

REHABILITATION APPLICATION PROGRAM FOR OBESITY ADOLESCENT  
USING STRUCTURAL EQUATION MODELLING

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REHABILITATION APPLICATION PROGRAM FOR OBESITY ADOLESCENT  
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In dedication to my parents (Nasir and Hernita Rais), my sisters (Harisaweni and Hersi Oliva) and my big family.

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## ABSTRACT

Obesity is one of the most important public health problems of the late twentieth century. Report by World Health Organization (2015) found the national prevalence of obesity in Indonesia was increased from 12.2% in 2007 to 16.8% in 2015 and reached 11.9% for the aged 6 to 12 years old. This research is conducted to identify the factors influencing obesity and their impact on obese adolescent. There are five influencing factors; nutrition, genetic, physical activity, socioeconomic, health awareness. This research was conducted in Padang, West Sumatera, Indonesia including 386 students in the age of 11-15 years old. Results of Partial Least Square Structural Equation Modelling analysis shows that there are 16 indicators from 47 indicators that provide a significant impact on each factor they represent. The significant indicators include; snack consumption, nap schedules, and pocket money. In addition to that, analysis results on factors that affect obesity in adolescents show that the nutrition factor has the most influence on obesity adolescent with  $T = 5.911$  followed by genetic = 4.321, physical activity = 3.174, and socioeconomic = 2.283. Meanwhile health awareness factor does not significantly affect on obesity in adolescents. However, the role of health awareness can be seen based on the correlation test results whereby all factors such as nutrition have the largest correlation with health awareness factors. The results of these statistical analysis will be used as a reference for the content on rehabilitation application program for obesity in adolescents. The validity and usability test for the developed application program shows most of users were satisfied with the program. However, there were several users that found difficulty in using english based application. The result of this research can be a reference for the authority and nutritionist in making guidelines or treatment in order to prevent the increase of obesity among adult and adolescents.

## ABSTRAK

Obesiti adalah salah satu daripada masalah kesihatan awam yang paling meruncingkan pada akhir abad kedua puluh. Laporan daripada Organisasi Kesihatan Sedunia (2015) mendapati bahawa prevalens obesiti kebangsaan di Indonesia meningkat daripada 12.2% pada tahun 2007 kepada 16.8% pada tahun 2015 dan mencapai 11.9% bagi golongan dalam peringkat umur 6 hingga 12 tahun. Kajian ini dijalankan untuk mengenalpasti faktor yang mempengaruhi obesiti dan bagaimana ia memberi kesan kepada berat badan. Lima faktor utama yang mempengaruhi obesiti ialah pemakanan, genetik, aktiviti fizikal, sosioekonomi, dan kesedaran tentang kesihatan. Lokasi kajian adalah di Padang, Sumatera Barat, Indonesia yang melibatkan golongan 386 remaja berumur 11-15 tahun. Hasil analisis menunjukkan, terdapat sebanyak 16 indikator daripada 47 indikator memberi kesan signifikan pada setiap faktor yang diwakilkan. Antara indikator tersebut adalah pengambilan makanan ringan, jadual tidur, dan wang saku. Di samping itu, pada analisis kesan pula menunjukkan pemakanan memberikan kesan paling besar dengan nilai  $T = 5.910$  diikuti dengan genetik = 4.320, aktiviti fizikal = 3.174, dan sosioekonomi = 2.283. Sebaliknya, faktor kesedaran kesihatan tidak menunjukkan kesan terhadap berat badan. Walau bagaimanapun, berdasarkan ujian kaitan, kebanyakan faktor seperti pemakanan mempunyai nilai kaitan terbesar dengan faktor kesedaran kesihatan. Hasil analisis statistik ini akan digunapakai sebagai rujukan dalam pembinaan program pembelajaran untuk pemulihan obesiti. Ujian kebolegunaan dan kesahihan program menunjukkan kebanyakan pengguna berpuas hati dengan program tersebut kecuali beberapa pengguna yang menyatakan kesukaran dalam menggunakan aplikasi yang berasaskan bahasa inggeris. Hasil penyelidikan ini mampu dijadikan rujukan kepada golongan pakar dalam membangunkan garis panduan untuk mencegah peningkatan obesiti di kalangan remaja.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1. Research Background**

Obesity has become one of the most important public health problem in the late twentieth century. Ogden et al (2010) stated, obesity is a serious threat in the United States because of an increasing prevalence of obesity cases. World Health Organization defined obesity as a disorder or a disease marked by the accumulation of excess body fat tissue. In general, overweight and obesity are assumed the cause of increasing caloric and fat intake. The high number of overweight person and obesity are mostly located in North America, South Africa and Middle East Region. In South East Asia, the prevalence of overweight and obesity in Malaysia in 1975 amounted 11.5% and 1.4% and increased to 41.6% and 14.9% in 2015. In the Philippines, the prevalence of overweight and obesity in 1975 amounted to 8.8% and 0.7% and increased to 27% and 6.2% in 2015. Meanwhile, in Indonesia the prevalence of overweight and obesity case also increased from 6.4% and 0.4% in 1975 to 27.4% and 6.5% in 2015 (WHO, 2015). Based on the data by WHO, it can be concluded, obesity has become a problem for all countries all over the world.

Obesity is not only found as a problem in adults, but also for children and adolescents. Therefore, it can be said as a general health problem for all human



being. There are a few studies have been conducted for a particular age in Indonesia and Malaysia. Ismail and Tan (2000) showed the prevalence of obesity in Malaysia is 6.6% for the age of 7 years old and 13.8% for the age of 10 years old. Meanwhile, based on the basic health research in Indonesia shows, the prevalence of obesity in Indonesia reached to 9.2% for the age of 6 to 12 years old (Departemen Kesehatan Republik Indonesia, 2010). Obesity among adults and children increased almost 1 % annually. From the report by Departemen Kesehatan Republik Indonesia (2013) found the national prevalence of obesity in Indonesia increased from 12.2% in 2007 to 14.6% in 2012. The World Health Organizations also recorded an increasing on prevalence of overweight and obesity for adolescent age 5-19 years old. For example, the prevalence of overweight and obesity in Indonesia in 1975 amounted 0.6% and 0% increased to 14.6% and 5.7% in 2015 (WHO, 2015).

Adolescent obesity associated with a higher possibility of premature death and some disability in adulthood. It also impact the physical and psychological health of the person with the disease. Some of the obese people suffer diseases such as; asthma, hepatic steatosis, sleep apnoea, and diabetes mellitus which are the impact of obesity. Ottevaere et al. (2011) found there are several consequences of obesity such as; Type 2 Diabetes, hypertension, abnormal glucose tolerance. Meanwhile, Daniels et al. (2009) reported, the medical consequences of obesity in adolescent have a greater risk compared to ordinary adolescent for a cardiovascular disease in the future.

The mechanism of obesity development cannot be fully described in detail but known to occur when energy intake is greater than the energy released (Spronk et al., 2014). Overweight children and adolescents are more likely to become obese in the future (Epstein et al., 2014) and (Serdula et al., 1993). Genetic factors influence the vulnerability of obese in children. The possibility of the child to be obese is increase for the children with obese parent. However, environmental factors, lifestyle preferences, and cultural environment have the same roles as genetic factor in rising prevalence of obesity. Furthermore, based on previous studies, the choice in personal lifestyle and cultural environment significantly influences in obesity.

All countries over the world choose a different way to reduce the number of overweight people. Many research found the rules and programs have been organized to manage the obesity cases in adolescents. The probability of adolescent to stay overweight until becomes adult is high. Therefore, China, Qatar, and Australia try to reduce the obesity cases by introducing weight management programs on adolescents. For example, Chinese University of Hongkong applied low glycaemic index diet to help in managing obese adolescents. In Qatar, the government launched a youth weight management program. Meanwhile Australian government removed sugary drink in schools and many more (Malik et al., 2013).

There are many studies estimated the factor affecting children weight status using many types of analysis. For example, Crouch et al. (2007) and Dancause et al. (2012) used regression analysis to estimate the factor affecting the weight status in children. On the other hand, the regression analysis does not present a comprehensive model to assess all the factors concerning children's obesity. The regression analysis also has a problem with the presence of multicollinearity (Kheirollahpour & Shohaimi, 2014). To overcome this problem, this research used partial least square structural equation modelling (PLS-SEM). PLS-SEM use to estimate the factor affecting adolescent weight with a comprehensive model which assesses all the factors concerning on adolescent obesity.

## **1.2 Background of Study**

Overweight and obesity are linked to more deaths worldwide compared to underweight. In 2013, 42 million children under five years old were declared overweight or obese. Initially, obesity is defined as a high-income country problem. However, overweight and obesity do now also exist in low- and middle-income countries, particularly in urban settings. Obesity exist in developed countries with emerging economies classified by the World Bank as lower and middle-income countries. In developing countries, the number of children facing overweight and

obesity problem has increased to more than 30% higher than developed countries (WHO, 2015).

According to WHO, the obesity is already a global epidemic and has become a health problem that must be addressed immediately. In Indonesia, the changes on lifestyle which lead to westernization and the changes in eating pattern whom prefer to consume foods with high calories and fat increases the risk of obesity. Gillman et al. (2007) claimed, there are more than 9 million children in the world around six years old and above who are obese. Since 1970, obesity incidence continue to increase. The numbers of obese prevalence becomes doubled to the children around 2 to 5 years old and 12 to 19 years old, even tripled to the children around 6 to 11 years old (Fatma, 2011).

The prevalence of obesity is increasing from year to year, both in the developed and developing countries. Based on a survey from Kesehatan Nasional in Indonesia the prevalence of obesity increased up to 120% compared to raw median WHO / NCHS in infants. The number of obesity increased in both urban and rural area. In urban areas in the year 1989 found 4.6% of men and 5.9% of women are obese and it was increasing to 6.3% of men and 8% of women in the year 1992. In the countryside in the year 1989 found 2.3% of men and 3.8% of women are obese and it was increasing to 3.9% of men and 4.7% of women in the year 1992 (Hidayati et al., 2006). Based on a research by Departemen Kesehatan Republik Indonesia (2013) found the prevalence of overweight children around 5 to 12 years old is 18.8% with 8.8 % of them classified as obese. This number is almost similar to the WHO estimates. WHO estimated 10% of the children around 5 to 17 years old are obese (Departemen Kesehatan Republik Indonesia, 2013). The prevalence of obesity in West Sumatra over all province in Indonesia based on BMI was ranked on the 21<sup>st</sup>. In the city of Padang, the prevalence of obesity in elementary school children was estimated around 5.6% (BPS, 2015).

Furthermore, adolescent obesity was undertaken into this study because there is still lack of research for obesity around 13 to 15 years old. The changes of the lifestyle leading to westernization and the rapid growth of Indonesia economy gives

an impact to each city in Indonesia including Padang. This was the reason why this research was conducted in Padang city, Indonesia.

### **1.3 Problem Statement**

In the last decade, the increasing prevalence of obesity is not just a problem in high-income countries but has also occurred in low and middle-income countries (Fatma, 2011). In Indonesia, adolescent around 13 to 15 years old cases of overweight were commonly found in the western region especially in the island of Sumatra (Departemen Kesehatan Republik Indonesia, 2013). There are 7 provinces from 10 provinces had overweight prevalence above national average of 10.8%. The prevalence of obesity of adolescent around 12 to 15 years old in Padang is 10.4% with 2.1% of them are obese. This amount is almost equal to the national prevalence whereby from 10.8% of the cases, 2.5% of them are obese.

Many cases of obesity are found in Sumatra and are caused by various factors. One of the factors is eating pattern. People in Padang have typical eating habits. The people tend to eat animal protein and more coconut milk and less vegetables. Rendang, Kalio and Curry are the common cuisines favoured by these people. The typical menu is assumed to be the cause of the high rates of obesity and coronary heart disease cases in Padang compared to other cities. There are many study on the effects of nutrition toward obesity. However, almost all the studies only concentrated on the amount of nutrition consumed in a day. Those study are not considering other indicators such as eating habits that lead to an unhealthy eating pattern.

Other causes of obesity are physical activity. The amount of physical activity will affect the body weight. More activities and movement mean more calories and fat burned. This will reduce the amount of fat accumulated in the body. There are some studies on obesity in Padang, for example Octari and Liputo (2014), Darwin

and Iryani (2015), Mahesa Desvita (2011) and Maidelwita (2013). Maidelwita (2013) conducted a research to see the effects of physical activity undertaken by children who are in grades 4 to 6 in elementary schools in Padang. The research was conducted using the case-control method by comparing between the children who are affected by obesity with the children who are not affected. On the other hand, none of the research above investigated the effect of daily physical activities towards boy weight. Especially for the boy in the age of 12 to 15 years old. More daily physical activities will reduce the fat accumulated in the body which leads to obesity in the group age of 12 to 15 years old.

The third factor is socioeconomic factors. Social economic factors deals with the economic condition or economic change influences social lives in the community. The influence of socioeconomic factors on obesity in adolescents can be divided into several indicators. Some of the indicators are; neighborhood, family income, and allowance given by parents to the children. Number of adolescents with excess weight or obese generally occurs in adolescents with fixed or stable family income. It can be concluded, the economic condition is closely related to an increase of overweight or obese cases (Octari & Liputo, 2014). The high from parents income could be followed by an increase in people's purchasing power and consumption. For example, the high income in a family would attain bigger allowance to the adolescents. Therefore, the adolescents free to choose and buy many kinds of food without having to worry the amount, price and food ingredients. Another indicator for socioeconomic is neighbourhood. Neighbourhood as the location of residence of the adolescents also has a part in obesity. Since the location of the neighbourhood causes less interaction between the residents, the adolescents are likely to stay at home watching television, reading, or doing other indoor activity which does not need a lot movement (Octari & Liputo, 2014). Eventhough there is a reserch to show the effect of socioeconomic but the influence of socioeconomic towards the weight of people especially for adolescents is still not clear.

Furthermore, the cause of obesity in adolescents is assumed to be the factor of health awareness. Health awareness becomes one of the most important factor causing obesity because through acknowledgement of the health awareness obesity can be avoid. Health awareness is not only medical check up but also an education or

knowledge to choose the right food to consume. There are a few studies on the effects of parent education for children obesity such as Darwin and Iryani (2015). Darwin and Iryani (2015) investigate the relationship between mother's knowledge of nutrition and childhood obesity among elementary school students. There is even a research on health awareness but still lack to determine obesity in adolescents. In conclusion, there are still little studies viewing the effects of knowledge of the health in adolescents.

Obesity is a complex nutritional factor. Obesity cannot be considered to occur due to one factor only because of the complexity of obesity itself. The effect of each factor explained above provides a direct or indirect effect into obesity to the adolescent. Some of these factor have a relationship which can cooperate with each other to effect the weight of adolescent. There has been a lot of research with many different cases. However, there are still shortcomings in the use of a variety of factors attempts to examine the relationship of each factors which are involved.

Nowadays, technology involved almost in all sector of human being. Technology based on hardware or software are already involved in health sector. There are many intervention and preventions in health cases such as obesity with using technology. As time goes by an access to technology, now it is become more easier to access any health information. In America, a third of American cell phone users have used the phone to access health information and 12% of smartphone users have at least one health application (Tate et al., 2013). Current study shows many people are using e-learning media including obesity e-learning obesity. However, most of e-learning only focus on one specific variable only eventhough obesity is a multifactorial disease. Therefore, all the factors are to be considered simultaneously.

#### **1.4 Significance of Study**

This research aims to investigate some of the factors influencing obesity in adolescent. There are five factors involved in this research which are assumed influence the obesity. There are genetic factor, nutritional factor, physical activity factor, socioeconomic factor and the last is health awareness factor. Therefore, this study also examines the effects of each factor to the obesity and the interaction of each of these factors. From influence of each of these factors, this study expects to determine the factors affecting adolescents weight and the sum of it.

Finally, this study is produce a structural model showing how these factors interfere each other so it may cause the obesity in adolescent. From the model it can be determined the relationship of each factors with the weight of adolescent. In addition, it can also determine the relationship among the factors itself. Moreover, as time goes by, the learning process is already exploiting these technological advances to learn and know more on obesity. This research expects to produce an e-learning application based on the result from the statistical analysis with the PLS-SEM. This is to produce an obesity rehabilitation learning application accordance with the existing situation.

#### **1.5 Objective of the Study**

There are three main objectives conducted throughout this research, which are:

1. To determine the influencing factors of obesity in adolescents aged 12 to 15 years old.
2. To analyse the relationship among factors leading to obese adolescent using PLS-SEM statistical analysis.
3. To develop rehabilitation application program for obesity adolescent.

## **1.6 Research Question**

Based on the objective mentioned above, the research questions are:

1. Is there influences from several factors that affected on weight towards adolescent obesity ?
2. Is there any relationship between factors that affect in adolescent obesity and how the factors works on the weight of adolescents ?
3. What is the basis to build rehabilitation application program for obesity adolescent?

## **1.7 Scope of the Study**

The research was held in Padang, West Sumatera, Indonesia. Padang was chosen as the people in Padang have a unique sense of food. Almost all the food in Padang have excess fat content and more spice than other provinces in Indonesia. The culture and the food tastes almost the same since majority of the Malay population are scattered in Malaysia and Singapore. Therefore, the result of this research can provide a great benefit for human beings worldwide.

Obese people have higher risk to be affected to other diseases such as heart disease and cholesterol compared to people with a normal weight (Daniels et al., 2009). Therefore, this research uses a population sample from ages 13 to 15 years old students from public junior high school. The research focuses on five factors; genetic, nutritional, physical activity, socioeconomic and health awareness. The research determines the factors influencing on weight and also the relationship amongst them.

The statistical method used in this research is PLS-SEM. The results from the analysis is used to build E-learning rehabilitation for obesity. Hopefully this



rehabilitation application can decreased the growth of obesity cases with early prevention in adolescents.

## **1.8 Conceptual and Operational Definition**

There are a some conceptual needs to clarify in this research. There are :

### **1.8.1 Multicollinierity**

Multicollinierity in statistisc was defined as a situation in which two or more predictor variable in multiple regression are highly correlated. This means one can be linearly predicted from the others with a substantial degree of accuracy.

### **1.8.2 Body Mass Index**

In general, Body Mass Index (BMI) is an inexpensive and easy-to-perform method of screening for weight category such as; underweight, normal or healthy weight, overweight, and obesity.

### **1.8.3 Riset Kesehatan Dasar**

Riset Kesehatan Dasar is a form of nationwide research activities or census conducted by the Indonesian Health Ministry. The purpose of the research is to measure all aspects of basic health care in the entire territory of Indonesia. Riset Kesehatan Dasar has been done three times in 2007, 2010 and 2013.

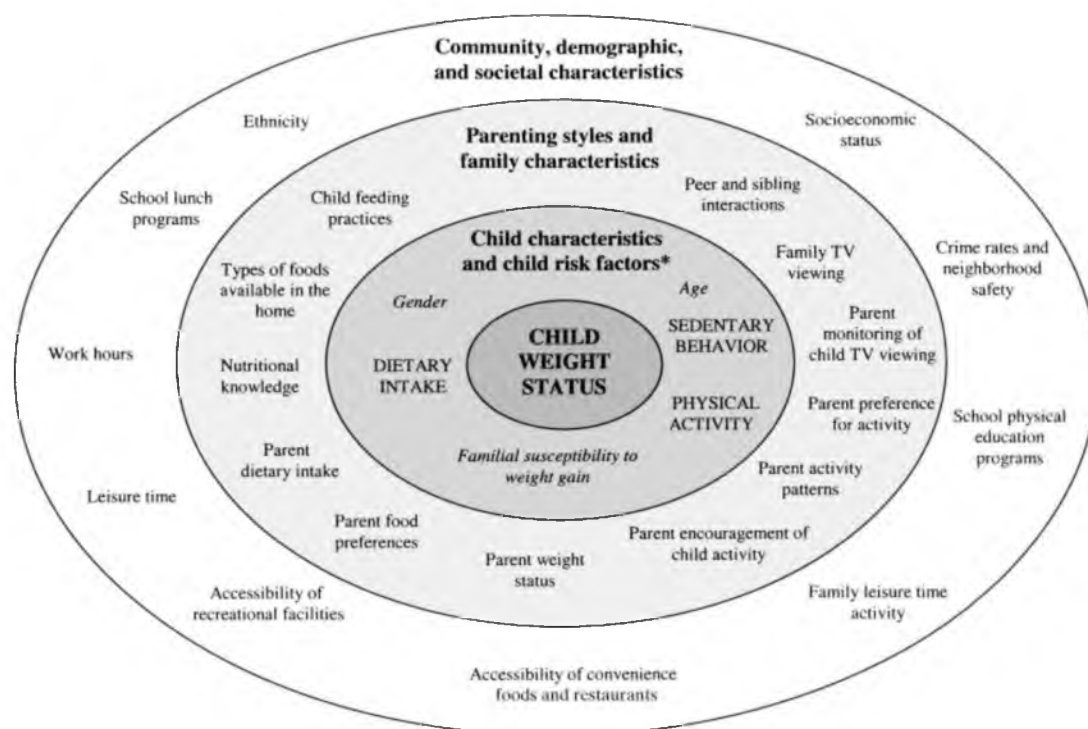
## **1.9 Theoretical Framework**

A research involving only one particular factor will only produce a single output or model. However, obesity is a complex nutritional problem involving many factors. Hence, the focus of this research is to look deeply in more factors causing obesity as well as the effects and relationships of each factors. Therefore, a thorough prevention in adolescent obesity needs a model involving many factors in daily life which could be the cause of obesity in adolescents.

An ecological theory was built as the theoretical framework for measuring and to determine the complex public health. An ecological theory is very good and can also be used to look at the factors affecting obesity. Bronfenbrenner (1994) stated, an individual ecological must be considered to make a changes on the person's health. This framework remarked as a critical examination of social determinants of health. WHO in 2010 also defined this framework as the conditions in which people are born, grow, live, work and age.

Based on the ecological theoretical study Bronfenbrenner (1994), development, or changes in individual characteristic cannot be effectively described without consideration of ecological aspect where the person lived. In the case of childhood obesity, the development of children weight is a result from interaction between child characteristic and child risk factor (Davison & Birch, 2001). The

application of ecological theoretical study to a factors of childhood overweight was presented by Davison and Birch (2001) as shown in Figure 1.1 below :

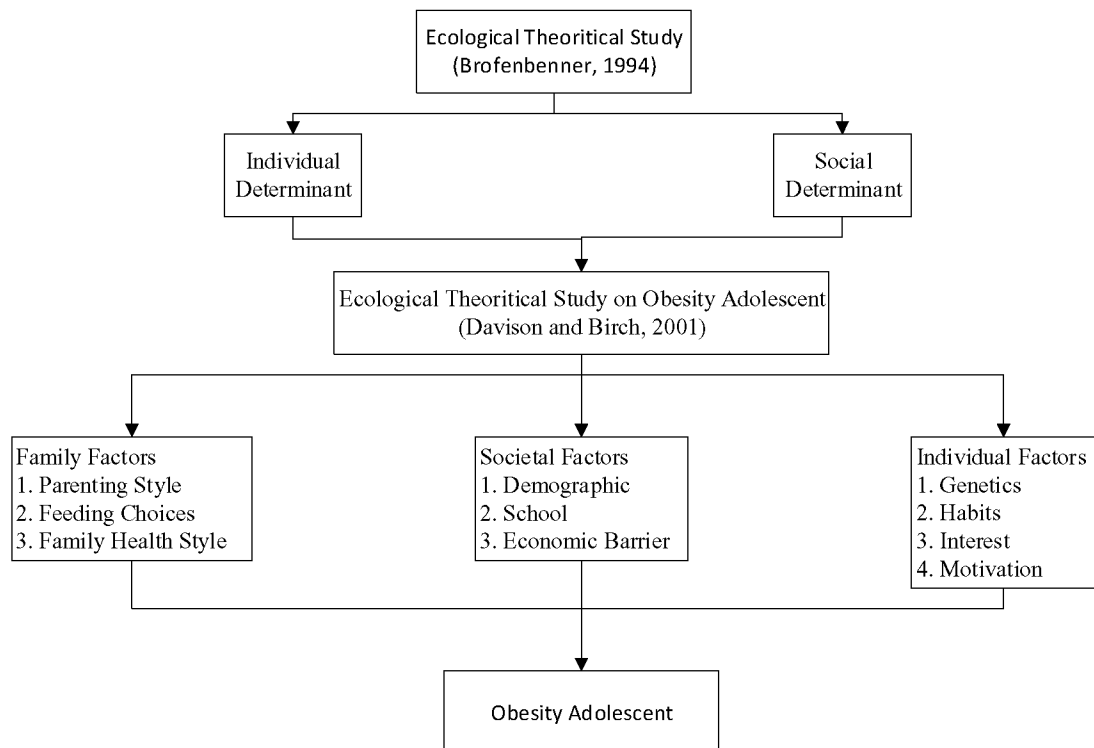


**Figure 1.1** Ecological theoretical framework for childhood overweight  
(Davison & Birch, 2001)

According to the framework in Figure 1.1, Davison and Birch (2001) classified dietary intake, physical activity, and sedentary behaviour as child risk factors. The child risk factors are moderated by child characteristics including age, gender, and susceptibility to weight gain. Child risk factors influence by another two-outer layer on the framework; parenting styles, family characteristic, community, demographic, and societal characteristics.

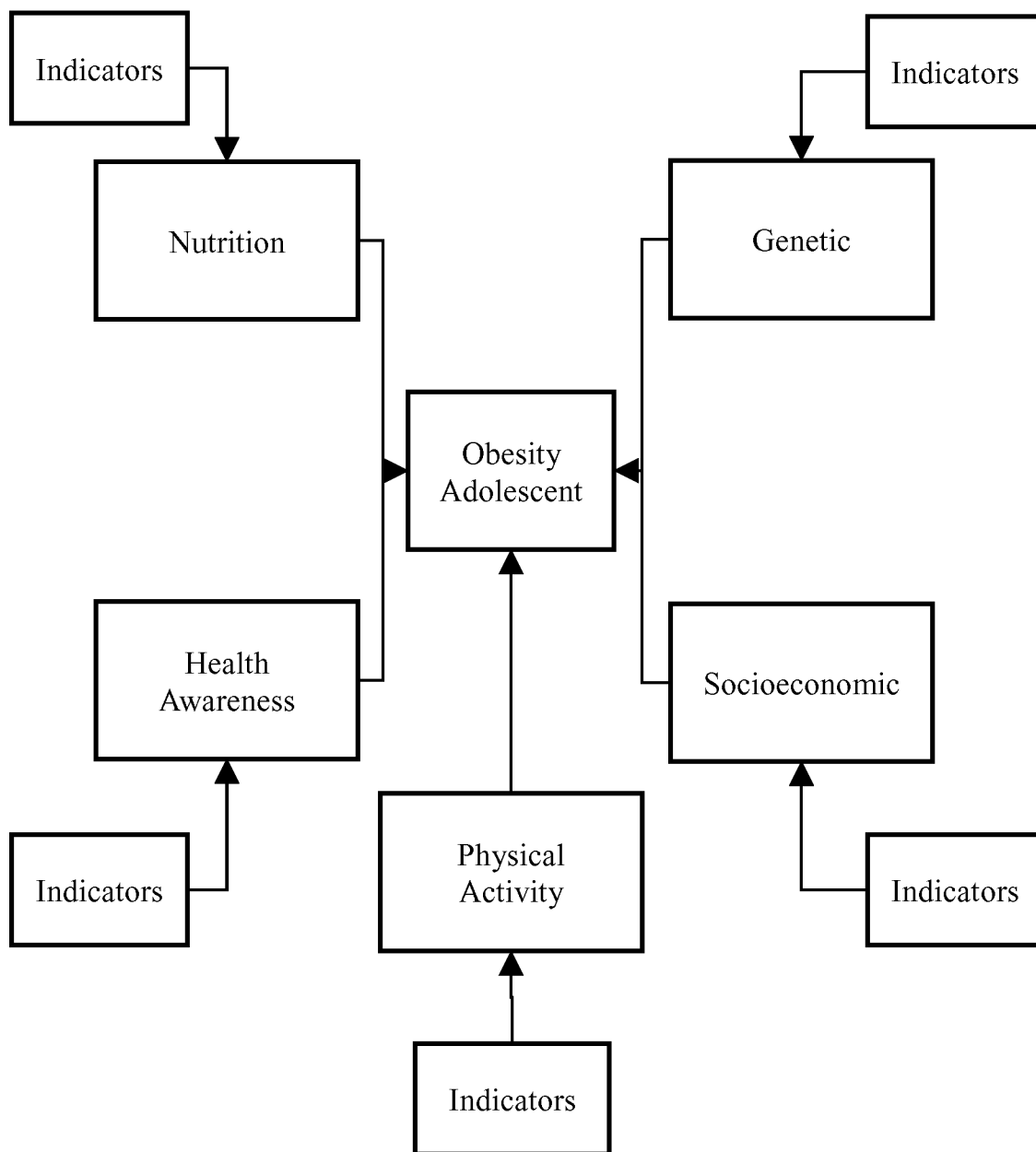
There are many studies using ecological theoretical framework for overweight children by Davison and Birch (2001) such as Scott et al. (2012), Schrepft et al. (2015), and Rachmi et al. (2016). Scott et al. (2012) developed the ecological framework of childhood overweight in sub-Saharan Africa. The framework focuses on multiple environmental factors affecting the weight in children (Details on Figure 1.2). A child weight status is directly influenced by individual risk factor which are influenced by family and societal characteristics. Family characteristics include parenting style, family structure, family feeding

choices and family exposure for a healthy lifestyle. Individual characteristics includes genetic factors, habits, interest and motivation. On the other hand, societal characteristics includes neighbourhood demographic, school and economic barriers. Ecological system theory of childhood overweight addressing the combined affect of family, societal and individual factors contributed towards childhood obesity (Scott et al., 2012).



**Figure 1.2** Ecological theoretical framework for obesity in sub-Saharan  
(Scott et al., 2012)

Therefore, this research also uses ecological theoretical study in adolescent obesity by Davison and Birch (2001). However, different with the original framework, this research uses five variables influences in adolescent obesity. The variables consist of; genetic factors, physical activity, socioeconomic factors, nutritional factors and health awareness factors. Each variable is supported with several indicators such as; income, exercise time, and knowledge. Details of the research framework is shown in Figure 1.3 below.



**Figure 1.3** Adolescent obesity theoretical framework

### 1.10 Organization of the Thesis

This thesis features the factors leading to obesity in adolescents and the relationship between each factor to have an impact on body weight of adolescents in

Padang, Indonesia. Brief details the relevance of this research was conducted and the development of obesity in the world and the development of adolescent obesity in Padang, Indonesia is included in Chapter 1. Chapter 1 also includes the definition of obesity, factors affecting in adolescent obesity and the after effect of obesity in adolescent's future.

In Chapter 2, a brief literature review related to this study is included. A review of the literature includes descriptions of each factor leading to obesity in adolescents and the relationship between each factor. Several factors discussed in this study are; genetic, nutritional, physical activity, socioeconomic factor and health awareness. Additionally, this chapter also explains the statistical analysis method and review of obesity rehabilitation and learning application.

Chapter 3 describes the details of the research design that uses cross sectional study which is justified clearly. The development of analysis method and research instruments such as questionnaires is also explained further in this chapter.

The result from statistical analysis outcomes of this study are discussed in Chapter 4. Chapter 5 includes an explanation and discussion on the results of statistical analysis. Moreover, obesity learning, and rehabilitation application is also discussed in Chapter 5. Lastly, further recommendations for future research along with conclusion on overall study are included in Chapter 6.

## **1.11 Conclusion**

This chapter basically describes in brief the reasons why this research is being conducted. There are many factors still have not seen his role in influencing body weight to become obese adolescents. This study explains all the factors and relationship of each factor towards obesity in adolescents. Hence, the major contribution of this study is to produce an E-learning application based on the result

of statistical analysis with the PLS-SEM. The findings of this study contribute in providing an obesity rehabilitation learning application according to with the existing situation.

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