Original Research Article

A Cross-Sectional Analysis of Online Food Delivery (OFD) Platform Usage to Nutritional Status of the University of the Philippines Los Baños Students

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Journal of Human Ecology and Sustainability

Citation
Laure, D. D., Cayetano, A. C., & Naupal-Forcadilla, R. T. (2025). A Cross-Sectional Analysis of Online Food Delivery (OFD) Platform Usage to Nutritional Status of the University of the Philippines Los Baños Students. *Journal of Human Ecology and Sustainability, 3*(1), 1.
doi: 10.56237/jhes-24-016

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Academic Editor
Casper B. Agaton

Received: 5 August 2024
Revised: 11 October 2024
Accepted: 03 February 2025
Published: 11 March 2025

Funding Information
Department of Science and Technology – Science Education Institute (DOST-SEI)

Abstract

With the increasing trend of online food delivery (OFD), it is vital to understand its nutritional implications for consumers, considering the rising malnutrition rates in the Philippines. Hence, this study analyzed the association between OFD usage and the nutritional status of sophomore students at UPLB using proportionate stratified sampling and an online self-administered questionnaire. Descriptive statistics and tests of independence were used to assess association at $p \leq 0.05$. The study revealed that most respondents used OFD platforms 1 to 3 times monthly (44.41%), with an average expenditure of <251 pesos per transaction (44.69%). FoodPanda was the most popular platform (54.75%), and most students ordered meat or meat-based items (65.92%). Most students had normal nutritional status (61.2%), while 21.5% were underweight, 12.57% were overweight, and 4.75% were obese. Although no associations were found between OFD usage and nutritional status, it provided valuable insights into the utilization of OFD services and the nutritional status trends among students. These findings could assist the foodservice industry in retrofitting their services to accommodate the consumers' standards while promoting health. Additionally, the public health sector should reassess existing policies and programs and formulate more efficient interventions that address malnutrition, its risk factors, and its consequences.

Keywords— FoodPanda, GrabFood, nutritional status, online food delivery, sophomore college students

1 Introduction

The electronic commerce (e-commerce) sector has rapidly evolved over the previous years due to widespread digitalization [1], giving birth to various business forms, including online-to-offline (O2O) business [2]. In O2O, consumers order products or services online and complete offline transactions [1]. Online food delivery (OFD) services swiftly emerged from this type of e-commerce, connecting food establishments with customers by delivering food directly to their homes [3].

Although OFD platforms were already expanding before the pandemic, their prominence surged during the Coronavirus Disease (COVID-19) pandemic since community quarantines and health protocols restricted dine-in options in food establishments. OFD has become one of the essential means that interconnected people and the environment, substituting for in-person interactions [3]. Foodservices faced significant challenges during the pandemic, prompting them to maximize OFD to sustain the catering and restaurant sector [2], as evidenced by the 60% increase in monthly active Food and Beverage businesses on GrabFood in 2020 compared to 2019 [4]. Likewise, the restrictions have led more customers to utilize OFD services, mainly due to the satisfaction and convenience they provide. This purchasing trend is expected to persist post-pandemic, as 85% of consumers from the 18 to 34 age group state their intent to keep ordering from OFD platforms in the future [4].

With this increasing trend in consumers' digital activity, OFD usage is likely to contribute tremendously to individual eating habits since it could lessen home cooking and provide convenient access to various food and beverage options. Most takeaway menu items offered by food establishments and available through OFD platforms have been documented to be of poor dietary quality [5, 6], characterized by excessive energy content [7] and high levels of saturated fat or total fat, sodium, and sugar [8]. In the Philippines, popular purchases through these platforms are pizza, cake, and pasta [4], highlighting consumers' preference for energy-dense items. While healthier options still exist on OFD platforms, unhealthier items may be more prominent due to algorithmic prioritization and advertisement funding [9].

Unhealthy food consumption is one of the key modifiable factors contributing to the development of overweight and obesity [10]. According to the 2021 Expanded National Nutrition Survey (ENNS) in the Philippines, there is a rising prevalence of overweight and obesity among at-risk groups: 13.0% of adolescents, 35.9% of women of reproductive age (15 to 49 years), and 30.6% of lactating women. Moreover, 30.2% of adults are overweight, and 10% are obese. Among young adults aged 20 to 29, 19.9% are overweight, while 7.2% are obese [11]. Considering this growing prevalence of overweight and obesity in the country, particularly among young adults who are the predominant users of OFD platforms [12], the implications of OFD platforms could be of significant public health concern since the frequent use of these platforms could lead to poor diet quality and an increased risk for excess weight gain [13]. Moreover, early adulthood represents a crucial phase where emerging lifestyle behaviors persist in the future and, thus, have considerable health consequences in the succeeding life stages [14].

Several studies have produced conflicting results regarding the association between OFD platform usage and nutritional status, possibly due to the differences in methods, population, and cultures. For instance, a multi-country study among participants across Australia, Canada, Mexico, the UK, and the USA found no association between OFD service usage and weight status [15]. Conversely, research among interns at medical and dental colleges in India suggested that obesity was associated with purchasing junk food or fried snacks from OFD platforms [16]. In Indonesia, a correlation was found between nutritional status and the frequency of online food ordering among students, but not with the types of food purchased [17]. Another study among female students in Malaysia revealed that BMI categories were not related to the frequency of OFD usage. Still, there was a direct relationship between the OFD usage frequency and waist circumference [18].

Additionally, no significant association was found between nutritional status and the frequency

of online food ordering among work-from-home workers in Jakarta, Indonesia [19]. Despite the existing research, there remains limited knowledge regarding the influence of OFD platform utilization on consumers' nutritional status, particularly among Filipino college students who were found to have the highest compulsive internet use, social media use, and general app usage scores among low- and middle-income countries (i.e., India, Mexico, Turkey) during the pandemic [20]. Related literature mainly focused on the correlation between nutritional status and frequency of OFD usage. In contrast, expenditure per transaction, platform used, and food category purchased are rarely studied regarding nutritional status.

Hence, this study sought to analyze the relationship between OFD platform utilization and the nutritional status of sophomore college students at the University of the Philippines Los Baños (UPLB), considered young adults, during the pandemic. Specifically, this study aimed to (1) describe the respondents' socioeconomic and demographic profiles, (2) characterize their OFD platform usage in terms of usage frequency, average expenditure per transaction, most frequently used platform, and most frequently purchased food item category, (3) determine their primary reasons for using OFD platforms, (4) collect recommendations on how OFD platforms can promote healthier food choices, and (5) assess their nutritional status based on self-reported weight and height.

Given the increasing prevalence of both OFD service utilization and overweight and obesity in the Philippines, there is a significance in conducting such studies to recognize and further understand the potential nutrition impacts of OFD usage in the local public health scene. It opens opportunities to develop multi-sectoral strategies that can hamper the transgenerational cycle of obesity and associated diseases, aligning directly with the United Nations' Sustainable Development Goals (SDGs), particularly SDG 2: Zero Hunger, and SDG 3: Good Health and Well-being. The public health sector can utilize the results of this study to formulate policies related to OFD services and promote healthier eating habits among the population. As for the foodservice industry, both the food establishments and the OFD sector can utilize this study to understand consumers' purchasing behavior better and improve their services while considering the health and nutrition of their patrons.

2 Methodology

2.1 Study Design and Participants

This study utilized an analytical cross-sectional study design to explore the relationship between OFD platform usage and nutritional status at a specific time. A remote setup was employed in this research due to restrictions brought about by the pandemic.

The participants of this study were sophomore college students aged 18 years old and above, as they were associated with the highest odds of obesity compared with other year levels [21], and their average fat consumption was found to exceed the upper limit of the recommended intake [22]. Acknowledging that UPLB serves as a dynamic and diverse community of individuals, it would be advantageous to utilize students from this university as respondents. These students reflect the rich tapestry of cultural and sociodemographic characteristics found throughout the Philippines, thereby fostering inclusivity for minorities and underrepresented groups.

The inclusion criteria for the respondents were as follows: (1) they must be second-year students from batch 2021 and enrolled at UPLB during the first semester of the academic year 2022-2023, and (2) they must have ordered ready-to-eat food items through any OFD platforms at least once. Pregnant or lactating women were excluded from this study as they typically experience considerable weight gain to support their growing offspring. This screening for pregnancy or lactation aimed to reduce variance in the study results, particularly in terms of nutritional status.

2.2 Sampling Method

The respondents were selected via a stratified random sampling method. The population was stratified based on the Becher-Biglan typology of academic discipline, which was based on the social dimension of academic disciplines [23] and consists of four main types of groups: Hard Pure, Soft Pure, Hard Applied, and Soft Applied disciplines. The degree programs were classified according to the characteristics of each discipline, as shown in Table 1. Students with degree programs categorized under the same stratum were pooled and then sampled proportionately using simple random sampling.

Table 1. Categorization of the degree programs based on the Becher-Biglan Typology of Academic Disciplines

Academic Disciplines	Definition	Degree Programs	
Hard Pure	emphasize explanations and discoveries of things	• Biology • Chemistry	• Mathematics • Statistics
Soft Pure	focus on understanding and interpretation	• Communication Arts • Economics	• Philosophy • Sociology
Hard Applied	highlight products and techniques	• Agricultural and Biosystems Engineering • Agricultural Biotechnology • Agricultural Chemistry • Agriculture • Applied Mathematics • Applied Physics • Chemical Engineering • Civil Engineering • Computer Science	• Electrical Engineering • Food Science and Technology • Forestry • Industrial Engineering • Mechanical Engineering • Nutrition • Veterinary Medicine
Soft Applied	concentrate on processes and protocols	• Agribusiness Management and Entrepreneurship • Agricultural and Applied Economics	• Development Communication • Human Ecology • Mathematics and Science Teaching

A confidence level of 95% and a 5% acceptable margin of error were used. Since the standard deviation of the sophomore college students was unknown, a standard deviation of 0.5 was utilized to ensure that the sample size would be sufficiently large to represent the target population accurately. The sample size was computed using Cochran's formula for infinite population size (Equation 1).

$$n_0 = \frac{z^2 pq}{e^2} \tag{1}$$

where, n_0 is the sample size, z is the selected critical value of the desired confidence level, p is the estimated standard deviation of the population, q is equal to 1 minus p, and e is the acceptable margin of error.

Since the population size was known, Cochran's correction formula was then applied (Equation 2).

$$n_1 = \frac{n_0}{1 + \frac{n_0 - 1}{N}} \tag{2}$$

where, n_0 is the sample size derived from the previous equation, and N is the population size.

Proportionate sampling was utilized to determine the sample size for each stratum, which would serve as the minimum frequency of responses to be satisfied to maintain confidence and ensure a statistically representative dataset. However, considering the 30% optimistic response rate typically observed in online surveys, the number of students targeted for participation was increased Equation 3 to meet the minimum required quota of responses. The number of targeted participants per stratum was then adjusted accordingly.

$$n_2 = \frac{n_1}{anticipated\ return\ rate} \tag{3}$$

where, n_2 is the adjusted number of targeted participants, n_1 is the sample size derived from Cochran's correction formula, and the anticipated return rate is the optimistic response rate equivalent to 30%.

The data collection concluded after fulfilling the minimum frequency of responses for all strata. Figure 1 summarizes the sampling method utilized in this study.

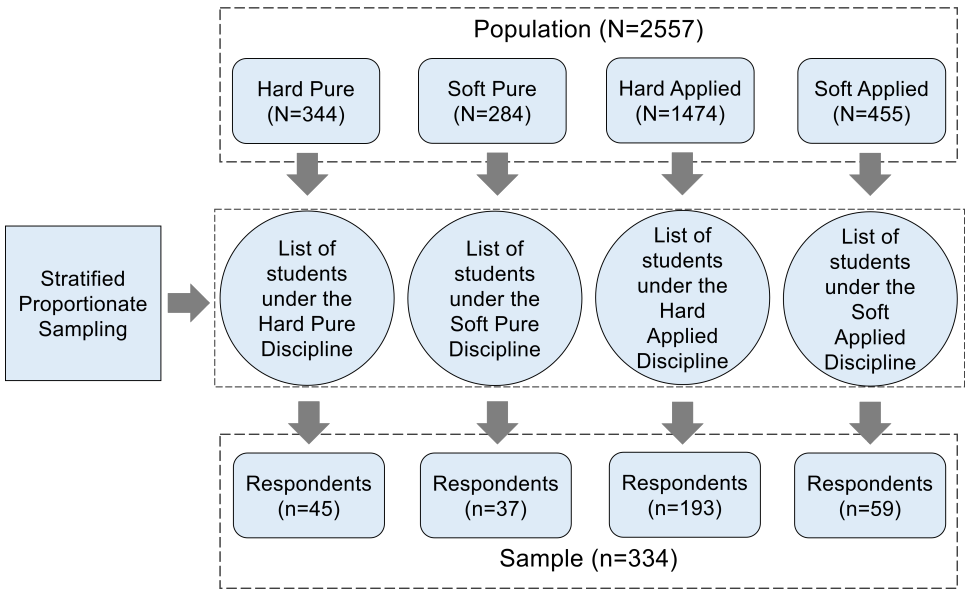

Figure 1.
Flowchart of the stratified proportionate sampling method

2.3 Data Collection Methods

The pertinent data was obtained through an online self-administered questionnaire via Google Forms, which underwent content validity assessment and pre-testing before the actual data gathering. Data collection was performed through the assistance of the UPLB Office of the University Registrar (OUR). The questionnaire was disseminated to the randomly selected respondents through email.

In compliance with the Republic Act No. 10173 or the Philippine Data Privacy Act of 2012, all respondents were requested to complete the informed consent form beforehand to ensure their voluntary participation, given all the necessary details about the study and the possible risks and benefits associated with participating. Moreover, all obtained data were treated with anonymity and confidentiality and strictly utilized for the specific purpose indicated in this study.

The questionnaire primarily comprised the informed consent form, participant screening section, and proper questionnaire. The data acquired from the respondents encompassed the socioeconomic and demographic profile, self-reported height and weight measurements, and OFD platform usage in terms of usage frequency, average expenditure per transaction, most frequently used platform, and most purchased food item category. Their main reasons for utilizing OFD platforms were also determined, as well as their recommendations for how OFD platforms can promote healthier food choices.

2.4 Data Analysis

The data obtained was analyzed using a combination of descriptive and inferential statistics. Descriptive statistics were used to profile the respondents, and the results were presented as frequencies, percentages, and ranks. The self-reported height and weight raw data were used to compute the BMI of the respondents using Equation 4.

$$BMI = \frac{weight(kg)}{height^2(m)} \tag{4}$$

Following the computation of BMI data, the nutritional statuses of the respondents were determined using the WHO BMI cut-off points, as shown in Table 2.

Table 2. Nutritional status based on WHO BMI cut-off points

Nutritional Status	WHO BMI Cut-Off (kg/m^2)
Underweight	< 18.5
Normal	18.5 – 24.9
Overweight	25 – 29.9
Obese Class I	30 – 34.9
Obese Class II	35 – 39.9
Obese Class III	≥ 40

Meanwhile, inferential statistics was used to analyze the associations between the variables. Fisher's exact test of independence was utilized since variables in this study were reported as categorical data, and the combinations of categories had expected values lower than five (5). A p-value of less than or equal to 0.05 was considered statistically significant.

A summary of the methodology employed in this study is presented in Table 3.

Table 3. Summary of the methodology

Component	Description
Study Design	• Analytical cross-sectional approach • Remote setup
Participants	• Sophomore college students at UPLB Inclusion criteria: ○ from batch 2021 and enrolled at UPLB during the first semester of the academic year 2022-2023 ○ ordered ready-to-eat food items through any OFD platforms at least once Exclusion criteria: ○ pregnant ○ lactating
Sampling Method	• Stratified proportionate sampling method • Strata: Becher-Biglan typology of academic discipline • Confidence level: 95% • Acceptable margin of error: 5% • Standard deviation: 0.5 • Population size: 2557 Sample size/ Quota of responses ○ Hard Pure = 45 ○ Soft Pure = 37 ○ Hard Applied = 193 ○ Soft Applied = 59 TOTAL = 334 Number of students targeted for participation ○ Hard Pure = 150 ○ Soft Pure = 124 ○ Hard Applied = 642 ○ Soft Applied = 198 TOTAL = 1114
Data Collection Methods	• Online self-administered questionnaire via Google Forms • Mode of communication – email • Accomplished informed consent forms were obtained Data obtained: ○ Anthropometric data (height and weight) ○ Socioeconomic and demographic characteristics ○ OFD platform details (usage frequency, average expenditure per transaction, most frequently used OFD platform, most frequently purchased food item category, reasons for using OFD platforms, and recommendations)
Data Analysis	• BMI from self-reported height and weight data • Nutritional status using the WHO BMI cut-off points Descriptive statistics ○ percentages – for most categorical data ○ frequencies and ranks – multiple-answer questions Inferential statistics ○ associations between variables ○ Fisher's exact test of independence - since combinations of categories had expected values lower than five ○ A p-value of ≤ 0.05 was considered statistically significant.

3 Results

3.1 Socioeconomic and Demographic Profile

Out of 402 sophomore students from UPLB who willingly participated in the study, only 358 were qualified. Table 4 shows the percentage distribution of the respondents according to their demographic characteristics. Most participants were female (67.88%) students. Their age ranged from 18 years old, being the youngest, to 24 years old, being the oldest. About 46.65% of the participants were 20 years old, while 44.13% were 19 years of age. Most respondents lived in Region IV-A - CALABARZON (84.08%) and stayed in their respective dorms (60.34%) during the first semester of the academic year 2022-2023.

Regarding food access, most respondents lived within one kilometer of a food market (75.42%) and within one kilometer of a food establishment (81.01%). Moreover, Table 5 presents the socioeconomic profile of the respondents. Approximately 27.09% of the respondents had an estimated family income of 13,001 to 25,000 pesos per month, while about 24.86% had 25,001 to 49,000 pesos per month. This means most respondents belonged to low-income but not poor households, followed by lower-middle-income households. More than half of the participants (58.38%) reportedly allotted about 40 to 50% of their monthly family expenditure on food. In terms of transportation, approximately 31.84% of the respondents seemingly allocated less than 301 pesos monthly. Meanwhile, when asked about their access to technology, all respondents reportedly had their gadgets, with the majority having two gadgets: a laptop and a smartphone (49.44%). Most of the respondents had unlimited access to the Internet (79.05%), which means they could access the Internet at any time without restrictions and additional charges.

3.2 OFD Platform Usage

The respondents' frequency of OFD platform usage, average expenditure per OFD transaction, most commonly used OFD platform, and most frequently purchased food item category from OFD platforms are all presented in Table 6. Around 44.41% of the participants used OFD platforms once to thrice per month, while approximately 40.22% used them less than once a month. Nearly half of the respondents (44.69%) reportedly spent less than 251 pesos per OFD transaction, while about 41.90% spent 251 to 500 pesos. FoodPanda was the most popular OFD platform, used by about 54.75% of the respondents, followed by GrabFood (26.54%), restaurant-based delivery platforms (16.20%), and area-specific delivery services (2.51%) such as Order Ready, Elbi Delivery, and Bring It On. Most participants (65.92%) reported purchasing Meat or Meat-Based Meat Alternatives most frequently, while 14.25% purchased Cereal or Cereal-Based Mixed Meals most frequently.

3.3 Reasons for Using OFD Platforms

Table 7 summarizes their various reasons for using OFD platforms. When the respondents were asked about their OFD motivations, the top 5 answers arranged in order were the following: 1) To save my time instead of buying food/beverages by myself; 2) To reduce my travel effort to buy food/beverages; 3) To lessen chores associated with cooking; 4) To satisfy my cravings for food during COVID-19 pandemic; and, 5) To purchase food items that I can't cook when I am lazy to go out. Among the options presented in the questionnaire, the least common reason cited by participants was compliance with social distancing regulations. Additionally, some respondents mentioned other reasons, such as feeling sick due to fluctuating symptoms of irritable bowel syndrome (IBS) and having difficulty cooking in their dormitory.

Table 4. Demographic profile of the respondents

Variable	Description	Percentage (%)
Sex (at birth)	Female	67.88
	Male	32.12
Age (years)	18	1.68
	19	44.13
	20	46.65
	21	6.42
	22	0.84
	24	0.28
Region of current residence	Cordillera Administrative Region (CAR)	0.28
	National Capital Region (NCR)	9.50
	Region I – Ilocos Region	0.84
	Region II – Cagayan Valley	0.28
	Region III – Central Luzon	2.79
	Region IV-A – CALABARZON	84.08
	Region IV-B – MIMAROPA	0.28
	Region V – Bicol Region	0.56
	Region VIII – Eastern Visayas	0.84
	Region X – Northern Mindanao	0.28
	Region XI – Davao Region	0.28
Place currently staying	Dorm	60.34
	Home	39.66
Residing within 1 km of a food market	No	24.58
	Yes	75.42
Residing within 1 km of a food establishment	No	18.99
	Yes	81.01

Table 5. Socioeconomic profile of the respondents

Variable	Description	Percentage (%)
Estimated monthly family income (pesos)	< 13,001	10.89
	13,001 – 25,000	27.09
	25,001 – 49,000	24.86
	49,001 – 85,000	16.48
	85,001 – 145,000	9.50
	145,001 – 250,000	4.75
	> 250,000	6.42
Estimated monthly family income allotted for food (%)	<40	25.70
	40 – 50	58.38
	>50	15.92
Monthly budget allotted for transportation (pesos)	<301	31.84
	301 – 600	30.45
	601 – 900	13.97
	901 – 1,200	10.61
	>1,200	13.13
Access to technology:		
1. Have your own gadget/s?	Yes	100.00
2. Gadget/s available	Desktop computer	0.28
	Desktop computer, laptop, & smartphone	4.75
	Desktop computer, laptop, smartphone, & tablet	3.07
	Desktop computer & smartphone	2.51
	Desktop computer, smartphone, & tablet	0.84
	Laptop	1.68
	Laptop & smartphone	49.44
	Laptop, smartphone, & tablet	9.50
	Laptop & tablet	0.28
	Smartphone	25.14
	Smartphone & tablet	2.51
3. Level of access to the Internet	Limited access	20.95
	Unlimited access	79.05

Table 6. OFD platform usage of the respondents

Variable	Description	Percentage (%)
OFD platform usage frequency	<1 time per month	40.22
	1-3 times per month	44.41
	1-2 times per week	10.89
	≥3 times per week	4.47
Average expenditure per transaction	< 251 pesos	44.69
	251 – 500 pesos	41.90
	501 – 750 pesos	6.70
	751 – 1,000 pesos	4.19
	1,001 – 1,500 pesos	1.68
	> 1,500 pesos	0.84
Most frequently used OFD platform	Area-specific delivery service provider	2.51
	FoodPanda	54.75
	GrabFood	26.54
	Restaurant-based delivery platform	16.20
Most frequently purchased food item category from the OFD platform/s	Baked Goods/Desserts	2.51
	Cereal or Cereal-Based Mixed Meal	14.25
	Fat & Oils / Savory Sauces, Condiments & Spreads	0.56
	Fruit or Fruit-Based Mixed Meal	0.28
	Iced Confectionary & Dairy-Based Desserts	1.40
	Meat or Meat-Based or Meat Alternative	65.92
	Milk & Milk Products or Milk Based	6.42
	Other Beverage	4.19
	Root crops & Products and Others	0.56
	Sugar-Sweetened Beverages	3.63
	Vegetable or Vegetable-Based Mixed Meal	0.28

Table 7. Reasons for Using OFD Platforms

Variable	Frequency (n)	Rank
To save my time instead of buying food/beverages by myself	285	1
To reduce my travel effort to buy food/beverages	284	2
To lessen chores associated with cooking	191	3
To satisfy my cravings for food during COVID-19 pandemic	184	4
To purchase food items that I can't cook when I am lazy to go out	169	5
To order food from anywhere and anytime	164	6
Availability of a variety of food in OFD platforms from multiple restaurants	118	7
I feel that discount provided encourages me to use OFD services	85	8
It is cheaper than dining in a food establishment because of offers on online orders	51	9
I have had good experiences with the quality of food and service from OFD platforms	39	10
To comply with social distancing regulations	35	11
Other (I was feeling sick due to fluctuating symptoms of IBS)	1	12.5
Other (It's difficult to cook at the dorm)	1	12.5

3.4 OFD Platform Recommendations

The respondents' recommendations regarding OFD platforms are summarized in Table 8. When asked about how OFD platforms can promote healthier food choices, their top 5 answers were as follows: 1) provide additional nutrition information such as calories, nutrients, allergens, etc.; 2) offer promotions, especially for healthy food options, such as discount vouchers, free delivery, etc.; 3) include healthy eating tips such as recommended serving size, cooking, and preparation methods, etc. in OFD apps; 4) recommend healthier alternatives to previously ordered meals; and, 5) restructure the menu to highlight healthier options.

Table 8. Recommendations on how OFD platforms can promote healthier food choices

Variable	Frequency (n)	Rank
Provide additional nutrition information such as calories, nutrients, allergens etc.	287	1
Offer promotions, especially for healthy food options, such as discount vouchers, free delivery etc.	273	2
Include healthy eating tips such as recommended serving size, cooking and preparation methods etc. in OFD apps	216	3
Recommend healthier alternatives to previously ordered meals	209	4
Restructure the menu to highlight healthier options	192	5
Complement each order with free fruits	179	6
Limit unhealthy food choices in OFD apps and replace with more healthy options	111	7
Set healthy items as defaults	106	8
Others (Make healthier options more accessible and not more expensive than the others in the menu)	1	10
Others (Provide a meal tracker and determine whether the food consumed within the past few days are healthy food choices or not)	1	10
Others (I think what would weigh the most is if they actually offered healthy foods that are delicious.)	1	10

3.5 Nutritional Status

The nutritional status of the respondents based on their BMI, as calculated using their self-reported height and weight, is shown in Table 9. Approximately 61.17% of the respondents had a normal nutritional status. Meanwhile, 21.51% of the participants were underweight, 12.57% were overweight, and 4.75% were obese.

Table 9. Nutritional status of the respondents

Variable [a]	Percentage (%)
Normal (BMI 18.5 – 24.9)	61.17
Obese (BMI >30) [b]	4.75
Overweight (BMI 25 – 29.9)	12.57
Underweight (BMI <18.5)	21.51

[a] *According to WHO BMI cut-off*

[b] *Obese Class I, Obese Class II, Obese Class III are clustered into Obese*

Table 10. Association between the usage of OFD platform and the nutritional status of the respondents

Variable	Nutritional status (%)				P-value α
	Normal	Obese	Overweight	Underweight	
OFD platform usage frequency					
<1 time per month	41.55	29.41	40.00	38.96	0.307
1-3 times per month	44.75	41.18	37.78	48.05	
1-2 times per week	10.96	17.65	11.11	9.09	
≥3 times per week	2.74	11.76	11.11	3.90	
Average expenditure per transaction					
< 251 pesos	46.58	23.53	40.00	46.75	0.108
251 - 500 pesos	42.47	58.82	35.56	40.26	
501 - 750 pesos	5.94	5.88	11.11	6.49	
751 - 1,000 pesos	2.28	5.88	13.33	3.90	
1,001 - 1,500 pesos	1.83	0.00	0.00	2.60	
> 1,500 pesos	0.91	5.88	0.00	0.00	
Most frequently used OFD platform					
Area-specific	0.91	11.76	6.67	2.60	0.084
FoodPanda	54.79	47.06	51.11	58.44	
GrabFood	28.31	11.76	24.44	25.97	
Restaurant-based	15.98	29.41	17.78	12.99	
Most frequently purchased food item category from the OFD platform/s					
Baked Goods/Desserts	3.20	0.00	2.22	1.30	0.473
Cereal or Cereal-Based…	12.79	29.41	13.33	15.58	
Fat & Oils or Savory Sauces…	0.91	0.00	0.00	0.00	
Fruit or Fruit-Based…	0.00	0.00	2.22	0.00	
Iced Confectionary & Dairy-Based	1.83	0.00	2.22	0.00	
Meat or Meat-Based…	62.10	64.71	73.33	72.73	
Milk and Milk Products…	8.68	0.00	2.22	3.90	
Other Beverage	5.48	5.88	2.22	1.30	
Root crops & Products…	0.00	0.00	0.00	2.60	
Sugar-Sweetened Beverages	4.57	0.00	2.22	2.60	
Vegetable or Vegetable-Based	0.46	0.00	0.00	0.00	

3.6 Association Between OFD Platform Usage and Nutritional Status

Table 10 shows the association between the respondents' nutritional status and their usage of OFD platforms, particularly in frequency, average expenditure per transaction, most used platform, and most purchased food item category. The majority of the participants with normal nutritional status used OFD platforms once to thrice per month (44.75%), followed by less than once per month (41.55%), once to twice per week (10.96%), and at least thrice per week (2.74%). This trend was consistent among underweight or obese respondents. In contrast, the percentage of overweight individuals decreased with increasing OFD platform usage frequency.

Regarding the average expenditure per OFD transaction, most respondents with normal, overweight, or underweight status spent less than 251 pesos per transaction (46.58%, 40.00%, and 46.75%, respectively), followed by 251 to 500 pesos per transaction (42.47%, 35.56%, and 40.26%, respectively). On the contrary, more than half of obese respondents reportedly spent between 251 to 500 pesos per transaction (58.82%), with only 23.53% spending less than 251 pesos per OFD transaction.

With respect to the most frequently used OFD platform, FoodPanda emerged as the predominant choice among the majority of the students with normal (54.79%), obese (47.06%), overweight (51.11%), and underweight (58.44%) nutritional statuses. The second most used platform for participants with normal, overweight, or underweight status was GrabFood. Conversely, restaurant-based delivery platforms were the second most used platform among participants who were obese.

For the most frequently purchased food group, a quite similar pattern was observed among each nutritional status. The Meat or Meat-Based or Meat Alternative group was the primary food category purchased on OFD platforms by more than half of the participants with either normal (62.10%), obese (64.71%), overweight (73.33%), or underweight (72.73%) nutritional status, followed by the Cereal or Cereal-Based Mixed Meal group.

Statistical analysis revealed that the computed p-values for each combination of categories were all greater than the set significance level, indicating no significant evidence of an association between the respondents' nutritional status and OFD platform usage.

4 Discussion

4.1 OFD Platform Usage

According to the results of this study, most sophomore college students used OFD platforms once to thrice a month, followed by less than once a month. Furthermore, the findings of this study revealed that a considerable percentage of students declared spending less than 251 pesos per transaction on OFD platforms and 251 to 500 pesos per transaction. Similar results were also discovered among Indonesian university students who ordered through the OFD platform, which is relatively rare [17]. In Malaysia, most public university students reportedly used OFD platforms either rarely, less than once a month (41.40%), or 1 to 3 times per month (40.30%). The same study also revealed that Malaysian students usually spend 15 to 19 Malaysian ringgit per transaction [24] or approximately 189 to 240 pesos if converted into Philippine currency. These findings are reasonable considering the respondents were college students, and most were more likely to rely on their fixed monthly allowances. Students must often choose between food and other necessities, including rent, utilities, medications, and transportation [25]. With higher expenditure on items such as rent and other necessities, students usually place food on their lowest priority, using only the remaining budget [26, 27]. Additionally, since a considerable percentage of respondents came from low-income to lower-middle-income households, their access to OFD services would likely be minimal due to their limited purchasing power.

Moreover, it was presented that the OFD platform most patronized by most students was FoodPanda, followed by GrabFood, the two most prominent delivery platforms in the Philippines.

Consumer satisfaction with the services of these OFD platforms had a positive impact on their frequency of usage [28]. According to a comparative study of OFD applications in the Philippines, FoodPanda acquired higher average scores than GrabFood in terms of the following criteria: availability of food and restaurant choices, flexibility of payment methods, availability of promos and offers, delivery fee, and speed of delivery. Among these factors, speed of delivery was determined as their primary consideration in utilizing a food delivery service, followed by security and safety and availability of food and restaurant choices [29]. Consequently, consumers generally prefer FoodPanda over GrabFood due to their higher satisfaction with FoodPanda's services.

In addition, it was found from this current study that the majority of the students were most frequently purchasing Meat or Meat-Based Meat Alternatives from OFD platforms, which is true despite the meat category being only the second largest group on OFD platforms while having the highest median price among all other categories [30]. This current finding could be attributed to adult Filipinos consuming meat products as the second most consumed food category in a day, next to cereals or rice [31]. However, unlike cereals or rice, meat-based products are usually more tedious to prepare, which adds to the daily food preparation chores. Therefore, purchasing ready-to-eat Meat or Meat-Based or Meat Alternative items was more convenient for the respondents than preparing them in their dormitories or homes as it reduces the hassle of additional chores, which was among their primary reasons for utilizing OFD services. Furthermore, most respondents were residing in dormitories, which usually have cooking restrictions limiting their capability to prepare food independently.

These findings could assist the OFD service providers and their partner food merchants in understanding the profile of their consumers, especially if they plan to conduct targeted marketing to students. They could focus on making necessary adjustments in terms of price, service, and food offerings. Since the price directly influences actual OFD use [32] and the capability to purchase, OFD platforms could provide discounts and special offers within the students' food allowance to engage more of their target customers. Moreover, as efficiency in service highly influences the consumers' preference on which platform to utilize, OFD service providers could improve their speed of delivery, security and safety, availability of food and restaurant choices, and geographical reach in the country. Meat or Meat-Based Meat Alternative items are the most popular ordered items, so OFD platforms could highlight this category and provide diverse options of this type, particularly healthier items, to captivate students' interest.

4.2 Reasons for Using OFD Platforms

It was observed that the main reasons provided by the respondents for utilizing OFD services revolved around convenience, i.e., to save time, to reduce travel effort, and to lessen chores associated with cooking. These results aligned with previous studies indicating that convenience was among the main reasons for utilizing OFD services [2, 18, 33]. In the Philippines, a study conducted by Flores and Castaño [34] revealed that about 94.50% of Filipinos residing in the NCR found OFD services more convenient than purchasing food physically.

This consumer behavior could also be tracked down to the rampant urbanization in the country. According to the Philippine Statistics Authority's Census of Population and Housing [35], the urbanization rate in the Philippines during 2020 was 2.8% higher than the 51.2% rate in 2015. This trend towards urbanization resulted in a fast-paced environment with busier people who prefer convenience through OFD services patronization [32, 36]. The desire for convenience could also be rooted in favorable lifestyle changes, which drastically modify consumer's daily routines, lives, and eating habits [36, 37, 38]. Furthermore, according to Sievert et al. [39], restrictions on time and available cooking space are due to the shift towards urban living in pursuit of better education and job opportunities. This is highly applicable in the present study, considering that the participants were students who often have hectic academic schedules, and most of them were staying in

dormitories that might impose cooking restrictions.

Since convenience is one of consumers' principal rationales for OFD usage, involved sectors can utilize this information to encourage healthier food choices by increasing the convenience of healthy food options in OFD platforms [6].

4.3 OFD Platform Recommendations

The recommendations provided by the respondents could be utilized by policymakers and the food and beverage sector in drafting interventions that promote healthy eating behaviors and knowledge-based decisions among OFD consumers. Among the suggestions most students gave was the inclusion of additional nutrition information on food items, such as calories, nutrients, and allergens. Previous research has shown that nutrition-labeled menus positively influence customers' purchasing intention by awakening their nutritional awareness [40]. However, nutrition labels could only increase the possibility of consumers noticing the calorie information. Still, they would not constantly mean a better approximation of calories purchased [41, 42] and some consumers would still opt not to pay attention to the calorie information provided [43]. All these findings from previous studies suggest that adding nutrition information to meals on OFD platforms will not automatically lead to healthier food choices. As a prerequisite, consumers need to have sufficient nutrition knowledge to fully understand the implications of these labels and translate this knowledge into desired behavior modification. Hence, it is vital to make accurate nutrition and health information accessible to the public and have active nutrition education interventions. Additionally, further recommendations and complementary interventions should be considered.

4.4 Nutritional Status

The 2021 Expanded National Nutrition Survey (ENNS) by the Department of Science and Technology - Food and Nutrition Research Institute (DOST-FNRI) showed that among adults aged 20 to 29, about 58.5% had normal nutritional status, 14.4% had chronic energy deficiency, 19.9% were overweight, and 7.2% were obese [7]. An almost similar pattern was observed in this current study as more than half of the sophomore students had normal nutritional status (61.17%), while 21.51% were underweight, 12.57% were overweight, and 4.75% were obese. Additionally, it is worth mentioning that both the percentages of overweight and obese students were significantly lower than the national percentage. However, unlike the national trend, this paper revealed a greater proportion of underweight students than overweight, and the prevalence of underweight respondents was considerably greater than the national prevalence. According to the WHO cut-off values for public health significance, the 21.51% prevalence of underweight students in this study is considered high [44]. In contrast, no established cut-offs were provided for overweight and obesity in adults.

These findings highlight the need for collaboration between public health and related sectors to alleviate malnutrition and its root causes, minimizing further repercussions. Similarly, there is a need to intensify the programs and policies that efficiently address malnutrition at a faster rate to achieve national and global targets.

4.5 Association Between OFD Platform Usage and Nutritional Status

This is the first known study to investigate the correlation between nutritional status and expenditure per transaction, platform used, and most purchased food category by OFD users. The statistical analysis revealed that no association was found between students' nutritional status and their OFD platform usage in terms of frequency (= 0.307), average expenditure per transaction (= 0.108), most frequently used platform (= 0.084), and most frequently purchased food item category (= 0.473). These findings align with previous studies among students, revealing no correlation between the frequency of OFD usage and nutritional status [18, 45, 46]. However, these contradict studies

showing a significant relationship between nutritional status and OFD usage frequency [17, 47, 48].

The current findings could be ascribed to several reasons. First, the distribution of categories per nutritional status was nearly comparable, leading to similar results across all OFD usage categories. Second, the study utilized a cross-sectional design, where both the respondents' OFD usage (exposure) and the nutritional status (outcome) were measured simultaneously. This could result in recall bias since the participants' prior knowledge of the subject might affect how accurately they report the exposure or the outcome [49]. Additionally, the anthropometric data used to compute the BMI and determine the nutritional status were self-reported by the participants only, which could lead to underreporting or overreporting depending on the respondents' judgment and the accuracy of the measuring device. Furthermore, relying solely on BMI to determine nutritional status may compromise data quality, as it may not accurately measure individuals' body composition and poses limitations in evaluating adiposity in those with varying muscle mass [50].

The inconsistent results from related studies suggest that more comprehensive research must be conducted concerning this topic to establish the potential of OFD service usage in directly influencing the nutritional status of patrons. Future research could consider employing alternative anthropometric methods, such as waist circumference, to differentiate between excess body fat and muscle and determine their distribution in the body. This would provide a more accurate indicator of health status. It is also highly recommended that the researchers perform anthropometric measurements to ensure the accuracy and precision of the data collected. Furthermore, future studies could develop and utilize a food frequency questionnaire (FFQ) to obtain a more specific description of the food items purchased and consumed through OFD platforms, including frequency, portion size, and nutritional content. Ultimately, employing a prospective longitudinal study design would help reduce possible recall bias and investigate the potential cause-and-effect relationships between variables. These measures would facilitate a more profound understanding of the association between OFD platform usage and nutritional status, guiding consumers in making healthier food choices and assisting the public health sector in drafting feasible nutrition interventions.

In 2015, all United Nations Member States adopted the 2030 Agenda for Sustainable Development, which consists of seventeen (17) Sustainable Development Goals (SDGs). These goals address critical issues related to poverty, hunger, health, education, gender equality, and sustainability [51]. As OFD affects how people eat, work, and care for the environment, the emergence of these services directly influences achieving these SDGs, either facilitating or impeding the current progress.

The 2nd SDG aims to eliminate hunger and malnutrition by ensuring everyone, particularly the poor and vulnerable, has access to safe, nutritious, and sufficient food year-round. This goal is closely related to SDG 3, which seeks to ensure healthy lives and promote well-being by preventing and treating communicable and non-communicable diseases [51]. Given that OFD services significantly increase the consumers' geographic access to takeaway foods [5], their alignment with SDGs 2 and 3 heavily relies on the dietary quality of food choices predominant in these platforms. Research indicates that most takeaway food items in OFD platforms have poor dietary quality and are high in calories, saturated fat or total fat, sodium, and sugar [5, 6, 7, 8]. The influences of OFD on nutritional outcomes also depend on individual consumption patterns and frequency of use. While most individuals order food online infrequently [17, 24], a clear preference for energy-dense food items is evident [4]. An unhealthy diet combined with frequent use of OFD services can increase the risk of being overweight and obese [13]. Consequently, OFD may undermine global nutrition efforts toward achieving SDGs 2 and 3, especially since several studies have revealed the potential of OFD usage to cause negative nutritional outcomes [16, 17, 47, 48]. The current challenge is to promote healthier, nutrient-dense, and sustainable food choices within OFD platforms to enhance overall health and nutrition.

The 8th SDG focuses on promoting sustained and inclusive economic growth, high levels of

productivity, and decent work for all [51]. The food and beverage sector faced setbacks during the COVID-19 pandemic due to the restrictions on dining services, leading them to rely on OFD services for their business to thrive [2, 4]. The increasing trend in OFD services sustained the catering and restaurant sector and facilitated new job opportunities for chefs, restaurant administrative staff, delivery personnel, and programmers behind OFD platforms. Moreover, food delivery also stimulated the growth of supporting industries, including those involved in vehicle sales and servicing and food packaging production and distribution [1]. While OFD supports SDG 8 by producing job opportunities and sustaining the workforce, there exist concerns regarding the poor working conditions and health and safety issues faced by delivery riders [52], often leading to decreased job satisfaction and high employee turnover rates [53].

Other sustainable goals associated with food delivery include SDG 12, which encourages responsible consumption and production, and SDG 13, which addresses climate action [51]. The increasing patronization of OFD services aggravates issues such as packaging waste and greenhouse gas emissions from food production and delivery, contributing to the disruption of natural environments [54]. Single-use plastic materials, which are often used as packaging and utensils for takeaway food items due to their lightweight and durable characteristics, significantly contribute to this problem. For instance, over 500 million plastic bags were used within the 30-day lockdown period in China during the pandemic [55]. The environmental impact of plastic use is severe since most commonly used plastics are not fully biodegradable, leading to accumulation in landfills and marine ecosystems [56]. In 2018, around 27.6 million orders were placed via the top three OFD platforms in Australia, resulting in 5,600 tons of carbon dioxide-equivalent emissions (CO2e) related to packaging production and disposal, and is expected to reach 13,200 tons CO2e by 2024 [57]. Considering all these issues, there is an urgent need to realign OFD practices with SDGs 12 and 13 through implementing sustainable measures, promoting eco-friendly packaging, optimizing delivery routes, and other carbon emission reduction measures.

5 Conclusion

The community quarantine and health protocols associated with the COVID-19 pandemic resulted in the upswing of OFD services globally, making food purchasing possible and convenient for consumers. This growing OFD trend is presumed to persist even after the surge of COVID-19 cases, and OFD platforms will likely have noteworthy implications on consumers' eating habits and diet quality. Understanding the impacts of gradual OFD services patronization could be substantial, especially now that malnutrition in the Philippines is swiftly increasing. The frequent utilization of OFD platforms, with the consideration of the type of food consumed, may lead to patrons consuming poor-quality diets, ultimately leading to overweight and obesity. However, there is a lack of information discussing the relationship of these platforms on the health and nutrition of consumers, especially among Filipino college students. Hence, this analytical cross-sectional study was conducted to determine the association between the utilization of OFD platforms and the nutritional status of sophomore college students at UPLB.

Based on the statistical analysis, there was insufficient evidence to assert that the students' OFD platform usage and nutritional status were related. This result could be attributed to several factors: 1) the distribution of categories per nutritional status being nearly similar, 2) the utilization of a cross-sectional study design, 3) reliance on self-reported anthropometric data, and 4) solely relying on BMI for nutritional assessment. With these in mind, future studies could employ other anthropometric methods, especially those that assess body composition. Additionally, to guarantee the accuracy and precision of the data, researchers could perform the anthropometric measurements themselves. For a more comprehensive investigation, the specific description of the respondents' consumed food items could also be obtained through a food frequency questionnaire (FFQ). Lastly, a prospective longitudinal study could be conducted to minimize potential sources of recall bias

and further explore associations between variables, particularly the possible cause-and-effect relationship.

While this study failed to prove a direct association between OFD usage and nutritional status, it revealed significant findings regarding students' characteristics in connection with OFD services utilization. The students' frequency of utilizing OFD platforms, which they found convenient, was only once to thrice per month. It was logically inconsistent since they regarded convenience as important daily. However, this result was reasonable considering that students might be relying on fixed allowances, especially for food, as reflected in their OFD expenditure of less than 251 pesos per transaction. Furthermore, students were more inclined to utilize the FoodPanda app and order food items classified under the Meat or Meat-Based or Meat Alternatives. These findings could serve as a basis for the OFD service providers and their partner food merchants to understand the profile of their consumers, especially if they plan to conduct targeted marketing to students.

Moreover, according to the participants, including additional nutrition information in food items was the most recommended measure that OFD platforms should take to promote healthier food choices. This suggestion could be considered by the food service industry in retrofitting their services to accommodate the customers' standards while also promoting health and wellness. However, since simply adding nutrition information to menus on OFD platforms will not instantly guarantee desirable food choices, the public health and nutrition sector has the responsibility of ensuring that people have adequate nutrition knowledge to be able to completely understand the implications of these labels, and thus promote healthier eating behavior.

This study also shed light on the current trend in the nutritional status of students. Both the percentages of overweight and obese students were significantly lower than the 2018-2019 national prevalence for ages 20-29 years old. Unlike the national trend, there was a greater proportion of underweight students than overweight, wherein the prevalence of underweight respondents was considerably higher than the national prevalence and regarded as of high public significance. These findings imply the need for extensive collaborative work between concerned sectors to extenuate undernutrition and overnutrition and achieve the national targets. Additionally, it could become a potential avenue for further investigation to appropriately and immediately address the root causes of the problem before it exacerbates. Ultimately, these results could indicate the need to reassess existing policies and programs and formulate more efficient interventions that address malnutrition, its risk factors, and its consequences.

Statements and Declarations

Funding Information

The corresponding author received a research grant from the Department of Science and Technology – Science Education Institute (DOST-SEI).

Acknowledgment

This study would not have been possible without the insightful questionnaire feedback and suggestions from the IHNF assistant professors, Paul Alteo Bagabaldo and Nica Marie Argañosa. The authors would also like to express their gratitude to Margarita Carmen S. Paterno, the UPLB University Registrar, for her invaluable assistance during the entire data collection process.

Competing Interest

The authors declare no conflicts of interest.

Ethical Considerations

Signed informed consent administered via Google Forms was obtained from all participants before the data collection. The processing and storage of information was in accordance with the Philippine Data Privacy Act of 2012.

Data Availability

The data presented in this study are available upon request from the authors.

Author Contributions

D.D.L.: conceptualization, methodology, formal analysis, investigation, data curation, writing – original draft, writing – review and editing, visualization. **A.C.C.**: conceptualization, methodology, validation, writing – review and editing, supervision. **R.T.N.F.**: conceptualization, methodology, writing – review and editing.

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