



Intake of Fiber and Sodium Toward the Risk of Obesity in Primary School Children in the City of Padang Indonesia

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ABSTRACT

High food intake and unhealthy diet are one of the main factors of obesity. The aim of the study was to determine the association between fiber and sodium intake with the risk of obesity occurrence among elementary school children in the Andalas Public Health Centre, Padang City. This study used a case control design with location was on Elementary School No. 30 and Kartika 1-10. The amount of sample was 114 students (57 cases and 57 controls). Fiber and sodium intake was calculated by Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) and child obesity was based on weighing and then compared to age. The result showed that the mean of fiber intake among case (deviation, standard) was 16,89 g (\pm 9,46 g) while the mean of fiber intake among control was 17,4 g (\pm 33,66 g). Then, the mean of sodium intake among case was 1.624,53 mg (\pm 367,34 mg) while the mean of sodium intake among control was 1.353,48 mg (\pm 350,58 mg). The result also showed that there was not statistically significant fiber intake with the risk of obesity among elementary school children (p -value=0,677; OR=1,19). However, higher sodium intake has proved statistically will increase the risk of obesity 2,29 times among elementary school children than normal sodium intake. Multivariate analysis showed that fat intake is a confounding factor of the relationship between fiber and sodium intake with the risk of obesity. Based on the result, the school side should monitor food and beverages that on sale in the canteen and around school, also giving education to school children how to choose a healthy and nutritious food.

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INTRODUCTION

Overweight and obesity tend to increase, including in the younger age groups in both developed and developing countries (World

Health Organization, 2017). The incidence of obesity and obesity in children is a serious problem because it will continue into adulthood. Under these conditions, the quality of children's life will be disrupted in

the form of sleep disorders, disorders of leg growth, sleep apnea (other shortness of breath) and other respiratory disorders (Directorate of Nutrition and Maternal and Child Health, 2011). The subsequent impact experienced by children at the following ages is the risk of suffering from metabolic diseases, such as cardiovascular disease, diabetes mellitus, cancer and osteoarthritis.

The description of the incidence of obesity in the United States based on the National Health and Nutrition Examination Survey (NHANES) in 2011-2012 shows that the percentage of obesity based on the age group of children aged 2-5 years is 8.4%, age 6-11 years is 17, 7% and 12-19 years old at 20.5% (Fryar CD, Carroll MD, 2014).

The results of the Basic Health Research (Riskesmas) in 2010 showed that the prevalence of obesity nationally in children aged 6-12 years was almost 10% (9.2%), while the prevalence in West Sumatra was 3.8%. In 2013 the prevalence of obesity nationally in children aged 5-12, which experienced a slight decrease of 8.8%, while the prevalence in West Sumatra Province experienced a fairly high increase compared to 2010, which amounted to 7.7% (Riskesmas, 2010, 2013) Especially in the city of Padang which is the center of the city in West Sumatra Province with the highest obesity prevalence of 2.9% in addition to the South Coast. According to the Padang City Health Office in 2015, the highest prevalence of obesity in primary school children in the city of Padang was in the Andalas Community Health Center work area, which was 6.1% (West Sumatra Provincial Health Office, 2015).

The World Health Organization defines obesity as abnormal or excessive fat accumulation that can interfere with health. Obesity can be interpreted as a disease that arises as a result of deregulation in the energy balance system to make adjustments between energy intake and expenditure (Gibney, 2009). Excess nutrition can cause obesity in children to adulthood (Freedman, Khan,

Dietz, Srinivasan, & Berenson, 2001). According to the Indonesian Pediatrician Association, body mass index in children can be assessed using the Central for Disease Control Prevention (CDC) 2000 because by using the CDC 2000 95th percentile body mass index, early detection of obesity can be enforced (IDAI, 2011).

Diet and physical activity are behavioral factors that can affect energy balance and weight status so that someone is at risk for obesity. The diet is not good, such as consuming large portions of food that exceed the needs, consuming foods that are high in energy, high in fat, high in simple carbohydrates, low in fiber and wrong eating behaviors such as the act of 'junk food' high in sodium and low in fiber, packaged foods and soft drinks (soft drinks) is one of the risk factors for obesity and obesity (Directorate of Nutrition and Maternal and Child Health, 2011).

Specific food intake factors such as sodium and fiber intake can affect body weight through a direct and indirect mechanisms, namely through increasing energy intake from the consumption of soft drinks. High sodium intake will stimulate the thirst center so that the habits of soft drink consumption increase (Grimes, C, 2012), then have an impact on obesity (Larsen SC, qungquist L, Sørensen TIA, 2013; Nurwanti, Hadi, & Julia, 2013; Yoon & Oh, 2013). While adequate fiber intake can increase satiety and reduce absorption of nutrients such as amino acids and fatty acids (Babio, balance, Basulto, Bulló, & Salas-Salvadó, 2010), so the risk of obesity is smaller (Kharismawati R, 2010). The needs of a person's sodium and fiber are distinguished by age. For children aged 7-9 years, it is recommended to meet sodium needs of 1200 mg / day, and fiber requirements of 26 gr / day. While for the age of 10-12 years, it is recommended to meet the needs of sodium by 1500 mg / day, and fiber requirements of 30 gr / day (Ministry of Health, 2013).

This research was conducted in 30 Public Elementary Schools (SDN) and 1-10 Kartika Primary Schools (SD) in Padang City. These two primary schools occupy the highest position of obesity in elementary school children in the Andalas Community Health Center work area. The prevalence of obesity in SDN 30 Padang is 20.8% and SD Kartika I-10 is 16.4% (Health Service of West Sumatra Province, 2015). The prevalence in these two primary schools is higher than the prevalence of Padang City. The results of the screening were obtained from information on school children who were obese by 14.2% at SDN 30 and 24.5% at SD Kartika 1-10. In addition, the results of interviews with 15 students found that 66.7% of students had a higher sodium intake than recommended intake and 86.7% of students had lower than recommended fiber intake.

Based on theoretical studies and previous studies, this study aims to determine the role of sodium and fiber intake with the risk of obesity in elementary school children in the work area of Andalas Health Center, Padang City.

METHOD

Case control design is used to determine the role of sodium and fiber intake on the risk of obesity in school children. The research location was chosen purposefully with the consideration that the schools had the highest obesity percentage (SDN 30 and SD Kartika 1-10). This research was conducted in November 2016 until May 2017. The study population was students in grade 4, 5, 6 SDN 30, and SD Kartika 1-10 Kota Padang, with a population of 362 students / I. The samples in this study were students in grade 4, 5, 6 SDN 30, and SD Kartika 1-10 Kota Padang with a total of 114 (57 cases and 57 controls) with criteria that were healthy and able to communicate well. Cases obtained from the results of screening the nutritional status of children, then taken by simple random sampling. While controls are taken in a

matching manner with the case, including; age, gender and school.

The dependent variable of this study is obesity, while the independent variable is fiber and sodium intake. Confounding variables are energy, protein, fat, carbohydrate intake and physical activity. The determination of obesity in school children is done by weighing the body using a digital scale that has been calibrated with a precision level of 0.1 kg and measuring height with microtoise with a precision of 0.1 cm. Then the status of obesity or not is determined through the graph Central for Disease Control Prevention (CDC). Children are categorized as obese, if ≥ 95 percentile and normal, if <95 percentile (based on CDC category).

Food intake data were collected through interviews using Semi Quantitative Food Frequency Questionnaire (SQ-FFQ). In collecting food intake data, food photo books are used to help respondents remember the type of food consumed and the amount of the portion consumed. Then food intake is grouped into two categories, which are more sodium intake (if intake $> 100\%$ AKG) and sufficient sodium intake (if the intake is $\leq 100\%$ AKG). Then less fiber intake (if the intake is $<100\%$ RDA) and enough fiber intake (if the intake is $\geq 100\%$ AKG).

Data on physical activity collected data using Physical Activity Questionnaire for Children (PAQ-C). This questionnaire consists of 10 questions about routine activities carried out by children, including exercise activities or other activities that make children sweat. Physical activities are grouped into two categories, namely physical activity is lacking or inactive if the PAQ-C score > 2.5 and physical activity are active if the PAQ-C score is ≥ 2.5 .

The data are processed using the SPSS Program and analyzed using the Chi-Square test with a confidence level of 95% and the significance level is determined if the value of $p < 0.05$. The risk of obesity is determined

based on the value of Odds Ratio (OR) with 95% Confidence Interval (CI). Furthermore the data were analyzed using multiple logistic regression tests to determine the role of the independent variable on the dependent variable after the confounding variable was controlled.

RESULT AND DISCUSSION

The description of the respondents' characteristics of the study shows that the majority of respondents were male (57.9%) and most respondents were 12 years old (49.1%). Based on fiber intake, it was found that the average fiber intake (standard deviation), which was 16.89 g (\pm 9.46 g), was slightly lower than the control with an average fiber intake of 17.4 g (\pm 33.66 g) (Table 1). After been grouped into 2

categories, namely less fiber intake ($<$ 100% Recommended Nutritional Adequacy Rate or RDA) and sufficient (\geq 100% AKG), information on case fiber intake and control was obtained, the most percentage being less fiber intake, 73 each, 7% and 70.2%. Then the average case of sodium intake (standard deviation), which is 1,624.53 mg (\pm 367.34 mg), is slightly higher than the control with an average sodium intake (standard deviation) of 1,353.48 mg (\pm 350.58 mg) (Table 1). Furthermore, sodium intake is grouped into more intake categories ($>$ 100% AKG) and sufficient (\leq 100% AKG), the results of the analysis show that almost half of the cases have sodium intake in more categories (49.1%) while controls, more than half have sodium intake with sufficient categories (75.4%).

Table 1
Description of Sodium Intake and Fiber Intake in Children

Variable	Case			Control		
	Mean	\pm SD	Minimum-Maximum	Mean	\pm SD	Minimum-Maximum
Fiber Intake (g)	16,89	9,46	6,10-31,49	17,4	9,73	6,04-31,61
% AKG Fiber	58,39	32,56	21,5-111,36	60,28	33,66	20,15-111,68
Sodium Intake (mg)	1624,53	367,34	1071,19-2498,15	1353,48	350,58	1011,28-2314,8
% AKG Natrium	109,80	25,78	71,41-166,54	91,45	22,94	67,43-154,32

The results of bivariate analysis showed that fiber intake was not statistically related to the risk of obesity in school children (p value = 0.677) with a value of OR 1.19 (95% CI = 0.52-2.69). Different results were obtained from bivariate analysis between sodium intake and the risk of obesity in school

children. The statistical test results found sodium intake was significantly associated with the risk of obesity in school children (p value = 0.007) with a value of OR 2.96 (95% CI 1.34-6.57), meaning that respondents with high sodium intake had a risk 2.96 times for obesity (Table 2).

Table 2
Relationship between Fiber and Sodium Intake with Risk of Obesity in Children

Variable	p score	OR
Fiber Intake	0,677	1,19
Sodium Intake	0,007	2,96

Multivariate analysis using multiple logistic regression tests was conducted to determine the association and magnitude of risk of fiber intake and sodium intake after being controlled by confounding variables (energy intake, carbohydrate intake, protein intake, fat intake and physical activity). The results of the analysis showed that low fiber intake

had the opportunity to be obese 1,161 times compared to adequate and excessive fiber intake after the variable fat intake was controlled. Then the sodium intake which is more likely to be obese 2,439 times compared to enough sodium intake after a variable control of fat intake (Table 3).

Table 3
Multivariate Final Model

Variable	B	OR	95% CI	p Score
Final Model				
Fiber Intake	0,149	1,161	0,497 – 2,712	0,730
Fat Intake	1,100	3,003	1,387– 6,501	0,005
Final Model				
Sodium Intake	0,892	2,439	1,068 – 5,570	0,034
Fat Intake	0,924	2,520	1,134 – 5,601	0,023

The average fiber intake was obtained from the information that almost no different fiber intake between cases with controls, the average case fiber intake was slightly lower (16.89 g) compared to the control group (17.4 g). The results obtained when compared with AKG can be explained that the two groups of respondents only meet about 60% of the recommended daily needs with details of obese school children, the average fiber intake is only 58.39% of daily needs and school children with no status Obese with an average fiber intake of only 60.28% of daily needs. According to the 2013 AKG, fiber requirements per day for children aged 7-9 years were 26 grams and those aged 10-12 years were 30 grams (RI, 2013) Based on the results obtained, it could be stated that most school children consume less vegetables and fruits as the main source of fiber. In this study, most school children consume food sources of fat. The results of the interviews revealed that on average school children consume less vegetables because they do not like the taste of vegetables or are not tasty.

But the results of the research obtained were higher than the results of a 2010 Kharismawati study, which found that the average fiber intake obtained in school children in Semarang was 10.9 grams / day in the case group and 11.7 grams / day in the control group (Kharismawati R, 2010).

Other information obtained related to fiber intake, namely a high-fiber food source that is often consumed by obese children is from water-soluble fiber, namely corn, potatoes and green beans. While high-fiber foods that are often consumed by children with non-obese nutritional status are from water soluble fiber and water insoluble fiber, namely cassava leaves, spinach, green beans, tofu, soybean, bananas, papaya and oranges.

The results showed that the average sodium intake in obese children was higher compared to non-obese children. Furthermore, it can be explained that obese children have an average sodium intake of 1,624.53 mg and meet 109.80% of the recommended daily requirement. Different results were found in

non-obese children obtained information that the average sodium intake of 1,353.48 mg and meet 91.45% of the recommended daily requirement. The source of this high sodium intake is obtained from snacks that contain high sodium and are often consumed by school children. The average sodium intake obtained from this study was higher than Nurwanti's 2016 study, which found that the average sodium intake obtained in the study subjects was 1,310.74 mg / day in the case group and 1,114.46 mg / day in the control group. The study was conducted in elementary school children in Yogyakarta City and Bantul Regency (Nurwanti et al., 2013).

Foods high in sodium that are often consumed by obese children in this study are meatballs, sausages, beef, instant noodles, mixed vegetables fritters, q-tela, and tea glass. Whereas in non-obese children, high sodium foods that are often consumed are fresh bread, mixed vegetables fritters and tea cups. It can be explained that most of the time spent in school makes children often consume snacks that are high in sodium.

The results of this study indicate that fiber intake is not much different between obese children and non-obese children, that is, most include less fiber intake (more than 70%), so this might play a role in the absence of a significant relationship between fiber intake and incidence obesity in elementary school children. The possibility of recall bias in the fiber intake data collection can occur and affect the results of the study. The opportunity for children to overestimate or reduce what is consumed is related to their nutritional condition, known as a flat slope syndrome. This finding is supported by the results of Kharismawati's research in 2010 and Aninditya in 2011 which also obtained the same results, namely the absence of a significant relationship between fiber intake and the incidence of obesity in elementary school children (Aninditya IK, 2011; Kharismawati R, 2010).

The results of this study indicate that there is no significant relationship between fiber intake and the risk of obesity, but theoretically fiber intake can reduce weight. The results of the study are not in accordance with the theory can occur because of the potential for information bias as stated in the previous paragraph and not specifically linking the type of fiber associated with the incidence of obesity. In general, foods high in fiber contain low energy which can then help you lose weight (Fachrunnisa, Abrori, & Rachmawati, 2007). Although fiber contains low energy, fiber can reduce the risk of excessive consumption.

This is because foods containing fiber increase the volume of food so that it sits longer (Kharismawati R, 2010). In addition, water soluble fiber when fermented in the large intestine will produce glucagon-like peptide (GLP-1) and peptide YY (PYY) which play a role in feeling full (Aninditya IK, 2011).

In this study the intake of fiber consumed was not differentiated between the intake of water soluble fiber and water insoluble fiber. According to Lattimer, fiber can lose weight depending on the type of diet and type of fiber consumed. Water-insoluble fiber has an important role in reducing weight in subjects who consume foods higher in more fat than water-soluble fiber (Lattimer & Haub, 2010). Thus, it is expected that in the next study it can be distinguished from the intake of water soluble fiber with water insoluble fiber which is associated with the incidence of obesity in children.

The results of this study indicate that sodium intake in obese children has excessive sodium intake. The results of bivariate analysis showed a significant relationship between sodium intake and the incidence of obesity in elementary school children with OR 2.96 (95% CI: 1.338 - 6.573), meaning that children with excess sodium intake had a risk of 2.96 times to be obese compared to children with enough sodium intake. The results obtained are the same as those of

Nurwanti's findings in 2016, namely a significant relationship between sodium intake and the risk of obesity and children who have high sodium intake 1.9 times at risk for obesity (Nurwanti et al., 2013).

High sodium intake can increase thirst. This is due to increased sodium concentrations in plasma and to maintain body fluid homeostasis, thus stimulating the thirst center in the hypothalamus and triggering fluid intake (Nurwanti et al., 2013). The tendency of children to prefer sweet drinks or soft drinks to relieve thirst because it feels good triggers an increase in energy intake which will later increase the risk of obesity. Based on the results of observations and interviews at the time of the study, information was obtained that children in both schools tended to choose drinks such as tea cups and tea shoots to relieve thirst compared to drinking mineral water.

Further analysis obtained information that children with excessive sodium intake had a risk of experiencing obesity events 2,439 times greater than children who had enough sodium intake after the variable fat intake was controlled. It can be explained that fat and oil factors are longer in the stomach compared to carbohydrates and proteins, so that foods containing fat can provide a longer feeling of satiety. Fat can produce energy up to twice so that it has the potential to increase body weight (Susianto, 2007).

Changes in lifestyle by consuming fast food (fast food) can increase the risk of obesity. Fast food besides containing high sodium also contains high fat. Fat is the biggest energy producer, 1 gram of fat will produce 9 kcal of energy. Energy intake will increase after consuming a high-fat diet (Fentiana N, 2012).

The Korea National Health and Nutrition Examination Survey (KNHANES) in 2007-2010 found that high sodium intake in children increased the risk of obesity 1.78 times greater than in children with sufficient sodium intake (Yoon & Oh, 2013). In

addition, research conducted by Larsen SC et. al in Denmark in 2013 also found that there was an increase in body fat by 0.24 kg per 100 mmol increased urinary sodium excretion (Larsen SC, qungquist L, Sørensen TIA, 2013). The results of this study are also supported by Nurwanti's findings in 2013 regarding exposure to junk food advertisements and patterns of consumption of junk food as a risk factor for obesity in elementary school children in the Special Region of Yogyakarta getting results that sodium intake in obese children is higher than non-obese children (Nurwanti et al., 2013).

CONCLUSIONS AND SUGGESTIONS

Sodium intake is a risk factor for obesity in elementary school children in the city of Padang and the confounding factor that plays a role is fat intake. The school is advised to supervise food and beverages sold in school areas in addition to the need to be educated through knowledge of children in school subjects regarding healthy and nutritious food and beverages.

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