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RESEARCH ARTICLE

Food safety knowledge, attitude, and practices among school children: a cross-sectional study based in the Colombo educational zone, Sri Lanka

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Abstract: The study focuses on assessing the knowledge, attitude, and practices (KAP) of food safety among school children in the city of Colombo, Sri Lanka, based on a questionnaire survey conducted from September to October 2020, with a sample of 380 teenagers from a selection of schools in the Colombo Educational Zone, Sri Lanka. It reports that the mean food safety knowledge, attitude, and practice scores of the participants were 59.949 ± 0.833, 84.336 ± 0.448, and 79.597 ± 0.616 (mean ± SE) respectively and hypothesises that the food safety practice score and the attitude score of school children both significantly increase relative to their food safety knowledge score ($r_p = 0.205$, $p < 0.001$ and $r_p = 0.359$, $p < 0.001$). A multiple linear regression analysis of the data establishes that the food safety knowledge score of the male participants is higher than that of the female participants and that poor food handling practices are common among the males in the population. The results further demonstrate a correlation between the individual schoolchild's academic performance, the educational background of his/her parents, and his/her knowledge of food safety. The present study reveals that the school children in Colombo Education Zone maintain an average level of food safety knowledge and satisfactory levels of food safety attitudes and practices. Thus, the authors suggest that school children should be provided with appropriate education and training to enhance their current level of food safety knowledge, especially about proper temperature control during food processing and food handling.

Keywords: Food safety, attitude, knowledge, practices, school children.

INTRODUCTION

Food safety and food-borne illnesses are two globally researched topics interlinked with each other. Thousands of people are reported to be in danger and many are vulnerable to foodborne illnesses and die each year owing to the consumption of food contaminated with biological, chemical, or physical hazards (Tewari & Abdullah, 2015; Azanaw *et al.,* 2021). Foodborne disease outbreaks remain of the prominent public health concerns globally. Trends such as mass-scale production and distribution of food, expansion of the global food supply chain and consumption of ready-to-eat food from street vendors and restaurants, and the advent of new foodborne pathogens expediate foodborne disease outbreaks (Nyachuba *et al.,* 2010; Quested *et al.,* 2010; King *et al.,* 2017).

To combat the growing number of food poisoning cases, the governments of almost all countries globally strengthen their efforts to upgrade the food safety aspects within their territories. It is a well-known fact that infants, youngsters, immune-compromised people, pregnant women, as well as older people are particularly at a higher risk of foodborne illnesses (Kendall *et al.,* 2003). Moreover, undernourished infants and children are two major risk groups, often vulnerable to foodborne diarrhoeal diseases (World Health Organization, 2020). This fact is quite evident from the data WHO which highlights that unsafe food contributes to more than one billion incidents of diarrhoea among children annually, leading over three million deaths (World Health Organization, 2020).

Accordingly, enhancement of food safety education among the target population is considered the most suitable approach to improving their knowledge of the

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food safety aspects (Diplock *et al.,* 2017). As Redmond & Griffith (2003) claim, it is difficult to prevent/reduce foodborne illnesses without proper knowledge and practice regarding food safety. Even though childhood is identified as a decisive time for upgrading food safety knowledge and skills (Mullan *et al*., 2013), most of the published works address issues pertaining to adult food consumers and food handlers in restaurants or the households.

According to the UN data, Mid-year population of Sri Lanka in 2020 was estimated at 21,413,249 people (worldometers.info). Among them 4,214,772 represented the School children (Ministry of Education, School Census Report, 2020) which is nearly 20% of the entire population in Sri Lanka. Thus, school children population can be considered as a major social category that can have a long-term impact on the food safety. Therefore, research on the food safety aspects of school children can be of great importance. Some might express controversial points of view on the above statement because School children are not the only category directly involved in the field of food handling, preparation, and distribution. Nevertheless, it is highly crucial to make them aware of and enhance their knowledge and attitudes about every aspect of food safety as that will be useful for their lives in the future regardless of what their destinies will be.

Although there are many studies conducted about the School children's food safety concerns in countries like the USA, Canada, China (Osaili *et al.,* 2011; Majowicz *et al.,* 2015; Cheng *et al.,* 2017; Majowicz *et al.,* 2017; Moghaddam *et al.,* 2020; Tutu *et al.,* 2020; Al ahdab, 2021), only a few studies have been published on the same subject in the South Asian context (Gavaravarapu *et al.,* 2009; Norazmir & Noor, 2012). Similarly, in the Sri Lankan context, such publications in recognised research journals are almost non-existent. Careful and systematic identification of gaps in the current status of the food safety knowledge and practices among the School children which is aimed at in this study will be useful when filling apertures to further enhancement of their knowledge.

In modern research, the knowledge, attitude, and practice (KAP) model is regarded as one of the promising theoretical approaches for many health-related education programmes (Watt, 2005). Experts generally agree that safety knowledge and attitudes are the most crucial cognitive elements that influence food safety practices of an individual (Mihalache *et al*., 2021). According to the KAP model, if individuals are provided with adequate knowledge, food hygiene practices could be improved (Zanin *et al*., 2017). Additionally, if a person adopts a positive attitude toward food safety, food quality, or food integrity, it can increase their awareness of food safety.

Therefore KAP models were utilised in numerous studies to reveal the significant associations between the food safety knowledge and attitude of individuals (Lim *et al*., 2016; Baser *et al*., 2017; Mihalache *et al*., 2021). Accordingly, the theory of KAP is used in the preset study to determine the significant relationships between the food safety knowledge, attitude and practices of school children and their connection with the sociodemographic profile. Thus, a cross-sectional study was conducted using school children of a randomly selected set of schools in the Colombo Educational Zone, Sri Lanka to evaluate their current level of KAP and suggest evidence-based recommendations for the improvement of their knowledge, attitudes, and practices of food safety.

MATERIALS AND METHODS

Study design

The study was conducted in the Colombo Education Zone, Sri Lanka. The target population was school children of 14 to 16 years of age in government schools, which represents child population of 35462 (Zonal Educational Office, Colombo). The formal approval to conduct the study in the twelve respective schools of the Colombo Education Zone from the month of September to October 2020 was first obtained from the Director of Zonal Education Office, Colombo, and the respective Principals. The data were collected through a self-administered questionnaire from volunteer anonymous participants (n = 380) from those schools. The questionnaire was administered as a paper copy and the school children were allowed to complete it under the supervision of their class teachers during school hours.

Questionnaire design

The questionnaire was modeled after previous similar studies carried out in Slovenia and China using school children as participants (Ovca *et al*., 2014; Cheng *et al.,* 2017). It consisted of 3 main sections and a particular field to include the respondent's demographic details. The 1st section was designed to evaluate the respondent's attitudes about food safety risks using seven statements. His/her knowledge about food safety was evaluated in the 2nd segment using 14 questions, under six basic categories; A-cleanliness of food contact surfaces, B-prevention of cross-contamination, C-handling leftovers, D- temperature control to ensure the microbial safety of food, E- making the correct food safety decision

during purchasing, and F-personal hygiene. Finally, the 3rd section was designed to evaluate the participant's self-reported food safety practices and it was composed of 13 previously described actions. The questionnaire was amended after a pilot test carried out with ten school children of 14-16 years in July 2020 to check the clarity of the questions, identify the participants' response options, and estimate the average time required to conclude the respondses.

Data analysis

Software packages of SPSS Statistics version 23 and Microsoft Excel 2010 were used to analyse the data collected. The descriptive statistics and inferential statistics were created and used to define and explain the results. The descriptive statistics (frequencies, percentages, means, and standard errors) were computed to provide basic information about the variables in the tested sample. The inferential statistics were computed to make inferences of the interested population based on the tested sample.

Accordingly, three different scores were developed to evaluate food safety knowledge, attitude, and practices of school children. To develop food safety attitudes, and practice scores, a scale was created based on the coding method as shown in Table 1. However, the food safety knowledge score was calculated based on the number of correct responses given by each participant for the food safety knowledge section of the questionnaire.

Based on the individual participant's score, three overall mean scores were obtained for the food safety attitude, knowledge, and practices among school children and were credited with the following scale to get better insights into the overall knowledge, attitudes, and practices of school children. Score of 50% was considered 'poor', score between 51% - 69% considered 'average' and score above 70% is labelled as 'satisfactory'. Thereafter Shapiro-Wilk test was performed to check the normality of data. Then Mann Whitney U test and Kruskal-Wallis test were carried out at 5% significance level to determine the relationship between the socio-demographic factors and food safety KAP scores based on the medians. Later, the correlations of the three main scores (knowledge, attitude, and practice) with socio-demographic factors were analysed separately using Pearson-correlation coefficients. Finally, a multiple linear regression analysis was carried out to develop statistical models to assess the participants' knowledge and practice regarding the food safety.

Table 1: Scale created to evaluate food safety attitude and practice scores

Options in the food safety attitude section	Attributed score	Options in the self-reported practice section	Attributed score
Disagree	1	Never	1
Do not know	2	Sometimes	2
Agree	3	Always	3

RESULTS

Demographic details of the participants

Of the 380 participants who participated in the study, 56.32% were male and 43.68% were female, respectively, while 34.74%, 31.32%, and 33.95% of the participants were in 14, 15, and 16 years age groups. The sample thus represents a nearly equal percentage of school children from each age group. The education background of their parents surveyed was identified under 4 main categories which include primary education only (16.58%), General Certificate of Education (Ordinary level) - G.C.E. O/L (28.68%), General Certificate of Education(Advanced level) - G.C.E. A/L only (30.53%) and Diploma/Degree holder (24.21%). When they were asked about their academic ranking in the most recent term, 41.8% reported rank between 1-10, 25.8% reported rank between 11-20, 19.5% reported rank between 21-30 and 12.9% reported rank between 31-50. Similarly, when asked to report their Science scores in the same term test, 31.32 % of them reported marks (out of 100) between 0-49, 42.63 % reported marks between 50-74 and 26.05% reported marks between 75-100.

Attitudes about food-related risks

According to the survey results on school children's attitudes about food-related risks in Table 2, the mean food safety attitude score of the participants was satisfactory (84.33 ± 0.44/ mean ± SE) and there was no significant gender difference observed ($p > 0.05$).

It was observed that the majority (77.4%) of the participants agreed that food poisoning can be fatal, indicating a good attitude toward possible risks associated with food. Also, about 86% of the participants understood that there's a higher possibility of being sick by eating food from outside home and were quite dissatisfied regarding the safety of the food items sold in small makeshift restaurants and by street food vendors in Sri Lanka. The school children's confidence regarding the general food safety state in Sri Lanka were not satisfactory (47.4%). Notably, over 92% of the participants believed that their food safety knowledge could be further improved through formal sessions on food safety education.

Table 2: School children's attitude about food-related risks

		% of Participants		
Statement No.	Statement	Disagree (%)	Do not Know (%)	Agree (%)
1	Food poisoning can be fatal.	8.2	14.5	77.4
2	Properly cooked food cause relatively fewer food poisoning cases.	39.7	28.4	31.8
3	The likelihood of getting sick by consuming food from outside is higher than consuming food from home.	5.8	8.2	86.1
4	Food poisoning is possible not only in developing countries but also in developed countries.	7.1	19.7	73.2
5	I'm dissatisfied with hygiene of the food sold in small restaurants and by street food vendors in Sri Lanka.	15.3	13.9	70.8
6	The general food safety situation in Sri Lanka is not satisfactory.	27.6	25.0	47.4

Knowledge of food safety

According to the survey results on the school children's food safety knowledge in Table 3, the mean food safety knowledge score of the school children was 59.94 ± 0.83 and it reveals that the members of this age category have an average knowledge of food safety.

The participants showed a satisfactory level of food safety knowledge related to taking the correct food safety decisions during purchasing (77.7%) and maintaining personal hygiene during food handling (70.4%). They also showed an average level of knowledge about the importance of cleanliness of food contact surfaces (61.7%) and preventing cross-contamination (59.05%) in assuring food safety. However, their knowledge of proper handling of leftover foods (43.7%) and correct temperature control during food handling (37.5%) was comparatively poor. Notably, the majority of the participants (~80 %) were unaware of the danger zone concerning the food storage temperature.

Table 3: School children's knowledge of various aspects of food safety

		% of Participants*			
Category$^{\phi}$	Statement	True	False	Do not Know	Correct answers-category wise
A	Before commencing food preparation, it is mandatory to make sure all food contact surfaces are cleaned.	<u>95.8</u>	2.9	1.3	61.7
	Cleaning food contact surfaces by only using cold running water removes dirt, debris, and the majority of the microbes.	50.0	<u>27.6</u>	22.4	
B	Proper cleaning of previously used utensils before using them again for cutting fruits is important.	<u>35.5</u>	45.3	19.2	59.05
	It is okay to use the same cloth for drying hands and wiping dishes and working surfaces.	10.0	<u>82.6</u>	7.4	
C	Hot food should be held at 65°C or warmer or cold food should be held at 4°C or colder until they are served	<u>32.6</u>	10.0	57.4	43.7
	Any leftover food kept at room temperature for more than 2 hours should be discarded.	<u>43.2</u>	22.4	34.5	
	Cooked leftovers should be used within 4 days or less.	<u>55.3</u>	25.5	19.2	
D	The ambient temperature for the growth of most pathogenic microorganisms is between 4°C and 65°C.	<u>27.9</u>	14.5	57.6	37.5
	The temperature inside the domestic refrigerator is 3-5°C.	<u>47.1</u>	13.7	39.2	
E	Food with damaged packaging must be avoided during purchasing.	<u>87.9</u>	7.9	4.2	77.7
	Foods which have undesirable traits concerning appearance, odour, and taste are not suitable for consumption even if the expiry date has not been reached.	<u>81.6</u>	12.1	6.3	
	There is no risk in consuming foods that come in a bulged can.	20.5	<u>63.7</u>	15.8	
F	Washing hands only with clean running water prior to food preparation is enough to remove germs and bacteria.	29.5	<u>62.6</u>	7.9	70.4
	It is important to take off jewellery from your hands before commencing food preparation.	<u>78.2</u>	8.7	8.7	

*Correct response for each statement is underlined.

$^{\phi}$ A-cleanliness of food contact surfaces, B-prevention of cross-contamination, C-handling left over foods, D- temperature control to ensure microbial safety of food, E- making correct food safety decisions during purchasing, F-personal hygiene

Furthermore, lack of knowledge about the importance of proper temperature control to assure microbial safety of food during its processing and storing was evident from the results in Table 3.

Self-reported food safety practices

The results of the participants' self-reported food safety practices shown in Table 4 reveal that the mean self-reported food safety practice score was 79.59 ± 0.6, indicating a satisfactory level of food safety practices among school children of the age category between 14-16 years old.

In response to the most queries on food safety practices, the participants reported satisfactory behaviour except for items 4, 5, 6, and 7 (Table 4). A significant number of participants in the study were ignorant about the fact that open wounds could contaminate food while cooking (Statement 4). As Table 4 depicts, most school children did not seem to engage in proper safety practices when handling leftover foods (Statements 5 & 6). Lack of interest in correcting the food safety-related mistakes made by the members of their households were observed during the study (Statement 7).

Correlations among school children's food safety knowledge, attitudes, practice, and socio-demographic factors

The results of the Mann-Whitney u test, Kruskal-Wallis test followed by Dunnett T3, and Tukey's HSD indicate that gender ($p = 0.035$), academic ranking in the class ($p = 0.002$), marks scored in Science ($p < 0.001$), and the educational background of their parents ($p < 0.001$) to have significantly different distributions across their' food safety knowledge score while gender ($p < 0.001$), academic ranking in the class ($p = 0.022$), grades scored in Science ($p < 0.001$) to have significantly different distributions over their' food safety practice score. Similarly, their Science grades ($p = 0.001$), their academic ranking in the class ($p = 0.011$), and the educational background of their parents ($p = 0.025$) also had significantly different distributions across their food safety attitude scores.

Consequently, there were significant correlations between the food safety knowledge score and practice score ($rp = 0.205$, $p < 0.001$), food safety knowledge score and attitude score ($rp = 0.359$, $p < 0.001$) and the food safety practice score and attitude score

Table 4: Self-reported food safety practices of School children

Statement no.	Statement	Never (%)	Sometimes (%)	Always (%)
1	I do not eat any food that comes in a damaged package.	2.4	26.1	71.6
2	I do not use the unwashed cutting board and/or knife which was previously used by someone else in the family while preparing food for myself/family.	12.9	21.8	65.3
3	I do not use the same kitchen towel to dry hands and clean dishes.	9.5	28.7	61.8
4	I do not prepare food if I have an open wound on my hands.	35.0	20.0	45.0
5	I store leftover foods in the refrigerator within 2 hours after preparation.	22.6	51.3	26.1
6	I reheat leftovers to at least to 74°C/165°F temperature before eating.	24.7	42.6	32.6
7	I warn my parent/siblings if I notice that they are making any food safety-related mistakes at home.	16.1	42.95	41.1
8	I wash used plates using clean water and a dishwashing agent.	14.7	28.7	56.6
9	I clean the countertop and used utensils using clean water and a cleaning agent after food preparation.	18.2	15.5	66.3
10	I take off any jewelry from my hands and tie my hair up and tight before food preparation.	22.6	20.5	58.8
11	I inform my parents or throw away by myself if I notice any suspicious-looking, smelling, or tasting food at home.	17.1	17.1	65.8
12	I wash my hands using clean water and soap before preparing or eating food.	11.6	17.6	70.8
13	I read the information on the food labels before purchasing.	13.2	22.1	64.7

(rp = 0.293, p < 0.001) (Table 5). Pearson Correlation coefficients and the relevant sig. values, the three main scores of food safety knowledge, attitude, and practices are presented in Table 5.

Statistical models for school children's food safety knowledge and practice with predictors

Before carrying out a multiple linear regression analysis, assumptions pertaining to the situation were checked. Scatter plots were used to check linearity, Durbin-Watson test statistic was used to check the independence of residuals, the homoscedasticity was checked with patterns of the residuals versus fitted plot, and the normality of the residuals was checked using histogram/ normal P-P Plot and multicollinearity was checked using VIF (variance inflation factor) values.

Table 6 is a summary of the results of the multiple linear regression analysis performed to build statistical models to represent the food safety knowledge and practice of the participants.

R^2 value (coefficient of determination) indicates that 14.4 % of the variation in food safety knowledge score ($R^2 = 0.144$) and 11.5% of the variation in food safety practice score ($R^2 = 0.115$) are completely explained by the predictor variables. Although the adequacy of the two models is somewhat low, here, both models are significant (p = 0.000) as in Table 6.

Based on the regression analysis results (Table 6), the regression equation was obtained to represent the average food safety knowledge score of participants.

Regression Model 1

Average food safety knowledge score = 42.400 - 4.716* G.C.E. O/L or below + 1.080* G.C.E. A/L + 3.579* Male + 3.887* Science marks + 3.294* rank in the class.

Among the predictors of the food safety knowledge score model, gender and the education background of the parents are categorical variables, while particpants' rank in the class and their grades in Science are quantitative. In the regression analysis, both categorical variables were defined as dummy variables. Accordingly, gender has two categories; male and female (reference group). The education background of parents has three categories, G.C.E. O/L or below, G.C.E. A/L, and diploma/degree holder (reference group). As Table 6 depicts, the average food safety knowledge score is expected to decrease by 4.716 for school children with parents having an education up to G.C.E. O/L or below compared to diploma/degree holder parents while other factors are held constant. Similarly, an increase in average food safety knowledge score by 3.579 can be seen for males compared to females while all other factors are held constant. It is shown that the average food safety knowledge scores of the school children tend to increase from 3.887 and 3.294 by one unit in their grades in Science and academic rank, respectively, while the other factors are kept constant.

Similarly, based on the regression analysis results (Table 6), the regression equation was obtained to represent the average food safety practice score of the participants.

Regression Model 2

Average Food Safety Practice Score = 74.125 + 4.228* Grade achieved in Science - 4.902* Male

According to the above model, both the gender and the grade achieved in Science by the participants are found to be significant (p < 0.05). Hence, their average food safety practice scores tend to increase from 4.228 by one unit as per their achievements in Science when all other factors are kept constant. When the effects of their grades in Science are taken into consideration, the

Table 5: Correlations between scores of food safety knowledge, attitude, and practices among school children

Pearson Correlation coefficients (rp)				
		Attitude	Practices	Knowledge
Attitude	rp	1	.293**	.359**
	Sig.		.000	.000
Practices	rp	.293**	1	.205**
	Sig.	.000		.000
Knowledge	rp	.359**	.205**	1
	Sig.	.000	.000	

**Correlation is significant at the 0.01 level (2 tailed)

Table 6: Results of multiple linear regression on factors associated with food safety knowledge and practice

	Unstandardised Coefficients		Standardised Coefficients			Model	
Predictors of the model	B	Std. Error	Beta	t	Sig.	R Square	Sig.
1 Knowledge						.144	.000
(Constant)	42.400	3.927		10.796	.000		
Science marks	3.887	1.202	.181	3.234	.001		
Rank in the class	3.294	.746	.216	4.413	.000		
Male	3.579	1.584	.109	2.259	.024		
G.C.E. O/L or below	-4.716	2.240	-.145	-2.106	036		
G.C.E. A/L	1.080	2.155	.031	.501	.617		
2 Practice						.115	.000
(Constant)	74.125	1.750		42.348	.000		
Science marks	4.228	.769	.267	5.501	.000		
Male	-4.902	1.171	-.203	-4.186	.000		

males will score -4.902 lower on the average food safety practice score than the females (Table 6). It is evident that although the food safety knowledge score of the male school children was greater than the females, poor food handling practices were often practiced by males.

DISCUSSION

Participants' attitudes about food-related risks

The main objective of the discussion was to demonstrate and evaluate the attitude of school children toward food safety and as shown in Table 2 to assist decision makers in formulating their recommendations as to on what type of attitudes school children should be built up through educational interventions for better awareness of food safety.

Even though the results indicate a satisfactory attitude of the school children towards many aspects of food safety, the majority of the participants did not know that the risk of microbial food poisoning can be reduced through cooking at high temperature conditions (Statement 2). Therefore, it can be suggested that those in this age group should be educated more on how cooking at high temperatures can reduce the harmful microorganisms present in food by emphasizing the effects of temperature on microorganisms.

Based on the following 3 main reasons, 1) a high number of food poisoning cases reported yearly, 2) lack of facilities for national food safety monitoring, and 3) recent research studies reporting the presence of harmful levels of food safety hazards in various types of foods, it can be confidently stated that Sri Lankas' general food safety situation is not that satisfactory (Munasinghe *et al.,* 2015; Wimalasekara & Gunasena, 2016; Dayasiri *et al*., 2017; 2018; Buckley *et al.,* 2021). However, in this study, only 47.4% of the participants agreed with this statement in their responses. This may be due to lack of awareness of the current food safety situation of the country as children in this age group are mostly interested in entertainment activities such as watching cartoons, playing video games, and doing sports than watching the TV news or reading newspapers. In Sri Lanka, even though most individual food poisoning cases are not frequently reported, food poisoning cases in garment factories, school canteens, university canteens *etc*. and serious food safety issues such as aflatoxin contamination in coconut oil, agricultural chemical residues in milk powder are often broadcasted in electronic media and published in newspapers and conveyed via text messages in layman language for making the public aware about such scenarios (Kariyakarawana, 2013; Aloysiu, 2014; Liyanage, 2022). Even though, many school children in Sri Lanka have access to either TV news, newspapers or text messages directly or indirectly, most of them do not use that information effectively when making food safety related decisions. Hence, it can be suggested that making them awere of the country's current food safety issues by parents and school teachers is important. However, in

a similar study carried out on school children in Beijing, China, the majority of them did not seem to show much confidence in the country's general food safety situation (Cheng *et al.,* 2017) suggesting that they may be more aware of the food safety situation in their country than the participants in the present study. May be due to school children in China receive effective food safety education through their school curriculum starting from the elementary school and from the parents. However, the nature and the level of food safety education in Sri Lankan school system is still questionable and in-depth studies on this matter will be useful in improving the food safety situation in the country.

Furthermore, it is important to note that the food safety context of a country is subjective and can vary depending on factors like the country's rules and regulations regarding food safety, economies of scale (such as developed/developing/under-developed), food safety culture, and analytical and technological developments. For example, since developed countries are capable of investing more money on improving laboratory facilities, adapting new technologies and trained human resources, they have the potential to perform more food sample analysis on safety hazards, do risk assessments and make appropriate decisions faster than a developing country in assuring food safety (Rahmat *et al*., 2016). The vast majority of the participants in this study agreed that their food safety knowledge could be further improved through proper education. In a recent study carried out in China, the majority (more than 80%) of the participants have shown a strong willingness to expand their food safety knowledge and to abandon their wrong food handling habits *(*Luo *et al.,* 2019).

This is one of the most important outputs of the present study where school children showed strong willingnesss to learn more about food safety. Hence, this observation can be taken into consideration by the responsible parties in the education administration in Sri Lanka to incorporate the food education-related contents into the school curriculum. Moreover, school is the most effective place to approach and teach youngsters about food safety concepts (Osaili *et al.,* 2011) where training programes, the inclusion of subject matter into the school curriculum, seminars, and workshops can be suggested as effective tools to improve food safety knowledge of school children (Majowicz *et al.*, 2017).

School children's knowledge of food safety

The six basic categories of this section include cleanliness of food contact surfaces, prevention of cross-contamination, handling leftover foods, temperature control to ensure microbial safety of food, making, correct food safety decisions during purchasing, and personal hygiene. The school children of this age category are found to have average knowledge on food safety (Table 3). However, in a recent study conducted in Canada, it was evident that the food safety knowledge amongst high school children is poor in general (Majowicz *et al.,* 2017) while in another study conducted in Beijing, China, the overall food safety knowledge among secondary School children is found to be relatively good (Cheng *et al.,* 2017). This variation can be normal as their knowledge can vary from country to country depending on the school curriculum, countries, food safety-related rules and legislations, *etc*. Notably, their lack of knowledge about the impact of temperature control on microorganisms has been reported during this study (Category C &D). In a similar study carried out in Slovenia, poor knowledge about food safety aspects has been reported (Ovca *et al.,* 2014). Therefore, the importance of proper heat treatment and correct temperature control during food processing and storage can be suggested as an important topic to be included in the school curriculum in Sri Lanka.

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Schoolchidren's self-reported food safety practices

The evaluation of the school children's food safety practices does not involve a long Likert scale as in most of the previously published studies (Ovca *et al.,* 2014), but only three options included in the questionnaire to make the statements less ambiguous. From face-to-face discussions carried out with the participants of this study prior to the questionnaire, it was revealed that many school children in this age group do not engage in meal preparation without an adult supervision. However, the majority of the school children mention that they support their parents by washing and cutting fruits and vegetables, scrapping coconut, preparing small dishes like pickels, sambols, instant noodles *etc*. which are also considered as active engagements in food preparation according to the research questionnaire.

Overall, the results depicted a satisfactory level of food safety practices among school children of this age category except for statements 5, 6, and 7 (Table 4). A satisfactory level of food handling practices among school children was also reported in similar studies carried out in Canada and Ghana (Majowicz *et al.,* 2015; Tutu *et al.*, 2019). However, in the present study, the school children do not seem to engage in good hygienic practices when handling leftover foods (Table 3, Statements 5 & 6). This can be due to the lack of food safety knowledge on this matter as reported in Table 3. Similarly, in Slovenia, school children between the age of 10-12 years also reported poor practices when handling leftover foods,

especially with proper heat treatment and temperature control during food storage (Ovca *et al.,* 2014).

Results further indicate that even though school children are more careful regarding their own food safety practices during food preparation, they are not that serious about the malpractices done by their family members during the cooking (Table 3, Statement 7). This observation suggests that it is important to let them know that ensuring food safety is everyone's responsibility and that even a single mistake can contaminate the food that is being handled/consumed.

Correlations among school children's food safety knowledge, attitudes, practice, and socio-demographic Factors

Modern food safety-related research often tries to investigate the relationship between food safety knowledge and practice with demographics (Grover *et al*., 2016; Rahman *et al.,* 2016; radaWoh *et al.,* 2016; Bou-Mitri *et al.,* 2018). The results of the correlation analysis in the present study indicate that gender, academic ranking in the class, science marks, and the educational background of parents have significant impact on the school children' food safety knowledge and practices while their age has no such effect.

Knowledge of food safety has a significant impact on the food safety attitudes of individuals, which may result in good hygienic practices while handling food (Rennie, 1995; Finch & Daniel, 2005). Results show that both food safety attitudes and practices increase along with that of their food safety knowledge (Table 5). Similarly, the results of a survey conducted by Tutu *et al.* (2019), show that there is a positive correlation between food safety knowledge and practices ($r_p = 0.2$ and p-value < 0.001). This reassures that better food safety attitudes and practices are associated with better food safety knowledge.

Statistical models for school children's food safety knowledge and food safety practice with their predictors

Results of the multiple linear regression analysis indicate that students' food safety knowledge significantly declines, when parents' level of education, students' academic ranking, and science marks ($p < 0.05$) are reduced (Table 6). Even though the food safety knowledge of male School children is higher than that of female, poor food safety practices are commonly shown by males in the population ($p < 0.05$). In this regard, the authors believe that anyone could gain food safety knowledge through different sources such as TV, newspapers, radio, books, and social media. However, practicing the knowledge acquired can be a different matter. Moreover, in Sri Lankan culture, mothers tend to encourage their daughters to be engaged in household chores especially kitchen work from their childhood while, sons, are not expected to engage in cooking. Therefore, it can be assumed that the female school children gain more hands-on experience regarding the safe food handling practices at home than the male counterparts.

CONCLUSIONS

The participants of the study are reported to have maintained an average level of knowledge, attitude, and practice of food safety. Although it is noticed that the food safety knowledge score of the male school children is higher than that of the female, it can be concluded that the female school children follow safe food handling practices more than their male counterparts in this scenario. In addition, a lack of awareness among the school children on the impact of temperature control to assure microbial safety of food while handling food was prominent. Thus, it can be suggested that the school children's knowledge of these areas needs further improvements. Almost all participants were confident that food safety knowledge among them could be further enhanced through proper education. Since their food safety knowledge had a significant impact on their food handling practices, it can be suggested that conducting education programs on food safety in school settings would be a viable strategy to minimise/prevent school children contracting foodborne diseases.

DATA AVAILABILITY

The data and materials that were used in this study are available from the corresponding author upon formal request.

CONFLICT OF INTEREST

There is no conflict of interest for any of the contributors.

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