



Survey on hygiene and food safety among kitchen staff in preschools in Podgorica, Montenegro

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Ensuring food safety in kindergartens is crucial for protecting the health of young children. This study assessed the knowledge, attitudes, and practices (KAP) of 113 kitchen employees across the capital of Montenegro, Podgorica. These employees prepare and serve two to four meals daily for children under six. The study aimed to explore correlations between KAP and sociodemographic characteristics and compare self-reported practices with the observed ones. We hypothesized a significant association between the kitchen staff's knowledge, attitudes, and food handling practices, emphasizing education and training for better hygiene practices. Data were collected using structured questionnaires and checklists. Respondents showed moderate knowledge ($77.25 \pm 2.69\%$) and positive attitudes ($95.72 \pm 4.53\%$), while observed practices were not as high ($64.65 \pm 27.73\%$). A weak positive correlation existed between knowledge and attitudes ($r=0.190$; $p=0.04$). Higher education, work experience, and frequent training were associated with better knowledge ($p<0.05$). Sociodemographic characteristics did not significantly influence attitudes and practices. Multivariate logistic regression indicated knowledge and attitude as predictors, with food safety attitude impacting safe handling practices. Our findings showed moderate knowledge and positive attitudes do not necessarily lead to good practices, as there was no significant correlation between knowledge and self-reported practices or between attitudes and self-reported practices. Education is crucial, as educated staff were more likely to know more about temperature control, cross-contamination prevention, and equipment hygiene. Overcoming external barriers such as infrastructure and time constraints is essential to applying knowledge fostering positive attitudes and improving hygiene practices in kindergartens. This study underscores the need for targeted interventions to ensure safe food handling practices in childcare settings, emphasizing continuous education to maintain food safety standards.

KEY WORDS: childcare; education; food handlers; KAP survey

Foodborne illnesses are a major public health concern worldwide, causing high morbidity and mortality. Each year, approximately 600 million people are affected, leading to 420,000 deaths. Children under five account for 40 % of cases, including 125,000 deaths annually (1). Improper food handling by food service personnel is linked to nearly 97 % of foodborne illness outbreaks (2), with food handlers often acting as asymptomatic carriers of pathogens (3).

In Montenegro, foodborne outbreaks in educational institutions have over the past two decades been reported in approximately 15 % of cases (2001–2021) (4, 5). Millions of children in preschool institutions globally consume food prepared and served on-site daily and the number of children attending childcare institutions has steadily increased (6). In Podgorica, 70 % of children aged from one to six attend preschool institutions, where over 20,000 meals are served daily through various kitchen setups, with staff rotating annually (6, 7). Close contact and natural curiosity among children increase infection risks, making daycare attendees two to three times more likely to become ill (8).

Foodborne illnesses can severely affect young children, causing dehydration from vomiting and diarrhoea, as their underdeveloped immune systems and stomach acid production make them particularly vulnerable (9). Although other studies have evaluated food safety knowledge, attitudes, and practices among food handlers in other parts of the world (10–20), limited data exist for Montenegro, particularly for preschools serving vulnerable children under six.

EU food safety regulation (852/2004) mandates proper training for food handlers (21), addressing various issues (22). Recent data from the European Food Safety Authority (EFSA) and European Centre for Disease Prevention and Control (ECDC) highlight the urgent need to improve hygiene standards and implement Hazard Analysis and Critical Control Point (HACCP) systems in schools and kindergartens (23).

This study aimed to assess the food safety knowledge, attitudes, and hygiene practices among kitchen staff in preschool institutions in order to possibly motivate prevention against foodborne outbreaks. The theoretical background suggests that knowledge

alone does not ensure safe practices if positive attitudes are absent. By addressing knowledge, attitudes, and practices together, this study sought to direct attention toward better food safety behaviour, which will consequently reduce risks in preschool environments.

MATERIALS AND METHODS

Study design and location

This cross-sectional behavioural study was conducted from May to July 2023 in all public and private preschools in Podgorica, Montenegro, encompassing 48 preschool kitchens and all 113 kitchen employees. The only exclusion criterion was absenteeism due to illness or other work-related reasons; however, all employees (100 %) were included in the study.

Questionnaire design and observation checklist

Data were collected using a structured questionnaire and an observation checklist. The questionnaire consisted of 62 closed-ended questions, covering sociodemographic characteristics (8 questions), food safety knowledge (22 questions), attitudes (12 statements), and self-reported practices (20 statements). The design of the questionnaire and observation checklist was based on a literature review and modified to align with Montenegrin regulations (11, 13–18, 24–27). More specifically, the knowledge questions were: focused on personal hygiene, time and temperature control, cross-contamination, food storage, and equipment hygiene. Responses were scored as “Yes” (1), “No” (0), and “I don’t know” (0). Attitude statements: rated on a five-point scale from “strongly disagree” (1) to “strongly agree” (5), with positive responses scoring “1” and negative or neutral responses scoring “0”. Self-reported practices: rated on a scale from “never” (1) to “always” (5), with the responses “often” or “always” scoring “1” and less frequent responses scoring “0”.

Results were converted into percentages and categorized as good/positive (80–100 %), moderate/satisfactory (50–80 %), or poor/negative (0–50 %) based on the Bloom cut-off point (10). Negative responses were transformed into positive ones for scoring consistency.

The researcher and three trained assistants observed the workflow, hygiene practices, and attitudes of the studied kitchen staff during different stages of the process: meal preparation, cooking and handling, food service, and post-service tasks such as cleaning. The same scoring system was applied to both the observation and self-reported assessments of food-handling practices, with identical questions for evaluation.

Data collection was anonymous, with each participant completing the questionnaire only once. Practices were monitored by observing each kitchen staff member individually, as they typically work in small groups at different locations across the city. This approach allowed for a focused assessment of specific activities,

such as meal preparation and hygiene practices, as well as a comparison of individual performance with self-reported practices.

A pilot study with 15 participants from a preschool outside Podgorica was conducted to test the clarity and reliability of the questionnaire and achieved a Cronbach’s alpha coefficient of 0.75. Participants provided informed consent, and ethical approval for the study was obtained from the Institute for Public Health of Montenegro (No. 01-3790, 28 April 2023) and the Ministry of Education (No. 01-011/23-3394/2, 3 May 2023).

Statistical analysis

Data were analyzed using SPSS, version 22.0 (IBM Corp., 2013, Armonk, NY, USA). Mean values, standard deviations, and response frequencies were calculated for each variable. Both parametric and non-parametric analyses were used. Pearson and Spearman correlation coefficients, Mann-Whitney, and Kruskal-Wallis tests examined the comparison and correlation of knowledge, attitudes, and practices of food handlers. Statistical significance was set at $p < 0.05$.

RESULTS

Sociodemographic characteristics of respondents

The socio-demographic characteristics of 113 respondents are summarized in Table 1. The surveyed group was predominantly female (98.2 %), with most employees in the 35–44 (34.5 %) and 45–55 (33.6 %) age groups. The average age was 43.6 ± 10.3 years, and the average work experience was 12.6 ± 8.5 years. Most respondents (88.5 %) completed secondary school, while only 2.7 % completed primary school alone, which is compulsory in Montenegro. More than five years of work experience was reported by 78 % of respondents. Training in safe food handling was attended more than once by 54.9 % of respondents, once by 21.2 %, and never by 23.9 %. The majority of respondents (83.2 %) knew that the hazard analysis and critical control points management system (HACCP) was implemented in their institution, but only 14.3 % had a “hygienic minimum” course certificate, which had been obligatory since June 2021 (28).

Food safety and hygiene knowledge

The average knowledge score among food handlers was 77.25 ± 2.69 %, ranging from 19.4 to 95.4 % (Table 2). Personal hygiene knowledge was high (89.76 ± 2.69 %), although 18 % of respondents were unaware that hands should be washed before using gloves. Most respondents (97.2 %) knew not to use the same gloves for handling fruit and meat and 89.7 % understood that hair can contaminate food. Knowledge about time and temperature control was lower, with a mean score of 69.60 ± 0.91 %. Half of the respondents (50.9 %) incorrectly answered questions about defrosting meat with water from a boiler or at room temperature

Table 1 Socio-demographic profile of food handlers in preschool kitchens in Podgorica (n=113)

Demographic variables	Category	n	%	Mean±SD %
Gender	Male	2	1.8	
	Female	111	98.2	
Institutions	Public	97	85.8	
	Private	16	14.2	
Age (Years)	<25	6	5.3	43.62±10.30
	25-34	13	11.5	
	35-44	39	34.5	
	45-55	38	33.6	
	>55	17	15.0	
Education level	Primary school	3	2.7	
	Secondary school	100	88.5	
	High vocational school	6	5.3	
	University	3	2.7	
	Other	1	0.9	
Working experience in food service (years)	<1	4	3.5	12.68±8.54
	1-5	21	18.6	
	5-10	23	20.4	
	10-15	21	18.6	
	15-20	19	16.8	
	>20	25	22.1	
Participation in training for safe food handling?	One time	24	21.2	
	Multiple time	62	54.9	
	Never	27	23.9	
Has HACCP been implemented in your establishments?	Yes	94	83.2	
	No	7	6.2	
	Do not know	12	10.6	
Did you attend and pass the hygiene minimum course, and get a certificate?	Yes	16	14.3	
	No	96	85.7	

overnight and 11.5 % were unsure. While 79.2 % recognized that freezing slows bacterial growth, 71 % correctly identified the optimal bacterial growth temperature range (5–61 °C). Cross-contamination knowledge was moderate (71.84±0.85 %), while equipment hygiene knowledge had the lowest score (68.48±1.04 %), with responses ranging from 19.4 to 91.7 %.

Food safety attitudes

The overall mean score for food safety attitudes was 95.72±4.53 % (Table 3). Proper food management is considered a significant part of the responsibility of food handlers, as agreed by 99.1 % of respondents. All of the respondents (n=113) confirmed that it was important to maintain personal hygiene during work, keep nails short and without nail polish, wash hands before handling food, take sick leave if they have a foodborne illness, and agreed that training on safe handling of food is essential to them. As many

as 93.8 % of respondents acknowledged that food handlers can be the source of foodborne outbreaks. A high percentage of respondents (>95 %) agreed that expired food should not be consumed, even if there is no change in its appearance and smell and that people with cuts on their hands should not touch unwrapped food. Furthermore, 96.5 % agreed that how we store food affects its safety.

Comparison between self-reported and observed hygiene practices

Our observation of food handling practices revealed discrepancies between the self-reported and observed behaviours (p<0.05) (Table 4). The overall mean observed practice score was 64.65±27.73 %, which is lower than the self-reported scores. While over 99 % claimed they washed hands properly before handling food, eating, and after using the bathroom, only 18.6, 49.6, and

Table 2 Knowledge of food handlers related to food safety and hygiene knowledge (n=113)

Knowledge	Respondents, n(%)			Mean±SD %
	Yes	No	Do not know	
Personal hygiene				89.76±2.69
Should you wash your hands before using gloves? Yes	89 (82.4)	16 (14.8)	3 (2.8)	
Can the same gloves also be used for handling fruit and handling meat? No	3 (2.8)	105 (97.2)	0 (0.0)	
Does hair contain different types of bacteria and can it be a source of food contamination? Yes	96 (89.7)	4 (3.7)	7 (6.5)	
Temperature control				69.60±0.91
The procedure of freezing foods does not kill bacteria but rather slows down their growth. Yes	84 (79.2)	14 (13.2)	8 (7.5)	
The correct method for thawing frozen meat is with water from a boiler or at room temperature overnight. No	55 (50.9)	40 (37.0)	13 (11.5)	
Food may be stored at room temperature for 2 hours after cooking before storing in the refrigerator. Yes	87 (80.6)	17 (15.0)	4 (3.5)	
The correct temperature range for a refrigerator storing food is 1 to 4 °C, and the freezer is below -18 °C. Yes	99 (81.7)	5 (4.6)	4 (3.7)	
The optimum temperature range for bacteria growth is between 5-61 °C (danger zone). Yes	76 (71.0)	12 (11.2)	19 (17.8)	
Cross-contamination				71.84±0.85
Vegetables should be chopped first and then washed. No	10 (9.3)	96 (88.9)	2 (1.8)	
Do you use the same knife for raw and cooked meat or chopping vegetables? No	5 (4.6)	103 (95.4)	0 (0.0)	
Bacteria cannot enter physically damaged canned food. No	45 (41.7)	52 (48.1)	11 (10.2)	
Staff cannot eat or drink in the food preparation area. Yes	36 (33.3)	71 (65.7)	1 (0.9)	
Do you use the same board for cutting raw meat and chopping vegetables? No	6 (5.6)	101 (93.5)	1 (0.9)	
Food storage				86.60±0.87
Raw (fresh) food should be kept on the lower shelves of the refrigerator. Yes	81 (75.0)	19 (21.4)	6 (5.6)	
Preparation of food in advance is likely to contribute to food-borne illnesses. Yes	87 (80.6)	14 (13.0)	7 (6.5)	
Food samples are taken from each meal for quality control and stored in the refrigerator for 48 hours. Yes	103 (95.4)	4 (3.7)	1 (0.9)	
Frozen food must not be refrozen after thawing. Yes	103 (95.4)	4 (3.7)	1 (0.9)	
Equipment hygiene				68.48±1.04
Bacteria can grow on broken and cracked dishes. Yes	100 (88.5)	6 (5.6)	2 (1.8)	
Washed dishes and equipment should be wiped with a dishcloth. No	17 (15.9)	88 (88.2)	2 (1.8)	
Is the detergent sufficient to ensure the efficiency of the cleaning equipment? No	45 (41.7)	59 (54.6)	4 (3.6)	
Refrigerators should be opened and checked often. No	77 (71.3)	21 (19.4)	10 (8.9)	
Sinks used for washing raw materials can be used for washing hands. No	6 (5.3)	99 (91.7)	3 (2.7)	

83.1 % were observed doing so, respectively. Although 96.6 % reported not touching their noses during work, only 23.0 % adhered to this. With regard to smoking, 98.3 % self-reported not smoking, but observation showed a 93.8 % adherence. While 92 % acknowledged not working while stricken with a confirmed food-borne infection and 80.5 % reported not working when ill, only 57.5 % adhered to this. Additionally, 84 % reported not working with cuts, but only 54.1 % truly did not. Compliance with short nails was reported by 96.4 % but observed in 91.2 %. Although 96.6 % reported drying hands with disposable towels, only 66.3 % were observed doing so. While 91.6 % reported regularly changing

gloves, only 14.3 % did so. Lastly, 95.3 % reported always cleaning surfaces in contact with food, but only 56.3 % were observed doing so.

Impact of socio-demographic characteristics on knowledge, attitude, and self-reported practices

The analysis of sociodemographic characteristics showed no significant difference in knowledge levels between respondents from public and private preschools ($p=0.96$, $p>0.05$). A weak positive correlation was found between knowledge and work experience

Table 3 Food handlers’ attitudes towards food safety (n=113)

Statements	Respondents, n (%)					Mean±SD% 95.72±4.53
	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	
Safe food handling is an important part of my job responsibilities. (Agree)	0 (0.0)	1 (0.9)	0 (0.0)	30 (26.5)	82 (72.6)	
I think that it is good to maintain a high degree of personal cleanliness while working. (Agree)	0 (0.0)	0 (0.0)	0 (0.0)	27 (23.9)	86 (76.1)	
Learning more about food safety through training courses is important to me. (Agree)	0 (0.0)	0 (0.0)	0 (0.0)	30 (26.5)	83 (73.5)	
Cleaning my hands effectively can prevent foodborne diseases. (Agree)	0 (0.0)	0 (0.0)	0 (0.0)	27 (23.9)	86 (76.1)	
I should take leave and should not work on the food premises if I am suffering from foodborne illness. (Agree)	0 (0.0)	0 (0.0)	0 (0.0)	25 (22.1)	88 (77.9)	
The way we store food affects its safety (Agree)	0 (0.0)	4 (3.5)	0 (0.0)	28 (24.8)	81 (71.7)	
Long fingernails could contaminate food with foodborne pathogens. (Agree)	0 (0.0)	0 (0.0)	0 (0.0)	28 (24.8)	85 (75.2)	
Food handlers should be medically examined every six months. (Agree)	1 (0.9)	0 (0.0)	0 (0.0)	21 (18.6)	91 (80.5)	
Food handlers can be a source of foodborne outbreaks. (Agree)	0 (0.0)	2 (1.8)	5 (4.4)	33 (29.2)	73 (64.6)	
Food handlers with wounds, bruises, or injuries on their hands must not touch or handle food. (Agree)	2 (1.8)	3 (2.7)	0 (0.0)	34 (30.1)	74 (65.5)	
Expired food should not be consumed, even without changes in smell and taste. (Agree)	1 (0.9)	1 (0.9)	2 (1.8)	22 (19.5)	87 (77.0)	
Foodborne outbreaks are natural life events. (Disagree)	7 (6.2)	14 (12.4)	12 (10.6)	30 (26.5)	50 (44.2)	

($r=0.20$, $p=0.03$), indicating that more work experience corresponds to higher knowledge ($p<0.05$).

A significant difference in knowledge was found between trained ($M=35.14$, $SD=1.70$) and untrained ($M=32.54$, $SD=3.18$) respondents ($p=0.01$, $p<0.05$). Those with higher education levels and those who attended the “hygienic minimum” course had higher knowledge scores ($p<0.05$).

Respondents with previous work experience in canteens, restaurants, and hotels had better knowledge about cross-contamination compared to those with experience in food production facilities or no prior employment ($p<0.05$). Repeated training also improved knowledge about food preservation ($p<0.05$). Higher education and HACCP implementation were associated with a better understanding of equipment hygiene ($p<0.05$).

Sociodemographic characteristics did not significantly influence attitudes or self-reported practices, except for the positive impact of possessing a food safety certificate (Table 5).

Relationship between food safety knowledge, attitude, and self-reported practices

The relationship between knowledge, attitudes, and self-reported practices is shown in Table 6. A weak positive correlation was found between knowledge and attitudes ($r=0.19$, $p=0.04$), indicating that good knowledge was associated with positive attitudes ($p<0.05$). However, no relationship was found between knowledge and self-reported practices, or between attitudes and self-reported practices ($p>0.05$). This suggests that good knowledge and attitudes do not necessarily lead to good practices.

Linear regression predicting food handlers’ self-reported practice

A multiple linear regression analysis was conducted to predict self-reported food hygiene practices based on knowledge and food safety attitudes. The model significantly predicted practices ($F=73.307$, $p<0.00$, $R^2=0.53$), explaining 53 % of the variance. The self-reported practice score increased by 0.35 with the knowledge score and 0.55 with the attitude score. This indicated that, while

Table 4 Comparison between self-reported and observed hygiene practices of food handlers (n=113)

Practices	Respondents, n (%)			
	Self-reported practices	Observed practices	t	p
1. Do you wash your hands with water and soap before preparing food? Yes	113 (100)	21 (18.6)	-13.80	0.00*
2. Do you wash your hands with water and soap before eating? Yes	112 (99.1)	56 (49.6)	-0.06	0.00*
3. Do you wash your hands with water and soap after using the bathroom? Yes	113 (100)	94 (83.1)	-21.28	0.00*
4. Do you have short, neat nails, without nail polish? Yes	109 (96.4)	103 (91.2)	-2,11	0.00*
5. Do you light a cigar while working? No	111 (98.3)	106 (93.8)	2.74	0.00*
6. Do you touch your nose while working, or sneeze into your hands? No	108 (96.6)	26 (23.0)	-1.23	0.01*
7. Do you dry your hands after washing them properly (e.g. with a disposable towel or hand dryer)? Yes	108 (96.6)	75 (66.3)	-0.76	0.20
8. Do you wear a clean and suitable uniform before starting work? Yes	112 (99.1)	74 (65.4)	-0.72	0.93
9. Do you remove all adornments (earrings, rings, watches, and bracelets) before starting activities? Yes	113 (97.0)	101 (89.4)	-1.95	0.60
10. Is your hair completely covered while working? Yes	111 (98.2)	90 (79.7)	-0.26	0.61
11. Do you work when you have diarrhea? No	100 (88.5)	92 (81.5)	-0.94	0.68
12. Do you work when you have a cold? No	91 (80.5)	65 (57.5)	-1.31	0.00*
13. Do you work when you have lesions on your hands? No	95 (84.1)	61 (54.1)	-0.06	0.39
14. Do you have a certified sanitary card? Yes	102 (94.7)	111 (98.2)	-0.42	0.38
15. Do you eat or drink in your working area? No	86 (80.4)	20 (17.8)	-0.87	0.02*
16. Do you wear gloves when you handle ready-to-eat food or prepare sandwiches? Yes	98 (91.6)	16 (14.3)	0.54	0.02*
17. Do you separate raw (fresh salad) food from ready-to-eat food or serve it on the same plate? Yes	94 (87.8)	82 (73.2)	-1.51	0.30
18. Do you check the shelf life of food products while using them? Yes	106 (99.0)	108 (95.6)	-1.79	0.46
19. Do you keep ready-to-eat food at room temperature for over 4 hours? No	99 (92.5)	95 (84.8)	0.96	0.37
20. Do you clean food contact surfaces before and after serving and preparing food? Yes	102 (95.3)	63 (56.3)	-4.16	0.00*

T-test, *significant at $p < 0.05$ **Table 5** Impact of socio-demographic characteristics on food handlers' knowledge, attitude, and self-reported practices regarding food safety and hygiene in preschool kitchens (n=113)

Demographic	Food safety and food hygiene knowledge						Self-reported food hygiene practice
	Personal hygiene	Temperature control	Cross-contamination	Food storage	Equipment hygiene	Safe attitude	
Age (years)	0.74	0.96	0.66	0.96	0.48	0.26	0.10
Educational level	0.43	0.18	0.19	0.08	0.02*	0.35	0.77
Food service working experience	0.42	0.20	0.54	0.47	0.40	0.76	0.43
Participation in training	0.82	0.76	0.29	0.03*	0.52	0.24	0.44
Previous working experience	0.49	0.56	0.03*	0.11	0.11	0.68	0.49
Implementation of HACCP	0.24	0.19	0.76	0.96	0.01*	0.16	0.46
Attending the "hygiene minimum" course certification	0.03*	0.74	0.11	0.00*	0.67	0.61	0.46

T test, *significant at $p < 0.05$; Mann-Whitney U test, *significant at $p < 0.05$; Kruskal-Wallis test, *significant at $p < 0.05$; Pearson correlation coefficient, *significant at $p < 0.05$

knowledge and attitudes were good predictors of self-reported practices, attitudes are the stronger predictor (Table 7).

DISCUSSION

Our study revealed that food handlers in kitchen settings had an average knowledge level (<80 %), consistent with findings from both European countries and low- and middle-income countries, where similar knowledge levels have been reported (10–13, 19, 20, 24, 27, 29). This consistency suggests that moderate knowledge gaps in food safety are widespread across diverse economic contexts, affecting both high-income and low- and middle-income regions.

Significant gaps were identified, such as 18 % of respondents not recognizing the importance of washing hands before using gloves, a critical practice highlighted in other studies (12, 30). Furthermore, a substantial proportion (58.9 %) was confused regarding the acceptable methods for defrosting food, reflecting the misconceptions noted in multiple studies (11, 13, 15, 17, 31).

Our findings revealed significant gaps in food safety knowledge among kitchen staff, particularly regarding refrigeration and equipment hygiene. Only 33.3 % of respondents recognized that eating and drinking are prohibited in food preparation areas, and 48.1 % misunderstood the bacterial risks associated with damaged canned food, consistent with findings from other studies (14). Notably, only 19.4 % answered questions about refrigerator checks correctly, and 54.6 % understood that detergent alone is insufficient for effective cleaning (15, 31). All of these deficiencies, as well as the knowledge gaps discovered as described earlier, underscored the need for targeted training programs and strict adherence to HACCP-based protocols to improve food safety practices, aligning with previous research (20, 31).

Attitudes towards food safety were found to significantly influence the prevention of foodborne diseases, which supports previous research (10, 11, 15). However, some studies indicated lower ratings of food handlers' attitudes (8, 32), potentially indicating varied perceptions of the importance of food safety training (33).

Despite high agreement rates (>90 %) on the importance of food safety, the minority expressed negative attitudes or lacked an opinion on the role of food handlers in outbreak prevention, as evidenced by studies on norovirus and parasite carriers among food handlers (3).

Our observations highlighted poor adherence to proper handwashing despite visible procedures, consistent with other research (15, 18). Barriers such as inadequate space and the absence of soap dispensers were identified as discrepancies between self-reported and observed practices (25). Work conditions, including workload pressures, often compelled food handlers to work while ill, although high compliance in certain practices (>92 %) was observed (30).

Our findings suggest that older workers usually performed better than their younger colleagues, with training playing a crucial role in improving knowledge retention (13, 18, 29, 34). However, discrepancies were observed, as Greek participants, despite receiving training, showed the lowest levels of knowledge in a comparative study across Serbia, Greece, and Portugal, indicating that contextual factors influenced knowledge acquisition (19). Higher education levels were positively associated with better knowledge outcomes (10, 18), although the impact of education, experience, or training varied across different studies (35). Attendance of hygiene courses significantly improved knowledge in personal hygiene, temperature control, and cross-contamination (15), while repeated training sessions enhanced knowledge retention in food preservation practices (26). Additionally, institutions with HACCP implementation demonstrated superior knowledge of equipment hygiene (20). Sociodemographic characteristics did not significantly influence attitudes and practices in our study, which is consistent with the relevant literature (10, 14). However, holding a food safety certificate had a positive impact on self-reported practices (15). A weak positive correlation was observed between knowledge and attitudes ($r=0.190$, $p=0.04$), consistent with previous research (10, 11, 24, 25). However, no significant relationship was found between knowledge and self-reported practices, or between attitudes and self-reported practices, aligning with other findings (11, 32, 36). This underscored the need

Table 6 Relationships between knowledge, attitude, and practice among food handlers in preschool kitchens

Domain	r value	p-value
Knowledge and attitude	0.19	0.04*
Knowledge and practice	0.35	0.72
Attitude and practice	0.00	0.93

Spearman's correlation coefficient, *significant at $p < 0.05$

Table 7 Score regression model for self-reported food safety and hygiene practices

Model	B	SE	δ	t	p
1 (Constant)	73.307	5.51		12.59	0.00
Knowledge score	0.35	0.12	0.43	0.41	0.55
Attitude score	0.55	0.87	0.51	0.51	0.04*

*significant at $p < 0.05$

for customized and efficient training approaches that efficiently link knowledge acquisition with practical implementation (36, 37).

Multiple linear regression analysis indicated that knowledge and attitudes independently predicted self-reported food hygiene practices, with attitudes showing a greater influence (15). Effective educational programs are crucial in enhancing understanding and attitudes, thus improving overall food safety practices (18, 19, 38).

Knowledge, attitudes, and practices (KAP) studies recommend regular, in-person training sessions every six months to a year to mitigate knowledge decay (26), a preference in Montenegro due to varying computer literacy levels and the self-discipline required for e-learning.

Future research should delve into additional factors influencing food safety practices among kitchen staff, including cultural norms, organizational culture, and the impact of specific interventions such as hygiene courses and certification programs. Longitudinal studies are also recommended to assess the sustainability of knowledge and practices over time, providing valuable insights into strategies for continuous improvement in food safety standards.

Limitations

The results from observations provide a realistic picture of the work environment and hygiene practices. However, as regulations do not allow unannounced access to public kitchens, visits were prearranged, potentially leading to better hygiene practices being observed than in normal circumstances.

CONCLUSION

This study revealed that food handlers employed in preschool institution kitchens in Podgorica possessed moderate knowledge, positive attitudes, and satisfactory practices. However, knowledge gaps in time and temperature control, cross-contamination, and equipment hygiene were identified, indicating the need for additional food safety training. The study provided a situational analysis of kitchens in preschool institutions, highlighting that the implementation of knowledge is often hindered by external factors such as lack of resources, employment conditions, financial limitations, facility infrastructure, work environment layout, equipment availability, managerial and coworker support, and time constraints. Additionally, the high number of enrolled children per group (≥ 40) requires extra resources and increases epidemiological risk.

The findings showed a weak positive correlation between the employees' knowledge and attitudes ($r=0.19$, $p=0.04$), supporting the hypothesis of a significant relationship between these factors. However, there was no significant correlation between knowledge and self-reported practices or between attitudes and self-reported practices. This suggests that good knowledge and positive attitudes do not necessarily lead to good practices.

The results indicate that, while education and training are crucial for acquiring knowledge, translating this knowledge into safe food

practices is complex and influenced by various external factors. Therefore, training should be conducted in the workplace environment to ensure that food handlers understand the risks, their responsibilities, and the importance of safe food for the health of children under 6 years of age. Continuous education and training targeted on critical areas such as temperature control, cross-contamination prevention, and equipment hygiene are imperative. Addressing barriers to knowledge application and fostering positive attitudes are essential to improving hygiene practices in kindergarten settings. This study emphasizes the necessity for tailored interventions to strengthen food safety practices in early childhood environments, underscoring the importance of ongoing education to uphold rigorous food safety standards.

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Conflict of interests

None to declare.

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Istraživanje higijenskih praksi i sigurnosti hrane u zaposlenika vrtićkih kuhinja u Podgorici u Crnoj Gori

Sigurnost hrane u dječjim vrtićima ključna je za zaštitu zdravlja djece predškolske dobi. Ovo istraživanje bavilo se procjenom znanja, stavova i praksi (eng. *Knowledge, Attitudes, Practices*; KAP) 113 zaposlenika vrtićkih kuhinja u crnogorskom glavnom gradu Podgorici. Ispitanici su dnevno pripremali i posluživali dva do četiri obroka za djecu mlađu od šest godina. Istraživanje je imalo za cilj istražiti korelacije između KAP-a i sociodemografskih obilježja te usporediti samoprocjene praksi zaposlenika s promatranjima ispitivača. Podaci su prikupljeni korištenjem strukturiranih upitnika i kontrolnih lista. Ispitanici su pokazali umjereno znanje ($77,25 \pm 2,69$ %) i pozitivne stavove ($95,72 \pm 4,53$ %), a promatrane prakse bile su manje kvalitete ($64,65 \pm 27,73$ %). Između znanja i stavova postojala je slaba pozitivna korelacija ($r=0,190$; $p=0,04$). Visoko obrazovanje, radno iskustvo i često stručno usavršavanje bili su povezani s boljim znanjem ($p<0,05$). Sociodemografske karakteristike nisu bitno utjecale na stavove i prakse. Multivarijatna logistička regresija pokazala je znanja i stavove kao prediktore, pri čemu je stav o sigurnosti hrane utjecao na sigurno rukovanje. Istraživanje je pokazalo da umjereno znanje i pozitivni stavovi ne vode nužno dobrim praksama, budući da nije bilo značajne korelacije između znanja i praksi prema samoprocjeni ili između stavova i praksi prema samoprocjeni. Obrazovanje je ključno jer je bilo vjerojatnije da će obrazovano osoblje znati više o kontroli temperature, sprječavanju unakrsne kontaminacije i higijeni opreme. Prevladavanje vanjskih prepreka kao što su infrastruktura i vremenska ograničenja ključno je za primjenu znanja koje potiče pozitivne stavove i poboljšava higijenske prakse u vrtićima. Rezultati ovoga istraživanja ističu potrebu za ciljanim intervencijama kako bi se osiguralo sigurno rukovanje hranom u predškolskim ustanovama, naglašavajući kontinuirano obrazovanje za održavanje standarda sigurnosti hrane.

KLJUČNE RIJEČI: obrazovanje; rukovanje hranom; upitnik o KAP; ustanove predškolskoga obrazovanja