Research Article

Assessment of Food Safety and Food Handling Practice Knowledge among College of Basic Education Students, Kuwait

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The aim of this study is to assess the overall food safety knowledge of students at the College of Basic Education in Kuwait and to explore the relationship between their knowledge and demographic characteristics. A valid questionnaire was used that included 16 food handling practice (FHP) questions and 15 food safety knowledge (FSK) questions. Each question had one correct answer that was awarded a score of one point, while a score of zero was given for all incorrect answers. In addition, a passing percentage was calculated. A passing percentage is the percentage of participants who answered correctly ≥ 50% of the questions. A total of 585 students participated in the study (mean age = 21.3 ± 3.88 years). The results showed that the mean score of FHP was 7.56 ± 1.96 (47.2%), with the highest mean practices being using a paper towel to dry hands and washing hands before cooking or eating (91.5% and 90.1%, resp.). The lowest mean practices (5.3%) were checking the temperature of burgers followed by (6%) the way of defrosting meat. The mean score of FSK was 3.44 ± 2.00 (22.9%), with the highest mean knowledge (63.8%) being related to cleaning the kitchen counter. The lowest mean knowledge (6.8%) was related to the optimum growth temperature for the most disease-causing bacteria. The overall passing percentage of FHP was 55%, while it was 2.9% for FSK. The results obtained showed that the students with the highest FHP scores were generally female, aged ≥ 28 years, and single, and they cook by themselves all the time or sometimes (p < 0.001, p < 0.001, p < 0.001, and p = 0.004, resp.). The students with the highest FSK scores were generally male and they cook by themselves all the time or sometimes (p = 0.018 and p = 0.002, resp.). In conclusion, the study showed that students had insufficient scores for FHP and FSK. Therefore, an effective food safety education programme is urgently needed.

1. Introduction

Food safety refers to the procedures used in handling, preparing, and storing food in a way that prevents contamination and foodborne diseases [1]. Nowadays, food safety is an international concern [2, 3]. Although governments all over the world are doing their best to improve the safety of food, the occurrence of foodborne disease remains a significant health issue in both developed and developing countries [4].

A report conducted by the World Health Organization (WHO) [5] has shown that almost 1 in 10 people in the world fall ill after eating contaminated food and more than 91 million people are affected in developing countries. Moreover, it has been estimated that each year 1.8 million people die as a result of diarrhoeal diseases. This may be due to poor food safety and unhygienic/improper handling practices, cross contamination from food contact surfaces, and inadequate preservation methods [3]. The WHO has developed the Five Keys to Safer Food programme as available guidance to provide basic principles that each individual should know to ensure safer food and prevent foodborne diseases. The basic principles are to keep clean, separate raw and cooked food, cook thoroughly, keep food at a safe temperature, and use safe water and raw materials [6].
Unsafe food creates a vicious cycle of disease and poor nutrition, and some age groups may be at higher risk of foodborne disease than vulnerable groups such as infants, young children, the elderly, and pregnant women [7]. For example, young adults (18–29 years old) are more likely to engage in risky food handling than others [8–11]. It was found that, overall, young adults have a lack of food safety knowledge (FSK) and safe food handling practices (FHP), and this may be due to a lack of food safety education, good role models, and/or food handling experience [9]. This becomes more serious when they are responsible for providing care to other family members who are at an increased risk, such as children and the elderly [7, 12].

Few studies have been published about FSK and FHP among young adults in universities. Those studies that have been undertaken have shown that FSK appears to be low among university students [11, 13–15]. Such studies have found that FSK, attitudes, and practices differ by gender, age, year of study, major, mother’s education level, psychological factors, and other demographic characteristics [11, 13–18].

Food safety education is an important part of foodborne disease prevention and young adults are an important vulnerable group to focus on [8, 12, 19]. Due to changes in the education system and a lack of food safety education, it is important to evaluate this group’s level of food safety awareness and to understand the issues surrounding it. This will help to tailor educational programmes that can improve FSK and FHP for this group. To the best of our knowledge, there is a lack of studies that investigate FSK and FHP among Kuwaiti students. Therefore, this study aims to assess the overall food safety knowledge of students at the College of Basic Education in Kuwait and to explore the relationship between their knowledge and demographic characteristics. This will help to provide valuable information for the planning of effective educational food safety programmes that can improve students’ knowledge and practices.

2. Materials and Methods

2.1. Study Population. A cross-sectional study was conducted during September and October 2019. The respondents were undergraduate students of different departments, with the aim of obtaining a broad student representation. The respondents are comprised of 600 students enrolled in both male and female campuses of the College of Basic Education (CBE), Kuwait. The CBE is a degree awarding tertiary institute in Kuwait with a population of ~25,000 students. It is operated by the Government’s Public Authority for Applied Education and Training (PAAET). The college provides teachers for the Ministry of Education [20]. The minimum required sample size was calculated based on a statistical power of 80%, a confidence level of 95%, a margin of error of 5%, and the student body of 25,000; thus, a minimum sample size of 379 was required [21].

Before administering the questionnaire, verbal explanations of the study were given to lecturers. The objectives, significance, and protocol of the study were explained and prior approval was obtained from each lecturer.

The protocol of the study and its significance were briefly explained on the first page of the questionnaire. After initial approval, a consent form was obtained from each student who was willing to participate in the study. Questionnaires were distributed to all students during regular class times by the researchers. It was stressed that completion of the questionnaire was voluntary and that all responses were anonymous. No extra credit was given to the participating students. Incomplete or inappropriately filled-in questionnaires were excluded. Out of 600 completed questionnaire forms, only 585 (97.5%) were valid.

2.2. Questionnaire. A structured questionnaire on overall food safety knowledge, including FHP and FSK related to basic principles, was used. The questionnaire was composed of three sections covering sociodemographic characteristics, FHP questions, and FSK questions. The first part was developed by the researchers to collect information about students’ sociodemographic and academic characteristics, including age, gender, field of study, year of study, marital status, governorate, nationality, mother’s employment, cooking habits, and the person responsible for preparing and cooking food in the family. In addition, a question about the main sources of food safety information was added and multiple answers were allowed.

The second and third parts of the questionnaire were developed from a published, reliable, and valid questionnaire created by Byrd-Bredbenner et al. [7] which has been used in similar studies undertaken in Jordan, Greece, Lebanon, and the USA, respectively [10, 14, 18, 22]. The FHP section included 16 questions, whereas the FSK section included 15 questions. Most of the questions were multiple choice questions.

The questionnaire was evaluated and assessed by a number of experts to make necessary modifications as appropriate. Then, a pilot study (comprising 50 students) was conducted to ensure initial validation of the questionnaire. The clarity and suitability of wording, in addition to the average time needed for its completion, were assessed. Necessary modifications were made but the pilot study results were not included in the final results of the study. The questionnaire took approximately 9 minutes to complete.

Each question in sections two and three had one correct answer that was awarded a score of one point, while a score of zero was given for all incorrect answers, those skipped, and those answered with “I do not know.” The sum of the FHP section and the sum of the FSK section were obtained and the total score was the sum of the two sections. The maximum of possible points was 31, reflecting the participant’s overall knowledge of food safety. In addition, a passing percentage was calculated for each section and a total was calculated as well. A passing percentage is the percentage of participants who answered correctly ≥ 50% of the questions [18].

Age groups were divided into ≤ 21, 22–27, and ≥ 28 years old. Students’ self-reported fields of study were divided into six departments: science and technology (science, math, and computer science), humanities and social sciences (English,
2.3. Statistical Analysis. Data were statistically gathered using the Statistical Package for the Social Sciences, version 23 [23]. The cut-off point for statistical significance was set at p value < 0.05. Descriptive statistics (means and standard deviations or frequencies) were calculated for all variables. Independent analysis of variance (ANOVA) tests were conducted to determine differences in sociodemographic variables and correct scores for FHP and FSK. Tukey’s test was used in conjunction with the ANOVA test to find means that were significantly different from each other. An independent sample t-test was used to show the relationship between gender, nationality, marital status, and correct FHP and FSK scores. The correlation between FSK and FHP was tested with a Pearson correlation.

Stepwise multiple regression (bidirectional elimination) was used to model the relationship of each of the response variables with independent variables, with p value < 0.05 considered to be statistically significant. A Cronbach’s alpha reliability coefficient was calculated for the 31 questions. Cronbach’s alpha was 0.70 (note that a reliability coefficient of 0.70 or higher is considered “acceptable” in most social science research situations) [24].

3. Results

Demographic characteristics of the sample are summarized in Table 1. A total of 585 undergraduate students participated in the study with a mean age of 21.3 ± 3.88; 56.2% were females; and 43.8% were males. The majority of respondents were aged less than or equal to 21 years (69.7%). Of the students in the study, 41.5% were studying in the humanities and others category. Around 37.3% of the students were in their second year. Most of the students were single (80%) and the majority were Kuwaiti (89.7%). Only 8.4% (n = 49) of the participants have children, and of these 44.9% have three or more children. Twenty-five percent of the students were from Al Jahra governorate. Only 10% of the students reported that they cook their own meals all the time; 41.7% have mothers who are housewives. Almost half of the students reported that their housekeeper cooks in their homes (47%). Social media/Internet was the main source of food safety information for the students (49.6%, n = 290).

The mean scores of FHP and the significance levels for each demographic characteristic are presented in Table 2. The mean ± SD (range) for FHP score was 7.56 ± 1.96 (1 to 13). The result shows that female students scored significantly better than male students (p ≤ 0.001). In addition, students who cook sometimes scored significantly higher than those who cook rarely (p = 0.001).

The mean ± SD (range) score for FSK was 3.44 ± 2.00 (0 to 11). Male students scored higher than female students, although the difference was not significant (p = 0.061). Students who cook all the time or sometimes scored significantly higher than students who never cook (p = 0.009) (Table 2).

Table 3 presents the score distribution details for the FHP questions. The highest percentage of correct answers was for the question asking “What is the best way you dry your hands?” (91.5%) and the question asking “What is the best way you wash your hands?” (90.1%). On the other hand, the lowest percentage of correct answers was for the question regarding “how to make sure that a burger is cooked properly” (5.3%) and the question regarding “the most ideal way to defrost frozen meat” (6%).

Response details for the FSK questions are presented in Table 4. Students were mostly knowledgeable (63.8%) about the best way to clean a kitchen counter. This was followed by 45% who knew about the microorganisms that are responsible for most foodborne diseases. Students were least knowledgeable (6.8%) about the optimum growth temperature for the most disease-causing bacteria. In addition, only 7% of the students knew the internal temperature that a burger needs to be to avoid food poisoning.

The overall passing percentage was 6.2%. The passing percentage for the FHP questions was 55%, while the passing percentage for the food safety knowledge questions was 2.9%.

The relationship between FSK and FHP was investigated using a Pearson product-moment correlation coefficient. Preliminary analysis was performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity. There was a small, positive correlation between the two variables, r = 0.116, n = 585, and p < 0.005, with a high score for FSK associated with a high score for FHP.

Since univariable analysis may be affected by other variables that are not included in the analysis each time, multivariable regression analysis was used to obtain final conclusions concerning the variables FHP, FSK, and overall scores. The models included the independent variables when they were either significant or important for control of confounding.

Stepwise multiple regression was used to model the relationship between demographic characteristics and percentages of total correct scores. The results of the linear regression model were significant (F (2,582) = 11.93, p < 0.001, and R² = 0.04), indicating that approximately 4% of the variance in the percentage of total correct scores is explainable by cooking habits and nationality. The mean total correct scores increased significantly for students who cook all the time or sometimes (Table 5).

Linear regression was used to model the relationship between demographic characteristics and FHP. The results of the linear regression model were significant, F (6,578) = 8.49, p < 0.00, and adjusted R² = 0.08. These variables (age, gender, marital status, and cooking habits) and the variables that were not significant but were maintained in the model for control of confounding explained 8% of the variability in FHP Table (6). The mean FHP increased significantly for
students who were in older age, female, single, and cook all the times or sometimes, compared to younger age, male, married, and those who reported to never cook.

Linear regression was used to model the relationship between demographic characteristics and FSK. The results depict that the linear regression model was significant, $F(4,580) = 5.88$, $p < 0.001$, and adjusted $R^2 = 0.04$. These variables (gender and cooking habits) and the variables that were not significant but were maintained in the model for control of confounding explained 4% of the variability in FSK (Table 7). The mean FSK increased significantly for students who were male and those who cook all the time or sometimes, compared to females and those who reported never cooking.

### Table 1: Demographic characteristics of the study ($n = 585$).

| Demographic characteristics of the study | $n$ | % |
|-----------------------------------------|-----|---|
| Age ≤ 21 years                          | 408 | 69.7 |
| Age Between 22 and 27 years             | 144 | 24.6 |
| Age ≥ 28 years                          | 33  | 5.6 |
| Gender Male                            | 256 | 43.8 |
| Gender Female                         | 329 | 56.2 |
| Field of study                          |     |   |
| Science and technology                | 107 | 18.3 |
| Humanities and others                 | 243 | 41.5 |
| Physical education and sport          | 61  | 10.4 |
| Applied arts and music                | 174 | 29.7 |
| Year of study                          |     |   |
| First year                            | 126 | 21.5 |
| Second year                           | 218 | 37.3 |
| Third year                            | 148 | 25.3 |
| Fourth year or more                   | 93  | 15.9 |
| Marital status                         |     |   |
| Single                                 | 470 | 80.3 |
| Married/divorced                      | 115 | 19.6 |
| Students have children                 |     |   |
| Yes                                    | 49  | 8.4 |
| No                                     | 536 | 91.6 |
| Number of children (n = 49)            |     |   |
| 1-2 children                          | 27  | 55.1 |
| 3-4 and more children                 | 22  | 44.9 |
| Number of children                    |     |   |
| Average (2.69 ± 1.7) minimum 1–maximum 7 |     |   |
| Governorate                            |     |   |
| Al Ahmadi                              | 120 | 20.5 |
| Capital                                | 62  | 10.6 |
| Farwaniya                              | 75  | 12.8 |
| Hawali                                 | 76  | 13.0 |
| Jahra                                  | 146 | 25.0 |
| Mubarak Alkabeer                       | 106 | 18.1 |
| Nationality                            |     |   |
| Kuwaiti                                | 525 | 89.7 |
| Non-Kuwaiti                           | 60  | 10.3 |
| Mother’s employment                    |     |   |
| Works                                  | 207 | 35.4 |
| Retired                                | 134 | 22.9 |
| Housewife                              | 244 | 41.7 |
| Cooking habits                         |     |   |
| All the time                           | 60  | 10.3 |
| Sometimes                              | 330 | 56.4 |
| Rarely                                 | 154 | 26.3 |
| Never                                  | 41  | 7.0 |
| Who prepares and cooks in your family? |     |   |
| By myself                              | 41  | 7.0 |
| Mother/wife                            | 247 | 42.2 |
| Housekeeper                            | 275 | 47.0 |
| Others                                 | 22  | 3.8 |
| Sources of food safety information     |     |   |
| Internet and social media             | 219 | 49.6 |
| Parent                                 | 211 | 36.1 |
| Doctors                                | 186 | 32.8 |
| Friends                                | 62  | 10.6 |
| Textbooks                              | 23  | 3.9 |
| I do not know                          | 16  | 2.7 |
| TV                                     | 15  | 2.6 |
| Government                             | 7   | 1.2 |

$n$: number of respondents.
| Demographic variable | FHP*  | FSK*  | Total*  |
|----------------------|-------|-------|---------|
|                      | Mean  | SD    | Mean    | SD    | Mean   | SD     |
| **Age**              |       |       |         |       |        |        |
| ≤ 21 years           | 7.47  | 1.93  | 3.40    | 2.01  | 10.87  | 2.91   |
| Between 22 and 27    | 7.72  | 2.02  | 3.60    | 1.95  | 11.32  | 3.04   |
| years                | 7.97  | 1.99  | 3.27    | 2.18  | 11.24  | 3.30   |
| ≥ 28 years           | 7.97  | 1.99  | 3.27    | 2.18  | 11.24  | 3.30   |
| **p value**          | 0.192 | 0.529 | 0.260   |       |        |        |
| **Gender**           |       |       |         |       |        |        |
| Male                 | 7.13  | 1.95  | 3.62    | 2.14  | 10.74  | 3.07   |
| Female               | 7.90  | 1.91  | 3.30    | 1.89  | 11.20  | 2.87   |
| **p value**          | 0.001 | 0.061 | 0.064   |       |        |        |
| **Field of study**   |       |       |         |       |        |        |
| Science and technology| 7.55  | 1.94  | 3.73    | 2.01  | 11.28  | 2.99   |
| Humanities and others| 7.55  | 1.96  | 3.38    | 1.93  | 10.93  | 2.91   |
| Physical education   | 7.26  | 1.96  | 3.00    | 1.93  | 10.26  | 2.89   |
| and sport            | 7.68  | 1.94  | 3.51    | 2.11  | 11.18  | 3.03   |
| **p value**          | 0.567 | 0.136 | 0.137   |       |        |        |
| **Year of study**    |       |       |         |       |        |        |
| First year           | 7.37  | 2.05  | 3.60    | 2.02  | 10.97  | 3.13   |
| Second year          | 7.83  | 1.98  | 3.30    | 1.95  | 11.13  | 2.85   |
| Third year           | 7.43  | 1.82  | 3.55    | 2.03  | 10.99  | 2.91   |
| Fourth year and more | 7.39  | 1.97  | 3.38    | 2.07  | 10.76  | 3.11   |
| **p value**          | 0.082 | 0.479 | 0.798   |       |        |        |
| **Marital status**   |       |       |         |       |        |        |
| Single               | 7.57  | 1.97  | 3.44    | 2.01  | 11.02  | 2.98   |
| Married/divorced     | 7.50  | 1.94  | 3.43    | 1.98  | 10.93  | 2.93   |
| **p value**          | 0.700 | 0.970 | 0.780   |       |        |        |
| **Students have children** | |       |         |       |        |        |
| Yes                  | 7.92  | 2.01  | 3.49    | 1.94  | 11.41  | 3.18   |
| No                   | 7.53  | 1.96  | 3.44    | 2.01  | 10.96  | 2.95   |
| **p value**          | 0.182 | 0.859 | 0.315   |       |        |        |
| **Number of children** |     |       |         |       |        |        |
| 1-2 children         | 7.67  | 2.03  | 3.37    | 1.75  | 11.04  | 2.92   |
| 3-4 and more children| 8.23  | 1.99  | 3.64    | 2.19  | 11.86  | 3.48   |
| **p value**          | 0.339 | 0.640 | 0.371   |       |        |        |
| **Governorate**      |       |       |         |       |        |        |
| Al Ahmadi            | 7.40  | 1.89  | 3.25    | 1.86  | 10.65  | 2.89   |
| Capital              | 7.71  | 2.06  | 3.63    | 2.10  | 11.34  | 3.15   |
| Farwaniya            | 7.63  | 1.97  | 3.61    | 1.85  | 11.24  | 2.79   |
| Hawali               | 7.88  | 1.81  | 3.95    | 2.48  | 11.83  | 3.11   |
| Jahra                | 7.55  | 1.93  | 3.13    | 1.86  | 10.68  | 2.79   |
| Mubarek alkabeer     | 7.38  | 2.13  | 3.49    | 1.96  | 10.87  | 3.12   |
| **p value**          | 0.524 | 0.060 | 0.056   |       |        |        |
| **Nationality**      |       |       |         |       |        |        |
| Kuwait               | 7.58  | 1.94  | 3.48    | 2.02  | 11.06  | 2.95   |
| Non-Kuwaiti          | 7.33  | 2.13  | 3.10    | 1.85  | 10.43  | 3.03   |
| **p value**          | 0.349 | 0.165 | 0.119   |       |        |        |
| **Mother’s employment** |     |       |         |       |        |        |
| Works                | 7.61  | 1.81  | 3.56    | 2.04  | 11.16  | 2.82   |
| Retired              | 7.59  | 1.92  | 3.46    | 1.91  | 11.04  | 2.80   |
| Housewife            | 7.50  | 2.11  | 3.34    | 2.03  | 10.84  | 3.16   |
| **p value**          | 0.826 | 0.511 | 0.496   |       |        |        |
| **Cooking habits**   |       |       |         |       |        |        |
| All the time         | 7.67  | 2.23  | 3.77    | 1.92  | 11.43  | 3.25   |
| Sometimes            | 7.80  | 1.92  | 3.60    | 2.03  | 11.40  | 2.91   |
| Rarely               | 7.14  | 1.81  | 3.16    | 1.96  | 10.29  | 2.84   |
| Never                | 7.02  | 2.11  | 2.76    | 1.92  | 9.78   | 2.66   |
| **p value**          | 0.001 | 0.009 | ≤ 0.001 |       |        |        |
| **Who cooks and prepares food in your family?** | |       |         |       |        |        |
| By myself            | 7.83  | 2.10  | 3.83    | 1.39  | 11.66  | 2.66   |
| Mother/wife          | 7.50  | 2.04  | 3.64    | 2.20  | 11.14  | 3.15   |
| Housekeeper          | 7.55  | 1.89  | 3.22    | 1.91  | 10.77  | 2.87   |
| Others               | 7.77  | 1.87  | 3.27    | 1.48  | 11.03  | 2.31   |
| **p value**          | 0.743 | 0.058 | 0.239   |       |        |        |

*Food handling practices; bfood safety knowledge; ctotal of food handling practices and food safety knowledge; *independent sample *t*-test applied; **independent analysis of variance (ANOVA) tests applied.
Table 3: Score distribution for food handling practices questions.

| Food handling practice questions                                                                 | Responses                      | n    | %    |
|-------------------------------------------------------------------------------------------------|-------------------------------|------|------|
| The best way to wash vegetables and fresh fruits is using                                       | Soup                          | 25   | 4.3  |
|                                                                                                | Hot water                     | 250  | 42.7 |
|                                                                                                | Water and salt                | 53   | 9.1  |
|                                                                                                | Water and vinegar             | 128  | 21.9 |
|                                                                                                | Cool running water            | 129  | 22.1 |
|                                                                                               | Use the board as it is        | 22   | 3.8  |
|                                                                                               | Wipe the board off with a paper towel | 48 | 8.2  |
|                                                                                               | Use the other side of the board | 53  | 9.1  |
|                                                                                               | Wash the board with soap and hot water | 228 | 39.0 |
|                                                                                               | Use a different cutting board | 234  | 40.0 |
| The best way to reuse a meat/chicken/fish knife is                                             | Reuse the knife as it is      | 15   | 2.6  |
|                                                                                                | Rinse the knife with cold water | 98  | 16.8 |
|                                                                                               | Wash the knife with soap and water | 449 | 76.8 |
|                                                                                               | Wipe the knife with a cloth   | 23   | 3.9  |
| The best way to reuse a meat/chicken/fish cutting board to cut other foods is                  | Use an automatic dishwasher   | 120  | 20.5 |
|                                                                                                | Soak them then wash in the same water | 42  | 7.6  |
|                                                                                               | Hand wash them and let them air dry | 263 | 45.0 |
|                                                                                               | Hand wash them and then dry them with a towel | 160 | 27.4 |
| The best way to wash dishes to avoid food poisoning is                                          | Soap and water                | 527  | 90.1 |
|                                                                                                | Water only                    | 47   | 8.0  |
|                                                                                               | Hand sanitizer                | 4    | 0.7  |
|                                                                                               | I do not wash my hands        | 7    | 1.2  |
| What is the best way you wash your hands?                                                      | Paper towel                   | 535  | 91.5 |
|                                                                                                | Hand air dryer                | 4    | 0.7  |
|                                                                                               | Dry on their own              | 30   | 5.1  |
|                                                                                               | Using my clothes              | 16   | 2.7  |
| Do you take off jewellery when preparing food?                                                  | Yes                           | 298  | 50.9 |
|                                                                                                | No                            | 107  | 18.3 |
|                                                                                                | Not applicable                | 180  | 30.8 |
| Do you prepare food if you have a sore on the back of your hand?                               | Yes, if you are putting on a bandage | 196 | 33.5 |
|                                                                                                | Yes, if you wear a glove      | 71   | 12.1 |
|                                                                                               | Yes, if you bandage the sore and wear a glove | 119 | 20.3 |
|                                                                                               | No, before the sore heals, you should not make food | 199 | 34.0 |
| You should wash your hands during cooking if you touch                                         | Your face                     | 191  | 32.6 |
|                                                                                                | Clean pots and counter        | 210  | 35.9 |
|                                                                                                | Utensils used in cooking food | 145  | 24.8 |
|                                                                                                | None of the above              | 39   | 6.7  |
| How many times per week is your kitchen sink drain sanitized?                                  | Daily                         | 377  | 64.4 |
|                                                                                                | Weekly                        | 71   | 12.1 |
|                                                                                                | Never                         | 31   | 5.3  |
|                                                                                                | Only when washing food in the sink | 106 | 18.1 |
| The best place to store raw meat in your fridge is                                             | Top shelf                     | 385  | 65.8 |
|                                                                                                | Medium shelf                  | 92   | 15.7 |
|                                                                                                | Lowest shelf                  | 108  | 18.5 |
| How do you make sure that a burger is cooked properly at home?                                 | By its color                   | 302  | 51.6 |
|                                                                                                | By its texture and firmness    | 101  | 17.3 |
|                                                                                                | By its core temperature       | 31   | 5.3  |
|                                                                                                | By measuring the cooking time | 67   | 11.5 |
|                                                                                                | I do not know                 | 84   | 14.4 |
| The most ideal way to fry eggs is                                                              | Until the egg white is solid and egg yellow is semisolid | 160 | 27.4 |
|                                                                                                | Until the egg white and yellow are semisolid | 79  | 13.5 |
|                                                                                                | Until the egg white and yellow are solid | 346 | 59.1 |
| The most ideal way to defrost frozen meat is                                                   | Use a microwave               | 27   | 4.6  |
|                                                                                                | Put it under running water for 1 hour | 416 | 71.1 |
|                                                                                                | Leave it outside the freezer for 1 hour | 107 | 18.3 |
|                                                                                                | Leave it in the fridge for a few hours | 35  | 6.0  |
4. Discussion

This study offers insight into the overall food safety knowledge among students at the CBE, Kuwait. In general, students have poor overall food safety knowledge (35.5%), including low adherence to appropriate FHP (47.2%) and poor FSK (22.9%). An insufficient level of overall food safety knowledge among university students was also discovered in previous similar studies [14, 18, 22].

It was unexpected that Kuwaiti students would exceed other students from previous studies [10, 14, 18, 22] in questions related to cleaning/hygiene practices and questions regarding cross-contamination practices. These results could be related to the fact that Muslims consider cleaning/hygiene to be part of their faith.

Regarding FSK questions, it was disappointing that Kuwaiti students were less knowledgeable of food safety than other students in different countries [10, 14, 18, 22]. This outcome may be explained by the fact that only 7% of the students in this study cook by themselves and infrequent cooking has been previously associated with relatively low knowledge [18]. Furthermore, in the current study, it has

### Table 3: Continued.

| Food handling practice questions | Responses       | n  | %  |
|----------------------------------|----------------|----|----|
| The most ideal place to store a hot meal is in | The fridge 130 22.2 |    |    |
|                                  | A cool oven 74 12.6 |    |    |
|                                  | A warm oven 287 49.1 |    |    |
|                                  | On the counter 94 16.1 |    |    |
| The best time to take refrigerated items during grocery shopping is | At the beginning 46 7.9 |    |    |
|                                  | In the middle 48 8.2 |    |    |
|                                  | At the end 318 54.4 |    |    |
|                                  | Any time 173 29.6 |    |    |

n: number of respondents. In this table, the best food handling practice is in bold.

### Table 4: Right, wrong, and "I do not know" responses to food safety knowledge questions.

| Food safety knowledge questions | Right N  | %  | Wrong N | %  | I do not know N | %  |
|---------------------------------|----------|----|---------|----|----------------|----|
| The best way to check kitchen counter | 373 63.8 | 118 20.2 | 94 16.1 |
| Soaping, then water, and then sanitizer | 146 25.0 | 315 53.8 | 124 21.2 |
| Washing hands and rubbing them 20 seconds | 112 19.1 | 141 24.1 | 332 56.8 |
| Harmful microbes can be killed when frozen false | 61 10.4 | 166 28.4 | 358 61.2 |
| The least likely food to cause food poisoning | 373 63.8 | 118 20.2 | 94 16.1 |
| Chocolate cake left on the counter overnight | 130 22.2 | 124 21.2 | 331 56.6 |
| The recommended temperature for freezers −18°C | 84 14.4 | 150 25.6 | 351 60.0 |
| The recommended temperature for refrigerators 4°C | 235 40.2 | 199 34.0 | 151 25.8 |
| Food that does not need to be refrigerated | 110 18.8 | 252 43.1 | 223 38.1 |
| Raisins | 86 14.7 | 150 25.6 | 349 59.7 |
| To avoid food poisoning, what is the period that leftover foods need to be heated? Until they are boiling hot | 41 7.0 | 74 12.6 | 470 80.3 |
| How can we protect ourselves from salmonella bacteria in food? | 263 45.0 | 148 25.3 | 174 29.7 |
| Cook it well | 44 7.5 | 389 66.5 | 152 26.0 |
| Internal temperature that a burger needs to reach to avoid food poisoning 71°C | 87 14.9 | 145 24.8 | 353 60.3 |
| Which microorganisms are responsible for most foodborne diseases? Bacteria | 197 33.7 | 130 22.2 | 258 44.1 |
| Individuals that should not prepare food for other people | 40 6.8 | 97 16.6 | 448 76.6 |
| A person with diarrhoea | 40 6.8 | 97 16.6 | 448 76.6 |
| Foods that should be avoided by pregnant women, infants, and children | 40 6.8 | 97 16.6 | 448 76.6 |
| Canned vegetables | 40 6.8 | 97 16.6 | 448 76.6 |
| Which individuals rarely get food poisoning? Teenagers | 40 6.8 | 97 16.6 | 448 76.6 |
| The optimum growth temperature for most disease-causing bacteria 5–60°C | 40 6.8 | 97 16.6 | 448 76.6 |

n: number of respondents. In this table, the correct answer for each question is highlighted in bold.
been found that all students live with their families and rely on their mothers or housekeeper for food preparation and cooking. It seems possible that these students are less interested in playing a role in the kitchen. In addition, changes in the education system, a lack of modules related to food safety, and a lack of food handling and preparation classes in schools cause a low level of food safety awareness. Food preparation classes are often not part of the basic educational curricula [17]. The situation in Kuwait is not dissimilar, as there are still no formal classes covering food safety taught in schools [13] and universities. Furthermore, a study by Slater [26] found that low FHP and FSK may be due to an increase in the number of working mothers, as they have less time to cook and children tend to learn food practices by observing their mothers [16]. Interestingly, cooking classes and electives are becoming rare in schools [9].

Regarding the relationship between food safety knowledge and demographic characteristics, the results of this study show that age, gender, marital status, and cooking habits have a significant effect ($p < 0.05$) on FHP, while gender and cooking habits have a significant effect ($p < 0.05$) on FSK.

In common with previous studies [25, 28], the current study found that older students gave more accurate answers regarding FHP. This interpretation differs from that of Al-Khamees [13], who undertook a study of 510 students at Kuwait University and observed that older students were significantly less knowledgeable, as well as Stratev et al. [29], who studied veterinary medicine students ($n = 90$) in Bulgaria and found that age and gender did not affect FSK, attitudes, and practices. This may be due to the variation of the study populations and the methods used in these studies, which can influence study results. Another possible explanation is that older students are more interested in and concerned about food safety, and they cook more than younger students [10]. In addition, it may be due to the rise in the number of working mothers, as they have less time to cook and children tend to learn food practices by observing their mothers [16]. Furthermore, cooking classes and electives are becoming rare in schools [9].

The findings of this study are consistent with previous research in which female students have significantly higher scores in FHP than male students. Interestingly, the study results revealed that male students had significantly higher scores in terms of FSK. A study of Lebanese university students ($n = 1172$) found that female students scored higher (53.6%) in knowledge and practice questions than male students (44.7%), but the differences were significant for the practice part only [14]. Similarly, a study by Green and

![Table 5: Result for linear regression with cooking habits and nationality predicting the percentage of total correct scores.](image)

| Variable       | B   | SE  | 95% CI       | B   | T    | $p$ value |
|---------------|-----|-----|--------------|-----|------|-----------|
| (Intercept)   | 31.75 | 1.96 | [27.91, 35.60] | 0.00 | 16.24 | $< 0.001$ |
| Cooking habits | 2.42  | 0.52 | [1.39, 3.45]  | 0.19 | 4.62  | $< 0.001$ |
| Nationality   | $-2.53$ | 1.29 | $[-5.06, -0.01]$ | $-0.08$ | $-1.97$ | $0.049$ |

Note. $R^2 = 0.04$. Unstandardized regression equation: percentage of correct scores $= 31.75 + 2.42 \cdot$ cooking habits $- 2.53 \cdot$ nationality. $B$: unstandardized coefficient; SE: standard error; $t$: standardized coefficient beta.

![Table 6: Results for linear regression with gender, cooking habits, age, marital status, maternal employment, and nationality predicting percentage of correct FHP.](image)

| Variable       | B   | SE  | 95% CI       | B   | T    | $p$ value |
|---------------|-----|-----|--------------|-----|------|-----------|
| (Intercept)   | 38.21 | 3.10 | [32.12, 44.29] | 0.00 | 12.34 | $< 0.001$ |
| Gender        | 5.85  | 1.06 | [3.77, 7.93]  | 0.24 | 5.52  | $< 0.001$ |
| Cooking habits | 1.95  | 0.67 | [0.63, 3.27]  | 0.12 | 2.90  | 0.004     |
| Age           | 3.54  | 0.95 | [1.67, 5.41]  | 0.17 | 3.72  | $< 0.001$ |
| Marital status | $-4.73$ | 1.42 | $[-7.51, -1.95]$ | $-0.15$ | $-3.35$ | $< 0.001$ |
| Maternal employment | $-0.96$ | 0.58 | $[-2.09, 0.17]$ | $-0.07$ | $-1.66$ | 0.097     |
| Nationality   | $-2.30$ | 1.63 | $[-5.50, 0.91]$ | $-0.06$ | $-1.41$ | 0.160     |

Note. $R^2 = 0.08$. Unstandardized regression equation: percentage of correct FHP $= 47.95 + 5.85 \cdot$ gender $+ 1.95 \cdot$ cooking habits $+ 3.54 \cdot$ age $- 4.73 \cdot$ marital status $- 0.96 \cdot$ maternal employment $- 2.30 \cdot$ nationality. $B$: unstandardized coefficient; SE: standard error; $t$: standardized coefficient beta.

![Table 7: Results for linear regression with cooking habits, gender, nationality, and “who cooks” predicting percentage of correct FSK.](image)

| Variable       | B   | SE  | 95% CI       | B   | T    | $p$ value |
|---------------|-----|-----|--------------|-----|------|-----------|
| (Intercept)   | 27.96 | 4.19 | [19.73, 36.19] | 0.00 | 6.67  | $< 0.001$ |
| Cooking habits | 2.47  | 0.78 | [0.94, 3.99]  | 0.14 | 3.18  | 0.002     |
| Gender        | $-2.66$ | 1.12 | $[-4.85, -0.47]$ | $-0.10$ | $-2.38$ | 0.018     |
| Nationality   | $-3.46$ | 1.82 | $[-7.03, 0.10]$ | $-0.08$ | $-1.91$ | 0.057     |
| Who cooks     | $-1.50$ | 0.84 | $[-3.15, 0.16]$ | $-0.08$ | $-1.78$ | 0.076     |

Note. $R^2 = 0.04$. Unstandardized regression equation: percentage of correct FSK $= 40.30 + 2.47 \cdot$ cooking habits $- 2.66 \cdot$ gender $- 3.46 \cdot$ nationality $- 1.50 \cdot$ who cooks. $B$: unstandardized coefficient; SE: standard error; $t$: standardized coefficient beta.
Knechtges [11] found that undergraduate students at an American university \((n = 786)\) had poor knowledge of food safety practices \((43\% \pm 4.13)\) and that females had higher scores than males \((45\% \pm 43\%, \text{ } p < 0.05, \text{ } \text{resp.})\). In Pakistan, a study of students \((n = 311)\) at the University of Agriculture, Peshawar, found that female students scored considerably better in food handling scores than male students [15]. A study in Kuwait showed that females scored significantly better in both knowledge and reported behaviour than male students [13]. This result may reflect the fact that females are traditionally responsible for food preparation and nutrition for the whole family in Kuwait, as well as in many other countries [13, 30]. However, young girls may gain traditional FHP from their mothers without any scientific knowledge [18]. Courtney et al. [25], in line with the current study, found that there is higher FSK among males than females. This may be influenced by several factors, such as variations in study populations and the statistical method used. In this study, multivariable analysis was used and adjusted for other factors, whereas this may have been unadjusted in previous studies that relied upon univariable analysis.

Students identified as single in this study obtained higher FHP scores than married students. This finding is in agreement with data from a previous study, according to which those unmarried are more knowledgeable regarding FHP \((53.3\% \text{ pass rate})\) than married participants with children or without children \((31.1\% \text{ and } 7.8\%, \text{ resp.})\) [31]. The reason for this may be due to the small number of participants in the married group. In the current study, most of the students were single \((80.3\%)\), so the most likely cause of this result is that there was a small number of participants in the married group. Another possible explanation is that in Kuwait, most of the married girls tend to live in an extended family house where their mother-in-law or housekeeper is responsible for family meal preparation.

This study found that students who cook by themselves all the time or sometimes have significantly better handling practices and food safety knowledge than those who never cook. Osaili et al. [18] suggest that students gain knowledge through the experience of preparing their own meals, as infrequent cooking has been associated with relatively lower FSK [25]. In contrast to earlier findings, Hassan and Dimassi [14] found that students who cook all the time had significantly lower food safety knowledge compared to those who cook less frequently.

The present study has some limitations. First, the study was carried out among students of the CBE, Kuwait. Therefore, current findings may not represent all university-aged students in Kuwait. Further studies that survey students in different universities are necessary. Second, self-reporting of FHP does not necessarily reflect students’ actual FHP and may lead to overreporting.

**5. Conclusion**

To conclude, this study has shown that students of the CBE, Kuwait, have insufficient scores for overall food safety knowledge. The data obtained from this study have revealed the great need for an effective food safety education programme starting at an early age and continuing through to university. Furthermore, a national multimedia food safety education campaign is needed, as nutrition education from an early age is an important way to gain essential foundational knowledge and skills.

**Abbreviations**

WHO: World Health Organization  
FSK: Food safety knowledge  
FHP: Food handling practices  
CBE: College of Basic Education  
PAAET: The Public Authority for Applied Education and Training.

**Data Availability**

The data used to support the findings of this study are available from the corresponding author upon request.

**Conflicts of Interest**

The authors declare that they have no conflicts of interest.

**Authors’ Contributions**

F. Ashkanani conceptualized the study, developed the methodology, performed formal analysis and investigation, and wrote the original draft. W. Husain conceptualized the study, developed the methodology, performed formal analysis and investigation, and reviewed and edited the article. M. A. Al Dwarijji conceptualized the study, developed the methodology, and reviewed and edited the article.

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