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**THE INFLUENCE OF OBESITY PREDICTORS TOWARD
PERCENTAGE BODY FAT AMONG ADOLESCENCES IN KELANG,
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Zarizi Ab Rahman

Ahmad Hashim

Rozita Ab Latif

Mohad Anizu Mohd Noor

*Fakulti Pendidikan, Universiti Teknologi Mara,
Cawangan Selangor, Kampus Puncak Alam.*

*Fakulti Sains Sukan dan Kejurulatihan, Universiti Pendidikan Sultan Idris,
Tg Malim, Perak.*

*Fakulti Sains Sukan dan Rekreasi
Universiti Teknologi MARA, Shah Alam, Selangor*

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Correspondents Author,

**Zarizi Abdul Rahman
013 - 2291393
Faculty of Education
Universiti Teknologi MARA Cawangan Selangor,
Campus Puncak Alam**

The Influence of Obesity Predictors toward Percentage Body Fat among Adolescents in Kelang, Selangor.

Zarizi Ab Rahman ¹,

Ahmad Hashim ²,

Rozita Ab Latif³,

Mohad Anizu Mohd Noor ³

*¹Fakulti Pendidikan, Universiti Teknologi Mara,
Cawangan Selangor, Kampus Puncak Alam*

*²Fakulti Sains Sukan dan Kejurulatihan, Universiti Pendidikan Sultan Idris,
Tg Malim, Perak.*

*³Fakulti Sains Sukan dan Rekreasi
Universiti Teknologi MARA, Shah Alam, Selangor*

Abstract

Obesity among adolescents had becoming a global epidemic in recent years. It was a challenging health problem with the increasing prevalence of obesity for the group. Prevalence of obesity was not considered a health threat to humans but also increased the economic burden on families and countries. Obesity was primarily caused by an increase in body fat percentage due to the energy imbalance between calorie intake and consumption. The effects of this energy imbalance were causing the accumulation and excess of body fat. There were various factors that predict obesity such as self-efficacy, motor skills, school environment, media, community, family, nutrition, sedentary behaviour, health knowledge, physical fitness and socioeconomic status. Complex risk factors make some obesity interventions difficult to achieve successfully and most of these programs failed. The theory or model of health promotion and disease prevention programs considered the importance of the various factors, health issues that need to be addressed, and the populations involved before any preventive measures were planned and implemented. Therefore, this study aimed to determine the effect of obesity predictor factors on boys and girls aged 13 to 14 in Kelang, Selangor. This quantitative study involved 150 sample students from Seri Andalas National Secondary School, Klang, Selangor (L = 32, P = 48) and the Rantau Panjang National Secondary School, Klang, Selangor (L = 30, P = 40) through simple random sampling techniques. Predictors of obesity factors and body mass index were used to collect data. Descriptive and inferential statistics were used for data analysis. Multivariate regression analysis found that all predictor factors are significant for body fat percentage, with eating behaviour was the primary predictor. As a result, aspects of healthy eating need to specifically focus on adolescents and children in an effort to address the prevalence of obesity.

Keywords: Obesity, Predictors, Body Mass Index, Adolescence

Introduction

Adolescence is a critical period as it is a transition period from childhood to adulthood. This period involves many changes and developments that include biological, physical, psychological and behavioural functions. Examples of changes such as eating behaviour, physical activity, psychological health, physical fitness, and body composition (Alberga, Sigal, Goldfield, Prud'Homme, & Kenny, 2012). Thus, this period is a period for shaping adolescent behaviours in many aspects.

Healthy behaviours adopted in early adolescence would have an impact on long-term health and well-being. Therefore, the growth, development and maturity that occurs during adolescence should be on a normal stage and no change will affect the development of adolescents especially in relation to health behaviours. Obesity among teenagers have become a global epidemic in recent years. It is a very challenging health problem with the increasing prevalence of obesity for the group. Over the past few decades, obesity among school-aged children and adolescents has doubled or tripled in some developed and developing countries (Wang & Lobstein, 2006). Overweight children and adolescence are more prone to becoming overweight adult (Gordon-Larsen, The, & Adair, 2010). The National Health and Morbidity Survey report by the Ministry of Health (2017) found that 44% of Malaysian adolescents suffer from overweight and 14% obesity.

Prevalence of obesity is not only considered a threat to human health (Vinturache, McDonald, Slater, & Tough, 2015) and public health but it also increases the economic burden on families and countries as a result of treatment and medical costs. Obesity is primarily due to an increase in the percentage of body fat due to the energy imbalance between calorie intake and consumption. The effects of this energy imbalance cause the accumulation and excess of body fat. Previous studies conducted abroad have shown that obesity risk factors are complex because they involve a combination of different aspects besides producing different findings.

Among the risk factors identified are individual behaviour, environment, race, age (Lee & Yong, 2018; Wang, 2011), gender (Crispim, Peixoto, & Jardim, 2014; Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006), socioeconomic status (Mohammed & Vuvor, 2012; Pirincci, Durmus, Gundogdu, & Aik, 2010). These factors have an impact on obesity among adolescents that vary by location, gender, age and so on. While, the Ahmad, Zulaily, Shahril, Abdullah, and Ahmed (2018), reported gender, household size, occupational level, household income and household income level are the predictors of obesity among adolescents.

The complex risk factors that drive some obesity interventions are not well-managed and many of these programs to be unsuccessful. The theory or model of health promotion and disease prevention programs explains the importance of considering various factors, health issues that need to be addressed, and the population involved before any preventive measures are planned and implemented. WHO (2019), proposed that risk factors contributing to an increase in overweight and obesity need to be identified in order for better control and preventing the prevalence of obese. Additionally, identifying risk factors for adolescents will be able to provide information to curb the increasing prevalence.

A clear understanding of the relevant factors would help to develop effective intervention policies and programs. Although many studies have been conducted on the factors of obesity, the impact and influence of obesity predictors in adolescents especially in recent years was still unclear in rural areas. Therefore, this study aimed to determine the impact and influence of obesity predictor factors on boys and girls between the ages of 13 and 14 in Kelang, Selangor.

Literature Review

Rapid socioeconomic transformation in developed and developing countries have affected lifestyle changes (Caballero, 2001; Drewnowski & Popkin, 1997). Recent studies (Chao, Shih, Wang, Wu, Lu, Chang, & Yang 2014; Peltzer, Pengpid, Samuels, Ozcan, Mantilla, Rahamefy, & Gasparishvili, 2014) revealed that socioeconomic status is considered one of the major contributing factors to obesity and overweight. While Brown, Broom, Nicholson, & Bittman, (2010) explaining that family and adolescents' social and personal well-being affects the body mass index.

Previous studies (Gittelsohn, Trude, Poirier, Ross, Ruggiero, Schwendler, & Anderson, 2017 ; Schwartz, King, Perreira, Blundell, & Thivel, 2017; Ek, Sorjonen, Nyman, Marcus, & Nowicka, 2015; Okubo, Miyake, Sasaki, Tanaka, Murakami, Hirota, & Osaka, 2014) found lifestyle, socioeconomic status, physical activity, and nutrition behaviour are major risk factors for obesity in children and adolescents. Lifestyle, health-related knowledge, social policy, neighbourhood characteristics are some of the key factors contributing to the worldwide epidemic of obesity (Yen, Chen & Eastwood 2009). This further suggested that obesity factors included behavioural, environmental, and individual factors.

Poor diet among the major contributors to excess body fat (Chee, Zawiah, Ismail, & Ng, 1996). Excessive dietary intake coupled with deficiencies in physical activity results in energy imbalances that may lead to weight gain. Changes in the dietary structure known as western have hit the world (Popkin, 2001). The composition of the food structure in western diets involves high fat and processed carbohydrate. Knol, Haughton, dan Fitzhugh (2005), revealed positive relationship between sugar sweetened, high fat junk food, snacks, and low nutritional quality in children and adolescents with obesity. The risk of obesity is becoming more serious with the lack of physical activity. The Australian Physical Activity Guide recommends that teens between the ages of 13 and 17 years of age have to undergo at least 60 minutes of daily physical activity with moderate intensity (Department of Health & Ageing, 2004). Regular physical activity was an important component of energy balance and it was the only method that could burn calories to avoid the risk of weight loss and obesity. Low levels of engagement and failure to meet these standards increased the risk for weight gain and other chronic diseases.

Sedentary behaviour was often referred to as any activity or behaviour that involves low energy expenditure (Hamilton, Hamilton & Zderick, 2007) such as sitting for a long time, reclining or lying posture. Watching television and using the computer for a long time was part of sedentary behaviour (Ainsworth, Haskel, Whitt, Irwin, Swartz, Strath, O'brien, Basset, Scmitz, Patricia, Jacobs, & Leon, 2000). Findings from previous studies shown that obesity was associated with screen time (Hardy, Wilson, Thrift, Okely & Baur, 2010; Mark and Janssen 2008) by watching television and using computers (Mark & Janssen; 2008). In the United States, watching television was a major activity of sedentary behaviour, while children and adolescents ages 8 to 18 were more interested in using a computer that had internet access than watching television (Rideout, Foehr, & Roberts 2009). Such situations gave the impression that using a computer with internet access was a priority for today's teenagers, although they may have to sacrifice their leisure time for recreational activities. It can thus be suggested that computer and internet use were activities that replace other activities in their life today.

Physical environment included building environment, transport infrastructure, pedestrian walkways, neighbourhoods, nutrition resources, and recreational facilities where people live, work, study, eat, and play (Sallis & Glanz, 2006). Behaviours and decisions by individual may have links to available environmental resources. Furthermore, unsafe neighbourhoods can cause a decline in recreational and physical activity (Veitch, Salmon & Ball, 2010; Maddison, Hoorn, Jiang, Mhurchu, Exeter, Dorey, Bullen, Utter, Schaaf, & Turley, 2009) because society is threatened by unsafe situations.

Family institutions play an important role in shaping children's behaviour in all aspects of life including healthy lifestyle practices. Children raised in families with unhealthy eating habits and sedentary lifestyles may be at risk for obesity in adolescence (Arizona State University, 2005). While the primary role of the school was to educate students in academics, values, and social responsibility in an effort to build student potential (Story, Nannery dan Schwartz 2009). Physical and Health Education (PHE) subject was a core subject taught in primary and secondary schools throughout Malaysia that focuses on health aspects. Physical activity conducted in the subject of PHE can contribute to healthy heart, muscle tissue, reduce the risk of chronic diseases, and improve self-esteem (Stellino dan Sinclair, 2014). Wang (2001), reported that family income and residential location were associated with increased risk for obesity for children and adolescents. Mohd Ismail (2002) and Sakinah, Seong-Ting, Rosniza, and Jayah (2012), reported that adolescents living in cities tend to be obese. This relationship may be seen from the point of view of dietary tendencies that tend to be high in fat and high calorie diet in lieu of traditional diet. In addition, this population also tends to adopt a sedentary lifestyle (Tesfalem, Singh, & Debebe 2013) such as watching television excessively (Ferreira, Horst, Wendel-Vos, Kremers, van Lenthe & Brug, 2007) on the basis of the ability to have paid television service, computers with high speed internet access, electronic gadgets, motor vehicle use.

Chivers (2010) identified individual and cognitive factors including individual, motor competence, health-related knowledge, and physical fitness. Motor skills competence was the mastery of physical skills and movement patterns that affect pleasure in participating in physical activity (Castelli & Valley 2007). Adolescent participation in sports and games activities because of motor competent and level of physical fitness. Okely, Booth and Chey (2004), found that locomotor skills were positively associated with the body mass index in adolescents. Therefore, children or adolescents who incompetent in motor skills and low level of fitness may find it difficult to engage in physical activity or games that will lead to an increase in their weight status.

Physical fitness was closely related to involvement in physical activity (McGuire & Ross 2011). Regularly engaging in physical activity could increase level of physical fitness. High levels of physical fitness were the important factors in maintaining weight and reducing the risk of cardiovascular disease (Lee, Blair & Jackson 1999). Chen, Fox, Haase and Wang (2006), observed that the physical fitness level of obese children was lower than that of children with normal weight status. This shows that physical fitness was an important element of maintaining ideal weight. In addition, health-related knowledge is an essential element of understanding and reducing the level of the body mass index (Wilson, 2009). Adolescents with nutrition-related knowledge had shown a positive attitude towards behaviour.

Research Methodology

This study was conducted using survey design. Survey studies could provide accurate measures for the large populations (Azizi, Shahrin, Jamaludin, Yusof & Abdul Rahim, 2007). It also can predict the phenomenon because a comprehensive study sample be used to understand the cause of a phenomenon (Sidek, 2002). A simple random sampling method was used to determine the sample size and location for this study. This research consider recommendation by Cohen's (1988) in terms of sample size. According to Cohen (1988) significance level $\alpha = .05$, effect size .50 (medium), and power level at .80 (high) often used in social health knowledge studies. This sample size was subject to multiple regression assumptions (Tabachnick & Fidell, 1996). Therefore, 150 respondents from Seri Andalas National Secondary School, Klang, Selangor (boys = 32, girls = 48) and Rantau Panjang National Secondary School, Klang, Selangor (boys = 30, girls = 40) were selected as a sample size and location for this study.

Field method body composition measurement was used to determine body fat percentage, while the obesity factor predictor instrument (Zarizi, 2017) to measure the influence of predictors on

obesity factors on body fat percentage. Body Mass Index was used to determine the percentage of body fat among obese adolescents. Zarizi (2017) revealed BMI was the most accurate and reliable field method instrument in that populations. Percentage of body fat be obtained using the following formula: $BF\% = 1.51 \times BMI - 0.70 \times \text{age} - 3.6 \times \text{gender} + 1.4$ (male = 1, female = 0) (Deurenberg, Weststrate, & Seidell, 1991). The obesity factor predictors questionnaire (Zarizi, 2017) contains 58 items measuring 11 constructs including eating behaviour, sedentary behavior, family environment, school, community, media, socioeconomic, physical fitness, motor competence, health knowledge, and efficacy self. This instrument uses a 5-point Likert Scale (1 strongly disagree, 2- disagree, 3- uncertain, 4- agree, 5- strongly agree).

Results

The data were analysed using SPSS Version 22 to obtain descriptive statistics (mean and standard deviation) and inferential statistics (multiple regression). Multiple regression analyses were used to determine the influence of predictors obesity factors on students aged 13 to 14 in Klang district. A total of 11 predictor variables (predictors) or independent variables were used in this study. The results in table 1 showed that students between the ages of 13 and 14 obtained average body fat percentage (M = 22.00kg /m², SD = 5.59), self-efficacy (M = 28.56, SD = 8.78), motor skills (M = 17.65 , SD = 5.48), school environment (M = 14.67, SD = 5.07), media environment (M = 10.92, SD = 3.97), community environment (M = 17.82, SD = 6.54), family environment (M = 7.17, SD = 1.97), eating behaviour (M = 14.80, SD = 4.30), sedentary behaviour (M = 9.30, SD = 2.67), health knowledge (M = 13.28, SD = 4.68), physical fitness (M = 11.60, SD = 3.45), and socioeconomic (M = 14.89, SD = 4.82)

Table 1: Body Fat Percentage and Obesity Predictors Factor Among Adolescence

Variables	Mean	SD	N
Body fat Percentage	22.00kg/m ²	5.59	150
Self-Efficacy	28.56	8.78	150
Motor Competence	17.65	5.48	150
School Environment	14.67	5.07	150
Media Environment	10.92	3.97	150
Community Environment	17.82	6.54	150
Family Environment	7.17	1.97	150
Eating Behaviour	14.80	4.30	150
Sedentary Behaviour	9.30	2.67	150
Health Knowledge	13.28	4.68	150
Physical Fitness	11.60	3.45	150
Socio Economic	14.89	4.82	150

The results of the multiple regression analysis as shown in Table 2 indicated predictors of obesity factor variables had a significant influence on body fat percentage, (R-Squared = 0.85, F (11, 138) = 72.97, p = 0.00). Correlation analysis of multiple regression coefficients was R = .92. As much as 85 percent of the variance in obesity predictor factors can be explained by the linear combination of scores in body fat percentages.

Table 2: Model Summary

Model	R	R	Adjusted R	Std Error of Estimate
1	0.92 ^a	0.85	0.84	2.23

a. Predictors: (Constant), Socio-economic, family environment, media, sedentary behaviour, knowledge, school environment, physical fitness, community environment, motor competent, self-efficacy, eating behaviour.

ANOVA (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3986.23	11	362.38	72.97	.000 ^a
	Residual	585.33	138	4.97		
	Total	4671.56	149			

a. Predictors: (Constant), Socio-economic, family environment, media, sedentary behaviour, health knowledge, school environment, physical fitness, community environment, motor competent, self-efficacy, eating behaviour.

b. Dependent Variable: Body Mass Index

coefficients (a)

Model	Unstandardized Coefficients			t	Sig.	Correlations Partial
	B	Std. Error				
1	(Constant)	1.486	.854	1.740	.084	
	Self-Efficacy	.125	.042	2.983	.003	.246
	Motor competence	.179	.062	2.903	.004	.240
	School environment	.024	.070	.339	.035	.029
	Media environment	.074	.064	1.155	.050	.098
	Community environment	.131	.051	2.585	.011	.215
	Family environment	.248	.123	2.019	.044	.169
	Eating behaviour	.383	.089	4.330	.000	.346
	Sedentary lifestyle	.187	.105	1.785	.027	.150
	Health Knowledge	-.057	.057	-.996	.021	-.084
	Physical fitness	.152	.091	1.676	.036	.141
	Socio economic	.006	.074	.080	.016	.007

a. Dependent Variable: Body Mass Index

b. Regression equation:-

$$+0.125self\ efficacy + 0.179motor\ competence + 0.24school\ environment + 0.74media\ environment + 0.131\ community\ environment + 0.248\ family\ environment + 0.383\ eating\ behaviour + 0.187\ sedentary\ life\ style - .057knowledge + 0.152physical\ fitness + 0.006\ socio-\ economic + 1.486$$

The analysis results in Table 3 explained that all the predictors variables had an influence on body fat percentage. Findings indicated that predictors of self-efficacy, motor skills, school environment, media environment, community environment, family environment, eating habits, sedentary behaviours, health knowledge, physical fitness, and socioeconomic status showed high and significant influence on body fat percentage. Eating behaviour predictors accounted for most of the variance in body fat percentages by 71 percent (.845 x .845 = .714). Other contributors accounted for 14 percent (85% - 71%) as additional contributors.

Table 3: Correlation between Predictors Factor and Body Fat Percentage.

Predictors	Correlation predictors and body fat percentage	sig.
Self-efficacy	.803	.003
Motor competence	.777	.004
School environment	.745	.035
Media Environment	.642	.050
Community environment	.756	.011
Family environment	.444	.044
Eating behaviour	.845	.000
Sedentary behaviour	.687	.027
Health Knowledge	.622	.021
Physical fitness	.752	.036
Socio economic	.754	.016

Discussion

The results showed that all of the predictors in this study consisted of self-efficacy, physical fitness, health knowledge, motor skills, school environment, family environment, community environment, media environment, socioeconomic status, sedentary behaviour, and eating behaviours showed a significant effect and influenced percentage of body fat among students aged 13 to 14 in Klang district, Selangor. However, finding indicated eating behaviour was the strongest predictor. This finding was in line with previous findings (Obregon, Pettinelli, & Santos, 2015; Patrick, & Nicklas, 2005). Unhealthy eating habits such as excessive calorie intake among the contributors to the prevalence of obesity among adolescents. Fast food was very popular among children and adolescents. Some of the popular fast food items include fries, burgers, fried chicken, pizza, donuts, and more. With the emergence of many fast food restaurants, society could have easier access to the food regardless of time. Most of the food and beverages available in these restaurants were from high-calorie and high-fat foods such as snacks and sweetened drinks (Obregon, Pettinelli, & Santos, 2015; Al-Rethaiaa, Fahmy, & Al-Shwaiyat, 2010). While Guthrie, Lin, and Frazao (2002) found that foods served in restaurants typically contain high amounts of calories, high fat and low in fibre, calcium, and iron content.

According to Anderson, Rafferty, Lyon-Callo, Fussman, Imes (2011), Patrick and Nicklas, (2005), most adolescents today prefer to eat fast-food restaurants and tend to eat in large quantities. Meals in fast food restaurants were recognized as high-calorie foods and drinks. Findings from Collison, Zaidi, Subhani, Al-Rubeaan, Shoukri, and Al-Mohanna (2010) confirmed that consuming soft drinks and fast food was an unhealthy dietary behaviour. Although Rosenheck (2008) stated that it was difficult to pinpoint the causal relationship between fast food intake and obesity, but fast food had been categorized as an unhealthy diet associated with obesity (Anderson, Rafferty, Lyon-Callo, Fussman, & Imes, 2011; Bowman, & Vinyard, 2004; Paeratakul, Ferdinand, Champagne, Ryan, & Bray, 2003). Whereas Fraser, Clarke, Cade, and Edwards, (2012) found that eating fast food among adolescents was significantly associated with increased Body Mass Index and body fat percentage. There was strong evidence that consuming fast food and sweet drinks in large quantities was positively associated with obesity (Collison, Zaidi, Subhani, Al-Rubeaan, Shoukri, & Al-Mohanna, 2010; Niemeier, Raynor, Lloyd-Richardson, Rogers, & Wing, 2006). Daily diets high in saturated fat and sugar content had been shown to increase weight, insulin resistance, hyperlipidemia and metabolic syndrome (Basciano, Federico, Adeli, 2005; Kromhout, 2001). According to Astrup and Finer (2000) the metabolic syndrome, also referred to as "diabesity", is an increase in diabetes in combination with obesity as a result of changes in behaviour, diet, and lifestyle. Fast food was usually fried and high content of saturated fat. This directly increased one's weight if taken too much.

Excessive calories in high calorie foods and sugary drinks eventually be stored as fat which lead to weight gained.

Conclusion

This study's results provided the first impression that self-efficacy, physical fitness, motor skills, health knowledge, school environment, media, community, family, socioeconomic, nutritional, and self-efficacy were among the contributors to the prevalence of obesity among adolescents. Moreover, the findings showed that large contributors such as nutrition behaviours can provide information that prevention methods through nutrition education should be emphasized especially in the early stages of schooling. Students needed to be exposed to healthy foods such as dietary guidelines, food pyramids, and calorie counting. Teaching and learning activities Physical and Health Education should be implemented with more interesting techniques and methods to make an impact to the students, especially in the areas of healthy nutrition knowledge. In addition, parents and the community need to be more sensitive to issues related to nutrition so that adolescents and children would not be exposed to unhealthy foods.

References

- Ahmad, A., Shahril, M. R., Zulaily, & Ahmed, A. (2016, August). Data Mining Techniques for Classification of Childhood Obesity Among Year 6 School Children. In *International Conference on Soft Computing and Data Mining*. Springer, Cham.
- Ainsworth, B.E., Haskel, W.L., Whitt, M.C., Irwin, M.L., Swartz, A.M., Strath, S.J., O'brien, W.L., Basset, D.R., Scmitz, K.H., Patricia, O., Emplaincourt, Jacobs, D.R., & Leon A,S. (2000). Compendium of physical activities: an update of activity codes and MET intensities. *Medicine and science in sports and exercise*, 32(9; SUPP/1), S498-S504.
- Alberga, A. S., Sigal, R. J., Goldfield, G., Prud'Homme, D., & Kenny, G. P. (2012). Overweight and obese teenagers: why is adolescence a critical period?. *Pediatric obesity*, 7(4), 261-273.
- Al-Rethaiaa, A. S., Fahmy, A. E. A., & Al-Shwaiyat, N. M. (2010). Obesity and eating habits among college students in Saudi Arabia: a cross sectional study. *Nutrition journal*, 9(39), 1-10
- Anderson, B., Rafferty, A. P., Lyon-Callo, S., Fussman, C., & Imes, G. (2011). Fast-food consumption and obesity among Michigan adults. *Prev Chronic Dis*, 8(4), A71.
- Arizona state university. (2005). family environment is a significant predictor of adolescent
- Astrup, A., & Finer, N. (2000). Redefining type 2 diabetes: 'diabesity' or 'obesity dependent diabetes mellitus'?. *Obesity Reviews*, 1(2), 57-59.
- Azizi Yahaya, Shahrin Hashim, Jamaludin Ramli, Yusof Boon & Abdul Rahim Hamdan (2007). *Menguasai Penyelidikan Dalam Pendidikan (Edisi Kedua)*. Kuala Lumpur: PTS Professional Publishing Sdn. Bhd
- Basciano, H., Federico, L., & Adeli, K. (2005). Fructose, insulin resistance, and metabolic dyslipidemia. *Nutrition & metabolism*, 2(1), 1. doi : 10.1186/1743-7075-2-5
- Bowman, S. A., & Vinyard, B. T. (2004). Fast food consumption of US adults: impact on energy and nutrient intakes and overweight status. *Journal of the American College of Nutrition*, 23(2), 163-168.
- Brown, J. E., Broom, D. H., Nicholson, J. M., & Bittman, M. (2010). Do working mothers raise couch potato kids? Maternal employment and children's lifestyle behaviours and weight in early childhood. *Social science & medicine*, 70(11), 1816-1824.
- Caballero B. (2001). Obesity in developing countries: biological and ecological factors. *Journal of Nutrition*.131(3):866S-870S.
- Castelli, D. M., & Valley, J. A. (2007). Chapter 3: The Relationship of Physical Fitness and

- Chee, S. S., Zawiah, H., Ismail, M. N., & Ng, K. K. (1996). Anthropometry, dietary patterns and nutrient intakes of Malaysian estate workers. *Malaysian Journal of Nutrition*, 2(2), 112-126.
- Chen, L. J., Fox, K. R., Haase, A., & Wang, J. M. (2006). Obesity, fitness and health in Taiwanese children and adolescents. *European Journal of Clinical Nutrition*, 60(12), 1367-1375.
- Chivers, P. T., Hands, B., Beilin, L., Kendall, G., & Bulsara, M. (2010). A comparison of field measures of adiposity among Australian adolescents from the Raine study. *Malaysian Journal of Sport Science and Recreation*, 6(1), 33-45.
- Collison, K. S., Zaidi, M. Z., Subhani, S. N., Al-Rubeaan, K., Shoukri, M., & Al-Mohanna, F. A. (2010). Sugar-sweetened carbonated beverage consumption correlates with BMI, waist circumference, and poor dietary choices in school children. *BMC Public Health*, 10(1), 1-13.
- Crispim, P. A. A., Peixoto, M. D. R. G., & Jardim, P. C. B. V. (2014). Risk factors associated with high blood pressure in two-to five-year-old children. *Arquivos brasileiros de cardiologia*, 102(1), 39-46.
- Department of Health and Ageing. (2004). *Australia's physical activity recommendations for 12-18 year olds*. Canberra: Commonwealth Department of Health and Ageing. Available from URL: <http://www.sports.det.nsw.edu.au>
- Deurenberg, P., Weststrate, J. A., & Seidell, J. C. (1991). Body mass index as a measure of body fatness: age-and sex-specific prediction formulas. *British journal of nutrition*, 65(2), 105-114.
- Drewnowski, A., & Popkin, B. M. (1997). The nutrition transition: new trends in the global diet. *Nutrition reviews*, 55(2), 31-43.
- Ek, A., Sorjonen, K., Nyman, J., Marcus, C., & Nowicka, P. (2015). Child behaviors associated with childhood obesity and parents' self-efficacy to handle them: Confirmatory factor analysis of the Lifestyle Behavior Checklist. *International Journal of Behavioral Nutrition and Physical Activity*, 12(1), 36.
- Ferreira, I., Horst, K., Wendel-Vos, W., Kremers, S., van Lenthe, F. J., & Brug, J. (2007). Environmental correlates of physical activity in youth—a review and update. *Obesity Reviews*, 8(2), 129-154.
- Fraser, L. K., Clarke, G. P., Cade, J. E., & Edwards, K. L. (2012). Fast food and obesity: a spatial analysis in a large United Kingdom population of children aged 13-15. *American Journal of Preventive Medicine*, 42(5), e77-e85.
- Gittelsohn, J., Trude, A., Poirier, L., Ross, A., Ruggiero, C., Schwendler, T., & Anderson Steeves, E. (2017). The impact of a multi-level multi-component childhood obesity prevention intervention on healthy food availability, sales, and purchasing in a low-income urban area. *International journal of environmental research and public health*, 14(11), 1371.
- Gordon-Larsen, P., The, N. S., & Adair, L. S. (2010). Longitudinal trends in obesity in the United States from adolescence to the third decade of life. *Obesity*, 18(9), 1801-1804.
- Guthrie, J. F., Lin, B. H., & Frazao, E. (2002). Role of food prepared away from home in the American diet, 1977-78 versus 1994-96: changes and consequences. *Journal of Nutrition Education and Behavior*, 34(3), 140-150.
- Hamilton, M. T., Hamilton, D. G., & Zderic, T. W. (2007). Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes and cardiovascular disease. *Diabetes*, 56(11), 2655-2667.
- Hardy, L. L., Denney-Wilson, E., Thrift, A. P., Okely, A. D., & Baur, L. A. (2010). Screen time and metabolic risk factors among adolescents. *Archives of Pediatrics & Adolescent Medicine*, 164(7), 643-649.
- Huang, H., Wan Mohamed Radzi, C., & Salarzadeh Jenatabadi, H. (2017). Family environment and childhood obesity: a new framework with structural equation modeling. *International journal of environmental research and public health*, 14(2), 181.
- Kementerian Kesihatan Malaysia. (2017). National Health and Morbidity Survey. Dapatan Kembali daripada

<http://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2017/NHMS2017Infographic.pdf>

- Lee, C. D., Blair, S. N., & Jackson, A. S. (1999). Cardiorespiratory fitness, body composition, and all-cause and cardiovascular disease mortality in men. *American Journal of Clinical Nutrition*, 69(3), 373–380.
- Maddison, R., Hoorn, S. V., Jiang, Y., Mhurchu, C. N., Exeter, D., Dorey, E., Bullen, C., Utter, J., Schaaf, D., & Turley, M. (2009). The environment and physical activity: The influence of psychosocial, perceived and built environmental factors. *International Journal of Behavioral Nutrition and Physical Activity*, 6(1), 19.
- Mark, A. E., & Janssen, I. (2008). Relationship between screen time and metabolic syndrome in adolescents. *Journal of Public Health*, 30(2), 153-160.
- McGuire, K. A., & Ross, R. (2011). Incidental physical activity is positively associated with cardiorespiratory fitness. *Medicine and Science in Sports and Exercise*, 43(11), 2189-2194.
- Mohammed, H., & Vuvor, F. (2012). Prevalence of childhood overweight/obesity in basic school in Accra. *Ghana medical journal*, 46(3), 124.
- Mohd Ismail, N. (2002). The Nutrition and Health Transition in Malaysia. *Public Health Nutrition*. 5(1A).191-195.
- Motor Competence to Physical Activity. *Journal of Teaching in Physical Education*, 26(4), 358–374
- Niemeier, H., Raynor, H., Lloyd-Richardson, E., Rogers, M., & Wing, R. (2006). Fast food consumption and breakfast skipping: predictors of weight gain from adolescence to adulthood in a nationally representative sample. *Journal of Adolescent Health* 39(6), 842–849. Obesity. *Biotech Week*, 85
- Obregon, A. M., Pettinelli, P. P., & Santos, J. L. (2015). Childhood obesity and eating behaviour. *Journal of Pediatric Endocrinology and Metabolism*, 28(5-6), 497-502.
- Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *Jama*, 311(8), 806-814.
- Okely, A. D., Booth, M. L., & Chey, T. (2004). Relationships between body composition and fundamental movement skills among children and adolescents. *Research Quarterly for Exercise and Sport*, 75(3), 238-247
- Okubo, H., Miyake, Y., Sasaki, S., Tanaka, K., Murakami, K., & Hirota, Y. (2014). Osaka Maternal and Child Health Study Group. Dietary patterns in infancy and their associations with maternal socio-economic and lifestyle factors among 758 Japanese mother-child pairs: the Osaka Maternal and Child Health Study. *Matern Child Nutr*, 10, 213-225.
- Paeratakul, S., Ferdinand, D. P., Champagne, C. M., Ryan, D. H., & Bray, G. A. (2003). Fast-food consumption among US adults and children: dietary and nutrient intake profile. *Journal of the American dietetic Association*, 103(10), 1332-1338.
- Patrick, H., & Nicklas, T. A. (2005). A review of family and social determinants of children's eating patterns and diet quality. *Journal of the American College of Nutrition*, 24(2), 83-92.
- Peltzer, K., Pengpid, S., Samuels, T., Özcan, N., Mantilla, C., Rahamefy, & Gasparishvili, A. (2014). Prevalence of overweight/obesity and its associated factors among university students from 22 countries. *International journal of environmental research and public health*, 11(7), 7425-7441.
- Pirinçi, E., Durmuş, B., Gundogdu, C., & Açıık, Y. (2010). Prevalence and risk factors of overweight and obesity among urban school children in Elazığ city, Eastern Turkey, 2007. *Annals of human biology*, 37(1), 44-56.
- Popkin, B. M. (2001). The nutrition transition and obesity in the developing world. *Journal of Nutrition*, 131(3), 871S-873S.
- Rideout, V. J., Foehr, U. G., & Roberts, D. F. (2009). Generation M [superscript 2]: Media in the Lives of 8-to 18-Year-Olds. *Henry J. Kaiser Family Foundation*. Available from URL: <http://files.eric.ed.gov/fulltext/ED527859.pdf>
- Rosenheck, R. (2008). Fast food consumption and increased caloric intake: a systematic review of a trajectory towards weight gain and obesity risk. *Obesity Reviews* 9(6), 535–547.

- Sakinah, H. A., Seong-Ting, C.A., Rosniza, R. B., & Jayah, K. P. B. (2012). Socio-demographic, dietary and physical activity determinants of adolescents overweight and obesity in Kelantan. *Health and the Environment Journal*, 3(1), 44-53.
- Sallis, J. F., & Glanz, K. (2006). The role of built environments in physical activity, eating and obesity in childhood. *Future of Children*, 16(1), 89-108.
- Sidek Mohd Noah. (2002). *Reka Bentuk Penyelidikan: falsafah, teori dan praktis*. Serdang: Penerbit Universiti Putra Malaysia.
- Stellino, M. B., & Sinclair, C. (2014). Examination of children's recess physical activity patterns using the activities for daily living-playground participation (ADL-PP) instrument. *Journal of Teaching in Physical Education*, 33(2), 282-296.
- Story, M., Nannery, M. S., & Schwartz, M. B. (2009). Schools and obesity prevention: creating school environments and policies to promote healthy eating and physical activity. *The Millbank Quarterly*, 87(1), 71-100.
- Tabachnick, B. G., & Fidell, L. S. (1996). *Using multivariate statistic* 3rd ed. New York: Harper Collins.
- Flegal, K. M., Tabak, C. J., & Ogden, C. L. (2006). Overweight in children: definitions and interpretation. *Health education research*, 21(6), 755-760.
- Tesfalem, T., Singh, P., & Debebe, M. (2013). Prevalance and associated factors of overweight and obesity among high school adolescents in urban communities of Hawassa, Southern Ethiopia. *Current Research in Nutrition and Food Science*, 1(1), 23-26.
- Veitch, J., Salmon, J., & Ball, K. (2010). Individual, social and physical environmental correlates of children's active free-play: a cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity*, 7(11), 1-10.
- Vinturache, Angela Elena, Sheila McDonald, Donna Slater, and Suzanne Tough. "Perinatal outcomes of maternal overweight and obesity in term infants: a population-based cohort study in Canada." *Scientific reports* 5 (2015): 9334.
- Wang, Y., & Lobstein, T. I. M. (2006). Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity*, 1(1), 11-25
- Wang, Y. (2001). Cross-national comparison of childhood obesity: the epidemic and the relationship between obesity and socioeconomic status. *International Journal of Epidemiology*, 30(5), 1129-36.
- Wang, D., Li, Y., Lee, S. G., Wang, L., Fan, J., Zhang, G., Wu, J., Ji, Y., & Li, S. (2011). Ethnic differences in body composition and obesity related risk factors: study in Chinese and white males living in China. *PloS One*, 6(5), e19835.
- Wilson, D. (2009). New perspectives on health disparities and obesity interventions in youth. *Journal of Pediatric Psychology*, 34(3), 231-244.
- WHO, (2000). *Obesity: Preventing and managing the global epidemic*. Report of a World Health Organisation (WHO) Consultation. WHO Technical Report Series 894: Geneva, Switzerland. Available from URL: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html
- Yen, S. T., Chen, Z., & Eastwood, D. B. (2009). Lifestyles, demographics, dietary behavior, and obesity: a switching regression analysis. *Health Services Research*, 44(4), 1345-1369.
- Zarizi Ab Rahman. (2017). *Pembinaan instrumen peramal faktor obesiti dalam kalangan pelajar berumur 13 dan 14 tahun* (Doctoral dissertation, Universiti Pendidikan Sultan Idris).