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Changes in sugar, salt, and fat intake among obese adults: cohort study

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ABSTRAK

Latar Belakang: *Asupan gula, garam, dan lemak yang berlebih merupakan salah satu faktor risiko terjadinya obesitas dan penyakit tidak menular. Perubahan asupan gula, garam, dan lemak pada orang dewasa dengan kasus obesitas baru belum diteliti di Indonesia.*
Tujuan: *Menganalisis pola asupan dan besaran perubahan asupan gula, garam, lemak pada orang dewasa obese selama dua tahun pemantauan.*
Metode: *Desain pada penelitian ini yaitu studi longitudinal dengan menggunakan data sekunder dari Studi Kohor Faktor Resiko Penyakit Tidak Menular oleh Kementerian Kesehatan Republik Indonesia. Subjek pada penelitian ini yaitu penyandang obesitas baru sebesar 138 subjek. Nilai cut-off obesitas yang digunakan dalam penelitian yaitu IMT ≥25.00 kg/m2. Asupan gula, garam, dan lemak diperoleh dari food recall 1x24 jam dan FFQ. Pola asupan gula, garam, dan lemak dikategorikan menjadi meningkat atau menurun berdasarkan perbandingan asupan pada akhir penelitian dengan asupan GGL di T2 (tertile sedang) pada awal penelitian. Besar perubahan asupan gula, garam, dan lemak adalah selisih asupan gula, garam, dan lemak subjek penelitian di dua tahun pengamatan.*
Hasil: *Mayoritas penyadang obesitas yaitu perempuan dengan rentang usia 35-44 tahun dan mempunyai kadar LDL yang tergolong tinggi. Adanya perubahan pada asupan gula, garam, dan lemak pada penyandang obesitas yang meningkat secara signifikan khususnya pada gula, dan lemak. Besar perubahan asupan gula, garam, dan lemak pada orang dewasa obese sebesar 10.5 g ($p<0.05$), 0.02 g ($p>0.05$), dan 10.7 g ($p<0.05$) selama dua tahun. Asupan pangan sumber gula, garam lemak seperti kue manis, minuman berpemanis, dan minuman sachet dengan penambahan gula, makanan kaleng, kecap, dan gorengan serta daging juga meningkat selama dua tahun pemantauan.*
Kesimpulan: *Asupan gula, garam, dan lemak pada orang dewasa yang obesitas cenderung meningkat, dan kemungkinan besar dapat meningkatkan prevalensi obesitas dan penyakit tidak menular di Indonesia*

KATA KUNCI: *dewasa; asupan gula-garam-lemak; obesitas; perubahan asupan; studi longitudinal*

ABSTRACT

Background: *Excessive intake of sugar, salt, and fat (SSF) is a risk factor for obesity and non-communicable diseases. Changes in sugar, salt, and fat intake in adults with new obesity cases have not been studied in Indonesia.*

Objectives: *To analyze dietary trajectories and sugar, salt, and fat intake changes in obese adults.*

Methods: *The design of this study was a longitudinal study using secondary data from the Study on Non-Communicable Disease Risk Factors by the Ministry of Health of the Republic of Indonesia. The subjects in this study were 138 subjects with obesity. The obesity cut-off value used in the study was BMI 25.00 kg/m2. Sugar, salt, and fat intake were obtained from food recall 1x24 hours and FFQ. The dietary trajectories of sugar, salt, and fat intake were categorized as increasing or decreasing based on the comparison of intake at the end of the study with the intake of SSF at T2 (medium tertile) at the beginning of the study. The change in the intake of sugar, salt, and fat was the difference in the subjects' intake of sugar, salt, and fat in the two years of observation.*

Results: *The majority of obese adults were women aged 35-44 years and had high LDL levels. There was a change in the intake of sugar, salt, and fat, which increased significantly, especially sugar and fat. Changes in sugar, salt, and fat intake in obese adults were 10.5 g ($p<0.05$), 0.02 g ($p>0.05$), and 10.7 g ($p<0.05$) for two years. Intake of food sources of sugar, salt, and fat such as sweet food, sugar-sweetened drinks, instant powder drink with added sugar, canned food, soy sauce, fried foods, and meat also increased during the two years of monitoring.*

Conclusions: *The intake of sugar, salt, and fat in obese adults tend to increase and is likely to increase the prevalence of obesity and non-communicable diseases in Indonesia.*

KEYWORD*:* *adult; sugar-salt-fat intake; obesity; dietary behaviour changes; longitudinal study*

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INTRODUCTION

Obesity is a serious public health issue in both developing and developed countries. Obesity is closely linked to non-communicable conditions including diabetes, metabolic syndrome, and cardiovascular disease, and can severely worsen these conditions (1,2). According to data from the Indonesian Family Life Survey (IFLS), 33.0% of people were overweight in 2014 increased from 17.1% (1993) to 33.0% (3). According to Basic Health Research, obesity in Indonesia increased from 10.5% in 2007 to 14.8% in 2013 and 21.8% in 2018 (4). Bogor City, one of West Java Province's cities, has a significant incidence of obesity. Bogor City has a 23.85% higher prevalence of overweight and obesity in adults over the age of 18 than West Java. (5). Obesity has a negative influence on the country's economic losses. In 2016, the economic loss from overweight and obesity was around $28.4 billion (Rp369.70 trillion) (6). According to the nutrition transition theory, economic growth, urbanization, and globalization have led to increasing consumption of processed foods, sedentary behavior, and excessive salt, sugar, and fat intake, all of which lead to obesity and non-communicable disease (7–9).

The Indonesian government's primary focus on preventing chronic or non-communicable illnesses is reducing sugar, salt, and fat intake (NCDs). The Balanced Nutrition Guidelines (PGS) limit sugar intake to less than 50 g/day, salt to less than five g/day, and fat to less than 67 g/day (10). However, data analysis of the Individual Food

Consumption Survey (SKMI) showed that 29.7% of the Indonesian population consumes more sugar, salt, and fat than recommended (11). The Non-communicable Disease Progress Monitor 2020 report also showed that decreasing the consumption of unhealthy food in Indonesia was not optimal as measured by the policy on the intake of salt, saturated fat, and trans-fat (12).

Behaviour changes are essential, especially in sugar, salt, and fat intake in obese adults. It can improve energy balance, lose weight and prevent and control non-communicable diseases (13,14). Research on sugar, salt, and fat intake using longitudinal data has not been conducted in Indonesia. This research aimed to analyze dietary trajectories and changes in sugar, salt, and fat intake among obese adults during two years of monitoring.

MATERIALS AND METHODS

The design of this study was a longitudinal study using secondary data from the Non-Communicable Disease Risk Factor Cohort Study. The Non-Communicable Disease Risk Factor Cohort Study was conducted in Bogor City on permanent residents in five urban villages (Kebon Kalapa, Babakan Pasar, Babakan, Ciwaringin, and Panaragan) in Central Bogor Regency, Bogor City, West Java Province since 2011. This research was approved by the Health Research Ethics Commission, Health Research and Development Agency Number: LB.02.01/5.2/KE. 143/2014 and LB.02.01/5.2/KE. 042/2016. The data analysed in this study were retrieved from 2014 to 2016.

The inclusion criteria for this research were men and women, 27 to 63 years old, having a Body Mass Index (BMI) ≥25.0 kg/m2 for two years from 2014 (beginning of the study) to 2016 (end of study). Exclusion criteria included pregnant women, taking supplements to lose or gain weight, and incomplete data. Determination of the number of subjects in this study began with determining the new incidences of obesity in adults after two years of study from the baseline of the Non-Communicable Disease Risk Factor Cohort Study in 2011-2012 with a total of 5 690 subjects. The subjects were 2 819 people with normal nutritional status, 2 475 subjects with obesity, and 396 subjects with incomplete data. The number of new incidences of obesity after being followed for two years of study (2014) from subjects who had normal nutritional status in 2011-2012 was 276 subjects. Subjects with a new incidence of obesity were followed up for two years of study (2016), and 145 remained obese. However, from 145 subjects, there were missing data on physical activity by two subjects and food consumption by five subjects. Thus, the total number of subjects in this study was 138 subjects.

Data collection was conducted by the Non-Communicable Disease Risk Factor Cohort Study team. The data in this research consisted of the following:

1. Characteristics of the subjects, including individuals (age, gender), socioeconomic (education, occupation, and income), and behaviour (physical activity, smoking habits, and mental and emotional disorders). Data on comorbidity consisted of hypertension, diabetes mellitus, and blood lipid profiles taken at the beginning of the study (2014).
2. Anthropometric data, including weight, height, abdominal circumference, and Body Mass Index, were taken from the baseline Non-Communicable Disease Risk Factor from the beginning of the study (2014) to the end of the study (2016).
3. Food consumption data, including 24-hour food recall and FFQ, was taken once a year from the beginning of the study (2014) to the end of the study (2016). The analysis of sugar, salt, and fat intake was conducted by selecting all foods and drinks containing sugar, salt, and fat from 24-hour food recall, then analyzed using Nutrisurvey and calculating the total intake of each sugar, salt, and fat per person per day. Analysis of salt intake was carried out by converting the amount of dietary sodium from the results of the nutrisurvey. Conversion from sodium to salt was consucted by dividing the value of sodium (mg) by 393.4, or 1 gram of salt contains about 393.4 mg of sodium (11). The frequency consumption of SSF food sources was taken using the Food Frequency Questionnaire (FFQ).

Data processing used Microsoft Excel 2019 and IBM SPSS Statistics 22. Univariate analysis

was conducted to analyze the subject's characteristics and other variables presented in requency, mean, standard deviation, and min-max. The dietary trajectories of sugar, salt, and fat were analyzed by comparing the intake of sugar, salt, and fat at the end of the study (2016) with the intake of sugar, salt, and fat in the T2 group (medium tertile) at the beginning of the study (2014) and categorized into increases and decreases. The change in sugar, salt, and fat intake was calculated from the difference between the measurement of sugar, salt, and fat intake at the beginning of the study (2014) and the end of the study (2016). To establish the data distribution, a normality test was performed and the Kolmogorov-Smirnov test was used. The Wilcoxon test was used to compare sugar, salt, and fat intake at the beginning to the end of study. P-values <0.05 were considered statistically significant.

RESULTS AND DISCUSSIONS

A total of 138 adults aged 27 – 63 years participated in this research. The characteristics of the subjects in this research are shown in table 1. Most of the subjects were women (77.5%), aged 35-44 years (39%), with moderate education (60.9%), low income (84.1%), and working as domestic workers (49.3%). The majority of subjects had non-smokers (76.8%), had good mental health (81.9%). Most of the subject both man (21.7%) and woman (75.4%) had sufficient physical activity. Based on comorbidity, most of the subjects did not suffer from diabetes mellitus (94.9%), had a normotension (73.2%), and had normal lipid profiles except LDL cholesterol level

Table 1. Characteristics of participants

Subjects Characteristic	n=138	%
Sex		
Male	31	22.5
Female	107	77.5
Age		
27-34 years	24	17.4
35-44 years	55	39.9
45-54 years	40	29.0
55-65 years	19	13.8
Education		
Low education level	47	34.1
Moderate education level	84	60.9
High education level	7	5.1
Income		
Poor	116	84.1
Adequate	22	15.9
Occupation		
Unemployed	16	11.6
Domestic workers	68	49.3
Labor	7	5.1
Officer	47	34.1
Smoking status		
Non-smoker	75	76.8
Light Smoker	48	13.8
Moderate Smoker	15	9.4
Mental and emotional disorder		
No	113	81.9
Yes	25	18.1
Physical Activity		
Low (<600 MET)	4	2.9
Adequate (≥600 MET)	134	97.1
Diabetes Mellitus		

Subjects Characteristic	n=138	%
No	131	94.9
Yes	7	5.1
Hypertriglyceridemia		
No	123	89.1
Yes	15	10.9
Hypercholesterolemia		
No	88	63.7
Yes	50	36.3
LDL Cholesterol level		
Normal	26	18.8
Abnormal	112	81.2
HDL Cholesterol level		
Normal	119	86.2
Abnormal	19	13.8
Hypertension		
No	101	73.2
Yes	37	26.8

(81.2%) were relatively high. Obesity is considerably more prevalent in women (11.5%) than in males (6.9%), according to data from the National Health and Nutrition Examination Survey 2017-2018. (15). The high prevalence of women with obesity is not only caused by changes in lifestyle, high energy food intake, and sedentary behaviour, but also menopause conditions, parity, and oral contraceptives can affect the incidence of obesity in women (16). Socioeconomic status also affects the incidence of obesity. High socioeconomic status has better accessibility to healthy food and health facilities than individuals with low socioeconomic status (17). Higher education also reflects higher health awareness and health care capabilities, as well as a healthier lifestyle (18). In contrast, lower levels of education are associated with a high-carbohydrate diet and higher consumption of sweets (19). Most subjects did not have comorbidities due to early obesity. High levels of LDL Cholesterol level subject can be caused by high intake of sugar and fat during the study.

The dietary trajectories and intake of sugar, salt, and fat during the two years of monitoring are shown in **Table 2**. The dietary trajectories of sugar intake increased (62.3%), with the average intake at the beginning of the study from 23.9 g/day to 34.2 g/day (Table 2). However, subjects with sugar intake higher than the recommendation increased from 10.9% (n=15) to 22.9% (n=31) at the end of the study. The change in sugar intake increased significantly by 10.2 g for two years ($p<0.05$). The increase in sugar intake in the subjects was caused by an increase in the consumption of food sources of sugar in the subject, such as sweet food, sugar-sweetened beverages, and instant powder drink with added sugar. The average increase in sugar intake in female subjects was 11.44 g higher than in male subjects by 5.96 g during two years of monitoring. Women are 2.38 times more at risk of consuming more sugar than recommended (OR; 95% CI: 2.38; 2.33-2.44) (20).

The dietary trajectories of salt intake also increased (58.7%) (Table 2). The average total salt intake of the subjects during the two years of monitoring was 4.8 g/day. Research conducted by Li et al. in China also showed stable dietary trajectories of salt intake (21). The change in salt intake increased by 0.018 g during the two years of monitoring, even not statistically significant ($p>0.05$). Research subjects with hypertension tended to reduce salt intake by -0.3 g. Research conducted by Aburto et al. using data from a longitudinal study in China showed that the diagnosis of hypertension in adults would have an impact on reducing sodium intake by 251 mg/day (22). The dietary trajectories of fat intake were increased (65.9%) (Table 2). The average fat intake of the subjects also at the beginning of monitoring was 55.7 g/day increased significantly

to 66.4 g/day with an average increase of 10.7 g ($p<0.05$) for two years of monitoring. This result is in line with the study conducted by Shan et al. using data from the National Health and Nutrition Examination Survey Cycles (1999-2016) in adults (23). In this study, fat intake more than the recommendation (>67 g/day) increased from 28.3% (n=39) to 42.8% (n=59)—average fat intake of 89.7 g/day at the beginning of the study and 96 g/day at the end of the study, respectively. This increase was due to increased consumption and frequency of fat-sourced foods such as fried foods, meat, and processed products, especially beef (meatballs), at the end of the study.

Table 2. Intake of sugar, salt, and fat in obese adults during two years of monitoring

Data	Decreasing[1]		Increasing[2]		Beginning of study (g/day)	End of the study (g/day)	Changes (g)	*p-value*[5]
	n	%	n	%				
Sugar	52	37.7	86	62.3	23.9±18.4 (0-86.4)[3]	34.2±27.3 (0-136.3)[3]	+10.2[4]	0.000*
Salt	57	41.3	81	58.7	4.8±3.8 (0.7-30.6)[3]	4.8±4.9 (0.4-41.1)[3]	+0.02[4]	0.127
Fat	47	34.1	91	65.9	55.7±26.6 (7.7-147.8)[3]	66.4±34.5 (6-190.1)[3]	+10.7[4]	0.005*

[1]Decreased (Intake of sugar, salt and fat at the end of the study was lower than the median T2 intake at the beginning of the study, which is 20.7 g/day (sugar), 3.9 g/day (salt), and 49.3 g/day (fat)); [2]Increased (Intake of sugar, salt and fat at the end of the study intake was higher than the median T2 intake at the beginning of the study, which is 20.7 g/day (sugar), 3.9 g/day (salt), and 49.3 g/day (fat)); [3]Mean±SD (min-max); [4]Mean; [5]Wilcoxon test;*significant at $p<0.05$

The dietary trajectories of sugar, salt, and fat intake that tended to increase could be affected by the area of residence of the subject. The subjects in the research resided in Central Bogor District, located in the centre of Bogor City, so foods high in sugar, salt, and fat are easily accessible and affordable. Food choices in urban areas tended to be high in calories, salt, fat, and sugar and low in nutrients because these foods are easy to obtain, convenient, and affordable compared to rural areas (24).

Consumption of SSF food sources in this study is shown in Table 3. The largest increase sugar food sources was sweet food, sugar-sweetened beverages (SSB), and instant powder drinks (Table 3). The average consumption of sweet food showed an increase from 45.4 g/day to 85.7 g/day at the end of the study, with an average increase of 39.2 g over two years. The frequency of sweet food consumption also increased significantly (Δ: 4x/week; $p<0.05$). Sugar-sweetened beverages (SSB) increased from 200.5 ml/day to 210.4 ml/day at the end of the study. The average amount of sugar contained in sweetened drinks consumed by research subjects was 15.75 g or equal to 1.5 tbsp. According to the Liquid Consumption over 7 Days (Liq.In7) study, sugar-sweetened drinks contributed 8% or 227 mL to total fluid intake. (25).

Although the powder instant drink contains sugar with an average of 12 g/sachet, most subjects add sugar 10-15 g or 1-1.5 tablespoons during food preparation, which was also found in a study conducted by Sartika et al. related to SSBs (26). 65% of the Indonesian population consumes sweet foods/drinks every day, and there are modifications in food processing, such as adding sugar to food recipes (26,27).

Table 3. Intake of food sources of sugar, salt, and fat in subjects in two years of monitoring

Food Sources	Actual intake		Changes (∆)
	Beginning of study (g/day)[1]	End of the study (g/day)[1]	
Sugar			
Sweet food (g/day)	46.5	85.7	39.2
Sugar-sweetened beverage (ml/day)	200.5	210.4	9.9
Instant powder drink (g/day)	29.3	34.8	5.5
Salt			
Canned food (g/day)	27.5	46.7	19.2
Bread (g/day)	80.0	95	15
Soy sauce (g/day)	7.9	13.9	5.9
Fat			
Fried snack (g/day)	116.6	144.5	27.9
Cheese (g/day)	20.0	30.0	10.0
Lamb (g/day)	0.0	80.0	80.0

[1]Mean

DISCUSSIONS

The most significant increase in intake of food sources of salt is in canned food, white bread, and intake of soy sauce (Table 3). Canned sardines contain 177.1 mg to 637 mg of sodium, equivalent to ±2 g of salt (28). In the process of cooking canned food, the subject also adds salt or flavouring so that it could increase the subject's salt intake.

Bread is also a source of sodium (29). Bread is also a source of sodium. The average consumption of white bread subjects was about 2-3 pieces of bread, with a total sodium content of about 140 mg per slice. So, the average sodium intake from bread is around 280-420 mg or the equivalent of 0.7 -1.1 g of salt. Intake of white bread also increased by 15 g for two years. Soy sauce consumption in this study also increased from 7.9 g or half a tablespoon to 13 g or 1.5 tablespoons. In fact, 1 tablespoon of soy sauce contains 400 mg of sodium or 1 g of salt. The consumption of soy sauce was a contributory source of sodium which was usually consumed as a condiment in most food preparations or as an addition when consuming food. Taking the initiative to reduce the amount or portion of high-sodium foods was one of the best ways to reduce salt intake (30).

The most significant increase in intake of food sources of fat was fried foods, cheese, and lamb (Table 3). The increased amount and frequency of fried food intake (∆: 4x/weeks, $p<0.05$) was caused by the availability of abundant foods in the community due to the easy cooking process. Furthermore, fried food such as gorengan, are inexpensive, making them accessible to people at all socioeconomic levels, from the lowest to high middle classes. Customers may get three fritters (fried banana, sweet potato, and mixed veggies) for just IDR 2000, which they can serve as a side dish with rice. People can still purchase for a modest percentage even if they don't have much money. (31). 70.14% of the population aged >18 years regularly consume fried foods (32). Consumption of lamb also increased in this study.

Some individual consideration in consuming food is taste and price. Taste is the main attribute motivating the choice of food or snacks. Obese people are more receptive to exterior food cues and less responsive to internal hunger and satiety signals than normal-weight people. Thus, they can increase food consumption both in frequency and amount. In addition, price is a second choice when choosing snacks (33,34).

The advantages of this study were that it could explain the dietary trajectories of sugar, salt, and fat intake, especially in obese adults, and the longitudinal study design was appropriate to explain the dietary trajectories.

However, this research also has a weakness, such as the data analyzed only in two years of observation. In addition, food consumption data was only taken once a year, and the 24-hour food recall method is also at risk of under/overestimating.

CONCLUSIONS AND RECOMMENDATIONS

The majority of obese adults were women aged 35-44 years, with moderate education, working as domestic workers with low income (<Rp3 557 146). Most subjects had sufficient physical activity and good mental health and were non-smokers, but more than half of obese adults had high LDL levels.

There was an increasing change in the intake of sugar, salt, and fat significantly, especially in sugar and fat. Changes in sugar, salt, and fat intake in obese adults were 10.5 g ($p<0.05$), 0.02 g ($p>0.05$), and 10.7 g ($p<0.05$), respectively, for two years. Food sources of sugar, salt, and fat such as sweet food, sugar-sweetened beverages, powdered instant drink with added sugar, canned foods, soy sauce, fried foods, and meats also increased in obese adults.

Consumption of SSF food sources needs to be reduced in frequency and quantity. In addition, obese adults should regularly weigh themselves, read the nutritional information on processed foods and choose products with the lowest sugar, salt, and fat content to reduce sugar, salt, and fat intake. Strengthening Integrated Guidance Post for Non-communicable Disease (Posbindu PTM) and nutrition education is essential for the community. Therefore, they have a high awareness to start increasing diet quality. Further research is recommended to collect data from more than two monitoring points. Therefore, the diet trajectory is more representative..

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