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Weight status and food insecurity among Universiti Sains Malaysia health campus undergraduate students

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Abstract

Food insecurity refers to the restricted or unsure availability of nutritionally adequate and safe foods or restricted or unsure ability to obtain foods. Most studies were conducted at the domestic level, but university students are also vulnerable to food insecurity. This study aims to determine the socioeconomic, weight status, and food insecurity among USM health campus undergraduate students. Convenience sampling was used for the recruitment of 286 respondents. Food security status was assessed using U.S. Adult Food Security Survey Module (AFSSM) derived from the U.S. Household Food Security Survey Module (HFSSM) with no child present. In addition, weight and height were obtained to assess their weight status (BMI). The results indicated that almost half (44.76%) of USM health campus undergraduate students experienced food insecurity, with 33.22% assigned as low food secure and 11.54% assigned as very low food secure. In conclusion, for socioeconomic, only family income and amount of allowance received per semester showed significant association with food insecurity, but no association was found between the primary source of allowance and food insecurity. Students with family income below RM3000 and students with an amount of allowance below RM2000 per semester were at the highest prevalence of food insecurity. There was also no significant association between food insecurity and weight status (BMI). However, it was found that being overweight was high in food-secure students, and obesity was also high in food insecure students.

1. Introduction

United States Department of Agriculture (USDA) defines food security for a household as the access by all members at all times to enough food for an active and healthy life. According to this definition, food security must include, at a minimum, adequate and safe foods that must be readily available and the secured ability to obtain food in socially acceptable manners. However, in contrast to food security, food insecurity does exist, and it refers to the restricted or unsure access to nutritionally adequate and safe foods or the capability to get foods in socially acceptable manners (Bickel *et al*., 2000). Food insecurity among university students should be given attention as the number of low-income younger generation attending universities is increasing, the cost of higher education is also increasing, and thus the issues of food insecurity will also rise (Azdie *et al*., 2019). Food insecurity is an issue because it affects people who experience it by being unable to have an adequate diet in terms of quality and quantity. For example, the economic status will affect people's affordability to purchase adequate and healthy food. They may obtain a large quantity of food, but the quality might be reduced. Thus, food insecurity is a barrier to adequate nutritional intake. Fewer servings of fruits and vegetables, milk products, and vitamins are consumed by people experiencing food insecurity compared to those in food-secure households (Mikkonen and Raphael, 2010). Food insecurity has been associated with school absenteeism and lower educational achievement, diabetes mellitus, poor mental health, obesity, and insufficient sleep (Davidson and Morrell, 2018). Therefore, health, quality of life and nutritional status will be affected by food insecurity (Ghanian, 2016). The impacts of food insecurity among university students will negatively affect their academics, physical health, social and emotional well-being (Davidson and Morrell, 2018; Azdie *et al*., 2019). However, the information on food insecurity in college populations is very limited in terms of the extent, determinants, or consequences (Pia Chaparro *et al*., 2009).

Both obesity and food insecurity are public health

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concerns (Hyochol *et al*., 2017). Obesity often co-exists with financial stress within the family environment as their access to adequate food, a healthful diet and nutrition education are limited by the lack of money and other resources. Food insecurity, or the lack of availability or access to healthful food, occurs because of insufficient money or other resources (Coleman-Jensen *et al*., 2016). Increasing and elevated obesity trends are a concern because they are related to severe health consequences such as arthritis, diabetes, hypertension, and high cholesterol (Mokdad *et al*., 2020).

Since the issue of food insecurity among university students in Malaysia is still lacking, this study was carried out to determine whether food insecurity is present among USM health campus undergraduate students and its link with weight status. As an explanation for the relationship between low food security and obesity, two hypotheses that are descriptive but not probative or mechanistic in nature were presented. Firstly, the association between low food security and obesity is due to the consumption of high calorie and palatable food by low food secure populations, for example, food high in simple carbohydrates and fat that were cheaper to fulfil the daily calorie requirements (Dhurandhar, 2016; Morales and Berkowitz, 2016). Secondly, it was proposed that the association between low food security and obesity in low food-secure populations occurred because they had limited knowledge, time, and resources to engage in healthful eating and exercise. However, energy intake that exceeds energy expenditure on a long-term and chronic basis causes substantial weight gain (Dhurandhar, 2016).

This study was conducted as a guideline to increase and improve awareness of food insecurity from different levels and perspectives, such as from students, universities, ministries, and other agencies in combating the problem. This study aimed to determine the association between food insecurity and the weight status (BMI) of USM health campus undergraduate students. This study also aims to determine the association between socioeconomic status (family income, primary source of allowance and amount of allowance per semester) and food insecurity among USM health campus undergraduate students.

2. Materials and methods

2.1 Research design

This cross-sectional study investigates the associations between risk factors and the outcome of interest (Levin, 2006). The study aims to obtain a representative sample by taking a cross-section of the population (Sedgwick, 2014), and this method of study was chosen as it was relatively inexpensive and took up minimal time to be conducted. It was based on a questionnaire survey, and the participants were only involved once in the study (Levin, 2006; Sedgwick, 2014). In addition, it was reasonable to estimate the prevalence of behaviour or disease in a population (Sedgwick, 2014). Thus, a cross-sectional study was used to determine the socioeconomic, weight status and food insecurity among USM health campus undergraduate students.

2.2 Research location

This study was conducted at Universiti Sains Malaysia (USM) health campus, Kubang Kerian, Kelantan (coordinate: 6.098184192075768, 102.28419266326515). It included three schools which were the School of Health Sciences (PPSK), School of Medical Science (PPSP) and School of Dental Science (PPSG), using questionnaires. These questionnaires were distributed to the students at specific locations such as Café Murni, Café Nurani, lecture halls and accommodations that included both Nurani and Murni residential colleges.

2.3 Research population

The study population were undergraduate students from USM health campus. The respondents were selected from the following criterion: they must be second to fourth-year undergraduate students. The fulfilment of the inclusion criterion was needed to ensure that the respondents were eligible for the study. Respondents with the exclusion criterion were excluded from the study.

The inclusion criteria for this study comprised second to fourth year USM health campus undergraduate students, students who agreed to be respondents, ages ranging between 18 and 25 years old and Malaysian citizens. The exclusion criteria included being first-year undergraduate students of USM health campus as they have not finished at least one-year session of studies and university life (registered undergraduate students for the academic session of 2019/2020), being the fifth year of USM health campus undergraduate students from the School of Medicine Science and School of Dental Science because it could cause imbalance data as the School of Heath Sciences do not have fifth-year undergraduate students. The final exclusion criterion was students who disagreed with being a respondent.

2.3.1 Sample size calculation

Sample size calculation per group:

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$$n = \left[\frac{Z}{\Delta}\right]^2 p(1-p)$$

Where n = sample size, Z = value representing the desired confidence level (95%) = 1.96, Δ = precision (0.05), P = anticipated population proportion (p = 0.21) (Pia Chaparro *et al*., 2009).

$$n = \left[\frac{1.96}{0.05}\right]^2 0.21(1-0.21)$$

= 254.93 students

= 255 students, additional 10 % drop out (25.5 = 26)

= 281 students

2.4 Sampling method and subject recruitment

The method used in this study for the sampling was non-probability sampling, specifically convenience sampling. In this sampling method, samples were chosen because it was convenient for the researcher or investigator at the right place and at the right time to select the respondents that meet the inclusion criteria (Acharya *et al*., 2013), and the accessibility for this sample was easier (Sedgwick, 2013). The samples that meet the criteria elements are selected simply as they just happen to be situated spatially or administratively (Etikan *et al*., 2017). The probability of being selected for the population members is also not equal (Sedgwick, 2013). In this case, a description of the subjects that needed to be excluded during the selection process and the subjects who were overrepresented in the sample must be given (Etikan *et al*., 2017). This type of sampling was also used when selecting food insecurity university students at two selected public universities in Malaysia (Ramlee *et al*., 2019).

This study involved 286 respondents who were undergraduate students in USM health campus from three schools: School of Health Sciences, School of Medicine Science and School of Dental Science. For this study, the questionnaires for the research were distributed in the residential colleges, cafes, and schools of study. The majority of the respondents were Malay females, who lived in the hostel, had family income below RM3000, had Jabatan Perkhidmatan Awam (JPA) as the primary source of student allowance, and the amount of student allowance per semester was more than RM5001.

Convenience sampling is less expensive, frequently used, and the list of all the population elements is not needed. However, this method has some limitations: bias and variability measurement cannot be controlled or accomplished, and the results cannot be generalized beyond the sample (Acharya *et al*., 2013).

2.5 Research instruments (Questionnaires)

The collection of data was mainly done using a questionnaire. The questionnaire consisted of 3 sections which included Section A for sociodemographic, Section B for assessing food insecurity and Section C for assessing the weight status of the participants. The questionnaire provided used single-choice items where the respondents were allowed to choose one choice from several choices provided for each of the questions.

2.5.1 Sociodemographic

In Section A, the questionnaire focused on the sociodemographic status of the respondents. The questions included gender, ethnicity, school, year of academics, living accommodation, family income, student's primary source of allowance, and amount of allowance per semester. The question of family income was constructed based on the Report of Household Income and Basic Amenities Survey 2016 that was obtained from the Department of Statistics Malaysia's website. According to this report, the household income of Malaysian could be grouped into three main groups, which were the Bottom 40% (B40), the Middle 40% (M40) and the Top 20% (T20) (Department of Statistics Malaysia, 2017).

2.5.2 Level of food security

For Section B, the questions were obtained from U.S. Adult Food Security Survey Module (AFSSM). This survey module had the same set of questions administered in the U.S. Household Food Security Survey Module (HFSSM) with no child present. However, the adult module could be used both for households with and without children present. AFSSM derived from HFSSM was validated and reliable for Asians and Pacific Islanders living in Hawaii (Derrickson *et al*., 2000). AFSSM consisted of 10 items derived from HFSSM that consisted of 18 items and is used to assess the food security survey module. The 10 items in the questionnaire assessed four components of food security: a decreased quantity of food consumed, decreased quality of food consumed, anxiety about food resources and disruption in eating patterns such as skipping meals (Knol *et al*., 2017; Pia Chaparro *et al*., 2009). Instead of weight control efforts, the questions specified the condition that can occur due to lack of finances or other resources to obtain food. The reference period for each question should be the last 12 months (Knol *et al*., 2017).

For further classification of the level of food security

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status, a score on the food security level scale was obtained from the sum of affirmative responses to questions in the questionnaire. Responses of "yes", "often", "sometimes", "almost every month", and "some months but not every month" were coded as affirmative responses (1-point). According to the Guide to Measuring Household Food Security, such responses should be scored and classified into 4 levels of food security. A raw score of 0 would be classified as high food security for the respondents, a raw score of 1 to 2 would be classified as marginal food security, a raw score of 3 to 5 would be classified as low food security, and a raw score of 6 to 10 was classified as very low food security.

The uses of AFSSM have a few advantages that include reducing the burden on the respondent and comparability of food security statistics that can be improved between households with and without children and among households with children in various age ranges. Besides, sensitivity in some survey contexts can be avoided by excluding questions about children's food security. However, the limitation of this questionnaire is that it did not provide specific information on children's food security (Coleman-Jensen *et al*., 2019).

2.5.3 Weight status

The questionnaire for Section B assessed the weight status; it was constructed by classifying the weight status in terms of BMI according to the World Health Organization (WHO). BMI is defined as an individual's weight in kilograms divided by the square of the individual's height in meters (kg/m^2) (WHO, 2019).

2.6 Data collection

An approval letter from Human Research Ethics Committee USM (HREC) with the JEPeM code: USM/ JEPeM/19100667 was obtained for data collection. Second, third and fourth-year undergraduate students from the three schools were approached. Information regarding the study, such as the purpose of the study and participant's criteria, were included in the questionnaires. Students who fulfilled the inclusion criteria were given the questionnaire and expected to spend about 20 minutes completing it. The data collection period was completed from February to June. The students measured or self-reported their weight and height for the anthropometry information. Only current height and weight were accepted.

2.7 Data analysis

Data collected from the questionnaire were analyzed using IBM Statistical Package of Social Science system (SPSS) Statistics Version 24.0 (USA). Descriptive statistics used to analyze the prevalence of food insecurity in USM health campus undergraduate students were measured using the 10-item HFSSM (AFSSM). They were analyzed using Pearson's Chi-square test or Fisher's exact test. For the association between food insecurity and weight status, food insecurity was the independent variable, while weight status was the dependent variable. The association is considered significant if the p-value is less than 0.05.

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3. Results and discussion

3.1 Sociodemographic data

As seen in Table 1, 71.7% of the respondents are females (n = 205), compared to male 28.3% (n = 81). Based on ethnicity, 72.4% of the respondents are Malays (n = 207), followed by Chinese 14.0% (n = 40), Indian 8.4% (n = 24) and others such as Kadazandusun and Bajau 5.2% (n = 15). According to the school of study, each school has an almost equivalent percentage of respondents' recruitment: School of Health Sciences forms 33.6% (n = 96), School of Medicine Science forms 33.9% (n = 97), and School of Dental Science forms 32.5% (n = 93). Based on the academic year, each year has an almost similar percentage of respondents, with the second year forming 33.2% (n = 95), the third year having 33.6% (n = 96) and the fourth year with 33.2% (n = 95).

Based on living accommodation, 99.0% of the respondents stay in hostels (n = 283), and only 1.0% (n = 3) live outside the university. In addition, according to family income, the majority of the respondents come from families with income below RM3000, which amounts to 37.4% (n = 107), followed by 27.6% (n = 79) families earning RM3001 to RM6274, 21.7% (n = 62) families earning RM6275 to RM13147, and 13.3% (n = 38) families earning more than RM13147. In terms of the primary source of respondents' allowance, 47.55% (n = 136) of the respondents obtain JPA scholarship as their main source of income, followed by 22.03% (n = 63) who depend on PTPTN, 14.69% (n = 42) solely rely on their parents as their source of income, 9.44% (n = 27) receive sponsorship from MARA, 4.20% (n = 14) receive other types of scholarship, 1.05% (n = 3) rely on loans, 0.70% (n = 2) rely on other financial support, while the remaining 0.35% (n = 1) has to work to support himself/herself. For the amount of allowance obtained per semester, 24.13% (n = 69) respondents have more than RM5001, 19.23% (n = 55) have below than RM5000, 12.94% (n = 37) have below than RM3000, 11.54% (n = 33) have below than RM2000, 11.19% (n = 32) survive on below than RM1000, and 10.49% (n = 30) have below than RM500 and below than RM4000.

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Table 1. Sociodemographic characteristics of the respondents (n = 286).

Characteristics		n (%)
Gender	Male	81 (28.3)
	Female	205 (71.7)
Ethnicity	Malay	207 (72.4)
	Chinese	40 (14.0)
	Indian	24 (8.4)
	Others	15 (5.2)
School of Study	PPSK	96 (33.6)
	PPSP	97 (33.9)
	PPSG	93 (32.5)
Year of Academic	2nd	95 (33.2)
	3rd	96 (33.6)
	4th	95 (33.2)
Living Accommodation	Hostel	283 (99.0)
	Others	3 (1.0)
Family Income	<RM3000	107 (37.4)
	RM3001-RM6274	79 (27.6)
	RM6275-RM13147	62 (21.7)
	>RM13147	38 (13.3)
Primary source of student allowance	Parents	42 (14.69)
	PTPTN	63 (22.03)
	Scholarship	12 (4.20)
	MARA	27 (9.44)
	JPA	136 (47.55)
	Work	1 (0.35)
	Loan	3 (1.05)
	Others	2 (0.70)
Amount	<RM500	30 (10.49)
	<RM1000	32 (11.19)
	<RM2000	33 (11.54)
	<RM3000	37 (12.94)
	<RM4000	30 (10.49)
	<RM5000	55 (19.23)
	>RM5001	69 (24.13)

3.2 Prevalence of food insecurity among USM health campus *undergraduate students*

Based on Figure 1, the pie chart shows that 55.24% (n = 158) of the students are classified as food secure, and 44.76% (n = 128) are classified as food insecure. Most of the students are found to be food secure compared to food insecure. However, the percentage difference of 10% between food secure and food insecure students is not significant.

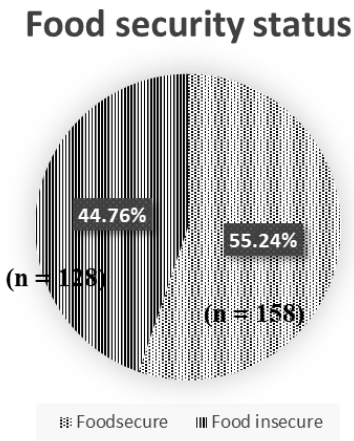

Figure 1. Food insecurity status among USM undergraduate students (n = 286).

Table 2 indicates that 21.68% of the respondents (n = 62) are classified as having high food security, while 33.57% (n = 96) are classified as having marginal food security. Next, for food insecurity, 33.22% (n = 95) are classified as having low food security, and 11.54% (n = 33) are classified as having very low food security. The prevalence of such findings in this study could be compared with the data from other studies involving students from other universities.

Table 2. Food security categories among USM health campus undergraduate students (n = 286).

Food Security Status	Degree of Food Security	n (%)
Food Secure	High Food Security	62 (21.68)
	Marginal Food Security	96 (33.57)
Food Insecure	Low Food Security	95 (33.22)
	Very Low Food Security	33 (11.54)
Total		286 (100)

Local studies were conducted to assess the prevalence of food insecurity among university students in Malaysia. From this current study, the prevalence of food insecurity among students was slightly lower

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compared to a study of university students in Pahang, Malaysia, which reported that 54.4% of the students were food insecure. Of this percentage, 32.9% were placed into the category of low food security and 21.5% as very low food security (Azdie *et al*., 2019). The prevalence of food insecurity in this study was also lower than in the previous study by Sulaiman *et al*. (2013), where it was found that 67.1% of students were facing food insecure where 44.4% assigned to low food security and about 22.7% were assigned very low food security. Besides, a lower prevalence of food insecurity in this study can be observed compared to a pilot study done during the holy month of Ramadhan, where 70.0% of university students experienced food insecurity. Based on these findings, 37.0% had low food security, and 33.0% were experiencing very low food security (Anuar *et al*., 2015). A lower prevalence of food insecurity was found when this study was compared to a study in the United States by Maroto *et al*. (2015), where in this study, 56.0% were food insecure, with 26.0% experiencing low food security and 30.0% experiencing very low food security. Another study that supports the evidence of the lower prevalence of food insecurity in this study was a study among university students in Southeast Nigeria, where the overall food insecurity rate was 80.7%, with 35.7% having low food security and 45.0% facing very low food security (Ukegbu *et al*., 2019).

However, in contrast, this study found a higher percentage of food insecurity in comparison to another local study among university students in Terengganu, which reported 22.0% food insecure students, with 14.0% having low food security and 8.0% having very low food security (Ramlee *et al*., 2019). Few studies were conducted in other countries to assess the prevalence of food insecurity among university students. The prevalence of food insecurity among USM health campus undergraduate students was higher than that in the University of Hawai'i, United States of America (USA), where the prevalence of food insecurity among its students was only 21.0%. 15.0% were classified as having low food security, and 6.0% were regarded as having very low food security (Pia Chaparro *et al*., 2009). Besides, in comparison to another study in New Hampshire, USA, it was also supported that this current study had a higher prevalence of food insecurity among its students as the prevalence of food insecurity in the previous study was 25.0%, with 17.7% of the students reporting low food security and 7.5% reporting very low food security (Davidson and Morrell, 2018). In addition, food insecurity in this current study was higher than food insecurity at the University of Arkansas, USA, with 38.0% experiencing food insecurity, 20.0% experiencing low food security, and 18.0% experiencing very low food security (Lisnic, 2016). Another study that supported a higher prevalence of food insecurity was a study in Brisbane, Australia, that found only 25.5% of its students were food insecure (Gallegos *et al*., 2014).

The differences in terms of the prevalence of food insecurity might be influenced by several factors, such as sample size, location, and methods used in the study (Ramlee *et al*., 2019). For the sample size, this study included about 286 students, which was a relatively bigger sample size. In comparison, the pilot study conducted during the holy month of Ramadhan only included 30 students. Therefore, the sample size made a more significant difference in both studies (Anuar *et al*., 2015). Instead, a study in New Hampshire, USA, showed a lower prevalence of food insecurity using a larger sample size of 943 students (Davidson and Morrell, 2018). Sample size difference could also be observed when this study recruited a higher number of students than a study done by Ramlee *et al*. (2019), where it only included 96 subjects and found a lower prevalence of food insecurity which was only 22.0 % (Ramlee *et al*., 2019).

Another difference was that this study only included undergraduate students, while other studies did include undergraduate and postgraduate students. For example, studies at the University of Arkansas and the University of Hawai'i, both in the USA, included postgraduates in their studies. The inclusion may affect the differences in the prevalence of food insecurity (Pia Chaparro *et al*., 2009; Lisnic, 2016). In this study, marital status was not measured, but other studies, such as those conducted at the University of Hawai'i, measured it (Pia Chaparro *et al*., 2009). Besides, this study also excluded international students, which was different from other studies in New Hampshire, USA and at the Metropolitan University in Brisbane, Australia (Gallegos *et al*., 2014; Davidson and Morrell, 2018). Finally, this study only included only full -time students compared to a study by Gallegos *et al*. (2014) that included part-time students.

The difference in prevalence could also be affected by the duration or time of the study. A study conducted during Ramadhan, a particular month in the Islamic calendar where Muslims are obliged to fast during daylight, found that the prevalence of food insecurity among university students was higher (70.0%) compared to this current study (Anuar *et al*., 2015). In this present study, subjects were recruited if their age were between 18 to 25 years old. This was quite different from other studies where a more extensive range of age was found. For example, a study in two universities in Southeast Nigeria included subjects aged 18 to 30 years old and a higher prevalence of food insecurity. The findings

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indicated that 80.7% prevalence of food insecurity (Ukegbu *et al*., 2019). A study in Brisbane, Australia, included a different age range of subjects where subjects aged 17 to more than 35 years old were included, and it was found that the prevalence of food insecurity was only 25.5% (Gallegos *et al*., 2014).

The difference in terms of study location could also affect the prevalence of food insecurity. A study by Ramlee *et al*. (2019) conducted in Terengganu, Malaysia, only found that 22.0% of university students were food insecure (Ramlee *et al*., 2019). Meanwhile, another study that included more than one university in Peninsular Malaysia (Universiti Teknikal Malaysia Melaka (UTeM), Universiti Sultan Zainal Abidin (UNiSZA), Universiti Malaya (UM) and Universiti Malaysia Perlis (UniMAP)) resulted in a different percentage of prevalence. It showed that the prevalence was considerably higher (67.1%) compared to the current study (Sulaiman *et al*., 2013). Studies conducted abroad, like the ones conducted in Southeast Nigeria, showed higher prevalence due to different locations of the study (Ukegbu *et al*., 2019). This study only used the questionnaire from the U.S. Adult Food Security Survey Module (AFSSM), while other studies utilized different questionnaires from a combination of multiple questionnaires, such as the Radimer Cornell Item that was used in the study conducted in Terengganu, Malaysia (Ramlee *et al*., 2019).

3.3 Food insecurity among USM health campus *undergraduate students according to gender, ethnicity, school, year of academic and living accommodation*

Table 3 shows food insecurity among students according to gender. Of the total male respondents, 43.2% (n = 35) are classified as food secure, while 56.8% (n = 46) can be classified as food insecure. Among the female respondents, 60.0% (n = 123) are classified as food secure while 40.0% (n = 82) are classified as food insecure. Compared to females, males experience more food insecurity as the percentage shown is higher than females.

Table 3. Food insecurity among USM health campus undergraduate students according to gender.

Variable	Food Security Status, n (%)		X^2 (df)	p-value
	Food Secure	Food Insecure		
Gender			6.620 (1)	0.010*
Male	35 (43.2)	46 (56.8)		
Female	123 (60.0)	82 (40)		

*Tested using Pearson's Chi-Square. Significant value: p<0.05

Based on ethnicity (Table 4), the Malays have the highest percentage of food insecurity compared to others, where 46.4% (n = 96) are classified as food insecure, and 53.6% (n = 111) are classified as food secure. It is found that the percentage for both food security statuses in the Malay ethnic group are almost similar. Meanwhile, among the Chinese, there is a difference in terms of food security level status where most of them are classified as food secure, 62.5% (n = 25) and only 37.5% (n = 15) are classified as food insecure. Among the Indians, 62.5% (n = 15) are classified as food secure and only 37.5% (n = 9) are food insecure. Among other ethnic groups such as Kadazandusun and Bajau, there was an almost equal percentage of both food security statuses where 46.7% (n = 7) are food secure, and 53.3% (n = 8) are classified as food insecure.

Table 4. Food insecurity among USM health campus undergraduate students according to ethnicity.

Variable	Food Security Status, n (%)		X^2 (df)	p-value
	Food Secure	Food Insecure		
Ethnicity			2.029 (3)	0.566*
Malay	111 (53.6)	96 (46.4)		
Chinese	25 (62.5)	15 (37.5)		
Indian	15 (62.5)	9 (37.5)		
Others	7 (46.7)	8 (53.3)		

*Tested using Pearson's Chi-Square. Significant value: p<0.05

Table 5 illustrates food insecurity among the students according to the school of study. The School of Health Sciences (PPSK) shows a higher percentage of food insecurity than other schools, with 52.1% (n = 50). Meanwhile, students categorized as food secure in this school are 47.9% (n = 46). For the School of Medical Science (PPSP), 53.6% (n = 52) are classified as food secure and 46.4% (n = 45) are food insecure. However, it is different for the School of Dental Science (PPSG), where 64.5% of students with food security (n = 60) outweigh those with food insecurity status, 35.5% (n = 33).

Table 5. Food insecurity among USM health campus undergraduate students according to school.

Variable	Food Security Status, n (%)		X^2 (df)	p-value
	Food Secure	Food Insecure		
School			5.423 (2)	0.066*
PPSK	46 (47.9)	50 (52.1)		
PPSP	52 (53.6)	45 (46.4)		
PPSG	60 (64.5)	33 (35.5)		

*Tested using Pearson's Chi-Square. Significant value: p<0.05

Based on Table 6, food insecurity can also be classified according to the academic year. For the students in the second year, 54.7% (n = 52) are classified as food secure, while 45.3% (n = 43) are classified as food insecure. 51.0% (n = 49) of students in the third year are classified as food secure, and 49.0% (n = 47) are classified as food insecure. Both academic years show an

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almost equal balance percentage of food security and food insecurity. However, among students in the fourth year, most of them were classified as food secure, 60.0% (n = 57), compared to food insecure, 40.0% (n = 38).

Table 6. Food insecurity among USM health campus undergraduate students according to year of academic.

Variable	Food Security Status, n (%)		X^2 (df)	p-value
	Food Secure	Food Insecure		
School			1.565 (2)	0.457*
2nd	52 (54.7)	43 (45.3)		
3rd	49 (51.0)	47 (49.0)		
4th	57 (60.0)	38 (40.0)		

*Tested using Pearson's Chi-Square. Significant value: p<0.05

Based on Table 7, most respondents live in university residences known as hostels. Food security statuses among them are almost equivalent: 55.8% (n = 158) are food secure, and 44.2% (n = 125) are food insecure. Meanwhile, a minority of respondents who live outside the university residences are food insecure, 100.0% (n = 3).

Table 7. Food insecurity among USM health campus undergraduate students according to living accommodation.

Variable	Food Security Status, n (%)		p-value
	Food Secure	Food Insecure	
Living Accommodation			0.088*
Hostel	158 (55.8)	125 (44.2)	
Others	0 (0)	3 (100)	

*Tested using Fisher's Exact Test. Significant value: p<0.05

3.4 Association between socioeconomic status and food insecurity among USM health campus undergraduate students

3.4.1 Association between family income and food insecurity among USM health campus undergraduate students

Table 8 shows the association between family income and food insecurity among the students. Based on Table 8, it is found that 43.9% (n = 47) of the students who come from families with income below RM3000 are food secure, and 56.1% (n = 60) are food insecure. It is observed that most of the students from this category have food insecurity. For those from families with income between RM3001 to RM6274, most of the students are food secure 62.0% (n = 49), and the remaining 38.0% (n = 30) are food insecure. Next, for those with a family income between RM6275 to RM13147, most of the students are food secure, 59.7% (n = 37). The remaining 40.3% (n = 25) of the students from this family income group are food insecure. Finally, most of the students from families who earn more than RM13147 are food secure, 65.8% (n = 25), and only 34.2% (n = 13) are food insecure. Thus, it is found that students with family income below RM 3000 form the highest percentage of food insecurity, with a prevalence of 56.1%. This was further followed by those from families who have an income between RM 6275 to RM 13 147, RM 3001 to RM 6274 and more than RM13 147, respectively. There is a statistically significant association between family income and food insecurity among USM health campus undergraduate students, tested using Pearson's Chi-Square test (X2 = 9.216; p-value = 0.027).

Table 8. Association between family income and food insecurity among USM health campus undergraduate students.

Variable	Food Security Status, n (%)		X^2 (df)	p-value
	Food Secure	Food Insecure		
Family Income			9.216 (3)	0.027*
<RM3000	47 (43.9)	60 (56.1)		
RM3001 – RM6274	49(62.0)	30 (38.0)		
RM6275 – RM 13147	37 (59.7)	25 (40.3)		
>RM13147	25 (65.8)	13 (34.2)		

*Tested using Pearson's Chi-Square. Significant value: p<0.05

This study was comparable to another study among university students in Pahang, Malaysia, that also found a significant association between family income and food insecurity. It is important to assess the financial status of students because family income causes financial constraints that can lead to further restrictions on expenses and irregular mealtimes. For example, due to financial problems, a student may have 'brunch', a meal combination of breakfast and lunch (Azdie *et al*., 2019). Besides, it was observed that students from less affluent families paid attention and put more importance on food convenience and price as significant characteristics when choosing food. In contrast, it means that students from more affluent families place less importance on choosing food based on these characteristics. This explained that rather than choosing healthier food, students from less affluent families tend to choose less expensive and more convenient meals (Maulida *et al*., 2016). This is to avoid encountering financial difficulties, which can cause students from low-income family's difficulties in paying for their college costs. Hence, what they did for a decent living, for example, was going hungry or homeless, which hinders learning and discourages steadiness (Broton *et al*., 2017). Another study supported the claim that low income increased the prevalence of food insecurity as people with limited economic access would consider the cost of food in order to determine what they can purchase (Hughes *et al*., 2011).

As previously indicated, one well-known contributing factor to food insecurity is income. However, based on a study at the University of Hawai,

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USA, the association between income variation in students' income and food insecurity cannot be established, leading to inconsistent results with this present study. This was because specific relevant information cannot be determined, and thus lead to difficulty in determining the contribution of income variation on food insecurity among its students. Instead, they assessed students' spending patterns based on a spending pattern survey instrument. However, the researchers reported that it was still an imperfect measure of purchasing power (Pia Chaparro *et al*., 2009; Mansour, 2014). Another study that found no significant association between food insecurity status and income was conducted at two selected public universities in Malaysia. This contradicting finding may be due to distinctive measurement techniques, different sample sizes, and a distinctive demographic profile (Ramlee *et al*., 2019).

Income-related household food insecurity can be defined as inadequate or insecure access to adequate food that is caused by financial constraints. This type of insecurity can cause adverse physical and mental health impacts on household members as it is believed to have substantial public health significance. An issue related to household food insecurity was that not all poor households are food insecure, and not all food insecure households are poor (Olabiyi and McIntyre, 2014). This can be related to our findings, where students with a family income of RM6275 to RM13 147 have the second highest prevalence of food insecurity compared to those with a family income lower than it which was RM3001 to RM6274.

Low household income is a predictor of food insecurity. Household food insecurity did play an important role in accessing food insecurity among students because students who grow up in a food insecure home have a 40.0% chance of developing food insecurity during college compared to food secure students who only had a 19.0% chance of facing food insecurity (Broton *et al*., 2018). Food-insecure households tend to have more children and larger household sizes than their food-secure counterparts. For example, this can be explained where a household with a greater number of children will have increased child education expenses, healthcare, and general expenses (Pei *et al*., 2018).

3.4.2 Association between the primary source of student allowance and food insecurity among USM health campus undergraduate students

Table 9 shows the association between the primary source of student allowance and food insecurity. Of students who receive their primary source of allowance from their parents, 59.5% (n = 25) are food secure, and 40.5% (n = 17) are food insecure. For the students who report having PTPTN as their primary source of allowance, 44.4% (n = 28) are food secure, and 55.6% (n = 35) are food insecure. This shows that most of them are categorized as food insecure. The same percentage of food security status is observed among those who receive scholarships, with 50.0% (n = 6) being food secure and 50.0% (n = 6) being food insecure. 48.1% (n = 13) of students who received MARA as their primary source of student allowance were food secure, and 51.9% (n = 14) of them were categorized as food insecure. Most students receiving JPA as their primary source of allowance are food secure, 60.3% (n = 82) and only a small percentage of them are food insecure, 39.7% (n = 54). Next, only one student reports working as the primary source of allowance, but the student is categorized as food secure. Nevertheless, 66.7% (n = 2) who receive loans are categorized as food secure, and 33.3% (n = 1) is categorized as food insecure. Similar to students who receive scholarships, students who report other means of financial sources as allowance show a similar percentage of food security status, with 50.0% (n = 1) being categorized as food secure and 50.0% (n = 1) being categorized as food insecure. There is no statistically significant association between the primary source of student allowance and food insecurity among USM health campus undergraduate students, tested using

Table 9. Association between the primary source of student allowance and food insecurity among USM health campus undergraduate students.

Variable	Food Security Status, n (%)		X^2 (df)	p-value
	Food Secure	Food Insecure		
Primary Source of Student Allowance			6.360 (7)	0.498 *
Parents	25 (59.5)	17 (40.5)		
PTPTN	28 (44.4)	35 (55.6)		
Scholarship	6 (50.0)	6 (50.0)		
MARA	13 (48.1)	14 (51.9)		
JPA	82 (60.3)	54 (39.7)		
Work	1 (100.0)	0 (0.0)		
Loan	2 (66.7)	1 (33.3)		
Others	1 (50.0)	1 (50.0)		

*Tested using Pearson's Chi-Square. Significant value: $p<0.05$

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Pearson's Chi-Square test (X2 = 6.360; p-value = 0.498).

However, this finding was inconsistent with other studies that found a significant association between food security status and scholarship type. It is stated that another factor that is consistently related to food insecurity among students is their financial situation. In a study in Pahang, Malaysia, the most significant proportion of their respondents who received PTPTN loans was among students of the Allied Health Sciences programs, where they also contributed to the most significant percentage of students experiencing food insecurity. Most medical faculty members were JPA scholarship recipients, and they were found to be at the lowest rank of food insecurity. From this study, it was explained that students received less funding with PTPTN loans compared to the JPA scholarship recipients. This finding showed that financial status would affect food security status among students (Azdie *et al*., 2019).

Another study by Morris *et al*. (2016) also found a contrasting result where there was a significant association between financial support and food security status. Morris *et al*. (2016) stated that students who received financial support such as student loans or other types of funding are more likely to be food insecure. This is compared to students who do not use financial support requiring repayment, where they are less food insecure and have higher food security. There was constrained information on the association between food insecurity and financial support for higher education. It is believed that students who are financially constrained to pay for college may also be limited in other resources (Morris *et al*., 2016). This study found that only 0.35% of the respondents reported having to work as the primary source of income. It is uncommon for Malaysian students to have part-time jobs to support their living costs, but the trend is growing due to financial reasons (Azdie *et al*., 2019).

Another study found that students who rely solely on family members such as parents or guardians are most vulnerable to experiencing food insecurity due to insufficient money to purchase adequate food compared to those with other sources of income (Job, 2017). This finding is different from the present study, where it was found that students receiving financial aid from families have better food security. The difference in findings may be due to this study not considering the amount of student expenditure. Students experiencing food insecurity were commonly associated with having an occupation, budgeting, and depending on others for financial support (Hughes *et al*., 2011).

3.4.3 Association between the amount of student allowance per semester and food insecurity among USM health campus undergraduate students

Table 10 shows the association between the amount of student allowance per semester and food insecurity. Most students (56.7%, n = 17) who receive an allowance per semester of less than RM500 are food insecure, with 43.3% (n = 13) being food secure. Most of the respondents (56.3%, n = 18) who received an allowance per semester of less than RM1000 are food secure, and the remaining 43.8% (n = 14) are food insecure. For students who receive an allowance of less than RM2000, most of them are found to be categorized as food insecure, with a percentage of 66.7% (n = 22) and 33.3% (n = 11) found to be in the food secure category. For those with an allowance of less than RM3000, 45.9% (n = 17) are food secure, and 54.1% (n = 20) are food insecure. Most students who receive an allowance of less than RM4000, less than RM5000 and more than RM5001 are found to be food secure. For those with an allowance of less than RM4000, 66.7% (n = 20) are food secure, and 33.3% (n = 10) are food insecure. 61.8% (n = 34) of the students who receive an allowance less than RM5000 are categorized as food secure, and only 38.2% (n = 21) are food insecure. This can also be seen in respondents who receive an allowance of more than RM5001, where 65.2% (n = 45) are food secure, and 34.8% (n = 24) are food insecure. A statistically significant association exists between the amount of student allowance per semester and food insecurity among USM health campus undergraduate students, tested using Pearson's Chi-Square test (X2 = 14.756; p-value = 0.022).

Table 10. Association between the amount of student allowance per semester and food insecurity among USM health campus undergraduate students.

Variable	Food Security Status, n (%)		X^2 (df)	p-value
	Food Secure	Food Insecure		
Amount of Student Allowance			14.756 (6)	0.022*
<RM500	13 (43.3)	17 (56.7)		
<RM1000	18 (56.3)	14 (43.8)		
<RM2000	11 (33.3)	22 (66.7)		
<RM3000	17 (45.9)	20 (54.1)		
<RM4000	20 (66.7)	10 (33.3)		
<RM5000	34 (61.8)	21 (38.2)		
>RM5001	45 (65.2)	24 (34.8)		

*Tested using Pearson's Chi-Square. Significant value: p<0.05

This finding was consistent with a study that suggested students' monthly allowance had an effect on food insecurity. Students given lower allowances are more likely to experience food insecurity than those receiving a higher monthly allowance. This can be

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explained by the fact that students who receive higher allowances are able to make more choices in terms of food selection, and a more significant percentage of their allowance could be used on food (Ukegbu *et al*., 2019).

Student income support sourced either from the government or the university's scholarship scheme is utilized to cover educational costs and other college-related expenses instead of daily necessities (Gallegos *et al*., 2014; Henry, 2017). Thus, in order to obtain a nutritionally adequate diet, the cost will exceed the allocated funds, for example, for students receiving the Canadian Student Loan Program (Gaines *et al*., 2014). Poverty status and vulnerability to food insecurity increase in the event that the students rely entirely on these allowances as their principal source of income. This will further lead to an increase in the need for paid employment that will decrease the time accessible for them to study and prepare their own meals, resulting in a cycle of food insecurity (Gallegos *et al*., 2014). Although loans were provided, current levels of loans or financial aid were insufficient to support student life on the campus as excess fund after deducting school and accommodation fees was used (Fatihah and Azmi, 2017; Gaines *et al*., 2014).

Nowadays, university students' enrolment has shifted to include more low-income and first-generation students. For example, in this study, most students recruited were from family incomes below RM3000. These shifts in terms of demographic, together with a decrease in state funding for universities, increasing tuition costs and increasing costs of goods and services, surpass available financial support for students to support their financial obligations. When students obtain food, cheap food is bought in bulk to make it available over long periods of time. However, students are aware of the quality of this food and its potentially harmful health effects (Henry, 2017).

To derive more explanation about this association, students' expenditure must be assessed. Students' monthly expenditures should be observed based on several options such as food, buying books and academic materials, buying basic needs and others. As food is one of the necessities of life, more than half of students (77.1%) reported in a study that they would use their money on food. Investigation of students' perceptions of the causes of food insecurity among university students was established by providing them with three options to choose from educational fees, expenses, high cost of food and high living costs. Almost half of the students agreed that high living cost is the main factor contributing to food insecurity (Ramlee *et al*., 2019).

3.5 Assessment of weight status among USM health campus undergraduate students

Figure 2 shows the weight status of USM health campus undergraduate students. It is observed that 10.14% (n = 29) of the respondents are underweight (BMI <18.5 kg/m^2). Most of the respondents are found to be in the normal category (BMI: 18.5 – 24.9 kg/m^2) with a percentage of 72.03% (n = 206). It is found that 14.34% (n = 41) of the respondents are categorized in the overweight category (25.0 – 29.9 kg/m^2), and the least number of respondents found to be in the obese category is 3.50% (n = 10).

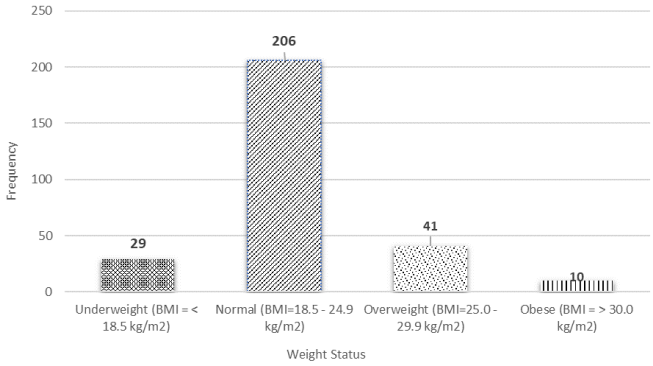

Figure 2. Assessment of weight status among USM Health Campus undergraduate students.

3.6 Association between food insecurity and weight status among USM health campus undergraduate students.

Table 11 shows the association between food insecurity and weight status. Based on the table, it is observed that weight status is divided into four main categories. For the underweight category, it can be observed that the food secure population forms a higher percentage of 11.4% (n = 18) compared to the food insecure population with only 8.6% (n = 11). Most of the students in both food security statuses are categorized in the normal category with the percentage of 70.3% (n = 111) and 74.2% (n = 95) for food secure and food insecure students, respectively. For the overweight category, the food secure students form a higher

Table 11. Association between food insecurity and weight status among USM health campus undergraduate students.

Variable	Weight Status, n (%)				X^2 (df)	p-value
	Underweight	Normal	Overweight	Obese		
Food Security Status					2.185 (3)	0.535*
Food Secure	18 (11.4)	111 (70.3)	25 (15.8)	4 (2.5)		
Food Insecure	11 (8.6)	95 (74.2)	16 (12.5)	6 (4.7)		

*Tested using Pearson's Chi-Square. Significant value: p<0.05

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percentage of 15.8% (n = 25), compared to the food insecure population of 12.5% (n = 16). However, 4.7% (n = 6) of food insecure students are obese, which is higher than food secure students, with only 2.5% (n = 4). Therefore, there is no statistically significant association between food insecurity and weight status.

Thus, this finding was in conjunction with a study that stated that food insecure adults had a significantly higher prevalence of obesity (Pan *et al*., 2012). A major hypothesis was that food insecurity leads to consuming more energy-dense foods, for example, food high in simple carbohydrates and fat that are cheaper to fulfil the daily calorie requirement. This occurs due to the need to substitute for healthier, higher quality and/or less calorie-dense food (for example, lean sources of protein) that are more expensive (Morales and Berkowitz, 2016).

This finding was also consistent with other studies by Knol *et al*. (2017) and Ukegbu *et al*. (2019), where they found that food security status is not associated with weight, especially overweight and obesity. Bruening *et al*. (2017) also found no significant association between food insecurity and weight status. However, they claimed that over time, excess weight gain itself might have resulted from unhealthy eating behaviors practiced by food insecure students in the study. Thus, this habit reflected the obstacles to healthy eating, including the absence of consistent access to affordable, nutritious foods. Long-term health and well-being of students would be affected, such as a higher risk of poor dietary quality, binge eating, chronic diseases and lower productivity due to food insecurity (Bruening *et al*., 2017). In addition, another study supported the claim that no significant association can be found between very low food security and weight status. In this previous study, it was found that even students experiencing marginal and low food security had increased chances of being overweight and becoming obese compared to high food secure students (Soldavini and Berner, 2019).

In contrast, another study among university students found that food insecurity was directly associated with higher BMI and poor health behaviors, where diet quality, physical activity and sleep sufficiency played their roles (Martinez *et al*., 2019). A major hypothesis was that food insecurity leads to the consumption of more energy-dense foods, for example, food high in simple carbohydrates and fat that were cheaper to fulfil calorie requirements in a day. This occurs as a substitution for better, higher quality, and/or less calorie-dense foods (such as lean protein sources) that are more expensive (Morales and Berkowitz, 2016).

4. Conclusion

In conclusion, this study provides evidence that almost half (44.76%) of USM health campus undergraduate students can be categorized as food insecure. Socioeconomic status does affect food insecurity among students. Family income ($p = 0.027$) and the amount of allowances received by students per semester ($p = 0.022$) are associated with food insecurity. Students with family income below RM 3000 and students with an amount of allowance below RM 2000 per semester have the highest prevalence of food insecurity. Surprisingly, no significant association can be found between the primary source of student allowance and food insecurity ($p = 0.498$).

In addition, food insecurity and weight status are not significantly associated ($p = 0.535$). However, the result establishes that being overweight is high in food secure students and obesity is high in food insecure students. Lack or limited access to healthier food and healthy eating practices tend to occur in food insecure students due to financial constraints. Thus, the identification of food insecure students needs to be done as it will affect their well-being, such as their health and academic performance. This study should be repeated at different institutions of higher learning around Malaysia to ensure better understanding is obtained, and intervention can be done. Even though the study is not representative of all university students in Malaysia, it gives a scope that reflects the situation of food insecurity among students at the university level.

Conflict of interest

The authors declare no conflict of interest.

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