Coffee consumption habits with the addition of added ingredients correlated with obesity among females students in Semarang

Kebiasaan asupan kopi dan bahan tambah kopi berhubungan dengan kejadian obesitas pada mahasiswi kesehatan di Semarang

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Abstract

Chemical compounds found in coffee are good for health, but most Indonesians often consume coffee with added ingredients, such as sugar and milk. Thus, it will potentially increase the risk of obesity. This study aimed to analyze coffee consumption habits with added ingredients and their correlation with the incidence of obesity among female students in Semarang. The research design was cross-sectional, with 77 female students randomly selected. This study was conducted from March to April 2021 in Semarang. All data collection process was conducted online. Data on coffee consumption habits, the kind of added ingredients, and the number of allowances were obtained through questionnaires. Furthermore, the food intake data were obtained from the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), physical activity data from the International Physical Activity Questionnaire Short Form (IPAQ-SF), and anthropometric data through self-anthropometric measurement guided by the researcher. Data were analyzed by the Chi-square test and multiple logistic regression test at a 95% CI. There was a relationship between coffee consumption habits and obesity according to the body mass index (p= 0,014), waist circumference (p= 0,001), and waist-hip ratio (p= 0,001). The multivariate analysis showed that the frequent consumption of coffee with added ingredients was correlated with the incidence of abdominal obesity based on waist circumference and waist-hip circumference ratio. It can be concluded that coffee consumption with added ingredients was correlated with the incidence of obesity.

Keywords: Coffee consumption, added ingredients, female students, obesity

Abstrak

Minuman kopi di Indonesia menjadi tren di masa ini. Zat yang dimiliki kopi baik untuk kesehatan, namun umumnya masyarakat di Indonesia mengasup kopi dengan menggunakan bahan tambah. Penelitian ini bertujuan untuk menganalisis hubungan kebiasaan asupan kopi dan bahan tambah kopi dengan kejadian obesitas pada mahasiswi kesehatan. Desain penelitian cross sectional dengan 77 sampel mahasiswi yang dipilih secara consecutive sampling. Seluruh pengambilan data berbasis daring. Data kebiasaan asupan kopi, bahan tambah, dan uang saku diperoleh dengan kuesioner, data asupan makan dengan Semi Quantitative Food Frequency Questionnaire (SQFFQ), data aktivitas fisik dengan International Physical Activity Questionnaire Short Form (IPAQ-SF), dan data antropometri dengan wawancara. Data dianalisis dengan uji Chi-

square dan uji regresi logistik ganda. Terdapat hubungan antara kebiasaan asupan kopi dengan kejadian obesitas berdasarkan indeks massa tubuh (p= 0,014), lingkar pinggang (p= 0,001) dan rasio lingkar pinggang-pinggul (p= 0,001). Uji multivariat menunjukan, asupan kopi sangat sering dan asupan bahan tambah sangat sering berpengaruh terhadap kejadian obesitas abdominal berdasarkan lingkar pinggang dan rasio lingkar pinggang-pinggul. Asupan kopi dengan bahan tambah kopi berhubungan dengan kejadian obesitas.

Kata Kunci: Abdominal, kopi, mahasiswi, obesitas

Introduction

Obesity is a state of excessive fat accumulation, a significant health problem in Indonesia, with increasing incidence every year. Of the Indonesian population aged 18 years and over, 13,60% were overweight, and 21,80% were obese. In addition, the prevalence of obesity cases mainly affected women. Moreover, around 31% of the Indonesian population aged 15 years and over has abdominal obesity (Kemenkes RI, 2018). Several factors may influence obesity, including external factors such as food and drink intake, physical activity, socioeconomic conditions, and internal factors such as gender. Gender can be a risk factor for obesity due to genetic susceptibility factors in women, which are more sensitive to fat accumulation (Link & Reue, 2017). Moreover, feelings and stress conditions may affect food intake among women (Li et al., 2017).

The increasing trend of per capita sugar consumption and decreasing physical activity assume significance, given the high tendency for Indians to develop abdominal adiposity. The increasing trend of per capita sugar consumption and decreasing physical activity assume significance, given the high tendency for Indians to develop abdominal adiposity. Multiple short-term studies find that sugar intake leads to the following adverse events, mostly through the accumulation of body fat (Johnson, 2007) and intra-abdominal fat (Stanhope, 2009). Moreover, the World Health Organization's expert panel recommended decreasing sugar intake to 5% of total calorie intake to tackle obesity (Gulati & Misra, 2014).

On the other hand, coffee is claimed to have nutrient substances that are good for human health, such as phenolic compounds, chlorogenic acid, and trigonelline, which can prevent obesity (Lee et al., 2019). In addition, coffee has caffeine that can increase body metabolism by accelerating energy expenditure and as an anti-obesity inhibiting adipogenesis (Harpaz et al., 2017; Rosa, 2017).

Caffeine has been reported to induce sympathetic nervous system hyperactivity, thereby accelerating energy consumption and body fat loss energy consumption and body fat loss energy consumption and body fat loss. In addition, after 16 weeks of caffeine intake, caffeine stimulated the breakdown of fat cells and the secretion of catecholamines to increase the oxidation and metabolism of fatty acids, which then inhibits body weight gain and fat accumulation in animals (Zheng et al., 2004).

Coffee is one of the widely consumed drinks in Indonesia. The ease of access to coffee drinks and various coffee variants increased coffee consumption in the community by 13.9% from 2018/2019 to 2019/2020 (Global Agricultural Information Network, 2019). Coffee drinkers are dominated by people aged 20-25 and usually work as employees or students. However, 82,25% of people often consume coffee with added ingredients, such as cappuccino, latte, mochaccino, and contemporary milk coffee variants (Toffin, 2020). In addition, the increasing trend of coffee consumption can also be due to different taste preferences and the effects of coffee that can improve physical performance awareness or prevent drowsiness and concentration (Harpaz et al., 2017; Rosa, 2017)

Coffee has caffeine as an anti-obesity via an adipogenesis inhibition mechanism (Harpaz et al., 2017; Rosa, 2017). However, another study shows that coffee intake can increase the incidence of obesity from the excessive use of added ingredients such as milk and sugar (Lee et al., 2017). One portion of instant coffee (12 grams) usually contains 5,7 grams of sugar; that is, sugar makes up about 50% of the ingredients of instant coffee. So additional calories from

coffee can contribute to body weight gain (Lee et al., 2012).

The correlation between coffee intake and health, especially in the incidence of obesity, is a widely studied topic. However, several studies have found that coffee intake can increase the incidence of obesity due to the use of some added ingredients, such as milk and sugar (Lee et al., 2017). Diversity in coffee consumption habits and preferences in the community can provide different results, especially for Indonesians who prefer to consume coffee with added ingredients. This study analyzed the correlation between coffee consumption habits with the addition of added ingredients with the incidence of obesity among female students in Semarang.

Methods

This study incorporated a cross-sectional design from March to April 2021. The independent variable in this study was coffee consumption habits, including the frequency of coffee consumption and the use of added ingredients. Confounding variables in this study were energy, carbohydrate, fat, protein, physical activity, and the number of allowances. Moreover, the dependent variables included the incidence of obesity based on body mass index (BMI), waist circumference, and waist-hip circumference ratio. A consecutive sampling technique was performed with the Cochran formula (1997) for sample calculation; p = 24,93% and q = 75,07% $(1-p)^9$ (Cochran, 1977). The sample calculation obtained 70 respondents as a minimum sample added with an estimated 10% drop-off. In total, 77 respondents were recruited based on the inclusion criteria, including the Faculty of Public Health and the Faculty of Medicine in Semarang City students who did not undergo a weight loss program, not smoking or consuming alcohol, and did not have serious illnesses.

This research was conducted online by completing a Google form and telephone interview. The research instruments include a personal data questionnaire, a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), a questionnaire on coffee consumption habits and added ingredients, and a questionnaire of the International Physical Activity Questionnaire Short-Form (IPAQ-SF). Data on respondents' coffee consumption, the number of allowances,

and physical activity were obtained from Google Forms completion. The coffee consumption data were analyzed using the frequency of coffee consumption and intake of added ingredients in a coffee drink. The coffee consumption habits frequency was categorized into three categories; infrequent or 1-4 cups/month; often or 2-6 cups/week; and very often or 1-3 cups/day. In this case, coffee consumption was defined as consuming coffee with various flavors and added ingredients.

Furthermore, the use of added ingredients in coffee was categorized into not using added ingredients, rarely or 1-4 cups/month, often or 2-6 cups/week, and very often or 1-3 cups/day. In addition, the added ingredients used in coffee drinks include sugar, liquid milk, sweetened condensed milk, powdered milk, creamer, and palm sugar (Bouchard et al., 2010). Physical activity was analyzed using the International Physical Activity Questionnaire Short-Form (IPAQ-SF), which recorded physical activity during the last seven days. The results of physical activity assessments were categorized into two; low activity was defined as inactive or the measurement value <600 MET (Metabolic Equivalent of Task) in minutes per week, and moderate-high activity was defined as active, or the measurement value600 MET (Hagströmer et al., 2006). Student allowances for one month were categorized into low (< IDR. 1,000,000) and high (IDR. 1,000,000).

Food intake and anthropometric data were obtained from telephone interviews using food photo books and pictures of anthropometric measurement instructions. Food intake was analyzed using the Nutrisurvey™ application and categorized into not excessive (<120% RDA) and excessive (≥120% RDA) based on the 2019 Nutritional Adequacy Rate. Food intake data, in this case, was food and drink intake other than coffee and added ingredients used while having a coffee drink (WNPG, 2014). Anthropometric data measurement was performed by the respondents (self-measured) and guided by the researcher using the pictures of anthropometric measurement instructions. Anthropometric data include body weight, height, waist circumference, and hip circumference. In addition, anthropometric data were analyzed using waist-to-hip circumference ratio and categorized as not at risk for obesity and

metabolic syndrome (ratio <0,95) and at risk for obesity and metabolic syndrome (ratio ≥ 0,95) (WHO, 2011).

      Univariate analysis was performed to describe the independent, confounding, and dependent variables in percentage. Bivariate analysis was performed to determine the relationship between variables using the Chi-Square test. Bivariate analysis was performed to determine the relationship between variables using the Chi-Square test. Bivariate analysis was analyzed using the Pearson Chi-Square test, used if there was an expected frequency of <5% or less than 20% (Santoso, 2018). Finally, a multivariate analysis using multiple logistic regression was performed to analyze the variables that have the most influence on the incidence of obesity based on body mass index (BMI), waist circumference, and waist-to-hip circumference ratio adjusted for physical activity, number of allowances, energy intake, carbohydrate intake, protein intake, and fat intake. All univariate, bivariate, and multivariate analyzes were performed using SPSS™ for Windows Version 25,0. The significance used was $p<0,05$. The Health Research Ethics Committee of Sultan Agung Islamic University, Semarang granted the research permission and ethical feasibility, with letter number 55.

Result and Discussion

This study was conducted on 77 female students, analyzing their coffee consumption habits and the incidence of obesity based on BMI, waist circumference, and waist-to-hip circumference ratio. The respondent's characteristics are presented in Table 1.

      The incidence of obesity based on the body mass index (BMI) indicator was higher (32,5%) compared to the incidence of obesity based on the waist circumference indicator (27,3%) and the waist-to-hip circumference ratio (28,6%). Most of the respondents' coffee consumption habits were categorized as infrequent or 1-4 cups/month (44,2%), with added ingredients consumption categorized as rare (54,5%). Although most of the total caloric, carbohydrate, and protein intake was not excessive, the fat intake exceeded the recommended needs (51,9%). These results can be seen in Table 1.

Table 1. Respondent's characteristics, coffee consumption habits, added ingredients, and food intake

Characteristics	n	%
Physical activity		
Not active (< 600 MET)	12	15,6
Active (≥600 MET)	65	84,4
Allowances		
Low (< IDR. 1.000.000)	49	63,6
High (≥ IDR. 1.000.000)	28	36,4
Body Mass Index		
Non-obese (< 23,0)	52	67,5
Obese (≥23,0)	25	32,5
Waist circumference		
Non-abdominal obese (≤ 80,0 cm)	56	72,7
Abdominal obese (> 80,0 cm)	21	27,3
Waist-to-hip circumference ratio		
Not at risk (< 0,95)	55	71,4
At risk (≥ 0,95)	22	286
Coffee consumption habits		
Infrequent (1-4 cups/month)	34	44,1
Often (2-6 cups/week)	33	42,9
Very often (1-3 glasses/day)	10	13,0
Add ingredients while drinking coffee		
Never	10	13,0
Infrequent (1-4 cups/month)	42	54,5
Often (2-6 cups/week)	19	24,7
Very often (1-3 glasses/day)	6	7,8
Energy intake		
Not excessive (< 120%)	65	84,4
Excessive (≥ 120%)	12	15,6
Carbohydrate intake		
Not excessive (< 120%)	62	80,5
Excessive (≥ 120%)	15	19,5
Protein intake		
Not excessive (< 120%)	48	62,3
Excessive (≥ 120%)	29	37,7
Fat intake		
Not excessive (< 120%)	37	48,1
Excessive (≥ 120%)	40	51,9

MET: the metabolic equivalent of task

      Table 1 shows that 80% of respondents have coffee consumption habits categorized as a regular frequency or 1 cup/day. Similarly, the consumption of added ingredients in coffee was also categorized as persistent frequency (≥1 time/day).

      There was a significant correlation between coffee consumption habits and the incidence of obesity based on the respondent's BMI ($p<0,05$). Table 1 showed that the prevalence of obesity in respondents who have coffee consumption habits with a persistent

frequency (70,0%) was higher than in respondents with a frequent (21,2%) and rare frequency (32,3%). In addition, the prevalence of abdominal obesity in respondents who consumed coffee with a persistent frequency (80,0%) was higher than in respondents who drank coffee frequently (15,1%) and rarely (23,6%).

Several studies found similar results to this study, where coffee consumption habits of more than three times a day can increase the incidence of obesity (Alfawaz et al., 2020; Kim & Park, 2017; Lee et al., 2017; Nordestgaard et al., 2015). However, several other studies also found that coffee consumption habits were not associated with the incidence of obesity (Koyama et al., 2020; Larsen et al., 2018). Nevertheless, a study conducted in Japan involving 3539 respondents, 2300 women, showed that coffee consumption could reduce visceral body fat, the incidence of obesity, and metabolic syndrome (Koyama et al., 2020). Furthermore, a cross-sectional population-based survey of 8.821 adults has shown that those who had higher coffee consumption (3 or more cups/day ∼ 150 ml/cup) had lower BMI, waist circumference, systolic and diastolic blood pressure than those who had drunk less than 1 cup/day (Grosso et al., 2015).

Analysis of the relationship between coffee consumption habits and the incidence of abdominal obesity showed a significant correlation ($p<0,05$). Also, a correlation analysis between coffee consumption habits and the incidence of obesity based on the waist-hip circumference ratio showed a significant relationship ($p<0,05$). In this study, the risk of abdominal obesity based on waist circumference and waist-to-hip circumference ratio increased along with the use of added ingredients in coffee drinks with a regular frequency compared to coffee drinkers who did not use added ingredients. The incidence of obesity based on waist-hip circumference ratio in respondents with very frequent coffee consumption habits (80,0%) was higher than the incidence of obesity in respondents with frequent (24,2%) and infrequent (17%) categories. Coffee consumption habits analyzed in this study include coffee consumption with the addition of various flavors of added ingredients and these results can be seen in Table 2.

Table 2. Relationship of coffee consumption habits with obesity incidence based on waist-to-hip circumference ratio

Predictor Variables	Waist-to-hip Circumference Ratio (cm)		
	Non-Obese (%)	Obese (%)	*p*
Very often	2 (20,0)	8 (80,0)	
Often	25 (75,8)	8 (24,2)	0,001
Infrequent	28 (82,4)	6 (17,6)	

[a] Pearson Chi-square test
Significance (p<0,05 shown in bold)
OR and lower-upper values can't be calculated because the table is not 2x2

Coffee drinkers' waist circumference and waist-to-hip circumference ratio were greater than non-coffee drinkers. This was because, in this study, most respondents used added ingredients in their coffee drinks. People who consume 3-in-1 coffee or coffee with added sugar, milk, and creamer more than once a day have a larger waist circumference than respondents who consume 3-in-1 coffee less than one time a day (Kim & Shin, 2019). Adding added ingredients in coffee drinks correlates to an increase in energy intake. For example, one instant coffee consumed by respondents generally had a sugar content of ±13 grams or equivalent to ±52 calories. Moreover, one serving of vanilla latte coffee at a well-known coffee shop has a sugar content of 35,3 grams, equivalent to 141,2 calories. The consumption of added sugar in vanilla lattes reached 70,6%, referring to Indonesian Ministry of Health Regulations 30, 2013 (Permenkes Nomor 30 Tahun 2013 Tentang Pencantuman Informasi Kandungan Gula, Garam, Dan Lemak Serta Pesan Kesehatan Untuk Pangan Olahan Dan Pangan Saji, 2013).

Added ingredients used in coffee drinks include dairy products, granulated sugar, and palm sugar. This process is mediated by lipoprotein lipase activation when fructose is consumed in excessive amounts and combined with glucose, then co-ingested as high fructose corn syrup (Hieronimus et al., 2020; Tchernof & Després, 2013). Fructose also increases fat deposition in visceral adipose tissue by activating intracellular glucocorticoids (Jiantao et al., 2017). Sweetened condensed milk and table sugar also contain high sucrose. Diets high in sucrose do not always induce obesity but can be one of the factors causing abdominal obesity

by inducing triglyceride synthesis, which is then stored as adipose tissue (Jankiewicz et al., 2015; Oliveira et al., 2014). Another study on mice induced with high sucrose (HS) diet for 20 weeks showed that the HS diet had increased visceral adipose tissue without increasing body weight (Cao et al., 2012).

Table 3. Odd ratio of coffee consumption habits with obesity incidence based waist-to-hip circumference ratio

Variables	Waist-to-hip Circumference Ratio (cm)		
	OR	CI 95%	p
Often consume coffee	0,040	0,018-98,004	0,360
Very often consume coffee	4,305	1,040-5,919	0,009*
Infrequent adding added ingredients	0,063	0,003-1,489	0,085
Often adding added ingredients	0,641	0,077-5,321	0,088
Very often adding added ingredients	7,621	1,040-9,875	0,007*
Calory intake	2,592	0,468-38,451	0,131
Carbohydrate intake	1,193	1,082-10,821	0,962

*Significance $p<0,05$

Excessive fructose consumption cannot be separated from excessive sugar or sucrose intake because sucrose is a disaccharide containing glucose and fructose (Almatsier, 2015). Consumption of more than 25% fructose of daily energy needs, equivalent to 85 grams or 6,5 tablespoons of fructose, has other health effects, such as hypertriglyceridemia and insulin resistance. Therefore, it is recommended to consume less than 85 grams of fructose per day (Prahastuti, 2011). Fruits generally contain 5-10% fructose from their net weight, honey contains around 21-43% of fructose from its net weight, and granulated sugar generally contains 50% of its net weight (Bobiş et al., 2018; Prahastuti, 2011). Therefore, it is concluded that adding 13 grams per serving of sugar (sucrose) to coffee drinks is equivalent to one tablespoon of sugar, which contains 6,5 grams of fructose per serving. Milk generally contains lactose, a dairy product often considered not to cause weight gain. This is because calcium in milk can reduce lipogenesis and stimulate lipolysis, and casein in milk can reduce appetite (Chen et al., 2012). The composition of milk with flavoring and sugar has the same composition as milk without flavoring and sugar. Still, milk contains flavoring, and sugar contributes 60 calories than milk without flavoring and sugar. Therefore, this product deserves special attention (Dougkas et al., 2019). Furthermore, adding milk to coffee drinks can reduce 1/3 of the antioxidant content. It is because chlorogenic acid interacts with proteins in milk, such as catechins (Niseteo et al., 2012).

The variables included in the multivariate analysis to analyze the most influential variables on the incidence of obesity based on BMI, waist circumference, and waist-to-hip circumference ratio were $p<0,25$ in the bivariate analysis; coffee consumption habits, added ingredients, caloric intake, and carbohydrate intake. The multivariate analysis showed that no variable influences coffee consumption habits and the incidence of obesity based on BMI ($p> 0,05$). The multivariate analysis of the dependent variable showed that persistent coffee consumption habits and the addition of added ingredients in coffee were the variables that had the most influence on the incidence of obesity based on waist circumference measurement ($p<0,05$). Subjects with very often coffee-drinking habits have a 1,392 times greater risk of experiencing abdominal obesity (95% CI: 1,385-156,500) than respondents with infrequent coffee-drinking habits. In addition, subjects who often consume coffee with added ingredients have 8,713 times greater abdominal obesity risks (95%CI: 8,044-43,609) than respondents who did not drink coffee with added ingredients. Persistent coffee consumption habits and adding added ingredients influenced the incidence of obesity the most based on the waist-to-hip circumference ratio ($p<0,05$). Subjects with frequent coffee-drinking habits have a 4,305 times greater risk of becoming obese based on the waist-to-hip circumference ratio (95%CI: 1,040-1,987) than respondents who infrequently drink coffee. Moreover, subjects who consume coffee with added ingredients have 7,621 times

higher risks for obesity based on waist-to-hip circumference ratio (95%CI: 1,040-7,875) than those who did not consume coffee with added ingredients. Besides the increased risk of abdominal obesity due to coffee consumption, the compounds found in coffee, such as caffeine, melanoid, chlorogenic acid, and serotonin, have antioxidant substances that potentially prevent cancer, cardiovascular disease, and diabetes mellitus and also provide a protective effect on liver cells (Buscemi et al., 2016; Farah, 2018). Coffee has beneficial compounds which have a good effect on human health. Still, coffee consumption using added ingredients such as sugar, sweetened condensed milk, and palm sugar has various adverse effects on health, such as obesity. Therefore, coffee consumption with added ingredients has raised a concern.

The strength of this study includes analyzing the frequency of coffee consumption habits with the use of added ingredients. This study also looks closely at several variables, including food intake, physical activity, and the number of allowances. Therefore, this study can analyze other variables that may affect the incidence of obesity in coffee drinkers. The limitations of this study include the online data collection method, which has potential bias. In addition, the coffee consumption habits and the use of added ingredients were not quantitatively analyzed. Also, the coffee consumption data analysis only covers the overall coffee consumption without considering various serving variations and the type of added ingredients. The Nutrisurvey™ application also has limitations in analyzing the respondent's consumption, creating a possibility of bias in the intake analysis. Finally, this study was cross-sectional, and determining the causal relationship between obesity incidence based on coffee consumption habits was difficult.

Conclusion

Coffee consumption is good for health, but consuming coffee with added ingredients is associated with obesity based on BMI, waist circumference, and waist-to-hip circumference ratio measurement. The risk of abdominal obesity increases with the use of added ingredients in coffee one time per day. Coffee products containing added ingredients are widely circulated in the market.

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