

Fast food consumption, obesity and nutrient intake among adults in Indonesia

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Abstract

Asian countries, including Indonesia, have experienced a significant shift in their diet with increased fast food consumption spurred by rapid economic expansion, urbanisation and social changes. Increasing mortality and morbidity following obesity and noncommunicable diseases have been linked to an imbalanced nutrient intake. This study assessed the pattern of fast food consumption with overweight, obesity and nutrient intake of Indonesian adults. Three hundred eighty-five participants were conveniently recruited; completed a questionnaire encompassing socio-demographics, the pattern of fast food consumption and nutritional status. Also, participants' anthropometric measurements were obtained. Some participants were overweight (27.5%) and obese (8.6%). Fast food was widely consumed by both genders; males (95%) and females (98%). Fast food consumption rate was significantly associated ($p < 0.01$) with marital status, education level and monthly income. Married individuals (54%), those with post-graduate education (68%), and higher-income earners (62%) consumed more fast food when eating out. There was no significant association between fast food consumption rate and anthropometric parameters, including obesity. However, fast food consumption rate, number of daily meals replaced with fast food was significantly associated ($p < 0.05$) with increased calorie intake and fat intake. This growing tendency of energy-dense food consumption may increase the risk of obesity in the long run, putting people at risk for various noncommunicable diseases. The prevalence of overweight and obesity may be reduced by promoting an active lifestyle, creating a supportive environment for voluntary physical activity and restricting high-energy food consumption.

1. Introduction

Rapid advancements in the socioeconomic standing of many Asian countries have significantly altered communal lifestyles, including eating and food consumption patterns. Globalisation changes the structure of the current system's structure, bringing the domestic economy closer to the global economy by enhancing the absorption of labour, incomes and general prosperity (Kennedy, 2004). Social and cultural influences are changing how the younger generations "taste" food, affecting everything from food choices to eating habits, becoming increasingly westernised (Yeti *et al.*, 2018). Jakarta has experienced one of the highest rates of growth among metropolitan regions in the area over the past 20 years. It has exceptionally high densities compared to other cities in Indonesia and Southeast Asia

(World Bank, 2016). Reduced expenditure shares for staple foods and increased expenditure shares for meat, eggs, milk, packaged and prepared meals, soft drinks and cooking oils were some changes in food acquisitions as reported by a longitudinal investigation on dietary change in urban Indonesia (Colozza and Avendano, 2019). Popkin (2006) refers to these changes as "nutrition transitions", the shift from a traditional diet and way of life to one that is more "westernised" or universal, typically alongside the change from an agricultural-dominant to a dominant industrial economy.

The WHO has identified overweight and obesity as the biggest chronic health issue since it has spread like a global pandemic. Genetic, socioeconomic, behavioural and environmental factors, contribute to obesity (Blüher,

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2019). Obesity often results from an imbalance in energy intake and expenditure. A positive energy balance occurs in a sedentary lifestyle with the consumption of food high in fat and carbohydrates (Hu, 2003). It was evident that Indonesians are shifting their food intake pattern to high energy density foods (Baker and Friel, 2014), frequently defying dietary guidelines from their health authorities (Usfar and Fahmida, 2011). For decades, fast food has been the primary diet of urban Indonesians (Sari, 2008). Fast food, defined as convenient food purchased through self-service or take out establishment, was postulated to be a significant dietary factor for the rising prevalence of obesity and type 2 diabetes due to its strong positive relations with weight gain and insulin resistance (Binkley *et al.*, 2000; French *et al.*, 2000; Pereira *et al.*, 2005). Fast food typically contains adequate nutritional density for protein and carbohydrates but is high in calories, total fats, saturated fats and cholesterol. They may have some vitamins but is low in calcium, vitamins C and A and fibre (Lin and Guthrie, 2012). Several issues are implicated in consuming fast food, such as its huge serving sizes that frequently surpass one's requirements; its palatability that emphasise primordial preferences for sugar, salt and fat; its high energy density; and high glycaemic load (Prentice and Jebb, 2003).

Over the past few decades, fast food consumption (FFC) has significantly increased as international fast food chains mushroomed across cities and countries (Abdullah *et al.*, 2015; Xue *et al.*, 2016). Additionally, children and teenagers prefer fast food more because of its accessibility, flavour and marketing strategies (Demory-Luce, 2005; Saha *et al.*, 2022). An Indonesian study found that 59.5% of students at a health institution had a propensity to eat fast food, while another local study reported more than 80% of high school students exhibited fast food eating habits (Al-Insyirah, 2016; Hidayati *et al.*, 2019). However, there was no correlation between adolescents' knowledge level and FFC (Fatikhani and Setiawan, 2019). These findings evidenced that fast food eating is ingrained in the younger Indonesian as their way of life.

Despite recognising the risk factors of overweight and obesity, the extent and degree of the correlation between factors may differ depending on the locality and population. Currently, there is a lack of research to determine the relationship between FFC and socio-demographic in Indonesia. It is essential to halt the impending increase of obesity and prevent further widening health disparities. Hence, this study aimed to assess the pattern of FFC with overweight, obesity and nutrient intake of Indonesian adults.

2. Materials and methods

2.1 Study design

Participants were recruited according to convenient sampling in this cross-sectional survey. Indonesian healthy respondents aged 18–60 was gathered from public places in Jakarta, the capital of Indonesia. Individuals who had a history of any chronic disease such as cardiovascular disease, diabetes, hypertension or stroke were excluded. Based on a population estimate of 6,000,000 people between the ages of 18 and 60 in the city of Jakarta (BPS-Statistics of DKI Jakarta Province, 2018) for finite population correction and a 27% obesity prevalence among Indonesian adults (Balitbangkes Kemenkes RI, 2018b), the minimum required sample size was found to be 303 individuals. Four hundred participants were recruited, however fifteen respondents got omitted due to incomplete response. A written informed consent was sought from each respondent prior to their enrolment into the study. Ethical approval for this study was granted by the Health Research Ethics Committee, National Institute of Health Research and Development, Ministry of Health Indonesia (LB.02.01/2/KE054/2018). The methodology complied with relevant institutional, national and international guidelines and legislation.

2.2 Questionnaires

Respondents were subjected to self-administered questionnaires modified from previous study which consisted of socio-demographic data, FFC and preference (Kumar *et al.*, 2012) along with a validated questionnaire, namely the Food Frequency Questionnaire (FFQ) (National Cancer Institute and NIH US, 2020).

2.3 Anthropometric measurements

Participants' weight (kg), height (m) and waist circumference (cm) were measured using a standard medical weighing scale and measuring tape, respectively. BMI (kg/m^2) was calculated and classified into four categories of underweight, normal, overweight and obese according to WHO's Asian criteria of BMI. The Asian criteria of BMI definitions are: BMI $< 18.5 \text{ kg}/\text{m}^2$ as underweight; BMI 18.5 to 23 kg/m^2 as normal; BMI 23.1 to 27.5 kg/m^2 as overweight; and BMI $> 27.5 \text{ kg}/\text{m}^2$ as obese (WHO, 2000).

2.4 Data and statistical analysis

For food frequency questionnaire (FFQ), data was analysed via Nutritionist Pro software version 6.2 (Axxya Systems, USA). Data from the instruments were then transferred to Statistical Package for the Social Sciences (SPSS) software, version 26 (IBM, USA). All statistical analysis was performed using SPSS. Pearson's

Chi-square test was used to analyse the association for socio-demographics and FFC rate and preference. ANOVA *F*-test was used for the analysis of association between anthropometric measurements and nutrient intake with FFC. Factors considered to have significant association if *p* value is less than 0.05.

3. Results

3.1 Participants' socio-demographic and fast food consumption

There were 256 female respondents (66.5%) and 129 male respondents (33.5%) among the 385 total respondents. More than half of the respondents were married (68.3%), while 31.6% were single and four of them were widows or widowers. In terms of ethnicity, most respondents were Javanese (52.5%), 17.4% were Betawi and 15.6% were Sundanese. The average age of respondents is 36.67 years old with a mean income of 11.773 million IDR.

The prevalence of FFC was 95% for males and 98% for females. FFC rate was significantly associated ($p < 0.05$) with marital status, education level and monthly income (Table 1). There were 5% of males and 2% of females reportedly did not consume fast food while 5% of male and 7% of female respondents always consume fast food. More respondents who were unmarried (14%)

eat fast food on a regular basis (always) than those who were married (2%). Respondents with a primary and secondary level of education possessed larger percentages (18% and 12%, respectively) than those with a higher educational degree level (2-7%) consuming fast food on a consistent basis (always). Similarly, low-income (<1 million IDR) respondents had the highest proportion (15%) of always consuming fast food. Conversely, just 1% of respondents with a middle-income (5-10 million IDR) reported a regular consumption of fast food.

Respondents who reported eating fast food were then asked how many daily meals they replaced with fast food. The number of daily meals substituted by fast food was significantly associated ($p < 0.05$) with marital status, ethnicity, educational level and monthly income (Table 1). Single people (17%) and Betawi ethnic people (21%) were more likely to substitute fast food for more than two daily meals. Fast food was commonly used as a substitute for two or more daily meals by lower-educated (primary and secondary level) respondents. Moreover, lower income groups (<5 million IDR) tend to substitute more meals with fast food.

On the other hand, 35 respondents (9.1%) admittedly consume fast food five days or more per week. The high consumption was significantly associated ($p < 0.05$) with

Table 1. Association between sociodemographic and fast-food consumption.

Sociodemographic	Fast food consumption (FFC) rate (%)				Daily meals replaced with fast food (%)			
	Always	Sometimes	No	<i>p</i> value ^a	One	Two	>Two	<i>p</i> value ^a
Gender								
Male	5	90	5	0.27	85	11	4	0.48
Female	7	91	2		84	9	7	
Marital status								
Single	14	86	0	<0.01**	70	13	17	<0.01**
Married	2	93	5		91	8	1	
Ethnicity								
Javanese	6	89	5	0.25	90	8	2	<0.01**
Betawi	6	91	3		63	16	21	
Sundanese	10	90	0		88	5	7	
Education level								
Primary	18	82	0	<0.01**	82	0	18	<0.01**
Secondary	12	84	4		67	17	16	
Diploma	7	82	11		82	18	0	
Undergraduate	2	96	2		94	5	1	
Post-graduate	4	96	0		100	0	0	
Monthly income								
< 1 million IDR	15	82	3	<0.01**	68	10	22	<0.01**
1 - 5 million IDR	9	89	2		80	13	7	
5 - 10 million IDR	1	99	0		86	14	0	
10 - 20 million IDR	2	93	5		98	2	0	
≥ 20 million IDR	3	91	6		91	9	0	

^aPearson's Chi-square test

***p* value < 0.01

marital status, ethnicity, education level and monthly income. More single respondents (16%) than married respondents (6%) consume fast food more than five days a week. Moreover, 21% of Indonesian of ethnic Betawi had such high consumption rate compared to Javanese (6%) and Sundanese (7%). Post-graduate educated respondent (21%) and lowest income group of <1 million IDR (16%) had the highest percentage of consuming fast food 5 times or more a week.

3.2 Pattern of fast food consumption

Fried chicken was the most preferred type of fast food by 60.8% respondents, followed by pizza (54.3%) and French fries (48.8%). Soda beverages, on the other hand, were the least favourite fast food, garnering only 15.3% of respondents' interest. Sandwich ranked second last least popular food as it was only favoured by 20% respondents.

When all types of fast food were considered, gender was shown to be significantly associated ($p<0.05$) with ice cream preference. In comparison to their male counterpart (46.5%), 66% of female respondents preferred ice cream. The findings also showed that ethnicity was significantly associated ($p<0.05$) with the preference for nugget, fried chicken, pizza, French fries, doughnuts and ice cream. Other ethnicities preferred nugget (54.6%), whereas Sundanese did not (8.2%). There was higher proportion of people from other ethnicities that preferred fried chicken (80.0%), pizza (76.4%), French fries (72.8%) and doughnut (34.5%). Ice cream is the most popular among Betawi people (53.8%), whereas pizza (11.9%) and doughnuts (29.9%) are the least popular.

Educational level was found to be significantly associated ($p<0.05$) with fast food preferences, namely for steak, fried chicken, pizza, spaghetti, French fries and doughnut. Tertiary educated respondents (diploma, graduate and postgraduate) (87%) were more likely to consume steak than primary and secondary educated respondents (13%). Similarly, among highly educated respondents, fried chicken, pizza, spaghetti, French fries and doughnuts were more popular. In addition, the respondents' income was significantly associated ($p<0.05$) with their preference for all types of fast food except burgers and sandwiches. Steak, pizza and spaghetti were preferred by high-income respondents over other fast food options such as nuggets, fried chicken, French fries, sandwiches, doughnuts, soda and ice cream.

3.3 Increase in fast food consumption

According to the findings, largest proportion of

respondents (48.8%) reported an increase in FFC when they are not at home, while 33.2% reported no increase and 17.9% were unsure. There were 36 respondents (9.4%) reported increasing their daily FFC. Table 2 reveals that there was a significant association ($p<0.05$) of the increased FFC with marital status, ethnicity, education level and monthly income. When married people left the house, they were found to be more likely to increase their FFC. Furthermore, higher wealth and education level were significantly associated ($p<0.05$) to higher daily FFC or FFC when out of home. In comparison, more single people (13%) than married people (8%) reported an increase in FFC within a day.

3.4 Relationship between fast food consumption and anthropometric measurements

Table 3 shows the relationship between FFC and anthropometric measurements. FFC rate was found to have no significant association with weight and waist circumference. Interestingly, the number of meals substituted with fast food had been found to be significantly associated ($p<0.05$) albeit negatively with weight. Moreover, the waist circumference had been determined to have significant negative association ($p<0.05$) with increased FFC when out of home and consumption of fast food for 5 days or more per week, while both weight and waist circumference was significantly associated ($p<0.01$) negatively with increased daily FFC. The data inferred that respondents with lighter weight and smaller waist circumference tend to consume more fast food.

BMI was computed from height and weight measurements of respondent. According to the BMI Asian standard criteria, 27.5% of the respondents were classified as overweight, 8.6% as obese and the remaining 55.6% as normal in this study. It was found to be negatively associated ($p<0.05$) with increased daily FFC and increased FFC when out of home (Table 4). No significant relationships were found between BMI and FFC rate, number of daily meals substituted with fast food and FFC of 5 days or more in a week. Those who agreed on having greater FFC when out of house had a higher proportion (60.6%) of normal BMI, while only 25% were overweight and 7.4% were obese, compared to those who disagreed with the statement (45.3%, 38.3% and 8.6%, respectively).

3.5 Association between fast food consumption and nutrient intake

The effect of FFC on nutrient intake according to the daily intake of protein, carbohydrate, fat and calories were assessed. The mean number of calories, carbohydrate and fat intake among fast food consumers

Table 2. Association between sociodemographic and increased fast-food consumption.

Sociodemographic	Increased FFC when out of home (%)				Increased daily FFC (%)			
	Yes	No	Cannot Say	<i>p</i> value ^a	One	Two	>Two	<i>p</i> value ^a
Gender								
Male	44	38	18	0.34	5	83	12	0.15
Female	51	31	18		11	76	13	
Marital status								
Single	38	28	34	<0.01**	13	64	23	<0.01**
Married	54	35	11		8	84	8	
Ethnicity								
Javanese	49	33	19	<0.01**	7	83	10	<0.01**
Betawi	40	31	28		9	64	27	
Sundanese	42	42	17		10	83	7	
Education level								
Primary	18	45	36	<0.01**	0	64	36	<0.01**
Secondary	23	44	33		10	65	25	
Diploma	44	47	9		11	84	4	
Undergraduate	64	24	11		9	86	6	
Post-graduate	68	21	11		14	75	11	
Monthly income								
< 1 million IDR	12	52	36	<0.01**	7	63	30	<0.01**
1 - 5 million IDR	49	28	22		11	76	13	
5 - 10 million IDR	59	28	13		11	76	13	
10 - 20 million IDR	59	33	8		2	97	2	
≥ 20 million IDR	62	27	11		14	81	5	

^aPearson's Chi-square test***p* value <0.01

Table 4. Relationship between BMI and FFC.

Fast food consumption (FFC)	Anthropometric measurement		
	Weight (kg)	<i>p</i> value ^a	Waist circumference (cm)
FFC rate			
Always	58.25	0.47	70.25
Sometime	60.86		71.16
No	62.15		70.08
Daily meals replaced with fast food			
One	61.42	<0.01**	71.48
Two	58.32		69.51
>Two	54.68		67.54
Increased FFC when out of home			
Yes	60.94	0.06	72.34
No	61.9		70.62
Cannot say	58.04		68.45
Increased daily FFC			
Yes	59.83	<0.01**	71.53
No	61.77		71.72
Can't say	54.94		66.65
FFC in 5 days or more per week			
Yes	58.34	0.31	68.46
No	60.89		71.09
Cannot say	62.63		75.47

^aANOVA F-test**p* value <0.05***p* value <0.01

were increased and significantly associated with the increase of FFC rate. Moreover, the increment of meals substituted with fast food had been demonstrated to positively associated with the increase of calories, protein and fat intake. The nutrient intake exhibited no significant association with the increased of FFC when out of home and increase of daily FFC. Despite that, there is still an increasing trend of mean nutrient intake observed correlated to both variables. On the other hand, high FFC of 5 days per week or more exhibited significant association ($p < 0.05$) with an increase in protein and fat ingestion. The findings and association between FFC and nutrient intake were summarized in Table 5.

4. Discussion

The purpose of this study was to describe the relationship between the pattern, demographics and frequency of FFC with obesity in a diverse adult Indonesian population living in Jakarta. According to the findings of the 2018 National Health Research (Riskesdas), the prevalence of obesity in adults in Indonesia grew from 14.8% in 2013 to 21.8% in 2018. Among Indonesians, the prevalence of overweight and obesity in those over the age of 18 was 27% (Balitbangkes Kemenkes RI, 2018b). In the Jakarta Province, 29.8% of adults over the age of 18 were obese.

This number was higher than the national average (Balitbangkes Kemenkes RI, 2018a). The data corresponded to the findings from this study where it was recorded a slight increase in the prevalence of overweight and obesity whereby 27.5% of the respondents were overweight and 8.6% of them were obese. In one study focusing on adolescent girls and two other studies examining adults, urban residence was positively associated with the likelihood of developing overweight or obesity (Rachmi et al., 2017). Adult obesity in Indonesia was also linked to higher overall food expenditures as well as higher consumption of meat and dairy products (Roemling and Qaim, 2012).

From the findings, the prevalence of FFC was 95% for males and 98% for females. The majority of Indonesians living in cities consumed fast food (Sari, 2008). The results saw a higher FFC compared to prior study done in Malaysia, which revealed that 84.5% of respondents bought and consumed fast food (Habib et al., 2011). Diet study in Jakarta revealed that 60.27% of the people aged 3 years and above consumed fast food 1–6 times a week with 6.32% consumed more than once per day. The study also found that 39.41% of Jakarta people consumed fatty foods, 36.43% consumed sweet foods and 25.49% consume salty foods at a frequency of at least once per day or more (Balitbangkes Kemenkes RI, 2018a). A longitudinal analysis on dietary change in

Table 5. Association between FFC and nutrient intake.

Fast food consumption (FFC)	Mean nutrient intake							
	Calories (kJ)	p value ^a	Protein (g)	p value ^a	Carbohydrate (g)	p value ^a	Fat (g)	p value ^a
FFC rate								
Always	2873.04		129.33		318.42		117.63	
Sometime	2525.85	0.04*	115.65	0.56	295.28	0.04*	101.26	0.04*
No	2417.85		109.23		286.08		97.54	
Daily meals replaced with fast food								
One	2494.58		111.90		294.90		98.83	
Two	2724.00	0.01*	135.46	<0.01 **	298.95	0.27	114.22	<0.01**
>Two	2970.82		148.95		314.55		131.14	
Increased FFC when out of home								
Yes	2555.89		113.63		302.96		101.06	
No	2503.91	0.77	115.89	0.51	289.94	0.08	100.73	0.53
Can't say	2585.12		124.25		290.55		107.78	
Increased daily FFC								
Yes	2685.64		116.69		308.75		108.36	
No	2513.38	0.36	114.33	0.39	295.50	0.36	100.46	0.39
Can't say	2628.54		128.21		292.85		108.15	
FFC in 5 days or more per week								
Yes	2821.00		145.34		300.63		122.31	
No	2519.06	0.10	113.58	0.02*	296.49	0.70	100.19	0.03*
Can't say	2465.11		109.89		287.26		99.26	

^aANOVA F-test

* p value <0.05

** p value <0.01

urban Indonesia had revealed several changes in food acquisitions that are consistent with the nutrition transition theory in urban Indonesia, including reduced expenditure shares for staple foods and greater shares for meat, eggs, milk, packaged and prepared foods, soft beverages and cooking oils (Colozza and Avendano, 2019). They also discovered that relocating especially to Jakarta is connected to a shift away from conventional diets. These include more spending on ready-made foods, reduced spending on self-produced food and rice (Colozza and Avendano, 2019).

The findings revealed that lower income group had significantly associated with greater consumption rate of fast food, with more individuals reported always consuming fast food or had more daily meals replaced with fast food. Similar pattern had been observed in industrialised countries where lower income individuals tend to have higher intake of highly processed and fast food (Prentice and Jebb, 2003; Bowman and Vinyard, 2004; Pereira et al., 2005; Duffey et al., 2007). Fast food's low price and perceived value may have appealed to low-income consumers' price sensitivity and influenced how frequently these outlets are used (Drewnowski and Specter, 2004; Drewnowski, 2009; Burgoine et al., 2018). Residents of Jakarta's underprivileged neighbourhoods were shown to frequently shop at establishments that sell calorie-dense foods of subpar nutritional value (Anggraini et al., 2016). Contrasting pattern was observed in socio-demographic characteristics linked to reported increasing daily FFC and increased FFC when away from home. Individuals with higher income level were found to be inclined to increase FFC when they left home.

This study demonstrated that increase of daily FFC and FFC away from home had inverse relationship with weight, waist circumference and BMI. Similar findings to current study had been reported whereby people who consumed fast food three or more times per week had significantly lower BMI compared to those who visited fast food restaurants two or less times per week whereas there was no significant correlation between fast food intake and BMI in females (French et al., 2001). Association between dietary intake habits and weight status vary depending on the type of restaurant (Larson et al., 2011). Those who frequently eat at full-service restaurants, may have higher intakes of vegetables (Larson et al., 2011). While sandwich shop and full-service restaurant use were unrelated to weight status, those who frequently eat at sandwich shops may have higher total energy, total fat, saturated fat and sodium intakes (Larson et al., 2011). Having said that, a systemic review of 28 studies suggested the behaviour of eating out frequently was associated with weight gain

(Bezerra et al., 2012). Eating out had been associated with men's BMI increased by 0.93 kg/m² and women's BMI increased by 1.24 kg/m² (Binkley et al., 2000; Kuchler and Lin, 2002; Duffey et al., 2007; Bezerra et al., 2012). Weight gain was mainly due to out-of-home food typically has a high energy content, going out may considerably increase one's intake of calories, which may lead to obesity (Guthrie et al., 2002; Orfanos et al., 2007; Choi et al., 2019). The connections are limited to causal inference since weight increase is a time-dependent variable and they could be impacted by the reverse causation effect, in which obese persons may consume fast food less frequently in an effort to reduce their calorie intake while non-overweight person might continue to enjoy fast food (Bezerra et al., 2012).

The analysis did not find significant association between FFC rate or meal substitution with fast food and weight, waist circumference or BMI. Studies indicate that fast food can increase BMI by up to 1.12 kg/m² for men and 1.55 kg/m² for women (Binkley et al., 2000; Kuchler and Lin, 2002; Duffey et al., 2007). A study on 3031 young adults over 15 years revealed that baseline FFC, after adjustment for lifestyle factors, was directly linked to the increase of BMI (Pereira et al., 2005). Duffey et al. (2007) followed 3394 young adults for three years in a similar manner. Throughout the trial, 40% of the sample increased their weekly FFC and experienced an average 0.16-unit rise in BMI at follow-up, with all other variables held constant. However, multiple cross-sectional studies had demonstrated inconsistent associations between consuming fast food frequently, increased energy intake and being overweight or obese in terms of BMI. A study in Iran reported FFC was associated with abdominal obesity based on waist-hip ratio but not general obesity based on BMI (Mohammadbeigi et al., 2018). In contrast, a study found a significant association between BMI with adults who visit fast food outlets once or more each week, however no association between FFC and BMI was found in 1 year follow-up (Jeffery and French, 1998). In addition, there was no statistically significant correlation between FFC and BMI in a cross-sectional study of 1092 transit workers (French et al., 2007). Results from observational studies have yet been able to prove that FFC causes weight gain or obesity. As several confounding factors, such as inactivity and less restrained eating, are independently related with both FFC and overweight or obesity, it is challenging to determine the direct causal relationship between FFC and weight gain or obesity. The results of observational study designs will therefore always be distorted by residual confounding from immeasurable lifestyle choices (Rosenheck, 2008).

In this study, frequency of FFC and more meals substituted with fast food was associated with higher fat and energy intake. Findings from this study corresponded to the findings from a systemic review that suggested a strong correlation between increased FFC and increased calorie intake, while making them far more prone to weight gain and obesity, even though a causal relationship cannot be determined (Rosenheck, 2008). Study in the US found that eating fast food significantly increased calorie and fat intake among 4344 undergraduates (French *et al.*, 2001). A randomized intervention trial on weight gain prevention was performed on women 20-45 years old shown that frequent FFC was linked to higher overall energy consumption, due to higher energy coming from fat and higher body weight. Over the course of the three-year study period, adding one fast food meal per week was linked to an increase in 234.4 kJ per day, 0.6% of fat energy per day and a weight gain of 0.72 kg (French *et al.*, 2000). These findings suggest that frequent FFC could be a risk factor for excess weight gain over time. The period of follow-up study is crucial to take into consideration because weight gain or obesity may be time-dependent, it may be necessary to provide sufficient time for weight changes to be observable (Jeffery and French, 1998). Pereira *et al.* (2005) documented the longest study available of 15 years and concluded that those who frequently consume fast food gained 4.5 kg more body weight than those who did so infrequently. Therefore, further longitudinal prospective study on this subject on Indonesian population is envisaged.

Thus far, the most convincing and comprehensive theory for fast food linked obesity was the high energy density of fast food, which causes increased calorie consumption and, ultimately, weight gain or obesity (Prentice and Jebb, 2003; Ebbeling *et al.*, 2004; Isganaitis and Lustig, 2005). It was demonstrated that Indonesians were switching to high energy density foods (Baker and Friel, 2014) and dietary advice is often not followed (Usfar and Fahmida, 2011). Average energy densities of fast food were found to be 1167, 1087 and 1054 kJ/ 100 g for three fast food establishments, with typical individual fast food items having energy densities of more than 900 kJ/100 g (Prentice and Jebb, 2003). Additionally, human being was known to lack of the ability to distinguish foods that are high in energy and regulate the amount of food accordingly (Stender *et al.*, 2007). When individuals were given a diet with a tripled energy density, the total energy intake was still found to be increased by 50%, demonstrating insufficient voluntary compensation (Rolls *et al.*, 1999). Fast food feeding trial of 26 overweight and 28 lean teenagers documented increased calories intake regardless of body type. While overweight teenagers were more likely to

overeat, they were also less likely to make the necessary adjustments to their caloric intake after the trial compared to lean participants (Ebbeling *et al.*, 2004). Thus, it is extremely challenging for people to stay under the average recommended dietary intake given the high energy densities per fast food meal.

Some people may overreport low consumption and underreport high intake to emulate a healthy diet; as a result, the meal frequency assessment may have been impacted by social desirability bias (Krumpal, 2013). This might have caused the underestimated association. Although observational studies may not be able to demonstrate a causal link between FFC and obesity, they are nonetheless required because experimental investigations on FFC may raise ethical concerns. This study is essential for establishing research and intervention priorities, as well as guiding Indonesian policies and programmes at all levels of government. A further cohort study examining potential confounding variables such as levels of physical activity and sedentary behaviour may shed light on factors causing this discrepancy that could help efforts to reduce FFC or promote healthier fast food options.

5. Conclusion

Although no significant association between FFC and obesity was found, most Indonesians are discovered to consume more fast food on a regular basis and this trend is expected to continue. Changes in their eating patterns result in increased energy intake, but inadequate micronutrient intake, low fibre, high glycaemic load and excessive portion size, causing many to exceed daily energy requirements. This growing tendency of energy-dense food consumption may increase the risk of obesity in the long run, putting people at risk for a variety of noncommunicable diseases. The prevalence of overweight and obesity may be reduced through the promotion of an active lifestyle, the creation of a supportive environment for voluntary physical activity, the restriction of high energy food consumption.

Conflict of interest

The authors declare no conflict of interest.

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