UNIVERSITI PUTRA MALAYSIA

FACTORS ASSOCIATED WITH BODY WEIGHT STATUS AMONG ADOLESCENTS IN LABUAN FEDERAL TERRITORY, MALAYSIA

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By

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FACTORS ASSOCIATED WITH BODY WEIGHT STATUS AMONG ADOLESCENTS IN LABUAN FEDERAL TERRITORY, MALAYSIA

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The prevalence of overweight and obesity among adolescents in developing countries are increasing including Malaysia. A cross-sectional study was conducted to determine socio-demographic characteristics, lifestyle factors, body image perception, family environment and built environment factors associated with body weight status (BMI-for-age) among adolescents in Labuan Federal Territory, Malaysia.

The study involved 481 secondary school Malaysian students aged 12-17 years. Information on socio-demographic characteristics, lifestyle, body image, family environment and built environment were collected using self-administered questionnaires. Body weight and height of the students were measured using standard procedures while BMI-for-age z-score (BAZ) was determined using WHO Growth Reference 2007. One day 24-hour dietary recall was obtained by face-to-face interview. The buffer analysis was conducted using Geographic Information System (GIS).

A majority of the respondents were female (67.4%), Malays (55.0%), from rural schools (55.7%) and had achieved pubertal status (95.7%). The prevalence of overweight and obesity among the respondents was 33.1% (Males: 30.7%; Females: 34.3%), with mean BAZ of the respondents was 0.36±1.46 SD. A majority of the respondents skipped main meals (83.6%), skipped breakfast (68.6%) and snacked between meals (96.9%) daily. About half of the respondents skipped lunch (47.9%) and skipped dinner (49.8%). A total of 28.3% of respondents were at high risk of eating disorders. About three in four respondents were dissatisfied with their body size (73.3%). The mother's mean BMI and father's mean BMI were 26.5±5.6kg/m^2 and 25.9±4.9kg/m^2, respectively. A majority of the respondents did not have fast food outlets within the 500m (95.2%), 1000m (85.2%) and 1500m (79.0%) buffer of their

homes. All respondents (100%) did not have fast food outlets within a 500m buffer of their schools.

Bivariate analyses indicated that energy intake ($r=0.274$, $p<0.001$), higher frequency of eating outside home ($r=0.145$, $p=0.038$), not snacked morning tea ($t=2.126$, $p=0.035$), not snacked afternoon tea ($t=2.414$, $p=0.017$), not snacked supper ($t=2.073$, $p=0.039$), higher disordered eating score ($r=0.212$, $p=0.002$), dissatisfied body size ($t=2.451$, $p=0.015$), higher mother's BMI ($r=0.216$, $p=0.002$), higher father's BMI ($r=0.249$, $p=0.001$), less parental pressure to eat ($r=-0.210$, $p=0.003$), perceived higher parent weight ($r=0.174$, $p=0.013$), perceived higher teen weight ($r=0.364$, $p<0.001$) and were significantly associated with higher BMI-for-age of the respondents.

Further, multiple linear regression indicated that being female ($\beta=1.064$), higher energy intake ($\beta=0.409$), higher disordered eating score ($\beta=0.017$), higher body size dissatisfaction ($\beta=0.190$), higher father's BMI ($\beta=0.052$), less parental pressure to eat ($\beta=-0.304$) and perceived higher teen weight ($\beta=1.020$) significantly contributed towards higher BMI-for-age of the acceptable diet reporting respondents at $p<0.05$ level of significance explaining 41.1% of the variances in BMI-for-age ($R^2=0.411$, $F=19.545$, $p<0.001$). The strongest factor of the BMI-for-age model was perceived teen weight ($\Delta R^2 = 13.3\%$).

In conclusion, the study found that being female, higher energy intake, higher disordered eating scores, higher body size dissatisfaction, higher father's BMI, less parental pressure to eat and perceived higher teen weight contributed to higher BMI-for-age of the adolescents in Labuan Federal Territory. Future healthy weight intervention may consider incorporating these identified factors to increase the effectiveness of the programmes.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

FAKTOR-FAKTOR BERKAITAN DENGAN STATUS BERAT BADAN DALAM KALANGAN REMAJA DI WILAYAH PERSEKUTUAN LABUAN, MALAYSIA

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Prevalens lebih berat badan dan obesiti dalam kalangan remaja di negara-negara yang sedang membangun meningkat termasuk Malaysia. Satu kajian secara keratan rentas telah dijalankan untuk menentukan faktor-faktor perkaitan antara ciri-ciri sosio-demografi, gaya hidup, persekitaran keluarga dan persekitaran binaan dengan status berat badan (BMI-untuk-umur) dalam kalangan remaja di Wilayah Persekutuan Labuan, Malaysia.

Kajian ini telah melibatkan 481 orang pelajar sekolah menengah warganegara Malaysia berumur 12 – 17 tahun. Maklumat ciri-ciri sosio demografi, gaya hidup, imej badan, persekitaran keluarga dan persekitaran binaan telah diambil menggunakan borang soal selidik. Berat badan dan tinggi pelajar telah diukur dengan menggunakan prosedur standard, manakala BMI-untuk-umur (z-skor) telah dinilai menggunakan Carta Pertumbuhan WHO 2007. Satu hari ingatan diet 24-jam telah dijalankan melalui temuduga muka-ke-muka. Analisis ukuran jarak telah dijalankan menggunakan Sistem Informasi Geografi (GIS).

Majoriti responden adalah perempuan (67.4%), Melayu (55.0%), dari sekolah luar bandar (55.7%) dan mencapai akil baligh (95.7%). Prevalens lebih berat badan dan obesiti responden adalah 33.1% (Lelaki: 30.7%; Perempuan: 34.3%) dan min bagi BMI-untuk-umur responden adalah 0.36±1.46 SD. Majoriti responden melangkau waktu makan (83.6%), melangkau sarapan pagi (68.6%) dan mengambil snek setiap hari (96.9%). Hampir separuh daripada responden melangkau makan tengahari (47.9%) dan melangkau makan malam (49.8%). Sebanyak 28.3% daripada responden mempunyai risiko yang tinggi mengalami masalah gangguan makan. Hampir tiga daripada empat responden tidak berpuas hati dengan saiz badan (73.3%). Min BMI bagi ibu dan bapa masing-masing adalah 26.5±5.6 and 25.9±4.9. Majoriti daripada

responden tidak mempunyai kedai makanan segera dalam jarak 500m (95.2%), 1000m (85.2%) dan 1500m (79.0%) dari rumah. Semua responden (100%) tidak mempunyai kedai makanan segera dalam jarak 500m dari sekolah.

Analisis bivariat menunjukkan bahawa lebih tinggi pengambilan tenaga ($r=0.274$, $p<0.001$), lebih kerap pengambilan makanan di luar rumah ($r=0.145$, $p=0.038$), tidak mengambil snek minum pagi ($t=2.126$, $p=0.035$), tidak mengambil snek minum petang ($t=2.414$, $p=0.017$), tidak mengambil snek minum malam ($t=2.073$, $p=0.039$), lebih tinggi skor risiko masalah gangguan makan ($r=0.212$, $p=0.002$), tidak berpuashati dengan saiz badan ($t=2.451$, $p=0.015$), lebih tinggi BMI ibu ($r=0.216$, $p=0.002$), lebih tinggi BMI bapa ($r=0.249$, $p=0.001$), kurang tekanan daripada ibu bapa untuk makan ($r=-0.210$, $p=0.003$), mengetahui lebih berat badan ibu bapa ($r=0.174$, $p=0.013$) dan mengetahui lebih berat badan anak ($r=0.364$, $p<0.001$) mempunyai perkaitan yang signifikan dengan BMI-untuk-umur responden yang lebih tinggi.

Dalam analisis regresi linear berganda, sebagai perempuan ($\beta=1.064$), lebih tinggi pengambilan tenaga ($\beta=0.133$), lebih tinggi skor risiko masalah gangguan makan ($\beta=0.017$), lebih tinggi skor ketidakpuasan saiz badan ($\beta=0.190$), lebih tinggi BMI bapa ($\beta=0.052$), kurang tekanan untuk makan ($\beta=-0.304$) dan mengetahui berlebihan berat badan anak ($\beta=1.020$) adalah penyumbang yang signifikan dengan BMI-untuk-umur responden yang tinggi pada tahap keyakinan $p<0.05$ menjelaskan 41.1% daripada variasi dalam BMI-untuk-umur ($R^2=0.411$, $F=19.545$, $p<0.001$). Faktor yang paling kuat dalam model BMI-untuk-umur adalah mengetahui berlebihan berat badan anak ($\Delta R^2 = 13.3\%$).

Pada kesimpulannya, dalam kajian ini menunjukkan sebagai perempuan, lebih tinggi pengambilan tenaga, lebih tinggi skor risiko gangguan makan, lebih tinggi skor ketidakpuasan saiz badan, lebih tinggi BMI bapa, kurang tekanan untuk makan daripada ibu bapa dan mengetahui berat badan anak yang tinggi adalah penyumbang terhadap BMI-untuk-umur yang lebih tinggi dalam kalangan remaja di WP Labuan. Intervensi program pada masa akan datang seharusnya mempertimbangkan faktor-faktor yang telah dikenalpasti untuk meningkatkan keberkesanan program.

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LIST OF ABBREVIATIONS

ASAQ	Adolescent Sedentary Activities Questionnaire
BMI	Body Mass Index
BMR	Basal Metabolic Rate
CDC	Centers for Disease Control and Prevention
CFQ	Child Feeding Questionnaire
CI	Confidence Interval
CNNHS	China National Nutrition and Health Survey
EAT	Eating Among Teens Survey
EAT-26	Eating Attitudes Test
EI	Energy Intake
FT	Federal Territory
GIS	Geographic Information System
HMIS	Health Management Information System
IOTF	International Obesity Task Force
IPH	Institute of Public Health
MOE	Ministry of Education
MOH	Ministry of Health
MSNS	Malaysian School-Based Nutrition Survey
MVPA	Moderate to Vigorous Physical Activity
NCCFN	National Coordinating Committee on Food and Nutrition
NCHS	The National Center for Health Statistic
NHMS	National Health and Morbidity Survey
PAQ	Parenting Authority Questionnaire

PAQ-A	Physical Activity Questionnaire for Adolescent
RM	Ringgit Malaysia
RNI	Recommended Nutrient Intakes for Malaysians
SEGAK	National Physical Fitness
SPSS	Statistical Packages for Social Sciences
UPM	Universiti Putra Malaysia
USA	United State of America
WGOC	Working Group on Obesity in China
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health (WHO, 2000). The World Health Organization [WHO] estimated that over 340 million children aged 5 to 19 years were overweight or obese in the year 2016 (WHO, 2017a). Obesity in children increased globally from 11 million in the year 1975 to 124 million in the year 2016 (Abarca-Gómez et al., 2017). Previous studies in high-income countries had shown the high prevalence of overweight and obesity in adolescents (O'Dea & Dibley, 2014; Oellingrath & Svendsen, 2017; Ogden et al., 2016). The United States has the highest prevalence of overweight and obesity among adolescents compared to European countries from the years 2002 to 2010 (Ahluwalia et al., 2015). Based on the CDC BMI-for-age growth chart, the prevalence of obesity among adolescents aged 12 to 19 years increased between the years 1998 to 2014 in the United States (Ogden et al., 2016).

However, studies showed that the rise in adolescent obesity in some high-income countries has slowed and plateaued from the year 2000 and this could be due to the effect of public health awareness campaigns and interventions to prevent obesity (Abarca-Gómez et al., 2017; Atay & Bereket, 2016). For instance, a previous study in Australia found that the prevalence of overweight and obesity slowed down in adolescents aged 13 to 18 years for both sexes between 2006 and 2012 using the International Obesity Taskforce (IOTF) cut-offs (O'Dea & Dibley, 2014). In contrast, BMI-for-age and the prevalence of overweight and obesity among adolescents in low and middle-income countries, especially in the East, South and Southeast Asia, are still on the rise (Abarca-Gómez et al., 2017; Atay & Bereket, 2016). More studies need to be conducted to determine factors associated with overweight and obesity in Asia to prevent overweight and obesity from increasing dramatically.

The prevalence of adult obesity had been increasing at an alarming rate in China, Japan, and India (Chakraborty & Das, 2016). As obese adolescents are more likely to become obese in adulthood, the prevalence of overweight and obesity in adolescents are being observed (Ranjani et al., 2016). A previous study among students aged 7 to 18 years in Shenyang, China reported that the rate of obesity was significantly higher between the years 2010 and 2014 (Zhai et al., 2017). Similarly, a study in India reported that the prevalence of childhood obesity was significantly higher in between the years 2001 and 2010 (Ranjani et al., 2016). Besides, studies in middle-income and low-income countries revealed that the prevalence of overweight and obesity were more prevalent than thinness among adolescents in urban compared to rural area (Ranjani et al., 2016; Zhai et al., 2017). Although the prevalence of overweight and obesity was increasing globally, especially in Asian countries, previous study across 40 countries from the Global School Health Survey indicated that thinness remained prevalent (7.6%) among

adolescents girls aged 12 to 18 years in Asia, with the highest prevalence of moderate underweight in Sri Langka (19.3%) (Candler, Costa, Heys, Costello, & Viner, 2017). Therefore, determining socio-demographic factors is crucial in the planning of intervention programme.

Malaysia is a middle-income country that is experiencing a rapidly rising prevalence of overweight and obesity in adults over the years. Based on the WHO Growth Reference (2007), the prevalence of overweight and obesity among adolescents aged 10 to 17 years in Malaysia increased from 14.6% to 15.6% and 12.4% to 14.5%, respectively between the years 2012 to 2017 (IPH, 2013; IPH, 2017). In other words, about one in three adolescents were either overweight or obese. The prevalence of thinness among adolescents aged 10 to 17 years in Malaysia reported in the year 2012 and 2017 was 6.0% and 6.6%, respectively (IPH, 2013; IPH 2017). The NHMS Adolescent Nutrition Survey 2017 reported that Labuan Federal Territory had the highest prevalence of overweight (17.0%) and the lowest prevalence of thinness (4.7%). Meanwhile, the state of Perlis had the highest prevalence of obesity (17.5%) and Labuan was ranked third highest in the prevalence of obesity (16.7%) in Malaysia (IPH, 2017). Overall, the prevalence of overweight and obesity among adolescents in Labuan was the highest in Malaysia (IPH, 2017).

Previous studies found that over- and under- nutrition have impacts on an adolescent's health or well-being. Obesity and underweight increase the risk of physical complication, co-morbidities and medical care cost. Obesity during adolescence has short- and long term effects For instance, insulin resistance, pre-diabetes, metabolic syndromes, dyslipidaemia, hypertension, asthma, skin problem and impaired peak bone mass (Atay & Bereket, 2016; Mosca et al., 2014) . In the long term, obese adolescents are more likely to stay obese in adulthood and develop non-communicable diseases such as type 2 diabetes, cardiovascular disease, cancers, mental health and eating disorders (Sahoo et al., 2015). Besides, obesity negatively affects psychosocial health of adolescents related to well-being, such as bullying, psychological complaints, shortness of breath or abnormal sleeping patterns, anxiety, depression, low self-esteem, distorted body image, stigmatisation, disordered eating and school absenteeism (Herranz Barbero, López de Mesa, & Azcona San Julián, 2015; Maggio et al., 2014). Additionally, studies showed that undernutrition during adolescence was linked to low bone mass (Matsuzaki et al., 2015), stunting and poor general health (Perignon et al., 2014). Previous studies showed that overweight, obese or underweight adolescents were associated with poor learning ability and poor academic performance (Morita et al., 2016; Perignon et al., 2014). As malnutrition affects the physical health and psychosocial health of adolescents, the examination of factors associated with body weight status in adolescents is crucial to implement effective interventions on the promotion of healthy lifestyles.

1.2 Problem Statement

Obesity is a growing global public health problem. In most of the developing countries in Asia suffer from double burden of malnutrition. The increasing trend of overweight and obesity prevalence among adolescents in developing countries are caused by changing dietary practices and sedentary lifestyle. The underweight problem among adolescents in developing countries is associated with food insufficiency (Perignon et al., 2014). Previous nationwide studies in Malaysia indicated that the prevalence of overweight and obesity was higher compared with prevalence of thinness among adolescents (IPH, 2013; IPH, 2017). Adolescents experience changes in physical, psychological and social development, which may impact behaviours related to healthy body weight status, yet food choices during adolescence remain influenced by home environment, peers, social, school and environment features (Berge et al., 2013; Viner et al., 2012). Adolescents aged 12 – 15 years had higher motivation to reduce weight as compared to children aged 8 - 11 years (Brown, Skelton, Perrin, & Skinner, 2016). The Malaysian adolescents who were trying to reduce weight did not have the correct perception of their body weight status (Ahmad Ali et al., 2014). Previous research had been carried out worldwide to study the prevalence of overweight and obesity among adolescents and its associated factors for effective public health interventions to combat obesity.

The nationwide Adolescents Nutrition Survey in year 2017 found that the prevalence of overweight and obesity (33.7%) among adolescents aged 10 to 17 years in Labuan Federal Territory was the highest in Malaysia (IPH, 2017). However, The Malaysian School-Based Nutrition Survey (MSNS) in year 2012 reported that Sabah and Labuan FT had the lowest prevalence of overweight (12.5%) and obesity (8.4%) (IPH, 2013). The contradiction in the previous findings indicated that further study is needed. To date, there is no known local study on the prevalence of overweight and obesity among secondary school students being carried out in Labuan Federal Territory.

Considering the high prevalence of overweight and obese among adolescents in Malaysia, determining which factors contribute to the development of overweight and obesity is necessary to overcome this public health concern. Limited local studies had been conducted to determine the associations between behavioural and environmental factors with overweight and obesity among adolescents in East Malaysia (Sabah, Sarawak and Labuan), as most recent studies were conducted in West Malaysia (Aainaa Syarfa, Zuriati, & Mohd Nasir, 2016; Nurul-fadhilah et al., 2013; Pell et al., 2016; Teo, Nurul-Fadhilah, Aziz, Hills, & Foo, 2014). Previous studies showed that socio-demographic characteristics were associated with overweight and obesity (Galfo, D'Addezio, Censi, Roccaldo, & Martone, 2016; Pell et al., 2016). Therefore, different ethnicity, culture and economy in East Malaysia are other key influences on the behaviour of adolescents that need to be identified.

Numerous studies showed that unhealthy lifestyles such as excessive energy intake, unhealthy eating, irregular eating behaviours, low physical activity and high sedentary behaviours during adolescence may affect body weight of the adolescents and increase

risk of non-communicable diseases (Marlatt, Farbakhsh, Dengel, & Lytle, 2016; Saikia, Ahmed, Saikia, & Sarma, 2016). Therefore, determination of lifestyle factors remains crucial in the present study. Although diet and physical activity factors have been emphasised in adolescent obesity, the current study focuses on the root causes that points to family environment factors. The parents' attitude, behaviours and home environment affect children's lives. A previous study found that home food availability and parental modelling was associated with dietary intake of adolescents (Loth et al., 2016). Parental food restriction, permissive feeding style, and concern for healthy food costs were positively associated with BMI-for-age of children (Couch, Glanz, Zhou, Sallis, & Saelens, 2014). However, there is limited local study that has been conducted to determine the association between family environment factors and BMI-for-age among adolescents. Therefore, the association between family environment factors with body weight status need to be determined in the present study.

Adolescents aged 10 to 15 years have some independence and mobility, and may be more limited by availability in their homes and schools as they travel by foot, while adolescent reach driving age, and their food environment and behaviour may change (Muhajarine, 2012). The neighbourhood fast-food outlets or convenience stores nearby homes or schools increase self-food purchasing (He et al., 2012) and is associated with higher BMI-for-age of adolescents (Gilliland et al., 2012). The Geographic Information Systems (GIS) is commonly used in measuring availability and accessibility of built environment is increasingly used in Western countries for developing strategies to promote and construct a healthier environment for obesity prevention (Gamba, Schuchter, Rutt, & Seto, 2015; Lytle & Sokol, 2017). However, there is little known on the association between built environment and body weight status among adolescents in the local context. To date, there is limited study using GIS method in measuring built environment in Malaysia, particularly the food environment. However, its utility as a predictor of obesity in population is poor. Thus, combining GIS method and validated self-reported measurement of the built environment has been suggested to assess what is available in food outlets, community and consumer food environment (Engler-Stringer et al., 2014; Gamba et al., 2015; Lytle & Sokol, 2017). Therefore, the present study used GIS method and self-reported measurement to determine the association between built environment factors with body weight status among secondary school students.

The study of socio-demographic, lifestyle and body image perception among adolescents in East Malaysia remain crucial. The family environment factors and built environment factors in association with body weight status among adolescents are limited in the local context. Therefore, to fulfil the current knowledge gap, this study examined the association between socio-demographic characteristics, lifestyle factors, body image perception, family environment factors, built environment factors and BMI-for-age among secondary school students.

1.3 Significance of the Study

The findings of this study can contribute to the data on the prevalence of overweight and obesity among adolescents of secondary school in Labuan Federal Territory. In the present study, body weight status among secondary students in Labuan Federal Territory can be used as baseline data for policy and programme planning for the Ministry of Health Malaysia (MOH) and Ministry of Education Malaysia (MoE). The findings of this study can be used as a reference in the implementation of the National Plan of Action for Nutrition of Malaysia (NPANM) and United Nations Sustainable Development Goals (SDGs), particularly in Goal 3 (Ensure healthy lives and promote well-being for all at all ages). In addition, the findings of the present study can also be used as a reference for health surveillance in the Health Management Information System (HMIS), Health Information Centre, Ministry of Health Malaysia and the assessment of the National Physical Fitness Test (SEGAK), Ministry of Education Malaysia.

Since there is a high prevalence of overweight and obesity among Malaysian adolescents, determining factors associated with body weight status among secondary school students is needed to develop more practical and effective approaches in prevention and management of obesity. The findings of the study can serve as one of the references for programme planning to improve the effectiveness of programme intervention in the prevention and management of obesity. Effective intervention programmes that promote healthy lifestyle and well-being in adolescents can contribute to the reduction of obesity and non-communicable diseases in the country. As there are limited studies on family and built environment factors with body weight status in East Malaysia, therefore the determination of associations between family environment and built environment with body weight status in the present research will fill this research gap and provide evidence to modify built environment to a healthier environment for obesity prevention in the population.

Generally, this study provides an overview of the factors associated to body weight status such as socio-demographic, lifestyle factors, body image perception, family and built environment factors. Besides, this study provides factors which contributed more towards BMI-for-age among secondary school students. Finally, the results of the study can be beneficial to health practitioners, such as nutritionists, community workers and health education officers in the community for developing an appropriate health intervention programmes to promote healthy lifestyle and weight management strategies in Labuan Federal Territory.

1.4 Objectives of the Study

1.4.1 General Objective

To determine the factors associated with body weight status (BMI-for-age) among secondary school students in Labuan Federal Territory.

1.4.2 Specific Objectives

1. To determine the body weight status among secondary school students in Labuan FT.
2. To determine the associations of socio-demographic characteristics, lifestyle factors, body image perception, family environment factors and built environment factors with body weight status (BMI-for-age) among secondary school students in Labuan FT.
3. To determine the contribution of socio-demographic characteristics, lifestyle factors, body image perception, family environment factors and built environment factors towards body weight status (BMI-for-age) among secondary school students in Labuan FT.

1.5 Hypothesis

1. There are significant associations between socio-demographic, lifestyle factors, body image perception, family environment factors and built environment factors with body weight status (BMI-for-age) among secondary school students in Labuan FT.
2. There are significant contributions of socio-demographic, lifestyle factors, body image perception, family environment factors and built environment factors towards body weight status (BMI-for-age) among secondary school students in Labuan FT.

1.6 Conceptual Framework

Overweight and obesity in adolescence increase health risks in adulthood. Hence, the determination of factors associated with BMI-for-age as depicted in Figure 1.1 is crucial. In the present study, socio-demographic, lifestyle, body image perception, family environment and built environment, are proposed as influencing factors that predict overweight and obesity among adolescents in Labuan Federal Territory.

Socio-demographic characteristics such as sex, ethnicity, household income and pubertal status were included in the present study. Previous studies showed significant associations between sex, ethnicity, socioeconomic and pubertal status with overweight

and obesity (Aris et al., 2016; Cook, Tseng, Tam, John, & Lui, 2017; Ranjani et al., 2016; Rossen, 2014; Zhai et al., 2017) For instance, a study showed that the prevalence of overweight and obesity was significantly higher in male adolescents compared to female adolescents (Zhai et al., 2017). Moreover, another study found a significant difference between household income level and BMI among adolescents in Terengganu (Aryati, Nurzaime, Mohd Razif, Engku Fadzli Hasan, & Amran, 2018).

The present study examined the lifestyle factors among secondary school students including energy intake, meal pattern, snacking behaviours, frequency of eating out, disordered eating, physical activity and sedentary behaviours as influencing factors that predict overweight and obesity among secondary school students. Previous studies showed that higher fast-food consumption (Braithwaite et al., 2014; Virtanen et al., 2015), breakfast skipping (Tee et al., 2017), less involvement in vigorous physical activity (Saikia et al., 2016), spending more time in sedentary behaviour (Mitchell, Pate, Beets, & Nader, 2013) had positive associations with overweight and obesity among adolescents. In addition, previous studies showed that disordered eating and body image perception were associated with body weight status (Farah Wahida, Mohd Nasir, & Hazizi, 2011; Syimir et al., 2017). Body dissatisfaction among adolescents significantly increased irregular eating behaviour, binge eating behaviour and BMI (Buckingham-Howes et al., 2018; Gan, Mohamad, & Law, 2018). Therefore, disordered eating and body image perception were also included in the present study.

Another influencing factor included in the present study was family environment factors. Research showed that home food availability, parental encouragement and modelling were associated with fruits and vegetables consumption in children (Couch et al., 2014; Loth et al., 2016). Availability of unhealthy foods were associated with higher BMI of children (Jennings et al., 2011). Parenting practices such as parental food restriction, permissive feeding style and concern for healthy food costs (Couch et al., 2014) were associated with overweight and obesity in children. On the other hand, findings showed that the authoritative parenting style may play a protective role related to adolescent overweight (Berge, Wall, Loth, & Neumark-Sztainer, 2010; Vollmer & Mobley, 2013).

The present study also included built environment as influencing factors that may predict overweight and obesity among secondary school students. Previous research showed that neighbourhood walkability influenced moderate-vigorous physical activity during the weekends (Molina-García, Queralt, Adams, Conway, & Sallis, 2017), and the availability and accessibility of food sources and physical activity were used to measure the built environment as factors associated with overweight and obesity (Casey et al., 2014; Papas et al., 2010).

In summary, Figure 1.1 shows the conceptual framework of the present study. Factors explaining the development of BMI-for-age are supported by previous studies. The independent variables were socio-demographic characteristics (sex, ethnicity, household income and pubertal status), lifestyle factors (energy intake, meal pattern,

snacking behaviour, frequency of eating outside, disordered eating, physical activity and sedentary behaviours), body image perception (body weight status perception, body size satisfaction and healthy body perception), family environment factors (parents' body weight status, parents' physical activity behaviour, home food availability and accessibility, purchases of fast food for family meals, family meal frequency, parents' perception of healthful food cost, parenting style, parent modelling and parental feeding practice) and built environment factors (perceived availability of food shops nearby home, perceived availability of foods in school, accessibility of healthy foods nearby home, accessibility of walking environment and availability of fast food outlets nearby home and school). The dependent variable was body weight status (BMI-for-age) among adolescents in Labuan FT.

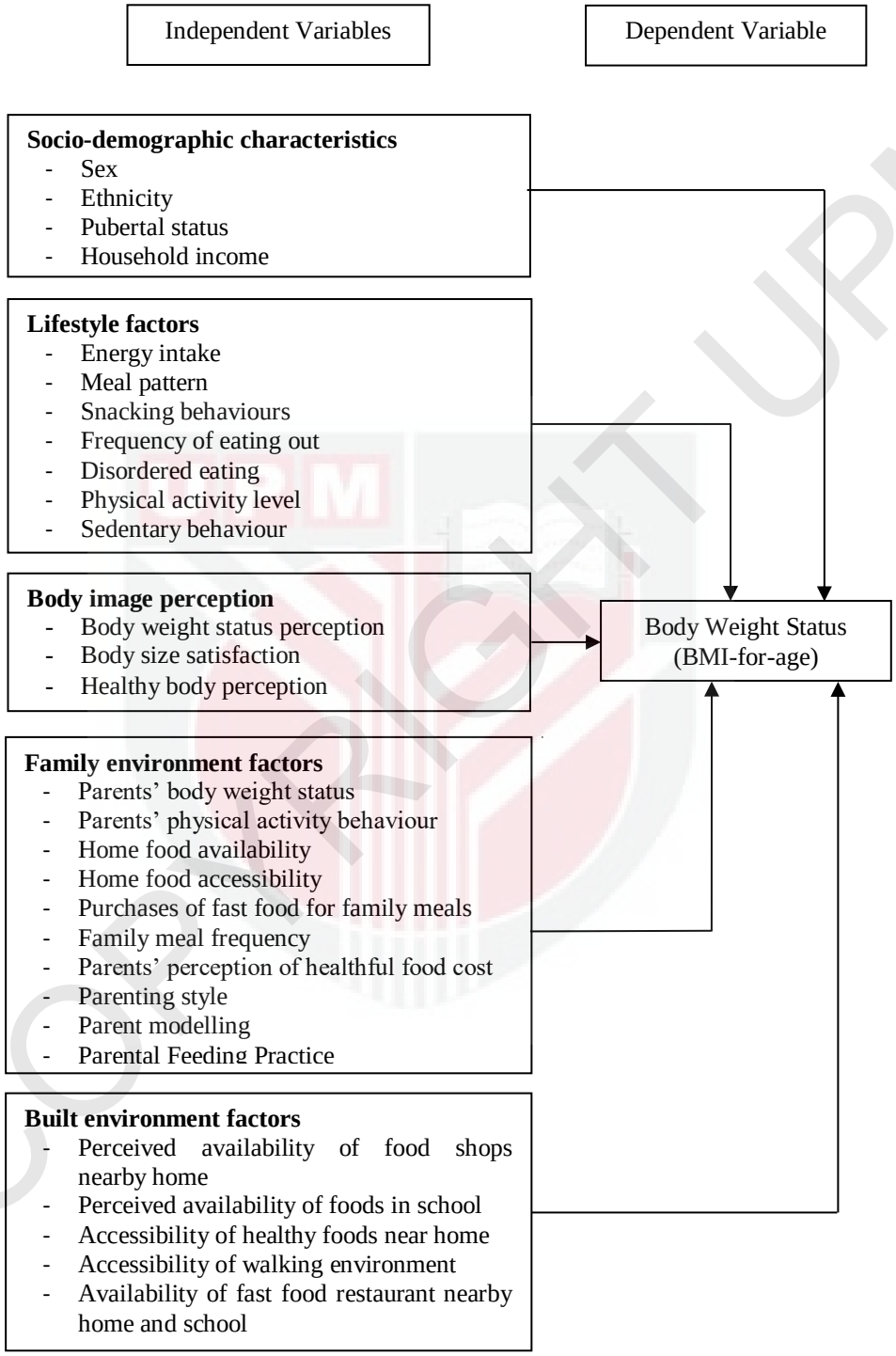

Figure 1.1 : Conceptual framework

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