

Prevalence and Lifestyle Risk Factors of Overweight and Obesity Among Indonesian Adolescents: An Analysis of Global School-Based Health Survey 2007 and 2015

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ABSTRACT

The prevalence of overweight and obesity has doubling globally including Indonesia. Adolescence is a golden period of nutritional intervention in the lifecycle. Objective: This study aimed to examine the prevalence and to identify the associated factors of over nutrition among Indonesian adolescent based on the GSHS data. Methods: This study was a secondary analysis using the GSHS data. Data were collected from 2,343 students (2007) and 11,124 students (2015) which selected based on a two-state cluster sample design. Self-administered questionnaire and anthropometric measurements were conducted as part of data collection. Over nutrition status was obtained from BMI classification based on the International Obesity Task Force (IOTF) cut off. Multivariate analyses were performed to evaluate the risk factors of overweight and obesity. Results: The prevalence of adolescent overweight and obesity was 8.2% (CI95% 6.0-11.2) on 2007 and 14.2% on 2015 (CI95% 12.7-15.8). From the 2007 GSHS, the overweight and obesity associated factors were food insecurity (AOR: 2.00; 95%CI: 1.04-3.84), not walking or biking activity to/from school (AOR: 2.12; 95%CI: 1.47-3.06) and more sitting activities more than 3 hours (OR: 1.42; 95%CI: 1.05-1.93). Based on the 2015 GSHS data, factors associated to over nutrition were fruit consumption (AOR: 0.83; 95%CI: 0.72-0.94) and similar finding on the sitting activities. Sitting activity more than 3 hours a day was strongly associate with overweight and obesity (OR: 1.35; 95%CI: 1.16-1.57). Interventions to physical activity, healthy diet and behavioral changes were still needed as over nutrition control strategies for Indonesian adolescents.

Keywords: *overweight, obesity, overnutrition, GSHS, adolescent, Indonesia*

1. INTRODUCTION

In the past few decades, there is an increasing rate of overweight and obesity among children and adolescents worldwide [1]. According to the Global School-Based Health Survey (GSHS) conducted on period 2007 to 2014, the prevalence of overweight and obesity in Southeast Asian adolescent aged 13-15 years old was 9.9%. Meanwhile, the trend for adolescent over nutrition in Indonesia has been rising dramatically. The prevalence of overweight and obesity for adolescent aged 13-15 has increased from 2.5% to 10.8% and reached 16%, based on National Basic Health Surveys (Riskesdas) year 2010, 2013 and 2018 [2,3,4]. Besides, for adolescent aged 16-18 the prevalence of over nutrition raised from 1.4% on 2010 to 7.3% in 2013 and almost doubling to 13.5% in 2018 [2,3,4].

Interestingly, this rising rate of over nutrition might have reached a plateau in developed worlds but remained increasing in developing and underdeveloped worlds [1,5]. There are some factors that play an important role in slowing down the rate of obesity in developed nations such as the use of tax and regulation of industry [6,7]. It is also important to note the role of local governments, schools, and communities to increase public awareness about overweight and obesity in children and adolescents [1]. Compared to developed countries, the developing countries, especially from Southeast Asian countries, have different conditions that might influence differences in determinants of obesity [5]. Understanding the determinants of obesity is one of the early crucial steps to develop a nationwide obesity prevention program among children and adolescents.

It was previously suggested that several factors play a role in the development of childhood obesity among developing nations. Those factors include reduced physical activity, increased caloric intake, high socioeconomic status, urbanization and residence in metropolitan cities, sociocultural factors, age, and female gender and school meal programs⁵. Unfortunately, the role of those components in the development of obesity was rarely been investigated in Indonesia. A recent study reported that wealth status was associated with overweight status [8], but not with dietary intake and physical activity. Overweight and obesity status during childhood are determinants of overweight and obesity status during adolescence [9]. The importance of a sedentary lifestyle by the use of computer and console games was reported to be associated with increased risk of obesity among Indonesian adolescents [10]. Limitations of those studies were low-to-medium sample size and the study location which mostly concentrated among major islands such as Java, Bali, and Lombok. Because Indonesia is a large multiethnic nation, a large nationwide study with a representative of its major island is necessary to provide more reliable data regarding determinants of obesity among adolescents.

Therefore, we conducted a secondary analysis of a Global School-Based Health Survey (GSHS) among Indonesian adolescents. The survey was aimed to provide data on health behaviors and several factors including dietary behavior, physical activity, and alcohol use [11,12]. We also would like to analyze the trend of changes in obesity prevalence for adolescents between 2007 and 2015 in Indonesia. By analyzing GSHS data we aimed to evaluate the important determinant lifestyle factors associated with obesity in a nationwide survey.

2. METHOD

This study was part of secondary analysis of the 2007 and 2015 Indonesia Global School-based Health Survey. These surveys were collaborative surveillance project between the World Health Organization, the US Centre for Disease Control and the Indonesian Ministry of Health and Ministry of Education [11,13]. Design of this study was cross sectional survey which data were collected in the year 2007 and 2015.

Sample size for the 2007 survey was 3,116 students, while there were 11,110 students participated for the 2015 survey. Sample was selected based on two-stage cluster sample design which selected 49 for 2007 survey and 75 senior and junior high school for 2015 survey using probability proportional sampling in the first stage. The next sampling step was systematic sampling to all classes at selected school. While the class was selected, then all students in that class were eligible to participate in the survey.

Every participant was subjected to self-administered questionnaire which adapted from standardized GSHS questionnaire developed by the WHO with specific modifications. Data were collected using questionnaire and

anthropometrics measurement conducted by the health practitioner. Details on the procedure, methods and questionnaires in the GSHS can be found on the WHO website [12].

The dependent variable of this study was being overweight and obesity. Overweight and obesity status was drawn from Body Mass Index (BMI) calculation. Cut-off point reference on the international age-and sex-specific child and adolescent from IOTF was being used on the categorization for being overweight-or-obese and not overweight-or-obese¹⁴. In children and adolescent, the BMI cut off points are different from adult. Demographic variable was self-reported age in years and sex. The independent lifestyle-related variables extracted from the original dataset that can be seen in Table 1.

Table 1. Independent Variables Included in the Analysis

Survey question/ variable	Coding (value coded) *	Variable
How old are you?	<11 – 18+ years	Age
What is your sex?	Male (1) Female (0)	
Went hungry most of time/always past 30 days	No (0) Yes (1)	Food insecurity
During the past 30 days, how many times per day did you usually eat fruit? (example provided)	+2 times a day (0) Less than 2 times a day (1)	Fruit consumption
During the past 30 days, how many times per day did you usually eat vegetables? (example provided)	3+ times a day (1) Less than 3 times a day (0)	Vegetable consumption
During the past 30 days, how many times per day did you usually drink carbonated soft drinks? (example provided)	1+ times a day (1) Less than 1 per day (0)	Soft drink consumption
During the past 7 days, on how many days did you eat food from a fast food restaurant? (example provided)	3+ times a day (0) Less than 3 times a day (1)	Fast food consumption
Physically active for a total of at least 60 minutes per day on 5 or more days during the past 7 days	Yes (0) No (1)	Consistently physically active
Attending physical education (PE) class on 3 or more days during this	Yes (1) No (0)	PE class
Walk or ride a bicycle to or from school during the past 7 days	Yes (1) No (0)	No walking/ biking to school
How much time do you spend during a typical or usual day sitting and watching television, playing computer games, talking with friends, or doing other sitting activities	< 3 hours a day (0) >= hours a day (1)	Sitting 3+ hours
During the past 30 days, how often did you wash your hands after using the toilet or latrine?	Most of the time/ Always (0) Never/Rarely/Sometime s (1)	Wash hand after toilet

During the past 30 days, how often did you wash your hands before eating?	Most of the time/ Always (0) Never/Rarely/Sometimes (1)	Wash hand before eating
During the past 30 days, on how many days did you have at least one drink containing alcohol?	0 days (0) >=1 day (1)	Alcohol consumption

*Stata is using lower value (0) as the reference group

Data management and analyses were conducted using STATA software version 13. Regarding the nature of study sampling, data were analyzed using complex sample/survey data analyses. Declaration on the study design firstly conducted before running out any statistical analyses. Logistic regression was carried out to find the relationship between two variables. Selected variables with p values <0.25 were included in the multivariate analysis. Multivariate logistic regression was performed to determine the predictors of overweight and obesity in the study.

3. RESULTS AND DISCUSSION

Results

Sample characteristics are presented in Table 2. There are differences on the age inclusion between GSHS 2007 and 2015, whereas in 2007 sample were recruited only for school-aged children younger than 16 years old. Total data recorded from 2,343 participants in 2007 and 11,124 participants in 2015 with completeness on weight, height, age and sex. Incompleteness on the anthropometrics measurement was quite high on GSHS 2007 and reached 24.5% of the total data. The proportion for male and female participants were almost equal. Majority or participants were 13 or 14 years old and in grade 8 or 9. The prevalence of being overweight and obese were 6.9% and 1.3% in 2007, while have increased to 10.3% and 3.9% in 2015.

Table 2. Sample Characteristics

Survey year		2007	2015
N (% missing BMI)		2,343 (24.5%)	11,124 (5.1%)
Sex	Male Female	49.9% 50.1%	48.9% 51.1%
Age	11 or younger	0.3%	2.2%
	12	3.6%	17.3%
	13	31.1%	24.2%
	14	42.2%	24.1%
	15	20.2%	14.7%
	16	2.7%	8.5%
	17	.*	7.5%
Grades	7	0.3%	25.9%
	8	51.3%	25.9%
	9	48.4%	25.0%
	10	.*	6.9%
	11	.*	7.9%
	12	.*	8.4%

Nutrition status	Underweight	26.8%	19.4%
	Normal weight	65.0%	66.3%
	Overweight	6.9%	10.3%
	Obese	1.3%	3.9%

Adjusted Prevalence of Overweight and Obesity

The prevalence of overweight and obesity was higher for male compare to female respondents (4.5% vs 2.4% and 0.8% vs 0.5%) in 2007. While in 2015, the prevalence of overweight switched higher for female than male respondents (5.6% vs 4.7%). However, the obesity prevalence remained higher for male than female (2.1% vs 1.8%) (Table 3).

Table 3. The Adjusted Prevalence of Overweight and Obesity in 2007 and 2015 by Sex

Year of Survey	Sex	Prevalence	
		Overweight% (95% CI)	Obesity% (95% CI)
2007	Male	4.5 (3.0-6.6)	0.8 (0.6-1.1)
	Female	2.4 (1.7-3.4)	0.5 (0.2-1.1)
2015	Male	4.7 (4.1-5.5)	2.1 (1.6-2.7)
	Female	5.6 (4.9-6.3)	1.8 (1.5-2.1)

Bivariate Analyses Between Lifestyle-Related Variables and Overweight and Obesity

In bivariate analyses based on the GSHS 2007 data, only walking or biking to school was the only variable which statistically significant with overweight and obesity after controlling sex and age. While according to GSHS 2015, more variables showed significant relationship to overweight and obesity which are fruit consumption, consistently on physical activity, and sitting activity. Details on the ORs can be seen in Table 4.

Table 4. Bivariate Logistic Regression on the Relationship between Lifestyle-Related Variables, Overweight, and Obesity Based On the GSHS 2007 Data

Variable	Category	Adjusted OR*	GSHS 2007		P
			95% CI		
			Lower	Upper	
Food Insecurity	Yes	1.70	0.90	3.22	0.10
	No	1 (ref.)			
Fruit consumption	>=2 times/ day	1 (ref.)			
	< 2 times/ day	1.05	0.75	1.47	0.77
Vegetable consumption	>=3 times/ day	1 (ref.)			
	< 3 times/ day	0.91	0.61	1.36	0.65
Fast food consumption	>= 3 days/week		**		

	< 3 days/week				
Carbonated soft drink consumption	>=1 times/day		**		
	<1 times/day				
Alcohol consumption	Yes	1.88	0.74	4.75	0.17
	No	1 (ref.)			
Consistent physically active	Yes	1 (ref.)			
	No	1.30	0.83	2.05	0.24
PE Class Attendance	Yes, >=3 days		**		
	No, <3 days				
Walking/ biking to and from school	Yes	1 (ref.)			
	No	2.10	1.42	3.12	0.001
Sitting activities	>= 3 hours/ day	1 (ref.)			
	< 3 hours/ day	1.32	0.93	1.87	0.12
Cigarette smoking	Yes	0.91	0.74	1.71	0.57
	No	1 (ref.)			
Used other tobacco product	Yes		**		
	No				
Handwash before eating	Yes	1 (ref.)			
	No	1.12	0.70	1.79	0.62
Handwash after toilet	Yes	1 (ref.)			
	No	1.09	0.67	1.76	0.71

Table 5. Bivariate Logistic Regression on the Relationship between Lifestyle-Related Variables, Overweight, and Obesity Based On the GSHS 2007 Data

Variable	Category	Adjusted OR*	GSHS 2015		P
			95% CI		
			Lower	Upper	
Food Insecurity	Yes	0.84	0.58	1.21	0.34
	No	1 (ref.)			
Fruit consumption	>=2 times/ day	1 (ref.)			
	< 2 times/ day	0.82	0.72	0.92	0.002
Vegetable consumption	>=3 times/ day	1 (ref.)			
	< 3 times/ day	0.96	0.84	1.09	0.51
Fast food consumption	>= 3 days/week	1 (ref.)			
	< 3 days/week	1.03	0.85	1.25	0.76

Carbonated soft drink consumption	>=1 times/day	0.99	0.88	1.12	0.84
	<1 times/day	1 (ref.)			
Alcohol consumption	Yes	0.75	0.55	1.02	0.06
	No	1 (ref.)			
Consistent physically active	Yes	1 (ref.)			
	No	0.86	0.74	0.99	0.04
PE Class Attendance	Yes, >=3 days	1 (ref.)			
	No, <3 days	1.16	0.98	1.38	0.09
Walking/ biking to and from school	Yes	1 (ref.)			
	No	0.98	0.85	1.14	0.84
Sitting activities	>= 3 hours/ day	1 (ref.)			
	< 3 hours/ day	1.32	1.14	1.54	0.001

*adjusted for sex and age

**not available in this year's survey; PE: physical exercise

Lifestyle-Related Risk Factors for Overweight and Obesity

Risk factors for overweight and obesity based on the multivariate logistic regression were presented in Table 5 and 6. Based on the GSHS 2007 data analyses found that adolescents with food insecurity (OR: 2.00; 95%CI: 1.04-3.84), not walking/ biking to school (OR: 2.12; 95%CI: 1.47-3.06) and spend more time for sitting activity more than 3 hours (OR: 1.42; 95%CI: 1.05-1.93) were associated with overweight and obesity. Whereas according to the GSHS 2015 revealed that adolescents who consume fruit 2 or more portion a day were 17% less likely to become overweight or obese (OR: 0.83; 95%CI: 0.72-0.94). Similar to the GSHS 2007 analyses found that sitting activity more than 3 hours a day was strongly associate with overweight and obesity (OR: 1.35; 95%CI: 1.16-1.57).

Table 6. Multiple Logistic Regression of Lifestyle-Related Risk Factors of Adolescent Overweight and Obesity Based On the GSHS 2007 Data

Variable	Adjusted OR	GSHS 2007		P
		95% CI		
		Lower	Upper	
Food Insecurity	2.00	1.04	3.84	0.04
Alcohol consumption	1.37	0.52	3.61	0.50
Consistent physically active	1.30	0.81	2.09	0.27
Walking/ biking to and from school	2.12	1.47	3.06	<0.001
Sitting activities	1.42	1.05	1.93	0.02
Used other tobacco product	1.90	0.93	3.90	0.08

Table 7. Multiple Logistic Regression of Lifestyle-Related Risk Factors of Adolescent Overweight and Obesity Based On the GSHS 2015 Data

Variable	Adjusted OR	GSHS 2015		P
		95% CI		
		Lower	Upper	
Fruit consumption	0.83	0.72	0.94	0.005
Alcohol consumption	0.78	0.58	1.04	0.09
Consistent physically active	0.89	0.77	1.03	0.11
PE Class Attendance	1.12	0.93	1.34	0.23
Sitting activities	1.35	1.16	1.57	<0.001
Used other tobacco product	0.69	0.37	1.27	0.23

Discussion

Prevalence of Overweight and Obesity

This study presents the prevalence of overweight and obesity based on two national representative adolescent health surveys using the IOTF BMI cutoffs. There has been a dramatic change on the prevalence of overweight and obesity between those survey periods (8.20% in 2007 to 14.20% in 2015). While based on GSHS 2007 data reported the prevalence was 7.0% and has increase to 13.4% in 2015. These numbers are similar to the result of Riskesdas, which depicted the prevalence that almost doubling for adolescent aged 16-18 years old (7.3% in 2013 to 13.5% in 2018) in the last 6 years [3,16]. Whereas the increment on the prevalence for adolescent aged 13-15 years old quite high, accounted to 5.2% difference in 5 years (10.8% in 2013 to 16% in 2018) [3,16].

The prevalence difference between various surveys due to differences on their study design, sampling methods, also in inclusion and exclusion criteria. Despite the difference between the exact prevalence rates of overweight and obesity in Indonesian adolescents, all references showed a significant upward trend. This should be the focus of the Indonesian government in controlling overweight and obesity.

According to a systematic review based on both cohort studies and observational studies found the relationship between childhood-adolescent overweight and obesity with premature death in particular on cardio metabolic morbidity in later life [17]. Even though this evidence comes from developed countries, but a longitudinal study taken place in Indonesia found a consistent result. Tracking on the children's BMI over 5 years found that 84.6% overweight children turned into overweight adolescent and all obese children remained as obese adolescent [9]. For a number of reasons, to date the topic of overweight and obesity in adolescents has not been the focus of government programs. In particular, in developing countries, where many other health problems take precedence. However, this evidence shows the urgency on the policy-maker to invest more on adolescent weight control on lowering the risk of premature death related to cardio metabolic in the future.

Risk Factors of Overweight and Obesity

Multivariate analyses on the GSHS 2007 and 2015 found different lifestyle-related risk factors on adolescent's overweight and obesity. Only sitting activities contributes to overweight and obesity on both GSHS's surveys. Sitting activity represents the sedentary lifestyle. Consistent with other GSHS data analysis comes from 7 Southeast Asian countries which found a high prevalence of physical inactivity (80.4%) and sedentary activity (33.0%). There has been growing evidence on the relationship between childhood and adolescent sedentary activity along with physical inactivity as overweight and obesity risk factors [5,18,10,19]. According to GSHS 2007 data, the odds of student who did not walking/ biking from and to school was twice times higher to be overweight or obese. The mechanism of physical inactivity and dietary contribution to overweight and obesity may happen through 3 different ways: decreasing on energy expenditure, increasing energy intake through snacking and reduction in resting metabolic rate [20].

Regarding dietary contribution along others dietary risky behaviors, only fruit consumption showed as protective factors to overweight and obesity. Unhealthy diet was common in adolescent with the preference mostly on sugar-sweetened beverages, sweet, salty and fatty food [21]. Currently, Indonesia is experiencing the nutrition transition, where there has been changes on the food preferences shifting from traditional diet to modern yet highly in fat, sugar and salty foods. Moreover, with decreasing consumption on fruit and vegetables [22]. Only 23.22% of Indonesian adolescents have met the reference for daily fruit consumption [13]. A literature suggested on the behavior of eating family dinner or food that being prepared at home. This promotes healthier food choices on fruit and vegetable consumption, less fried foods and sugar-sweetened foods [21].

Another risk factor determined in this study was food insecurity. Food insecurity is a situation where an adolescent is experiencing a limited access to sufficient, safe and nutritious food to meet their nutritional requirement to grow and live a healthy life [23]. A longitudinal study found that food insecurity experience at the age 15 years old tend to accelerate the BMI in later life [24]. This relationship may be explained through some potential factors, such as low socioeconomic status, low knowledge and education resulted on the poor food preferences and increase the risk on overweight and obesity [24,25].

Strengths and limitations

The main strength in present study was using national-representative surveys on adolescent health that were globally comparable. Some limitations on this study need to be acknowledged. First, this study was cross-sectional which the causality cannot be established. Secondly, due to self-administered questionnaire may lead to high response bias. However, the GSHS questionnaire reported as standardized, rapid, cost-effective and useful surveillance instrument to capture adolescent's health behaviors. Third, regarding the BMI missing value in GSHS 2007 data that

quite high. This should be taken into account on the generalizability. Reference usage also resulted on difference prevalence rates on overweight and obesity. Currently there are 3 references that globally used: WHO BMI z-score, IOTF BMI cut-offs and CDC percentile [26].

4. CONCLUSION

In summary, this study presents the urgency on adolescent health intervention as part of overweight and obesity control. There has been a dramatic increasing on overweight and obesity prevalence in the last 6 years. Interventions to physical activity, healthy diet and behavioral changes were still needed as over nutrition control strategies for Indonesian adolescents. To date, programs to prevent adolescent obesity have so far remained limited and less likely to be prioritized. The rapid increase in over nutrition prevalence called for serious interventions involving multi-setting approach by schools, families, communities, government and markets. Interventions should not be only limited to the promotion of healthy lifestyles. Policies such as taxes on sugar sweetened beverages should also put into consideration to be implemented in the future.

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