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**Schoolchildren's Obesity Status, Lifestyle Behaviors, and Their  
Predictors:  
Development of Healthy Weight Model  
in Urban Indonesia**

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## Schoolchildren's Obesity Status, Lifestyle Behaviors, and Their Predictors:

### Development of Healthy Weight Model in Urban Indonesia

This first chapter comprises a description of the study's background, purpose and objectives, significance, theoretical framework, and definitions of terms.

#### **Background**

Pediatric obesity is one of the biggest health issues in the world. In May 2014, the World Health Organization (World Health Organization [WHO], 2014a) established a high-level commission to end child obesity. The WHO defined “overweight” as one standard deviation from body mass index for age and sex, and “obese” as two standard deviations from body mass index for age and sex (WHO, 2014b). The number of obese or overweight children from the ages of two to 19 increased 26%, from 246 million in 1993 to 311 million in 2013 (Institute for Health Metrics and Evaluation [IHME], 2014). Of these children, 83% or 257 million live in low- or middle-income countries (IHME, 2014).

Child obesity is a major contributor to adult obesity and the global burden of noncommunicable diseases (NCDs) such as cancers, diabetes, and heart diseases (WHO, 2014a). NCDs are one of the 17 targets of sustainable development goals (SDGs; United Nations Development Programme [UNDP], 2015). In 2010, NCDs were responsible for 65% of world deaths (IHME, 2014). Obesity is largely caused by lifestyles comprising excessive food intake and physical inactivity (International Council of Nurses, 2009); therefore, it is generally preventable, but basically irreversible once established (Luttikhuis et al., 2009). Furthermore, low- and middle-income countries are suffering from a “double burden” of malnutrition, obesity, and under-nutrition (Black et al., 2013).

As a lower-middle income country, Indonesia has experienced considerable socioeconomic changes since the 1990s. Indonesia's total economic activity, expressed as its gross domestic product per capita, has increased five-fold (960 USD to 5,214 USD) during the last 30 years (International Monetary Fund, 2013). In accordance with changes in lifestyles, NCDs have

increased from 45% in 1990 (IHME, 2013) to 71% in 2014 as major causes of death (WHO, 2014).

With Indonesia's "double burden," child obesity is becoming a significant public health problem. The majority of the Indonesian population lives in urban areas (51%) and Java Island (57%) (Badan Pusat Statistik [Indonesian Bureau of Statistics], 2014). Irrespective of rural or urban locations, almost all Indonesians can access high-calorie foods, and 30% of them demonstrated physical inactivity (WHO, 2012). In 2013, the overweight or obesity rate of Indonesian children aged five to 12 was 19%, but Jakarta, the capital, has the highest rate at 30%, and the rate is also relatively higher in Java Island (Kementerian Kesehatan Republik Indonesia, 2013b). Thus, child obesity prevention programs are especially needed in urban areas.

At the program level, child obesity prevention is limited even though NCDs are one of the seven priorities of the Ministry of Health, Republic of Indonesia. As stated in their national strategic plan 2010–2014, the Ministry's target was to reduce NCDs by 30% by 2014 (Kementerian Kesehatan Republik Indonesia [KKRI], 2010). However, the programs have mainly targeted the middle-aged and the elderly (KKRI, 2012). In 2012, the Ministry developed the detailed "Guidelines of Schoolchild Overweight and Obesity Prevention" for schoolchildren (KKRI, 2012), but these guidelines are yet to be implemented in schools. The Appendix 1 contains a summary of these governmental guidelines, which aimed to develop a comprehensive, multisectoral approach, with teams consisting of schoolchildren, family, school, community, and health service providers. In collaboration with schools, health centers play important roles in screening, consultation, and follow-up activities presented by health service providers. The program based on this guidelines has not yet implemented with no human resource nor budget allocation. Although the government noticed the importance of child obesity prevention, their focus is still on communicable diseases, elderly care, and maternal health which are currently visible than prevention.

Thus, along with the existing policy, implementing child obesity prevention programs for urban Indonesia is a pressing issue.

## Purpose

This study aims to investigate structural relationships among schoolchild obesity status, lifestyle behaviors, and their predictors in order to suggest a healthy weight development model in urban Indonesia.

## Objectives

The first objective of the study is to describe schoolchild obesity status, lifestyle behaviors (diet, physical activity, and sleep), and their predictors (predisposing, reinforcing, enabling, and environmental factors) relating to child obesity. Second objective of the study is to examine structures between and among schoolchild obesity status, lifestyle behaviors, and their predictors to develop a healthy weight development model for South Tangerang District, Banten Province, Indonesia.

## Significance

This research will become a basis of the project and collaborative process for developing a future obesity prevention program to benefit Indonesian society. Predictors (predisposing, enabling, reinforcing, and environmental factors) and child lifestyle behaviors related to child obesity will be examined. Expected contributions to research and practice are as follows:

**Information of child obesity prevention in middle-income countries.** The study will add to the very limited information on middle-income countries' child obesity status and its predictors. Additionally, it will contribute to child obesity prevention studies in middle-income countries and school health policy making.

**Model development to improve children's health status in urban Indonesia.** The study will develop a model to improve the health status of children aged 9 to 11 in South Tangerang District, Banten Province, Indonesia.

**Development of a child obesity prevention program to reduce future NCDs deaths.** Within a community health program, the study will provide a school health program for implementation by stakeholders, including guardians, schoolteachers, health service providers, and health policy makers in urban Indonesia.

### **Study Framework**

The framework is based on the PRECEDE-PROCEED Model developed by Green and Kreuter (2005) as shown in Figure 1. Urban Indonesia has different—negative, positive, and mixed—values of obesity, and in this situation, the number of people with obesity is rapidly increasing. In response, the government has established a schoolchild obesity prevention policy and guidelines, but no prevention programs have been implemented. Therefore, an early childhood obesity prevention program is needed.

In the obesity prevention program's literature review, the most frequently used theory in programs to promote positive behaviors was Bandura's Social Cognitive Theory (1986). Bandura's theory was used in phase two—epidemiological, behavioral, and environmental assessments—and in phase three—educational and ecological assessments (Glanz et al., 2008). Bandura has theorized that people are influenced by both internal and external factors. Therefore, in the first phase of child obesity prevention program development in this cross-sectional study, the researcher will investigate the relationship among predictors of obesity such as perceptions of obesity, child LSBs, family, environments, and obesity status.

Childhood is the ideal time to acquire healthy lifestyle and behaviors (LSBs). The Precede-Proceed Model aims to develop a health program, and for developing countries, a practical guide for planning obesity prevention programs among school-age children and adolescents has already been published using the Precede-Proceed Model (University of Montreal, 2014). Therefore, a more effective prevention model specifically for the Indonesian context can be developed by utilizing this childhood period and the Precede-Proceed Model.

## Definition of Terms

**Obesity status.** In this study, obesity status refers to indicators representing weight, height, body mass index (BMI), waist–hip ratio (WHR), and bioelectrical impedance analysis (BIA). Based on the IOTF (International Obesity Task Force) criteria, BMI 25 at 18 years old is calculated by degree of obesity by month and current BMI. In this criteria, obesity status is classified by obesity, overweight, normal and thinness.

**Prevention.** Prevention refers to the knowledge, attitudes, and behaviors of children, families, schools, and government to protect themselves.

**Schoolchild.** In this study, schoolchild refers to children aged 9 to 12, who attend elementary school, that is, fourth-, fifth-, and sixth-grade children.

**Healthy weight development model.** Healthy weight development model refers to prevent overweight and underweight for child healthier development. Model aims to prevent overweight and underweight beforehand by lifestyle behaviors which are influenced by lifestyle behaviors predictors.

**Predictors.** Predisposing, reinforcing, enabling, and environmental factors which predict child lifestyle behaviors.

**Predisposing factors.** Predisposing factors refers to knowledge, attitudes, values, and perceptions that promote and motivate children's lifestyle behaviors and health status.

**Reinforcing factors.** Reinforcing factors refers to attitudes and behaviors of other individuals that promote or hinder schoolchild behaviors.

**Enabling factors.** Enabling factors refer to the factors which promote the behaviors. For instance, existence of friends or family which promote children to conduct certain lifestyle behaviors.

**Environmental factors.** Environmental factors refers to external factors around children; for example, parents, elementary schools, health services, and policy, which influence child lifestyle behaviors and obesity status. Children are exposed to the environment by living in a community and

are affected by, for example, the national policy of food labeling, local governments' restriction of chemical food additives, and accessibility to obesogenic foods.

**Lifestyle behaviors (LSBs).** Lifestyle behaviors refers to children's individual responses such as dietary, physical activity, and sleep lifestyle behaviors influenced by certain predictors, in this study, predisposing, reinforcing, enabling, and environmental factors.

**Screen time.**Screen time refers to the amount of time spent watching television, using computers, playing computer games, and using mobile phones.

## Literature Review

This chapter comprises a description of a country profile, the health profile of the South Tangerang District, worldwide issues of child obesity, and obesity issues in developing countries and in Indonesia. Additionally, it reviews global child obesity prevention intervention programs, including search methods, study quality, settings, theories used, participants, predictors of child obesity, interventions, measurements, outcomes, and implications.

### Country Profile of the Republic of Indonesia

**Overview.** The Republic of Indonesia is located in Southeast Asia, and its capital is the Special Capital Region of Jakarta (Figure 2). In Indonesia as a whole, there are 300 ethnic groups that speak 350 languages and are spread over 17,000 islands (Central Intelligence Agency [CIA], 2014). The population of 250 million people is the fourth largest in the world (CIA, 2013). Of these, 51% live in urban areas (Badan Pusat Statistik, 2014). The climate is tropical—hot and humid all year (CIA, 2014). The average life expectancy is 71.9 years (CIA, 2013).

**Islamic background.** The majority (86%) of the people are Muslims, 9% are Christians, and 2% are Hindu (Departmen Kesehatan [Ministry of Health, Indonesia], 2013). The majority of Indonesian people believe in the five pillars of Islam, which are faith, prayers, alms giving, fasting, and pilgrimage to Mecca (Ali, Liu, & Humedian, 2004). It is inevitable for Muslims to live without believing in these pillars. Every year, Muslims fast for one month, and this is the most important month for them. During daylight hours, they consume nothing, eating only before sunrise and after sunset. This practice is a religious trial expressing gratitude for food (Ali, Liu, & Humedian, 2004). During this time, everyone is interested in food, and, certainly the irregular behavior of eating very early in the morning and very late at night occurs.

In some Islamic countries, women generally stay inside their houses and rarely go out alone. Women exercise and shop with their friends or families. In Indonesia, when a woman goes out,



others ask her where she is going and who is attending her, using typical set phrases that might translate as “Who attends you?”

**Politics and society.** In Indonesia, the first democratic legislative election was held in 1999 (CIA, 2014), and the economy has been growing since the 1990s. The gross domestic product (GDP) per capita was 960 U.S. dollars (USD) in 1983, but by 2013, it had risen to 5,214 USD—a five-fold increase in 30 years (International Monetary Fund, 2013). The unemployment rate is 6.6%, and 12% of the population live below the poverty line (CIA, 2014). Primary sector of industry (agriculture) is 13.7%; secondary (industry) is 42.9%; tertiary (services) is 43.3% of working population (CIA, 2014). The human development index was .684 in 2013, ranking Indonesia at 108 of 187 countries (United Nations Development Programme, 2014). Poverty and wealth, rural and urban coexist in the same country.

**Health profile of the South Tangerang District, Banten Province, Indonesia.** South Tangerang District is located at the peri-urban area of the Special Capital Region of Jakarta and comprises seven sub-districts. The total land area is 147.19 km<sup>2</sup>. The area’s population was estimated at 1,443,403 in 2013 (Badan Pusat Statistik [Central Statistics Bureau, Indonesia], 2015), and 1.75% of the population exist below the poverty line (Badan Pusat Statistik, 2015). The average life expectancy is 71.9 years (CIA, 2013). There are 25 *Puskesmas*, or health centers, and one general hospital in the South Tangerang District (Dinas Kesehatan South Tangerang, 2015).

The South Tangerang District has 347 elementary schools, with 129,240 students. Almost all (99%) of the children are a part of school education (Dinas Pendidikan Kota Tangerang Selatan, 2015). In 2013, concerning school health services, the district health office began the *Perilaku Hidup Bersih dan Sehat (PHBS)* or the Clean and Healthy Lifestyles Campaign, focusing mainly on hygiene.

Following are the two reasons for selecting the South Tangerang District: (a) it is a place whose residents are inclined toward being obese a highly populated and urbanized area and (b) it is the study field of the University of Syarif Hidayatullah Jakarta (UIN), our research partner. The UIN is interested in research in the South Tangerang district, is trusted by the community, and

possesses as much information on the area as health professionals. The community and the local government also readily grant permission for research. Furthermore, for security reasons, this familiar area is better for participants and research assistants.

### **Issues of Child Obesity in the World and Indonesia**

**Child development.** Because few textbooks are written in the Indonesian language, most nursing students use textbooks on child health published in English-speaking countries. Therefore, the researcher used the stages of development of Japanese children as a reference.

Okado (1983, pp. 50–59) mentioned that the age from 9 to 11 years is one in which children are significantly influenced by family and classmates concerning personality development. Generally, children of this age play actively and have an adequate appetite. Additionally, during this period, children begin expressing their opinions and stating justifications to others. They start keeping secrets among friends—secrets not to be known by parents. They learn about social rules and rights by playing with their friends, and they know that they will be punished if they break these informal rules. Through reading and writing skills, abstract thinking also develops during this period.

Physically, schoolchildren are at a phase of physical growth when they play very actively and have good appetites. With appropriate diet, exercise, and resting behaviors, children can acquire healthy lifestyles. Psychosocially, they are in a rebellious phase and try to be independent of their guardians. Mentally, they compare themselves with their friends, keep secrets among friends, and make fun of other friends. This period is important because children's lifestyles might affect their lifelong health, and certainly, the age of 9 to 11 is a crucial point in supporting children in acquiring healthy lifestyles.

Five reasons for selecting schoolchildren aged 9 to 11 (fourth to fifth graders) are as follows. First, this period is ideal to acquire healthy lifestyles. Second, in Indonesia, accessibility to kindergarteners is difficult because the numbers of children and kindergartens are limited. Third, children aged 9 and older can understand the meaning of items in a questionnaire. Fourth,

according to the preliminary study, children at this age can concentrate on conversing with adults for up to 30 min. Fifth, among children in the sixth grade, some have failed and must repeat the year to become junior high school students, making selection for the study difficult.

**Social and cultural perception of obesity.** Developing and developed countries have different body images of obesity. Globalization has brought new lifestyles and values to developing countries, so a double burden of malnutrition (obesity and thinness) and mixed values (obesity as healthy and thinness as healthy) exist in one country.

There are two primary social values for body shape are “thin-ideal” and “obese-ideal.” Thin-ideal associates positive values with thinness; for instance, successful, self-regulated, and attractive. Obese-ideal associates negative values with obesity; for instance, lack of self-control, poor health, and poor hygiene. Obese people are often discriminated against, become depressed, have low self-esteem, and suffer eating disturbances (Delisle, LeDoux, & Strychar, 2014).

However, most developing countries tend to value obesity as a sign of health, wealth, and sexual attractiveness (Delisle, LeDoux, & Strychar, 2014). In Indonesia, many people mentioned that obese children are cute, healthy, and wealthy, while others mentioned obesity as a risk of death (Uun, personal communication, December 9, 2014).

**Healthism and obesity, health as a human right to attain personal goals.** Discussions of healthism include the “self-responsibility” of individuals for maintaining a healthy weight. Some countries have taxation regime for obesogenic foods such as saturated fat, sugary drinks, and junk foods and generally reduced taxed products consumption. However it also increased the food price and cross-border consumptions (European Competitiveness and Sustainable Industrial Policy Consortium [ECSIP], 2014). Ikari (2014) observed that U.S. local governments view weight control and health promotion as individual duties. Campaigns warning parents and children about the dangers of obesity and showing obese children’s photos were accused of fostering discrimination. Ikari criticizes new public health systems that classify BMI deviants as social risk factors or society’s drop-outs (Ikari, 2014).

Based on this discussion, we should not simply blame children or mothers for lack of responsibility because multiple factors are related to child obesity. Obese children and their parents should not be discriminated against because of obesity. However, a healthier weight increases children's options for realizing their future possibilities. Therefore, the researcher would like to focus on this issue from a health perspective to prevent child obesity.

The aspect of human security explains why we must prevent obesity. Developing countries have both "western" and "traditional" values, which mix perspectives on obesity as healthy or unhealthy. We need to be sensitive about social discrimination or stigma toward obesity. The researcher is concerned about obesity only because it causes various health problems that might hinder studying, working, and attaining personal goals.

Human security involves protecting the vital core of all human lives in ways that enhance human freedoms and human fulfillment—free of want and threat (Commission on Human Security, 2003). Health is both a purpose and a method of human security, and being healthy is the core of human security. Thus, obesity and NCDs threaten society because good health enables people to choose from a wide range of options, to pursue opportunities, and to plan the future, especially for children.

**Obesity in Indonesia.** Health status and the issue of child obesity have been undergoing a drastic change along with socioeconomic development.

***Double burden of malnutrition in an emerging country.*** In accord with the Indonesian people's economic development and lifestyle, the proportion of diseases has shifted drastically to the double burden of communicable and noncommunicable diseases. NCDs have been increasing from the 1990's in accordance with economic growth. In 1990, the prevalence of NCDs accounted for 43% of total deaths and 58% in 2000, and 67% in 2010 (Harvard School of Public Health, 2015). The NCDs cost in Indonesia are enormous. Total health expenditure has been almost 5-fold from 1995 to 2013 (29,673 and 156,671 USD, respectively; WHO, 2016). According to the estimates, 4.47 trillion USD (or 17,863 USD per capita) will be spent on the major five of NCDs such as cardiovascular disease,

cancer, chronic pulmonary disease, diabetes and mental health from 2012 to 2030 in Indonesia (Harvard School of Public Health, 2015). Although Indonesia has an NCDs prevention policy, the programs focus on adults, not children, and treatment, prevention is under development (KKRI, 2012). In 2014, the Indonesian government launched a new national insurance system, operated by the BPJS (Badan Penyelenggara Jaminan Sosial), the Social Security Organizing Agency. Under this universal health coverage system, the national government comprehensively insures health services for its citizens. The national insurance system has been in transition, aiming toward a comprehensive and preventative society (Badan Penyelenggara Jaminan Sosial [Social Security Organizing Agency], 2014). To maintain the national health system and the national budget, early prevention is needed.

Simultaneously, Indonesia faces the double burden of malnutrition (DBM) (World Bank [WB], 2012). Some children suffer from under-nutrition, whereas others suffer from over-nutrition (WB, 2012). The majority of obesity in Indonesia is exhibited in the poorer population and conditioned by obesogenic urban environments (WB, 2012). In 2014, the greatest percentage (19%) of overweight children were in the younger age group of five to 12 years, and as groups' ages increased, this percentage decreased to 11% in 13- to 15-year-olds and to 7% in 16- to 18-year-olds (BPS, 2014).

In Indonesia, genetic factors were negative contributors to obesity (WB, 2012). Other factors related to child obesity in Indonesia will be discussed in the following chapter.

***Diet and physical activities.*** Indonesians' dietary trend has changed along with lifestyle changes. Recent total caloric intake was 2,725 kcal per day in 2011, which increased from 2,390 kcal in 1990 (Food and Agriculture Organization of the United Nations, 2014). In 2007, compared with 1967, rice consumption remained stable; meat or fish consumption doubled; milk consumption rose three-fold; and wheat consumption rose eight-fold (WB, 2013). Indonesians are well nourished, and overall caloric intake is increasing.

In fact, Indonesian children can easily access salty, oily, sugary, energy-dense, and global processed foods. Additionally, children prefer snacks to proper meals, and 35% of schoolchildren purchase high-calorie snacks from street vendors (WB, 2012). The number of supermarkets has increased from 10,365 in 2007 to 16,922 in 2010 (Japan External Trade Organization, 2013). Expenditure on processed foods has increased 46% from 13 billion USD in 2007 to 19 billion in 2010, and is expected to increase 69% to 22 billion in 2013 (Japan External Trade Organization, 2013). The Decree of Information and Daily Suggestion for Processed and Fast Food (KKRI, 2013a) regulated providing proper food (sugar, salt, and fat) information to avoid an NCDs-friendly environment. Certainly, every Indonesian possessed easy access to obesity-friendly foods anywhere, any time.

In addition, the prevalence of physical inactivity is approximately 30% of the total population (WHO, 2012). Economic development has enabled people to own vehicles, and public transportation systems such as buses, minibuses, and bike-taxis have instituted door-to-door transportation from people's houses to their workplaces without having to walk long distances.

Increasingly excessive calories and physical inactivity can predict future obesity and NCDs among Indonesians. The Ministry of Health prioritizes NCDs and obesity prevention at the national level, but programs focus on adults, not children (KKRI, 2012). Due to insufficient support from child-centered programs, Indonesian children are at high risk from obesity-friendly foods and a low-exercise environment.

**Environments of diet and physical activity.** In urban Indonesia, environmental backgrounds possibly hinder physical activity; for example, the hot and humid weather, air pollution, road accidents, and crime.

Hot weather certainly influences LSBs. For example, in the past, Indonesians fried foods to avoid spoilage because they lacked refrigeration systems, and high-calorie, high-fat frying might still be a common custom. Moreover, people prefer spicy foods.

Chaotic traffic situations and air pollution can be hazardous to those who exercise outside. The number of cars and motorcycles has significantly increased, and air pollution is so severe that

people wear surgical masks in town. Undisciplined drivers and the car-dominant traffic system cause frequent road accidents, hence, threatening pedestrians. Approximately 8% of Indonesians die of accidental injuries (IHME, 2014). In 2010, the number of road traffic deaths was 31,234 (WHO, 2014), the highest in Southeast Asia and the eighth highest in the world.

High incident rates of theft, violent crime, and kidnapping (United States Department of State Bureau of Diplomatic Security, 2014) causes parents to discourage children from going out to play and exercising alone. The researcher often hears the question, “Who is attending you to go there?” Commonly in Indonesian society, one is accompanied by another when going outside. Women, especially, do not commonly shop, eat, or exercise alone, even though this situation has gradually been changing in urban areas. These environmental backgrounds possibly cause people to avoid exercising in urban Indonesia.

### **Systematic Review of Studies on Child Obesity Prevention Programs**

**Purpose of the literature review.** This literature review aims to review systematically extant child obesity studies throughout the world and to inform this study in order to develop an effective child obesity prevention model.

**Search methods.** A comprehensive, systematic review was conducted based on the method of Holly and Saimbert (2012). Electronic database searches were conducted to locate child obesity prevention studies. The keywords used were as follows: population (child, young children, and schoolchildren), interventions (diet, nutrition, exercise, physical activity, and physical exercise), and outcomes (pediatric obesity, prevent). Within the time parameter of 1999 through 2014, there were 50 randomized controlled trials and 27 observational studies that met inclusion criteria.

**Study quality.** Results of the study quality (Newhouse et al., 2011) revealed that of the 50 randomized controlled trials, two were low-quality trials and 48 were high-quality trials. The remaining 27 observational studies included 9 low-quality studies and 18 high-quality studies.

**Settings.** Settings of the studies were as follows: 70 of 77 studies were conducted in high-income countries, and the other seven studies were conducted in low- or middle-income countries.

Of the 70 studies, 37 were conducted in the US. Locations of interventions were as follows:

community, home, or schools where children study, clinics, hospitals, recreation centers, churches, summer camps, and meetings of income-generating associations.

**Theories used.** Approximately half (38 of 77) of the studies had theoretical frameworks. For example, six used social cognitive theory, five used social learning theory, five used the environmental change model, three used the transtheoretical model, three used behavioral change, two used anticipatory guidance, and two used a socioecological model (26); including 12 others.

**Participants.** The studies' sample sizes ranged from 26 to 189,891 participants. The range of children's ages was from four months to 13 years old. Age groups were as follows: five studies of 0 to two years old, 42 studies of three to five years, 23 studies of six to eight years, and seven studies of 9 to 12 years. Participants were classified into four groups: 12 child only (CO), 51 parent and child (PC), and 14 parent only (PO) studies.

**Predictors of child obesity.** There were 14 correlational studies and 63 intervention studies. Correlational studies examined correlations between obesity and its predictors. The following three backgrounds were contributing predictors of child obesity status: (1) maternal background (low education, low attendance at maternal classes, single or divorced, smokers, Body Mass Index [BMI], dietary habits, acculturation), (2) parental background (presence of obesity, higher educational level), and (3) children's lifestyles (less sleep, higher family income, nonsnackers, longer television viewing time, consumption of sweet beverages, physical activity level).

**Interventions.** Among 63 intervention studies, major interventions were as follows: nutritional approach: 18; physical activity promotion: 10; combination of nutrition and physical activities: 26; and screen time reduction: one.

**Measurements.** Measurement tools for child obesity prevention were as follows: nutrition, physical activity, sleep quality, screen time, parenting skills, laboratory data, anthropometric data, and psychological data.

As shown in Table 1, the Behavioral Risk Factor Surveillance System (BRFSS) was used for measuring behavioral risk factors. For nutritional intake measurements, three 24-hr dietary recalls



(fruit intake, vegetable intake, water intake, noncore drink intake, sweet snack intake, savory snack intake), total energy intake, total and saturated fat intakes, Child Feeding Questionnaire (CFQ), Parental Feeding Style Questionnaire (PFSQ), feeding mode, food refusal, and Block Kids Questionnaire were used as measurement tools. The following were used to measure physical activity, sedentary behavior, and sleep quality: MVPA (Moderate to Vigorous Physical Activity), Pittsburgh Sleep Quality Index (PSQI), screen time, support for exercise scales (Sallis), Physical Activity Questionnaire for Older Children (PAQ-C), and home and environmental supports for physical activities (neighborhood traffic, crime, social norms, supports for physical activity, fearing to get bitten by stray dogs, physical activity equipment, and infrastructure for physical activity). Time measures were used for screen time of television and DVD watching and game playing. To measure parenting skills, the Confidence Degree Questionnaire for Families (CDQ) and the Parent Stress Index were used. Laboratory data gathered were hemoglobin, blood lipids, pentadecanoic acid concentrations, sugars, and complex carbohydrates. For the anthropometric data, the measurements of waist circumference, waist-hip ratio, BMI, consumption of soft beverages, body fat, step counts, and resting blood pressure were used. Psychological data was measured using the Center for Epidemiologic Studies Depression Scale (CES-D) and a health-related quality of life instrument, KINDL-R (QOL).

**Outcomes by interventions.** The following four major types of interventions impacted outcomes: nutrition, physical activity, nutrition plus physical activity, and screen time.

***Nutritional interventions outcomes.*** Nutritional interventions outcomes are shown in Table 2. Sixteen nutrition-only interventions improved nutritional/eating behaviors, but not BMI reduction. Nutritional intervention increased knowledge of nutrition (Roofe, 2011) and protective feeding practice (Daniels et al., 2013), reduced the amount of calorie intake (Paineau et al., 2008; Paineau et al., 2010), and modified the content of intake (increased healthier foods and decreased unhealthy foods) (Epstein et al., 2001; Golley et al., 2012; Hendrie et al., 2011; McGarvey et al., 2004; Thundiyil et al., 2010; Wolfenden et al., 2014). However, there was no impact on reducing

children's BMI (Fernandes et al., 2009; Harvey-Berino et al., 2003; Paineau et al., 2008) or the prevalence of overweight (Epstein et al., 2001), except for one study that reduced BMI with a low-evidence grade (Grummer-Strawn et al., 2004). One study raised the prevalence of overweight by intervention—against expected outcomes (Fernandes et al., 2009).

***Physical activity interventions outcomes.*** Physical activity interventions outcomes are shown in Table 3. Ten physical activity-only interventions showed the following: reduced BMI, no reduced BMI, physical exercise behavior improvement, and some laboratory data improvement. Four studies (Barkin et al., 2011; Guagliano et al., 2012; Lazaar et al., 2007; Mo-Suwan et al., 1998) found that physical activity intervention impacted reduction of BMI; among these, two studies (Guagliano et al., 2012; Mo-Suwan et al., 1998) reduced BMI only in girls. Two studies (Donnelly et al., 2009; Reilly et al., 2006) revealed no reduction of BMI. Three physical activity promotion interventions (De Bock et al., 2013; Wilson et al., 2011; Macias-Cervantes et al., 2009) increased the amount of physical exercises and reduced sedentary time. One physical activity intervention (Macias-Cervantes et al., 2009) improved children's laboratory data; for example, blood sugar, triglycerides, cholesterols, and insulin resistances.

***Nutrition and physical activity combination interventions outcomes.*** Nutrition and physical activity interventions' outcomes are shown in Table 4. Forty-two nutritional and physical activity combination interventions had the following outcomes: reduced BMI, no reduced BMI, and increased BMI, improved nutritional behavior, increased physical activity, decreased screen time, and some improved laboratory data. Interventions reduced BMI in 9 studies (Boutelle et al., 2011; Elder et al., 2014; Estabrooks et al., 2009; Fitzgibbon et al., 2005; Jouret et al., 2009; Pittson et al., 2011; Slusser et al., 2012; Taylor et al., 2008; & Wright et al., 2013), made no difference in 9 studies (Baranowski et al., 2003; Caballero et al., 2003; Coleman et al., 2005; Fitzgibbon et al., 2006; Gentile et al., 2009; Keller et al., 2009; Marcus et al., 2009; Muller et al., 2001; & Sahota et al., 2001), and increased BMI in one study (Davoli et al., 2013). Three randomized controlled trials (RCTs) (Coleman et al., 2005; Jouret et al., 2009; Marcus et al., 2009) reduced the prevalence of

overweight, and one RCT (Taylor et al., 2008) made no difference in reducing the prevalence of obesity by a combined nutritional and physical activity approach. Intervention improved nutritional behavior such as the amount and content of intake in seven studies (Baranowski et al., 2003; Keller et al., 2009; Campbell et al., 2013; Elder et al., 2014; Gentile et al., 2009; Junnila et al., 2012; Sahota et al., 2001). A combination of nutrition and physical exercise intervention had a high-evidence grade in exercise time increments in three studies (Boutelle et al., 2011; Sahota et al., 2001; Wright et al., 2013); among these, one study was effective only for girls (Wright et al., 2013). Interventions also reduced the screen time of children in two studies (Campbell et al., 2013; Wright et al., 2013), and between these, one study was effective only for boys (Wright et al., 2013). One study resulted in no difference (Gentile et al., 2009). One intervention reduced glucose tolerance (Mustila et al., 2013). Body fat was reduced in one study (Gutin et al., 2008) although another study indicated no difference (Caballero et al., 2003). Triceps skinfold thickness reduced in one study (Muller et al., 2001) but showed no difference in another study (Caballero et al., 2003). There were no differences in waist circumferences (Baranowski et al., 2003) and waist–hip ratios (Coleman et al., 2005). One interventional study raised self-worth (Sahota et al., 2001).

***Screen time reduction only/nutrition or screen time reduction combination interventions outcomes.*** Screen time intervention outcomes are shown in Table 5. Six screen time reduction interventions had no effect on BMI (Birken et al., 2012; Dennison et al., 2004; Taveras et al., 2011). However, some were effective in reducing television viewing time (Dennison et al., 2004; Taveras et al., 2011) and unhealthy eating behavior (Birken et al., 2012).

**Summary of the studies.** The literature review revealed the following results: (1) the majority of recent child obesity prevention studies were conducted in high-income countries, and studies in low- or middle-income countries were limited; (2) the most frequently used theories were social cognitive theory and social learning theory; (3) targeting parent(s)–child had better outcomes than child-only or parent(s)-only interventions; (4) most interventions focused on child–mother dyads; (5) the majority of interventions targeted younger children (three to eight years old); and (6) most

frequently used and effective interventions were combinations of nutrition and physical activity, as compared with other interventions such as nutrition only or physical activity only interventions.

**Implications for the main study.** From the literature review, developing countries had fewer obesity prevention studies, indicating that basic studies are needed to assess the current status of child obesity in Indonesia, to implement child obesity prevention programs. Predictors of obesity in existing studies were reviewed. Dietary behavior, physical activity behavior, sleeping behavior, and resting behavior would also be major predictors of child obesity in this study. Therefore, the structure among child lifestyles, environments, and health status needs to be examined.

### **Preliminary Study**

This chapter describes the preliminary study's purpose and objectives, methods, results, and implications for the main study. LSBs, predisposing factors, reinforcing factors, and environmental factors were categorized from interviews with children, their mothers, school personnel, and health personnel.

#### **Purpose**

To construct a tentative theoretical framework, this preliminary study's purpose was to describe children's LSBs, mothers' perceptions of children's LSBs, current health status of children and mothers, and community health needs in urban Indonesia.

#### **Objectives**

Following were the objectives of this preliminary study:

- 1) To describe children's LSBs relating to child obesity status.
- 2) To describe maternal perceptions of child lifestyles behavior relating to child obesity status.
- 3) To measure physical data such as weight, height, and waist-hip ratio of children and mothers to describe child obesity status.
- 4) To describe perceived health needs, current policies, and programs for children's health by stakeholders such as the director of the district health office, district health officers, elementary school principals, and elementary schoolteachers in South Tangerang District, Banten Province, Indonesia.
- 5) To construct a tentative theoretical framework of the study.

#### **Methods**

**Design.** The design was descriptive, to explore lifestyles and behaviors of children, mothers, and school health stakeholders.

**Settings and participants.** Fourteen elementary school children (fourth to sixth grade, aged 9 to 12) were recommended by the schoolteacher based on purposive sampling and introduced by the teacher at the selected elementary school. Inclusion criteria were visibly obese children with no chronic diseases and no medication, nominated by fourth- to sixth-grade schoolteachers. Thirteen mothers of these children were also recruited. Stakeholders—one director of the health center, one school health officer of the health center, one sub-director of the school, and one physical exercise teacher in the elementary school—were selected by purposive sampling and introduced by the health center or the elementary school.

**Study team.** The study team was managed in collaboration with four UIN faculty members and comprised a pediatric nurse, community nurse, maternal child nurse, and nursing administrator. The Indonesian researcher, who had experience with Japanese researchers, nominated the members. The researcher obtained consent from Indonesian researchers that the study would be part of the researcher's dissertation.

The researcher assumed responsibility for the following: budget, planning, orienting Indonesian researchers, ethical considerations for participants, data gathering and storage, data analysis, and study publication. The Indonesian researchers coordinated and facilitated the survey; in addition, they informed the researcher of cultural and social considerations.

**Data collection.** Data was collected from December 2 to 10, 2014. All interviews and measurements were conducted with the study team. The content of interviews were as follows:

***Child data collection.*** Semi-structured interviews, using the interview guide (Appendix 2) and consisting of knowledge and behavior of obesity and lifestyles, were audiorecorded and noted. The average interview time was approximately 35 minutes.

***Mother data collection.*** Semi-structured interviews, using the interview guide (Appendix 3) and consisting of knowledge and behavior of child obesity and child-rearing lifestyles, were audiorecorded and noted. The average interview time was approximately 45 minutes.

**Physical measurement.** Physical measurement tools such as the weighing scale (Innerscan 50 BC-309-PR, TANITA), the height scale (Seca 206, Seca), the waist–hip ratio meter (Seca 203, Seca), and the pedometer (HJA307, Omron) were used and noted. Only one person wore the pedometer. The average measurement time was approximately three minutes.

**Stakeholder data collection.** Semi-structured interviews, using the interview guide (Appendices 4 and 5) and consisting of health needs and current policy or programs of schoolchild obesity prevention were audiorecorded and noted. The average interview time was approximately 45 minutes.

**Analysis.** Collected data was transcribed by the groups (children, mothers, and school health stakeholders) and analyzed using content analysis (Krippendorff, 1980). Data was sorted by knowledge and behavior regarding obesity and typed into categories and subcategories as constructs.

**Ethical consideration.** First, in November 2014, the researcher obtained approval from the ethics committee of St. Luke's International University (Approval Number: 14-083).

Second, the researcher requested and received approval for a collaborative study from the Dean of the Faculty of Medicine and Health Science of Islamic State University Syariff Hydayatullah Jakarta (UIN) in November 2014. Finally, the study team requested research permission from the Director of the Agency for National Unity, Politics, and Community Protection, and permission was issued in December 2014 (Approval Number: 070/ 0596/ Umpeg).

## Results

Initially, general information on child lifestyles will be described; then, details of interviews will be described.

**Participants' characteristics.** Participants' characteristics are shown in Table 6. The participants were 27 in total, 14 children and 13 mothers. The participants belonged to the Islamic religion. The age of children averaged  $10.5 \pm 0.77$  years, and mothers averaged  $39.6 \pm 5.75$ . The

mothers' educational backgrounds ranged from high school graduates (6) and less than junior high school graduates (7). The majority were classified as the middle-income group.

**Support from health services.** In interviews, schoolteachers mentioned that their health priority was the children's hygiene such as hand washing, nail hygiene, and school facilities' sanitation. The school curriculum included exercise once a week; for example, futsal and basketball. Swimming classes were available if students paid an extra fee. Saturday school lunch and an exercise program were implemented, but not continuously. The participants' school staff believed that a triangle of parents, schools, and health centers should collaborate in being responsible for children's health. However, the health center visited the school only twice a year, and parents seldom visited. School staff also observed that parents had the major responsibility for controlling their children, providing nutritional education, and ensuring participation in physical activity because children spent most of their time at home.

Interviews with health service providers revealed that child obesity was not their main priority; instead, they prioritized maternal-child health and communicable and noncommunicable diseases (NCDs). In the NCD programs, they did not focus on prevention, but on treatment, especially on hypertension in the middle-aged population.

In fact, the health center has been unaware of the severity of child obesity. There was no policy for school obesity prevention, nor were there any programs. For a health center of an area with 10,000 children, one staff member covered school health—from kindergarten to high school.

This staff member mentioned that the health center's priorities were oral hygiene, hygiene promotion, and immunizations. Except for elementary school first graders, no routine physical measurements were conducted in schools.

The health center director mentioned three factors of obesity. He recognized the main factor as the parents: The more the parents' income increased, the more calories their children could consume. Parents were too busy to help their children acquire healthy lifestyles. The urban environment was unsuitable for children to play outside, thus leading to physical inactivity.



**Mothers' perception of child obesity.** Mothers' perceptions of child obesity did not appropriately reflect children's obesity status. Most mothers recognized that their children were obese and knew that obesity was unhealthy. However, regarding their own children, they stated that their children were obese, but it was not a problem because the children displayed no current symptoms. Mothers expected children to be thinner when they grew up. In other words, they assumed that children would simply "grow out" of obesity. Therefore, although mothers apply significant efforts to teach their children and direct them to healthy lifestyles, they allow their children to get what they want, rather than conflicting with them.

**School life of children.** In Indonesia, the elementary school has two semesters (January to June and July to December) with the year-end holiday and the inter-semester holiday. There is also a moveable feast after the Islamic one-month fasting period.

The participating elementary school had 416 students. Some sixth graders failed the elementary graduation examination and remained there because they could not enter junior high school.

Students attend school from Monday to Saturday, and Sunday is a holiday. Their weekday starts at around 4:00 to 5:00 a.m., they bathe, pray, and eat breakfast. Then, they come to school at 7:00 a.m., with a short break at 9:30 a.m., and go home around midday. During the break, students purchase food from the canteen. Around 1:00 p.m., they eat lunch and play with their friends. From 4:00 p.m. to 6:00 p.m., they go to a Islamic school, pray, eat dinner, and relax. Around 8:00–10:00 p.m., they go to bed to sleep 7 to 9 hours.

**Dietary behaviors.** Children eat more than three meals and three snacks per day. Of the participants, four girls skipped breakfast, fearing school tardiness or avoiding nausea. Children consumed  $1,678 \pm 243$  kcal per day on average—more than they burned ( $1,621 \pm 266$  kcal). Jajan or snacking on fried foods, instant noodles, and juice comprised a third of children's calorie consumption. They were given money to buy snacks, 20,000 Indonesia Rupiahs (around 2 USD) per day, the equivalent of the family's half-day income (Kompas, 2014). The balance of their daily

protein, fat, and carbohydrate (PFC) was 18, 29, and 53%, respectively, as opposed to the recommended 10–15, 15–30, and 55–75% (Food and Agriculture Organization of the United Nations, 2015). Although their fat intake was normal, they consumed saturated fat. Therefore, excessive protein and saturated fat intake were characteristic of children's dietary behavior. Half of the participant children ate alone because their families were busy working; the television accompanied and entertained the children during their meals.

***Physical activity related behavior.*** Children exercised less on weekdays, except for their weekly class, and they exercised on Sunday sports day. On average, children burned 1,621 kcal per day. The weekly exercise class at school lasted 45 min. However, parents could pay for extra exercise classes such as swimming or futsal. Besides organized school sports, boys liked playing soccer with their friends. Girls often went out with their friends on bicycles, but for less than 30 min. Girls mainly preferred chatting while sitting by small snack shops. The Indonesian government promotes Sunday as “sports day,” and, with their families, most children went out walking, jogging, or playing sports like badminton, football, and practicing aerobics.

***Sleeping behavior.*** Although schoolchildren are recommended to sleep approximately 9 to eleven hours per day (Hirshkowitz et al., 2015), the participants slept an average of 7.9 hours.

***One day of the participant school child.*** The researcher focused on the lifestyle of one participant, an 11-year-old girl, in the sixth grade, whose BMI was 23.4 (obese according to the IOTF); she cooperated in the interview by sharing her lifestyle practices and wearing the pedometer for a week. For dietary behavior, she self-reported a caloric intake of 1,541 kcal, 80% comprising her mother's cooking such items as fried Tofu, fried egg, fried chicken, and rice. The remaining 20% comprised brownies, dumplings, and coffee with sugar and milk; all snacks and drinks were free from her parents' small shop.

For her exercise behavior, during weekdays, she walked to school every day and participated in exercise class once a week. After school, she went directly to her parents' small shop to help them. She played games on her mobile phone for approximately three hours a day or

chatted with her family while waiting for customers. Her step counts were 5,979 on average. On Sunday, she went to her grandmother's house in the suburbs, and her step counts increased to 8,083. In total, 6,330 step counts were averaged that was equivalent with consuming 1,800 kcal.

**Physical measurement of participant schoolchildren and mothers.** Physical measurements of 166 fourth- to sixth-graders were taken at the target elementary school. As Table 7 shows, approximately 33% of these schoolchildren were overweight or obese, 51% were of normal weight, and 15% were underweight according to the body mass index (BMI) for their age (Cole and Lobstein, 2012). Half of the target schoolchildren were within normal weight, and the other half suffered from malnutrition, whether they were overweight or underweight.

All participating children were overweight, obese, or morbidly obese. Mothers of these children were all overweight, obese, or morbidly obese, except for one normal-weight mother.

#### **Predictors and LSBs Relating to Child Obesity Status.**

The framework from the preliminary study is shown in Figure 3. Twelve categories and 27 sub-categories were categorized from the preliminary study, shown in Table 8. Explanations of these categories are as follows: A001 is the code for child A's phrase, and A'001 is the code for A's mother's phrase.

**Predisposing factors.** Categories of values concerning child obesity, knowledge of obesity, and attitudes of children were derived as categories for predisposing factors.

**Values of child obesity.** This means that children had both positive and negative values of obesity. Negative values were often derived from the girls participants' statements.

*Obesity is healthy/ unhealthy.* This means that there are children who think obesity is both healthy and unhealthy. “Obesity is not a problem; it is healthy” (J002); “*My weight is too much and not healthy. I am very big, bigger when compared with my friends.*” (C007)

*Obesity is a sign of happiness.* This means that children think obesity is a sign of happiness. Children think that if they feel happy, they eat; hence, they become obese. “*Obesity is caused by excess eating, and excess eating because of happiness*” (F004)

*Obesity is shameful being bad shape.* This means that children feel ashamed and fear having a bad shape or a poor figure. “*Obesity is not good because of bad shape, and I fear that.*” (E007) “*I feel I am obese and feel ashamed; my friends say I am plumped, and I think so too.*” (E001)

*Admire models.* This means children are influenced by media and admire models and wish to be like one. “*I hope I am not too obese and too thin; I watched a model on the television, and I admire her.*” (E002)

*Fear of raillery because of obesity.* This means that children fear being teased because of obesity. Children often allow their friends or siblings to tease them regarding obesity; however, they feel uncomfortable being called “obese.” “*I do not know if my weight is healthy or not, but I have been made fun of for obesity. Let them say so, but I felt disappointed and angry.*” (H001)

**Knowledge of obesity.** This means child had knowledge regarding obesity; for instance, dietary behaviors, physical inactivity, and other factors of obesity.

*Because of excessive calorie intake diet (amount, content, and frequency).* This means that the participants were aware of factors that led to excess consumption of food. “*Because I continue eating too much, I want to eat much, but I wanted to eat more because I was hungry.*” (E004) This also means that children knew the ingredients of a healthier diet. “*I know 4 sehat 5 sempurna, (Vegetables, Tohu, rice, fruits, milk, and side dishes). And that excess snacking causes obesity.*”

(A004) This also means that children knew how frequently they should have meals. *“We should not eat as much as we want, and we have to eat healthy meals regularly.”* (I005)

*Because of physical inactivity.* This means that children knew that physical inactivity is a factor of obesity. *“Obese people seldom exercise.”* (G003)

*Because of less sleep.* This means that children had less sleep in their daily life. From the preliminary study, average hours of sleep was 7.9 hours which was desirable 9 to 11 hours per day for this age group.

*Because of traditional healer.* This means that participants believe that obesity was caused by a traditional healer. *“I was taken to the traditional healer, and I could eat so much food and be fat because of the healer.”* (D008)

#### ***Attitudes of obesity.***

*Attitudes to change behavior.* This means that participants lacked the motivation to exercise because they already had physical exercise class at school and did not want to exercise additionally, or they preferred watching the television or sleeping. *“I am lazy to exercise because I am sleepy. It is better to watch television at home.”* (F006)

*Socially influenced behavior.* This means that the children’s behavior is influenced by a person or a particular environment. For instance, snacking is influenced by small shops, friends, or siblings. Girls, especially, exercise if they have friends; however, this situation might be related to security.

*Influenced if friends or family invite snacking.* This means that the children’s LSBs were influenced by their friends and environments. *“I often eat snacks because my friends invite snacking.”* (C101). *“Because I have school friends who invite me to snack.”* (E012)

*No friends, no exercise.* This means that the children do not exercise if they do not have friends with whom they can exercise, and they do not want to exercise alone. *“If I am alone, I do*

*not have any motivation to exercise. I like exercising, but I hardly have friends who will accompany me.” (G102)*

*Self-efficacy of controlling lifestyles.* Efficacy of controlling lifestyles means that children are confident with their lifestyle change. *“I hope by junior high school, my child will change dietary behavior and not to be too obese.” (C’024); “Maybe she will be thinner when she attends junior high school.” (I’002)*

**Enabling Factors.** From the preliminary study, categories of family involvement, family usage of health facilities, and fear of obesity were derived as categories of reinforcing factors of child obesity.

***Presence of family who teach about obesity prevention.*** This means that the family members teach the consequences of obesity such as diabetes or heart diseases. *“I teach my child to not be obese. I warn my child that obese people can hardly move and easily get tired.” (B’103)*

*Family teach proper eating/ balanced diet.* This means that the family members teach timing, frequency, amount, and contents of eating to children. *“Prevent the consumption of unhealthy food; I advise my child to not eat too much.” (B’113) “We teach them to not leave any leftovers and eat whatever is being served since childhood.” (B’112)*

*Family order decreasing food intake.* This means that family members order decreasing amount of dietary intake to children and do not eat randomly, have regular meals. *“Decrease amount of food intake and do not eat randomly, have regular meals” (I005). “With father, she was ordered fasting, she followed one day, after fasting, she ate whatever she wanted to eat. She is lazy.” (J’107).*

*Family order increasing exercise.* This means that family members order their children exercise more. *“I order my child to exercise more.” (A’110); “After the meal I say my child not to lie down or fall asleep. I recommend him to go out.” (B’104)*

*Family cook child's favorite/ dislike food frequently.* This means that the family gave in to their children’s demands and cooked what they liked. Sometimes the family cooked what their

children did not like, aiming to reduce their eating, but this tactic was in vain. *“I decide the daily dishes, but I cook what my child likes. It is inappropriate, if my child leaves over my cooking, and it is easier to cook his favorites.”* (G’104); *“I intentionally cook what my child does not like, but my child continues eating.”* (A’105)

**Family restrict money for snacks.** This means that the family provided money for snacks between meals. Usually parents gave children more than 20,000 Indonesia Rupiahs (1.46 USD) for snacking. If that amount was insufficient for the children, they could ask relatives for money so that they could buy more snacks. *“Now that I am lazy, my child is hard to control, my child is uncontrollable, and so it is easier to give money for snacks than to be in conflict with her.”* (C’105); *“We have relatives and they give money to my child for snacks even if I do not give money to my child.”* (D’018); *“I give 10,000 Rupiahs to my child, the important thing is that we do not give enough money to buy snacks.”* (B’115).

#### **Reinforcing factors.**

**Family avoid buying foods from outside.** This means that the family members avoid purchasing food prepared outside the home such as in small shops and restaurants. *“Rice, I cook by myself. I buy foods from outside about four times per week so that not too frequently buying from outside”* (C’103)

**Presence of family exercising together.** This means family try to exercise together with children. *“I invite exercising together with my child, but he is crazy about computer games.”* (M’008)

**Friends support.** This means there are children who accompany exercising with. *“If I am alone, I do not have any motivation to exercise. I like exercising, but I hardly have friends who will accompany me.”* (G102)

**Child Behavior and Lifestyles.** Categories of child-led dietary behavior, physical activity behavior, and sleeping behavior were derived from the preliminary study.

***Child-led excessive calorie intake.*** Child-led excessive calorie intake behavior was derived which means that children themselves decide on the content, amount, and frequency of food intake; children were the primary decision makers concerning their daily meals and snacks. For daily meals, children often asked their mothers to cook or buy what they liked, and they asked for deep-fried, fatty foods such as chicken nuggets and fried chicken. Mothers also wanted to cook what children liked so that they could eat a lot. Additionally, mothers did not want any leftovers, so they fulfilled their children's needs. For snacks, mothers provided money but were unaware regarding what types of snacks their children purchased: Children could choose and buy anything they wanted.

***Imbalanced dietary contents: Western foods preference.*** Many of children prefer buying western foods such as French fries, hamburger, and sodas.

***Imbalanced dietary contents: Less fruits and vegetables intake.*** This means that the children did not eat what they disliked and ate only what they liked. *"I do not like eating vegetables. Fruits, sometimes."* (D006)

***Imbalanced dietary contents: Buy snacks from street vendors, small shops.*** This means that the children purchase foods from street vendors or small shops. *"I like fried chicken, and I buy only once a week. Sometimes I buy fried chicken from street vendors if my mom was out in the evening. Me and my sister buy fried chicken twice a week."* (G104)

***Imbalanced eating style behavior: Eat without parents present, with television.*** This indicates who the children eat with. Eating alone often involved watching television at the same time. This means that the children ate alone if their parents were busy. Mostly they eat in front of the television. *"I eat alone while watching television. If not, with my sister because my dad comes*



*home late, and my mom works in a restaurant.” (D) ; “If my mom is busy, I cook instant noodles by myself for dinner once a week, and I eat with the television on.” (M101)*

*Imbalanced eating style behavior: Eat favorite foods only.* This means children eat only likes and avoid eating dislikes.

*Imbalanced eating style behavior: Eat quickly.* This means children finish their meal very quickly.

*Imbalanced eating style behavior: Sleep right after the meal.* This means children sleep right after the meal. “*Eat, directly to sleep, is my child’s habit, it causes obesity.*” (G’007)

*Imbalanced dietary frequency behavior: Ask for extra portion.* This means children’s dietary frequency is not regulated and too frequent. Basically it is caused by frequent snacking between meals.

*Imbalanced dietary frequency behavior: Ask for extra portion.* This means children ask extra portion of the meal when they have a meal.

*Imbalanced dietary frequency behavior: Skip breakfast because of nausea.* This means that the children did not eat breakfast because they feared vomiting thereafter. “*I don’t eat breakfast. If I eat, I feel nausea.*” (D)

*Imbalanced dietary frequency behavior: Skip breakfast fearing being late to school.* This means children have no breakfast because they have no time to have breakfast. “*I don’t have time to eat breakfast because I fear being late to school.*” (E)

*Imbalanced dietary frequency behavior: Snack centered.* This means that the children can eat snacks three or more times a day. “*I eat snacks three times a day*” (A102)

*Imbalanced dietary style behavior: Angry if food is decreased.* Children decide amounts of meals and snacks. Children became angry if their amount of food was decreased. “*However, it is difficult to control his appetite. He just wants to eat and drink, so I cannot decrease the amount of his foods. If foods were decreased, he would be very angry.*” (J’106)

*Imbalanced dietary style behavior: Charge the payment to the family.* Children charge their snacks to their families if they do not have enough money to purchase them from small shops or

street vendors. *“Even if my child does not have enough money, he just buys, and the street vendors later state that the payment is not yet made. So, I borrow money from someone and pay back the street vendors.”* (A’106)

***Physical activity related behavior.***

*Exercise time.* This indicates the duration of exercise by a child. *“I skip for 10 minutes per day, jog once a week, and practice aerobics for 60 minutes every Saturday and Sunday.”* (C102)

*Vehicle usage.* This means children use vehicles to move. Most of the children could ride public transportation alone.

*Tiredness.* This means that children are lazy or tired to exercise.

*Busy with something else to do.* This means that children cannot go outside to play and exercise because they must care for their siblings.

*Safety issue: Fear of kidnapping.* This means that children do not play sports alone because they fear being kidnapped. *“Sometimes there is no friend who invites me to go jogging, and I am scared of being kidnapped if I’m alone.”* (I006)

*Contents of exercise.* This indicates the types of exercise in which children engage. *“I walk to school every day.”* (B105) *“Saturday and Sunday, morning and evening, I play sports such as jogging, run–rest, it’s routine. I am always with my neighbor friends. Often play badminton, jog, play badminton for 2 hours again, after that, I ride my bicycle.”* (A103)

***Sleeping behavior.***

*Sleep quality.* This refers that children feel their sleep is enough and good quality.

*Late bedtime and short sleeping duration.* This refers to children’s sleep hours and quality of sleep. Sleeping behavior is often linked with the television viewing time or games; some children sleep less than seven hours because of these behaviors. *“I sleep at 10:00 p.m. and get up at 4:30 a.m. to pray.”* (E)

*Long screentime.* This means that children watch television, play games using mobile phone, computer, or other devices. This behavior is not only sedentary behavior but is often linked with

snacking. *“I watch television for one hour and have snacks every day” (A104); “I play the computer game every Sunday.” (A105)*

**Environmental factors.** Categories of access to foods, social barriers, and support from health services were derived from the preliminary study.

***Access to foods.***

*Accessibility to foods.* Accessibility to foods means that easy access to foods shop such as canteen, small shops in neighborhood. *“I eat wildly because there are small shops in my neighborhood.” (B008)*

*Family owns small shop.* This means that the children eat snacks because their families own small shops in their compounds; thus, snacks are available at any time. *“Because there is this small shop, my child picks snack by herself.” (D’017)*

*Affordability of foods.* This means child has money to buy foods. *“I am given 10,000 Rupiahs (0.73 USD) for my snacks, plus snacks from my family’s shop for free.” (G)*

***Access to exercise.***

*Accessibility to exercise: Limited exercise facilities.* This means that children have limited access to exercise because of limited exercise facilities. Children have to stay in the classroom if it rains especially in the rainy season. *“If it rains, we cannot play futsal, just stay in the classroom, yes we do not have gymnasium.” (G)*

*Join “Sunday sports day”.* This means that children have access to Sunday sports day, as recommended by the government. *“On Sunday sports day, I practice aerobics and jogging from 3:00 p.m. to 4:00 p.m., bicycle for 30 min, and exercise for 30 min.” (I104)*

***Access to health services.***

*Access to school health: Health education from school teachers.* This means that children can access health education at school. “A healthy lifestyle is exercise—football, basketball—this is taught by the school teacher. The teacher is the one who helps a healthy lifestyle.” (N005)

*Access to health: Information from health center.* This means that children can obtain information from the health center or the health service providers. “I have never acquired information from the health center.” (G’102)

*Support from health volunteer.* This means that health volunteers in the community provide support for children. “Here, no health volunteers visited my place.” (C)

### **Implication for Main Study.**

**Measurement tool.** The food recall method was not so much reliable as the measurement tool of dietary behaviors according to the preliminary study. Under-reporting of the calorie consumption was suspected. Compared with high BMI level, children consumed less calories. If the ratio of calorie intake/ (Basal metabolic rate times 1.55 [light physical activity level]) is less than .76, under-reporting could be suspected (Black, A. E., 2000). Out of 14 target children, seven students were lower than .76 (.57-.76) and four students were approximate results (.80-.89). From these results, the researcher should consider the reliable measurement tool of dietary behaviors. Body weight, height, and the BMI are the reliable index for the main study.

**Quantitative study.** Predisposing factors such as child knowledge, attitude, and positive and negative beliefs concerning obesity were derived from interviews. Reinforcing factors such as family involvement to child lifestyles and behaviors, fear of obesity were derived. Child LSBs, such as child-led dietary, physical activity, screentime, and sleeping LSBs were derived from interviews. The environment surrounding children, access to food, access to exercise, and access to the health services were also derived from interviews.

However, relationships among these factors are tentative and need further examination. Since this preliminary study’s design was qualitative, with a few participants (14 children and 13

mothers), the structure could not be examined. With a larger sample, the main study's design will be quantitative.

## **Methods**

This chapter describes the main study's theoretical framework, design, sample, measurement tools, pilot study, recruitment, data collection, data analysis, and ethical considerations.

### **Theoretical Framework**

The theoretical framework was based on the preliminary study, as shown in Figure 4. Then the theoretical and operational framework was planned with subtructions (Holzemer, 2000), as shown in Figure 5. The researcher hypothesized that predictors of child obesity (predisposing factors, reinforcing factors, environmental factors, and child LSBs) were associated with child obesity status in urban Indonesia.

The framework above allows examination of the following:

- 1) Describe predisposing, reinforcing, enabling, and environmental factors of child obesity to develop a child obesity prevention model.
- 2) Describe children's lifestyles related to children's obesity status to develop a child obesity prevention model.
- 3) Examine the structure among predisposing, reinforcing, enabling, and environmental factors, plus children's lifestyles and environments related to children's obesity status to develop a child obesity prevention model in South Tangerang District, Banten Province, Indonesia.

### **Design**

This study was a cross-sectional, descriptive quantitative design using questionnaire in combination of random cluster sampling for the sample frame and stratified random sampling for the participants to examine the structure between child lifestyles predictors and child obesity status. Then, using structural equation modeling (SEM), a child obesity prevention model was developed for an urban area of Indonesia.

## Sample

**Participants.** Participants were recruited school-aged children from the South Tangerang District of Banten Province. Both girls and boys were included.

**Inclusion criteria.** The number of students in the South Tangerang District is 129,240 (Table 9). Using stratified sampling, about 600 school children (national: private = 360 : 240), aged from 9 to 11, fourth or fifth graders, from at least three elementary schools, were selected. Participants with no chronic diseases or no medication, and who live in the South Tangerang District of Banten Province. Approximately comprising 43,080 of the fourth and the fifth graders live in the target area.

**Sampling method.** Figure 6 shows the sampling procedure. Stratified random sampling was conducted with three national and two private schools from among 347 elementary schools (208 national and 139 private) for about 600 children (360 national and 240 private schoolchildren) in the South Tangerang District. If the researcher utilized pure random sampling methods, all four schools might be either national or private. Therefore, elementary schools were divided into same proportion according to their organization (national or private). In a previous study concerning Indonesian adolescents' obesity (Collins, 2008), both public and private schools had been recruited to obtain a variety of income levels and educational backgrounds and ensure a representative group. Since the researcher also wanted to collect various student samples, the researcher randomly selected the participants from national schools and the other from private schools with same proportion of current national and private schools.

**Sample size.** Estimated sample size for the correlational study: An interactive two-sided correlation coefficient was calculated based on taking the alternative hypothesis. The researcher set the level of statistical significance at  $\alpha = .05$ , and the power .80 ( $\beta = .20$ ), to deny no correlation. Because of limited studies in middle-income countries, the correlation coefficients between lifestyle and BMI were approximately 0.26 to 0.45, following studies conducted in the US (Grimes et al., 2013; Rutkowski et al., 2011) According to the table of sample size calculation, the needed sample

size was 123. Considering an 80% expected response rate, the tentative sample size was 154 participants for the main study. This number was based on Hulley's (2013) sample size calculator.

***Estimated sample size for factor analysis.*** There were various methods of sample size calculation for factor analysis. In this study, the sample size calculation for factor analysis followed Polit and Beck (2012), who suggested estimating 10 participants per item. The questionnaire contained 82 items; therefore, the sample size should be 820. Considering an 80% response rate, the tentative sample size for the main study needed to be 1,025 participants.

Another possibility was the suggestion from Nunnally and Bernstein (1994), who recommended 300 as adequate for factor analysis. Considering an 80% expected response rate (Polit and Beck, 2012), the tentative sample size for the main study was 375 participants.

For this study, recruiting 1,025 participants was unrealistic in terms of the budget, human resources, and data management; a total of 154 participants was very small to be representative and to support factor analysis. Therefore, considering the budget and analysis feasibility, the researcher used a recruiting sample size of at least about 600 participants for the main study. Amongst total 347 elementary schools of the area, the researcher randomly selected amongst 208 national and 139 private schools at the same proportion, which are 60%: 40%. Finally, 594 schoolchildren were recruited from selected schools.

**Study team.** This study was conducted in collaboration with the UIN faculty members of pediatric nursing and nursing administration. These members were nominated by the Indonesian researcher who had experience with the Japanese researchers supported by the Japan Society for the Promotion of Science (JSPS) in the same region. This Indonesia researcher finished the doctoral course at St. Luke's International University. The researcher informed the Indonesian researchers and obtained their consent for the study was to be conducted as the main study of the researcher's dissertation.



### **Study Instruments.**

**Questionnaire.** To meet the objectives of examining predictors of child obesity in urban Indonesia, schoolchild obesity prevention predictors and lifestyles behaviors questionnaire (Appendix 6) were developed with 82 items which were consisted of 18 demographic data, 37 items (4-point scales), and 27 items (5-point scales). The questionnaire's content inquired about children's daily lives, including the following lifestyle behaviors: dietary, physical activities, sleeping, and screen time. The questionnaire's validity and reliability was tested in a pilot study. The researcher, who speaks Indonesian fluently, translated from English to Indonesian, and the Indonesian researcher conducted back-translation. Indonesian research assistants were informed the purpose, methods, and ethical considerations of the research and conduct the face-to-face survey using directions (Appendices 7 and 8). The research assistants read the questionnaire and filled in answers on the questionnaire. The researcher asked for the research assistants not lead to or force socially desirable answers.

**Aims to include core items.** This part included aims for including core items as follows: participants' demographics, physical measurement, dietary behaviors, physical activity behaviors, and sleeping behaviors.

***Participant children's demographics.*** These questions were to measure the date of birth, religion, gender, grade, screen time, total calorie intake, sleeping hours, and money for snacking. The inclusion of these questions was justified by research that documents these demographic characteristics as related to predictors of health and lifestyle predictors. Data present demographic characteristics that were related to obesity and guided development of the obesity prevention program.

***Predisposing factors of child obesity.*** Questions intended to measure children's values, knowledge, and attitudes toward obesity. Beliefs inquired about positive and negative factors of obesity. In values, these data indicate what predisposes children to obesity. Knowledge of obesity

inquired about factors and consequences of obesity. Attitudes inquired about children's motivation toward healthy lifestyles.

**Reinforcing factors of child obesity.** Questions intended to measure the familial factors of obesity such as acquiescence to the child, optimistic attitudes toward obesity, magnitude of family involvement, and family health behaviors. These data revealed which familial factors reinforce child obesity.

**Environmental factors of child obesity.** Questions intended to measure food accessibility and support from health services related to child obesity. These data revealed which environmental factors relate to child obesity.

**Child LSBs.** Questions inquired about child behaviors: child-led dietary behaviors, socially influenced lifestyles, physical activity, and resting. These data indicated which child LSBs were associated with child obesity status.

**Dietary patterns questions.** This measured children's food decision making, eating style, payment for snacks, and socially influenced dietary behavior. Food decision making contained the frequency, amount, and content of consumption: fruit and vegetables, sweet drinks, junk foods, instant foods, outside foods, and attitudes toward snacking were included. Results of the preliminary study justified including these items: many of the children and their mothers referred their dietary patterns as related to their obesity status.

**Physical activity questions in this module.** These questions measured the following: child physical activity behavior, invited exercise behavior, barriers to exercise, sedentary behavior, resting behavior, and sleeping patterns. These were included based on the preliminary study's results and the literature review.

Participant physical measurement included the following: body mass index (BMI), waist-hip ratio (WHR), Bioelectrical Impedance Analysis (BIA), and step counts. Data directly measured children's obesity status. The BMI, WHR, BIA, and step counts were the proxy measurement

tools of child obesity. Some of these objective data provided the structure between the measurements and other lifestyle predictors of obesity and guided the obesity prevention model development.

Physical measurement tools were weighing scales (Innerscan 50 BC-309-PR, TANITA), height scales (Seca 206, Seca), waist–hip ratio meters (Seca 203, Seca), and pedometers (HJ325, Omron). BMI was calculated by the following formula:

$$\text{BMI} = \text{Weight in kg} / \text{height in meters}^2$$

To avoid inaccuracy, weight measurements were taken without shoes or accessories and without heavy items in pockets. Additionally, participants were instructed not to look down and not to hold onto anything. In fact, the scale was guaranteed within 50 grams of accuracy. The scheduling of measurement was between the morning break and lunchtime.

BMI 25 kg m<sup>2</sup> at 18 years old was also calculated to examine the obesity status. Major international BMI references were introduced by the International Obesity Task Force (IOTF) and the WHO. The WHO used the overweight cut-off based on age such as plus 2 SDs before age 5 and plus 1 SD after 5 years old gathering data from WHO growth standard and the National Center for Health Statistics (NCHS) 1977 growth reference (Cole & Lobstein, 2012). IOTF used the data from children in six countries: Brazil, Hong Kong, the Netherlands, Singapore, the U.S., and the U.K. IOTF's overweight cut-off uses the country-averaged-centile corresponding values of BMI 25 at 18 years old (Cole & Lobstein, 2012). Comparison of the IOTF and WHO cut-offs and revealed that WHO cut-offs estimates higher prevalence or sensitivity of obesity after 5 years old because the data was combined from less fat preschoolers and more fat childhood (Cole and Lobstein, 2012; Bray, 2014). Bray (2014) examined various references of obesity and recommended using IOTF tools when the data collection was conducted before obesity become common place. The researcher uses the IOTF international cut-offs because they consider Asian children's growth and adjust after 5 years level. In this study, the level of BMI at 18 years level was named from 1 (thinness), 2 (normal), 3 (overweight), and 4 (obesity).

Height measurement was also done without any accessories or shoes and without any heavy items in pockets. The height scale's accuracy was within 0.5 cm.

WHR was measured after breathing once with participants for them to avoid holding their breath. The narrowest point of the waist and the widest point of the hip was measured. Accuracy of the height scale was within 0.5 cm. The WHR was calculated by the following formula:

$$\text{WHR} = \text{hip in cm} / \text{waist in cm}$$

BIA was measured with a digital weighing scale at the same time children were weighed. Accuracy was repeatable to within 1% variation.

Step counts were measured seven days' walking record for each student. The researcher instructed children to place pedometers in their right pockets with clips, not to shake them, and to behave as normally as possible. Accuracy was repeatable to within 5% variation.

In assessing degrees of obesity, the cut-off for a normal BMI for an 18-year-old Asian is more than 18.5 and less than 23 (IOTF, 2014). The researcher referred to detailed cut-offs for exact ages by month, based on IOTF cut-offs (IOTF, 2014). WHO defines obesity as a waist-hip ratio above .90 for boys and above .85 for girls (WHO, 2008). For Bioelectrical Impedance Analysis (BIA), at 9 to 12 years of age, 16 to 27% of girls and 13 to 23% of boys were with the normal range (McCarthy, 2006).

### **Pilot Study**

**Purpose.** The pilot study was conducted to confirm study feasibility and to test the scale's content validity and face validity.

**Design.** This study employed a cross-sectional design using a questionnaire and its checklists.

**Validity test.**

**Content validity.** Six experts as recommended (Polit & Beck, 2007), introduced by Indonesian collaborating faculty members of the UIN, Indonesian faculty members of universities in Indonesia and health professionals in Indonesia were recruited to confirm content validity using the Content

Validity Index (CVI) after obtaining consent of research participation (Appendix 9). While reviewing the questionnaire, the recruited faculties or professionals rated a checklist using an index of a 4-point scale (1 = not relevant to 4 = highly relevant). Then, the researcher calculated the average content validity of individual items (I-CVIs), recommended to be .78 (Polit & Beck, 2007). Content validity of the overall scale (S-CVIs) should be .90 or higher (Polit & Beck, 2007). Average I-CVIs showed .92 and S-CVIs showed .92, too. Items with less than .78 in I-CVIs (Question number 24, 43, 52, 60, 65, 68, and 75) and .90 (None in the questions) in S-CVIs were discussed and revised with Indonesian researchers.

**Face validity.** One elementary school was selected for testing face validity. This school was excluded from the main study. In the target school, fourth and fifth graders was nominated as participants for the face validity test. The researcher checked the length of time to answer, comprehensibility, understandability, and respondent burden. This process was conducted with research assistants, and comments were noted. Less valid items were revised with Indonesian researchers. Length of time to answer was approximately 35 minutes on average including the rest. Few children complained about the length of the questionnaire, however, most of the cases children were happy to answer the questions because the research assistants kept entertaining them to be attracted to answer the questionnaire. Comprehensibility was checked by the research assistants and the wording of the questionnaire was modified so that children can comprehend and understand the meaning of the questions.

**Data collection.** Data collection was conducted in August and September 2015 for about one month. The data collection process took approximately 30 minutes. The schedule of survey was completely at the students' and schools' convenience so that the survey did not disturb their studies. Basically the place of survey was in the library, the school infirmary (if there), or vacant classroom where the privacy of children could be kept at the target elementary school. When the participant children tired answering, the research team recommended children to take a rest and continued.

**Data entry.** Data entry was conducted in September and October 2015. Research assistants wrote down the codes based on the coding list and other research assistants checked the codes were appropriate. One research assistant read the number of codes and another research assistant input the data into the Microsoft Excels. Then the rest research assistants checked the data entered one by one. Finally the author checked all the data entered.

Missing data was managed as follows. If the missing value were found, the data was confirmed by the research assistants the following day. Data of students who lost pedometers or who was absent until the end of the study were recognized as missing data.

**Ethical considerations.** The ethics committee of St. Luke's International University approved this study (Approval number: 15-036). The Dean of the Faculty of Medicine and Health Science, Syarif Hidayatullah State Islamic University Jakarta (UIN) (Appendix 10) approved the study collaboration. The UIN has an agreement with the Agency for National Unity, Politics, and Community Protection of Indonesia (KesBangPol) (Appendix 11), therefore, this study was approved under the authority of the UIN. This KesBangPol covers whole study permission. Then the proposals and the letters requesting for study permission were sent to the South Tangerang District Health Office (DHO) (Appendix 12); and the elementary schools (Appendix 13). The permission and collaboration letter was issued under the name of the researcher and the Indonesian researcher, with the collaboration with the UIN.

The researcher conducted the study according to the rules of the Helsinki Declaration and Ethical Guidelines for Medical and Health Research Involving Human Subjects (Ministry of Health, Labour and Welfare Japan, 2015) along with Indonesian law and guidelines. The researcher ensured the autonomy and confidentiality of the study participants and institutions. Eligible subjects were invited to participate and informed by written consent/withdrawal format (Appendices 14, 15) in the Indonesian language. These formats explained the following:

**Informed consent.** This study and the researcher do not discriminate and have no prejudice about people's body shapes, including their height, weight, and waist circumference. Eligible

participants was informed that no disadvantage occurred if obese children or mothers participated in this study.

After the schools' approval of research cooperation, principals of the sample schools sent request letters for research participation, consent form, and withdrawal form to guardians through eligible children. In the name of children, guardians confirmed children's will of participation and signed the consent form. Agreed children brought letters back to the school. Participants' guardians were informed of the study's purpose, methods, advantages, disadvantages, contact information of the study team in a written consent form, using Appendix 16.

Even though child participants might not completely grasp the research information, an oral explanation was provided using plain language at a level appropriate to the eligible children's ages with request for research participation form (Appendix 17). Consent was obtained from guardians on behalf of children if the children decide to participate. Data provided by participants, including the researchers' notes, was anonymously coded.

The researcher was responsible for the planning, orientation of Indonesian researchers, ethical considerations for the participants, data gathering and storing, data analysis, and study publication. Indonesian researchers coordinated the study schedule with relevant organizations, facilitated the survey in the Indonesian language, translated the questionnaire, and directed the researcher on cultural and social considerations.

Results of the study will be published in order to benefit Indonesian children and their health as soon as possible. Study reports will be shared via research partners to all relevant study participants in Indonesian language made by the researcher.

***Voluntary participation.*** Participants decided whether to join the study according to their own wishes and desires. Participants were provided a withdrawal form prior to the study, so they could withdraw at any time without being further contacted for any research-related purpose. Subjects did not receive any negative influence if they reject participation. To avoid being forced by the researchers' power or authority during recruitment, the study team asked the elementary schools'

staff to not check students' participation status. Simultaneously, subjects' participation status was provided to the elementary school or the district health office. Participants had the right to confidentially refuse participation at any point, even after agreeing to participate in the research.

***Protection of privacy.*** The survey, including physical measurements, was conducted in a place of the participants' choice so that their privacy could be protected. The questionnaire was completely anonymous, so no participants could be identified in any possible manner. To avoid the participants were forced by the power or authority of the researchers or school staff during recruitment, the researchers told the elementary schools not to check children's each participation status (including checking pedometers) when the researchers request the elementary schools to ask for the research participation. The researchers also told the eligible participant children that we did not inform the school about their participation status. The researcher explained confidentiality of personal information or participation status to the study team members and instructed them to not divulge any information. The study results will be published or presented, but participants' anonymity will constantly be protected.

***Data security.*** Concerning data sharing, the researcher collected data immediately after the Indonesian researchers and the researcher finish the survey. The data provided is securely stored in a locked cabinet that can be accessed only by the researcher. Results will be shared with the study team as soon as possible, but all the data will be destroyed three years after publication.

If the researcher would like to use the data for further studies, the researcher will again ask permission for the Institutional Review Board for the secondary usage of the data.

***Advantage and disadvantage of participation.***

***Advantage.*** The provided information will be presented or published as a study in order to prevent child obesity in Banten Province, Indonesia. At the study's initiation, pedometers costing approximately 10 United States Dollars (USD) or equivalent was provided to the participant children in appreciation for contributing their precious time toward this research. For content



validity test, approximately 15 USD or equivalent was given as an appreciation for the experts' knowledge. For research assistants, approximately 15 USD or equivalent per day was given as an appreciation for their support. The amount of rewards was calculated by consulting the researchers who had been involved in the same region supported by Japan Society for the Promotion of Science (JSPS) and the amount as about the household's daily income. Monthly minimum wage in the area in January 2014 was 1,325,000 Indonesian Rupiahs (IDR) which was equivalent with 96.86 USD (Kompas, 2014).

*Disadvantage.* Participants spent their precious time on the survey. If participants become uncomfortable and feel that the survey is very time-consuming, they could withdraw at any time they wished. Furthermore, no discrimination or disadvantage arose when obese children participate. If participants experienced discomfort or anxiety when they individually participated with their guardians, teachers, or friends, we prepared to halt the survey and then asked mothers or principals to consult with a doctor. If participants feel uncomfortable revealing their thoughts, we prepared stopping the survey and then request collaboration from school principals or the director of a province health office to consult with a doctor if the participant consents to do so. If the guardian notice child's uncomfortable response, the mother can consult with the elementary school staff who recommended consulting with the health center or a doctor. Medical expenses are covered by national insurance, and the researcher would not pay any costs. If participants feel uncomfortable, the first contact was the individual who was responsible at the respective survey location. If the location was in the elementary school, the first contact was the school's principal. If the location was the participant's house, the first contact was the mother or a responsible family member. However, no one felt uncomfortable and stopped the survey.

**Conflict of interest.** In this study, I disclose a Conflict of Interest with the Yamaji Fumiko Professional Nursing Education and Research Foundation. However, funds for this study was appropriately utilized by all study members, with no interest influencing the study's fairness.

**Data analysis.** The objective of this analysis was to develop a child obesity prevention model from observed data. Each variable collected from the questionnaire (Table 8) was analyzed. First, the

analysis for participants' characteristics were conducted. The obtained data was summarized and the descriptive statistics was performed. Relationships among variables was confirmed. A principal factor analysis was conducted to select feasible variables for the model development, and then the child obesity prevention model was developed using the SEM. Details of the analysis procedure were as follows: all statistical analysis was performed using SPSS (version 22 and 23) (IBM, Chicago, IL, U.S.A.), and AMOS for SEM.

***Descriptive statistics.*** Descriptive statistics were conducted to describe each variables and their structures.

- (1) Response rate of the questionnaire was calculated.
- (2) Missing values was imputed by mean imputation technique.
- (3) Summary statistics was computed.
- (4) Continuous variable: mean, standard deviation, maximum, minimum, quartiles, correlation coefficient, paired t-test, and Mann-Whitney test
- (5) Discrete variable: frequency
- (6) Discrete variables: contingency table, chi-square test, Fisher's exact test
- (7) Correlation between all interest pairs of variables was evaluated. Statistical significance was tested.

***PCA.*** PCA was used to derive the components of the variables of child obesity prevention LSBs.

***Reliability test.*** Reliability test was performed in order to test the reliability of subscales which were derived from the PCA using Cronbach alpha's coefficient calculation.

***Structural Equation Modeling.*** Structural equation modeling (SEM) was conducted to examine the structures among BMI and predictors associated with obesity.

- (1) An exploratory factor analysis was conducted to verify the hypothesized model drawn in Figure 3. All variables in Table 8 was included in the tentative model.

- (2) The number of factors used was determined by the cumulative contribution ratio; the significant variable was detected by the Wald test under the significance level of .05.
- (3) Goodness of model fit was evaluated by several fit indices (e.g., p-value of Chi-square test, confirmatory fit index (CFI), or root mean square error approximation (RMSEA)). The model did not fit the data well, the PCA was performed to seek a more feasible model.
- (4) The child obesity prevention model was built by the SEM. Significant variables of the previous model building was included in the model. Statistical significance was evaluated when the p-value of the Wald test was less than .05.

## Results

This chapter includes participants' attributes, participants' attributes relating to obesity, obesity status, evaluation of instruments, descriptive statistics of lifestyle behaviors (LSBs) relating to obesity including dietary, physical activity, and sleep, and their predictors including predisposing, reinforcing, enabling, and environmental factors. Also the associations and structural equation modeling between and among obesity status, LSBs, and their predictors in urban Indonesia are reported.

### Participants' Attributes

A total of 594 children were invited to participate in the study. Of those 97.5% (579 schoolchildren) agreed to participate. Participants' attributes consisting of age, gender, type of elementary schools, religion, number of siblings, and parents' occupations are described (see Table 10).

**Age.** Participants' mean age was 10.1 years;  $SD = 0.66$  (age in months = 121.6;  $SD = 7.9$ ). Age ranged from 8.3 years to 11.9 years.

**Gender.** About half of the participants were girls (49%) and other half were boys (51%).

**Type of elementary schools.** Approximately 61% (355) were from national school students. The remainder, 39% (224) were from private school students.

**Religion.** The vast majority of the participants were Muslims (99.7%). The small minority were Christians (0.3%).

**Number of siblings.** More than half of students had one or two older (51.4%) or younger (53.4%) siblings ranged from zero to 6. Mean number of older siblings was 0.9 ( $SD = 1.0$ ) and 0.8 ( $SD = 0.9$ ) for younger siblings.

**Parents' occupations.** Having both parents work were 44%, either parent worked were 53%, and neither parent worked were 3%. A majority of private students' parents 'both worked' (59%) as compared to national students' parents (35%).

### Participants' Attributes Relating to Obesity

Diet, physical activity, and sleep pattern of children including minutes to nearest small shop, minutes of exercise class in schools, minutes to most frequently visited health facility, snack expenses per day, screen-time per day, sleeping behaviors, daily step-counts, and parents' small-shop ownership is described (see Table 11).

**Minutes to nearest small shop.** Mean score of minutes to the nearest small shop was 2.9 minutes ( $SD = 2.9$ ).

**Minutes to nearest sports facility.** Mean minutes to the nearest sports facility was 8.3 minutes ( $SD = 4.5$ ).

**Minutes of exercise class in schools.** Mean number of minutes for exercise class in schools was 88.3 minutes per week ( $SD = 39.9$ ).

**Minutes to most frequently visited health facility.** The mean number minutes to the most frequently visited health facility was 28.3 minutes ( $SD = 28.9$ ).

**Snack expenses per day.** Snack expenses per day were 11,351 IDR; 0.84 USD;  $SD = 7,199$ . Private schoolchildren (9,818 IDR; 0.70 USD;  $SD = 4,021$ ) were given more money than national (13,848 IDR; 1.02 USD;  $SD = 10,008$ ) ones ( $p = .000$ ).

**Screen time per day.** The mean daily screen time was 226 minutes ( $SD = 203$ ). Private schoolchildren's screen-time (255;  $SD = 132$ ) was significantly more than national (208;  $SD = 124$ ) ones ( $p = .000$ ).

**Sleeping behaviors.** Mean score of bedtime was at 9:27 p.m.; 38 % of schoolchildren went to bed after 9:00 p.m. Mean sleeping hours was 8.2 hours ( $SD = 1.1$ ) and 46 % slept less than 8 hours. Mean score of nap hours was 1.2 ( $SD = 1.3$ ). Naptime was significantly higher in national schools (1.6;  $SD = 1.3$ ) than in private ones (0.6;  $SD = 1.1$ ;  $p = .000$ ).

**Daily step-counts.** Participants' mean step-counts was 6,448;  $SD = 3,501$ . Nationals walked more than private schoolchildren ( $6,952 \pm 3,994$  and  $5,615 \pm 2,255$ , respectively;  $p = .000$ ).

**Parents owned small shops.** About 16% of the participants' houses had small shops, which sold snacks, drinks, and daily necessities. Parents of the national schoolchildren (21%) had higher a rate of small shop ownership than private school ones (8%).

### Obesity Status

Obesity status of schoolchildren is described and associations among obesity status are examined.

**Obesity status of schoolchildren.** Obesity status was measured using BMI for their current age, estimated BMI at 18 years old, body fat, and waist-hip ratio.

**BMI at current age.** Participants' mean current BMI was 17.7;  $SD = 3.9$ . The BMI ranged from 11.5 to 34.2. By type of schools, private (19.4) had higher mean BMI than national (16.6) schoolchildren ( $p = .000$ , Mann-Whitney U- test; see Table 12). The BMI was significantly different by type of school and gender (see Table 13). By type of school and gender, the mean BMI was highest in boys in private schools and lowest in boys in the national schools ( $20.67 \pm 4.40$  and  $16.33 \pm 3.07$ , respectively).

**Estimated BMI at 18 years old.** Table 14 shows the distribution of BMI at 18 years old by type of school and gender. There was 22% obese, 18% overweight, 25% normal, and 34% underweight among participant children. By type of schools, prevalence of underweight was higher in the national schools than in private schools (43.7 and 19.6%, respectively;  $p = .001$ , Kruskal-Wallis test). Prevalence of obese or overweight was higher in the private schools than in national schools (62.9 and 26.5%, respectively;  $p = .001$ , Kruskal-Wallis test). Table 14 shows boys in the private schools had highest obese and overweight prevalence (79.8%) among participants, then girls in private schools, girls in national schools, and boys in national schools (56.2, 51.2, and 36.7%, respectively;  $p = .001-.005$ , Games-Howell test). On the contrary, the prevalence of underweight was lowest in the private schools and highest in national schools (19.6 and 43.7%, respectively).

**Body fat.** About 45% of children were overweight or obese. Mean score of body fat in private school children (25.1%;  $SD = 12.6$ ) had much higher body fat than national school children (15.7%;  $SD = 9.6$ ) ( $p = .000$ ; see Table 12).

**Waist hip ratio.** About 34.7%, or 201 children were obese or overweight. By gender, girls had bigger waist hip ratio than boys ( $p = .000$ , Mann-Whitney U- test; see Table 12).

**Associations among obesity status measures.** Associations of obesity status measures were examined using correlational analysis (see Table 15). Current BMI had strong associations with BMI at 18 years old and body fat ( $r = -.88$  and  $.92$ , respectively). Waist hip ratio had no associations with BMI and slight negative associations with body fat. Waist hip ratio was removed from the analysis because of weak associations with other measures. Hereafter, current BMI will represent obesity status because it had the strongest correlations with other obesity measures.

### Evaluation of Lifestyle Behaviors Relating to Obesity Instruments

Instruments measuring lifestyle behaviors relating to obesity were evaluated and refined. In order to refine the items, the following tests were conducted: normality, principal component analysis, and reliability.

**Normality test.** Normality test of 29 items revealed that some LSBs items had a non-normal distribution. However, all items were included into the following analysis because each item was considered as important information to know LSBs.

**Components of lifestyle behaviors.** Components of lifestyle behaviors were analyzed using principal component analysis (see Table 16). Nine components were categorized from 29 items that measured lifestyle behaviors. Components with a Cronbach alpha of less than  $.50$  were excluded from the analysis. Five components were retained: PA preference, healthy diet, healthy sleep and rest experience, PA willingness, and fruits-vegetables preference. Originally it was expected to have three components consisting of dietary, physical activity, and sleep LSBs. Categorized components were: two dietary (healthy diet and fruits-vegetables preference), two physical activity (PA preference and PA willingness), and one sleep (healthy sleep and rest experience) LSBs.

**Reliability of lifestyle behaviors relating to obesity instruments.** Reliability of lifestyle behaviors was examined to assess item consistency of instruments. All five components of lifestyle behaviors relating to obesity were examined and total Cronbach  $\alpha$  was .70.

**Revised lifestyle behaviors relating to obesity instruments.** Revised lifestyle behaviors such as PA preference, healthy diet, healthy sleep and rest, PA willingness, and fruits-vegetables preference were named as follows.

***Physical activity preference.*** Three items were included in this component. This component was named ‘PA preference’ because items included prefer or not lazy exercising.

***Healthy diet choices.*** Seven items were included in this component. This component was named ‘healthy diet’ because items included dietary contents, frequency, and eating style.

***Healthy sleep and rest experience.*** Four items were included in this component. This component was named ‘healthy sleep and rest experience’ because items included rest pattern after the meal, daytime sleepiness, and staying up late.

***Physical activity willingness.*** Three items were included in this component. This component was named ‘physical activity willingness’ because items included independent exercise behavior, exercise frequency, and length of exercise.

***Fruits-vegetables preference.*** Two items were included in this component. This component was named ‘fruits-vegetables preference’ because items included preference of fruits and vegetables.

### **Evaluation of Predictors Instruments**

Instruments measuring lifestyle behaviors relating to obesity were evaluated and refined. In order to refine the items, the normality test, principal component analysis, and reliability test were conducted.



**Normality test.** Normality test of 35 items revealed that some items measuring predictors had a non-normal distribution. However, all items were included into the following analysis because each item was considered as important information to know predictors.

**Components of predictors.** Components of predictors were categorized using principal component analysis (see Table 17). Twelve components were categorized from 35 items that measured predictors and components. Components with a Cronbach alpha less than .50 were excluded from the analysis. Five of the twelve components remained: knowledge of obesity, family, school, plus health center support, physical activity safety environment, efficacy control lifestyle behaviors, and family education and support. Originally it was expected to have four components consisting of reinforcing, predisposing, enabling, and environmental factors. Categorized components mostly reflected expected factors. The component of knowledge of obesity was categorized from items of predisposing factors. The component of family, school, plus health center support was categorized from items of predisposing, reinforcing, and enabling factors. The component of physical activity safety environment was categorized from items of environmental factors. The component of efficacy control LSBs was categorized from items of predisposing factors. The component of family education and support was categorized from items of reinforcing factors.

**Reliability of predictors.** Reliability of predictors was examined to assess item consistency of instruments. Components with a Cronbach alpha less than .50 were excluded from the analysis. All five components were examined and the total Cronbach  $\alpha$  of the predictors was .68.

**Revised predictors relating to obesity instruments.** Revised predictors including knowledge of obesity, family, school, plus health center support, physical activity safety environment, efficacy control lifestyle behaviors, and family education and support are named as follows.

**Knowledge of obesity.** Six items were included in this component. This component was named knowledge of obesity because items included knowledge of obesity prevention.

***Family, school, and health center support.*** Seven items were included in this component. This component was named family, school, and health center support because items included support or education from family, school, and or health center.

***Physical activity safety environment.*** Three items were included in this component. This component was named physical activity safety environment because items included safety of exercise such as no fear of road accidents, air pollution, and or being kidnapped.

***Efficacy control lifestyle behaviors.*** Four items were included in this component. This component was named efficacy control LSBs because items included efficacy of controlling dietary amount, exercise time, and screen-time.

***Family education and support.*** Three items were included in this component. This component was named family education and support because items included family's education and support of dietary and rest patterns toward children.

### **Descriptive Statistics of Lifestyle Behaviors Relating to Obesity**

Descriptive statistics of revised five lifestyle behaviors relating to obesity are explained as follows (see **Table 18**):

**PA preference.** Mean scores of 'not lazy to exercise' were 4.18 and higher in private schools than in national schools.

**Healthy diet.** Mean scores of 'avoiding sweet drinks' were 2.60 and higher in private than in national schools (2.72 and 2.52, respectively;  $p = .002$ ). Mean scores of 'not skip breakfast' were 3.05 and higher in private than in national schools (3.29 and 2.90;  $p = .000$ ).

**Sleep and rest experience.** Mean scores of 'no nap after lunch' were 3.25 and higher in private than in national school children (3.59 and 3.03, respectively;  $p = .000$ ). Mean scores of 'not sleepy during daytime' were 2.72 and higher in private than in national schools (3.05 and 2.52, respectively;  $p = .000$ ).

**PA willingness.** Mean scores of ‘exercising Sundays and holidays’ were 2.68 and higher in national than in private schools (2.83 and 2.45, respectively;  $p = .000$ ). Mean scores of exercising 60 minutes per day were 2.26 and higher in private than in national schools (2.36 and 2.20;  $p = .035$ ).

**Fruits-vegetables preference.** Mean scores of vegetable preference were 4.06 and higher in national than in private schools (4.14 and 3.95, respectively;  $p = .016$ ).

### **Descriptive Statistics of Predictors.**

Descriptive statistics of revised 5 predictors are explained as follows (see [Table 19](#)):

**Knowledge of obesity.** Mean score of ‘think obesity as bad shape’ was 2.87 and was higher in private than in national schools (3.25 and 2.63, respectively). Mean score of ‘think obese were easily teased’ was 2.68. It was higher in private than in national schools (2.93 and 2.53, respectively). Mean score of ‘obesity as unhealthy’ was 3.24; it was higher in the privates than in nationals (3.75 and 2.92, respectively). Mean score of ‘knowledge physical inactivity is a cause of obesity’ was 3.42 and was significantly higher in private (3.76) than in national schools (3.20;  $p = .000$ ). Mean score of ‘think lifestyle changes were important’ was 3.66. It was higher in private than in national schools (3.84 and 3.54, respectively).

**Family, school, and health center support.** Mean score of ‘presence of teachers’ was 1.30 and was significantly higher in national than in private schools (1.35 and 1.21;  $p = .009$ , respectively). ‘Presence of health center staff’ was 1.35 and it was significantly higher in national than in private schools (1.45 and 1.20;  $p = .000$ , respectively).

**Physical activity safety environment.** Mean score of ‘no fear of being kidnapped when exercising’ (reversal question) was significantly higher in national than in private schools (3.17 and 2.88, respectively;  $p = .011$ ).

**Efficacy control lifestyle behaviors.** Mean scores of efficacy for ‘controlling dietary LSBs’ (dietary amount and snack amount) were all significantly higher in private (4.02 and 3.83, respectively) than in national schools (3.58 and 3.52, respectively;  $p = .000$  and  $p = .002$ ,

respectively). Mean scores of efficacy for ‘controlling PA LSBs’ (exercise time) was significantly higher in private (4.11) than in national (3.87) schools ( $p = .004$ ).

**Family education and support.** Mean score of ‘family teach not to sleep after meal’ was significantly higher in private than in national (3.01 and 2.63;  $p = .000$ , respectively). Mean score of ‘family control dietary amount’ was significantly higher in national than in private (2.65 and 2.23;  $p = .000$ , respectively). Mean scores of ‘learn at schools about obesity’ and ‘learn at health centers about obesity’ were significantly higher in national (1.51 and 1.76, respectively) than in private schools (1.36 and 1.36;  $p = .011$  and  $p = .000$ , respectively). Mean scores of ‘family teaches dietary behaviors’ or ‘controls amount of meal’ were also higher in private (3.01 and 2.65, respectively) than in national schools (2.63 and 2.23, respectively).

In summary, a total of 579 schoolchildren were from national (355) and private schools (224). About 41% of participants were obese or overweight. By schools, 27% of national and 63% of private schoolchildren were obese or overweight. Obesity status markers such as body fat, BMI, and waist hip ratio were all higher in private than in national schools.

Step-counts and nap hours were higher in national than private schoolchildren. Children had access to the small shops only 2.9 minutes away, although access to the exercise facilities were almost 3-fold (8.3 minutes). Children walked 6,448 steps per day and exercised 88 minutes a day in schools. Screen-time of children was 226 minutes. About 38 % of schoolchildren went to bed after 9:00 p.m. and 46 % sleep less than 8 hours. Snack expenses and screen time were higher in private than national schoolchildren.

Descriptive statistics revealed that participant children reported limited practice in healthy diet, PA willingness, and family, school, and HC support.

### **Associations Between Obesity Status, Lifestyle Behaviors Relating to Obesity, and Their Predictors**

Associations between obesity status and LSBs, and LSBs and their predictors were examined through correlation analysis. Associations between obesity status and LSBs were examined for all participants, by type of schools, and by gender.

***Obesity status and lifestyle behaviors.*** There were slight positive correlations ( $r = .22$ ;  $p = .000$ ) between BMI and ‘sleep and rest patterns’ LSBs of all participants (see Table 20).

***Obesity status and lifestyle behaviors by gender.*** There were no wide differences between girls and boys in obesity status and gender (see Table 21 and 22).

***Obesity status and lifestyle behaviors of girls.*** There were slight positive correlations ( $r = .23$ ;  $p = .000$ ) between BMI and ‘sleep and rest patterns’ LSBs of girls (see Table 21).

***Obesity status and lifestyle behaviors of boys.*** There were slight positive correlations ( $r = .22$ ;  $p = .000$ ) between BMI and ‘sleep and rest patterns’ LSBs of boys (see Table 22).

***Obesity status and lifestyle behaviors by schools.*** Correlation coefficients of BMI and family, school and HC support were significantly different between national and private schools ( $r = .07$  and  $.24$ ;  $p = .22$  and  $.000$ , respectively; see Table 23 and 24).

***Obesity status and lifestyle behaviors of children in national schools.*** There were no correlations between BMI and ‘sleep and rest patterns’ LSBs of national schoolchildren (see Table 23).

***Obesity status and lifestyle behaviors of children in private schools.*** There was a slight positive correlations ( $r = .26$ ;  $p = .000$ ) between BMI and ‘sleep and rest patterns’ LSBs of boys (see Table 24).

#### **Lifestyle behaviors and their predictors.**

***Lifestyle behaviors and their predictors by gender.*** There were some coefficient differences between girls and boys although they were not all significant. PA willingness had positive

correlations with obesity knowledge and had difference between girls and boys ( $r = -.04$  and  $.16$ ,  $p = .55$  and  $.01$ ). These gender differences will be discussed further from the perspective of finding of the multiple group analysis in structural equation modeling.

***Girls' lifestyle behaviors and their predictors*** . PA preference had a slight positive correlation with 'efficacy control LSBs' ( $r = .25$   $p = .000$ ). Sleep and rest patterns had a slight positive correlation with knowledge ( $.16$   $p = .01$ ) and a significant negative correlation with family, school, and health center support ( $r = -.20$   $p = .000$ ). PA willingness had slight positive correlations with family, school, and HC support, PA safety environment, efficacy control LSBs, and family education support ( $r = .34$ ,  $.23$ ,  $.23$ , and  $.16$ ;  $p = .000$ , respectively). (see [Table 21](#))

***Boys' lifestyle behaviors and their predictors***. PA preference had slight positive correlations with PA safety environment and efficacy control LSBS ( $r = .20$  and  $.32$ ;  $p = .000$ , respectively). Sleep and rest patterns had a slight negative correlation with family, school, and HC support ( $r = -.24$ ;  $p = .000$ ). PA willingness had slight positive correlations with all predictors ( $r = .16$ ,  $.23$ ,  $.17$ ,  $.17$ , and  $.27$ ;  $p = .01$ ,  $.000$ ,  $.000$ ,  $.000$ , and  $.000$ , respectively). Fruits-vegetable preference had slight positive correlations with knowledge, efficacy control LSBs, and family education support ( $r = .12$ ,  $.28$ , and  $.14$ ;  $p = .03$ ,  $.000$ , and  $.02$ , respectively; see [Table 22](#)).

***Lifestyle behaviors and their predictors by schools***. There were some correlation coefficient differences between national and private schools although they were not all significant. Correlation coefficients between BMI and family, school, and HC support had significant differences private schools compared to national schools ( $r = .24$  and  $.07$ ;  $p = .000$  and  $.22$ , respectively). PA preference had a positive correlation with efficacy control LSBs and had a significant difference between national and private schools ( $r = .18$  and  $.47$ ;  $p = .000$ , respectively). Correlations between PA willingness and PA safety environment had different coefficients between national and private ( $r = .12$  and  $.35$ ;  $p = .03$  and  $.000$ , respectively) schools. Correlation coefficients of fruits-vegetables preference and family education and support had significant differences between national and private

schools ( $r = .23$  and  $.10$ ;  $p = .000$  and  $.14$ , respectively). These school differences will be discussed further in the section about multiple group analysis in structural equation modeling.

***Lifestyle behaviors and their predictors of children in national schools.*** PA preference had a slight positive correlation with efficacy control LSBs ( $r = .18$ ;  $p = .000$ ). Sleep and rest patterns had a slight negative correlations with family, school, and HC support ( $r = -.24$ ;  $p = .000$ ). PA willingness had slight correlations with PA safety environment and efficacy control LSBs ( $r = .12$  and  $.15$ ;  $p = .03$  and  $.01$ , respectively). Fruits-vegetables preference had positive correlations with family education and support ( $r = .23$ ;  $p = .000$ ). (see [Table 23](#)).

***Lifestyle behaviors and their predictors of children in private schools.*** PA preference had a slight positive correlation with PA safety environment ( $r = .25$ ;  $p = .000$ ) and a moderate correlation with efficacy control LSBs ( $r = .47$ ;  $p = .000$ ). Healthy diet had a slight positive correlations with efficacy control LSBs ( $r = .20$ ;  $p = .000$ ). PA willingness had negative correlations with PA safety environment and efficacy control LSBs ( $r = .35$  and  $.29$ ;  $p = .000$ , respectively). Fruits-vegetables preference had a positive correlation with PA safety environment ( $r = .19$ ;  $p = .01$ ). (see [Table 24](#)).

### **Structural Equation Modeling of Obesity Status, Lifestyle Behaviors, and Their Predictors**

In order to investigate the structures among obesity status, LSBs, and their predictors of healthy weight development in urban Indonesia, structural equation modeling (SEM) was conducted by type of school and by gender. In total, 10 latent variables (five LSBs and five predictors) consisting of 42 observed variables were entered into the model and the relationships among them were examined. Five components of the LSBs were categorized by three LSBs: dietary, physical activity, and sleep LSBs. Dietary LSBs consisted of two components: fruits-vegetables preference LSBs and healthy dietary LSBs. PA LSBs consisted of PA willingness LSBs and PA preference LSBs. Sleep LSBs consisted of sleep and rest patterns LSBs. Observed variables with factor loadings of less than  $.35$  were omitted from the model. All path coefficients in the model were statistically significant. Some models included a single observed variable from

the results of the correlation analysis because the latent variables were not always the strongest subscales in the model.

**Structural equation modeling of national schools.** SEM of the national schools was conducted. Goodness of model fit was evaluated by several fit indices. The  $p$ -value of Chi-square test was  $p = .000$ ; Confirmatory Fit Index (CFI) was .909; Goodness of Fit Index (GFI) was .940; Adjusted Goodness of Fit Index (AGFI) was .922; the root mean square error approximation (RMSEA) was .035 (see Figure 7).

**Obesity status and lifestyle behaviors.** 'No happy eating' had a slight negative influence on BMI ( $\beta = -.11$ ;  $p = .031$ ).

**Physical activity lifestyle behaviors and their predictors.** 'PA safety environment' and 'family education and support' had slight positive influences on PA preference LSBs ( $\beta = .16$ ;  $p = .035$  and  $.21$ ;  $p = .037$ , respectively). 'PA safety environment', 'family education and support', and 'Family, school, and HC support' had positive influences on PA willingness LSBs ( $\beta = .25$ ,  $.43$ , and  $.36$ ;  $p = .019$ ,  $.037$ , and  $.007$ , respectively).

**Structural equation modeling of private schools.** SEM of private schoolchildren was conducted. The  $p$ -value of Chi-square test was  $p = .000$ , CFI was .888, GFI was .887, AGFI was .861, and the RMSEA was .037 (see Figure 8).

**Obesity status and lifestyle behaviors.** 'Junk food frequency LSBs' and 'Family avoid outside foods' had slight negative influences on BMI ( $\beta = -.18$  and  $-.19$ ;  $p = .000$  and  $.010$ , respectively). These LSBs decreased BMI in private schools.

**Dietary lifestyle behaviors and their predictors.** 'Efficacy control LSBs' had strong positive influences on fruits-vegetables preference LSBs ( $\beta = .71$ ;  $p = .000$ ) and healthy dietary LSBs ( $\beta = .65$ ;  $p = .000$ ).

**Physical activity lifestyle behaviors and their predictors.** 'Family education and support' and 'PA safety environment' had positive influences on PA willingness LSBs ( $\beta = .50$  and  $.48$ ;  $p = .000$  and  $.000$  respectively).



***Sleep lifestyle behaviors and their predictors.*** 'Efficacy control LSBs' had a positive influence on sleep and rest patterns LSBs ( $\beta = .35$ ;  $p = .003$ ).

**Structural equation modeling for girls.** SEM for girls was conducted. The  $p$ -value of Chi-square test was  $p = .000$ , CFI was .893, GFI was .907, AGFI was .885, and the RMSEA was .036 (see Figure 9).

***Obesity status and lifestyle behaviors.*** 'Sleeping hours' and 'snacking money' had a slight positive influence on BMI ( $\beta = -.11$  and  $.16$ ;  $p = .010$  and  $.001$ , respectively).

***Dietary lifestyle behaviors and their predictors.*** 'Efficacy control LSBs' had a positive influence on fruits-vegetables preference LSBs ( $\beta = .52$ ;  $p = .000$ ).

***Physical activity lifestyle behaviors and their predictors.*** 'PA safety environment', 'PA peer presence', and 'Efficacy control LSBs' had positive influences on PA preference LSBs ( $\beta = .12$ ,  $.88$ , and  $.34$ ,  $p = .025$ ,  $.038$ , and  $.005$ , respectively).

**Structural equation modeling for boys.** SEM for boys was conducted. The  $p$ -value of Chi-square test was  $p = .000$ , CFI was .883, GFI was .923, AGFI was .900, and the RMSEA was .045 (see Figure 10).

***Obesity status and lifestyle behaviors.*** 'No trouble sleeping', and 'Not decide what to eat' had slight negative influences on BMI ( $\beta = -.18$  and  $-.10$ ;  $p = .005$  and  $.044$ , respectively).

***Dietary lifestyle behaviors and their predictors.*** 'Efficacy control LSBs' had a positive influence on fruits-vegetables preference LSBs ( $\beta = .47$ ;  $p = .000$ ).

***Physical activity lifestyle behaviors and their predictors.*** 'Efficacy control LSBs' and 'PA safety environment' had positive influences on PA preference LSBs ( $\beta = .52$  and  $.28$ ;  $p = .000$  and  $.000$ , respectively).

In summary, SEM by type of school, by gender, and by obesity status was conducted. The model revealed the relationships among obesity status, LSBs and their predictors. Most of LSBs positively influenced BMI.

In national schools, the predictor of dietary LSBs was 'knowledge of obesity'. Predictors of PA LSBs were 'family education and support' and 'family, school, and HC support'. The predictor of sleep LSBs was 'family, school, and HC support'.

In private schools, the predictor of dietary LSBs was 'efficacy control LSBs'. Predictors of PA LSBs were 'efficacy control LSBs' and 'PA safety environment'. The predictor of sleep LSBs was 'efficacy control LSBs'.

Regarding girls, the predictor of dietary LSBs was 'efficacy control LSBs'. The predictor of PA LSBs was 'efficacy control LSBs'. The predictor of sleep LSBs was 'family education and support'.

Regarding boys, the predictor of dietary LSBs was 'efficacy control LSBs'. Predictors of PA LSBs were 'family education and support' and 'efficacy control LSBs'. The predictor of sleep LSBs was 'family, school, and HC support'.

### **Summary of Results**

A total 594 schoolchildren were invited to join the study and 579 (97.5%) participated in the study. They were 355 national and 224 private schoolchildren. About 40% of all participants, 27% of national and 63% of private school children were obese or overweight. Prevalence of thinness was higher in the national schools than in the private schools (43.7 and 19.6%, respectively). Obesity status such as body fat, BMI, and waist hip ratio were all highest in boys in the private schools and lowest in boys in the national schools. Attributes relating to obesity revealed easy access to snacks, limited walking, long screen-time, less sleep, limited rejecting snack invitation environment. Descriptive statistics revealed that schoolchildren practiced limited LSBs in healthy diet; PA willingness; family, school, and HC support.

Principal component analysis extracted 10 components of lifestyle behaviors relating to obesity and their predictors of schoolchildren. They were five components of LSBs and five predictors. These components were similar as expected in the theoretical framework.

The relationships among obesity status, LSBs, and their predictors were examined by structural equation modeling by type of schools, gender, and obesity status.

By schools, national schoolchildren's LSBs were influenced by 'PA safety environment', 'family education and support' and 'family, school, and HC support'. Private schoolchildren's LSBs were influenced by 'efficacy control LSBs' and 'PA safety environment'.

By gender, girls' LSBs were influenced by 'PA safety environment', 'PA peer presence', and 'efficacy control LSBs'. Boys' LSBs were influenced by 'knowledge of obesity', 'efficacy control LSBs', 'family education and support', 'family, school, and HC support'.

## Discussion

The discussion includes the following issues: (a) schoolchild obesity status in urban Indonesia; (b) double burden of schoolchild malnutrition in urban Indonesia; (c) economics of noncommunicable diseases and obesity in Indonesia; (d) lifestyle behaviors and predictors which relate to schoolchild obesity status in urban Indonesia; (e) model of schoolchild obesity status, LSBs, and their predictors in urban Indonesia (f) implications for health policy makers and health programs for the local government, and (g) strengths and limitations of the study.

### Schoolchild Obesity Status in Urban Indonesia

Participants' obesity and overweight rate (40%) was exceedingly higher than the national average and it was an alarming issue. Private schools had higher prevalence of obesity or overweightness than national schools (63% and 27%, respectively). It was much higher than the obesity or overweightness of 19%, which was the Indonesian children's average (5 to 12 years old) in 2013 (BPS, 2014). In Jakarta, neighboring our survey site, it was 30% and it was considered the highest rate in Indonesia (KKRI, 2013b). However, the results of this study showed the severity of schoolchild obesity in the area in that it exceeded the highest documented rate.

Obesity prevention in Indonesia is an alarming issue like in other low- and middle-income countries. The number of obese and overweight children from the ages of 2 to 19 increased 26% in these 20 years and 83% or 257 million live in low- or middle-income countries (IHME, 2014). Obesity and overweight rates in these emerging countries such as Mexico, Brazil, Turkey, and Malaysia (68, 52, 62, and 44%, respectively), all of which attained economic growth prior to Indonesia (see [Table 25](#)) might predict the future risk scenario for Indonesia. It seems clear that earlier obesity prevention is needed.

### Double Burden of Schoolchild Malnutrition in Urban Indonesia.

A double burden of diseases such as NCDs and communicable diseases; overweight and underweight existed in one country; one suffers from emaciation and another suffers from obesity.

The national health survey showed this inter-country gap. Nusa Tenggara Timur province was the lowest overweight (8.7%) and highest underweight (7.8%) province in Indonesia although the capital region of Jakarta had the highest prevalence (30%) of obese and overweight (BPS, 2014).

At the national level, the Indonesian government has issued the schoolchild obesity prevention guidelines as mentioned in the literature review (KKRI, 2012). At the regional level, the local government health office collaborating with the health centers, are responsible for child health. However, current the regional focus is still on communicable diseases and maternal child health under five years old. Limited human resources are thus unable to monitor children frequently to prevent diseases. Measurement and immunization programs are the main focus of the regional health offices (Preliminary study). Health officers are aware of the problem of obesity, however, at the same time, they have to respond to underweight. Obesity information is limited and they have limited human resources to implement any projects. At the school level, the physical activity teachers or class teachers with no health professional background are the only personnel who can teach about obesity to schoolchildren.

The study also described the double burden of malnutrition among schools. Obesity status gap between national and private schoolchildren existed. Obesity and overweight in private this gap. Basically, guardians' income level of the private schoolchildren was higher than that of the national schoolchildren. They have different lifestyle behaviors. In the study, we measured snack expenses, vehicle usage, and step-counts. Snack expenses and vehicle usage were higher in private schoolchildren than national schoolchildren. Private schoolchildren walked less than national schoolchildren. Private schoolchildren did not walk to school because they usually come from outside the original school area and parents or drivers often took the children to private schools. The more wealthy obese and overweight children and the poorer thin children might exist in same area. However, economic growth and lifestyle change possibly increase the risk to be obese.

### **Economics of Noncommunicable Diseases and Obesity in Indonesia.**

Indonesia experienced drastic lifestyle changes and a shift of disease structure beginning in the late 20<sup>th</sup> century due to globalization and economic growth. As mentioned, NCDs economic

pressure on the government of Indonesia are substantial and the total health expenditure has seen a 5-fold in the same time period (WHO, 2016). In response to these increased expenditures the governments instituted prevention policies. Globally, there has been a trend of taxation policies for saturated fat foods, junk foods, and sugary drinks in high income countries such as the United States and England. It was aimed to reduce the risk of obesity related diseases and related costs. However, the taxation policy failed in Hungary and increased food price affected the low-income people often consume high amount of high-fat products (ECSIP, 2014).

Decentralization and the double burden of diseases might cause delay of prevention programs implemented at the local government level. For sustainable development, obesity prevention and healthy weight development is needed.

### **Predictors Relating to Schoolchild Obesity Status in Urban Indonesia**

From participants' attributes relating to obesity and descriptive statistics, participant children reported limited practice in obesity prevention LSBs, which were inevitable in promoting child obesity prevention. These were easy access to snacks, limited physical activity, limited monitoring own weight, and obesity education and support environment.

**Easy-access to snacks.** Participant children reported easy-access to small shops and affordability of snacks although there is a schoolchild obesity prevention guideline, which recommend reducing snacks and outside foods (KKRI, 2012). As a background, in Indonesia nationally, the number of supermarkets has increased 63% and the expenditure on processed foods has increased 46% in three years due to globalization (Japan External Trade Organization, 2013). From street vendors to restaurants, high-calorie foods environment are all around. Food distribution system change (WB, 2013) made widespread obesogenic friendly environments.

Family lifestyles change also causes easy access to snacks. The shift from the primary to tertiary sector of industry results in those employed in the primary sector to lose their source of employment. Guardians of children often employed; this study showed that 44% of both parents outside the home. Guardians worked late, precluding home cooked meals so they might purchase

food after work. Although the Indonesian governments had issued food regulations (Decree of Information and Daily Suggestion for Processed and Fast Food; KKRI, 2013a), the global obesogenic environment is becoming ubiquitous, that is anytime, for everyone, and everywhere equally for poor or rich, rural or urban; the country as a whole is becoming more obesogenic.

The WHO recommended limiting energy intake from total fats and sugars and instead increasing fruits, vegetables, whole grain, nuts, and legumes (WHO, 2013). Clearly a dietary shift to healthier foods is needed in Indonesia. Awareness of reducing excessive snack consumption including reducing snack money from guardians is a necessary and needed first step.

**Limited physical activity.** Although childhood obesity prevention guidelines recommend exercising at least one hour a day (KKRI, 2012) children reported limited physical activity. Private school students reported limited walking behaviors compared with national students as measured by step-counts and no-vehicle usage. At the national level, 30% of Indonesian were considered physically inactive (WHO, 2012). Several factors are involved in promoting less physical activity. For example the development of the transportation system reduced citizens need to walk or bike to their destination. Physical activity safety environment was also derived from the preliminary study. Fear of kidnapping and accidents were an important factor and challenge for children considering whether or not to engage physical activity.

**Limited monitoring of own weight.** Participant children reported a limited monitoring of their own weight. This might be caused by lack of equipment and school health monitoring system. At the monthly *Posyandu* (health care program at the village level), health staff mainly focused on the maternal and child health programs such as immunization, and health status measurements. Children under five years old are measured and their growth levels are monitored. After 5 years old when they enter elementary schools, schoolchildren have less opportunity to be measured. In the preliminary study and main study, only one out of six private schools had equipment such as weighing scales and measuring devices (e.g. calipers, measuring tape).

Concerning their own weight is important for schoolchildren under physically development, however current environment does not allow children to monitor their own weight. Improvement of schoolchild health environment such as installation of equipment is needed.

**Limited obesity education and supportive environment.** Limited child obesity prevention education and support from the family, health center, and schools were reported in the target district of this study.

Continuous monitoring of own weight and healthy LSBs education is also needed for healthy weight development. The Indonesian government also issued the guidelines and recommend physical measurement and screening (KKRI, 2012).

WHO also issued a warning about the severity of childhood obesity in the world, particularly in low- and middle-income countries and established a high-level commission to end child obesity in 2014 (WHO, 2014a). WHO recommended interventions focusing on the dietary, physical activity lifetime education for pregnancies, early-childhoods, and adolescents. Therefore, practical programs to implement these recommendations for schoolchildren is needed.

### **Structural Equation Modeling of Obesity Status, Lifestyle Behaviors, and their Predictors in Urban Indonesia**

This study developed the schoolchild healthy weight development model in urban Indonesia (see **Figure 11**). This model showed the structure among healthy weight status, LSBs, and their predictors in urban Indonesia. Theoretical framework (Figure 4) indicated that obesity status was predicted by LSBs. As predisposing factors, efficacy controlling LSBs and knowledge of obesity were the predictors of LSBs. As reinforcing factors, ‘family education and support’ and ‘family, school, and HC support’ were the predictors of LSBs. As enabling factors, ‘family, schools, and HC support’ were the predictors of LSBs. As environmental factors, PA safety environment was the predictors of LSBs. ‘Family, schools, and HC support’ were categorized as reinforcing and enabling factors because they mentioned about presence of supporters (enabling factors) and



supporting system themselves (reinforcing factors). However, the BMI was not strongly predicted by LSBs for the national schools compared to the private schools.

The models (CFI = .88-.91) indicated boys trouble sleeping ( $\beta = -.18$ ), junk food frequency and foods from outside ( $\beta = -.18$  and  $-.19$ ) of private schoolchildren predicted BMI. Self-efficacy and PA safety environment predicted most of the lifestyle behaviors by gender and by type of schools. PA safety environment predicted PA lifestyle behaviors ( $\beta = .12-.48$ ). For girls, PA peer presence predicted PA lifestyle behaviors ( $\beta = .88$ ).

These findings from the models and predictors relating to obesity from descriptive statistics suggest the followings: (a) school health system development to implement healthy weight development programs; (b) healthy weight-development programs to support children's healthy lifestyle behaviors such as healthy diet, PA, and sleep; to promote and maintain efficacy control lifestyle behaviors; (c) healthy environment development such as dietary, PA safety, and PA peer-group to reduce obesogenic foods and to increase PA.

### **Implications for Healthy Weight Development**

Healthy weight development is a pressing issue because of the rapid lifestyle changes in Indonesia. Disease structure has been shifting to noncommunicable diseases, which are responsible for 71 % of total deaths in Indonesia (WHO, 2014). Private and national schools in urban Indonesia, especially obesity was a challenging issue. In order to tackle this requires three foci: (1) implementation of the healthy weight development program at school and community; (2) development of the school health system and (3) development of a healthy environment.

**School health system development in urban Indonesia.** Needs of obesity educations were shown in the model that 'family education and support' and 'family, school, and HC support' had an influence on LSBs in all schools, gender, and obesity status. A school health system, which can monitor, evaluate, and implement healthy weight development program is needed. Installation of equipment such as physical activity equipment and weighing scales is needed to monitor healthy weight. Development of human resources such as school health nurse, nutritionist, and health center

staff are needed. Development of the training program for human resources such as nutritionists, school health nurses, and health center staff are needed for further interventions.

**Healthy weight development program development.** Program development focusing on predictors is needed at the family, schools, community, and national policy levels.

***Dietary-physical activity combination intervention.*** Result from the literature review showed that the combined interventions of the dietary and PA LSBs were more effective than single intervention such as dietary only or PA only interventions (Boutelle, et. al, 2011; Elder, et. al, 2014; Estabrooks, et. al, 2009; Fitzgibbon, et. al., 2005; Jouret, et. al, 2009; Pittson, et. al., 2011; Slusser, et. al., 2012; Taylor, et. al., 2008; Wright, et. al., 2013).

Results of this study also showed the importance of PA, dietary, and sleep LSBs. PA and dietary combination support groups at community and school level are needed. A previous study showed dancing (Fitzgibbon, 2005) and school vegetable garden (Centers for Disease Control and Prevention, 2015) interventions were effective in reducing BMI. School meal program is also a possible program so that children can learn appropriate dietary contents, eating style, and frequency such as the one implemented in Vietnam (Le, Duc Son Nguyen Trung, 2012)

**Healthy environment development.**

***Accessibility to healthy foods environment.*** Children reported enough knowledge and efficacy regarding diet, however they also reported high snack expenses. This lifestyle behavior predicted obesity status especially in private schoolchildren. Food environment was obesogenic in terms of accessibility and affordability. For accessibility, by replacing healthier foods in canteens or small shops inside and outside schools could provide healthier foods to children. For affordability, restriction of the money for snacks especially for private school children is needed. In addition, education for better choice of foods is needed from an earlier age. Dietary education should include such information and practice as how to read food labels, healthy contents of foods, amount and frequency of food intake.

***Physical activity safety environment.*** The model showed PA safety environment was an important predictor of PA LSBs. Safer road conditions, development of public sports facilities, and a safer society for children could be provided by the government and the community so that children have neither worries about accidents nor concerns about being kidnapping. Formulating PA support group in the community and schools are needed so that children could feel safe and be motivated to exercise.

***Physical activity peer support environment.*** The model showed girls' invited physical activity behaviors. Basically girls feel unsafe if they do not exercise with friends from the preliminary study. Presence of friends or family motivated girls to exercise, therefore peer support and maintenance are important to promote more exercise.

***Good sleep environment.*** Descriptive statistics showed children's short sleep. The model identified sleep lifestyle behaviors influenced on obesity status. Meta-analysis of 696 studies on obesity and sleep also revealed that children with short sleep had nearly double the risk of obesity than normal sleepers ( $OR: 1.89$ ;  $95\% CI: 1.46-2.43$ ;  $p < 0.0001$ ; Cappuccio et al., 2008). Long screen-time could be a possible predictor of short sleep although there were no correlations between screen-time and sleep LSBs in the model. Education for screen-time reduction such as no television or computers in the child's room means involving the family in the decision..

### **Strengths of the Study**

This study offers a rich source of information about children's obesity status, LSBs relating to obesity, and their predictors in urban Indonesia. Therefore it can be a well-grounded resource for the further development of child obesity prevention programs. In addition, this study will become a basis of the program and collaborative process for developing a future obesity prevention program to decrease NCDs and to benefit Indonesian society. Structures among obesity status, lifestyle behaviors, and predictors related to child obesity were examined. This study contributed to research and practice as follows:

**Primary information of child obesity prevention in middle-income countries.** The study added information on middle-income countries' child obesity status, lifestyle behaviors, and predictors, which was very limited in the literature review. Additionally, it contributed to the child obesity prevention studies in middle-income countries and school health policy making.

**Model development to improve children's health status in urban Indonesia.** The study developed a model to improve the health status of children aged 9 to 11 in South Tangerang District, Banten Province, Indonesia. The model showed pathways for the possible intervention program.

**Evidence for child obesity prevention program to reduce future NCDs deaths.** Within a community health program, the study will provide information and direction for a school health program implemented by stakeholders, including guardians, schoolteachers, health service providers, and health policy makers in the future for urban Indonesia.

### **Limitations of the Study**

This study has some limitations in terms of measurement tools and study design.

**Waist hip ratio as measures of obesity status.** The waist hip ratio had weak correlations with all other obesity status measures for schoolchildren in the area. For future studies, other types of obesity status measurement should be considered to measure child obesity status. The body mass index and the waist hip ratio might be more valid to measure the obesity status.

**Pedometers as a measures of physical activity.** During the survey, the children participants were very happy to receive the pedometers. At the same time, they were very curious about the tools and often ran instead of walking. This response might cause more step counts than their usual situation. It was hard to control the unusual situation because we had already informed the children that the pedometers counted their steps as they walked. Possible bias might have resulted because of this unusual measurement situation. In addition, 18 children lost their pedometers and no data was available. Even though we have informed children that pedometers could be given to children after survey, children feared that pedometers might be taken and they did not bring them to schools.

However, it showed objective evidence of children's daily physical activities. For future studies, longer-term observation or another measurement tools could be discussed.

**Cross sectional study as study design.** The study design of this survey was a cross sectional study. Therefore, the study could describe proximal results and limited causal effects. Further longitudinal studies are needed. This study also had limited generalizability and future comparisons among different provinces, different ethnic groups, and different countries are needed. Study replication is advised. In addition, future program implementation based on this cross sectional study is needed to test the effectiveness of this child obesity prevention model.

**Proximal weak associations between obesity status and lifestyle behaviors.** Results of the study showed weak correlations between BMI and other variables such as attributes relating to obesity, lifestyle behaviors, and their predictors. Possible reasons are; (a) questionnaire of lifestyle behaviors relating to obesity had not covered all child lifestyle behaviors and it might be culture or values of Indonesian society of which the children were unaware; (b) children of this age are still developing physically and mentally and their current lifestyle behaviors did not predict current obesity status; (c) samples were a diverse mix of both girls and boys, national and private schools, and obese and non-obese children. Variety of child attributes might affect the results. Hence, the proximal structures between obesity status and lifestyle behaviors were not so strong. However, those health LSBs might predict future obesity status in future. Longer-term follow-up study would show greater impact on obesity.

**Validity of the questionnaire.** Results of the reliability test showed slightly low Cronbach  $\alpha$  coefficients in some components. There are two possible reasons. First, number of questions were too few to ask various lifestyle behaviors and their predictors. The ethics committee pointed out that the numbers of questions (120 items) were too much of a burden for schoolchildren. In the study, the number of items was reduced considering children's concentration on the questionnaire (82 items). Therefore, the limited number of questions could have decreased reliability. For further study, number of items and contents of the questionnaire should be refined. Second, the preliminary and pilot study was conducted only in one national school and did not reflect the lifestyle behaviors and

predictors of private schools. For further study, the questionnaire should be tested with both types of schoolchildren and refined. A qualitative approach, such as focus groups with children might also provide insights for additional questionnaire items.

### Conclusion

There were two major area of findings from this study. First, the study provided a description of schoolchild obesity status, lifestyle behaviors relating to child obesity, and their predictors. Second, the study identified the structures between and among schoolchild obesity status, lifestyle behaviors, and their predictors and developed a child obesity prevention model for South Tangerang District, Banten Province, Indonesia.

The theoretical framework based on the PRECEDE-PROCEED model, a literature review, and the interview was tested using the structural equation modeling. The framework assumed there were associations between and among obesity status, lifestyle behaviors, and their predictors; The framework also assumed that obesity status was predicted by lifestyle behaviors; lifestyle behaviors were predicted by lifestyle behaviors predictors.

Schoolchildren had accessibility and affordability to small shops, limited access to sports facility, limited stepcounts, less sleep, and lot of screentime.

Theoretical framework was partially supported. Obesity status of boys and private schoolchildren was predicted by LSBs and LSBs were predicted by predictors. 'Efficacy control LSBs' and 'knowledge of obesity' as predisposing, 'family, school, and health center support' as enabling factors, and 'physical activity safety environment' as environmental factors predicted lifestyle behaviors as study framework based on PRECEDE-PROCEED model.

Development of schoolchild obesity prevention programs to promote or support healthy lifestyle behaviors are needed. At government level, it is recommended to develop healthy dietary environment, physical activity safety environment, and school health system to implement obesity prevention program. At program level, it is necessary that PA and dietary combination program such as school meal, peer physical activity group, obesity education involving family and students at community and school level.

This study contributed to provide information on schoolchild obesity status, obesity prevention lifestyle behaviors, and their predictors in urban Indonesia.