

The correlation of dietary fiber intake with nutritional status among adolescents of junior high school in Medan, North Sumatera Indonesia

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Abstract

Background : The prevalence of obesity and overweight are increasing in adolescents. It can be risk factor of obesity , chronic disease such as diabetes, cardiovascular disease in adulthood. The risk factor of obesity and overweight are high calorie intake and lack of physical activity. Dietary fiber can be an alternative because it is proven to be able to lose weight because it has fewer calories and have filling effect because it has a high viscosity. There are less study benefit of dietary fiber intake in nutritional status in adolescent.

Objective: The aim of this study was to investigate the correlation of dietary fibre and the other factors that caused overweight and obesity among adolescents of Junior high school.

Methods: A cross sectional study with total of 102 subjects, including 42% boys and 58,8% girls aged 12-16 with normal weight, overweight and obesity. Dietary fiber information was reported using the food recall for a week and conversion it to self nutrition data. The nutritional status was assessed on the basis of body mass and height measurements with CDC 2000 curve. Data analysis used chi square and logistic regression.

Results: There was correlation between dietary fiber intake and nutritional status ($p < 0,001$) ($p < 0,001$) with Rasio Prevalence 2,830 (CI 95% = 1,845-4,341). But snack consumption have more correlation with $p < 0,001$ with Rasio Prevalence 4,782 (IK 95% = 2,075-11,018).

Conclusion: The intake of dietary fibre was associated with nutritional status in adolescent, but snack consumption have more correlation.

Key word : dietary fiber, nutritional status, adolescent

Introduction

Dietary fiber has played an important role in diet and health rules since ancient times. A high-fiber diet can help maintain a healthy gut microbiota, colon relaxation and cardiometabolic processes. Adequate fiber diet, is useful for reducing the risk of chronic cardiometabolic disease, weight control so that it can improve health (Dreher ML, et al., 2018). Obesity is an example of a weight control disorder that has become a global epidemic and its incidence is still increasing both in developed and developing countries, although the increase in the prevalence of obesity in children in developing countries is still not as high as in children in developed countries (Riset

Kesehatan Dasar, 2013). The prevalence of overweight and obesity in children increased from 4.2% in 1990 to 6.7% in 2010, and is expected to reach 9.1% in 2020 in the world (Onis MD, et al., 2010).

Based to The National Health and Nutrition Examination Survey (NHANES) in 2013-2014, 34% of children aged 2-19 years are overweight and 17% are obese (Ariani A, et al., 2007). Based on the 2013 Basic Health Research data, the prevalence of obesity in Indonesia in adolescents 13-15 years has a prevalence of overweight and obesity of 8.3% and 2.5%, respectively (Onis MD, et al., 2010). Ariani and Sembiring's study showed that the prevalence of overweight and obesity in children was 31% and obesity 17.7% at the age of 6-9 years, which was higher than the prevalence of obesity and overweight based on Ministry of Health Basic Health Research in 2013 (Ariani A, et al., 2007).

One of the functions of fiber is to lose weight through the mechanism of increasing satiety-inducing peptides such as cholecystokinin (CCK), glucagon-like peptide-1 (GLP-1) and peptide YY because fiber has a higher viscosity so it is more filling, because the nature of the fiber can forms a gel that can help slow down the intestinal emptying process (Dreher ML, et al., 2018). The amount of dietary fiber consumption has been determined by the International Health Authority since the first decade of the 21st century. In 2002, the National Academy of Sciences Institute of Medicine set the amount of dietary fiber as 14 g/1000 kcal (Dahl WJ, et al., 2015).

Based on a longitudinal study conducted by Davis et al, in 2009 85 adolescents with overweight status in Latino were carried out for 2 years and it was found that a decrease in total fiber intake by an average of 3gr/1000 kcal significantly increased visceral adipose by 21% (Davis JN, et al., 2009). Based on the study of Bahrenian et al in 2018, showed a significant relationship between fiber intake and weight loss, where every 1g/1000 kcal increase in fiber intake can reduce body weight and waist circumference (Bahreinan M, et al., 2018). A longitudinal study conducted by Altman et al, in 2015 found that dietary fiber patterns were associated with lower body mass index (BMI) and total body fat (Altman M, et al., 2015). The benefits of dietary fiber are well known, but little is known about children and adolescents. Based on these data, researchers feel the need to further investigate whether there is a relationship between dietary fiber and nutritional status in adolescents.

Materials and Methods

This study is a cross sectional study with a retrospective design and aim to find out the correlation of dietary fiber intake and nutritional status among adolescents of Junior High School in Medan, North Sumatera, Indonesia. This study received permission from the Research Ethics Commission of the Universitas Sumatera Utara, Indonesia.

This study examined 221 students of Assyafiyah and PAB 1 Klumpang Junior High School, there were 102 students with inclusion and exclusion criteria. The group of junior high school adolescents aged 12-16 years with good nutrition, overweight and obesity were included in this study. The group of adolescents who did not follow the study procedure completely, adolescents who had poor nutritional status, adolescents who refused to be part of the study sample, and adolescents who had a history of long-term corticosteroid treatment were excluded from the study. The nutritional status was assessed on the basis of body mass and height measurements with CDC 2000 curve. Dietary fiber information was reported using the food recall for a week and conversion it to self nutrition data. Data analysis used chi square and logistic regression.

The data analyzed statistically with SPSS (Statistical Product and Science Service) version 24. Demographic characteristics of the subjects were analyzed with descriptive analysis. The correlation of dietary fiber intake with nutritional status were normally distributed and analysis by Chi square test and regression logistic. The datas were significance if the p value < 0.001.

RESULT

There were 221 students follow the study. 52 subjects with absent because of online school, 27 subjects with mild malnutrition, 40 subjects who were not routinely control or loss to follow up. After passing the selection of exclusion and inclusion criteria, this study was finally followed by 102 research subjects who can follow this study (figure 1). The majority of subjects were women as many as 60 peoples (58,8%) and men as many as 42

peoples (41,2%). The mean age of the subjects in this study was 13,06 years. The characteristics of subject can be seen in table 1.

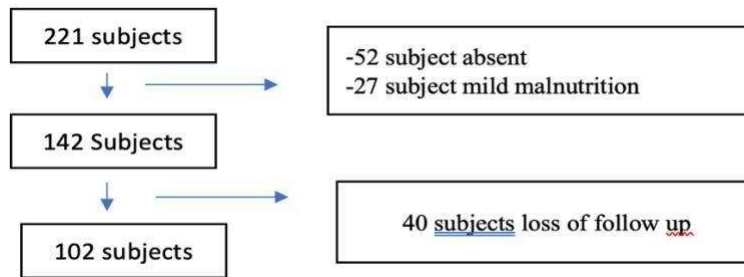


Fig 1. Flowchart of patient inclusion

Table 2 shows the results of the analysis of the relationship between subject characteristics, fiber intake, snack consumption and physical activity with children's nutritional status. There are 22 (52.4%) of 42 boys, with nutritional status obesity/overweight. Likewise, there were 25 (41.7%) of the 60 girls with obesity/overweight nutritional status. The results of the analysis using the Chi Square test showed that there was no significant relationship between gender and nutritional status ($p = 0.285$).

The multivariate analysis used in this study aims to determine which independent variables have the most dominant influence in predicting nutritional status. In addition, it is also to obtain a formula for calculating the probability of a child's nutritional status from significant independent variables from the results of multivariate analysis. The type of multivariate analysis used is multiple logistic regression because the dependent variable in this study is categorical. The variables included in the multivariate analysis were independent variables that had a p value < 0.25 from the results of bivariate analysis. The independent variables that met the requirements were dietary fiber, snack consumption and physical activity. The results of the complete multivariate analysis are presented in table 3.

Table 1. Charateristics of Subject

Charateristics	n (%)	Mean (SD)	Median (Min – Max)
Gender, n (%)			
Men	42 (41,2)		
Women	60 (58,8)		
Age, year		13,06 (0,74)	13 (12 – 15)
12	23 (22,5)		
13	52 (51)		
14	25 (24,5)		
15	2 (2)		
Body Weight, kg		50,8 (14,14)	48 (26 – 110)
Body length, cm		152,81 (7,12)	152,75 (131,5-174)
BMI, kg/cm ²		21,39 (4,78)	19,99 (15,04-36,33)
Status Nutritional			
Normal	55 (53,9)		
Overweight	34 (33,3)		
Obesity	13 (12,7)		
Diet Fiber Intake/Day		11,94 (2,04)	12 (7-16)
Diet Fiber Intake			
Less	37 (36,3)		
Enough	65 (63,7)		
Snack Consumption			
Less	37 (36,3)		
More	65 (63,7)		
Physical Activity			

No	22 (21,5)
Yes	80 (78,5)

Table 2. The Correlation between Characteristic of Subject and Nutritional Status

Characteristics	Nutritional Status		p	RP
	Obesity and Overweight	Normal		95% CI
Gender, n (%)				
Boys	22 (52,4)	20 (47,6)	0,285 ^a	1,257
Girls	25 (41,7)	35 (58,3)		0,830-1,905
Age, years				
14 and 15 years	14 (51,9)	13 (48,1)	0,483 ^a	1,178
12 and 13 years	33 (44)	42 (56)		0,756-1,837
Dietary Fiber Intake				
Less	29 (78,4)	8 (21,6)	<0,001 ^a	2,830
More	18 (27,7)	47 (72,3)		1,845-4,341
Snack Consumption				
More	42 (64,6)	23 (35,4)	<0,001 ^a	4,782
Less	5 (13,5)	32 (86,5)		2,075-11,018
Physical Activity				
No	13 (59,1)	9 (40,9)	0,167 ^a	1,390
Yes	34 (42,5)	46 (57,5)		0,903-2,140

^aChi Square

Table 3. The Correlation between Characteristic of Subject and Dietary Fibers

Dietary Fibers	B	p	OR	95% CI
Dietary Fiber Intake	1,760	0,001	5,811	2,087 - 16,179
Snack Consumption	1,957	0,001	7,080	2,258 - 22,203
Physical Activity	0,239	0,680	1,271	0,407 - 3,969
Constanta	-2,197	<0,001	0,111	
Dietary Fiber	1,762	0,001	5,826	2,092 - 16,221
Snack Consumption	1,990	0,001	7,314	2,358 - 22,685
Constanta	-2,165	<0,001	0,115	

By using the enter method, by removing the independent variables one by one starting from the variable with the highest p value > 0.05, it was found that only two independent variables had a significant effect on nutritional status in this study, namely dietary fiber (p = 0.001) and consumption snacks/snacks (p = 0.001). The dominant variable that affects nutritional status is snack consumption with the largest OR value of 7.314 (95% IK = 2.358 – 22.685) meaning that subjects with frequent snack consumption tend to be at risk of obesity or overweight by 7.314 times greater than child subjects with snack consumption. seldom. While the dietary fiber variable has an OR value = 5.862 with 95% CI = 2.092 - 16,221, meaning that subjects with a low fiber diet tend to be at risk of obesity or overweight by 5.826 times greater than subjects with sufficient fiber diet. The logistic regression formula obtained is:

$$P(x) = \frac{1}{1 + e^{-(2,165 + 1,762 \text{ fiber diet} + 1,990 \text{K snack consumption})}}$$

Based on the regression equation, it can be calculated the probability that a subject with the characteristics of a child with a low fiber diet (code = 1) and frequent snack consumption (code = 1) will have an 83% chance of being obese or overweight.

$$P(x) = \frac{1}{1 + e^{-(2,165 + 1,762(1) + 1,990(1))}} = 0,83$$

The resulting overall percentage value is 76.5%. This figure shows that overall, the model used has the ability to predict obesity or overweight is 76.5 percent.

Discussion

Obesity and overweight in adolescents are serious problems because they are at risk for metabolic and degenerative diseases such as cardiovascular disease, diabetes mellitus, cancer, osteoarthritis, sleep disorders, sleep apnea, and respiratory disorders (Kemenkes, 2012). The number of adolescents with obesity and overweight has increased (Engeland A, et al., 2003). Based on data from the CDC, children and adolescents aged 2-19 years in 2017-2018 had an obesity prevalence of 19.3% from 14.4 million. The prevalence of overweight and obesity in the province of Jakarta, Indonesia in adolescents is 7.3%, consisting of 5.7% of overweight adolescents and 1.6% of obesity with a prevalence of obesity of 4.2% ($p < 0.001$) (Riset Kesehatan Dasar, 2016).

The subjects in the study were adolescents aged 12-15 years with 33.3% overweight and obesity 12.7% with a higher prevalence of overweight and obese boys (52.4%) and 41.7% woman. They are similar to the previous study by Juan et al. In 2018 in China, boys with more nutritional status and obesity (20.9%) were more than girls (11.6%) (Juan Z, et al., 2018), which is because women have higher concentrations of leptin, this hormone functions in suppressing appetite (Yoon JS, et al., 2010). Other studies have found that women in developed countries prefer to consume foods that have a lower number of calories such as vegetables and fruits, while men prefer to consume meat and other high-calorie foods (Wang VH, et al., 2018). However, in another study, the incidence of obesity and overweight was higher in women than men, due to the growth velocity in men and differences in secondary sex development (Maynard LM, et al., 2001).

The risk factor for overweight and obesity is excessive energy intake. Dietary fiber into water soluble fiber (WSF) and insoluble fiber (WIF). WSF can slow down the absorption of food, thereby lowering cholesterol absorption because it has a higher viscosity (Tan KY, et al., 2007). WSF fermentation can produce SCFA which can reduce hunger, have a lower glycemic level which can reduce insulin response and prevent insulin resistance. WIF can increase fecal mass which has the effect of decreasing the transit time of food in the intestine. Both play a role in weight loss (Mathern JR, et al., 2009).

In this study, a food recall was carried out for 1 week to assess the amount of fiber consumed using self nutrition data which was associated with nutritional status in adolescents. In subjects with a low fiber diet showed 78.4% with overweight and obesity. Based on the results of the chi square test, there was a significant relationship between dietary fiber and nutritional status ($p < 0.001$) with an RP (Prevalence Ratio) of 2.830 (95% CI = 1.845-4.341). These results are similar to a study conducted by Bahrenian et al in 2018 that there is a relationship between dietary fiber and body weight and waist circumference (Bahreinian M, et al., 2018). In the study of Sudiasih NLP et al in 2019, it was reported that there was a relationship between fiber consumption and obesity in adolescents (Sudiasih NLP, et al., 2019). In the research of Parikh et al in 2012 there was also a relationship between fiber intake and low visceral fat in the body (Parikh S, et al., 2012). However, a 2014 study by Lin et al. found no relationship between fiber consumption and the percentage of body fat. This study assessed the relationship between WSF and WIF fiber intake and fat percentage but did not compare the two. There is a higher amount of WIF consumption than WSF (Lin Y, et al., 2014).

Adolescence is a very risky transition period to adopt the habit of consuming foods that are high in calories and low in fiber intake (Nicklas TA, et al., 2000). Diet in adolescents is closely related to the habit of consuming snacks. In general, some snacks have a large number of calories, are high in fat and high in sugar, so that if they are consumed continuously, they will cause obesity (Yoon JS, et al., 2010).

This study also assessed other factors that could lead to overweight and obesity, namely the consumption of snacks and physical activity. In this study, children with overweight and obesity status consumed snacks as much as 63%. These results are in accordance with a survey in 2003-2008 that the prevalence of snack consumption in children aged 2-18 years increased by 74% compared to 1977-1978 (Piernas C, et al., 2010).

Based on the results of the analysis using the Chi Square test showed that there was a significant relationship between snack consumption and nutritional status ($p < 0.001$) with an RP value of 4.782 (95% CI = 2.075-11.018). These results are similar to a study conducted by Mukhlisa et al in 2018 which showed that excessive snack consumption was associated with more energy intake and overweight status in adolescents (Mukhlisa WNI, et al., 2018). In another study by Yoon et al in 2010 there was also a significant correlation

between snack consumption and the incidence of obesity/overweight in adolescents. In a study by Piernas et al in 2010 that there was an increase in the number of calories up to 27% of snack consumption in children and adolescents.

In this study, it was reported that 59.1% of subjects who lacked physical activity were overweight and obese. These results are similar to research by Baharudin et al in 2012, there is still a lack of physical activity in adolescents.²³ In this study there was no relationship between physical activity and nutritional status. However, several other studies have reported that physical activity has a correlation with weight loss, such as the 2008 study of McMurray. In a systematic review study, lack of physical activity in children is associated with overweight and obesity in children (Jimenez PD, et al., 2010). In this study, the overall percentage has also been carried out with the result of 76.5%. These results indicate that overall, the model used has the ability to predict obesity or overweight by 76.5 percent. However, in this study, it was found that the factors that most influence the occurrence of overweight and obesity are the habit of consuming snacks and dietary fiber.

Conclusion

In this study, there was a significant relationship between dietary fiber and nutritional status in adolescents, with other factors associated with obesity, namely snack consumption habits.

Suggestion

It is necessary to assess the physical activity carried out on the research subject in the form of the type of physical activity carried out. Further research is needed to assess the relationship between dietary fiber in adolescents to find out its benefits for weight loss in adolescents with obesity

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