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The Effect of Snack Consumption on Body Mass Index and Body Fat Percentage in Students During the COVID-19 Pandemic

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Abstract

Introduction: Coronavirus disease 2019 (COVID-19) is an infectious disease caused by SARS-CoV-2 and has been declared a pandemic by the World Health Organization (WHO). To reduce transmission, the government has announced several policies encouraging working from home, resulting in increased snack consumption. This may lead to increased calorie intake and risk of obesity, making it necessary to identify the effects on young adults who require balanced nutrition. This study aims to understand whether healthy and unhealthy snack consumption influences body mass index and body fat percentage in pre-clinical students at Atma Jaya Catholic University of Indonesia during the COVID-19 pandemic.

Methods: A total of 76 pre-clinical students from Atma Jaya Catholic University of Indonesia participated in this cross-sectional study conducted during the pandemic. Data was collected using anthropometric measurements, a Snacks-Food Frequency questionnaire, and body fat scales. Chi-square analysis was performed using Statistical Package for the Social Sciences (SPSS).

Results: Of the participants, 52.9% were female, 42.9% had a normal body mass index, 48.6% had a normal body fat percentage, 52.9% rarely ate healthy snacks, and 51.4% often ate unhealthy snacks. Statistical calculations revealed significant effects of unhealthy snack consumption on body mass index (p=0.033) and body fat percentage (p=0.013).

Conclusions: This study found that unhealthy snack consumption had significant effects on body mass index and body fat percentage in pre-clinical students at Atma Jaya Catholic University of Indonesia during the COVID-19 pandemic.

Keywords: young adult - COVID-19 - snack consumptions - fat mass - S-FFQ - body mass index

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by SARS-CoV-2 and has been declared a pandemic by the World Health Organization (WHO). To reduce transmission, the government has announced several policies that encourage working from home, leading to longer snack times. [2,3]

Unfortunately, the majority of food consumed during snack time is unhealthy and high in fat

and calories, such as fast food and snacks. Excessive calorie intake can have a negative impact on health and can cause various complications, including obesity, dyslipidemia, heart attack, diabetes mellitus, stroke, and other health issues, which can subsequently lead to increased morbidity and mortality.[4] According to Sitoayu et al., high-fat food consumption such as coconut milk and fried food, can increase body mass index and lead to overweight or obesity.[5] In order to prevent obesity and promote good health, it is crucial to have a balanced diet that provides adequate calories and nutrients.

Calorie intake was calculated based on the frequency and the number of calories in a single serving of food. An increase in the frequency and total calorie intake, especially caused by snacks, can lead to an increase in fat mass and body mass index.[6,7]

Snacks were defined as food consumed between two mealtimes.[8] According to Mondelēz International's Annual State of Snacking report, 9 out of 10 adults consumed more snacks during the pandemic than before.[9] Therefore, this study aims to investigate whether snack consumption has an impact on body mass index and body fat percentage in university students. Due to difficulties in calculating the number of snacks consumed during working from home, calorie intake was not counted in this study. The study targeted university students because young adults require adequate and balanced nutrition.[10,11] The subjects were chosen using a sampling method to obtain data that represents the general population of university students during the COVID-19 pandemic.

METHODS

Study Design

This study utilized a cross-sectional design, and data was collected between April and October 2022.

Subject and Sampling Method

The study included a total of 70 participants aged between 18 and 21 years old, who were selected using stratified random sampling. The inclusion criteria required participants to be active university students within the age range, willing to provide informed consent, and agreeable to having their body weight, height, and body fat percentage measured. The Snacks-Food Frequency Questionnaire was used to collect information on the types and frequency of snacks consumed by the participants. To ensure the questionnaire matched the available snacks in Indonesia, it was validated and evaluated by adjusting the snack composition. The questionnaire was distributed online using Google Forms. Participants who were currently on a diet program or had chronic digestive disorders were excluded from the study

Data Collection

This research obtained ethical approval from the ethical review committee of the School of

Medicine and Health Sciences, Atma Jaya Catholic University of Indonesia, on March 30th, 2022, with the number 09/03/KEP-FKIKUAJ/2022. We also obtained approval from each respondent in the form of informed consent before filling out the research questionnaire and measuring their body fat percentage, body weight, and height.

Statistical Analysis

Statistical analysis was conducted using SPSS program version 25 with chi-square analysis to determine the correlation between the dependent and independent variables. A p-value of <0.05 indicated a correlation between snack consumption, body mass index, and body fat percentage.

RESULTS

The characteristics of the study subjects are presented in Table 1, which includes three factors: gender, frequency of healthy snack consumption, and frequency of unhealthy snack consumption. The results indicate that the majority of the subjects were female (52.9%), and both male and female participants rarely consumed healthy snacks (52.9%), while frequently consuming unhealthy snacks (51.4%).

Respondent's characteristics were then tested to be correlated with body fat percentage and body mass index.

Table 1. Respondent Characteristics

No.		n	(%)
	Subject Characteristics		
1	**Gender**		
	Male	33	47.1
	Female	37	52.9
2	**Frequency of Healthy Snack Consumption**		
	Never	0	0.0
	Rarely	37	52.9
	Often	33	47.1
3	**Frequency of Unhealthy Snack Consumption**		
	Never	0	0.0
	Rarely	34	48.6
	Often	36	51.4

Most subjects had a normal body mass index (42.9%). Body mass index was calculated by directly measuring subjects' body weight and height. In this study, body mass index was classified using the Asia Pacific classification.

Most subjects had a normal body fat percentage (48.6%), which was calculated using body fat monitoring. The classification used in this study was based on the study by Maffeton et al.[12]

Table 2. Respondent's Body Mass Index

Body Mass Index	n	(%)
Underweight	7	10.0
Normal	30	42.9
Overweight	15	21.4
Obese	18	25.7
TOTAL	70	100

Table 3. Respondent's Body Fat Percentage

Body Fat Percentage	n	(%)
Low	3	4.3
Normal	34	48.6
High	33	47.1
TOTAL	70	100

The result shows that the subject's frequency of unhealthy snack consumption correlates with their body mass index (p=0.033) and body fat percentage (p=0.013), while the subject's frequency of healthy snack consumption does not correlate with the same dependent variables (p=0.241; p=0.090).

Table 4. Correlation Between Frequency of Healthy and Unhealthy Snack Consumption with Body Mass Index

Variable	Body Mass Index				Total	p-value
	Underweight (%)	Normal (%)	Overweight (%)	Obese (%)		
Frequency of Healthy Snack Consumption						
Never	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0	0.241
Rarely	3 (8.1)	13 (35.1)	8 (21.6)	13 (35.1)	37	
Often	4 (12.1)	17 (51.5)	7 (21.2)	5 (15.2)	33	
Frequency of Unhealthy Snack Consumption						
Never	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0	**0.033***
Rarely	3 (8.8)	11 (32.4)	6 (17.6)	14 (41.2)	34	
Often	4 (11.1)	19 (52.8)	9 (25.0)	4 (11.1)	36	
Total					70	

Table 5. Correlation Between Frequency of Healthy and Unhealthy Snack Consumption with Body Fat Percentage

Variable	Body Fat Percentage			Total	p-value
	Low (%)	Normal (%)	High (%)		
Frequency of Healthy Snack Consumption					
Never	0 (0.0)	0 (0.0)	0 (0.0)	0	
Rarely	0 (0.0)	18 (48.6)	19 (51.4)	37	0.090
Often	3 (9.1)	16 (48.5)	14 (42.4)	33	
Frequency of Unhealthy Snack Consumption					
Never	0 (0.0)	0 (0.0)	0 (0.0)	0	
Rarely	0 (0.0)	17 (50.0)	17 (50.0)	34	**0.013***
Often	3 (8.3)	17 (47.2)	16 (44.4)	36	
Total				70	

DISCUSSION

This study analyzed three factors that may be associated with the subject's body mass index and body fat percentage during the COVID-19 pandemic: gender and the frequency of healthy and unhealthy snack consumption. Study conducted by Mehmood Y et al., shows majority of medical university student were in the age of 19 and 25 years old.[13] Similar findings on the prevalence of obesity and overweight in Indian university students within the age range of 18 to 24, particularly among those aged 18 to 20 (65.1%), were also reported by Manojan KK et al.[14] This tendency was not only observed in other countries but was also seen in Indonesia. Nura EV et al. conducted a similar study involving students in Semarang, with an average age of 18.45 years old.[15] It is concluded that this tendency occurs because most people enter university when they are still young adults.

Gender is the first factor discussed in this study. As demonstrated in Table 1, the number of female participants is higher compared to male participants. Previous studies have noted that females are more inclined than males to pursue higher education, as exemplified by Rahman MA et al.'s research on body mass index in Bangladesh's university students, which revealed that the majority of subjects were female (67.6%).[16] Comparable results were observed in investigations carried out by Jha RK

et al. and Mehmood Y et al.[13,17,] and also in a study conducted by Vikawati NE et al. in Indonesia.[15]

Based on the information above, it can be deduced that the tendency was found not only in Indonesia but also in other countries as well. This may be related to another factor that could be associated with female dominance in higher education.

We found a few factors that contribute to the dominance of female students in higher education which were the low socioeconomic and linguistic capacity of cognitive function. Another study also showed that families with only one child would focus more on that child's education, regardless of gender.[18,19]

Different outcomes are shown by Uunk W et al. According to this study, the proportion of male and female university students is equal, and have the same chance of entering the university. However, there is a tendency for females to choose medical study programs more than males, which leads to data polarization and a tendency for one gender to predominate in a certain study program.[20] Therefore, discussing whether any fundamental differences between male and female individuals contribute to female dominance in this research is important.

The second factor is snack consumption. Based on a valid snacks food frequency questionnaire, this study classified snacks into two categories: healthy snacks and unhealthy snacks. We changed healthy and unhealthy snacks into snacks often consumed in Indonesia to reduce bias since the questionnaire primarily serves snacks list from European countries, which are different from Indonesia.

As shown in Table 1, most subjects rarely consumed healthy snacks (52.9%) and often consumed unhealthy snacks (51.4%). These findings were consistent with previous studies. Aljefree NM et al. found that the majority of university students in Jeddah, Saudi Arabia consumed high-calorie meals and snacks three to four times per day.[21] The same findings from Mithra P et al. conducted in India also show the same results, in which the majority of the subject had the habit of snacking in their spare time.[22]

This issue concerned the researchers because snacking tends to increase the subject's risk of imbalances in nutrition. A study by Adelina R et al. that focused on student nutrition intervention in Malang found that subjects tended to consume snacks with high amounts of carbs, sodium, and calories more frequently during the pandemic than before. Moreover, this study found that the incidence of overweight decreased after individuals received healthy dietary interventions.[23] Therefore, it is concluded that healthy and unhealthy snack consumption plays a significant role in abnormal nutritional status, making it necessary to provide interventions and improve the subjects' nutritional status.

The reason for the relatively high snack consumption is closely related to the subjects' taste and sensory perception. Feyzabadi VY et al. found that this is the main factor in Iranian young adult subjects (prevalence ratio (PRR): 1.18; 95% CI = 1.09 – 1.27).[24] These results are in line with the study by Liem DG et al., which found that overweight and obesity would increase as a result of the subjects' preference for tasty food that is also satisfying to the senses.[25]

Based on Table 2, 30 out of 70 subjects who participated in this study had a normal body mass index (42.7%). This number did not differ from other studies with the same characteristics conducted in Malaysia, Nepal, and Indonesia. The subjects' body mass index is expected to increase during the pandemic due to the decrease in physical activity. This will likely increase the risk of excessive nutritional intake and the incidence of obesity in the subjects.[17, 26, 27]

Vijayan V et al. also reported similar results, stating that the majority of medical university students in Kerala, India had a normal body mass index (53.9%). This study aimed to assess how lifestyle factors, such as dietary habits and physical activity, affect body mass index.[28] Another study by Lisetyaningrum I et al. found that subjects with high snack consumption and nutritional intake tended to be overweight or obese later in life (p<0.05).[29] Additionally, several studies have reported a significant increase in the proportion of individuals with overweight and obese body mass index during the pandemic, primarily due to decreased physical activity and increased food intake. This shows a shift towards a sedentary lifestyle and an increasing prevalence of malnutrition, particularly in students.[30,31]

This study shows that 21.4% of the subjects are overweight, and 25.7% are obese. This number has significantly increased compared to previous data before the pandemic. In 2015-2017, obesity rates ranged from 4.5% to 12%.[32-34] Considering these previous studies, we found a significant increase in the incidence of obesity in the same population during the pandemic compared to before the pandemic.

Subsequently, we also evaluate body fat percentage as another parameter. Based on Table 3, it is concluded that 34 out of 70 subjects had normal body fat percentages. This parameter is crucial to assess because if the subjects were shown to have a high body fat percentage, malnutrition with overweight and obesity would be described more accurately. However, researchers have not yet come across many studies that examined students' body fat percentage during the pandemic. This will likely happen since monitoring nutritional status using body mass index is far less expensive. Nonetheless, there is proof that body mass index positively correlates with body fat percentage. This is reported by a study from Putri SE et al.[35]

Based on the studies mentioned above, researcher found that there is a variety of subjects with overweight and obese body mass index around the world. We also found that some factors, such as the sampling method, will likely cause these disparities. Several studies use the purposive sampling method, while others use random sampling. Probability sampling certainly had more strength than non-probability sampling. [36] Furthermore, it is found that there are variations in how each research presents the nutritional condition of the subject. Different classification concerns researcher because they might differ subject's data distribution. Nevertheless, body mass index classifications based on WHO or Asia Pacific are valid and reliable.

Table 4 and Table 5 show correlations between the frequency of healthy and unhealthy snack consumption with body mass index and body fat percentage. Based on Table 4 and Table 5. it is concluded that healthy snack consumption was not a factor that correlated to body mass index and body fat percentage (p=0.241; p=0.090). We found this likely to occur because subject consumed healthy and unhealthy snacks simultaneously. Healthy snacks are defined as snacks with low calories and high nutrition, in contrast to unhealthy snacks. Each individual snack proportion might vary, which might be one reason for insignificant results in this study. Moreover, there were only 6 types of healthy snacks on this questionnaire's list, compared to 22 types of unhealthy snacks. This tends to lead the subject to choose unhealthy snacks. The small amount of healthy snacks on the list might be biased because subjects are likelier to have never eaten any of those healthy snacks.

This study does not analyze about the subject's daily snack intake. Snacks food frequency questionnaire was a questionnaire with the risk of recall bias. One of this questionnaire's weaknesses is its high recall bias because subjects are likelier to forget or pseudo-memory about snacks they eat. Then, each snack differs from other snacks. For example, one type of chocolate from one company is more likely to have different composition than another chocolate from another company. Moreover, total snack intake was not measured specifically; it would also increase recall bias. This statement was supported by Naska A et al. from their study, who found that each consumption method or nutrition from dietary histories, food frequency questionnaire, 24–hour dietary recalls had high recall bias. This study even suggests using nutritional biomarkers to raise the effectiveness of nutritional intake.[37]

Some studies state that healthy snacks contribute to increased abnormal nutritional status. Adelina R et al. report that shifting consumption from unhealthy to healthy snacks reduces the prevalence of overweight and obese university students.[23] Fernandez MA et al. specifically reports that yogurt and fruits

included in healthy snacks which have high nutrition, such as protein, unsaturated fat, vitamin, calcium, and other nutrients, which can reduce metabolic disorder such as dyslipidemia, metabolic syndrome, type 2 diabetes mellitus.[38–40]

Another factor that has been evaluated is the frequency of unhealthy snack consumption. Table 4 and Table 5 show that unhealthy snack consumption correlates with body mass index and body fat percentage (p=0.033; p=0.013). This study indicated that participants with overweight and obesity preferred to consume more unhealthy snacks (high in calories) than those with normal body mass index, which is consistent with a study by Trippichio GL et al. that involved young adults in the United States.[41] The study results by Rubinska AS et al. are also in line. This study determines that consuming unhealthy snacks is associated with gaining weight and that a number of variables, including insufficient physical activities and excessive stress levels, play a role.[42] Therefore, Robinson E et al. explain the importance of reducing calorie intake from unhealthy snacks, using different social and health aspects to reduce obesity incidence.[43]

The significant result in this study was certainly affected by other factors, which we did not analyze, such as the total number of snacks consumed each snack time, the correlation between healthy and unhealthy snack consumption, and the subject's level of physical activity. As was previously mentioned, one of the factors that adversely correlates with body mass index and body fat percentage is physical activity.

Although some studies show similar findings, the study by Bindu A et al. shows different findings. This study found no significant correlation between snack consumption and obesity in the same population.[14] These are likely to happen because of unspecific snacks definition. This study discusses that snacks include fast food, chocolate, sweets, and carbonated drinks. Also, there is no consideration of healthy snacks that the subject might consume.[14] Previous studies have shown that healthy snacks also correlate as a protective factor among obesity in subjects.[23] To pinpoint the outcomes of this study, it is crucial to analyze the intake of healthy and unhealthy snacks specifically.

CONCLUSIONS

Unhealthy snack consumption significantly affects students' body mass index and body fat percentage during the COVID-19 pandemic. Further study is needed to evaluate other factors that might correlate to body mass index and body fat percentage, such as physical activity and total calorie intake per day.

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CONFLICT OF INTEREST

There is no conflict of interest from any related parties in this study.

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