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Research Article
Evaluating Nutrition Students' Knowledge of Food Safety in Indonesia: Multi-Strata Comparison Review

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Abstract

Background and Objective: Knowledge of food safety is one of many requirements that nutrition students should master. The quality of food organization and community education associated with food safety depend on the quality of the educator (in this context, nutrition students), whereas the quality of nutrition graduates depends on the educational quality of the school. This study aimed to evaluate the food safety knowledge of all students with a nutrition major in Indonesia. **Materials and Methods:** A cross-sectional study was conducted with a random cluster sampling method. The research sample size was 482 students, consisting of 3 nutrition educational strata (associate degree D3; bachelor degrees D4 and bachelor degrees S1) in 6 major island clusters in Indonesia (Sumatera, Kalimantan, Sulawesi, Java, Bali and Nusa Tenggara, Papua). Sample respondents were asked to answer a validated food safety knowledge questionnaire. Food safety knowledge differences among the 3 strata were measured with an ANOVA test. **Results:** Bachelor degree (S1) respondents had the highest results (5.84±1.52) compared to associate degree (D3) (5.46±1.76) and bachelor degree (D4) respondents (5.52±1.49). However, no significant knowledge difference among the groups was found [$F(2.479) = 2.83$, $p = 0.06$]. The mean scores of food safety knowledge of nutrition students at various levels of education (D3, D4 and S1) were 5.46, 5.52 and 5.84, respectively. **Conclusion:** A specific program should be implemented to improve food safety knowledge among Indonesian nutrition students. Food safety components, such as food storage principles, safe food consumption principles, food-borne disease principles, handling food at risk of microbes causing food-borne disease and subjects at risk of food-borne disease, seem to influence food safety knowledge among Indonesian nutrition students.

Key words: Higher education, nutrition education, food borne disease, students with nutrition major, food safety

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Sanitation and food safety are critical. Disease-causing microbes are able to survive in various places in the kitchen and on hands, cooking utensils and cutting boards[1]. Microbes and parasites may enter food and cause food-borne illness, such as diarrhea and vomiting. Food-borne illness may even cause death[2].

The prevalence of diseases transmitted through food, such as hepatitis and diarrhea, is quite high. The prevalence of hepatitis in 2013 was 1.2%, which was two times higher than the prevalence in 2007[3]. The incidence and period prevalence of diarrhea for all age groups in Indonesia were 3.5 and 7.0%[3].

There is an urgent need to decrease food-borne illness. Food handlers' knowledge of food safety plays an important role in preventing food-borne illness. Food handlers are at the highest risk for food contamination that may lead to food-borne illness[4]. A previous study conducted by Abdul-Mutalib *et al.*[5] reported that food-borne illness was caused by food handlers' low understanding of food safety during food preparation, processing and storage. A study by Osaili *et al.*[6] showed low understanding of basic food handling, such as appropriate cooking and storage temperature. In Turkey, half of young consumers did not understand that checking the internal temperature of meat is one of the safest ways to ensure that the meat is perfectly cooked[7].

According to a study by Lange *et al.*[8], most Swedish students did not have basic knowledge of food safety until they graduated. Lange's research motivated us to study Indonesian students' knowledge of food safety. Nutrition students should be equipped with adequate food safety knowledge compared to students in other majors. After graduation, food safety knowledge becomes more important in the food service industry. Moreover, these students will contribute to educate the community regarding food safety.

Food safety knowledge among nutrition students in Indonesia has not yet been studied. Therefore, this study aimed to evaluate the food safety knowledge of all students with a nutrition major in Indonesia. This study will help the AIPGI organization update the nutrition curricula in higher education programs while providing input for periodic training involving students and for students with a nutrition major to become more attentive to food safety.

MATERIALS AND METHODS

Design: This study was a cross-sectional and using a random cluster sampling method.

Time and place: Data were collected from August 1 to August 20, 2017. The study was conducted in 58 higher education institutions in Indonesia with nutrition major programs.

Sampling method: This research studied 482 associate and bachelor degree students in Indonesia with the following inclusion criteria: active nutrition associate (D3) and bachelor (D4, S1) degree students. Exclusion criteria included nutrition students who had not yet taken a food safety course or students who had not undergone food safety training or workshops (e.g., HACCP, ISO 22000, SQF, BRC, FSSC 22000).

All eligible subjects were given the questionnaire and informed consent form. The questionnaire and informed consent form were distributed online to expand the sampling.

Data types and collection: Data were collected with an online study instrument that consisted of 2 questionnaires: biodata and a food safety knowledge questionnaire.The questionnaire was validated using expert and empirical validations. Empirical validation was conducted two times because less reliable questions were initially found. The validated questionnaire was transformed into an online form that was then distributed through Ilmagi (Ikatan Lembaga Mahasiswa Gizi Indonesia/Indonesian Nutrition Students Association), Isagi (Ikatan Sarjana Gizi Indonesia/Indonesian Nutrition Graduates Association), Persagi (Persatuan Ahli Gizi Indonesia/Indonesian Nutritionists Association), nutrition lecturer networks and other networks known by the researchers.

Data processing and analysis: Questionnaires completed by the respondents were tabulated to obtain respondent characteristics, including age, sex, education level, semester and institution.The results were expressed as percentages, mean and standard deviation.

To assess the variable of food safety knowledge, each question was valued as 1 for a correct answer and 0 for an incorrect answer. The total score for food safety knowledge was calculated by summing the correct answers on the ten knowledge questions. Data were presented as a score with range 0-10. The mean of the food safety knowledge score of students from different strata was generated with a one-way ANOVA using Statistics Data Analysis (STATA 12.1, Statacorp LP., College Station, Texas) with a confidence interval of 95%.

RESULTS

The characteristics of the respondents are presented in Table 1. Female students constituted the majority of students enrolled in nutrition higher education in Indonesia. The

research subjects were mostly third- and fourth-year students, which meant that they were in their fifth to eighth semester (Table 1). This occurred due to the eligibility criteria, which required respondents to have already attended the food safety course, which is mostly offered in the 3rd or 4th year. The respondents' origin included institutions from Sumatera, Java, Kalimantan, Sulawesi, Bali, Nusa Tenggara and Papua. The proportion of correct answers for food safety questions is presented in Table 2.

After performing validation twice, a questionnaire consisting of 10 questions representing general food safety knowledge was produced. The majority of questions were answered incorrectly. The topics with the highest proportion of incorrect answers included food storage principles, safe food consumption principles, food-borne disease principles, handling food at risk of food-borne disease-causing microbes, subjects at risk of food-borne disease, safe food processing and preparation and contamination prevention of animal-sourced foods. The mean food safety knowledge score is presented in Table 3.

Chi^2 value was 0.263, which was higher than the significance level of 0.05. This meant that we could not reject the zero hypothesis, which stated that all three population

Table 1: Characteristics of respondents

Characteristic	Total (n = 482)	Percentage
Age (year)	21±1.5	
Sex		
Women	447	92.74
Men	35	7.26
Educational strata		
Associate degree (D3)	61	12.66
Bachelor degree (D4)	130	26.97
Bachelor (S1)	291	60.37
Semesters		
1	1	0.21
2	6	1.24
3	16	3.32
4	42	8.71
5	99	20.54
6	69	14.32
7	147	30.50
8	93	19.29
9	7	1.45
>9	2	0.41
Origin institution		
Java	403	83.6
Sumatera	38	7.9
Sulawesi	18	2.3
Kalimantan	11	0.8
Nusa Tenggara and Bali	1	
Papua	8	1.7

Table 2: Proportion of correct answers for food safety questions

Variable No.	Category of questions	Answers	Proportion±SE (%)
p1	Food storage principles	Correct	36±2.19
		Wrong	64±2.19
p2	Safe food consumption principles	Correct	31±2.11
		Wrong	69±2.11
p3	Food-borne disease principles	Correct	16±1.67
		Wrong	84±1.67
p4	Clean and healthy living behavior	Correct	74±1.99
		Wrong	26±1.99
p5	Safe temperature for food storage	Correct	77±1.91
		Wrong	23±1.91
p6	Handling food at risk of contamination with food-borne disease-causing microbes	Correct	26±1.99
		Wrong	74±1.99
p7	Safe cooking temperature	Correct	59±2.24
		Wrong	41±2.24
p8	Subjects prone to food-borne disease	Correct	36±2.19
		Wrong	64±2.19
p9	Safe food processing behavior	Correct	29±2.06
		Wrong	71±2.06
p10	Preparation and contamination prevention of animal source foods	Correct	45±2.27
		Wrong	55±2.27

Table 3: Mean food safety knowledge score of nutrition students by strata in Indonesia

Education strata	Mean±DS	Total	F	p
Nutrition associate degree (D3)	5.46±1.76	61	2.83	0.06
Nutrition bachelor (D4) degree	5.52±1.49	130		
Nutrition bachelor (S1) degree	5.84±1.52	291		
Total	5.71±1.55	482		

groups had equal variance. With a 95% confidence interval, it could be concluded that all three population groups had equal variance, so an ANOVA test could be performed.

ANOVA tests revealed that bachelor (S1) degree students had the highest and above-average scores. However, no significant difference was found among all three groups (D3, D4 and S1) [F(2.479) = 2.83. p = 0.06].

DISCUSSION

This study is the first to provide information on basic food safety knowledge evaluation results among nutrition students of different educational levels in all higher education institutions in Indonesia. Numerous studies have reviewed the food safety knowledge of food handlers[2,9,10,11] but no research has specifically investigated this topic in relation to nutrition students. Nutrition students are expected to possess a greater understanding of food safety compared to students of other majors. When these students graduate, food safety knowledge becomes critical in their working environments, especially for those who work in the food service industry or seek to educate the community[12].

The respondents possessed a high level of knowledge when answering questions on clean and healthy life behaviors. Behaviors including hand-washing practices are important aspects of food hygiene and sanitation. Many respondents answered hand-washing practice questions correctly due to repetitive information exposure starting from elementary school. This campaign was also distributed widely in posters in public places, such as schools, primary health centers, hospitals and restaurants. Distribution was also achieved through the media, such as TV, the Internet, mass media and the radio.

The high portion of correct answers regarding safe food storage temperature was most likely because this is arguably common knowledge. In addition, students were previously taught about the matter in Microbiology, Food Sanitation, Hygiene and Food Safety classes. The respondents might also be well informed about safe food storage temperature through food packaging and may be familiar with storing food in a refrigerator. It is known that the temperature should be maintained below 5°C to store food in a refrigerator or below 18°C in a freezer (0°F). Bacteria may grow in environments with a temperature between 5 and 60°C (40 and 140°F) with a growth speed of less than 20 min[13].

The respondents showed a low level of food safety knowledge regarding food storage principles, safe food consumption principles, food-borne disease principles, handling food at risk of contamination of food-borne disease-causing microbes, safe food processing behavior and preparationand contamination prevention of animal source foods. A low level of food safety knowledge in these aspects is associated with inaccurate cooking practices that are practiced daily. For example, many respondents were not aware that eggs should be fried until both the yolk and whites are solid. They also did not know that food that is prone to contamination should be consumed less than 2 h after the food is cooked or processed. This finding is in agreementwith the results of a study conducted by Ovca *et al.*[14], in which they found that formal education was not associated with food safety knowledge.

According to Wilcock *et al.*[15], knowledge is associated with daily habits and other perceptions occurring from social, cultural and economic influences. This develops from an early age and remains deeply engraved in memory. In this context, food safety knowledge may be associated with parents' cooking habits, economic status and food sensory attributes such as taste, texture, or tenderness.

A low level of food safety knowledge in particular aspects might be caused by students' misconceptions, which may be due to the students (intuition), lecturers (educator), text book, context, or learning strategy[16]. Low effectiveness of learning strategies may prevent students from fully grasping concepts, thus leading to misconception. Educators (lecturers) play a major role in food safety education[14]. A lack of emphasis by educators on important concepts regarding particular matters may cause misconceptions.

According to the study results, the means of the food safety knowledge scores of D3, D4 and S1 nutrition students showed no significant difference. The food safety knowledge of nutrition students needs to be improved. This can be achieved by including materials into subjects related to food safety, such as Food Ingredients, Food Technology, Food Microbiology and Food Service System Management and by developing an additional module on food safety.

Universities should also promote food safety programs by installing food safety posters in strategic places and conducting trainings or seminars on food safety with professional food safety experts. Thus, it is expected that food safety will become a cornerstone for student culture in the university environment. The government also plays a role in developing and socializing policies related to food safety. Finally, food safety education will be more effective with continuous and harmonious efforts from students, parents, lecturers, higher education, food safety professionals and the government.

The data gathered from this study reveal that there is an urgent need for food safety education in this target group. The

university setting is the best place to educate the youth regarding key food safety concepts. The results of this study will help academic educators in nutrition and the AIPGI organization to develop curricula on food safety knowledge that deliver reinforced food safety messages, especially for future health professionals. In this manner, academic educators in nutrition can motivate their students to practice microbiologically safe food handling.

CONCLUSION

The majority of the respondents failed to correctly answer questions on food storage principles, safe food consumption principles, food-borne disease principles, handling food at risk of microbes causing food-borne disease and subjects at risk of food-borne disease. The mean scores of food safety knowledge of nutrition students at various levels of education (D3, D4 and S1) were 5.46, 5.52 and 5.84, respectively. No significant mean score difference among the three groups was observed.

SIGNIFICANCE STATEMENT

This study demonstrates that the food safety knowledge of students with a nutrition major in Indonesiacan benefit the AIPGI organization in updating the nutrition curricula in higher education centers. This study will help researchers identify the critical areas of food safety knowledge scores of nutrition students by strata in Indonesia, which many researchers have been unable to explore. Thus, a new theory for a specific program in food safety to improve the quality of nutrition higher education in Indonesian may be realized.

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