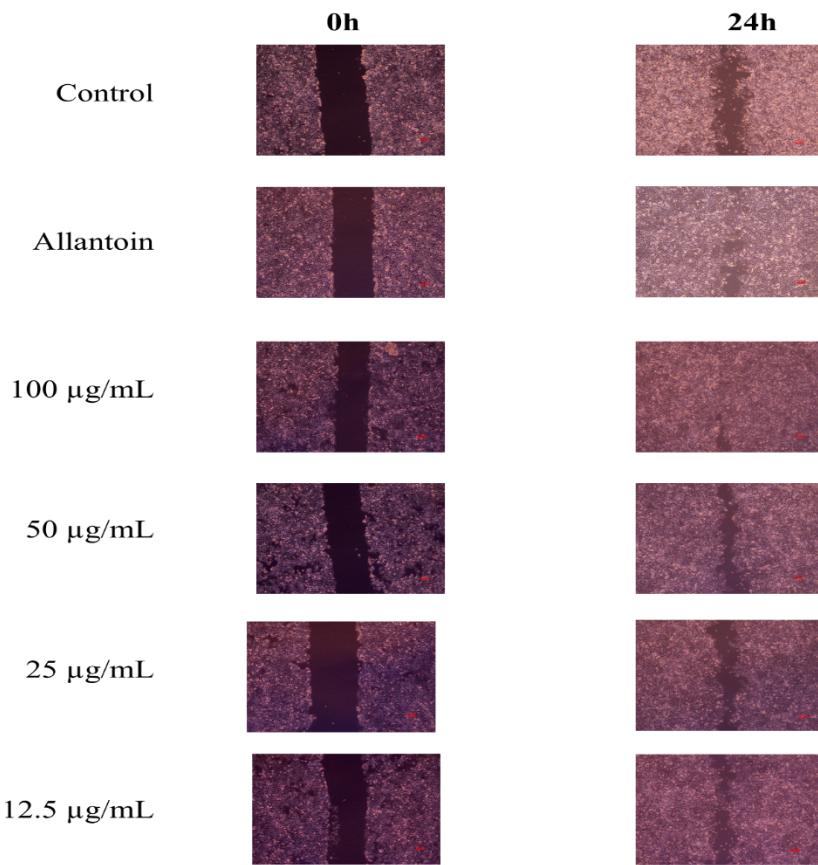
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**Figure 1: Effect of *T. apicalis* ethanolic extract on the viability of HaCaT cells after 24 hours exposure to various concentrations. Control group represents cells treated with 0.5% DMSO. Experiments were performed in triplicate and data are presented as mean  $\pm$  SD.**



**Figure 2: Effect of *T. apicalis* ethanolic extract on the proliferation of HaCaT cells at 48 and 72 hours. Control group represents cells treated with 0.5% DMSO. The data are presented as mean  $\pm$  SD of three independent experiments. Values of  $^*P < 0.05$  were considered statistically different as compared to control.**



**Figure 3: Representative images for migration of HaCaT cells treated with different concentrations of the *T. apicalis* ethanolic extract at 24 hours after incubation (x4 magnification).**

## CONCLUSION

In conclusion, this study highlights the wound healing potential of *T. apicalis* propolis extract by promoting the cell proliferation and migration of keratinocytes. These preliminary findings suggest that *T. apicalis* propolis extract warrants further investigation as a potential wound healing material. Future studies are needed to confirm its efficacy as a wound healing agent.

## REFERENCES

- [1] Kasote, D., Bankova, V. & Viljoen, A.M. (2022). Propolis: Chemical diversity and challenges in quality control. *Phytochemistry Reviews*, 21: 1887–1911.
- [2] Popova, M., Trusheva, B. & Bankova, V. (2021). Propolis of stingless bees: A phytochemist's guide through the jungle of tropical biodiversity. *Phytomedicine*, 86: 153098.
- [3] Al-Hatamleh, M.A.I., Boer, J.C., Wilson, K.L., Plebanski, M., Mohamud, R. & Mustafa, M.Z. (2020). Antioxidant-based medicinal properties of stingless bee products: Recent progress and future directions. *Biomolecules*, 10(6): 923.
- [4] Samsudin, S. F., Mamat, M. R., & Hazmi, I. R. (2018). Taxonomic study on selected species of stingless bee (Hymenoptera: Apidae: Meliponini) in Peninsular Malaysia. *Serangga*. 23(2):203-258.
- [5] Nafi, N. M., Zin, N. B. M., Pauzi, N., Khadar, A. S. A., Anisava, A. R., Badiazaman, A. A. M., & Mohd, K. S. (2019). Cytotoxicity, antioxidant and phytochemical screening of propolis extracts from four different Malaysian stingless bee species. *Malaysian Journal of Fundamental and Applied Sciences*, 15(2-1):307-312.
- [6] Wang, G., Y, F., Zhou, W., Xiao, N., Luo, M., & Tang, Z. (2023). The initiation of oxidative stress and therapeutic strategies in wound healing. *Biomedicine and Pharmacotherapy*, 157, 1-12.

[7] Dam, P., Celik, M., Ustun, M., Saha, S., Saha, C., Kacar, E. A., ... & Mandal, A. K. (2023). Wound healing strategies based on nanoparticles incorporated in hydrogel wounds patches. *RSC Advances*, 13(31), 21345-21364.

[8] Albahri, G., Badran, A., Hijazi, A., Daou, A., Baydoun, E., Nasser, M., & Merah, O. (2023). The therapeutic wound healing bioactivities of various medicinal plants. *Life* (Basel, Switzerland), 13(2), Article 317.

[9] Lordani, T. V. A., de Lara, C. E., Ferreira, F. B. P., de Souza Terron Monich, M., Mesquita da Silva, C., Felicetti Lordani, C. R., ... & Lonardoni, M. V. C. (2018). Therapeutic effects of medicinal plants on cutaneous wound healing in humans: A systematic review. *Mediators of Inflammation*, 2018, Article 7354250.

[10] Adli, M. A., Zohdi, R. M., Othman, N. A., Amin, N. S. M., Mukhtar, S. M., Eshak, Z., & Jahrudin, D. H. J. (2022). Determination of antioxidant activity, total phenolic and flavonoid contents of Malaysian stingless bee propolis extracts. *Journal of Sustainability Science and Management*, 17(12), 132-143.

[11] Adli, M. A., Idris, L., Mukhtar, S. M., Payaban, M., James, R. J., Halim, H., George, A., & Zohdi, R. M. (2024). Phytochemical assessment, antioxidant activity, and in vitro wound healing potential of *Polygonum minus* huds. *Journal of Current Science and Technology*, 14(1), Article 18.

[12] Abdel Latif, Y., El-Bana, M., Hussein, J., El-Khayat, Z., & Farrag, A. R. (2019). Effects of resveratrol in combination with 5- fluorouracil on N-methylnitrosourea-induced colon cancer in rats. *Comparative clinical pathology*, 28, 1351-1362.

[13] Abate, M., Citro, M., Pisanti, S., Caputo, M., & Martinelli, R. (2021). Keratinocytes migration promotion, proliferation induction, and free radical injury prevention by 3-Hydroxytirosol. *International Journal of Molecular Sciences*, 22(5), Article 2438.

[14] Martinotti, S., Pellavio, G., Laforenza, U., & Ranzato, E. (2019). Propolis induces AQP3 expression: a possible way of action in wound healing. *Molecules*, 24(8), 1544.

[15] M. Afonso, A., Gonçalves, J., Luís, Â., Gallardo, E., & Duarte, A. P. (2020). Evaluation of the in vitro wound-healing activity and phytochemical characterization of propolis and honey. *Applied Sciences*, 10(5), 1845.

[16] Cao, X. P., Chen, Y. F., Zhang, J. L., You, M. M., Wang, K., & Hu, F. L. (2017). Mechanisms underlying the wound healing potential of propolis based on its in vitro antioxidant activity. *Phytomedicine*, 34, 76-84.

[17] Oryan, A., Alemzadeh, E., & Moshiri, A. (2018). Potential role of propolis in wound healing: Biological properties and therapeutic activities. *Biomedicine & pharmacotherapy*, 98, 469-483.

## **PUSAT ASASI**

# A STUDY ON LECTURERS' SELF-EFFICACY IN USING TECHNOLOGY IN THE CENTRE OF FOUNDATION STUDIES, UiTM DENGKIL CAMPUS

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## ABSTRACT

It is undeniable that technology adds advantages in teaching and learning and there is a need to prepare the younger generation and encourage them for changing work, social and cultural environments. This study investigates the level of self-efficacy in technology use among the lecturers at the Centre of Foundation Studies, UiTM Dengkil Campus, Selangor and the relationship between self-efficacy in technology use and the use of technology in classroom. The study also seeks explanation for the reasons to the use of technology in classroom among the lecturers. It applies both qualitative and quantitative approach to observe lecturers' self-efficacy in using technology in teaching. Six-Point Likert-scale questions developed from Technology Proficiency Self-Assessment Scale (TPSA) were administered amongst 51 lecturers. Collected data from the survey was then prepared for the statistical procedures using Statistical Package of Social Science (SPSS) Version 2.0. It is found that there are significant correlations between lecturers' self-efficacy in technology use and the application of technology in the classroom ( $r=0.413$ ). The finding obtained from this study concludes that increases in self-efficacy are correlated with the use of technology in classroom. This study finally concludes that there is a need for lecturers to equip themselves with the current technology advancement and to apply it in the process of teaching and learning to create a more meaningful learning environment.

**Keyword:** Lecturer's self-efficacy, technology proficiency, technology in education

## INTRODUCTION

Numerous efforts have been taken by the government to upskill the lecturers in technology and digital knowledge to create a productive classroom and amplify the effectiveness of students' learning. This allows the lecturers to make themselves relevant to the rapidly progressing pedagogical approach. Using technology in classroom is important to give a positive impact on students' learning. Students may likely have a high level of technology self-efficacy if the lecturer has as well, hence creating a more conducive learning environment to the students. A study discovered that students would use computer and online platforms if they feel confident in using technology in the classroom [1]. Another study showed that students not only felt the learning efficiency increment when accessing information, but also highlighted that the use of technology in classroom benefited them better in the workplace [2]. They agreed that most traditional learning methods like using textbooks and whiteboards could not deliver the lesson the same way as the advanced learning approaches.

### *Self-Efficacy*

Bandura studied self-efficacy as the psychology of procedures that change one's confidence, beliefs and ability [3]. When it comes to self-efficacy, one is able to deduce whether an action should take place, how many attempts should one strive and how long the strive is sustained when dealing with drawbacks and complications. Other people's concern about an individual's capability has not affected on him or her, but rather the personal belief that he or she can perform a challenging task is measured. Threatening situations are feared and avoided if individuals believe that they exceed their capability, whereas those who have faith in themselves will behave assuredly to perform necessary activities. Those who doubt their capabilities may have the tendency to give up on a difficult task, as opposed to those who have higher self-efficacy who would put more effort and strive harder [4]. Thus, a good quality work performance may not be achieved without high self-efficacy.

A study that focused on sport competition examined the athletes' self-efficacy when they lost the game [5]. Their low self-efficacy was reflected by a stream of misery with statements like "I stink" and "I don't belong in the field". The researchers believe that one's strong and consistent self-efficacy is needed to sustain the effort put in work and the success that may follow, and this can be possible when he or she develops and improves his or her skills and undergoes changes to meet the demands of his or her functioning workplace. For example, the athletes in would have had a much positive level of self-efficacy if the people around them (relatives, coach or spectators) could boost their confidence after the loss. Later research made a connection between their perceived control model with Bandura's self-efficacy theory [6]. The model, which includes three beliefs (strategy, capacity, and control beliefs), looks at the ability to put effort in strategizing an individual's work performance, guided by a strong control belief and capacity belief that he or she can produce work accomplishment. Self-efficacy is mirrored by 'I believe I can do this' capacity belief.

### ***Lecturer's Technology Self-Efficacy***

Information and communication technology (ICT) in education is a system which is implemented through a systematic effort to modernize the education, and there are efforts to develop the information society [7]. There is positive relationship between ICT use in teaching and the students' achievements. The usage of ICT during lessons conducted in classes has improved the learning outcomes of students. Hence, the use of ICT should be recognised by all teachers in order to enhance students' achievement in academic [8].

It is significant to understand the lecturer's self-efficacy with respect to numerous instructional practices [9]. The higher the level of technology self-efficacy among lecturers, the more inclined they are to accept transformations and choose the best option in teaching. As the Internet became more vital in our daily routines, it also impacted the teaching and learning process [10]. Lecturers admitted that students are more interested and engaged when completing assignments using internet by providing them different choices, increasing their level of interest, and providing opportunities relatable to their experiences. While a survey found that most new teachers have challenges in using technology in their first years of teaching [11], another survey proved that many new teachers now are digital natives and have grown up using technology and they have high confidence in applying technology in their daily routines [12]. Relating efficacy for technology use in classroom especially in selecting appropriate tools used should be explored further in order to enhance teaching and learning.

Therefore, creating a conducive learning environment to the students should start by having lecturers with high technology self-efficacy. A successful use of technology in classroom can be seen when the goal of a lesson is met after using certain applications or when tools and resources run smoothly in classroom. This, in turn, strengthens their technology self-efficacy even more, to the extent that they would consider using technology in other classes. However, if the method fails due to some external challenges or not fully utilizing technology, self-efficacy in using technology can be weakened. They may face failure in transforming classes and are unable to align with learning goals, making integrating technology into curricular content more difficult.

In this study, lecturers' technology self-efficacy and the use of technology in classroom are two important variables for lecturers to achieve best learning environment. Therefore, the main purpose of this study is to investigate the statistical relationship between self-efficacy in technology use and the use of technology in classroom. Three research questions were constructed as to guide this study:

- 1. What is the mean score of lecturers' self-efficacy in technology?***
- 2. What is the mean score of technology use in classroom amongst the lecturers?***
- 3. Is there any significant relationship between lecturers' self-efficacy in technology use and the use of technology in classroom?***

## **METHODOLOGY**

The main aim of this study is to investigate the level of self-efficacy in technology use and the correlation with the use of technology in the classroom amongst the lecturers at the Centre of Foundation Studies, UiTM Dengkil Campus, Malaysia. To achieve the research objective and research

questions of this study, both quantitative and qualitative procedure were employed for data collection and analysis.

A set of instruments consisting of demographic data and six-point Likert-scale questions developed from Technology Proficiency Self-Assessment Scale (TPSA) was administered amongst the respondents. Christensen and Knezek presented self-efficacy as ‘confidence in one’s competence’ to operate this instrument [13]. This instrument comprised 38 items measured on a 6-point scale, 1 being “strongly disagree” and 6 being “strongly agree”. The items were organized as follows: a) items 7, 8, 10 and 11; referring to email; b) items 12, 15 and 16; referring to World Wide Web; c) Items 18, 19, 20 and 21; referring to integrated application; and d) items 23, 24, 25 and 26; referring to teaching with technology. Cronbach’s Coefficient Alpha was used in order to measure the reliability of the instruments used. The reliability of the instrument was established and the results proved that the instrument was reliable ( $\alpha=.951$ ).

To improve the sampling process, 51 lecturers were randomly selected from the Science Faculty (Physics, Biology, Chemistry and Mathematics), Law Faculty, TESL department, Academy of Contemporary Islamic Studies (ACIS) and Akademi Pengajian Bahasa (Academy of Language Studies, APB). From the survey, 11 lecturers were below the age of 30, 34 between the age of 31-40, 3 between the age of 41-50, and 3 over the age of 50. Data collection tool was performed using Google Form that allowed each respondent to answer in 10 minutes. Collected data from the survey was then prepared for the statistical procedures using Statistical Package of Social Science (SPSS) Version 2.0. To support the survey, a brief interview session with a small selection of the respondents was then conducted to further discuss on their survey responses.

## RESULTS AND DISCUSSION

From the survey, the mean score of lecturers’ self-efficacy in technology use is derived from Table 1.

**Table 1: Lecturers’ Perceived Self-Efficacy in Technology Use**

Responses	r	%
Strongly disagree	6	0.31
Disagree	29	1.5
Do not know	166	8.57
Neither agree nor disagree	356	18.37
Agree	653	33.69
Strongly Agree	728	37.56

Table 1 shows that 37.56% of the lecturers perceived the highest level of self-efficacy in technology. The mean score is equivalent to 1.1765 (1 = high, 2 = low), which shows that most of the lecturers rated their perceived self-efficacy as high in technology use. This is similar to previous studies who found that many teachers are digital natives and felt confident in their ability to implement technology as part of the teaching and learning process [12, 14].

The survey also analysed the mean score of technology use in classroom among lecturers. The mean score is derived from Table 2.

**Table 2: Technology Use in Classroom Among Lecturers**

Teaching Field	No	Yes	Total
Physics	1 12.5%	6 14%	7 13.7%
Biology	0 0%	4 9.3%	4 7.8%
Chemistry	1 12.5%	3 7%	4 7.8%
Mathematics	3 37.5%	2 4.7%	5 9.8%
Law	2 25%	4 9.3%	6 11.8%
ACIS	0 0%	3 7%	3 5.9%
APB	1 12.5%	15 34.9%	16 31.4%
TESL	0 0%	6 14%	6 11.8%
<b>TOTAL</b>	<b>8</b>	<b>43</b>	<b>51</b>

As tabulated in Table 2 above, 43 lecturers responded “YES” to applying blended learning in-class application. The mean score is equivalent to 1.1373 (1 = high, 2 = low), which explains that they feel comfortable in using technology in their teaching and learning. They found it useful to apply technology in classroom as it helps to expedite the understanding of the students in certain chapters. It is also believed that when technology is applied, students are more engaged in the classroom. The use of technology such as flipped classroom will also allow lecturers to have greater insight into students' understanding of information and learning as a result of more inter-communication in classroom [15].

Table 3 below displays the statistical relationship between perceived self-efficacy and technology use in classroom amongst the lecturers. The findings showed that there was a positive and significant relationship between perceived self-efficacy and technology use in classroom ( $r=413$ ,  $p<0.01$ ).

**Table 3: Correlation Between Perceived Self Efficacy and****Technology Use in Classroom Among Lecturers**

		Perceived Self-Efficacy	Technology Use in Classroom
Perceived Self-Efficacy	Pearson Correlation Sig. (2-tailed) N	51	.413*.00351
Technology Use in Classroom	Pearson Correlation Sig. (2-tailed) N	.413*.00351	51

\*Correlation is significant at the 0.01 level (2-tailed).

An earlier study stated that “having a high computer self-efficacy among the basic preconditions for positive self-efficacy regarding the use of computers for instruction” will also lead to the usage of technology in classroom [16]. In fact, another study discovered a positive relationship between lecturers' self-efficacy and technology integration in their teaching approaches [17]. These lecturers recognize high technology self-efficacy a crucial component that allows them to provide a more effective teaching and learning environment, especially for today's generation that is making Internet an essential part of their lives. All this research provides a critical appraisal to the current study; the ability of the lecturers to display the various ways of applying technology in classroom (for example, adapting lesson plans to incorporate technological tools and engaging students to explore real issues digitally) starts by having high confidence in using technology.

Besides conducting the survey, the researchers also interviewed selected lecturers based on their responses from the questionnaire. When they were asked how they feel about their technological competency level, majority of the lecturers perceived their technological level as intermediate to advance. Besides sending emails and using search engines to subject matter, they also believe that they could use social media tools in classroom and evaluate students' work in various format. Lecturers realise that in this 21st century, it is a necessity to equip themselves with the technology that can be applied in classroom which will help the process of teaching and learning. Though most lecturers have high self-efficacy in technology use, they understand that they need to learn more about enhanced technology from time to time.

The lecturers were also asked how useful technology is in their teaching and learning. Most of them agree that there are three main advantages of applying technology in classroom. Firstly, technology helps teaching and learning more interactive. Students and lecturers can interact easier and with the application technology, students can get quick feedback from the lecturers [18]. Secondly, due to the availability of different platforms, technology in classroom can help to inject more creativity in the learning process. Contemporary technologies often bring new possibilities for people to be creative [19], thus allowing them to have better knowledge retention. Lastly, the use of technology in classroom helps to improve students' achievement as students can expand their knowledge and get better understanding [8].

Lastly, the lecturers were asked about the challenges that they had faced in using technology in classroom. Some responded that they fear their incapability to consistently adapt with the technological changes. This situation can be supported by earlier research who found that teachers' use of technology in classroom has been correlated with their belief in their ability to do so [20]. If the lecturer does not have confidence to apply the technology, the chances for the lecturer to apply the technology will be smaller. The lecturers believe that they had low self-efficacy in using more complicated tools and platforms such as creating wiki blog, data analysis tools and troubleshooting system applications. This, in fact, had affected their time, not just during class hours but also when preparing the lesson itself.

## CONCLUSION

The current research was carried out to investigate the level of self-efficacy and the relationship between self-efficacy in technology use and the use of technology in classroom among the lecturers at the Centre of Foundation Studies, UiTM, Selangor, Malaysia. Using a set of questionnaires by Christensen and Knezek that comprises 38 items [13], the research is able to gather data that supports these two research questions. Evidence suggests that lecturers' technology self-efficacy can be an important predictor of pedagogical success in classroom and be a valuable and critical variable to be considered for professional development.

Firstly, this study provides explanation for the substantial and consistent research findings of the relationship between technology self-efficacy and the use of technology in classroom among the lecturers. The higher the level of perceived self-efficacy in technology, the more the lecturers use technology in classrooms. These results are certainly in support of a few research that showed a high self-efficacy in using technology in classroom and the positive impacts they bring to the students' academic development [12, 14, 21]. A lesson that utilizes technology in the classroom, used by both lecturers and students, can create a more effective learning environment for students, provided that the lecturers have intermediate level, if not advanced, technology self-efficacy.

Secondly, this study is able to explore the implications for future research. Because of the consistent research findings, the possibilities to extend the scope to other significant variables are immense. One variable is digital natives and digital immigrants. Future studies on technology beliefs from digital natives and digital immigrants could provide a more in-depth perspective about technology self-efficacy and they handle technology resources in classroom. Comparing the divergent response may provide better strategies for university leaders to "find a way to effectively communicate in order to better educate lecturers as to what currently exists to aid them in their instructional practice" [9]. Another variable is the different departments in the university. Explicit findings that compare the reasons for using or not using technology in classroom among the different departments (eg: Science and Social Science) could help provide a more concrete solution to encourage all lecturers to benefit technology in their lessons, regardless of their syllabus content.

Lastly, findings from this study could bring implications on lecturers' professional development. The most significant data suggests that there is knowledge gap in troubleshooting the system, which had made a few lecturers have low self-confidence to use technology for Blended Learning and future lessons. Lecturers must be trained to handle malfunctions in situations where they might mishandle the tool, to improve lecturers' belief in technology. This matter can be expanded further to observe how the lecturers react to difficulties and challenges when using educational technology, which can provide more accurate information about their perceived technology self-efficacy in their classroom. This, in turn, not only allows the lecturers to fully utilize technology for lesson developing and in-class use, but also to sustain an ongoing need for learning and relearning about technology.

## REFERENCES

- [1] Henson, R. K. (2002). From adolescent angst to adulthood: Substantive implications and measurement dilemmas in the development of teacher efficacy research. *Educational Psychologist*, 37, 137–150.
- [2] Li, Q. (2007). Student and teacher views about technology: A tale of two cities? *Journal of research on Technology in Education*, 39(4), 377-397.
- [3] Bandura, A. (1978). Self-efficacy: Toward a unifying theory of behavioral change. *Advances in Behaviour Research and Therapy*, 1, 139-161.
- [4] Schunk, D. H. (1991). Self-Efficacy and Academic Motivation. *Educational Psychologist*, 26, 207-231.
- [5] Lane, A. M., & Terry, P. C. (2000). The nature of mood: development of a conceptual model with focus on depression. *Journal of Applied Sport Psychology*, 12, 16–33.
- [6] Skinner, E. A., Kindermann, T. A., Connell, J. P., & Wellborn, J. G. (2009). Engagement and disaffection as organizational constructs in the dynamics of motivational development. In K. R. Wenzel & A. Wigfield (Eds.), *Educational psychology handbook series. Handbook of motivation at school* (pp. 223-245). New York, NY, US: Routledge/Taylor & Francis Group.
- [7] Lee, B. N. (2012). ICT Use in Teaching and Learning of History. *IRACST – International Journal of Computer Networks and Wireless Communications (IJCNWC)*, 2(4).
- [8] Ziden, A.A., Ismail, I., Spian, R., Kumutha, K. (2011). The Effects of ICT Use in Teaching and Learning on Students' Achievement in Science Subject in a Primary School in Malaysia. *Malaysia Journal of Distance Education*, 13(2), 19-32.
- [9] Farah, A. C. (2011). Factors influencing teachers' technology self-efficacy: a case study. A Dissertation Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Education Liberty University.
- [10] Slutsky, A. (2016). Factors influencing teachers' technology self-efficacy. Gardner-Webb University.
- [11] Clausen, J. M. (2007). Beginning teachers' technology use: First-year teacher development and the institutional context's affect on new teachers' instructional technology use with students. *Journal of Research on Technology in Education*, 39(3), pp. 245–261.
- [12] Kent, A. M., Giles, R. M. (2017). Preservice teachers' technology self-efficacy. *SRATE Journal*, 26(1), 9-20.
- [13] Christensen, R., & Knezek, G. (2014). The technology proficiency self-assessment questionnaire (TPSA): Evolution of a self-efficacy measure for technology integration. In T. Brinda, N. Reynolds & R. Romeike (Eds.) *Proceedings of KEYCIT 2014 – Key Competencies in Informatics and ICT*, 2014, pp. 190–196.
- [14] Nadelson, L. S., Bennett, S., Gwilliam, E., Howlett, C., Oswalt, S., & Sand, J. (2013). The intersection of preservice teachers' confidence, perceptions, and ideas for using instructional technology for teaching and learning. *International Journal of Higher Education*, 2(4), 77-90.
- [15] Roehl, A., Reddy, S. L., & Shannon, G. J. (2013). The flipped classroom: an opportunity to engage millennial students through active learning strategies. *Journal of Family and Consumer Sciences*, 105, 44–49.
- [16] Teo, T. (2010). A path analysis of pre-service teachers' attitudes to computer use: Applying and Extending the Technology Acceptance Model in an educational context. *Interactive Learning Environments*, 18(1), 65-79.

- [17] Bakar, N. S. A., Maat, S. M., & Rosli, R. (2018). A Systematic Review of Teacher's Self-efficacy and Technology Integration. *International Journal of Academic Research in Business and Social Sciences*, 8(8), 540–557.
- [18] Stošić, L. (2015). The importance of educational technology in teaching. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, 3, 111-114.
- [19] Henriksen, D., Mishra, P., & Fisser, P. (2016). Infusing Creativity and Technology in 21st Century Education: A Systemic View for Change. *Educational Technology & Society*, 19(3), 27–37.
- [20] Paraskeva, F., Bounta, H., & Papagianni, A. (2008). Individual characteristics and computer self-efficacy in secondary education teachers to integrate technology in educational practice. *Computers & Education*, 50 (2008) 1084–1091.
- [21] Pajares, F., Usher, E. L., & Johnson, M. J. (2007). Sources of writing self-efficacy beliefs of elementary, middle, and high school students. *Research in the Teaching of English*, 42(1).

# PRELIMINARY STUDY ON MICRONUTRIENTS DIETARY INTAKE PATTERN AMONG EXCLUSIVELY BREASTFEEDING MOTHERS IN MALAYSIA

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## ABSTRACT

Human milk is the first source of exogenous micronutrients among breastfeeding infants. Thus, maternal food intake is important in determining the level of micronutrients in human milk. The purpose of this study is to ascertain the pattern of fluid, iron, calcium, and fiber intake among mothers in Malaysia who are exclusively breastfeeding. A total of n=36 of exclusively breastfeeding mothers was recruited in the study from December 2018 until March 2019. Mothers underwent a survey on anthropometry and demographic factors using a constructed questionnaire. The dietary intake of the mother was collected as data and was analyzed using Nutritionist Pro. Software. Data was analyzed using SPSS software over the lactating stage of the mothers. For iron, the highest mean of intake occurred during fifth to sixth months of lactation period with,  $729.07 \pm 539.65$  mg per day. In addition, the highest mean of intake occurred during the third to fourth months of lactation period with,  $729.07 \pm 539.65$  mg per day while for fiber intake, the highest mean occurred during fifth to sixth months of lactation period with,  $6.83 \pm 2.53$  g per day. For fluid dietary intake, the highest mean occurred during the third to fourth months of lactation period with  $2150 \pm 783.51$  ml per day. Overall, the intake for iron and fluid among exclusively breastfeeding mothers were reported to be higher than recommended RNI (2017) value over lactating period. However, calcium and fiber intake reported to be below RNI requirement. Overall, during the postpartum and nursing periods, the mothers' dietary regimen and lifestyle vary dramatically, potentially affecting their nutritional consumption.

**Keywords:** Maternal, dietary, micronutrient, exclusively breastfeeding

## INTRODUCTION

In Malaysia, iron deficiency was synonymous with anemia episodes among pregnant women. This issue continues until the postpartum period and causes challenging health problems as it relates to the high risk of iron deficiency among infants [1]. One study in Nepal determined that withholding certain iron-rich food such as meat, fish, poultry or eggs could lead to the low intake of iron during the postpartum period [1]. Malaysia is abundant with food that is rich with calcium besides milk and dairy products, such as fish with edible bones like canned sardines and anchovies, beans and bean products including yellow dhal, tofu and tempeh (fermented soybeans), locally processed foods such as shrimp paste, cincalok and budu, as well as vegetables like spinach, watercress, mustard leaves, cekur manis, tapioca leaves, kai-lan and broccoli [2]. However, similar iron, calcium intake is also subjected to the efficiency of absorption. According to [3], even though the knowledge of Malaysians towards the health benefits of dietary fibre was sufficient, most respondents were not aware about the recommended value and portion of fruits and vegetables intake as suggested in the food pyramid. Besides, only 69.2% of respondents reported consuming fruits and vegetables in their daily meals. Earlier studies also reported that the intake of fluid was relatively low in Malaysia [4]. It was supported in another recent study by [5][6] specific to lactating mother that lower amount of fluid intake which ranged from  $727.4 \pm 144.7$  to  $1019.3 \pm 153.3$  ml/day along the six months of lactation period.

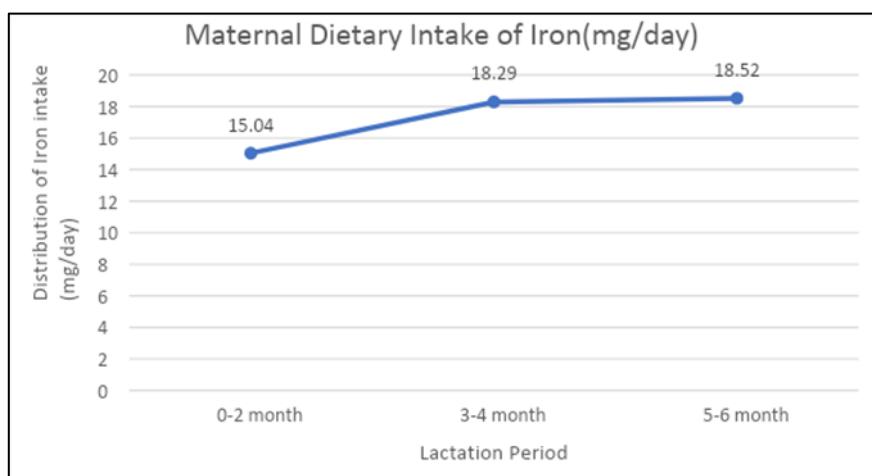
## MATERIAL AND METHOD

This observational, cross-sectional study is a preliminary study that assesses the pattern on maternal dietary intake of several micronutrients including calcium, iron, fibers and fluid. n=36 of exclusively breastfeeding mothers was recruited in the study which was carried out in Central Research Animal Facility (CREAM) and Laboratory at International Islamic University Malaysia (IIUM), Kuantan. Ethical approval for this study was obtained from IIUM Research Ethics Committee (IREC-2019/011). This study was conducted in Kuantan, Pahang and Dengkil, Selangor. The inclusion criteria were as follows: (1) Mother aged between 18–39 years, (2) Full term birth ((birth at gestational age 37 to 42 weeks) without any health complications, (3) Singleton pregnancy at 32 weeks onwards and (4) exclusively breastfeed their baby (0-6 months old). All the participants signed an informed consent form prior to their participation in the study.

The maternal dietary intake assessment was conducted with the help of certified dietitians. A 24-hour dietary recall (24HR) is a structured interview which is used to capture detailed information about all food and beverages consumed by the respondents in the past 24 hours [7]. In-depth face to face or phone interviews were carried out among the study participants to recall their dietary intake information within the previous 24 hours. A day before the interview, the mothers were reminded to record and note all their food and beverages to avoid recall biases. Detailed data about food preparation methods, ingredients used in mixed dishes, and the brand name of commercial or supplement products and amounts of each food consumed are estimated using common household utensils such as spoons, bowls, cups, and glasses. Interviews were usually done at night after the mothers had had their last meal or before the sample collection on the next day. The collected data which demonstrates the macronutrients intake per mother was analyzed using the Nutritionist Pro. (NP) software. All statistical analysis was performed using the SPSS Statistical Software (Version 20) for windows. The significance level was set at 95% (p<0.05) confidence interval.

## RESULTS AND DISCUSSION

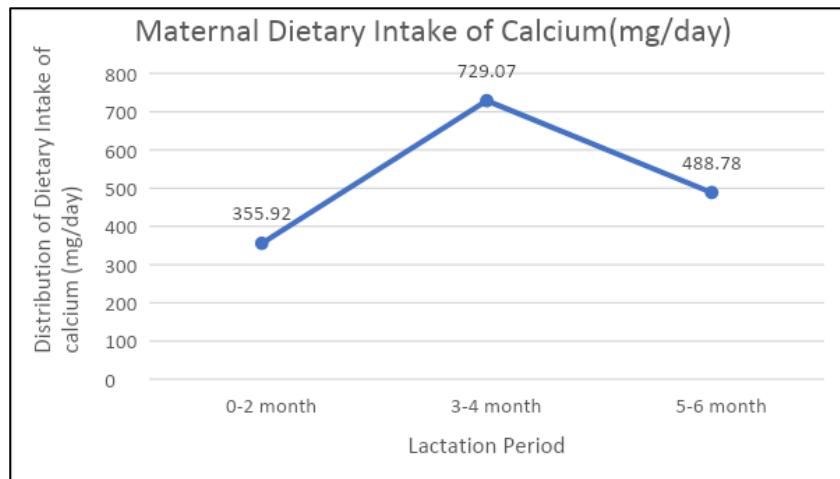
Figures 1.0 to 4.0 represented the intake of iron, calcium, fiber, and fluid within the lactation period. For iron, the highest mean of intake occurred during the fifth to sixth months of the lactation period with,  $729.07 \pm 539.65$  mg per day followed with  $18.52 \pm 10.25$  during third to fourth months and  $15.04 \pm 6.86$ , which was the lowest during the first two months. All mean values exceeded the recommended value by RNI (2017). 60%, 90% and 93.8% of respondents had iron intake above RNI value during the first two months, third to fourth months and fifth to sixth months, respectively. Overall, there was a significant difference of all means dietary intake of iron over the six months of lactation as compared to RNI value since p<0.005.



**Figure 1.0: The pattern of maternal Iron intake in daily basis over 6 months of breastfeeding period (n=36)**

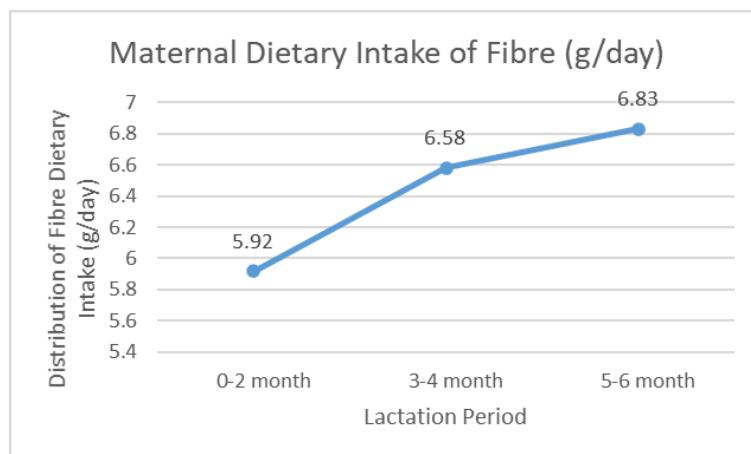
On the other hand, Figure 2.0 for calcium showed that the highest mean of intake occurred during the third to fourth months of lactation period with,  $729.07 \pm 539.65$  mg per day followed with

$488.78 \pm 263.26$  during five to six months and  $355.92 \pm 191.49$  during the first two months, which was the lowest. All mean values were below the recommended value by RNI (2017). 100% of respondents had calcium intake below the RNI value during the first two months and fifth to sixth months of the lactating period. 70% of them also had the same average intake during the third to fourth months. Overall, the means intake of calcium for the first two months and five to six months of lactation were significant since  $p<0.005$  as compared to RNI value [8]. The intake of calcium changes due to the changes pattern of dietary intake after the postpartum period.

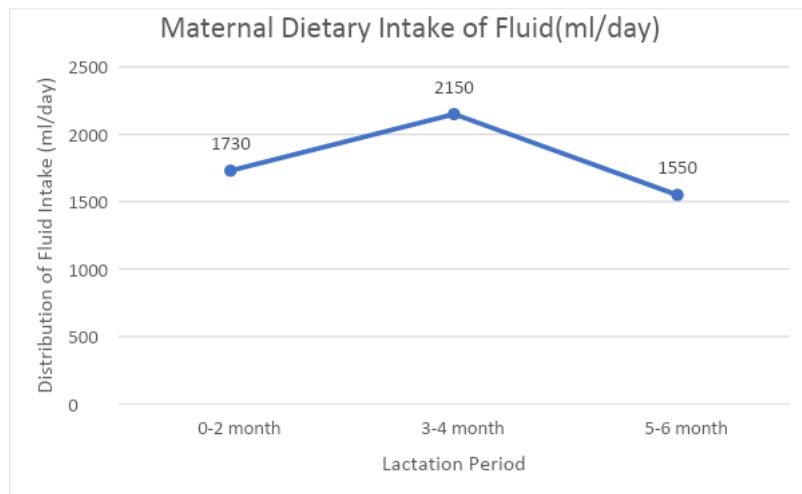


**Figure 2.0: The pattern of maternal calcium intake in daily basis over 6 months of breastfeeding period (n=36)**

As presented in Table 3.0, the highest mean intake of fiber occurred during the fifth to sixth months of lactation period with  $6.83 \pm 2.53$  g per day followed by  $6.58 \pm 4.67$  during third to fourth months. The lowest intake occurs with  $5.92 \pm 2.60$  within the first two months. All mean values were below the daily recommended value by RNI (2017) and 100% of respondents at each lactation period had fiber intake below that. Overall, all the means intake of fiber during zero to six months of lactation were significant since  $p<0.005$  as compared to RNI value. For maternal fluid dietary intake in Table 4.0, the intake gradually increases until the third to fourth months of lactation period. However, from this point, the intake decreased steeply towards the end of the lactation period. The choice of food among mothers within particular period of lactation affects the level of fiber intake especially when mothers tend to dine outside rather than home cook when they are working.



**Figure 3.0: The pattern of maternal fiber intake in daily basis over 6 months of breastfeeding period (n=36)**



**Figure 4.0: The pattern of maternal fluid intake on daily basis over 6 months of breastfeeding period (n=36)**

## CONCLUSION

Overall, the maternal lifestyle and food habits change significantly during the postpartum and nursing phases, which may have an impact on how much nutrition they consume. At this moment, their food intake is always affected by the period of postpartum. As most Malaysian mothers practice the confinement period, some of the food intake may reflect several traditional beliefs. Activities such as postpartum class as example aimed at educating nursing women about a balanced diet would raise their concern for maintaining a healthy diet both before and after childbirth. Low intake of micronutrients affects severely to successful of breastfeeding rate and infant's nutrient requirement.

## REFERENCES

- [1] Chandyo, R. K., Henjum, S., Ulak, M., Thorne-Lyman, A. L., Ulvik, R. J., Shrestha, P. S., Locks, L., Fawzi, W., & Strand, T. A. (2016). The prevalence of anemia and iron deficiency is more common in breastfed infants than their mothers in Bhaktapur, Nepal. *European journal of clinical nutrition*, 70(4), 456–462. <https://doi.org/10.1038/ejcn.2015.199>
- [2] Tee ES, Ismail MN, Mohd Nasir A and Khatijah I (1997). Nutrient Composition of Malaysian Foods. 4th Edition. Malaysian Food Composition Database Programme, Institute for Medical Research, Kuala Lumpur; 310 p.
- [3] Daud, N. M., Fadzil, N. I., Yan, L. K., Makbul, I. A. A., Yahya, N. F. S., Teh, A. H., & Rahman, H. A. (2018). Knowledge, attitude and practice regarding dietary fibre intake among Malaysian rural and urban adolescents. *Malaysian Journal of Nutrition*, 24(1), 77–88.
- [4] J Ng, T., Jia, Y., Low, Y.O., Yeoh, L., & Gan, C. (2016). Dietary fibre and total fluid intakes are inversely associated with risk of constipation in Malaysian adolescents, adults and the elderly.
- [5] Abdul Basir, Siti Munirah & Abdul Ghani, Radiah & Ibrahim, Muhammad & Khattak, Muhammad Muzaffar Ali Khan & Omar, Muhammad & Shukri, Nor. (2019a). Maternal diet and its association with human milk energy and macronutrient composition among exclusively breastfeeding Malaysian Malay mothers. *Malaysian Journal of Nutrition*. 25. 309-320. 10.31246/mjn-2019-0020.
- [6] Abdul Basir, Siti Munirah and Abdul Ghani, Radiah and Ibrahim, Muhammad and Khattak, Muhammad Muzaffar Ali Khan and Omar, Muhammad Nor and Mohd Shukri, Nor Azwani (2019b) Dietary intake of mothers who practised traditional confinement during exclusive breastfeeding period. *Malaysian Journal of Medicine and Health Sciences*, 15 (2). pp. 39-46. E-ISSN 2636-9346
- [7] Shim, J. S., Oh, K., & Kim, H. C. (2014). Dietary assessment methods in epidemiologic studies. *Epidemiology and health*, 36, e2014009. <https://doi.org/10.4178/epih/e2014009>
- [8] National Coordinating Committee on Food and Nutrition (NCCFN). Malaysian Dietary Guidelines for Children and Adolescents. Putrajaya, Malaysia: Ministry of Health Malaysia, National Coordinating Committee on Food and Nutrition; 2017.

# EXTRACTION OF PHENOLIC COMPOUNDS FROM PINEAPPLE PEEL USING NATURAL DEEP EUTECTIC SOLVENT (NADES)

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## ABSTRACT

Agricultural biomass particularly pineapple wastes are among the highest waste produced in Malaysia and the report on the valorisation of the wastes is still scarce. The processing waste from pineapple processing constitutes 50% of the total fruit which largely includes peel, core, trimmings, shreds, crown and leaves. These wastes are rich sources of biomolecules of commercial interest such as phenolic and flavonoid compounds which are advantageous to human health due to their broad-spectrum biological activities. Throughout the years, conventional methods were used to carry out the extraction of biomolecules from plants which employ a variety of organic solvents that are mostly volatile, toxic, and flammable leading to several human risk, safety issues and environmental problems. Mulling over all these, the exploration of natural deep eutectic solvent (NADES) compatibility as green solvents for phytochemical extraction is expected to address the raised issues brought about by the conventional methods. In this study, a newly approach on the green chemistry method of extraction using NADES will be performed for the first time on pineapple wastes. The potentiality of various NADES was screened in determining the best combination of hydrogen bond donor (HBD) and hydrogen bond acceptor (HBA) in extracting the phenolic compounds from pineapple peels. Results have shown that the highest extraction yield of phenolic compound was obtained from the combination of choline chloride and ascorbic acid at 1:2 molar ratios. It is hoped that through this research, the method of green chemistry can be further explored in replacement of the use of organic solvent in an attempt to extract the potential of active constituents that may add value to the biomass particularly from pineapple wastes.

**Keywords:** NADES, pineapple waste, extraction, phenolic compounds, green solvent.

## INTRODUCTION

As one of the top commodities in Malaysia, the pineapple processing industry has been recognized as a highly potential industry by the Ministry of Agriculture and Agro-based Industry of Malaysia (MOA). The industry is expected to grow at 5% per annum and the export value of the pineapple industry is predicted to increase to RM 258 mil by the year 2020 [1]. Pineapple and its by-products contain several biomolecules of commercial interest which could be utilized through extraction, as ideal methods of extraction determine proper types and quantities of bioactive compounds that can be obtained [2]. Therefore, the use of green and economic solvents is one of the most important considerations to help reduce environmental impact while improving the extraction efficiency of polyphenolic antioxidants of commercial value.

In recent decades, natural deep eutectic solvents (NADESs) have gradually attracted the interest and attention of both scientific and industry areas. NADES is composed of naturally occurring hydrogen bond donors (e.g sugar, organic acid) and hydrogen bond acceptors (e.g. choline salt) forming a lower melting point mixture than its individual component. NADESs possess many advantages, such as low cost, easy preparation, adjustable viscosity, biodegradability, pharmaceutically acceptable toxicity and sustainability [3]. Given their excellent characteristics, NADESs have been used as efficient alternatives to organic solvents to extract phenolic compounds from different natural sources. Thus, the aim of this study is to determine the best combination ratio of hydrogen bond donor and acceptor that form the best NADES for maximum extraction of phenolic compounds from pineapple peel.

## MATERIAL AND METHOD

### *Preparation of pineapple peel*

Pineapples were purchased from a local source in Semenyih, Selangor, Malaysia. The fruit was processed by detaching the crown and stem followed by skin peeling. After cleaning, the samples were dried at 60 °C for 48 hours or until constant weight was obtained to ensure the removal of moisture. The dried samples were ground into a mixture of particle sizes (2 mm - 5 mm) and stored at a temperature below -10°C in a sealed plastic bag for further use.

### *Screening of different NADES combination*

Different combinations of hydrogen bond donors (HBD) and hydrogen bond acceptors (HBA) were used to determine the best combinations for phenolic compound extraction. The list of HBD and HBA and molar ratios used is presented in Table 1. The heating method was used to develop the NADES. The mixtures were placed on a hotplate with a magnetic stirrer at a temperature of 65 °C for 30 minutes or longer until a clear solution was attained.

### *Screening of different NADES combination*

The NADES was then used to extract phenolic compounds from 0.05 g of sample (pineapple peel) at room temperature by stirring for 30 minutes at 100 rpm followed by filtering. The extracted solution was measured for its total phenolic content using the Folin-Ciocalteu method. The method was adapted from [4] with some modifications.

## RESULTS AND DISCUSSION

The selection of NADES was of great importance, considering their properties such as viscosity, polarity, physicochemical interactions, and solubility [5]. The best NADES combination for pineapple peel was choline chloride with ascorbic acid at 2:1 molar ratio with the highest total amount of phenolic (13609.399 mg GAE/L) extracted as depicted in Table 1. It was closely followed by choline chloride with ascorbic acid at 1:1 molar ratio extracting 11960.378 mg GAE/L of total phenolic content. Generally, the use of NADES helps to produce hydrogen bond for optimum phenolic extraction. However, the use of ascorbic acid specifically affects the extraction positively as can be observed from the two highest yields extracted so far. These results were in agreement with research conducted by [4], which used ascorbic acid as component of NADES. On the other hand, the lowest extraction yield was observed from NADES combination of sucrose and ascorbic acids at 1:1 molar ratio with 2508.829 mg GAE/L. This is likely due to the relatively high viscosity of NADES at room temperature which may decrease the mass transfer rates from the matrix to the solvent. The analytes' diffusion coefficients may be reduced, resulting in slow mass transfer and prolonged extraction periods [6]. Thus, the solubility of target compounds in NADES and the efficacy of extraction may both be impacted by this situation [7].

**Table 1: Combination of HBA and HBD with different molar ratio**

Hydrogen bond acceptor (HBA)	Hydrogen bond donor (HBD)	Molar ratio	Total phenolic content (mg GAE/L)
ChCl	Sucrose	2:1	564.774
ChCl	Lactic acid	1:2	7087.08
ChCl	Lactic acid	2:1	612.19
ChCl	Ascorbic acid	1:1	9963.36
ChCl	Ascorbic acid	2:1	10174.38
Sucrose	Ascorbic acid	1:1	232.86

ChCl: Choline chloride

## CONCLUSION

This study has been successful in screening the best NADES combinations with the highest total phenolic compounds extracted from pineapple peel. Several hydrogen bond donors and hydrogen bond acceptors were assessed and combination of choline chloride with ascorbic acid at 1:2 molar ratio showed the highest extraction capacity. The use of NADES improves the phenolic extraction by the formation of hydrogen bonding between NADES components with the phenolic compounds. In extension to this study, further investigation on the optimization of the extraction using the same NADES will be carried out in the future.

## REFERENCES

- [1]. Tang, P. L., & Hassan, O. (2020). Bioconversion of ferulic acid attained from pineapple peels and pineapple crown leaves into vanillic acid and vanillin by *Aspergillus niger* I-1472. *BMC Chemistry*, 14(1), 1–11. <https://doi.org/10.1186/s13065-020-0663-y>
- [2]. Sagar, N. A., Pareek, S., Sharma, S., Yahia, E. M., & Lobo, M. G. (2018). Fruit and Vegetable Waste: Bioactive Compounds, Their Extraction, and Possible Utilization. *Comprehensive Reviews in Food Science and Food Safety*, 17(3), 512–531. <https://doi.org/10.1111/1541-4337.12330>
- [3]. Saini, A., Kumar, A., Panesar, P. S., Thakur, A. (2022). Potential of deep eutectic solvents in the extraction of value -added compounds from agro-industrial by-products. *Applied Food Research*, 2(2), 100211
- [4]. Aziz, A. H. A., Engliman, N. S., Mansor, M. F., & Nasaruddin, R. R. (2021). Extraction of Phenolic Compound using Natural Deep Eutectic Solvent from Biomass Waste. *IOP Conference Series: Materials Science and Engineering*, 1192(1), 012001. <https://doi.org/10.1088/1757-899x/1192/1/012001>
- [5]. Plaza, M., Domínguez-Rodríguez, G., Sahelices, C., Marina, M.L. (2021). A Sustainable Approach for Extracting Non-Extractable Phenolic Compounds from Mangosteen Peel Using Ultrasound-Assisted Extraction and Natural Deep Eutectic Solvents. *Applied Sciences*. 11, 5625. <https://doi.org/10.3390/app11125625>
- [6]. Lusiana, L., Ramadon, D., Jantan, I., & Mun'im, A. (2021). Natural Deep Eutectic Solvents (NADES): Phytochemical extraction performance enhancer for pharmaceutical and nutraceutical product development. *Plants*, 10(10), 2091. <https://doi.org/10.3390/plants10102091>
- [7]. Shishov, A., Pochivalov, A., Nugbienyo, L., Andrush, V., & Bulatov, A. (2020). Deep eutectic solvents are not only effective extractants. *Trends in Analytical Chemistry*, 129, 115956. <https://doi.org/10.1016/j.trac.2020.115956>



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