

UNIVERSITI TEKNOLOGI MARA

**A CROSS-SECTIONAL
INVESTIGATION OF BINOCULAR
FUNCTION, SCREEN TIME AND
VISUAL FATIGUE IN CHILDREN
WITH DYSLEXIA**

SUHAIDA BINTI SHAHUDIN

Thesis submitted in fulfilment
of the requirements for the degree of
**Master of Health Sciences
(Optometry)**

Faculty of Health Sciences

September 2025

ABSTRACT

Background: Dyslexia is a specific learning disorder characterized by difficulties in reading, spelling, and writing. Previous studies suggested that individuals with dyslexia may experience binocular function abnormalities and visual fatigue. However, most studies investigating these issues have been conducted elsewhere outside Malaysia, leaving a population gap with local data. Therefore, this study aimed to address this gap by examining the visual and binocular vision status of children with dyslexia. Visual fatigue symptoms and screen time exposure were also investigated and compared with typically developing peers as these two are related to binocular function. **Method:** This cross-sectional study involved 137 students with dyslexia aged 13 to 19 ($M=15.24$; $SD=1.75$) years from 15 secondary schools with Program Pendidikan Khas Integrasi (PPKI) across three districts in Selangor. Refractive and binocular assessments were conducted at the respective schools, while screen time exposure and visual fatigue symptoms were evaluated using a validated questionnaire. As a comparison, screen time exposure and visual fatigue symptoms were also gathered from 83 typically developing students with mean age of 14.59 ± 1.42 years. **Results:** 88% of the dyslexic children had a good visual acuity (VA) of 6/9 or better at distance while 95% of them had a good VA of N6 or better at near. Refractive errors were found in 49% of the dyslexic group with myopia (44%) and astigmatism (59%) being the most common type of refractive error, followed by hyperopia (5%). The most commonly impaired accommodation parameters were lag of accommodation (67%), binocular and monocular facility of accommodation (50-59%), and negative relative of accommodation (55%). Despite the majority of them being orthophoric, exophoria was the most common type of ocular deviation at near (29%) and distance (19%). Based on the binocular function findings, the most common type of binocular vision anomalies were convergence insufficiency, accommodation insufficiency and accommodation infacility. Screen time exposure and visual fatigue score were significantly higher in typically developing students compared with the dyslexic group. Pearson's correlation revealed a significant correlation between screen time exposure and visual fatigue symptoms during weekdays ($p=0.02$, $r=0.25$) and weekends ($p=0.002$, $r=0.33$) only in typically developing but not dyslexic group. Multilinear regression showed near point of convergence was a significant predictor for visual fatigue symptoms score in dyslexic children. **Conclusion:** Altogether, results suggest that dyslexic children have considerably good level of vision, but reduced binocular function particularly the ability to accommodate and converge at near possibly due to the immature motor control and poor visuo-attentional span. This study highlights the importance of enforcing regular eye examination in children with dyslexia.

ACKNOWLEDGEMENT

Alhamdulillah, first and foremost, I would like to express my gratitude to Allah for granting me the the opportunity to pursue my studies at the master's level.

Next, I would like to extend my deepest appreciation to my supervisor, Dr. Sabrina bt Subri, for all the assistance, guidance, advice, and words of encouragement she has provided throughout the process of completing this thesis. I truly appreciate and am grateful for her help. I would also like to thank my co-supervisor, Prof. Madya Dr. Akehsan Hj Dahlan and Dr Sumithira Narayanasamy for invaluable ideas and guidance throughout this journey.

Then, I would also like to express my heartfelt thanks to my husband, Muhammad Asyraf bin Azman, for always being my pillar of strength throughout this journey. Thank you for your constant encouragement from the very first day of my scholarship interview to the busiest days of writing this thesis. Thank you for lending an ear and a helping hand in times of need. My sincere gratitude also goes to my children, Ammara, Eusoff, Eidrees, and Kamilia, for always cooperating and understanding my situation throughout these two years. I am also deeply grateful to my mother, , mother-in-law, and other family members for their support and assistance in moments of great need.

I would like to extend my appreciation to the Bahagian Pengurusan Latihan, Kementerian Kesihatan Malaysia, for sponsoring my studies under Cuti Belajar Bergaji Penuh (CBBP).

My sincere thanks also go to UiTM Vision Care and Zukrina for their support in lending equipment and workforce during the data collection process.

Not forgotten, a special thanks to the Optometrists team at Hospital Kuala Lumpur, for covering my work during my absence. I am also deeply grateful to my best friends and postgraduate friends for endless support, words of encouragement, and assistance throughout this journey.

Lastly, I would like to thank the teachers from schools across Kuala Selangor, Petaling Utama, and Klang districts for their assistance during the data collection process, as well as the students who were directly and indirectly involved in this research.

Thank you.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	i
AUTHOR'S DECLARATION	ii
ABSTRACT	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENTS	v
LIST OF TABLES	ix
LIST OF FIGURES	x
CHAPTER 1 INTRODUCTION	1
1.1 Research Background	1
1.2 Problem Statement	4
1.3 Research Questions	5
1.4 Research Objectives	5
1.5 Hypotheses	5
1.6 Significance of the Study	6
1.7 Scope of Study	7
1.8 Thesis Outline	7
1.9 Definition of Term	8
1.10 Conceptual Framework	9
1.11 Chapter Summary	10
CHAPTER 2 LITERATURE REVIEW	11
2.1 Introduction	11
2.2 General Overview of Dyslexia	11
2.2.1 Definition and Prevalence	11
2.2.2 The Theories behind Dyslexia	13
2.3 Visual Function	16
2.3.1 Visual Acuity	17
2.3.2 Visual Status in Dyslexia	18
2.4 Normal Binocular Function	18

CHAPTER 1

INTRODUCTION

1.1 Research Background

Dyslexia is a specific learning disability in which the children will have difficulties in reading and writing ability. It is characterized by challenges in accurate and fluent word recognition, poor spelling, and impaired decoding skills (Kuerten et al. 2019). This condition is one of the most common learning disabilities in the world, with the prevalence rates ranging between 5% to 17% across different population. In Malaysia, approximately 5% to 10% of primary school students were identified with dyslexia (Ramli et al. 2020).

Several theories have been suggested to explain the aetiology of this condition, with phonological deficits theory being one of the most widely accepted explanation for dyslexia (Kuerten et al. 2019; Norton et al. 2015). This theory suggests that individuals with dyslexia struggle with phonological processing, making it difficult for them to distinguish and manipulate phonemes, which in turn affects their ability to translate written words into spoken language (Stein, 2023). Therefore, despite having average or above average intelligence quotient (IQ) (Evans et al. 1994), children with dyslexia still face challenges in reading comprehension, word recognition, and vocabulary expansion which ultimately may impact their academic performance and cognitive development. This learning disability has been suggested to have neurodevelopmental origin, as brain imaging studies revealed some changes in the brain structure and functions (Healy et al. 2011). The differences include a smaller and underactive left hemisphere, specifically Broca's area, the occipitotemporal and the parietotemporal regions during reading activities (Healy et al. 2011; Norton et al. 2015) which contributes to this language processing disorder.

The senses, particularly vision, play a crucial role in receiving and processing information, and is fundamental to read and learn (Wajuihian & Naidoo, 2011). Reading is a complex task that requires the coordination of both eyes, which is also known as binocular vision. Given the significance of vision in literacy, many researchers have explored visual processing in dyslexia and found that binocular vision dysfunction is more common among individuals with dyslexia. Several studies have reported vergence