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Relationship between Use of Food Delivery Applications, Fat Intake, Physical Activity and Weight Status among Students

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ABSTRACT

This study aimed to determine the relationship between food delivery app usage, fat intake, physical activity, and the overweight status of students at public high school in Jakarta. The cross-sectional study involved 77 students from grades X and XI. The frequency of food delivery was grouped into ≥3 times/ week or less. Types of food were grouped into light or heavy meals. Physical activity was measured using IPAQ-SF (International Physical Activity Questionnaire - Short Form) and fat intake using SQ FFQ (Semi-Quantitative - Food Frequency Questionnaire). Fat intake was grouped into sufficient and excess category. Physical activity was grouped into low and sufficient category. Chi-square analysis found that there is a significant correlation between overweight status and frequency of food delivery application usage ($p<0.001$). However, there is no significant correlation between overweight status with the type of food ordered ($p=0.467$) as well as the amount of food ordered ($p=0.655$). On the other hand, fat intake showed a significant association with overweight status in adolescents ($p<0.001$). A significant association was also found between physical activity and overweight ($p<0.05$). This study showed that the adolescents' use of food delivery applications, fat intake, and physical activity have a significant correlation with their overweight status. However, the type and amount of food ordered did not show a significant correlation. Despite the insight offered, the study was small and limited in one school hence generalization of findings is limited. Thus, a larger study with diverse subjects is needed.

Keywords: fat intake, food delivery application, overweight status, physical activity

INTRODUCTION

Malnutrition is becoming one of the severe problems that occur in many countries. Based on data from the 2018 National Basic Health Research Survey (Riskesdas), the prevalence of overweight and obesity among adolescents aged 16–18 years in Indonesia is 13.5%. Adolescents in Jakarta Province with body weight status of overweight reach 12.8% and are obese get 8.3% (MoH RI 2018a). In South Jakarta, adolescents with the body weight status of overweight reached 14.52%, and the body weight status of obesity reached 7.32% (MoH RI 2018b).

In general, being overweight is caused by an imbalance between energy intake from macronutrients (carbohydrates, fats, and protein) and energy expenditure. One of the things that affect energy balance is diet (Yahya 2020). Along with the times, access to get food is now easier. It can change food patterns, especially in urban areas.

Changes in food patterns in urban areas are generally caused by technological advances that provide convenience in accessing food. An online food delivery application is one piece of evidence of technological developments that are widely used to access food in urban areas. This food delivery application provides a lot of calorie-dense foods like junk food which contributes 37% of fat to daily nutritional needs (Nuzulla 2022). The trend of ordering food through applications makes it easy for consumers to order food without leaving their homes. Access to food and various payment methods are why many people use this service. Another advantage of this service is discounts and cheaper than cash payments (Suryadi & Ilyas 2018). Based on the results of a Statista survey, there will be 19.1 million consumers using online food delivery platforms in Indonesia in 2020 (Statista 2023a).

The ease of access to food causes a decrease in physical activity. Currently, most teenagers feel

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too lazy to do exercise at home (Supardan 2021). Low physical activity is one of the risk factors for being overweight because physical activity can carry out the process of burning energy. If the energy that comes out of the body can be adjusted to the energy that goes into the body, it can keep body weight within normal limits.

METHODS

Design, location, and time

This study uses a cross-sectional research design. The independent variables examined are food delivery application usage, fat intake, and physical activity. The dependent variable examined is overweight status. This study was conducted from March to April 2022 at SMAN (Sekolah Menengah Atas Negeri) 63 Jakarta. Ethical approval was obtained from the Ethics Commission for Health Research at UPN Veteran Jakarta with the number 65/IV/2023/KEPK.

Sampling

The population in this study was students of SMAN 63 Jakarta. The minimum total sample for this study calculated using sample size calculation for comparison two proportion resulted in 77 respondents (P1=0.675, P2=0.426) (Ramayanti 2020). Sample selection followed the Stratified Random Sampling technique. This sampling technique aims to obtain a representative sample by looking at the population from each grade level. Sampling using this method is carried out by dividing the population into 2 grades, there is grade X and XI. From grade X which consists of 6 classes (A–F), there are 5 to 6 people are taken randomly from each class, totaling up to 38 students as samples. From grade XI which consists of 6 classes (A–F), there are 6 to 7 people were taken randomly from each class, totaling up to 39 students as samples. The selected random sample from each class were chosen based on the student numbers in random order and then combined it into one sample. The sample inclusion criteria were students aged 16–18 years and having a food delivery application. The sample exclusion criteria were students who were sick so data collection could not be carried out.

Data collection

The primary data collection was obtained using several questionnaires as well as anthropometric assessment. The structured questionnaires included socio-demographic characteristics and food delivery application usage. The food delivery application usage contain questions on frequency of usage categorized into ≥3 times/week or less and list of food ordered which then categorized into light or heavy meals. In addition, we also collected data on Body Mass Index (BMI), fat intake and physical activities. BMI for age was obtained from height and weight measurement using digital scale and microtoise which then plotted on the WHO BMI for age 5–19 years old. Body weight is categorized normal if the z-score value is in the range -2 SD to 1 SD. Body weight is categorized overweight if the z-score value is >2 SD (WHO 2023).

Fat intake data was obtained using the SQ-FFQ (Semi-Quantitative - Food Frequency Questionnaire). SQ-FFQ is a table form that contains several high-fat foods that respondents often ordered in the past one month. This list was obtained from the results of a market survey regarding the food available in the application. Respondents can choose the amount and the number of times they consume these foods in past one month and the results of fat intake from the ordered food will be categorized into sufficient and excess category (Sari 2018).

Physical activity was obtained using the IPAQ-SF (International Physical Activity Questionnaire – Short Form). This questionnaire contains questions regarding the type of activity, duration of implementation, and frequency of a person doing physical activity in the last 7 days. Physical activity is calculated by multiplying the score of an activity by the minutes performed and categorized into low and sufficient activities (IPAQ 2005).

Data analysis

This study conducted univariate, bivariate, and multivariate analyses using IBM SPSS Statistics 25 software to determine the relationship between food delivery app usage, fat intake, and physical activity with overweight status. Univariate analysis described the distribution of respondents' characteristics, body weight status, food delivery app usage, fat intake, and physical activity. Bivariate analysis determined the relationship between the aforementioned factors using Chi-Square with significance cut off <0.05.

Multivariate analysis predicts the tendency for overweight students to occur based on the same factors using the Logistic Regression test.

RESULTS AND DISCUSSION

There was a total of 77 students participating in this study where the majority of them aged 16 years old 67.5%, followed by 26% of those aged 17, and 6.5% of those aged 18 years old (Table 1). Most respondents are girls (63.3%) (Table 1). Findings showed that majority of the students are having normal body weight status 70.1% and 29.9% of them are overweight. Although this result is similar to previous research by Murti (2017) which showed that most high school students in DKI Jakarta had normal body weight. Our study highlighted that the proportion of students in our study site who are overweight was almost double from the national prevalence and higher than the prevalence in the South Jakarta region where the school is located.

Various factors, including food consumption and physical activity, can influence body weight status. Consumption of nutrients must be balanced with sufficient physical activity (Widiastuti & Widiyaningsih 2023). Most of the respondents had normal body weight status might be because of their fat intake was in the sufficient category and balanced with sufficient physical activity (Jayanti & Novananda 2017) while in our study, excessive fat intake might also explains this high prevalence of overweight problem.

Based on Table 2, more than half of respondents used the food delivery application three times a week or more as much as 54.5% and only 45.5% respondents used the food delivery application less than three times a week. Most of the respondents ordered heavy meals (54.5%) and 35 respondents (45.5%) ordered light meals. In this study, heavy food category is defined as the staple foods, vegetables, and side dishes, such as rice and fried chicken, fried rice, chicken noodles, egg omelette, and others. While light meals are snacks such as ice cream, boba drinks, milk coffee, cireng (fried tapioca snacks), and others. Most respondents ordered food in small quantities (68.8%), and 24 respondents (31.2%) ordered food in large quantities. This category is divided based on the average number of food orders at one time, where more than two portions order were categorized into small quantity order.

The habit of ordering food via food delivery application among younger generation in urban area is a phenomenon that is growing in globally in Asia. Almansour *et al.* (2020) study showed that as many as 242 (87%) youth in Kuwait aged <20 years had used the food delivery application. A survey conducted in the US also showed that 40% of them had actively used food delivery applications in the last 90 days (Zion 2019). An Indian study showed that customers considered ease of use and convenience as a main driver for this behavior (Ray *et al.* 2019). While study in Indonesia also showed that positive attitude toward the app itself and the previous experience

Table 1. Respondents' characteristics distribution

General characteristics	n	%
Age		
16 years	52	67.5
17 years	20	26
18 years	5	6.5
Gender		
Boy	28	36.4
Girl	49	63.3
Nutritional status (Body mass index for age)		
Normal	54	70.1
Overweight	23	29.9

Table 2. Respondents' food delivery applications usage distribution

General characteristics	n	%
Frequency of food delivery applications usage		
Rarely (<3 times per week)	35	45.5
Frequent (≥3 times per week)	42	54.5
Type of food ordered		
Heavy meals	42	54.5
Light meals	35	45.5
Amount of food ordered		
Small quantities (order<average*)	53	68.8
Large quantities (order≥average*)	24	31.2

*: The average amount of orders=2 portions

have been the mediating factor for continued use (Wiastuti *et al.* 2022).

Based on Table 3, majority of the respondents as much as 70.1% consume fat according to the recommended intake while 29.9% respondents are having excessive fat intake coming from their online food. This study's results align with research previously conducted, which showed that 82.5% of students had sufficient fat intake (Yanti *et al.* 2021). Various study showed that the proportion of adolescents who has high fat consumption in Indonesia were vary ranging from 17.5% based on Florens *et al.* (2022), up to 24.3% in high school student in Bandung, West Java based on Putri (2019).

Most of the respondents in this study had sufficient fat intake from the food they ordered online because the amount of food ordered by the respondents was in a small category. However, this might not reflect the bigger picture of their overall fat intake from food eaten outside the online ordered food. But the fact that almost one third of all students surveyed in our study were consuming excessive amount of fat from their online food orders might help explain the high proportion of students with overweight problem in this study.

Based on the physical activity assessment, majority of the respondents as much as 66.2% do sufficient physical activity while 33.8% of them had low physical activity. This finding is somewhat contradict to a study by Markuri and Ashan (2021) which showed that the majority of subjects had moderate physical activity, as many as 69.7% and the rest 30.3% subjects had high physical activity. The results of a similar

Table 3. Respondents' fat intake and physical activity distribution

General characteristics	n	%
Fat intake from ordered food		
Sufficient (80−110% RDA)	54	70.1
Excess (>110% RDA)	23	29.9
Physical activity		
Low (total MET score*<600 MET minutes/week)	26	33.8
Sufficient (total MET score*≥600 MET minutes/week)	51	66.2

MET: Metabolic Equivalent of Task; RDA: Recommended Daily Allowance

study also showed consistent results that most of the subjects carried out physical activity in the moderate category 48.7%, followed by heavy category 32.2%, and low category 20% (Merita *et al.* 2018). Another study by Nagata *et al.* (2023) also showed similar results, that 69.9% of respondents had medium physical activity, followed by high physical activity 17.2%, and low physical activity 12.9%. Differences in the level of physical activity can be influenced by the number of activities carried out by students. Students do a lot of physical activity, both at and out of school. Some students have a physical activity that is classified as heavy due to participating in extracurricular sports activities at school, such as futsal, badminton, basketball, volleyball, martial arts, and taekwondo. In addition, some students also actively do physical activities at home, such as cycling, doing workouts, and dancing.

The relationship between variable factors and body weight status is presented in Table 4. Based on the frequency of food delivery application usage, it concluded that there is a significant correlation between the frequency of food delivery application usage and the overweight status of adolescents at SMAN 63 Jakarta, with $p<0.001$. Respondents with normal body weight status rarely use food delivery applications to order food/drinks (62%), in contrast to overweight students (95.7%).

The results of this study are similar to previous research which shows a relationship between diet and the incidence of obesity in adolescents ($p=0.011$) (Mutia *et al.* 2022). Obese adolescents have a more frequent consumption than adolescents without obesity. Obese adolescents tend to eat frequently so their daily caloric intake is often in excess from their needs

Table 4. The relationship between variable factors and nutritional status

Variable	Body weight status				*p*
	Normal		Overweight		
	n	%	n	%	
Frequency of food delivery applications usage					<0.001***
Rarely (<3 times per week)	34	63	1	4.3	
Frequent (≥3 times per week)	20	37	22	95.7	
Type of food ordered					0.467
Heavy meals	28	51.9	14	60.9	
Light meals	26	48.1	9	39.1	
Amount of food ordered					0.655
Small quantities (order<average*)	38	70.4	15	65.2	
Large quantities (order≥average*)	16	29.6	8	34.8	
Fat Intake from ordered food					<0.001***
Sufficient (80–110% RDA)	39	72.2	4	17.4	
Excess (>110% RDA)	15	27.8	19	82.6	
Physical activity					0.006***
Low (total MET** score <600 MET minutes/week)	13	4.1	13	56.5	
Sufficient (total MET** score ≥600 MET minutes/week)	41	75.9	10	43.5	

*The average number of orders=2 portions

**MET: Metabolic Equivalent of Task; RDA: Recommended Daily Allowance

***Indicate a significant difference at 0.05

(Mutia *et al.* 2022). This is similar to another research, which shows a significant correlation between online food consumption and the body weight status of adolescents (p=0.035), where adolescent who have a habit of frequently buying food online are at risk of 2.487 times being overweight (Sandy *et al.* 2023).

More than 1,2 billion people use online food delivery systems worldwide (Statista 2023b). This application makes it easy to provide access to menus and offers available in restaurants. This convenience can have an impact on lifestyle and health changes. High use of food ordering applications in adolescents can lead to excessive food consumption, affecting health (Alyami & Alharbi 2023).

Based on the type of food ordered, there is no relationship between the type of food and the overweight status of adolescents in our study site (p=0.467) 51.9% of respondents with normal body weight status bought heavy meals. The results of this study are similar to research conducted by Azizah (2022) which shows that there is no relationship between the type of snack food ordered through online food delivery and the overweight status of adolescents (p=0.103). Research by Fathin (2018) also showed no relationship between the contribution of snacks and body weight status because other factors could influence them, such as portions, meal frequency, and physical activity. However, research conducted by Mukhlisa showed different results, showing a relationship between the consumption of snack-type foods and overweight body weight status in adolescents (p<0.001). In Mukhlisa's research, teenagers consume high-calorie and fatty snacks not based on their needs but according to their wishes. Snacks only rely on calories and make teenagers want to avoid consuming foods with complete nutrients. Excessive consumption of snacks can cause a buildup of energy, leading to obesity (Mukhlisa *et al.* 2018).

In addition to the contribution of calories, the size of food portions is also one of the most relevant factors in the occurrence of being overweight. A food portion is described as the amount of food that we decide to consume and is significantly related to excess energy intake, which can increase body weight. Excess energy intake will be stored in the body as glycogen in the liver and muscles, and excess fat will be held around the stomach, kidneys, and under the skin. Therefore excess energy can cause obesity.

Based on the amount of food ordered, it concluded that there is no relationship between the amount of food and the overweight status of adolescents at SMAN 63 Jakarta (p=0.655). Most respondents from both body weight status ordered food in small quantities.

The results of research conducted by Yahya (2020) showed that the amount of food purchased and ordered is related to the incidence of obesity. The results of this study are different from Dewita (2021) which shows a significant correlation between diet and the incidence of obesity in high school adolescents. The results of Dewita's research show that excessive eating patterns can cause obesity in adolescents. However, another study explained further that the risk factor for obesity in adolescents is an increase in the consumption of high-calorie foods (Grace *et al.* 2021). In addition to the amount of calorie-dense food intake, obesity can also be influenced by the amount of fruit and vegetable intake as a protective factor against obesity. Epidemiological studies have shown that sufficient fruit and vegetable intake can be beneficial in preventing the development of obesity (Grace *et al.* 2021).

Based on fat intake from ordered food, it concluded a significant correlation exists between fat intake and overweight status in adolescents at SMAN 63 Jakarta (p<0.001). Respondents with normal body weight status mostly consumed fat in sufficient quantities (72.2%). Meanwhile, respondents with overweight status mostly consumed fat in excess (82.6%). Therefore, we suggest that the amount of fat coming from online ordered food can have a significant impact on the overall nutrition status of the adolescents. Therefore, we should start to consider the contribution of high fat intake from food ordered via application in our nutrition education content.

The results of this study are similar to Pusparani (2022) which shows that there is a relationship between fat intake and overweight body weight status in adolescents (p=0.010). Fat is the body's largest energy reserve. Energy reserves from this fat will be stored in the tissue under the skin (subcutaneous), around the abdominal organs, and in the intramuscular tissue, which if the amount is excessive, will cause accumulation. Overweight adolescents in this study tended to consume high-fat foods from snacks and junk

food. The results of Kaur's research stated that the reason the majority of teenagers (86.3%) consumed junk food was because they liked the taste. Kaur's research also showed similar results, that junk food consumption patterns and body mass index have a positive relationship (p=0.001) (Kaur *et al.* 2016). The results of another study conducted by Allioua *et al.* (2015) stated that high fat intake is associated with poor diet quality and an increase in body mass index, causing a high prevalence of overweight (13.7%) and obesity (3.2%) in adolescents in Tlemcen.

Based on physical activity, it concluded that there is no significant correlation between physical activity and overweight status in adolescents at SMAN 63 Jakarta (p=0.006). Respondents with normal body weight status mostly did sufficient physical activity (75.9%). Meanwhile, those with overweight status did low physical activity, as many as 13 respondents (56.5%).

The results of this study are similar to previous research which shows a relationship between physical activity and overweight body weight status in adolescents (p<0.001) (Hutabarat *et al.* 2020). Another study showed similar results that a high level of physical activity in adolescents and children is related to the amount of total body fat (Paschaleri *et al.* 2016). Food consumption and physical activity can affect a person's body weight status. This relates to the balance between energy consumed and energy expended. The condition of the body that experiences excess energy due to high intake if it is not balanced with adequate physical activity and exercise can result in overweight and obesity (Widiastuti & Widiyaningsih 2023).

The odds ratio value, which can be seen from the exp(β) value in Table 5, showed that adolescents with frequent usage of food delivery applications have an overweight tendency of 38.225 times more than adolescents with rarely usage of applications and this odd was statistically significant. Although the adolescents with excess fat intake have an overweight tendency of 4.646 times more than adolescents with sufficient fat intake the result was not statistically significant. The same with findings for adolescents with sufficient physical activity have a lower overweight tendency of 0.071 times than adolescents with low physical activity, the result was also not significant statistically.

Despite some risk showed non statistically significant results, which can be a consequence of small sample size, the results of this study are similar to various studies regarding the topic among adolescents in Indonesia. Dewita (2021) showed that in SMA Negeri 2 Tambusai students who have an overeating pattern have a 3.691 times higher risk of developing obesity. While adolescents at SMA Muhammadiyah 4 Kartasura who had excessive fat intake had a higher risk of being overweight by 3.37 times (Wulandari 2017). Another study showed that adolescents with a high sedentary lifestyle (≥6 hours/day) had a 0.315 times greater risk of experiencing overweight than adolescents with a mild sedentary lifestyle (<6 hours/day) (Amrynia & Prameswari 2022).

CONCLUSION

The trend of ordering food through delivery applications among adolescents can influence adolescents' dietary patterns and body weight status. We found a relationship between the frequency of using food delivery applications, fat intake from food ordered online, and physical

Table 5. Multivariate analysis

Variable	B	df	Sig.	Exp(B)	CI	
					Lower	Upper
Frequency delivery applications usage	3.643	1	0.001*	38.225	4.286	340.896
Fat intake	1.536	1	0.408	4.646	0.112	176.813
Physical activity	-2.641	1	0.150	0.071	0.002	2.594

Indicate a significant difference at 0.05

activity with overweight status. It is hoped that adolescents pay more attention to the use of food delivery applications, reduce consumption of food rich in fat, and do sufficient physical activity to prevent overweight.

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DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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