Nutrition knowledge, online food delivery usage, and eating habits among college students

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ABSTRAK

Latar Belakang: *Maraknya konsumsi makanan berkalori tinggi, lemak tinggi, dan serat rendah yang diikuti dengan kurangnya aktivitas fisik, dapat menjadi faktor penyebab obesitas. Salah satu hal yang berkontribusi terhadap fenomena ini adalah meningkatnya penggunaan OFD (Online Food Delivery), terutama sejak pandemi COVID-19. Kemudahan akses terhadap berbagai jenis makanan, khususnya makanan tidak sehat, dapat menyebabkan konsumsi yang tidak terkendali, baik dari segi jenis maupun jumlah.*
Tujuan: *Menganalisis hubungan pengetahuan gizi dan frekuensi penggunaan layanan pesan-antar makanan online dengan pemilihan makanan dan asupan lemak, gula, dan garam.*
Metode: *Penelitian cross-sectional ini melibatkan sebanyak 135 mahasiswa Universitas Gadjah Mada. Instrumen yang digunakan adalah kuesioner tervalidasi untuk mengukur pengetahuan gizi, penerapan OFD, kuesioner Food Choice Questionnaire (FCQ), dan Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). . Hubungan antar variabel menggunakan uji chi-square dengan tingkat signifikansi p<0,05.*
Hasil: *Sebanyak 55.6% responden jarang menggunakan layanan pesan antar makanan online, 76.3% responden menunjukkan tingkat pengetahuan gizi yang buruk, 57% dan 80% responden memiliki asupan lemak dan natrium yang cukup, sedangkan 56.3% responden mengonsumsi gula dalam jumlah yang terlalu tinggi. Pengetahuan gizi responden tidak mempunyai korelasi dengan pilihan makanannya (p=0.891), juga tidak ditemukan hubungan antara frekuensi penggunaan layanan pesan-antar makanan online dengan asupan gula (p=1.000) dan garam (p=0,120). Frekuensi penggunaan layanan pesan-antar makanan daring dan asupan lemak berkorelasi secara signifikan (p=0.001).*
Kesimpulan: *Terdapat hubungan yang signifikan antara frekuensi penggunaan layanan pengiriman makanan daring dengan asupan lemak, namun tidak ditemukan hubungan serupa antara frekuensi penggunaan layanan pengiriman makanan daring dengan asupan gula dan garam.*

Kata kunci*:* *asupan gula; asupan lemak; asupan natrium; pengetahuan gizi; pengiriman makanan online*

ABSTRACT

Background: *The widespread consumption of high-calorie, high-fat and low-fiber foods, followed by insufficient physical activity, can contribute to obesity. One contributing factor is the increasing use of online food delivery (OFD) services, especially since the COVID-19 pandemic. The easy access to various types of food, especially unhealthy food, can lead to uncontrolled consumption, both in terms of type and quantity.*

Objectives: *Analyze the relationships between nutritional knowledge and the frequency of using food delivery services with food selection and intake of fat, sugar, and sodium.*
Methods: *A cross-sectional study with 135 of Universitas Gadjah Mada college students involved. Validated questionnaires were used to measure nutrition knowledge, OFD application, the Food Choice Questionnaire (FCQ), and Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). Chi-square tests were used with a significance level set at p<0.05.*
Results: *A total of 55.6% respondents reported seldom using OFD services, 76.3% showed a poor level of nutritional knowledge, 57% and 80% had an adequate intake of fat and sodium, while 56.3% of the respondents consumed overly high amount of sugar. Students' nutritional knowledge had no correlation with their food selection (p=0.891), also no relationship found between frequency of online food delivery service usage with sugar (p=1.000) and sodium intake (p=0.120). There was a significant correlation between OFD usage frequency with fat intake (p=0.001).*
Conclusions: *A significant relationship exists between the frequency of online food delivery service usage with fat intake, but no such association is observed between the frequency of online food delivery service usage with sugar and sodium intake.*

Keyword*:* *fat intake; nutrition knowledge; online food delivery; sodium intake; sugar intake*

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INTRODUCTION

During and after the Coronavirus Disease 2019 (COVID-19) pandemic, the habit of overconsumption increased the risk of obesity, high cholesterol, and various non-communicable diseases. The lifestyle shifts among individuals since the COVID-19 pandemic have created new challenges, particularly in how people access food, marking a major transition from dining out at restaurants to ordering food online (1). Food delivery services are used by various groups, with a high percentage of users being students. A significant proportion of food delivery service users in Indonesia, approximately 89.5%, were students and college students (2). The study participants were randomly selected online from various regions of the country, and the results suggest that food delivery services are particularly popular among this demographic. Similarly, other study found that 61% of food delivery service users in Palembang, Indonesia were students, university students, and job seekers (3). The strict lockdown regulations and implementation of social distancing led people started using practical solutions like services to meet their daily needs, including food (4). The behavioral changes enforced by the pandemic are likely to persist in the long term, leading to a permanent shift in consumer habits (1).

While online food delivery services offer several conveniences, they can also have negative impact on people's lifestyles. The use of these services can lead to low physical activity, as people no longer have to leave their homes to purchase food (5). Additionally, the wide access to various kinds of food especially unhealthy one can result in uncontrolled consumption in terms of both type and quantity. Limited accessibility to unhealthy food was globally associated with lower obesity prevalence (6). Therefore, maintaining balanced nutrition and reducing excess sugar and fat intake is essential for optimum health and well-being. The consumption of food sources rich in protein, vegetables, and fruits containing vitamins and minerals is highly recommended (6).

Fast food is one type of food that is often purchased through online food delivery applications (5). Students, in particular, tend to buy food high in fat, carbohydrates, sugar, and sodium, such as "geprek" or smashed fried chicken, and snacks containing chocolate and fried foods (7). The processing of fried chicken involves ingredients high in sugar, flour, and oil, which are used repeatedly, making fried chicken an unhealthy food (8). Increased consumption of high-calorie, high-fat, and low-fiber foods, coupled with a lack of physical activity, can lead to obesity (9). According to the Indonesian Health Survey (SKI), the prevalence of obesity in Indonesia increased to 23.4% in 2023 among individuals aged over 18 years (10). Obesity that is not treated immediately and is allowed to continue into adulthood can result in the emergence of degenerative diseases, such as type 2 diabetes mellitus, hypertension, and cardiovascular diseases, and can also reduce a person's level of productivity (11).

Based on the background explained above, several previous studies related to the use of online food delivery have discussed food consumption patterns, ordering frequency, and nutritional status (5,7), but there are still few studies that specifically highlight how nutritional knowledge contributes to food choices and intake of specific nutrients such as fat, sugar, and sodium among college students in the context of online food delivery usage. Therefore, this study aimed to investigate the associations between nutritional knowledge and the frequency of utilizing food delivery services with food selection and the intake of fat, sugar, and sodium among college students. Through this analysis, the study intends to provide valuable insights into the eating habits of this demographic group.

MATERIALS AND METHODS

This research was an observational study with a cross-sectional design which was conducted in June 2022 with the participation of 135 college students of Universitas

Gadjah Mada (UGM), Yogyakarta, Indonesia. To participate in the research, students had to fulfill specific criteria, such as being active students at UGM at Diploma or Bachelor level, having used online food delivery services in the past month, being willing to take part in the research, and having the necessary facilities for filling out online questionnaires, such as a device and Internet quota. Respondents who did not complete the questionnaire or who were on a special diet were excluded from participating in the study.

The study population included all UGM students from various levels of education and clusters, with faculties categorized into health and non-health clusters. The health cluster consisted of faculty in the medical field, while the non-health cluster included faculty in the agro, science, and social humanities fields. Population was obtained from the Higher Education Database (PDDikti) in 2021, which reported 37,938 UGM students. A minimum sample size of 100 subjects was required based on the Slovin formula calculation with an error limit of 10% (12). The respondents were enrolled through proportionate stratified random sampling, with stratification on major clusters between UGM students. Information about respondent recruitment were shared via social media. Those who fall within the criteria could sign informed consent and continue to fill survey instruments online via google form. **Figure 1** shows the sampling technique conducted in this study. Those who fall within the criteria could sign informed consent and continue to fill survey instruments online via google form.

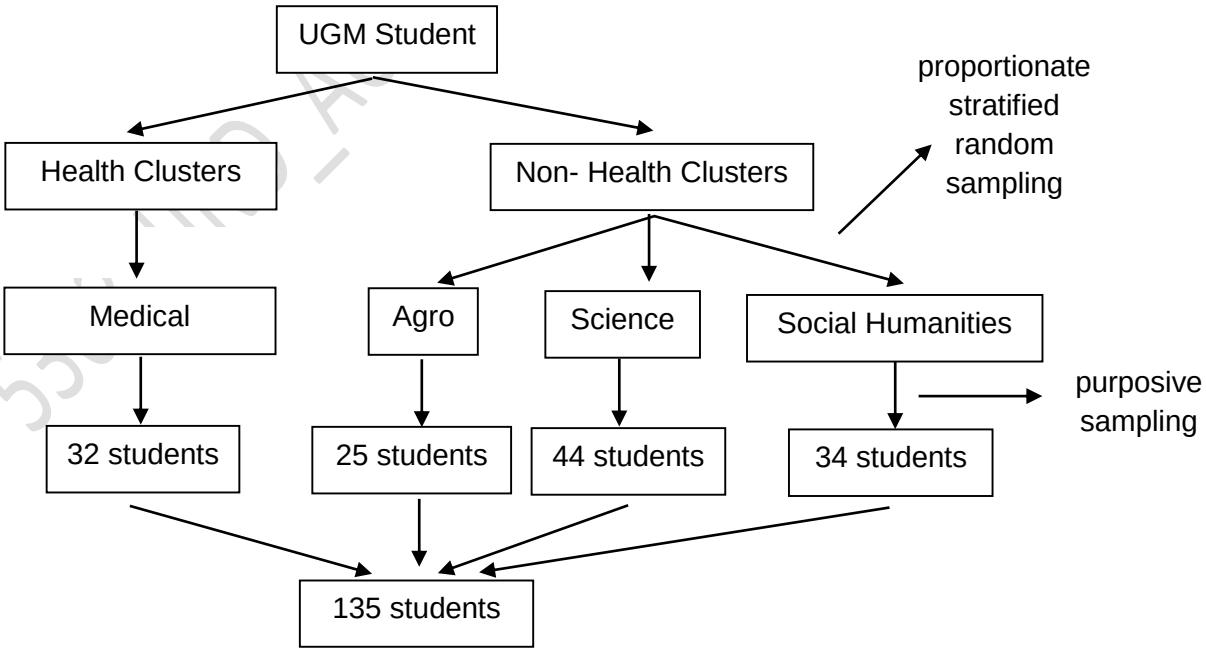

Figure 1. Sampling Technique Diagram

To measure the students' nutrition knowledge, a validated questionnaire consisting of ten questions was used, covering topics such as balanced nutrition, nutrients in food, and the relationship between nutrition and health (13,14). The nutritional knowledge questionnaire has a Cronbach's Alpha value of 0.700 (reliable if more than 0.600). Each question on the nutritional knowledge questionnaire has four answer choices, with only one being the correct answer. Students' nutritional knowledge was categorized as poor if ≤75% of the answers are correct, and good if >75% of the answers are correct (15). The study also collected data on food selection ordered via the OFD application. The food selection questionnaire was developed based on the Food Choice Questionnaire (FCQ) (16) with several modifications. The questionnaire contained statements describing the process of selecting food based on the principles of balanced nutrition and the nutritional content of food ingredients. Students answered this questionnaire using a Likert scale with 4 answer choices: always (every day), often (once a week), sometimes (one to three times a month), and never (17). The food selection ordered via the OFD application was categorized into 2 categories based on class interval, namely less nutritionally balanced if the score is between 1 – 2.5, and nutritionally balanced if the score is between 2.6 – 4. The average intensity of food or drink purchases via food delivery services in one month during the COVID-19 pandemic was categorized as rarely (less than 3x/week) or often (more or equal to 3x/week) (5).

Fat, sugar, and sodium intake were measured as the average amount of daily consumption expressed in grams. Subjects recorded all the foods and drinks they consumed for five days in the last month (30 days), and intake of fat, sugar, and sodium was calculated based on the results of the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) or consumption of various types of food. The amounts of fat, sugar, and sodium consumed were from staple foods, vegetable side dishes, animal side dishes, ready-to-eat foods, snacks, drinks, and other food additives. The study used the Indonesian Food Group Table (TKPI) and Fatsecret websites, as well as the Nutrisurvey application to calculate the nutritional values of each type of food ingredient and ready-made food. Fat, sugar, and sodium intake were categorized as enough if less than or equal to 67 grams/day; 50 grams/day; and 2000 mg/day, respectively. Overconsumption was defined as more than 67 grams/day; 50 grams/day; and 2000 mg/day, consecutively (18).

Before conducting the study, the instruments were tested on a group that had similar characteristics to the research sample, comprising 36 students from universities other than UGM, to ensure the validity and reliability of each questionnaire. Based on

the results of the statistical analysis for the validity test of the food selection questionnaire, it is known that all 10 question items have a calculated r value greater than 0.339. The r table of the 2-sided test for df (N-2) or df (36-2) with a significance level of 5% was 0.339 (19). Therefore, it can be concluded that the food selection questionnaire through this online food delivery application is valid. The relationships between variables were analyzed using chi-square tests, with a significance level set at $p<0.05$. This research has been approved by ethics commission Faculty of Medicine Public Health and Nursing, Universitas Gadjah Mada after full review, with letter number No KE/FK/1532/EC. Each respondent participated in this research was asked to sign written informed consent after being explained about this research.

RESULTS AND DISCUSSIONS

The majority of respondents were female (71.1%), 22 years old (26.7%), had a non-health-related study background (76.3%), and were from areas other than the Special Region of Yogyakarta (69.6%). Most of the respondents (65.2%) had a monthly allowance of less than IDR 1,000,000 (64 USD), with an average monthly allowance of IDR 688,068 $\pm$ 233,168. The remaining respondents were classified as having a higher allowance, with an average monthly allowance of IDR 1,819,149 $\pm$ 648,037.

Descriptive statistics of the measurement variables are presented in **Table 1**. According to our study, more than half of the respondents (55.6%) reported seldom using online food delivery services, while the other 44.4% considered frequent as their weekly usage ar more than 3 times. Most respondents (76.3%) demonstrated a poor level of nutritional knowledge and only 25.9% of the subjects had a nutritionally balanced food selection through online food delivery applications. The assessment results of the respondents' intake of fat, sugar, and sodium show that while most respondents had an adequate intake of fat (57%) and sodium (80%), over half of the respondents (56.3%) consumed excessive amounts of sugar in their diet. The recommended amount of sugar, sodium, and fat by the Indonesian Ministry of Health, is no more than 50 grams per day, 2,000 mg per day, and 67 grams per day, consecutively (18).

Table 1. **Distribution of respondents by nutritional knowledge, frequency of online food delivery (OFD) service usage, food selection through OFD, and daily intake of fat, sugar and sodium based on clusters**

Variable	Total			Health Clusters			Non-health Clusters		
	n	%	Median (SD)	n	%	Median (SD)	n	%	Median (SD)
Nutritional Knowledge									
Poor	103	76.3	50 (12.3)	11	34.4	70 (11.9)	92	89.3	50 (11.9)
Good	32	23.7	85 (7.5)	21	65.6	90 (7.7)	11	10.7	80 (6.9)
The Frequency of OFD Service Usage									
Infrequent (<3x/week)	75	55.6	1 (0.6)	21	65.6	4 (3.6)	54	52.4	1 (0.6)
Frequent (≥3x/week)	60	44.4	4 (2.3)	11	34.4	2 (0.6)	49	47.6	4 (1.9)
Food Selection Through OFD Services									
Less Nutritionally Balanced	100	74.1	2.1 (0.4)	24	75	2.2 (0.4)	76	73.8	2.1 (0.4)
Nutritionally Balanced	35	25.9	2.9 (0.3)	8	25	2.9 (0.3)	27	26.2	2.9 (0.3)
Fat Intake*									
Adequate (≤67 g/day)	77	57	52.8 (11.1)	19	59.4	53.4 (9.3)	58	56.3	50.8 (11.6)
Over (>67 g/day)	58	43	87.3 (25)	13	40.6	83.6 (13.9)	45	43.7	92 (26.9)
Sugar Intake*									
Adequate (≤50 g/day)	59	43.7	34 (9.19)	11	34.4	33.5 (5.9)	48	46.6	34.6 (9.8)
Over (>50 g/day)	76	56.3	67.3 (27.2)	21	65.6	66.2 (22)	55	53.4	70.5 (29.0)
Sodium Intake*									
Adequate (≤2,000 mg/day)	108	80	1074.5 (403.0)	26	81.3	1089.8 (421.1)	82	79.6	1071.3 (399.6)
Over (>2,000 mg/day)	27	20	2544.9 (643.2)	6	18.8	2156.4 (518.4)	21	20.4	2585.6 (661.6)

* Cuttoff values (18)

Around 76.3% of the total respondents in this study showed a poor understanding of nutrition, including diet and its link to health. This finding was primarily observed among students from non-health related backgrounds. Only 10.7% students from non-health related background have good nutrition knowledge. While students from health related background have more people (65.6%) that have good nutrition knowledge. This finding is contrary to earlier research among Health Science Students in National

University of Malaysia, where only 10.5% of respondents know how to estimate food calories (20). Despite having health science educational background, only the small amount of respondents get calories knowledge score above 70%.

Different result showed from research among Diponegoro University students in Semarang, Indonesia, more than half of respondents (77.3%) had a good level of nutritional knowledge (21). One potential explanation for the observed level of nutritional knowledge among students is their background of education. Education plays a vital role in shaping an individual's nutritional knowledge. This could be due to the impact of education on the learning process and an individual's ability to receive information. Individuals with higher levels of education are more likely to have better access to information, leading to greater knowledge acquisition (22). Furthermore, nutritional information is easily accessible through individuals in nearby surroundings, printed materials like books, posters, leaflets, newspapers, and magazines, as well as electronic media such as the internet, television, and radio (23).

Currently, a considerable proportion of the population lacks nutritional knowledge. Enhancement in nutrition literacy is needed to improve health condition (24). Nutrition literacy is a process in developing individual skills to understand nutritional message in order to improve one’s health (25). It is important to work on increasing nutritional literacy to improve health through nutritionally balanced meal food selection. Improving nutritional literacy should start before someone turns into adult. Adding nutrition label in food menu at canteens could raise consumer awareness about their nutritional intake (26).

A few questions that most of respondent answered incorrectly pertained to the calorie content of food, daily consumption of fruits and vegetables, and recommended frequency of exercise. In addition, the percentage of respondents who provided wrong answers to questions related to sodium and fiber was considerable, at 34% and 26%, respectively. This finding is in alignment with the results of a dietary sodium survey conducted in the United States, where a college student population also showed poor knowledge, attitudes, and practices regarding sodium (27). Nutritional knowledge related to sodium and fiber consumption is crucial for students due to their association with non-communicable diseases. Excessive sodium consumption is known to increase the incidence of hypertension, with hypertension complications being the third leading cause of death according to the results of the Registry Sample Survey in 2014. Moreover, hypertension is a risk factor for cardiovascular disease, which is the second leading cause of death according to the survei (28).

Table 2 indicates that individuals residing in a boarding house tended to use online food delivery services more frequently (56.4%) compared to those who lived in their own house (p=0.000; p<0.05). Only 17.1% of those living in their own house reported using food delivery services frequently. The statistical analysis showed that there was a significant relationship between the type of housing and the frequency of online food delivery service usage (p<0.001). Notably, more than half of the subjects infrequent / frequent used online food delivery services (54%) and had adequate fat intake (61%) as well as adequate sodium intake (88%), but slightly higher sugar intake (53%). The analysis demonstrated a statistically significant relationship between the frequency of food delivery service usage and fat intake (p=0.022, p<0.005). However, no significant relationship was found between the frequency of food delivery service usage and sugar intake (p=0.247, p>0.005) or sodium intake (p=1.000, p>0.005).

Table 2. **Relationship between the Type of Housing, Fat Intake, Sugar Intake, Sodium Intake with the Usage of OFD Services**

	The Frequency of OFD Service Usage				Total		*p*-value
	Infrequent		Frequent				
	n	%	n	%	n	%	
Type of Housing							
Home	34	82.9	7	17.1	41	100	<0.001*
Boarding House	41	43.6	53	56.4	94	100	
Total	75	55.6	60	44.4	135	100	
Fat Intake							
Adequate	53	70.7	24	40	77	100	0.001*
Over	22	29.3	36	60	58	100	
Total	75	55.6	60	44.4	135	100	
Sugar Intake							
Adequate	33	44	26	43.3	59	100	1.000
Over	42	56	34	56.7	76	100	
Total	75	55.6	60	44.4	135	100	
Sodium Intake							
Adequate	64	85.3	44	73.3	108	100	0.130
Over	11	14.7	16	26.7	27	100	
Total	75	55.6	60	44.4	135	100	

**Chi-square test*, significant if p-value<0.05

Mobile applications designed for online food delivery have gained immense popularity in today's digital era. According to a previous survey conducted in Palembang, Indonesia, Go-Jek's “Go-Food” feature was found to be the most frequently used online food delivery service among 200 individuals (3). Food delivery apps offer an easy and fast way to order food from a variety of restaurants. Users can browse menus, compare prices, read reviews, customize orders, and track deliveries in real time. These apps have made it possible to satisfy cravings without leaving home.

This study focused on analyzing the food selection behavior of respondents who used online food delivery applications. Out of all the respondents, 74.1% (100 individuals) selected less nutritionally balanced food when using the app. This finding is consistent with prior research in which 53.7% of Bandung Health Polytechnic students in Indonesia exhibited poor behavior in choosing food via online applications (29). Most participants showed infrequent tendencies in selecting nutritious and natural food items, as well as those that were free of artificial ingredients and additives. Participants also showed a lack of preference for food items that were low in fat and rich in fiber, vitamins, and minerals when making purchases via online food delivery applications. Approximately 40% of the respondents occasionally choose healthy food options, while an equal proportion (40.7%) often select healthy food. The study highlighted that the majority of participants favored cheaper food options over healthier alternatives when using these applications.

The study findings suggest that the preference for less nutritionally balanced foods on online food delivery applications could be attributed to the limited availability of nutritionally balanced food options on these platforms. The types of food products that are widely available on online food delivery applications are mostly fast foods. While some applications feature a healthy food section, it is often not easily visible on the app's main page. As a result, users may overlook it and instead opt for price-promoted or less healthy options, such as fast food, which are more prominently displayed on the main page.

Fast food, such as pizza, French fries, and other similar foods, are high in calories, fat, sugar, and sodium, but low in nutrients such as protein, fiber, vitamins, and minerals. In contrast, vegetables and fruits, which are rich in nutrients, are still rarely available in online food delivery applications. Consuming fast food excessively or too often can increase the risk of various non-communicable diseases, such as obesity, cancer, hypertension, diabetes mellitus, and cardiovascular diseases like heart disease and stroke (30).

The present study investigated the relationship between the frequency of food delivery service use with the intake of sugar, sodium, and fat among college students at UGM, Indonesia. The outcomes of the research indicate that the use of online food delivery services by the respondents was relatively infrequent, with a median frequency of eight times per month or approximately two times per week. This rate is slightly higher than that reported by a study involving Diponegoro University students, Semarang, where the median frequency was six times per month (31). The difference in the location

and time of data collection could be the reason for this variation. It is noteworthy that this study was conducted during the COVID-19 pandemic when food delivery services were in high demand (32), whereas the previous study (31) research took place before the pandemic. These findings are consistent with a study conducted in the Special Region of Yogyakarta Province, which found no significant changes in the use of food delivery services before and during the pandemic (33). Although there was a slight decline in the use of food delivery services during the pandemic, students tended to increase their usage.

The study also found a significant relationship between the place of residence and the frequency of using food delivery services (p-value = 0.001). This finding concurs with research conducted on young adults (18-25 years) in the United States, which found that living alone was associated with increased food delivery service use (34). Given the busy nature of student life, students living alone may lack cooking skills and look for practical ways to fulfill their dietary needs, which may be one reason why food delivery services are a popular option (34,35). On the other hand, students who live at home tend to have someone cooking for them and follow the same household eating patterns, which could explain why they use food delivery services less frequently (34).

In terms of dietary intake, the study analyzed the total daily intake but did not analyze intake from food delivery services separately. The study revealed that a majority of the participants (56.3%) had a daily sugar intake that exceeded the recommended amount. On average, the subjects consumed 58 grams of sugar per day, which surpasses the limit set by the Indonesian Ministry of Health, which is 50 grams per day (18). Another study conducted at Surabaya State University in Indonesia showed a sugar intake of 33.83 grams per day from sweetened beverages alone (36), indicating that the total daily sugar intake is likely to be higher. Research among students at Zarqa University in Jordan yielded comparable results, with an average sugar intake of 57.4 grams per day (37). Excessive sugar consumption has been linked to a higher risk of obesity, cardiovascular diseases, and other non-communicable diseases. As a preventive measure, the American Heart Association recommends limiting free sugar intake to 25-37.5 grams (6-9 teaspoons) per day (38).

The study showed that the average value of the subjects' sodium intake was 1,423 mg per day, which is below the recommended daily intake by the Indonesian Ministry of Health of no more than 2,000 mg (18). However, the analysis of sodium intake may be underestimated, as the study did not inquire about the amount of daily use of salt or sodium-rich food additives. The results of this study are in line with the findings of

research among students at Campus III of Semarang Health Polytechnic in Indonesia, where the average sodium intake was 1,632.8 mg per day (39). Conversely, a previous study among IPB University students found an average sodium intake of 2,261.1 grams per day (38).

Most of the subjects had sufficient total daily fat intake (57%). However, the average value of the subjects' fat intake was 70.12 grams per day, exceeding the recommended fat intake of 67 grams per day by the Indonesian Ministry of Health (18). Research conducted by El-Qudah (2023) on students at Zarqa University in Jordan showed a lower average fat intake of 56.7 grams per day (37). Similarly, Sakai et al. found that students at IPB, Indonesia had a lower average fat intake of 51 grams per day (38).

The study discovered a significant relationship between the frequency of online food delivery service use and fat intake (p-value = 0.001). Subjects who frequently used food delivery services mostly had excessive fat intake (60%), while those who rarely used them mostly had sufficient fat intake (70.7%). These results agree with Zang et al.'s study, which stated that subjects who consumed food and drink outside the home had an increase in fat intake (40). Another study by Oh et al. also revealed that the frequency of eating out was positively correlated with fat intake (41). Unhealthy cooking techniques adopted by most food delivery service providers, such as frying with excessive oil and adding food enhancers to improve taste, color, and aroma, often lead to the provision of high-energy, saturated fat, and sodium-rich meals (42). This is in line with study results by Haamiim et al. (43) that characteristics of food posts on Instagram contains high carbohydrate, high fat, high sodium, low protein, and low fiber.

On the other hand, there was no significant relationship found between the frequency of online food delivery service use and sugar intake, with a p-value of 1.000. This may be caused by many factors other than the use of online food delivery (OFD) services that contribute to students' excessive sugar intake. Students' diets generally tend to be high in sugar, as shown in a study which found that students consume more than one serving of sweet drinks per day on average, contributing significantly to their total sugar intake (44). Moreover, eating patterns at home are not always healthier, a study by Llanaj et al. which assessed the food and beverage intake of students at the University of Tirana in Albania found that home-cooked food contributed significantly to daily sugar intake (69.5%) (45).

Similarly, there was no significant relationship between the frequency of utilizing online food delivery services and sodium intake (p-value = 0.130). Most of the

respondents who frequently or rarely used online food delivery services had sufficient sodium intake, accounting for 73.3% and 85.3%, respectively. These insignificant results may be influenced by the food intake assessment method used, SQ-FFQ, which has the potential for memory bias or portion estimation errors which can affect the accuracy of measuring sodium intake (46). Previous research conducted by Oh et al. (41) in South Korea and Zang et al. (40) in Shanghai analyzed the nutritional intake, including sodium, of food and beverages consumed outside of the home. Both studies concluded that the more frequently the subjects consumed food from outside the home, the higher their sodium intake. However, in this study, the majority of the subjects rarely used food delivery services, thereby making a small contribution to their sodium intake.

The findings of this study suggest that the majority of respondents who consumed less nutritionally balanced meals either had poor (73.8%) or good (75.0%) nutritional knowledge. Interestingly, the analysis revealed that there was no significant relationship found between nutritional knowledge and food selection through online food delivery services (p=0.891; p>0.05) (**Table 3**).

Table 3. **Relationship between Nutritional Knowledge and Food Selection through OFD Services**

Nutritional Knowledge	Food Selection Through OFD Services				Total		*p*-value
	Less Nutritionally Balanced		Nutritionally Balanced				
	n	%	n	%	n	%	
Poor(≤75% of the answers are correct)	76	73.8	27	26.2	103	100	
Good (>75% of the answers are correct)	24	75.0	8	25.0	32	100	0.891
Total	100	74.1	35	25.9	135	100	

A bivariate analysis was conducted to examine the relationship between the nutritional knowledge of respondents and their food selection through online food delivery applications. The analysis revealed that there was no significant correlation between the two variables. This aligns with the findings of previous research among college students in Medan, Indonesia which also discovered that there was no correlation between knowledge and fast food choices (5). Although knowledge is an important factor that affects one's actions, its application in daily life is not guaranteed (47). The study's results differ from those of another study, which found that nutritional knowledge can impact an individual's food choice behavior and, in turn, their nutritional status and eating habits among college students at Diponegoro University in Semarang, Indonesia (21).

The absence of an association between nutritional knowledge and food selection through online food delivery applications may be attributed to other factors that were not accounted for in this study. In addition to knowledge and socioeconomic conditions, other factors, such as internal and external food factors, personal circumstances, as well as sociocultural and cognitive factors, can all have an impact on food choices (48).

A recent study conducted during the COVID-19 pandemic to investigate nutrition knowledge and food choices in individuals revealed a positive but weak correlation. While nutrition knowledge is a critical component of health literacy, food availability became a major factor influencing food selection during the pandemic due to the lockdown (49). Digitalized food environments are often filled with unhealthy food options, making it challenging for some individuals to find well-balanced food (50). Additionally, food provided through food delivery services is typically more energy-dense compared to retail counterparts. Therefore, food delivery companies need to offer healthier options to consumers.

CONCLUSIONS AND RECOMMENDATIONS

The study reveals that most participants possess an inadequate level of nutritional knowledge and only a quarter of them make nutritionally balanced food choices while using online food delivery applications. The research shows that there is no significant relationship found between students' nutritional knowledge and their food choices. Moreover, more than half of the respondents rarely use online food delivery services but still consume excessive sugar while maintaining adequate fat and sodium intake. Interestingly, a significant relationship exists between the frequency of online food delivery service usage and fat intake, but no such association is observed between the frequency of online food delivery service usage and sugar and sodium intake.

The strength of this study holds particular importance as it is the first of its kind to investigate the relationship between the use of online food delivery services and sugar, sodium, and fat consumption among UGM students, thereby adding value to the existing knowledge in this domain. However, it is pertinent to acknowledge that the study has certain limitations, including the potential for bias introduced by the online SQ-FFQ and the possibility that some subjects may not have fully adhered to instructions or provided honest data, which could impact the accuracy of the calculated intake levels for fat, sugar, and sodium among respondents.

The findings of this research have significant implications for developing nutrition education programs and designing effective strategies to promote healthy food choices

among college students. Nutrition education efforts should be aimed not only at OFD users, but also at the wider population of college students. The study emphasizes the importance of maintaining a nutritionally balanced diet, in compliance with the stipulated guidelines for nutrition and restricting the intake of fat, sugar, and sodium. College students, regardless of their OFD usage, should pay close attention to their food intake, both at home and from online delivery services, and follow the Balanced Nutrition Guidelines. To promote healthier food choices, companies providing online food delivery services must expand their network of restaurants/outlets that offer healthy, nutritionally balanced food and provide more promotions for these options compared to less healthy alternatives.

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