ASSESSMENT OF FOOD SAFETY KNOWLEDGE AMONG UNIVERSITY STUDENTS: A CROSS-SECTIONAL STUDY

A PROJECT-REPORT

BY

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Submitted to the Department of Nutrition and Food Engineering in the partial fulfillment of B.Sc. in Nutrition and Food Engineering

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APPROVAL

This Internship titled "**Managing Urinary Tract Infections in Chronic Kidney Disease: Risks, Prevention, and Treatment**", submitted by **Sonia Afrose, ID: 201-34-315** to the Department of Nutrition and Food Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Nutrition and Food Engineering and approved as to its style and contents.

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ABSTRACT

This study presents the development and implementation of a food safety knowledge assessment instrument tailored for students at Daffodil International University. With the growing importance of food safety in ensuring public health, this research aimed to evaluate students' awareness, knowledge, and practices in handling and consuming food safely. The instrument was designed to identify knowledge gaps and inform targeted educational interventions to foster a culture of safety within the university community. The development process involved an extensive literature review to identify key areas of food safety knowledge, including hygiene, storage, contamination prevention, and personal responsibility. The initial draft of the instrument was refined through expert consultations with professionals in food safety, nutrition, and education. We have made a development and knowledge-based questionnaire to assess the participants. The data collected provided a detailed analysis of students' food safety knowledge and highlighted areas needing improvement. Results revealed significant gaps in understanding critical concepts such as cross-contamination and the safe storage of perishable foods, as well as variability in adherence to best practices. The findings emphasized the necessity of integrating food safety education into the university's curriculum or offering workshops to enhance students' practical knowledge and skills. Additionally, the study underscores the broader implications of food safety awareness, as university students often influence their families and communities. By successfully designing and deploying this output, the research contributes to the growing field of food safety education and provides a model for similar initiatives in other academic settings. This initiative serves as a stepping stone toward improving food safety literacy and fostering healthier communities.

Keywords: Food safety, Assessment, Public health, Knowledge.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Food safety and quality have long been seen as global concerns. A crucial scientific foundation for developing food safety management policies and procedures is provided by food safety risk assessment, a scientific procedure that ascertains the extent and likelihood of the detrimental impacts of food hazard elements on human health. Risk management for food safety has changed from being non-threatening to being risk-based (*Malik et al., 2021; Qin, 2023*). Improving risk management requires the development of food safety knowledge for risk assessment.

The 21st century's fast advancements in science, technology, and globalization have created opportunities for worldwide coordination and the use of international risk assessment methods. Guidelines for using contemporary benefits in food safety risk assessment were released by the European Food Safety Authority (*EFSA 2015, EFSA 2014*). The "Application of Science in Risk Assessment in the 21st Century," published in 2017 by the American Academy of Sciences, American Academy of Engineering, and American Academy of Medicine, provided a systematic summary of the advancements in risk assessment-related learnings, over the previous 20 years (*National Academies of Sciences, Engineering, and Medicine, 2017*).

In addition to producing a wealth of scientific research data (such as internal exposure data and histopathological data) that can be used in the study of food borne diseases and their side effects, the rapid development of risk assessment has also altered the way to find the gap using research is carried out, particularly in the field of food microbiology. From conventional research on the relationship between disease and illness to research on the relationship between knowledge and disease (*Babin et al., 2023*).

By evaluating food safety knowledge among university students, this study aims to identify critical knowledge gaps and inform educational strategies to enhance awareness and behavior (*Carlson et al., 2022; Hoteite et al., 2024*). It is a major example of how these knowledges are currently being applied in the risk assessment field and have become the basis for public health

decision-making based on risk assessment (*Deglin et al., 2021*). the global interconnectedness of food systems, improving food safety education at the university level can have broader implications for public health. Understanding the current level of knowledge among students will help in designing effective curricula and public health initiatives, aligning with international efforts to promote risk-based food safety management (*Boberg et al., 2021; Li et al., 2020; Xin et al., 2022*).

This study contributes to ongoing research by providing insights into students' knowledge of food hygiene and its correlation with demographic factors, supporting the goal of building a safer and more informed society (*Dorne et al., 2021; Liu et al., 2021a; Sharifian et al., 2023*).

1.2 Research Objectives

Here are some research objectives for the study:

- Identify gaps in students' understanding of key food safety concepts, such as hygiene, storage, and contamination prevention.
- Find out the demographic factors affect food safety knowledge
- Use the findings to recommend or implement educational programs that enhance food safety awareness and practices within the university community.

CHAPTER 2

LITERATURE OF REVIEW

Foodborne illnesses have long been a significant concern and burden on public health, persisting for as long as people have been consuming food and water. These illnesses occur when individuals ingest food or beverages contaminated by harmful bacteria, their toxins, parasites, viruses, or hazardous chemicals. Such contamination can lead to a wide range of medical conditions, from mild gastrointestinal discomfort to severe and life-threatening diseases. The problem transcends borders and affects both industrialized and developing nations, making the global incidence of foodborne illnesses a critical public health issue that demands immediate and sustained attention.

Foodborne illnesses are a significant global public health concern, causing substantial morbidity and mortality. According to the World Health Organization (WHO), approximately 600 million cases of foodborne illnesses occur annually, resulting in 420,000 deaths, with the highest burden in low- and middle-income countries (*WHO, 2015*). These illnesses are caused by a range of pathogens, including bacteria, viruses, and parasites, as well as chemical contaminants. The economic costs of foodborne diseases, including healthcare expenses and productivity losses, further emphasize the need for improved food safety practices globally.

Several pathogens contribute to the global burden of foodborne illnesses, with bacteria such as *Salmonella, Escherichia coli* (*E. coli*), and Listeria monocytogenes among the most common culprits. For instance, salmonellosis, often linked to contaminated poultry and eggs, continues to be a major concern worldwide (*EFSA, 2014*). Similarly, *E. coli* outbreaks have highlighted the risks associated with undercooked meat and unpasteurized dairy products, as well as the growing challenge of antibiotic-resistant strains (*Babin et al., 2023*). Inadequate food handling practices and a lack of hygiene knowledge contribute significantly to the transmission of these pathogens, particularly in settings where education and awareness are limited.

According to a 2010 estimate by the World Health Organization (WHO), the consumption of food contaminated with enteric bacteria was responsible for approximately 600 million cases of foodborne illnesses and 420,000 deaths worldwide (*Kirk M. D. et al., 2015*). This alarming

statistic highlights the immense global health burden caused by unsafe food, particularly in regions with inadequate food safety measures. The impact of contaminated food is especially severe in low-resource settings, where limited access to clean water, proper sanitation, and healthcare exacerbates the risk of infection and mortality.

The situation is similarly concerning in more developed regions. For example, in the European Union, meat and meat-based products have consistently been identified as the most frequent source of foodborne illnesses. In 2018, these food items were linked to 5,146 foodborne outbreaks, illustrating the persistent challenges in ensuring the safety of animal-derived foods despite advanced food safety infrastructure (*EFSA, 2019*). The contamination of meat products often results from improper handling during processing, storage, or preparation, underscoring the importance of stringent safety protocols throughout the food supply chain.

Salmonellosis, a foodborne illness caused by the Salmonella bacterium, remains a significant public health issue in the European Union and beyond. In Hungary alone, 3,340 cases of salmonellosis were reported in 2022, making it the most common foodborne illness in the country and one of the leading causes of foodborne disease in the European Union as a whole (*Chaname Pinedo et al., 2022; HCSO, 2022*). This high incidence highlights the ongoing struggle to control Salmonella contamination, which can occur in various foods, including poultry, eggs, dairy products, and fresh produce.

Salmonellosis is not the only widespread foodborne illness caused by bacterial contamination; infections caused by Escherichia coli are also a significant concern. In Europe, Escherichia coli remains one of the leading causes of bacterial infections in both humans and animals, posing a persistent challenge to public health and food safety systems. Of particular concern is the increasing prevalence of multidrug-resistant strains, which complicates treatment and heightens the risk of severe health outcomes (*Allocati N et al., 2013*). This growing resistance underscores the urgent need for enhanced monitoring, better antimicrobial stewardship, and innovative strategies to manage infections caused by this pathogen.

The severity of *Escherichia coli* infections was starkly demonstrated during the 2011 outbreak in Europe, which had devastating consequences. The outbreak was caused by a particularly virulent strain of *Escherichia coli* and led to 46 deaths and approximately 4,000 reported

illnesses, with many cases resulting in severe complications such as hemolytic uremic syndrome (HUS). This incident highlighted the vulnerabilities in existing food safety systems and the need for rapid, coordinated responses to such threats. In the wake of this crisis, the European Commission allocated EUR 12 million to bolster research capabilities and enhance preparedness for managing similar epidemic risks in the future (*EET, 2011; Kienle et al., 2019; Baars et al., 2019*).

This investment supported advancements in detecting and controlling *Escherichia coli* outbreaks, including improved diagnostic tools, surveillance systems, and risk assessment methods. The 2011 outbreak serves as a critical reminder of the far-reaching impacts of foodborne illnesses on public health, economies, and food systems. It underscores the necessity for ongoing research, international collaboration, and public health initiatives to address the challenges posed by *Escherichia coli* and other foodborne pathogens. By leveraging such efforts, Europe aims to reduce the occurrence of outbreaks and safeguard the health of its populations.

Staphylococcus aureus is one of the most significant pyogenic bacteria that cause infections in hospitals and the community, in addition to these two diseases. Additionally, it has the ability to colonize human and many animal mucous membranes and skin. A 2012 research found that Staphylococcus aureus is present in the nostrils of around one-third of preschool-aged, healthy Hungarian youngsters. This outcome is consistent with research from other European nations showing that around 30% of individuals have intermittent and 20% have chronic Staphylococcus aureus nasal discharge (*Laub et al., 2018*).

According to the research that is currently accessible, students are seeking independence and self-sufficiency, and when their daily routines change, they are less likely to pay attention to food safety knowledge and food cleanliness (*Karnai et al., 2019; Vuksanvic et al., 2022; Jankovic et al., 2021*). Prior research has demonstrated the importance of understanding food safety and hygiene regulations in reducing a number of foodborne illnesses (*Islam M. N. et al., 2022*). In order to combat illnesses, it is essential to follow good hygiene habits at home, such as keeping food and ingredients at the appropriate temperature, keeping the kitchen clean, and using proper hand washing and disinfection methods (*Soon et al., 2012; Ali M. M. et al., 2014*). Since food hygiene instruction is typically lacking in Hungary, it is important to gauge students'

knowledge of the subject. Their understanding of food safety can be improved by giving them relevant instructional resources.

University students, representing a critical segment of the population, often lack sufficient awareness and understanding of food safety practices. Despite being educated, many students demonstrate poor knowledge of key concepts such as cross-contamination prevention, safe cooking and storage temperatures, and the risks posed by certain high-risk foods. Studies indicate that factors like age, study discipline, and socioeconomic background can influence students' food safety awareness and behaviors (*Qin, 2023; Sharifian et al., 2023*). These gaps not only increase the risk of foodborne illnesses among students but also highlight the need for targeted educational interventions to build a culture of food safety. Addressing these knowledge gaps is essential for empowering students to adopt safe practices and reduce the public health burden of foodborne diseases.

Despite ongoing research and various food safety interventions, the global burden of foodborne illnesses remains alarmingly high. According to the World Health Organization (WHO), one in ten people worldwide suffer from foodborne illnesses each year, resulting in a staggering number of cases, many of which could be prevented through proper awareness and practices. Of these, over 91 million cases occur in low-income nations, where poor sanitation, unsafe water supplies, and limited healthcare access exacerbate the problem. These statistics underscore the urgent need for comprehensive food safety measures, public health campaigns, and global collaboration to reduce the prevalence of foodborne diseases and their impact on health and society (*WHO, 2015; Notermans S et al., 1992*).

CHAPTER 3

METHODOLOGY

3.1 Research Design

The study employed a cross-sectional design, which is commonly used in public health and educational research to assess knowledge, attitudes, and behaviors at a single point in time. In this case, the design aimed to evaluate food safety knowledge among university students, focusing on understanding their awareness of critical food safety practices. A structured questionnaire was administered to gather both demographic information and responses to food safety knowledge-related questions. The design allowed for the collection of data from a wide range of participants in a relatively short time frame, providing a snapshot of the students' food safety knowledge across different demographic groups.

3.2 Sample Size Calculation

For this study, the sample size was calculated with below process:

Z is the Z score =1.96 at 95% confidence. P is the estimate proportion of attribute, Q = 1-P, E is the margin of error 5% or 0.05. We assume that, 72% of the person have no knowledge food safety.

So,

P=0.72, Q=1-P, Q=1-0.72, Q=0.28

The following formula has adopted for sample size calculation-

$$n_0 = \frac{Z^2 PQ}{E^2}$$

$$= \frac{1.96^2 X 0.72 X 0.28}{(0.05)^2}$$

$$= 310$$

3.3 Population

The study targeted university students enrolled in various academic disciplines, ensuring a diverse sample of the student population. Convenience sampling was used to select participants, meaning that students were chosen based on their availability and willingness to participate. This sampling method is practical and efficient for cross-sectional studies but may limit the generalizability of the findings. The participants were informed about the study's purpose, and their consent was obtained before participation. The study aimed to include a representative mix of students from different backgrounds to explore whether factors like gender, age, and education level influence food safety knowledge. All students who agreed to participate were included, and confidentiality was maintained to protect personal information.

3.4 Data Collection Tool

The data collection tool consisted of a two-part structured questionnaire. The first part of the questionnaire focused on demographic information, including variables such as age, gender, academic year, field of study, and any prior education or exposure to food safety training. This information helped categorize the participants into relevant subgroups to facilitate comparisons between groups.

The second part of the questionnaire contained a food safety knowledge assessment tool, which was designed to evaluate students' understanding of key food safety concepts. The questions covered topics such as food hygiene practices, proper handling and storage of food, awareness of foodborne illnesses, and general safety measures to prevent contamination. The tool was based on established food safety knowledge frameworks and validated in prior studies, ensuring its reliability in measuring participants' knowledge.

3.5 Data Analysis

The collected data were analyzed using both descriptive and inferential statistical methods. Descriptive statistics were used to summarize the demographic characteristics of the participants and to calculate the distribution of knowledge scores. This included calculating frequencies, percentages, means, and standard deviations to gain an overall understanding of the data. To explore the relationships between demographic factors and food safety knowledge, chi-square

tests were performed. This inferential statistic allowed for the examination of potential associations between categorical demographic variables (such as gender, education level, or field of study) and students' knowledge levels. The chi-square test was used to determine if there were statistically significant differences in food safety knowledge based on these demographic factors. A significance level of $p < 0.05$ was set, indicating that results with p values less than 0.05 were considered statistically significant. This analysis helped identify which demographic factors may influence food safety knowledge and highlighted areas where targeted educational interventions could be beneficial.

3.6 Ethical Considerations

Ethical approval for the study was obtained from the relevant university ethics board before the commencement of data collection. Informed consent was obtained from all participants, ensuring they understood the purpose of the study and their right to anonymity and confidentiality. The study adhered to ethical guidelines regarding the protection of participants' personal information, and the data were stored securely for analysis.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Results and Discussion

In this segment, I have generated some visualization of graph with my collected data. I have noted the datapoints of every participant and updated in database.

Table 4.1: The demographic characteristics of participant

Characteristic	Number	Percentages
Gender		
Male	152	48.7
Female	160	51.3
Age		
18-21	56	17.9
22-24	167	53.5
25-28	89	28.5
Study Level		
Undergraduate	206	66
Graduate	106	34
Household Income		
<30,000 BDT	208	66.7
>30,000 BDT	104	33.3
Body Mass Index		
<18.5	36	11.5
18.5-24.9	133	42.6
>24.9	143	45.8
Field of Study		
Food Science and Nutrition	216	69.2
Other than Science and Nutrition	96	33.3

The tabular data provides demographic and characteristic insights into the study population: The sample is nearly evenly split, with 48.7% male (152 individuals) and 51.3% female (160 individuals). Most participants are aged 22–24 years (53.5%), followed by 25–28 years (28.5%) and 18–21 years (17.9%). The majority are undergraduate students (66%, 206 individuals), with the remaining 34% (106 individuals) being graduate students. A significant portion (66.7%, 208 individuals) has a household income below 30,000 BDT, while 33.3% (104 individuals) earn

more than 30,000 BDT. Participants are categorized into underweight (BMI <18.5, 11.5%), normal weight (BMI 18.5–24.9, 42.6%), and overweight/obese (BMI >24.9, 45.8%). A large majority (69.2%, 216 individuals) study Food Science and Nutrition, while 30.8% (96 individuals) are from other fields.

The demographic breakdown indicates a diverse sample in terms of gender, age, income, and study focus, with a strong representation of students studying food science and nutrition, aligning well with the context of food safety and nutrition research.

Table 4.2: Food Hygiene Knowledge Score

Type of Knowledge	Min.	Max.	Mean	Std. deviation
Cross Contamination Prevention/ Disinfection Procedures	9.0	81.82	54.10	20.9
Safe Times/Temperatures for Cooking/Storing Food	7.14	100	68.72	20.49
Foods that Increase Risk of Foodborne Disease	0.0	66.67	46.68	25.28
Population Groups at Greatest Risk for Foodborne Disease	0.0	66.67	51.0	23.27
Common food sources of foodborne disease pathogens	0.0	100	63.46	33.86
Overall Knowledge	9.68	81.21	56.8	22.70

The table summarizes the participants' food hygiene knowledge across various areas, highlighting their understanding of critical food safety concepts: Scores ranged from 9.0 to 81.82, with an average score of 54.10 and a standard deviation of 20.9, indicating moderate knowledge with some variability among participants. Scores ranged from 7.14 to 100, with a higher mean of 68.72 and a standard deviation of 20.49, showing relatively better understanding in this area. Scores varied from 0.0 to 66.67, with a lower mean of 46.68 and a standard deviation of 25.28, reflecting weaker knowledge in identifying risky foods. Scores ranged from 0.0 to 66.67, with an average of 51.0 and a standard deviation of 23.27, indicating moderate awareness about vulnerable groups. Scores ranged widely from 0.0 to 100, with a mean of 63.46 and a high standard deviation of 33.86, showing varied levels of knowledge about pathogen sources. The overall scores ranged from 9.68 to 81.21, with an average score of 56.8 and a standard deviation of 22.70, reflecting moderate food hygiene knowledge across the population.

This data suggests areas where knowledge is relatively stronger, such as cooking/storing temperatures, and areas needing improvement, like identifying high-risk foods and pathogen sources.

Table 4.3: Correlation of demographic factor with nutritional knowledge

Characteristic	Food Hygiene Knowledge Level		χ2	p- value
	Poor	Good		
	n (%)			
Gender				
Male	51 (33.6)	101 (66.4)	0.45	0.50
Female	48 (30.0)	112 (70.0)		
Age				
18-21	11 (19.6)	45 (80.4)	10.48	0.005*
22-24	66 (39.5)	101 (60.5)		
25-28	22 (24.7)	67 (75.3)		
Study Level				
Undergraduate	79 (37.6)	131 (62.4)	10.28	0.001*
Graduate	20 (19.6)	82 (80.4)		
Household Income				
<30,000 BDT	62 (29.8)	146 (70.2)	1.06	0.30
>30,000 BDT	37 (35.6)	67 (64.4)		
Body Mass Index				
<18.5	36 (100.0)	0 (0.0)	89.0	0.000*
18.5-24.9	35 (26.3)	98 (73.7)		
>24.9	28 (19.6)	115 (80.4)		
Field of Study				
Food Science and Nutrition	71 (32.9)	145 (67.1)	0.42	0.59
Other than Science and Nutrition	28 (9.2)	68 (70.8)		

*** p- value <0.05 statistically significant**

The table outlines the relationship between various demographic factors and food hygiene knowledge levels (classified as "Poor" or "Good") among the study participants. Key findings are: Food hygiene knowledge levels did not differ significantly by gender (p = 0.50). Males (33.6%) and females (30.0%) showed similar proportions of poor knowledge. There was a statistically significant correlation between age and food hygiene knowledge (p = 0.005). Participants aged 18–21 had the lowest proportion of poor knowledge (19.6%), while those aged

22–24 showed the highest (39.5%). A significant relationship was observed (p = 0.001). Graduate students demonstrated better knowledge (80.4% "Good") compared to undergraduates (62.4% "Good"). No significant association was found between income levels and food hygiene knowledge (p = 0.30). Both income groups showed comparable distributions of poor knowledge. A strong and statistically significant relationship existed (p = 0.000). All participants with BMI <18.5 had poor knowledge, while those in the 18.5–24.9 range showed the highest proportion of good knowledge (73.7%). There was no significant difference in food hygiene knowledge between students of Food Science and Nutrition and those from other fields (p = 0.59).

4.2 Discussion

The analysis of the three tables highlights critical insights into food hygiene knowledge and its demographic correlations among the study participants. The first table demonstrates moderate overall knowledge, with participants performing relatively well in safe cooking/storage temperatures (mean: 68.72) and poorly in identifying high-risk foods (mean: 46.68). The second table shows a gender balance in food hygiene knowledge, while age and study level emerged as significant factors influencing knowledge levels, with younger participants and undergraduates displaying poorer knowledge. BMI also significantly correlated with knowledge, as all participants with BMI <18.5 had poor scores. Household income and field of study, however, did not show significant relationships. These findings suggest that educational interventions should prioritize younger students, undergraduates, and individuals outside the healthy BMI range to address gaps in food hygiene knowledge effectively. Moreover, the variability in knowledge across specific areas highlights the need for targeted content in food safety education programs.

The other researches showed that, the Cross-Contamination Prevention/ Disinfection Procedures obtained mean 62% score and coefficient were 78%. But in our analysis, mean score were 54.10% and deviation were 20.9. Safe Times/Temperatures for Cooking/Storing Food obtained mean 60% and coefficient were 72%, but in our case, we got score were 68.72% and deviation were 20.49. Foods that Increase Risk of Foodborne Disease obtained mean 71% and coefficient were 80%, but in our case, we got score were 46.68% and deviation were 25.28. Population Groups at Greatest Risk for Foodborne Disease obtained mean 64% and coefficient were 87%, but in our case, we got score were 51% and deviation were 23.27. Common food

sources of foodborne disease pathogens obtained mean 33% and coefficient were 72%, but in our case, we got score were 63.46% and deviation were 33.86. Overall the analysis mean 61% and coefficient were 92%, but in our case, we got score were 56.8% and deviation were 22.70.

4.3 Limitations

This study has several limitations that should be considered. First, the sample is limited to a specific demographic from Daffodil International University, which may not fully represent the broader population in Bangladesh or other regions. Additionally, the cross-sectional nature of the study restricts the ability to draw causal conclusions about the factors influencing food hygiene knowledge. The reliance on self-reported data may also introduce response bias, as participants may overestimate their knowledge. Furthermore, the study does not account for external factors such as participants' previous exposure to food safety education or practical experience, which could influence their knowledge levels. Lastly, while the study considers several demographic variables, other factors like cultural beliefs, lifestyle habits, or access to food safety information could also play a significant role in shaping food hygiene knowledge but were not explored in this analysis.

CHAPTER 5

CONCLUSION

5.1 Conclusion

The study highlights significant variations in food hygiene knowledge among university students, with age, study level, and body mass index emerging as key demographic factors influencing knowledge levels. Younger participants, undergraduates, and those with abnormal BMI values exhibited lower knowledge, suggesting that targeted educational interventions could improve food safety awareness in these groups. Despite the overall moderate level of knowledge, areas such as identifying high-risk foods and understanding contamination prevention require greater emphasis in food hygiene education programs. Future research should address the limitations of this study by expanding the sample size, considering additional influencing factors, and exploring causal relationships to enhance food safety education strategies.

5.2 Recommendation

Here are the recommendations based on the findings of the study:

- **Targeted Educational Programs:** Focus on younger participants (ages 18-21) and undergraduates, who demonstrated poorer food hygiene knowledge, by offering specialized food safety training and workshops.
- **BMI-Related Interventions:** Design interventions that specifically address students with lower or higher BMI values, as they exhibited significant gaps in food hygiene knowledge, potentially linked to dietary habits and lifestyle.
- **Enhanced Curriculum Integration:** Integrate food hygiene and safety topics into the curriculum for all students, particularly in fields outside Food Science and Nutrition, to ensure broader awareness and practical knowledge.
- **Interactive and Practical Learning:** Include hands-on learning experiences, such as food safety simulations and laboratory exercises, to improve students' ability to apply theoretical knowledge in real-world settings.

- **Increase Awareness of High-Risk Foods:** Develop educational campaigns that focus on the identification of high-risk foods and their proper handling to reduce the likelihood of foodborne illnesses.
- **Continuous Monitoring and Feedback:** Regularly assess food hygiene knowledge levels among students to monitor progress and provide ongoing feedback, ensuring that food safety education remains effective and up-to-date.
- **Collaborations with Public Health Agencies:** Establish collaborations with public health organizations to create resources and outreach programs aimed at improving food hygiene knowledge beyond the university setting.
- **Further Research:** Conduct longitudinal studies to explore causal relationships and the impact of specific interventions on improving food hygiene knowledge over time.

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CHAPTER 6

APPENDIX

Appendix 1: Synopsis

Student Name: Sonia Afrose
Id: 201-34-315
Title: Creating and Applying a Food Safety Knowledge Assessment at Daffodil International University.

Introduction

The practices used to handle, prepare, and store food in a way that avoids contamination and food-borne illnesses are referred to as food safety (Ashkanani F et al., 2021). A major focus of the 2030 Agenda for Sustainable Development Goals (SDG) (FAO, 2021) is food safety, which is also a global public health problem because of the elevated risk of morbidity and death linked to the outbreak of food-borne illnesses (Negri S, 2009; Azanaw J et al., 2021). Food handling errors raise the possibility of bacterial, viral, parasite, or chemical toxin contamination (WHO, 2007). Shigella species, salmonella species, campylobacter species, cryptosporidium, rotavirus, and enterotoxigenic Escherichia coli are the most prevalent agents in low- and middle-income countries (LMIC) (Girmay AM et al., 2020). Disease and mortality are caused by toxins such as aflatoxin (Kumar P et al., 2017). Foodborne illnesses are responsible for 420,000 fatalities from diarrhea (Azanaw J et al., 2021), cholera (Focus Adriano L et al., 2023), and other foodborne illnesses (Azanaw J et al., 2021), as well as 33 million disability-adjusted life years. LMICs, especially those in Africa, are disproportionately impacted; 92 million people get sick from eating tainted food, and 130,000 of them die annually (Bisholo KZ et al., 2018). Inadequate food handling procedures, negative attitudes (Azanaw J et al., 2021), and ignorance about food safety among students and the university/college setting all have an impact on students' health (Luo X et al., 2019). Due to their move from home to live alone, inadequate food handling procedures, and local laws controlling food sellers on college or university property, students are particularly susceptible to foodborne illnesses (Obande D et al., 2020). As a result, food-borne illnesses among college students may cause them to miss class, get distracted, and do poorly academically (Whatnall MC et al., 2020). Information on Bangladeshi university students' food safety practices, attitudes, and awareness is still scarce. Such information is crucial for raising awareness of the food's quality, safety, and hygienic conditions both within and outside of academic settings.

Objective

1. Design and validate a reliable instrument tailored to evaluate the food safety awareness, knowledge, and practices of university students in Bangladesh.
2. Identify gaps in students' understanding of key food safety concepts, such as hygiene, storage, and contamination prevention.
3. Use the findings to recommend or implement educational programs that enhance food safety awareness and practices within the university community.
4. Support efforts to reduce foodborne illnesses by fostering a culture of food safety among students, thereby influencing broader community practices.

Methodology

1. **Study Design:** A cross-sectional study design will be adopted to gather data among University Students.
2. **Data Collection:** Using questionnaires to collect information on daily Food safety knowledge assessment. Specifying the characteristics of the participants such as age, gender, health status and food safety knowledge.
3. **Sample Size and Sampling Technique:** A multi stage random sampling technique will be used to select study participants. The sample size will be 300 to 350 for this research project.
4. **Data analysis:** Using SPSS to analyze the food safety knowledge assessment.
5. **Ethical Consideration:** The study adheres to ethical standards, ensuring consent from participants and maintaining confidentially. Ethical clearance up to be obtained from the relevant institutional review board before the outset of data collection.

Work Plan

Major activities	**Duration in month**		
	June-July (2024)	**August-September (2024)**	**October-November (2024)**
Literature Review			
Questionnaires			
Sample Selection			
Data Collection			
Data Analysis			
Project Paper writing and Submission			

Expected Outcomes

The expected outcome of this study is an enhanced understanding of the factors influencing food hygiene knowledge among university students, leading to the development of targeted educational interventions. By addressing gaps in knowledge, particularly among younger students, undergraduates, and those with abnormal BMI values, it is anticipated that food safety awareness will improve. This could result in safer food handling practices, reduced risks of foodborne illnesses, and a more informed student population that is better equipped to apply food hygiene principles in daily life. Additionally, the findings may inform future curriculum changes and public health initiatives aimed at strengthening food safety education across diverse demographics.

Conclusion

The study highlights significant variations in food hygiene knowledge among university students, with age, study level, and body mass index emerging as key demographic factors influencing knowledge levels. Younger participants, undergraduates, and those with abnormal BMI values exhibited lower knowledge, suggesting that targeted educational interventions could improve food safety awareness in these groups. Despite the overall moderate level of knowledge, areas such as identifying high-risk foods and understanding contamination prevention require greater emphasis in food hygiene education programs. Future research should address the limitations of this study by expanding the sample size, considering additional influencing factors, and exploring causal relationships to enhance food safety education strategies.

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Supervised By

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Md. Shamsur Rahman

Senior Lecturer
Department of Nutrition and Food Engineering
Daffodil International University

Appendix 2: Ethical Approval

12/25/2024

The Head
Department of Nutrition and Food Engineering
Daffodil International University
Daffodil Smart City, Birulia, Savar, Dhaka 1216, Bangladesh

Subject: Ethical Approval of Research Study

Dear Sir,

With due regards, I am Sonia Afrose, a student of the 201 batch, wish to submit the project titled “Assessment of Food Safety Knowledge Among University Students: A Cross-Sectional Study" for ethical clearance.

I request you to kindly consider the project for review by the Ethical Committee. I shall be highly obliged for the same.

Kindly find attached the required documents regarding the project.

Sincerely,

Sonia Afrose
Id: 201-34-315

Appendix 3: Questionnaire

Are you from Nutrition Background? *

- ◯ Yes
- ◯ No

Demographic

Age *

Your answer

Height *

Your answer

Weight *

Your answer

Occupation *

- ◯ Student
- ◯ Graduate
- ◯ HSC/Relevelent
- ◯ SSC/Relevelent
- ◯ Job holder

Monthly family income *

- ◯ 0-10000
- ◯ 10000-20000
- ◯ 20000-30000
- ◯ 30000-50000
- ◯ More than 50000

Scale 1: Cross contamination prevention & disinfection procedures

1. The best way to keep from getting food poisoning from fresh fruits and vegetables is to wash them with *

- ◯ Regular Soap
- ◯ Hot water
- ◯ Anti-bacterial soap
- ◯ An anti-bacterial sponge
- ◯ Cool running water

2. After you have used a cutting board to slice raw meat, chicken, or fish and need to cut other foods, which of these is the best way to preventfood poisoning? *

Choice 1: wipe the cutting board off with a paper towel
Choice 2: rinse the cutting board under very hot water
Choice 3: turn the board over and use the other side
Choice 4: wash the cutting board with hot soapy water and rinse
Choice 5: set the cutting board aside and use a different cutting board to cut other foods

- ◯ Choice 1 or 3
- ◯ Choice 2, 3 or 5
- ◯ Choice 3 or 4
- ◯ Choice 4 or 5
- ◯ All of the choices

3. To prevent food poisoning, the best way to wash dishes is to: *

Choice 1: wash and dry them in an automatic dishwasher
Choice 2: soak them in the sink for several hours and then wash them in the same water
Choice 3: hand-wash them right after the meal and then let them air-dry
Choice 4: hand-wash them right after the meal and then dry them with a dish towel

- ◯ Choice 1 or 2
- ◯ Choice 1 or 3
- ◯ Choice 2 or 4
- ◯ Choice 3 or 4
- ◯ Any choice is fine as long as the dishes look clean

4. When should kitchen counters be washed, rinsed, and sanitized? *

- ◯ After each use
- ◯ when you begin working with another type of food
- ◯ at 4-hour intervals if the counter is in constant use
- ◯ All of the avobe

5. Which procedure for cleaning kitchen counters is most likely to prevent food poisoning? *

- ◯ Spray with a strong sanitizing solution
- ◯ wash with a detergent, rinse, then wipe with a sanitizing solution
- ◯ wipe with a sanitizing solution, then rinse with clean water and wipe dry
- ◯ brush off any dirt or food pieces, then wipe with sanitizing solution

6. To prevent food poisoning, how often should the kitchen sink drain in your home be sanitized? *

- ◯ daily
- ◯ weekly
- ◯ monthly
- ◯ only when food is going to be thawed or washed in the sink

7. Which is the most hygienic way to wash your hands? *

- apply sanitizer, run water, rub hands together for 20 seconds, rinse hands, dry hands, rub on an antiseptic hand lotion
- apply soap, rub hands together for 20 seconds, rinse hands under water, dry hands, apply sanitizer
- un water, moisten hands, apply soap, rub hands together for 20 seconds, rinse hands, dry hands
- run water, moisten hands, apply sanitizer, rub hands together for 20 seconds, rinse hands, dry hands, rub on antiseptic hand lotion

8. If you have a sore on the back of your hand, should you prepare food for other people? *

- Yes, if it isn't infected
- Yes, if you put a bandage on it
- Yes, if you wear a glove
- Yes, if you bandage the core and wear a glove
- No, you should not prepare food until the sore heals

9. Which should not be done when storing raw meat, fish, or poultry in the refrigerator? *

- place it in the coldest part of the refrigerator
- set it in a larger container before refrigerating
- place it on the lowest shelf in the refrigerator
- leave it in the package it came in
- all should be done when storing raw meat, fish, or poultry

10. To prevent food poisoning, which of these individuals should not prepare food for other people? (Check all that apply) *

- [ ] A person with diarrhea
- [ ] a person with severe acne
- [ ] a person with bandaged burns on his or her hands that are covered with gloves
- [ ] a person with a fever
- [ ] a person with unexplained itching
- [ ] a person who smokes
- [ ] a person with a sore throat
- [ ] a person with a cold
- [ ] a person with vomiting
- [ ] person with HIV
- [ ] none of these individuals

11. When preparing food, you should wash your hands after touching which of these? (Check all that apply) *

- [ ] your face
- [ ] clean pots and pans
- [ ] utensils that are being used to prepare food
- [ ] fresh fruit
- [ ] dishes that ccame out of the dishwasher
- [ ] a pimple
- [ ] clean countertop
- [ ] clothing
- [ ] none of these foods

Scale 2: Safe Times/Temperatures for Cooking/Storing Food Scale

1. Which practice is most likely to cause food poisoning? *

- ( ) leaving stuffing in a cooked turkey until it cools to room temperature
- ( ) stuffing turkeys just before cooking them
- ( ) cooking turkeys until the stuffing reaches 165▪ F
- ( ) removing the giblet bag before cooking a turkey

2. When is it safest to place refrigerated foods in your cart when grocery shopping? *

- ◯ early in the shopping trip
- ◯ about halfway through the shopping trip
- ◯ near the end of the shopping trip
- ◯ at the very end of the shopping trip, just before checking out
- ◯ it doesn't matter when I place them in the cart

3. What is the recommended freezer temperature for preventing food poisoning? *

- ◯ 0 Degree F (−18 Degree C)
- ◯ 18 Degree F (−8 Degree C)
- ◯ 24 Degree F (−4 Degree C)
- ◯ 32 Degree F (0 Degree C)

4. Imagine that your electricity went off and the meat, chicken, and/or seafood in your freezer thawed and felt warm. To prevent food poisoning, what should you do? *

- ◯ throw them away
- ◯ cook them right away
- ◯ see how they smell or look before deciding what to do
- ◯ immediately re-freeze until solidly frozen, then cook them

5. Which of the following is considered the most important way to prevent food poisoning? *

- ◯ spray for pests in the kitchen area at least every week
- ◯ rarely or never serve leftovers
- ◯ keep foods refrigerated until it's time to cook or serve them
- ◯ clean kitchen counters with sanitizing solutions weekly

6. For ground beef to be safe to eat, it needs to be cooked until its internal temperature reaches *

- ◯ 90 Degree F (32 Degree C)
- ◯ 125 Degree F (52 Degree C)
- ◯ 160 Degree F (71 Degree C)
- ◯ 250 Degree F (121 Degree C)

7. What is the maximum temperature refrigerators should be to preserve the safety of foods? *

- ◯ 0 Degree F (−18 Degree C)
- ◯ 25 Degree F (−4 Degree C)
- ◯ 40 Degree F (4 Degree C)
- ◯ 45 Degree F (7 Degree C)
- ◯ 60 Degree F (16 Degree C)

8. If a family member is going to be several hours late for a hot meal, how should you store the meal to keep it safe until this person is ready to eat it? *

- ◯ store it in the refrigerator and reheat it when the person is ready to eat it
- ◯ store it in on the kitchen counter until the person is ready to eat it
- ◯ store it in a cool oven until the person is ready to eat it
- ◯ store it in a warm oven until the person is ready to eat it

9. All foods are considered safe when cooked to an internal temperature of *

- ◯ 130 Degree F (54 Degree C)
- ◯ 140 Degree F (60 Degree C)
- ◯ 150 Degree F (66 Degree C)
- ◯ 165 Degree F (74 Degree C)

10. Which method is the most accurate way of determining whether hamburgers are cooked enough to prevent food poisoning? *

- ◯ cut one to check the color of the meat inside
- ◯ check the color of the juice to be sure it is not pink
- ◯ measure the temperature with a food thermometer
- ◯ check the texture or firmness of the meat
- ◯ measure the length of time the hamburgers cook

11. Which food does not need to be refrigerated to prevent food poisoning? *

- ◯ fresh fruit salad
- ◯ roasted ears of corn on the cob
- ◯ open box of raisins
- ◯ chocolate pudding
- ◯ an open can of green beans

12. To prevent food poisoning, how long should leftover foods be heated? *

- ◯ until they are boiling hot
- ◯ just until they are hot, but not too hot to eat right away
- ◯ just until they are at least room temperature
- ◯ reheating isn't necessary

13. What is the least safe method for thawing a frozen roast? *

- ◯ leave it in the refrigerator until it is thawed
- ◯ leave it on the kitchen counter until it is thawed
- ◯ put it in a microwave oven set to automatic defrost
- ◯ put it in under running water for 1 hour

14. What is the safest method for cooling a large pot of hot soup? *

- ◯ put the soup in a shallow pan and refrigerate it right away
- ◯ place the cooking pot filled with soup in the refrigerator right away
- ◯ transfer the soup to clean, deep pot before refrigerating it
- ◯ leave it on the counter until it cools to room temperature, then refrigerate it
- ◯ add ice cubes to the soup

Scale 3: Foods that Increase Risk of Foodborne Disease Scale

1. Chilling or freezing eliminates harmful germs in food. *

- ◯ true
- ◯ false

2. Which food is least likely to cause food poisoning? *

- ◯ slices of cantaloupe left on the counter overnight
- ◯ baked potato that was left on the kitchen counter overnight
- ◯ leftover turkey eaten cold
- ◯ chocolate cake that was left on the kitchen counter overnight

3. Eating which of these foods will increase a person's risk of food poisoning? * (Check all that apply).

- ☐ Raw oysters, clams, or mussels
- ☐ Home canned beans, carrots, peas or potatoes right from the jar
- ☐ Unpasteurized milk
- ☐ Rare hamburgers
- ☐ Leftover soup reheated until warm, but not boiling
- ☐ Fried eggs with a runny or soft yolk
- ☐ Raw homemade cookie dough or cake batter
- ☐ Grilled steak served on the same plate that held raw steak without washing the plate
- ☐ Sushi
- ☐ Food right from the refrigerator that feels warm
- ☐ Meat cooked medium-well
- ☐ Unpasteurized fruit juice
- ☐ Cooked shellfish that have unopened shells
- ☐ Sliced melon
- ☐ Foods prepared in a kitchen with a pet present
- ☐ Fresh fruit salad stored at room temperature
- ☐ Frozen foods with frost build up on the package
- ☐ Food stored in a cabinet beside oven
- ☐ Fresh raw milk cheese
- ☐ Soft food like jelly or sour cream after scraping off mold
- ☐ Soft scrambled eggs
- ☐ Raw sprouts (alfalfa, clover, radish)
- ☐ Commercially canned vegetables right out the can without re-heating them
- ☐ Picnic foods that were stored at room temperature for more than 2 hours
- ☐ Box of rice that does not show a USDA inspection stamp
- ☐ none of these foods

1. People should be especially careful about not eating raw seafood, if they have *

- ◯ diabetes
- ◯ HIV infection
- ◯ cancer
- ◯ any of these diseases

2. Which foods do pregnant women, infants, and children not need to avoid? *

- ◯ soft cheeses, cold smoked fish, cold deli salads
- ◯ hot dogs and lunchmeats that have not been reheated
- ◯ raw or undercooked eggs
- ◯ canned vegetables, pasteurized fruit juice
- ◯ These individual do not need to avoid any type of food

3. Compared to most people, which of these individuals are more likely to get sick * or seriously ill from harmful germs in food? (Check all that apply)

- ☐ preschool children
- ☐ teenagers
- ☐ pregnant women
- ☐ older people (age 60 and over)
- ☐ people who are HIV positive
- ☐ cancer patients
- ☐ people who frequently eat at restaurants or get take-out food often
- ☐ none of these individuals

Scale 5: Common Food Sources of Foodborne Disease Pathogens

1. Salmonella bacteria can cause food poisoning. How can a food be made safe * if it has salmonella in it?

- ◯ cook it thoroughly
- ◯ wash it under extremely hot running water
- ◯ freeze it for at least 3 days
- ◯ the food cannot be made safe
- ◯ don't know

2. Staph (Staphylococcus) bacteria that cause food poisoning are most likely associated with which food? *

- ◯ contaminated water from unfiltered mountain streams and lakes
- ◯ food prepared by cooks with their bare hands and then left at room temperature
- ◯ undercooked pork, especially bacon
- ◯ raw or undercooked eggs and poultry
- ◯ don't know

3. Botulism is a disease that is most likely associated with which food? *

- ◯ canned foods
- ◯ food prepared by cooks with their bare hands and then left at room temperature
- ◯ undercooked pork, especially bacon
- ◯ raw eggs, or raw or undercooked poultry
- ◯ don't know

4. Listeria bacteria are most likely associated with which food? *

- ◯ home canned foods
- ◯ raw or undercooked beef
- ◯ deli meats
- ◯ raw eggs and poultry
- ◯ don't know

5. Harmful E. coli bacteria are most likely associated with which food? *

- ◯ raw or undercooked pork
- ◯ sliced lunch meat
- ◯ soft cheeses like Brie
- ◯ raw or undercooked beef
- ◯ don't know

6. Trichinosis is most likely associated with which food? *

- ◯ deli meats
- ◯ raw or undercooked pork
- ◯ soft cheeses like Brie
- ◯ raw or undercooked beef
- ◯ don't know

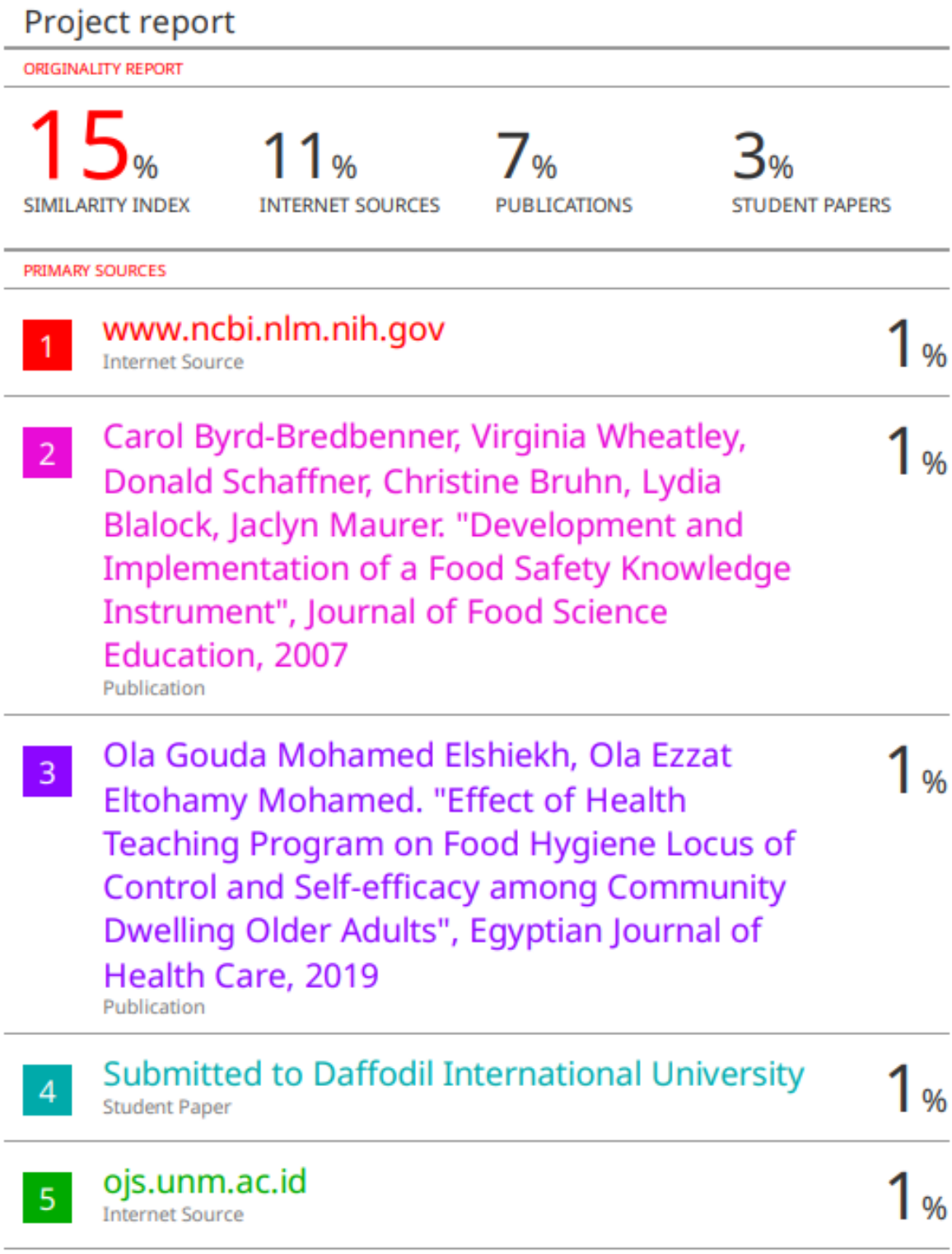
7. Campylobacter bacteria are most likely associated with which food? *

- ◯ canned food
- ◯ raw or undercooked pork
- ◯ raw or undercooked poultry
- ◯ raw or undercooked beef
- ◯ don't know

8. You may contaminate the next food you touch with salmonella bacteria if you don't wash your hands after touching: *

- ◯ raw pork
- ◯ raw sprouts and lettuce
- ◯ raw beef
- ◯ raw chicken
- ◯ don't know

Appendix 4: Plagiarism



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