AMERICAN UNIVERSITY OF BEIRUT

ASSESSING THE PERCEPTION OF UNIVERSITY
STUDENTS AND THE SAFETY OF SNACK BAR FOOD IN
UNIVERSITY NEIGHBORHOODS

by
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ABSTRACT

OF THE THESIS OF

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Title: Assessing the Perception of University Students and the Safety of Snack Bar Food in University Neighborhoods

Food Safety is a global concern that heavily affects developed and developing countries. Snack bar food is considered one of the most popular consumed foods by young adults, mainly university students. This study aimed to assess, compare, and evaluate the safety of snack bar food catered to university students across two universities in Lebanon, the American University of Beirut (AUB) and Beirut Arab University (BAU), and study the student's perception in those two universities. The study involved 30 food establishments distributed equally from Bliss Street and Tarik Al Jadedeh. Ninety samples were collected, and 401 surveys were conducted from the two target universities. The surveys showed that peer influence affects BAU students' decisions while age affects AUB's consumption decisions. In addition, the living status of students was shown to influence the choice of the students to consume snack bar food significantly in both universities. Regarding the frequency of consumption, only distance influenced AUB students. In contrast, price, safety certificate, quality, taste, reputation, and peer influence were shown to be the most significant factors affecting it. As for non-consumers, AUB students' main influencing factor was the concern for safety while BAU students' main factor was the hours spent in university. Microbiological results showed that 42% of the samples were contaminated across the AUB (Bliss) area and 31.1% across the BAU (Tarik Al Jadedeh) area. These results show that snack bar food vendors need training to improve food safety practices and that adjusting for the significant factors can affect the students' consumption. Further guidance and interventions are required to lower contamination levels to safe levels.
Keywords: *Street food, Microbial contamination, Consumer perception, University students*

TABLE OF CONTENTS

TABLES

Table

ABBREVIATIONS

E.coli : Escherichia coli

S. aureus : Staphylococcus aureus

Lab: Laboratory

AUB: American University of Beirut

BAU: Beirut Arab University

CFU: Colony Forming Units

CHAPTER 1

INTRODUCTION

Eating habits developed in early stages, such as childhood and the young adult years, were likely to dictate the individual's eating habits in later stages of life. These eating habits will affect the individual's weight and were considered a major cause of non-communicable diseases such as cardiovascular diseases and others that can be prevented through proper dietary habits (Lorenzoni et al., 2021). Students and young adults in post-secondary education struggle with having a healthy lifestyle due to obstacles such as time management, high levels of stress, and low-quality sleep (Nelson et al., 2008). This is why food snack bars were popular among students. They were convenient and accessible, especially in peri-urban and urban areas. The increased demand for food away from home was a reality, especially in the current standard of living. Snack bar food was considered among the most popular consumed foods by young adults, specifically university students. However, despite the high prevalence of snack bar food, they contributed to spreading foodborne illnesses due to improper practices of the food vendors (Dela et al., 2023).

Foodborne diseases are a health concern that can cause up to 600 million cases annually around the globe. These food-related outbreaks seriously burdened the health sector, with 61% of the cases between 2009 and 2015 linked to eating outside (Kirchner et al., 2021). Foodborne illnesses, especially in developing countries, can affect a wide population, namely immunocompromised individuals and pregnant women. Estimated data suggested that nearly 2.2 million deaths occured due to foodborne illness every year in developing countries, and of that number, 1.9 million were children. Monitoring food safety was even more difficult in developing countries

where foodborne outbreak surveillance systems covered less than 1% of the actual outbreaks (Loukieh et al., 2018).

Snack bar food can be subject to several microorganisms when sold outdoors, which increased the risk of foodborne illness, especially if the food was also prepared under unhygienic conditions and/or was originally contaminated. Contamination can occur through various pathways, such as contamination from working surfaces, food contact areas, or improper handling practices (Fahim et al., 2022). Although many factors were associated with food contamination in the food service industry, cross-contamination remained the most commonly attributed factor (Kirchner et al., 2021). Another source of contamination was the transmission of foodborne pathogens through the food handler. Various pathogenic microorganisms spread through contaminated hands, which emphasized proper handling and hand-washing practices in preventing outbreaks (Fahim et al., 2022).

Research suggested that food vendors in developing countries can have good knowledge of food safety practices and proper hygiene, as shown by the study done in Mekelle City in northern Ethiopia. The study concluded that street food vendors in Mekelle City had a good attitude towards food safety, with the majority of street food vendors following good food handling practices (Werkneh et al., 2023). However, Lebanon had no efficient control over food handling and hygienic practices, and there was a lack of properly developed food regulations and laws. This was one of the contributing factors to Lebanon's risk of foodborne outbreaks. In addition to these existing limitations, there was also a lack of data on the current status of the food service sector in Lebanon (Loukieh et al., 2018).

1.1 Objectives

This study aimed to compare the safety levels of the food vending facilities, which were snack bars surrounding two universities located in neighborhoods of different socioeconomic levels. For this study, the American University of Beirut located on Bliss Street, and the Beirut Arab University located on Tarik Al Jadedah were chosen. The study also targeted university students enrolled in the two universities to observe the trend in behavior among consumers and study the relationship between consumption decisions and factors influencing the consumer's decisions as well as non consumers.

1.2 Significance

This study was significant because it targeted a public health-related concern about the safety of snack bar food around universities. Given the widespread consumption among students, it was important to assess the repercussions of consuming snack bar food and the possible health hazards that were associated with them. The study also shed light on the perspective of the students who were consuming the aforementioned foods to offer insight into their consumers' needs and concerns when it comes to snack bar food.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Students and Snack Bar Food

2.1.1 The Appeal to Students

When transitioning to higher education, university students shifted towards snack bar food. Many factors influenced this change in behavior, including stress factors (increased workload and exams) and easy access to quick and affordable food. Another influential factor was the change in food selection from Mediterranean options to Western junk food(Alolabi et al., 2022). Research conducted by Alolabi et al. had shown that, on average, half of the students enrolled in secondary education tended to have inadequate dietary habits driven by factors such as physical activity, the status of living with parents or alone, smoking habits, and other psychological aspects (Alolabi et al., 2022). To better understand students' behavior, one must look into the driving forces influencing the decision-making process when choosing a meal. This raised a concern because the eating habits developed during early adulthood often shaped the dietary choices throughout adulthood (Lorenzoni et al., 2021). Poor eating habits tended to increase the risk of non-communicable diseases, which contributed to 36 million deaths per year (Alolabi et al., 2022).

2.1.2 Snack Bars

Snack bar food is away-from-home food that can be consumed as a takeaway or delivery. It is categorized as commercial food services, which often prioritize quality and taste over nutritional balance and safety (Cunha et al., 2018). Snack bar food is

usually prepared and sold in locations that are on or exposed to the street. This difference in the facility layout increases the risk of foodborne illness that can arise from consuming snack bar food (Cunha et al., 2018).

2.2 Factors Influencing Students

2.2.1 Peer Influence

The integration of social media into marketing introduced a new outlet for peer reviews that were readily available and accessible. Young adults were often influenced by surrounding factors such as parental suggestions, mass media, and peers. It remained inconclusive which factor drove consumer behavior the most among those three factors in young adults. However, research suggested that students preferred to shop with their friends because they valued peer approval. Peer influence was also affected by the culture and ethnicity of the consumer, which can make a significant difference across different regions (Mishra & Maity, 2021).

2.2.2 Price

Price was one of the most common driving factors for consumer behavior, and it can influence the decisions a consumer makes consumer decisions (Gabor, 1973). As discussed by (Pelau & Stamule, 2011), 85% of consumers stated that price was the most important factor when deciding on a purchase, followed by the second highest factor, which was the brand, mentioned by 52%. Another aspect was stability; people on the lower end of the socioeconomic scale tended to buy impulsively more staple products, such as food when the price started to increase (Gupta et al., 2021). In the case of university students, price and purchasing decisions were usually affected by brand

loyalty. Consequently, we can infer that consumers tended to lean towards lower prices and higher value, yet they showed tolerance to price increases that they perceived as justified (Gabor, 1973).

2.3 Main Concerns with Snack Bar Foods

The food safety aspect remained the main concern for snack bar foods. The high rate of foodborne illnesses highlighted the importance of implementing food safety standards. Pathogens can contaminate the food at any stage of processing, whether it be the raw material, during processing, or the final product (Madilo et al., 2023). Snack bar food continued to be a burden on the health sector, with almost 10% of the yearly sickness cases stemming from a foodborne illness and an estimated 420,000 deaths per year (Pilamala Rosales et al., 2023). Developing countries often struggled with food safety; between the years 2010 and 2018, Vietnam reported an average of 152 outbreaks (Luu-Thi & Michiels, 2021). Compared to Lebanon, which has a few recorded outbreaks. One of the outbreaks was a hepatitis outbreak recorded in the Northern and Bekaa governantes. Records show that there were 278 cases recorded in the northern governate in 2022 (Uwishema et al., 2022).

Contamination can occur through improper handling, improper personal hygiene, contaminated raw material, and improper storage of ingredients (Fahim et al., 2022). Several bacterial contaminations were frequently found when investigating a food outbreak, including *Salmonella spp, Staphylococcus aureus*, coliforms, and *Escherichia coli* (Luu-Thi & Michiels, 2021).

2.3.1 Salmonella

Salmonella is a burden that weighs on the health sector. An estimated 1.3 billion cases of salmonellosis are recorded annually across the globe. *Salmonella spp.* is a gram-negative facultative anaerobic bacterium that is pathogenic to humans (Coburn et al., 2007). Clinical manifestation of salmonellosis usually starts 6 to 48 hours after consumption of the *Salmonella*-contaminated food (Center for Food Safety and Applied Nutrition, 2024). *Salmonella* is typically associated with food of animal origin, such as chicken meat, eggs, and dairy products (Padungtod & Kaneene, 2006). Symptoms range from diarrhea, fever, and malaise to abdominal pain and vomiting. One of the more drastic and commonly present symptoms of salmonellosis is hepatosplenomegaly (Coburn et al., 2007). *Salmonella* persists in the body of post-symptomatic individuals for months and carries the potential of relapse. An additional concern that comes with *Salmonella* is the chronic asymptomatic carriage (Buchwald & Blaser, 1984). This means that *Salmonella* is communicable among humans as well, which is why it poses another concern when food handlers do not abide by hygienic food handling practices (Coburn et al., 2007).

2.3.2 Staphylococcus aureus

Staphylococcus aureus is a coagulase-positive, gram-positive, pathogenic microorganism naturally occurring in the skin microbiota (Josse et al., 2017). It can cause various infections in animals and humans. *S. aureus* is also a common bacteria associated with foodborne diseases (Shalaby et al., 2024). Research showed that *S. aureus* infections encompass a large burden of foodborne diseases in developing and

non-developing countries. It can indicate hygienic practices during food processing (Ou et al., 2017).

A major part of its virulence is the adhesive and invasive mechanism leading to internalization in the host cells. This mechanism promotes chronic infections in the human body (Josse et al., 2017). Another aspect of *S. aureus* pathogenicity is the enterotoxins it produces (Shalaby et al., 2024). *S. aureus* is commonly associated with retail food, dairy products, and chicken (Wu et al., 2022). The onset symptoms develop in a very short incubation that can be as quick as thirty minutes to eight hours from consumption time (CDC, 2023). The most common clinical manifestations include vomiting, nausea, abdominal cramping, and diarrhea. The illness is generally self-limiting; however, the concern occurs with immunocompromised individuals such as the elderly and children, where the patient might require hospitalization. Although there are international reports of *S. aureus* outbreaks, the data remains very limited, especially in countries with lower income due to the lack of people who seek medical attention and limited surveillance (Shalaby et al., 2024). *S. aureus* also posed a threat because it had shown a trend in acquiring antimicrobial resistance with rapid gene mutation. Specifically, methicillin-resistant *S. aureus* showed a higher resistance to antimicrobial agents than methicillin-susceptible strains (Khatoon et al., 2024).

2.3.3 Total Coliforms

Total coliforms are an indicator organism that reflects the hygienic and unsanitary conditions of all food products. They are gram-negative, facultatively anaerobic, rod-shaped bacteria characterized by lactose fermentation with acid and gas production. Coliform quantification remains an important requirement in food

microbiology across most types of consumables. The coliform count is a safety indicator in the final product in processes involving heat treatment or thermal processing. The theory is that coliforms present in the raw product should be reduced or eliminated by the heating process; however, if coliforms are present in the final product, they may indicate post-processing contamination and unsanitary practices (Martin et al., 2016). As such, snack bar food was subjected to heat, and thus, any contamination indicated a recontamination or unhygienic practices (Twedt & Boutin, 1979). Coliforms are common in vegetables such as leafy greens, cucumbers, and radishes (Keeratipibul et al., 2011). The most distinctive symptom associated with acute or chronic illness caused by coliforms is diarrhea. Studies suggested that coliforms can invade the human intestines and produce heat-stable toxins that are hazardous to human health. Epidemiological studies recorded outbreaks associated with coliforms, which led health experts to advise monitoring of coliforms in foods (Twedt & Boutin, 1979).

2.3.4 Fecal Coliforms

Fecal coliforms are a sub-category of coliforms that are gram-negative facultative anaerobic bacilli. Fecal coliforms are also used to indicate hygienic status, especially in water and food. Possible contamination with fecal coliforms can stem from animal origins or humans (Leclercq et al., 2002). They inhibit the intestines of warm-blooded animals and find their way into food and water sources through the environment. It is nearly impossible to eliminate fecal coliforms from food. Thus, the aim is to minimize the count as much as possible. Evidence suggested a high correlation between fecal coliform counts and *E.coli* counts (Doğan-Halkman et al., 2003).

2.3.5 Escherichia coli

  E. coli is a heterogeneous group that is a type of fecal coliform (Peresi et al., 2016). *E.coli* is native to the gut microflora and is usually harmless to humans, but some recorded strains have shown pathogenicity (Yang et *al*., 2017). These pathogenic strains of *E. coli* are categorized based on their virulence technique. Some common strains are enterotoxigenic *E. coli*, Shiga toxin-producing *E. coli*, and enteroinvasive *E. coli*. The Shiga toxin-producing *E. coli* is considered one of the biggest concerns among the *E. coli* strains because it can induce a range of illnesses, starting from simple diarrhea to hemolytic uremic syndrome (Peresi et al., 2016). *E.coli* can find its way into the food chain through contaminated soil, water, and animal products (Yang et al., 2017). It can be roughly estimated that 265,000 cases are yearly recorded from Shiga toxin-producing *E.coli* (Peresi et al., 2016). Diarrhea-inducing diseases were the second highest contributing factor to children under the age of five years old. Around 760,000 fatalities were recorded annually in children under five years old from diarrheal diseases. *E. coli* is generally treated with proper oral rehydration and restoring the balance of body electrolytes, but in cases of severe illness, medical intervention is required through antidiarrheal drugs, intravenous fluids, and pain relief drugs (Yang et al., 2017).

CHAPTER 3

METHODOLOGY

3.1 Location of the Study

The study targeted two college neighborhoods of different socioeconomic backgrounds in Beirut, Lebanon. All data was collected between the 26th of January, 2024, and the 31st of March, 2024, from the Bliss area and Tarik Al Jadedeh neighborhood. 90 food samples were collected from 30 food vending facilities within a 10-minute walk from the target areas, and 401 surveys were conducted from the two targeted universities, the American University of Beirut and the Beirut Arab University. The university's tuition fees were used to reflect the socioeconomic status of the neighborhood in which they are located, which is why these two universities were chosen, with Bliss as a representative of a higher-end socioeconomic neighborhood and Tarik Al Jadedeh as a middle-class neighborhood.

3.2 Student Perception

3.2.1 Sample Size

The total population size for this study was around 12,000 students. The American University of Beirut had an estimated 8,000 students (American University of Beirut, 2022), and Beirut Arab University's Beirut campus had around 4,000 students (inquired through phone from the office).

The sample size was 400, split into 200 participants from each university. The sampling was convenience sampling, where the participants were approached and asked to consent after listening to the oral consent script.

3.2.2 Inclusion and Exclusion Criteria

For consumer behavior, the inclusion criteria were students enrolled in the universities selected (American University of Beirut and Beirut Arab University) and above 18 years old. Any person below 18 or not enrolled in the selected universities was excluded.

3.2.3 Student Surveys

For the data collection, a survey of 21 questions was constructed. The survey targeted students, consumers and non-consumers, to collect data on behavior surrounding snack bar food perception, consumption, and attitude. The survey inquired general questions related to the participant's profile, such as age, self-reported monthly household income, and field of study. Then, the following section focused on the frequency of purchasing food from snack bars and the reasons behind it. The survey also covered questions related to consumer behavior. The data collected remained anonymous and confidential and was only used for statistical analysis.

3.2.4 IRB Approval

The Institutional Review Board of the American University of Beirut reviewed and approved this research for the consumer surveys. The approval was obtained from the board on 26th January 2024. In addition, the study was also approved by the Beirut Arab University Institutional Review Board on 21st February 2024. The study abided by the regulations set per the 1964 Helsinki Declaration and its amendments. Oral consent was secured for all the participants, and all participants were above the legal age of 18 years old.

3.4 Microbiological Assessment

3.4.1 Sample Collection

Thirty facilities distributed equally per neighborhood were selected, and three representative samples were chosen per snack bar. The samples were purchased during lunch hours (between 12:30 pm and 2 pm) under the disguise of normal consumption with no indication for lab analysis. The samples collected were carefully placed in sterile Ziplock bags without contact with any surface or hands. The samples were then placed on ice and transported to the food microbiology laboratories at the American University of Beirut for analysis within 30 minutes of purchase time to minimize further bacterial growth.

3.4.2 Inclusion and Exclusion Criteria

The snack bars' inclusion criteria were to be within walking distance of 10 minutes from the university, have three walls or less, and contain food traditionally consumed by students. Any food vending facility that did not meet all three requirements was disqualified and not included in the sampling.

3.5 Microbiological Analysis

3.5.1 Sample Preparation and Microbiological Techniques

Ninety samples were collected (n=45 from 15 places in the AUB neighborhood and n=45 from 15 places in the BAU neighborhood) and transported back to the lab on ice. All samples were analyzed for *Salmonella* spp., *E. coli*, *S. aureus*, total coliforms, and fecal coliforms. The sampling procedure was conducted using Loukieh and Mouannes' method (Loukieh et al., 2018).

For the enumeration of *S. aureus, coliforms,* and *E. coli*, 25g of the sample were weighed in stomacher bags and homogenized with 225 ml of buffered peptone water

using a stomacher. Serial dilutions were prepared, 0.1 ml was spread in duplicates on

Barid Parker (HiMedia, India), Rapid *E. coli* (BIO-RAD, United States of America),

MacConkey (HiMedia, India), plate count agar (HiMedia, India), and Dichloran Rose

Bengal Chloramphenicol agar (Scharlau, Spain). MacConkey plates were incubated at

44°C for 24 hours to enumerate fecal coliforms. The Barid Parker and Rapid *E. coli*

plates were incubated at 37°C for 24 hours to detect *S. aureus*, total coliforms, and *E.

coli*. The plate count agars were incubated at 30°C for 24 hours to detect the total

aerobic bacterial count at 30°C. The Dichloran Rose Bengal Chloramphenicol plates

were incubated at room temperature for four days to account for yeast and mold. For

Salmonella spp detection, secondary enrichment was performed on Rappaport

Vassiliadis Broth (HiMedia, India) and incubated at 41.5°C for 24 hrs. After incubation,

the sample was streaked onto a *Salmonella Shigella* agar plate (BIO-RAD, United

States of America) and a Xylose Lysine Deoxycholate agar plate (HiMedia, India) and

incubated at 37°C for 24 hours.

3.5.2 Stocking of Isolates

The bacterial isolates were identified using the colony's morphology on

selective agars and then purified. The purified bacteria was then heavily streaked to

increase the count for stocking. They were then transferred into 1ml of buffered peptone

water and stocked with 0.5ml of 80% glycerol into a cryogenic tube. The isolates were

transferred to a -80C freezer for storage.

3.6. Statistical Analysis

Statistical analysis tests were performed on IBM SPSS statistical software. The surveys were analyzed for descriptive statistics, including mean, median, and frequency. The data was then analyzed using binary logistic regression and ordinal logistic. All tests were done using an $\alpha= 5\%$ and a confidence interval of 95%.

CHAPTER 4

RESULTS

4.1 Student Demographics

4.1.1 Demographics AUB

The student demographic variables of AUB students are presented in Table 1. The study's sample size totaled 204 participants, consisting of predominantly females, with 127 participants (62.3%) and 77 male participants (37.7%). 72.1% of the participants were between 18 and 20 years old, and 24.0% were between 21 and 23 years old. The rest of the students fall into the older age categories, such as 2.9% between 24 and 27 years old and 1.0% above 27 years of age. The vast majority of students were studying towards an undergraduate degree (82.4%), and the rest were studying towards a graduate degree or not studying towards a degree. Regarding living status, students tended to stay at home, with 78.4% of students living at home with their parents, 14.2% in shared dormitories, and 5.4% only living alone. 49.0% of the students did not rely on a scholarship, but 61.8% relied on financial aid. Of the 204 students, only 23 (11.2%) were employed in full-time or part-time jobs, and 180 (88.8%) were not. Lastly, 36 students (18.8%) fell into the 1001-2000$ range for the self-reported monthly income. An abundance of students reported a monthly household income of 2001-4000$ range with 31 students (16.2%). The results showed that around half of the students fell into the higher middle income bracket, with a small percentage falling into the extreme ranges.

Table 1 Demographic variables of the university students enrolled in AUB with frequencies and percentages

Variables	Total n=204 (100%)
Sex at birth	
Male	77 (37.7%)
Female	127 (62.3%)
Age (in years)	
18-20	147 (72.1%)
21-23	49 (24.0%)
24-27	6 (2.9%)
Above 27	2 (1.0%)
Degree	
Undergraduate	168 (82.4%)
Master's	32 (15.7%)
PhD	3 (1.5%)
Not studying towards a degree	0 (0%)
Scholarship	
No	100 (49.0%)
Yes	79 (38.7%)
Not applicable	24 (11.8%)
Financial aid	
No	67 (32.8%)
Yes	126 (61.8%)
Not applicable	11 (5.4%)
Employment	
No	180 (88.8%)
Yes	23 (11.2%)
Living Status	
With family	160 (78.4%)
In shared dormitory	29 (14.2%)
Alone	15 (7.4%)
Income (in USD)	
Below 250	13 (6.8%)
251 – 500	29 (15.2%)
501-1000	32 (16.8%)
1001-2000	36 (18.8%)
2001-4000	31 (16.2%)
4001-6000	21 (11.0%)
6001-10000	18 (9.4%)
Above 10000	11 (5.8%)

4.1.2 Demographics BAU

The student demographic variables are presented in Table 2. The study's sample size totaled 197 participants consisting of predominantly females, with 119 participants (60.4%) and 78 male participants (39.6%). 62.8% of the participants were between 18 and 20 years old, and 30.6% were between 21 and 23 years old. The rest of the students fell into the older age categories, such as 4.1% between 24 and 27 years old and 2.6% above 27 years of age. The vast majority of students were studying towards an undergraduate degree with 93.9%, and the rest were studying towards a graduate degree or not studying towards a degree. Regarding living status, students tended to stay at home, with 82.5% living at home with their parents, 8.8% in shared dormitories, and 8.8% only living alone. 69.4% of the students did not rely on a scholarship, and 85.7 did not rely on financial aid. Of the 197 students, only 35 (17.9%) were employed in full-time or part-time jobs, and 340 (82.1%) were not. Lastly, 44 students (24.0%) fell into the 501-1000$ range for the self-reported monthly income. The second most common monthly household income was in the 1001-2000$ range, with 36 students (19.7%). The results show that around half of the students fall into the lower middle-income bracket, with a small percentage falling into the extreme ranges.

Table 2 Demographic variables of the university students enrolled in BAU with frequencies and percentages

Variables	Total n=197 (100%)
Sex at birth	
Male	78 (39.6%)
Female	119 (60.4%)
Age (in years)	
18-20	123 (62.8%)
21-23	60 (30.6%)
24-27	8 (4.1%)
Above 27	5 (2.6%)
Degree	
Undergraduate	184 (93.9%)
Master's	9 (4.6%)
PhD	1 (0.5%)
Not studying towards a degree	2 (1.0%)
Scholarship	
No	136 (69.4%)
Yes	30 (15.3%)
Not applicable	30 (15.3%)
Financial aid	
No	168 (85.7%)
Yes	19 (9.7%)
Not applicable	8 (4.1%)
Employment	
No	160 (82.1%)
Yes	35 (17.9%)
Living Status	
With family	160 (82.5%)
In shared dormitory	17 (8.8%)
Alone	17 (8.8%)
Income (in USD)	
Below 250	19 (10.4%)
251 – 500	34 (18.6%)
501-1000	44 (24.0%)
1001-2000	36 (19.7%)
2001-4000	21 (11.5%)
4001-6000	17 (9.3%)
6001-10000	5 (2.7%)
Above 10000	7 (3.8%)

4.2 Consumer Behavior

4.2.1 Consumer Behavior AUB

The consumer behavior data for AUB students is presented in Table 3. Most

students preferred to purchase snack bar food during extended university hours, where

179 (87.7%) of the students were consumers. When asked about the purchasing

frequencies, 61 students (30.3%) ate three to four days per week. Most of the students

reported that they got influenced by peer recommendations, with 173 (86.1%) of the

answers stating they got influenced.54.2% had also reported that they were influenced

by social media when making consumption choices. Results showed that 47.8% of the

students had not been food poisoned in the last year, while 39.3% had been. A clear

demand for more snack bar food was observed where 156 students (78.0%) had

indicated that demand.

Table 3 Consumer behavior variables of the university students enrolled in AUB with
frequencies and percentages

Variables	Total n=204 (100%)
Purchase Food	
No	25 (12.3%)
Yes	179 (87.7%)
Purchasing frequency	
Never	25 (12.4%)
One time or less per month	29 (14.4%)
Every three to four days	61 (30.3%)
Every one to two days	44 (21.9%)
At least once per day	42 (20.9%)
Peer Influence	
No	28 (13.9%)
Yes	173 (86.1%)
Social media influence	
No	92 (45.8%)
Yes	109 (54.2%)
Food poisoning in the last year	
No	96 (47.8%)
Yes	79 (39.3%)
Do not recall	26 (12.9%)
Want more options	

No	36 (18.0%)
Yes	156 (78.0%)
Not interested	8 (4.0%)

4.2.2 Consumer Behavior BAU

The consumer behavior data for BAU students was presented in Table 4. Most students had shown a preference for purchasing snack bar food during extended university hours, where 168 (85.3%) of the students were consumers. The highest purchasing frequency (67 students (34.9%)) was at least once per day. Most of the students reported being influenced by peer recommendations (172 (87.8%)) .56.6% had also reported that they were influenced by social media when making consumption choices. Results showed that 57.2% of the students had not been food poisoned in the last year while 33.5% had been. A clear demand for more snack bar food was observed where 156 students (80.4%) indicated that demand.

Table 4 Consumer behavior variables of the university students enrolled in BAU with frequencies and percentages

Variables	Total n=197 (100%)
Purchase Food	
No	29 (14.7%)
Yes	168 (85.3%)
Purchasing frequency	
Never	29 (15.1%)
One time or less per month	10 (5.2%)
Every three to four days	38 (19.8%)
Every one to two days	48 (25.0%)
At least once per day	67 (34.9%)
Peer Influence	
No	24 (12.2%)
Yes	172 (87.8%)
Social media influence	
No	85 (43.4%)
Yes	111 (56.6%)
Food poisoning in the last year	
No	111 (57.2%)

Yes	65 (33.5%)
Do not recall	18 (9.3%)
Want more options	
No	34 (17.5%)
Yes	156 (80.4%)
Not interested	4 (2.1%)

4.3 Association Between the Decision to Consume and Factors Affecting the Decision

4.3.1 Factors Affecting Consumption for AUB

A binary logistic regression test was run on the choice to purchase or not to purchase from snack bar food concerning potential factors affecting the purchasing decision for AUB students (Table 5). The factors included were sex, age, university, self-reported income, employment status, living situation, financial aid, scholarship, peer influence, and previous food poisoning experience.

Table 5 Summary of results for the association between the decision to purchase snack bar food and factors affecting the decision for AUB students with significance and odds ratio

	Significance	Odds Ratio
Sex (Female)	.052	.174
Sex ref (Male)	-	
Age(above 27)	1.000	18.523
Age (24-27)	.702	.653
Age (21-23)	.034*	7.260
Age ref(18-20)	-	
Scholarship(Yes)	.489	.601
Scholarship(N/A)	.510	2.212
Scholarship ref (No)	-	
FinancialAid(Yes)	.952	.957
FinancialAid(N/A)	.999	19.575
FinancialAid ref(No)	-	
Employment(Yes)	.983	.978
Employment ref (No)	-	
Income(Above 10000)	.999	.266
Income(6001-10000)	.856	1.305

Income(4001-6000)	.471	.399
Income(2001-4000)	.376	3.99
Income(1001-2000)	.319	4.84
Income(501-1000)	.274	.259
Income(251-500)	.263	6.241
Income ref (below 250)	-	
Peer influence(Yes)	.982	1.022
Peer influence ref (No)	-	
FoodPoisoned(Don't recall)	.730	1.469
FoodPoisoned(Yes)	.766	1.400
FoodPoisoned	-	
Living(Alone)	.942	1.098
Living Status (Shared Dorm)	.027*	.197
Living Status ref(With Family)	-	

*: significant

From all the analyzed factors, only two had a P-value < 0.05, indicating significance for the factor. The student's age group showed a P-value = 0.034. Students aged 21-23 were 7.2 times more likely to purchase snack bar food than those aged 18-20. The second significant factor influencing purchasing decisions was living status with P-value = 0.027, where those who lived in shared dorms were 0.197 times less likely to purchase snack bar food than those who lived with their family. Lastly, sex at birth was a marginally significant factor with P-value = 0.052, in which females were 0.174 times less likely to purchase snack bar food.

4.3.2 Factors Affecting Consumption for BAU

A binary logistic regression test was run on the choice to purchase or not to purchase from snack bar food concerning potential factors affecting the purchasing decision of BAU students(Table 6). The factors included were sex, age, university, self-reported income, employment status, living situation, financial aid, scholarship, peer influence, previous food poisoning, and desire for more snack bar options.

Table 6 Summary of results for the association between the decision to purchase snack bar food and factors affecting the decision for BAU students with significance and odds ratio

	Significance	Odds Ratio
Sex (Female)	.430	1.56
Sex ref (Male)	-	
Age(above 27)	1.000	19.018
Age (24-27)	.685	.610
Age (21-23)	.197	.450
Age ref(18-20)	-	
Scholarship(Yes)	.258	.442
Scholarship(N/A)	.343	.475
Scholarship ref (No)	-	
FinancialAid(Yes)	.101	.258
FinancialAid(N/A)	.750	1.571
FinancialAid ref(No)	-	
Employment(Yes)	.877	1.120
Employment ref (No)	-	
Income(Above 10000)	.364	4.528
Income(6001-10000)	.999	19.961
Income(4001-6000)	.998	20.260
Income(2001-4000)	.109	8.8000
Income(1001-2000)	.071	6.143
Income(501-1000)	.293	2.252
Income(251-500)	.114	4.126
Income ref (below 250)	-	
Peer influence(Yes)	.001*	10.134
Peer influence ref (No)	-	
FoodPoisoned(Don't recall)	.228	3.151
FoodPoisoned(Yes)	.889	.890
FoodPoisoned	-	
Living(Alone)	.010*	.107
Living Status (Shared Dorm)	.236	.337
Living Status ref(With Family)	-	

*: significant

From all the analyzed factors, only two factors had a P-value < 0.05, indicating significance for the factor. Of the significant factors influencing purchasing decisions, peer influence P-value = 0.001 was significant, where those who were peer-influenced were 10.13 times more likely to purchase snack bar food than those who were not

susceptible to peer influence. Another significant factor was the living status of students with P-value = 0.010, in which those who lived alone were 0.107 times less likely to purchase snack bar food than those who lived with their families.

4.4 Association Between the Frequency of Consumption and Factors Affecting the Decision

4.4.1 Factors Affecting Frequency of Consumption for AUB

An ordinal logistic regression test was run on the frequency of purchasing from snack bars with potential factors affecting the purchasing decision, the results were displayed in Table 7. The factors included were: safety certificate, cleanliness of the snack bar, taste, quality of the food, snack bar reputation, distance from the university, speed of service, prices, peer influence, dietary options, variety of the menu, and social media promotions.

Table 7 Summary of results for the association between the frequency of purchasing snack bar food and factors affecting the decision for AUB students with estimate, significance, and odds ratio

		Estimate	Odds Ratio	Sig.
Threshold	[Q12Frequency = 1]	-23.77		
	[Q12Frequency = 2]	-2.308		
	[Q12Frequency = 3]	-.051		
	[Q12Frequency = 4]	1.215		
Location	[Q19distance=1]	2.945	19.01	0.68
	[Q19distance=2]	-.922	0.39	.378
	[Q19distance=3]	1.095	2.98	0.029*
	[Q19distance=4]	-.312	0.73	.497
	[Q19distance=5]	0a		
	[Q19safetyCertificate=1]	-11.771		.956
	[Q19safetyCertificate=2]	.655		.438
	[Q19safetyCertificate=3]	.615		.280
	[Q19safetyCertificate=4]	-.697		.091
	[Q19safetyCertificate=5]	0a		
	[Q19cleanliness=1]	12.917		.952

[Q19cleanliness=2]				
[Q19cleanliness=3]	.503		.551	
[Q19cleanliness=4]	.314		.480	
[Q19cleanliness=5]	0a			
[Q19speed=1]	-1.346		.552	
[Q19speed=2]	-1.561		.131	
[Q19speed=3]	-.475		.479	
[Q19speed=4]	-.107		.860	
[Q19speed=5]	0a			
[Q19price=1]	17.269		.994	
[Q19price=2]	-.594		.575	
[Q19price=3]	-.558		.266	
[Q19price=4]	.185		.687	
[Q19price=5]	0a			
[Q19quality=1]	-19.339		.994	
[Q19quality=2]				
[Q19quality=3]	.605		.463	
[Q19quality=4]	-.247		.568	
[Q19quality=5]	0a			
[Q19Taste=1]	0a			
[Q19Taste=2]				
[Q19Taste=3]	.539		.509	
[Q19Taste=4]	.478		.279	
[Q19Taste=5]	0a			
[Q19Reputation=1]	.026		.986	
[Q19Reputation=2]	.563		.477	
[Q19Reputation=3]	.464		.385	
[Q19Reputation=4]	.418		.380	
[Q19Reputation=5]	0a			
[Q19Peer=1]	-1.067		.370	
[Q19Peer=2]	-.994		.190	
[Q19Peer=3]	-.271		.640	
[Q19Peer=4]	-.541		.348	
[Q19Peer=5]	0a			
[Q19Variety=1]	-.572		.489	
[Q19Variety=2]	-1.299		.060	
[Q19Variety=3]	-.529		.447	
[Q19Variety=4]	.256		.709	
[Q19Variety=5]	0a			
[Q19Dietary=1]	-.049		.951	
[Q19Dietary=2]	.016		.984	
[Q19Dietary=3]	.084		.918	
[Q19Dietary=4]	.481		.591	
[Q19Dietary=5]	0a			
[Q19socialMedia=1]	-.192		.863	
[Q19socialMedia=2]	.326		.763	

		Estimate	Odds Ratio	Sig.
	[Q19socialMedia=3]	.668		.520
	[Q19socialMedia=4]	-.543		.635
	[Q19socialMedia=5]	0a		

*: significant

As shown in the ordinal regression results, the relationship between various factors and the frequency of consumption was analyzed. The majority of the factors had shown an insignificant result at α=0.05 except one factor was significant P-value < 0.05. A significant P-value was observed in relation to the walking distance from the snack bar, which showed significance at one level. Those who rated the walking distance as somewhat important had a P-value = 0.029 with an odds ratio =2.98. Those who had ranked the walking distance as somewhat important had a 2.98 times chance of moving to a higher consumption frequency as compared to the students who ranked the walking distance as vital.

4.4.2 Factors Affecting Frequency of Consumption for BAU

An ordinal logistic regression test was run on the frequency of purchasing from snack bars with potential factors affecting the purchasing decision, the results were displayed in Table 8. The factors included were: safety certificate, cleanliness of the snack bar, taste, quality of the food, snack bar reputation, distance from the university, speed of service, prices, peer influence, dietary options, variety of the menu, and social media promotions.

Table 8 Summary of results for the association between the frequency of purchasing snack bar food and factors affecting the decision for BAU students with estimate, significance, and odds ratio

		Estimate	Odds Ratio	Sig.
Threshold	[Q12Frequency = 1]	-23.032		
	[Q12Frequency = 2]	-4.135		

	[Q12Frequency = 3]	-1.393		
	[Q12Frequency = 4]	.590		
Location	[Q19distance=1]	1.748		.068
	[Q19distance=2]	.850		.345
	[Q19distance=3]	.458		.467
	[Q19distance=4]	.415		.457
	[Q19distance=5]	0a		
	[Q19safetyCertificate=1]	-.084	0.91	.959
	[Q19safetyCertificate=2]	-4.833	0.007	.000*
	[Q19safetyCertificate=3]	-1.037	0.35	.091
	[Q19safetyCertificate=4]	-1.142	0.31	.037*
	[Q19safetyCertificate=5]	0a		
	[Q19cleanliness=1]	-.416		.802
	[Q19cleanliness=2]			
	[Q19cleanliness=3]	.731		.484
	[Q19cleanliness=4]	.196		.691
	[Q19cleanliness=5]	0a		
	[Q19speed=1]	-2.786		.293
	[Q19speed=2]	-.271		.910
	[Q19speed=3]	1.002		.210
	[Q19speed=4]	.344		.583
	[Q19speed=5]	0a		
	[Q19price=1]	-7.497	0.005	.000*
	[Q19price=2]	-3.387	0.03	.001*
	[Q19price=3]	-4.369	0.012	.000*
	[Q19price=4]	-2.473	0.08	.001*
	[Q19price=5]	0a		
	[Q19quality=1]			
	[Q19quality=2]	15.615		.992
	[Q19quality=3]	1.663		.136
	[Q19quality=4]	1.414	4.11	.016*
	[Q19quality=5]	0a		
	[Q19Taste=1]	-12.258		.994
	[Q19Taste=2]	-28.605		.985
	[Q19Taste=3]	-1.191		.177
	[Q19Taste=4]	-1.291	0.27	.026*
	[Q19Taste=5]	0a		
	[Q19Reputation=1]	19.353		.981
	[Q19Reputation=2]	3.047	21.05	.003*
	[Q19Reputation=3]	.561		.446
	[Q19Reputation=4]	.964		.180
	[Q19Reputation=5]	0a		
	[Q19Peer=1]	-.616		.569
	[Q19Peer=2]	1.767	5.8	.035*
	[Q19Peer=3]	3.158	23.5	.000*
	[Q19Peer=4]	2.174	8.79	.005*

[Q19Peer=5]	0a		
[Q19Variety=1]	.024		.984
[Q19Variety=2]	-.502		.615
[Q19Variety=3]	-.579		.537
[Q19Variety=4]	-1.812		.060
[Q19Variety=5]	0a		
[Q19socialMedia=1]	-.165		.891
[Q19socialMedia=2]	.992		.377
[Q19socialMedia=3]	.796		.455
[Q19socialMedia=4]	1.919		.100
[Q19socialMedia=5]	0a		
[Q19Dietary=1]	-.409		.646
[Q19Dietary=2]	.054		.954
[Q19Dietary=3]	-.838		.391
[Q19Dietary=4]	-1.084		.262
[Q19Dietary=5]	0a		

*: significant

As shown in the ordinal regression results for BAU, the relationship between various factors and the frequency of consumption was analyzed. Almost half of the factors had shown to be insignificant at α=0.05 with a P-value < 0.05. A significant P-value was observed in relation to the price which showed significance at all levels, where the higher the student valued the price in their decision-making process, the higher the possibility of increasing the frequency of consumption. Those who had ranked the safety certificate as somewhat not important and very important were less likely to increase the frequency of consumption than those who ranked the safety certificate as vital. While those who rated the quality as very important had a significant P-value = 0.016. Students who rated the quality as very important had a 4.11 times chance to move to a higher consumption category than other students who ranked the quality as vital. The peer influence significantly increased the probability of moving to a higher frequency of consumption across three ratings. Meanwhile, those who rated the taste as very important were 0.27 times less likely to increase consumption as compared to those who rank the taste as vital. Lastly, the brand reputation showed to significantly

positively affect the student's consumption frequency for those who ranked it as

somewhat not important.

4.5 Non-Consumer Behavior

4.5.1 Non-Consumer Behavior for AUB

25 (12.3%) AUB students out of 204 reported not to consume food from snack

bars (Table 9) mainly due to safety concerns (40%) and secondly due to the lack of

options and food variety (28%). However, 60% of the non-consumers were open to

consuming snack bar food if their concerns were resolved.

Table 9 Non-consumer behavior variables of the university students enrolled in AUB
with frequencies and percentages

Variables	Total n= 25 (100%)
Price	
Affects decision	6 (24.0%)
Does not affect the decision	19 (76.0%)
Safety Concerns	
Affects decision	10 (40.0%)
Does not affect the decision	15 (60.0%)
Lack of Options	
Affects decision	7 (28.0%)
Does not affect the decision	18 (72.0%)
Bad Experience	
Affects decision	3 (12.0%)
Does not affect the decision	22 (88.0%)
Quality	
Affects decision	7 (28.0%)
Does not affect the decision	18 (72.0%)
Dietary	
Affects decision	4 (16.0%)
Does not affect the decision	21 (84.0%)
Hours Spent in Uni	
Affects decision	4 (16.0%)
Does not affect the decision	21 (84.0%)
Distance	
Affects decision	6 (24.0%)
Does not affect the decision	19 (76.0%)
Other	
Affects decision	4 (16.0%)

Does not affect the decision	21 (84.0%)
Open to Consumption	
No	3 (12.0%)
Yes	15 (60.0%)
I do not know	7 (28.0%)

4.5.2 Non-Consumer Behavior for BAU

29 (14.7%) BAU students out of 197 reported not to consume food from snack bars (Table 10) mainly due to not spending enough hours in university (34.5%) and secondly due to quality concerns regarding snack bar food (27.6%). However, 48.2% of the non-consumers were open to consuming snack bar food if their concerns were resolved.

Table 10 Non-consumer behavior variables of the university students enrolled in BAU with frequencies and percentages

Variables	Total n= 29 (100%)
Price	
Affects decision	7 (24.1%)
Does not affect the decision	22 (75.9%)
Safety Concerns	
Affects decision	5 (17.2%)
Does not affect the decision	24 (82.8%)
Lack of Options	
Affects decision	1 (3.4%)
Does not affect the decision	28 (96.6%)
Bad Experience	
Affects decision	0 (0.0%)
Does not affect the decision	29 (100%)
Quality	
Affects decision	8 (27.6%)
Does not affect the decision	21 (72.4%)
Dietary	
Affects decision	7 (24.1%)
Does not affect the decision	22 (75.9%)
Hours Spent in Uni	
Affects decision	10 (34.5%)
Does not affect the decision	19 (65.5%)
Distance	
Affects decision	1 (3.4%)
Does not affect the decision	28 (96.6%)

Other		
Affects decision	5 (17.2%)	
Does not affect the decision	24 (82.8%)	
Open to Consumption		
No	6 (20.6%)	
Yes	14 (48.2%)	
I do not know	9 (31.2%)	

4.6 Microbiological Results from the American University of Beirut

19 out of 45 samples (42.2%) exceeded the limits set by ISO NL/ISO 4833 *S. aureus* was found in only one sample, whereas total coliforms were found in 16 samples and fecal coliforms in 10. *E. coli* and *Salmonella*, however, was not detected in the food tested (Table 11).

Table 11 Microbiological results of snack bar food from the American University of Beirut neighborhood according to the NL/ISO 4833 standards for microbiological limits in food

Microorganism	Limit in food (CFU/g)	The number of samples that exceeded the guidelines out of n=45
Staphylococcus aureus	$< 10^3$	1
Escherichia coli	$< 10^2$	0
Total coliforms	$<10^3$	16
Fecal coliforms	<10	10
Salmonella	<0 in 25g	0

4.7 Microbiological Results from the Beirut Arab University

14 out of 45 samples (31.1%) exceeded the limits set by ISO NL/ISO 4833 *S. aureus* was found in only one sample, whereas total coliforms were found in 12 samples

and fecal coliforms in 11. *E. coli* was also found in 3 samples. *Salmonella,* however was

not detected in the food tested (Table 12).

Table 12 Microbiological quality of snack bar food from the Beirut Arab University
neighborhood according to the NL/ISO 4833 standards for microbiological limits in
food

Microorganism	Limit in food (CFU/g)	The number of samples that exceeded the guidelines out of n=45
Staphylococcus aureus	$< 10^3$	1
Escherichia coli	$< 10^2$	3
Total coliforms	$<10^3$	12
Fecal coliforms	<10	11
Salmonella	<0 in 25g	0

**4.8 Association Between the Neighborhood's Socioeconomic Status and Food
Safety**

A Pearson Chi-Square test was run to determine the association between the

neighborhood's socioeconomic status and the number of samples that exceeded safe

guide limits. The results showed no significant differences since the P-value of 0.310

exceeded the limit of 0.05.

CHAPTER 5

DISCUSSION

From the influencing factors studied, three factors had shown significance in affecting the student's behavior and choice to consume or not. The first factor affecting the choice to consume snack bar food across both universities was the status of living, which, according to (Alolabi et al., 2022) can influence the student's decision to consume when the food might not be as easily accessible as at home. However, the results were in disagreement with (Hafiz et al., 2023) which indicated that students consumed snack bar food when away from home, however, in our study, those who lived at home with their families were more likely to consume snack bar food. As for age, it was shown to impact only AUB students significantly, whereas those in the middle-range age group were more likely to consume than those in the lower age range. This can stem from the financial power that those in a higher group were more likely to have than those in lower age groups (Akbar, 2011). Lastly, peer influence was shown to be a significant factor affecting BAU students, but it had no significant impact on AUB students. (Mishra & Maity, 2021) indicated that those who were peer-influenced were more likely to consume than those who were not, which would require further data to assess the students enrolled in BAU. In addition, distance was the only factor shown to influence the frequency of consumption of AUB students significantly. This was also highlighted in research done by He et al. (2012), which discussed the effect that walking distance within one km had on consumer decisions. Students often prefered shops and snack bars within a short distance for easier access.

Meanwhile, BAU students had many factors affecting their consumer decisions. Those with a stronger opinion on the price of snack bar food were more likely to be

more frequent consumers of snack bar food than those who showed a lack of interest in the price. This result was in agreement with (Pelau & Stamule, 2011), which discussed the positive relationship between consumption and a good price. The article also highlighted how most consumers showed interest in the price, which was an influential factor in their consumption-related decisions. Another factor that affected their frequency was the brand reputation, which was also discussed by (Pelau & Stamule, 2011) where almost half of the consumers were highly affected by the brand name and reputation. The brand's perception also included its safety certification, a significant factor for BAU students. Another factor affecting BAU students' choice to consume snack bar food was peer influence. Peer-influenced students were more likely to consume snack bar food than those who were not. These results were in agreement with (Mishra & Maity, 2021) which suggested that young adults were highly influenced by peer recommendations and online peer reviews on social media, which can be a driving force enough to shift a student from a nonconsumer to a consumer. The food quality and taste also significantly impacted the students. One of the most attention-grabbing aspects for a consumer is the taste which can impact the purchasing frequency (Lorenzoni et al., 2021).

When comparing AUB students to those of BAU, AUB consumers were mainly affected by the walking distance as the only significant factor, while this factor was not significant for BAU students. A possible explanation was the variation in the campus size; BAU had a smaller campus than AUB. Thus, this might not be an active concern for BAU students. Further assessment is required to further understand the relation between walking distance and the impact on students. Another significant factor for BAU consumers was price; meanwhile, it was not a significant factor for AUB. The

statistical analysis had shown that the majority of the students at AUB belong to a higher income range than the majority of students at BAU, which might be the reason why the factor affected BAU students but not AUB students. A research by (Akbar, 2011) discussed how purchasing power and price affected the consumer's decision, especially when the consumer did not have a high purchasing power such as students. This might explain why BAU students relied on six factors when making a consumption decision whereas AUB students were only influenced by one factor.

On another note, the most frequent reason why a student would not consume food from snack bars was the safety concern for AUB students, which was in agreement with (Ha et al., 2019) who highlighted the increase in concern for food safety among consumers. This fear and worry about the risk associated with unsafe food can discourage students from consuming snack bar food. As for BAU students, they were mainly discouraged by the lack of need for food because they do not spend prolonged hours at the university. Another factor that also discouraged BAU students from consuming was the concern for the quality of the food, a factor that was also described by (Tirelli et al., 2013). It is noteworthy to mention that this factor was very important for BAU students, whether they were consumers or not.

When safety and accommodations in variety were the main concerns for AUB non-consumers, the lack of need to consume was the main drive for BAU non-consumers. In fact, BAU students tended to focus more on the need for consumption, which was the most common reason for not consuming those who did not spend enough hours in the university to require snack bar food.

When it comes to the food safety sold in those snack bars, the microbiological results showed that 42.2% of the AUB samples were contaminated compared to 31.3%

of the BAU samples. A study by (Loukieh et al., 2018) conducted in Beirut showed as well a lack of good food-handling practices. In fact, the presence of coliforms (total and fecal) and S. aureus are indicators of non-hygiene sourced from raw material and food handlers respectively. E. coli, however, is an indicator of fecal contamination that might be sourced from contaminated water, post-treatment bad handling, or cross-contamination between the final product and the raw material(Doğan-Halkman et al., 2003). When it comes to the snack bar food vendor's knowledge, an article by (Werkneh et al., 2023) has shown that vendors can have good food safety knowledge and an attitude regarded as good. The article also suggested that an effective training and promotion of food safety among vendors can yield good results (Werkneh et al., 2023).

Although no significant difference were shown when comparing the level of contamination to the socioeconomic status of the neighborhood, the samples from the Beirut Arab University harboured pathogens considered of bigger concern. For example, *E. coli* was not found in AUB samples while 6.67% of BAU's samples were contaminated. A possible suggested route for *E.coli* was environmental contamination since the snack bars lack a fourth wall which usually lowers the outside contamination entry from the outside air, which was highlighted in (Fahim et al., 2022). It should be mentioned that the structure of snack bars located in BAU's neighborhood was more exposed to the street than those in AUB's neighborhood that tried to isolate the facility as much as possible. In addition, the BAU campus was surrounded by a main street busier than AUB.

Another noticeable difference between AUB and BAU samples was the total coliform results. AUB had a higher number of samples exceeding safe levels of total coliform contamination with 35.5%. In comparison, BAU had a prevalence of 26.6% of samples exceeding the limit for total coliform levels in food. As suggested by (Martin et al., 2016), total coliform contamination was associated with contaminated water, which can affect the raw material or water source used by the snack bar.

As for *S.aureus* contamination in samples, both AUB and BAU had one sample each, exceeding the safe limits. However, in (Loukieh et al., 2018) 11 out of 60 samples were contaminated. It should be mentioned that during sample collection, it was observed that most food vendors did not wear gloves while preparing the food. According to (CDC, 2023), *S.aureus* died after prolonged exposure, but heat-stable toxin could be secreted in the food. More than half of the samples were collected from snack bars that vend hot-held food, whether heated or prepared on the spot. Although the bacteria might have died from long heat exposure, it might have survived enough to produce toxins. Thus, there is a possibility of high toxin levels in the food which needs further research and quantification to assess.

CHAPTER 6

CONCLUSION

In conclusion, the research showed that the most probable factors affecting the students' choice to consume snack bar food in the case of university students were peer influence, living status, age, and possibly the student's gender. As for the frequency of consumption, the price, brand name, quality of food, distance from the snack bar, safety certificate, peer influence, and taste were significant factors affecting the student's consumption. As for non-consumers, factors such as safety concerns, variety of options, and food quality had discouraged students from consuming.

It was also concluded that the socioeconomic status of the neighborhood where the snack bar food was located did not affect the safety level of the food significantly since the results were not statistically significant. Further improvement can be made concerning the hygienic practices of snack bar food vendors. A future intervention can probably change the attitude towards food safety and further improve snack bar food safety. It was recommended to resample during summer when the temperatures will be more suitable for bacterial growth to get a more accurate result.

Limitations

The samples were collected during winter when the temperatures were less suitable for bacterial growth. This might have influenced the bacterial count. Therefore, the tests should be repeated during summertime, when the weather would be more appropriate for microbial growth. If, during winter, the level of contamination was somehow concerning, it could be hypothesized that more contamination would be detected during summer. Furthermore, conducting a facility inspection and taking swabs

from the surroundings would be interesting. If indicators were found in food, it would be interesting to search for the source of contamination and create a corrective plan to minimize the risk of food poisoning.

Conflict of interest

The author declares there is no conflict of interest in this study.

APPENDIX 1

CONSUMER SURVEY

Student Profile

1) What is your sex at birth?

   ☐ Male

   ☐ Female

2) How old are you?

   ☐ 18-20

   ☐ 21-23

   ☐ 24-27

   ☐ Above 27

3) Which university are you currently enrolled in?

   ☐ American University of Beirut

   ☐ Beirut Arab University

4) What is your discipline of study?

   ☐ Arts

   ☐ Business

   ☐ Engineering

   ☐ Humanities

   ☐ Medicine / Health

   ☐ Science

   ☐ Social science

   ☐ Other ………………………………

5) What is the current degree level you are studying to achieve?

   ☐ Undergraduate

   ☐ Masters

   ☐ Ph.D.

   ☐ Not studying towards a degree

6) Are you on a partial or full scholarship?

- ☐ No
- ☐ Yes
- ☐ Not applicable

7) Do you benefit from financial aid?

- ☐ No
- ☐ Yes
- ☐ Not applicable

8) What is your status of living?

- ☐ Living with Family
- ☐ Living in a shared dorm
- ☐ Living alone

9) Are you employed?

- ☐ No
- ☐ Yes

10) What is your monthly household income?

- ☐ Below 250$ monthly
- ☐ Between 251$ and 500$ monthly
- ☐ Between 501$ and 1,000$ monthly
- ☐ Between 1,001$ and 2,000$ monthly
- ☐ Between 2,001$ and 4,000$ monthly
- ☐ Between 4,001$ and 6,000$ monthly
- ☐ Between 6,001$ and 10,000$ monthly
- ☐ Above 10,001$ monthly

Consumer Behavior

11) Do you purchase food from snack bars when in university?

    ☐ No

    ☐ Yes

12) If yes, how many frequent?

    ☐ At least once per day

    ☐ Every 1-2 days

    ☐ Every 3-4 days

    ☐ $1 \geq$ time per month

13) Are you more likely to purchase food from snack bars when with your friends?

    ☐ No

    ☐ Yes

14) Does social media influence you to buy/ try new snack bar items?

    ☐ No

    ☐ Yes

15) Do you recall being food poisoned in the last year?

    ☐ No

    ☐ Yes

    ☐ I do not recall

16) Would you like to have more snack bar options around the university?

    ☐ No

    ☐ Yes

    ☐ Not interested

----

17) What meal do you purchase? (Select all that applies)

    □ Breakfast

    □ Lunch

    □ Dinner

    □ Snacks

18) Why do you purchase food from snack bars? (Select all that applies)

    □ Taste

    □ Easy accessibility (available around university)

    □ Time constraint (no time to prepare, no time between classes, etc.....)

    □ Do not like to carry food to university

    □ Cheaper than cooking

    □ No area to heat food or consume food in

    □ Other: --

19) Please fill the following table of factors with the degree that the factor influences your decision-making process when selecting which snack bar to purchase from:

Factor	Not important at all	Somewhat unimportant	Somewhat Important	Important	Vital
Safety certificate					
Cleanliness of the place					

Factor	Not important at all	Somewhat unimportant	Somewhat Important	Important	Vital
Speed of service					
Price					
Quality of the food					
Taste					
Reputation of the snack bar					
Peer recommendation					
Variety in options (big or small menu)					
Dietary restrictions (vegan, vegetarian, low carb, high protein, etc...)					
Distance					
Social Media (posters, videos, influencers promoting, etc…)					

----------- The following questions are for non-consumers ONLY, otherwise the

questionnaire is completed

----

20) Why do you **<u>NOT</u>** consume food from a snack bar? (Select all that applies)

- ☐ Price

- ☐ Safety concern

- ☐ Do not consume the available options

- ☐ Previous bad experience

- ☐ Quality concerns (taste, odor, texture, etc..)

- ☐ Dietary restriction (including due to health issues)

- ☐ Do not spend enough hours in university to be hungry during hours

- ☐ Far distance from the snack bar

- ☐ Other: --

21) Would you be open to consuming food from snack bars if the reason(s) were

resolved?

- ☐ No

- ☐ Yes

- ☐ I do not know

APPENDIX 2

MICROBIOLOGICAL RESULTS AUB

Table 13 Microbiological results of laboratory analysis for food samples collected from the American University of Beirut neighborhood

Sample number	*Staphylococcus aureus* CFU/g	Total coliform CFU/g	Fecal coliform CFU/g	*Escherichia coli* CFU/g
1	$5 \times 10^3*$	$1 \times 10^5*$	0×10^0	0×10^0
2	0×10^0	$2.27 \times 10^5*$	$2.35 \times 10^5*$	0×10^0
3	0×10^0	0×10^0	$2.75 \times 10^4*$	0×10^0
4	0×10^0	$2.95 \times 10^3*$	0×10^0	0×10^0
5	0×10^0	0×10^0	0×10^0	0×10^0
6	5×10^1	$7.8 \times 10^3*$	0×10^0	0×10^0
7	0×10^0	4×10^2	0×10^0	0×10^0
8	0×10^0	$2.5 \times 10^3*$	0×10^0	0×10^0
9	0×10^0	0×10^0	0×10^0	0×10^0
10	0×10^0	0×10^0	0×10^0	0×10^0
11	0×10^0	$3.6 \times 10^3*$	0×10^0	0×10^0
12	0×10^0	0×10^0	0×10^0	0×10^0
13	0×10^0	0×10^0	0×10^0	0×10^0
14	0×10^0	0×10^0	0×10^0	0×10^0
15	0×10^0	5.5×10^4	0×10^0	0×10^0
16	0×10^0	$4.72 \times 10^4*$	$1 \times 10^2*$	0×10^0
17	0×10^0	0×10^0	0×10^0	0×10^0
18	0×10^0	0×10^0	0×10^0	0×10^0
19	0×10^0	0×10^0	0×10^0	0×10^0
20	0×10^0	7×10^2	0×10^0	0×10^0
21	0×10^0	$1.34 \times 10^5*$	$5 \times 10^1*$	0×10^0
22	0×10^0	$3.46 \times 10^4*$	$5 \times 10^1*$	0×10^0
23	0×10^0	$1.08 \times 10^4*$	$7.05 \times 10^3*$	0×10^0
24	0×10^0	$3.9 \times 10^3*$	$2.3 \times 10^3*$	0×10^0
25	0×10^0	$2.6 \times 10^3*$	0×10^0	0×10^0
26	0×10^0	0×10^0	0×10^0	0×10^0
27	0×10^0	0×10^0	0×10^0	0×10^0
28	0×10^0	0×10^0	0×10^0	0×10^0
29	0×10^0	$1.65 \times 10^3*$	0×10^0	0×10^0
30	3×10^2	$8.35 \times 10^3*$	0×10^0	0×10^0
31	0×10^0	0×10^0	0×10^0	0×10^0
32	0×10^0	0×10^0	0×10^0	0×10^0
33	0×10^0	2×10^2	$1 \times 10^2*$	0×10^0
34	0×10^0	0×10^0	0×10^0	0×10^0
35	0×10^0	0×10^0	0×10^0	0×10^0
36	0×10^0	$1.41 \times 10^5*$	$1.5 \times 10^2*$	0×10^0

37	0×10^0	0×10^0	0×10^0	0×10^0
38	0×10^0	1.5×10^2	$1 \times 10^2*$	0×10^0
39	0×10^0	0×10^0	0×10^0	0×10^0
40	0×10^0	0×10^0	0×10^0	0×10^0
41	1×10^2	$5.95 \times 10^3*$	0×10^0	0×10^0
42	0×10^0	0×10^0	0×10^0	0×10^0
43	0×10^0	0×10^0	0×10^0	0×10^0
44	0×10^0	0×10^0	0×10^0	0×10^0
45	0×10^0	0×10^0	0×10^0	0×10^0

*: exceeded ISO standard

APPENDIX 3

MICROBIOLOGICAL RESULTS BAU

Table 14 Microbiological results of laboratory analysis for food samples collected from the Beirut Arab University neighborhood

Sample number	Staphylococcus aureus CFU/g	Total coliform CFU/g	Fecal coliform CFU/g	Escherichia coli CFU/g
1	0×10^0	0×10^0	0×10^0	0×10^0
2	0×10^0	$1.1 \times 10^3*$	$5 \times 10^1*$	1×10^2
3	0×10^0	0×10^0	0×10^0	0×10^0
4	$2 \times 10^3*$	$1.39 \times 10^4*$	$2 \times 10^3*$	0×10^0
5	0×10^0	$4.9 \times 10^4*$	0×10^0	5×10^1
6	1×10^2	8×10^2	$1.5 \times 10^2*$	0×10^0
7	0×10^0	0×10^0	0×10^0	0×10^0
8	0×10^0	0×10^0	0×10^0	0×10^0
9	5.5×10^2	$1.05 \times 10^3*$	$1 \times 10^2*$	0×10^0
10	0×10^0	0×10^0	0×10^0	0×10^0
11	0×10^0	0×10^0	0×10^0	0×10^0
12	0×10^0	0×10^0	0×10^0	0×10^0
13	0×10^0	6.5×10^2	0×10^0	0×10^0
14	5×10^1	0×10^0	0×10^0	0×10^0
15	0×10^0	$1.5 \times 10^3*$	0×10^0	0×10^0
16	0×10^0	$4.85 \times 10^3*$	$2.5 \times 10^2*$	1×10^2
17	0×10^0	$1.2 \times 10^3*$	0×10^0	0×10^0
18	0×10^0	3×10^2	0×10^0	0×10^0
19	0×10^0	0×10^0	0×10^0	0×10^0
20	0×10^0	$1.19 \times 10^4*$	$1 \times 10^2*$	$\times 10^1$
21	0×10^0	$1.28 \times 10^4*$	$4.5 \times 10^2*$	0×10^0
22	0×10^0	0×10^0	0×10^0	0×10^0
23	0×10^0	0×10^0	0×10^0	0×10^0
24	0×10^0	0×10^0	0×10^0	0×10^0
25	0×10^0	$3.42 \times 10^5*$	$6.5 \times 10^4*$	0×10^0
26	0×10^0	$2.42 \times 10^5*$	$1.94 \times 10^4*$	$5 \times 10^2*$
27	0×10^0	$1.2 \times 10^6*$	$1.65 \times 10^4*$	$1.5 \times 10^2*$
28	0×10^0	5×10^1	0×10^0	0×10^0
29	0×10^0	1×10^2	0×10^0	0×10^0
30	0×10^0	0×10^0	0×10^0	0×10^0
31	6.5×10^2	0×10^0	0×10^0	0×10^0
32	0×10^0	0×10^0	0×10^0	0×10^0
33	0×10^0	0×10^0	0×10^0	0×10^0
34	3.5×10^2	0×10^0	0×10^0	0×10^0

35	0×10^0	0×10^0	0×10^0	0×10^0
36	0×10^0	0×10^0	0×10^0	0×10^0
37	0×10^0	0×10^0	0×10^0	0×10^0
38	0×10^0	0×10^0	0×10^0	0×10^0
39	0×10^0	0×10^0	0×10^0	0×10^0
40	0×10^0	1×10^3	$3.5 \times 10^2*$	2×10^2
41	0×10^0	0×10^0	0×10^0	0×10^0
42	5×10^1	0×10^0	0×10^0	0×10^0
43	0×10^0	0×10^0	0×10^0	0×10^0
44	0×10^0	0×10^0	0×10^0	0×10^0
45	0×10^0	0×10^0	0×10^0	0×10^0

*: exceeded ISO standard

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