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The changes of dietary fiber intake in obese adults: NCDs cohort study in Bogor City

Perubahan asupan serat pada orang dewasa obese: Penelitian kohor FR-PTM di Kota Bogor

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Abstract

The prevalence of obesity in the adult is increasing each year due to increased consumption of fast food and decreased consumption of fiber. Based on Basic Health Research there was 20% of Indonesians suffered from obesity in 2018. The objective is to analyze changes in dietary fiber intake in adult obese in Bogor City. Methods: This research is conducted using secondary data from Risk-Factor of Non-Communicable Disease Bogor. The research design was prospective cohort. Total subjects were 138 subjects who were newly suffer from obesity in 2014 and 2016, and had normal BMI in baseline (2011 and 2012). Consumption data were collected using 24-hr recall and FFQ and were processed and analyzed using Nutri Survey, Microsoft excel and SPSS 23.0 version. Univariate analysis was used to see the characteristic of the subjects, while different test was using Wilcoxon test since the data are not distributed normally. Results,most subjects were women (77,5%) aged 35-44 years old. The mean of dietary fiber intake was at about 9,7 g in the beginning and it increased by 1,2 g. Despite the increment in the percentage of the people who consumed dietary fiber at about 58%, the mean was still under the recommendation (<25g) at 96,4%. Conclusions, there was an increasing number of dietary fiber in the obese adult who were newly suffered from obesity in two years follow-ups, but the intake is still under the recommendation.

Keywords: Adult, dietary fiber intake, obesity

Abstrak

Prevalensi obesitas pada orang dewasa semakin meningkat setiap tahunnya yang dikarenakan oleh terjadinya peningkatan konsumsi makanan cepat saji dan menurunnya konsumsi serat. Berdasarkan hasil Riset Kesehatan Dasar, prevalensi obesitas di Indonesia pada tahun 2018 sebesar 20%. Penelitian bertujuan untuk menganalisis perubahan asupan serat pada orang dewasa obesitas di Kota Bogor. Penelitian ini menggunakan data sekunder yang diambil dari penelitian faktor resiko penyakit tidak menular (FR-PTM) Bogor. Desain studi yang digunakan adalah kohort prospektif. Total subjek sebanyak 138 yang mengalami obesitas mulai dari 2014 dan 2016, subjek ini pada tahun 2011 dan 2012 memiliki IMT yang normal. Data konsumsi dikumpulkan dengan menggunakan *24-hr recall* dan FFQ dan diproses menggunakan *Nutri Survey 2004*, serta data lain menggunakan *Microsoft Excel* 2019 dan SPSS versi 23. Uji univariat digunakan untuk melihat karakteristik subjek, sementara uji beda yang digunakan adalah uji *Wilcoxon* dikarenakan data tersebar tidak normal. Mayoritas subjek berjenis kelamin perempuan (77,5%) berusia 35-44 tahun. Rata-rata asupan serat sekitar 9,7 g pada awal dan meningkat sebanyak 1,2 g pada akhir pemantauan. Walaupun terjadi peningkatan pada sebagian besar subjek (58%), rata-rata konsumsi serat masih di bawah rekomendasi (96,4%). Terdapat

peningkatan jumlah asupan serat pada orang yang baru mengalami obesitas selama kurun waktu dua tahun, tetapi asupan ini masih berada di bawah rekomendasi.
Kata Kunci: Asupan serat, orang dewasa, obesitas

Introduction

Obesity is a complex health problem caused by a combination of individual factors such as behavioral and genetics. These behaviors are related to physical activity, diet, drug use and other exposures (Centers for Disease Control and Prevention, 2018). Other influential factors include education and skills, environment and food marketing and promotion (Centers for Disease Control and Prevention, 2018).

The prevalence of obesity in the world from 1975-2016 quadrupled from 4%-18% in children and adolescents aged 5-19 years. While in Indonesia, obesity in adults over the age of 18 years was 21,8% in 2018, this percentage increased by twice compared to Basic Health Research (Riskesdas) data in 2007 which was only 10,5% and in 2013 of 14,8% (Kementerian Kesehatan Republik Indonesia, 2018). This figure is not much different from the prevalence of obesity in Bogor City in 2018 of 20,73%, which is around 9842 people who are obese (Dinas Kesehatan Kota Bogor, 2018). Obesity that occurs within a certain period of time will interfere with regulation including insulin activity in glucose, fat and fatty acid metabolism and will have an adverse effect on the process of controlling glucose, and blood pressure (Misra & Khurana, 2008; Al Rahmad, 2021).

There have been many studies that report that dietary fiber as one of the factors that can prevent cardiovascular disease (Tejada-Ortigoza et al., 2020). The total fiber intake recommended by the American Heart Association (AHA) for consumption every day is around 25-30 g and this intake only comes from food not from supplements (Horn, 1997). Based on World Health Organization (2020) recommends total consumption of vegetables and fruits around 400 g/person/day, if ported approximately about five servings a day. Fiber intake in various countries in the world is still below the recommendation, in the UK in one day only consume about 19,9 g, in China around 9.7 g/capita/day, in Malaysia around 13-16 grams/day and in Indonesia only about 7 g/day (Bingham et al., 1979; Ng, 1997; Sari et al., 2014b; Yu et al., 2020).

Many benefits will be obtained by consuming high fiber in accordance with the recommendations (>25 g) (Mumford et al., 2011). In obese people, fiber has an important role in reducing the risk of various diseases; namely, fiber can help people lose weight by changing metabolism and inflammatory status by stimulating the composition of the gut microbiota (Tejada-Ortigoza et al., 2020).

In addition, fiber can modulate appetite and energy intake directly through physical effects on the stomach and intestines or through metabolism involving microbial fermentation of the gut such as Short Chain Fatty Acid (SCFA). Another effect that arises by consuming high fiber is that fiber can interact with digestive enzymes in the small intestine which will ultimately decrease the absorption of nutrients or entangle nutrients and limit their absorption. The growth of bacteria in the gut and the production of gas and SCFAs will have an effect on energy homeostasis and fight insulin resistance (Tejada-Ortigoza et al., 2020).

Based on research conducted in Indonesia, there has been no study with a cohort study design that examines fiber intake both conducted by the Ministry of Health and other researchers, mostly using a cross-sectional study design. In addition, this study will also see changes in fiber intake that are not done by other researchers. Therefore, this study aims to analyze changes in fiber intake in obese adults in Bogor City.

Methods

This study used secondary data on risk factors for non-communicable diseases in Bogor City. This activity is carried out by the Health Research and Development Agency (Balitbangkes) in the Bogor City area, which includes 5 of the 11 Kelurahan in Bogor City (Kebon Kalapa, Babakan Pasar, Babakan, Ciwaringin, and Panaragan) on the grounds of a heterogeneous population from socioeconomic, ethnic, and cultural aspects (Riyadina et al., 2018). Prospective cohort starting from April 2022 to September 2022 at the Faculty of Human Ecology, Bogor Agricultural University.

The sample in this study consisted of subjects who had recently suffered from obesity. The inclusion criteria of this study were adults (25–60 years) who were subjects in the FR-PTM cohort study, both women and men, had a BMI (body mass index) of 25,0 kg/m2 for two monitoring points, and had no physical disability (taking into account physical activity). While the exclusion criteria of this study are people who take supplements or weight-loss drugs, women who are pregnant, and people who come out of follow-up during data collection, data were taken twice, starting when new subjects suffered from obesity in 2014 and 2016, so that the baseline data respondents had not been obese (BMI < 25,0 kg/m2). The minimum sample size was found to be 138 subjects using the Lameshow formula as follows:

$$n = \frac{\left[z_{1-\frac{\alpha}{2}}\sqrt{2P(1-P)} + z_{1-\beta}\sqrt{P_1(1-P_1)+P_2(1-P_2)}\right]^2}{(P_1-P_2)^2}$$

Information:
n = Sample size
α = The probability of making a type I error (the probability of rejecting the correct Ho). In this study, α=0,05 was used, so Z1-α/2=1,96.
ß = The probability of making a type II error (the probability of failing to reject the wrong Ho). In this study ß will be calculated to find out the precision that can be achieved. Test strength of 80%
P1 = Proportion of exposed subjects who are Obese (Kemenkes RI 2018a)
P2 = Proportion of unexposed subjects who were not obese
P1 = (RR)P2.
P = (P1 + P2)/2
P2 = P1/RR.

In this study, using RR = 1,5 (Sudikno, 2017) and P1 =52,2 (Kementerian Kesehatan Republik Indonesia, 2018), a minimum sample size was found to be as many as 96 subjects using the calculations as above. However, in this study, all new obese subjects provided data.

Demographic data includes age, gender, education, and occupation. Other factors, such as smoking status and physical activity, were also seen in determining nutritional status using anthropometric data taken by conducting interviews and taking measurements directly at only one starting point, namely in FU0/2014. Consumption data retrieval using 24-hr recall was used to see fiber intake from subjects. Researchers also took data from FFQ (food frequency) to complement the existing data; this data was used to see the frequency of fruit and vegetable consumption by subjects for one week. Consumption data were taken once a year in 2014 (FU0) and 2016 (FU1) by nutritional enumerators.

Researchers obtained data in the form of SPSS from Balitbangkes, which was then encoded (recoded) back into Microsoft Excel and carried out cleaning and screening to obtain total samples that could meet the inclusion and exclusion criteria. 1x24-hour recall consumption data is also included in the 2004 Nutrisurvey to be processed and obtain the desired nutrient intake. This data is combined with other data, such as demographic and anthropometric data, as well as laboratory data, using Microsoft Excel.

Data analysis using SPSS version 23.0, which includes univariate, bivariate, and multivariate data analysis, The data normality test was carried out using Kolomogorov-Smirnov. The data obtained are abnormally distributed, so the other test used is the Wilcoxon test. The test strength used is 95% and significant when p < 0,05. The null hypothesis is rejected if α < ρ value (0,05), and the null hypothesis is accepted when α > ρ value.

Result and Discussion

Based on Table 1, the demographic characteristics of people with new obesity are mostly female (77,5%) and under 45 years old, with 17,4% aged 25–34 years and 39,9% aged 35–44 years. This research is in line with research by Sari et al. (2014) using NCD (non-communicable diseases) cohort data. The percentage of women (58,7%) in Sari's study (2014) was higher than that of men, and subjects aged less than 45 years were as high as 60,8%. The level of subject education is mostly low (59,4%), namely among those who graduated from junior high school or equivalent and those classified as having higher education (graduated from high school or equivalent) by 40,6%.

Based on data from the Directorate of Population and Civil Registration (Dukcapil) of the Ministry of Home Affairs (2021), the number of Indonesians who graduated from junior high school is 39,7 million people, and 56,2 million people graduated from high school (Kusnandar, 2021). Almost half of the subjects in this study were domestic workers (49,3%), some worked

as both public and private employees (34,1%), and there were 5,1% who worked as laborers, while those who did not work (students and retirees) amounted to 11,6%. Most domestic workers have a relatively low education age range of 45–54 years (30,9%), while those with higher education mostly work as employees (48,9%).

Based on data from the ILO (International Labour Organization) (2015) and the National Manpower Survey (2008–2015), the number of domestic workers is increasing. In 2008, there were 2.6 million domestic workers, which increased to four million in 2015. Out of a total of 859,000 domestic workers in Indonesia, 859,000 work in West Java. The increase in fiber intake in this study was most prevalent in subjects who had jobs as employees, although the percentage was still very low. Consumption of vegetables and fruits in employees is still not in accordance with the recommendations, where employees only consume 60% of fruits and 40% of vegetables compared to the consumption that should be (Ronda-Pérez et al., 2020).

Table 1. Characteristics of the subject of study

Characteristic	n	%
Demographic Factors		
Gender		
Male	31	22,5
Female	107	77,5
Age		
25-34 years	24	17,4
35-44 years	55	39,9
45-54 years	40	29
55-65 years	17	13,8
Mean ±SD	40,7 ±9,3	
Education Level		
Low (Graduated from junior high school/equivalent)	82	59,4
High (High school graduation/equivalent)	56	40,6
Employment Status		
Does not work	16	11,6
Household Servant	68	49,3
(PRT)	7	5,1
Laborer	47	34,1
Employee		
Behavioral Factors		
Physical activity		
Low	4	2,9
Medium	57	41,3
Weight	77	55,8
Smoking Habits		
No smoking	72	52,2
Never smoked	34	24,6
Smoking every day	32	23,2
Mental Emotional Disorders		
No	113	81,9
Yes	25	18,1
Anthropometric Data		
Abdominal circumference		
Central Obesity	105	76,2
Normal	33	23,9
BMI (kg/m^2)		
Degree 2	2	1,4
Degree 1	136	98,6

The results of the study of behavioral factors in table 1 showed that most of the subjects did strenuous physical activity (≥ 2999 MET) which was 55,8% and those with low physical activity were only 2,9%. The subjects who had low physical activity were around 35-59 years old with jobs as domestic workers (4,4%) and employees (2,1%). The percentage obtained in this study is higher than the research conducted by Sari et al., (2014) which shows that 84,6% have moderate activity. In Sari's study, there were only two categories (low and medium) with a limit of 600 MET (Metabolic Equivalent) and in this study used 3 categories. Based on the recommendations provided by WHO (2020), Adults can at least do physical activity about 150-300 minutes with moderate intensity or 75-150 minutes with heavy intensity or a combination of moderate and high intensity for one week to maintain their health.

About half (52,2%) of the subjects did not have a smoking habit, which may be due to most of the subjects being female, while those who smoked daily (23,2%) were men over the age of 30 years. The prevalence of male smokers in Indonesia is 16 times higher than that of women (Kemenkes, 2013). Most subjects (81,9%) had no GME with fewer than 6 symptoms out of a total of 20, while those with GME had 25 subjects (18,1%). This research is also in line with research conducted by Sudikno (2017), which shows the percentage of people who do not experience GME at 73,9%. There

were 1.4% of subjects who were in the second degree of obesity at both the beginning and end of the monitoring, and 98,6% had first-degree obesity. At the beginning and end of the monitoring, two obese subjects were women with domestic work, and three out of four subjects had low education. The prevalence of central obesity was higher (76,2%) than that of those with normal nutritional status because this study focused on people who were newly obese and obese as measured by BMI, so not all subjects had central obesity.

The prevalence of obesity in Indonesia doubled from 17,1 to 33% from 1999 to 2014 (Oddo et al., 2019). Weight gain, BMI, and abdominal circumference have a higher risk of suffering from various diseases. Based on research conducted by Zheng et al. (2017) Using a prospective cohort study design for 18 years in women and 15 years in men in the United States, it was stated that compared to subjects who had a stable weight (lost 2,5 kg or increased <2,5 kg), respondents who increased their weight (2,5–10 kg) were at risk of diabetes, cardiovascular disease, cancer, and death.

Table 2. Change in average fiber intake

Nutrients	Beginning Mean±SD (Min-Max)[a]	End Mean±SD (Min-Max)[b]	Changes in intake (Mean)[c]
Fiber Intage (g)	9,2±6 (2,4-35,2)	10,8±7,7 (1,6-58,4)	+1,2
Frequency of Vegetable Intake (times/week)	10,6±7,5 (0-40)	8,55±6,1 (0-37)	-2
Frequency of Fruit Intake (times/week)	5,9±6,2 (0-34)	5,7±4,8 (0-25)	-0,2

Information: [a] The initial monitoring was carried out in 2014 (FU0) in the form of medians; [b] End of monitoring conducted on 2016 (FU1); [c] The change is the mean difference between FU0 and FU1; *Wilcoxon test, significant p-value when <0,05

Based on Table 2, there was an increase in fiber intake of 1.2 g during follow-ups, with an average of 9,62 g/day at the beginning of monitoring and 10,8 g/day at the end of monitoring. The fiber density at the beginning and end of the monitoring had the same result of 5,7 g/1000 kcal. The subjects who consumed the fiber as recommended were mostly female at both the beginning and end of the monitoring. Based on research conducted by Alharbi and Alarifi (2022), it shows that women consume a higher fiber intake of 14 g per day, while men only consume 12 g per day. Subjects had a recommended fiber intake of only 3,6%, below the recommendation of 96,4%. Based on research by Permanasari & Rachmawati (2012) using Riskesdas 2007 data, the fiber intake of Indonesians, especially those who are overweight, is still below the recommendation; about 91,8% of Indonesians have a low fiber intake.

The frequency of vegetable consumption among subjects was significantly different; there was a decrease in consumption during the two years of follow-up. At the beginning of the monitoring, the average frequency of vegetable consumption was 10 times, and at the end, it was as many as eight times. The frequency of fruit consumption among subjects also decreased by 0,2 times less than in the previous two years. In one day, the average consumption of vegetable subjects was only about 1,5 times per day, and fruit consumption was less than once (0,8 times per day). This is in accordance with the results of the recall carried out; in one day, many subjects only consumed vegetables and fruits one to two times in one day.

Research results Nakaji et al. (2002) stated that the subjects' total fiber intake decreased, initially by around 20,5 g/day, and decreased by 70% 18 years later. Food sources of fiber are found mainly in cereals and legumes. In this study, fiber intake increased by about 1,2 g within two years, and the main source of fiber consumed was not much different, namely cereals and nuts. However, trends in research by Nakaji et al. (2002) decreased and in this study increased, although not statistically significant. The fiber density in the study was around 9,7 g/1000 kcal, which resulted in a higher density than this study, which was only 5,7 g/1000 kcal. This happens because the subjects in this study are people who are newly obese.

Fiber intake provides many benefits for the body. One study that looked at the benefits of fiber intake on body fat was conducted by Tucker and Thomas (2009). Within 20 months, almost 50% of women experienced an increase

in body weight and fat percentage. For every one gram increase in total fiber intake, body weight decreased by 0,25 kg (P = 0,0061) and fat decreased by 0,25% (p = 0,0052). The results of another study were a systematic review and meta-analysis of 21 randomized controlled trials (RCTs), showing that overall there was a weight loss of 0,34 kg. In the six-week intervention group of 21 RCTs, six studies showed a link between fiber intake and body fat percentage (Kim et al., 2016).

This is related to the ability of polyphenols to act as radical scavengers in the gastro-intestinal pathway and be delivered to the colon due to the action of microbial esterases. Free polyphenols play a role in the colon (as antioxidants and microbiota agents), which can also change the composition of the gut microbiota systematically (as antioxidants and anti-inflammatory agents) after absorption through the colon (Tejada-Ortigoza et al., 2020).

Table 3. Average consumption of food sources of fiber (g)

Food	Average Consumption (g)		Change Average (g)
	Beginninng	End	
Vegetable			
Melinjo	13,7	13,2	-0,5
Young jackfruit	23,7	23,3	-0,4
String beans	22,6	22,1	-0,5
Siamese pumpkin	30,6	23,5	-7,1
Water spinach	27,1	24,4	-2,7
Fruits			
Uli banana	100,7	62,9	-37,8
Ambonese banana	84,7	62,5	-22,2
Banana lampung	113	104,1	-8,9
Grape	20	20	-5
Cereals and their processed products			
Rice	169,5	186,6	17,1
Sweet Bread	71,3	71,5	0,3
White Bread	80	95	15
Instant Noodles	81,6	79,6	-2
Rice	169,5	186,6	17,1
Nuts and their processed products			
Tempeh	54,7	65,4	10,7
Tofu	54,1	60,9	6,8

Based on Table 3, different types of vegetables were consumed by the subjects, but the most consumed type of food was tamarind vegetables. Food ingredients are used to make these types of foods, namely: melinjo leaves, chayote, young jackfruit, long beans, and corn. In one day, the average consumption of melinjo leaves was 11,4 g, young jackfruit 23,7 g, long beans 22,5 g, chayote 30,6 g, and corn 25,3 g. In addition to these two types of vegetables, kale and spinach were also quite often consumed by subjects every day, as much as 27,4 g and 45,38 g, respectively.

One of them is due to the production of long beans and kale, which is one of the largest vegetable productions in Bogor, as much as 621 tons and 517 tons in one year (Dinas Pertanian Bogor, 2014). Subjects rarely consumed fruit; from a total of 138, only about 57 subjects consumed fruit at the beginning; this number increased to 69 subjects, although the types varied. The most commonly consumed type of fruit is bananas, especially uli bananas, with an average consumption of 100,7 g in one day. Ambonese bananas and float bananas are also quite often consumed by subjects. The least and least consumed type of fruit is grapes, with an average of only 20 g consumed in one day by only one person, both at the beginning and end of the observation. The most popular fruit in Bogor is bananas, whose production reaches 205,171 quintals in one year. Grapes are rarely consumed; this fruit is not produced in Bogor (Dinas Pertanian Bogor, 2020).

The average consumption of vegetables and fruits is still below the recommendation from the WHO, which is 400 g, or five servings in one day. Based on the processing of Individual Food Consumption Survey (SKMI) data conducted by Hermina & Prihatini (2016), it states that around 94,8% of Indonesians consume vegetables and only 33% consume fruit, with an average of 70 g/person/day for vegetables and 38,8 g/person/day for fruit consumption. However, when compared to nutritional adequacy, vegetable and fruit consumption is still relatively low.

Consumption of cereals and processed products is most abundant in rice; in one day, subjects can consume about 169,5 g, which increases by 17,1 g within two years. The next most consumed types of processed cereals are bread, instant noodles, and flour. In one day, the average

consumption of sweet bread and white bread was above 70 g, and both experienced an increase in consumption at the end of the monitoring. Instant noodle consumption was about one pack (70 g) both at the beginning and end of the monitoring. Rice production in Bogor City has increased every year, from around 99 tons in 2018 to 172 tons in 2020 (Dinas Tanaman Pangan Hortikultura dan Perkebunan Bogor, 2019).

The average consumption of tofu and tempeh is the highest consumption of nuts compared to other types of nuts, with a portion of approximately two fruits a day, and both have increased to 65 g in tempeh and 60,9 g in tofu at the end of the monitoring.

In addition to tofu and tempeh, the consumption of green beans is also quite high (around 28,3 g), although at the end of the study, the consumption decreased by 9,3 g. Consumption of cereals and processed cereals is relatively high; although cereals contain fiber, their carbohydrate content is also quite high, which can increase TG (triglyceride) levels. Based on research conducted by Min et al. (2016), triglyceride levels were positively associated with glycemic index intake (how quickly carbohydrates can be converted into sugar in the body) and glycemic load (how much carbohydrate is contained in food) in women, especially in overweight subjects.

The advantage of this study is that the study design used is a prospective cohort that analyzes data from more than one measurement. In addition, this study focused on new obese people who began to experience obesity, which is still rarely done; most other studies do not distinguish when subjects are obese. In this study, the study design used was a prospective cohort that allowed bias to occur, namely systematic error, where the same error was made in data collection during follow-up.

Conclusion

In this study, two observation points were conducted in 2014 and 2016, with the highest age range of 35–44 years, and most of them were female. The subject's education level is mostly low, with the most jobs as domestic workers. The subjects' physical activity was mostly strenuous, and the majority of subjects did not smoke due to the large number of females. Only a small percentage of Subjects experience GME. The subjects' fiber intake was still largely below recommendations. Although there was an increase during the observation time (1,2 g) because the subjects used were newly obese, more were still in the first degree of obesity and had central obesity.

The need to increase fiber intake in obese people by regulating the amount of vegetable and fruit consumption at each meal so that a day's fiber intake can be fulfilled for related institutions to improve the quality and quantity of consumption data by collecting recall data 2-3 times in one observation point. For the government, it is necessary to increase the use of social media in conducting education related to the importance of vegetable and fruit consumption. In addition, it is necessary to hold a regular exercise program at PTM Posbindu to increase the subject's physical activity. For further research, it is necessary to be able to develop high-fiber foods that can be reached by all levels of society.

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