

## Human Reliability in Food Safety: A Systematic Review of KAP Interventions

Andrea Insfran-Rivarola

*Universidad Americana, Paraguay. E-mail: andrea.insfran@americana.edu.py*

Ana Pamela Arealos

*Department of Industrial Engineering, Facultad de Ingeniería, Universidad Nacional de Asunción, Paraguay. E-mail: aarevalos@fiuna.edu.py*

Airi Maehara

*Facultad Politécnica, Universidad Nacional de Asunción, Paraguay. E-mail: airi321@fjpu.edu.py*

Jose Luis Vazquez Noguera

*Universidad Americana, Paraguay. E-mail: jose.vazquez@ua.edu.py*

Sebastian Grillo

*Universidad Autónoma de Asunción, Paraguay. E-mail: sgrillo@uaa.edu.py*

Laura Gonzalez-Cespedes

*Departamento de Nutrición, Dirección de Investigación, Facultad de Ciencias Químicas, Universidad Nacional de Asunción, Paraguay. E-mail: lgonzalez@qui.una.py*

Pastor Enmanuel Pérez-Estigarribia

*Facultad Politécnica, Universidad Nacional de Asunción, Paraguay. E-mail: peperez.estigarribia@pol.una.py*

Ulises Sanabria-Villamayor and Yamila Velazquez

*Universidad Americana, Paraguay. E-mail: gabrielpirro98@gmail.com; yamila.da12@gmail.com*

Food safety is a critical aspect of system integrity in the food industry. The operational performance of these systems depends primarily on human behavior. Workers' motivation, risk perception, and knowledge directly shape safety actions. Consequently, this systematic review investigates the effectiveness of interventions designed to improve the Knowledge, Attitudes, and Practices (KAP) of food handlers. These individuals represent the fundamental human component in the safety chain, where human error can lead to significant public health risks and economic losses. This research analyzed 31 peer-reviewed studies published between 2019 and 2024. The reviewed studies cover diverse operational environments, such as industrial food production, healthcare facilities, universities, hotels, and catering services. The findings reveal a predominant trend regarding "knowledge-practice gap". Most interventions successfully improve theoretical knowledge. However, the transition to reliable safety practices and positive attitudes remains a major challenge. Key human-related risk factors include poor hygiene practices, improper thawing techniques, and inadequate compliance with protocols. These factors directly impact the reliability of the food safety system. The overall results underscore the necessity of moving from the passive learning of rules toward active involvement and ongoing supervision to ensure human reliability. The current study provides evidence-based insights for future training programs that prioritize human factors as core elements of risk management. Furthermore, the findings highlight critical safety gaps and behavioral failures in both large-scale industrial production and small-and medium-sized enterprises. This approach ensures that human performance aligns with high-reliability standards.

**Keywords:** Food safety, systematic review, training interventions, human reliability, food handlers, hygiene practices.

## 1. Introduction

The food supply chain is a complex sociotechnical system. Safety in this framework depends on technology, processes, and human performance. Food safety is a global challenge with major implications for health and economic sustainability. An estimated 600 million people fall ill each year due to contaminated food (Segbedzi et al., 2024). Foodborne diseases (FBD) cost over 100 billion USD in low- and middle-income countries alone (Madjdian et al., 2024). These incidents represent critical failures in the reliability of the food supply chain, where human performance is the most volatile variable. The food service sector is a critical point for FBD outbreaks (Pattono et al., 2023). Such events lead to product recalls, legal actions, and reputational damage and legal actions for companies. In developing countries, outbreaks are intensified by poor handling practices and gaps in food safety training (Alemu et al., 2023). Food handlers act as safety-critical components (Pattono et al., 2024). Despite regulations, gaps persist between knowledge and practice. These gaps are often influenced by performance factors such as inadequate knowledge, negative attitudes, time constraints, and cultural norms (World Health Organization, 2007).

Recent research utilizes the Knowledge-Attitude-Practice (KAP) framework. This model suggests that improved knowledge leads to attitude change and better practices (Ernawati et al., 2021). However, synthesizing current evidence is essential to identify reliability gaps. This study conducts a systematic review of research published between 2019 and 2024. The review assesses the impact of educational interventions on food handlers' KAP. The objective is to identify human reliability gaps that affect the resilience of food safety systems. In this study, human reliability refers to the ability of food handlers to consistently apply safety protocols under operational conditions. **Human reliability is operationalized by assessing the "knowledge-practice gap" as a primary metric for human-induced risk.** These findings support stakeholders in strengthening food safety systems and promoting safer handling practices.

## 2. KAP among food handlers

Several studies assessed food handlers' KAP across different food service sectors. These assessments reveal gaps that contribute to FBD outbreaks. In restaurants, high KAP levels exist, but targeted training is recommended for less experienced staff. This training should emphasize practical topics like hand hygiene and thawing methods (Alzhrani & Shatwan, 2024). Trained chefs showed superior food safety practices, supporting the need for mandatory programs (Kılıçhan et al., 2020). In food trucks, researchers noted deficiencies in personal hygiene and chemical handling (Auad et al., 2021). Expert interventions improve these hygiene practices (De Lima et al., 2019). However, supervision remains essential for long-term reliability (Wan Nawawi et al., 2022). Street food vendors often exhibit poor KAP levels. These vendors require tailored interventions, awareness campaigns, and financial support (Ma et al., 2019; Abid et al., 2022; Meher et al., 2022). Factors like education and business certification influence their performance, requiring stringent inspections (Yakubu et al., 2023). Hospitals and institutional settings show good practices but limited knowledge of pathogens (Al Banna et al., 2022; Siddiky et al., 2024). University and school handlers also demonstrate deficiencies in temperature control and pathogen risks (Phyu et al., 2019; Ferreira et al., 2022). In the bakery industry, behavioral interventions are necessary to translate knowledge into safe practices (Jubayer et al., 2020). Overall, context-specific training is essential to reduce FBD risks across all sectors (Phyu et al., 2019).

## 3. Food handlers' training

Training programs are widely used to improve the human component of food safety. Notable improvements occurred in the bakery and restaurant sectors following sessions on hygiene laws (Sadeghizadeh-yazdi & Rahaei, 2020). Evidence-based programs on microbiology yield significant knowledge gains (Yu et al., 2020). Interactive sessions increase awareness but may leave gaps in transmission knowledge

(Wickramatilake et al., 2020). This highlights the need for training that combines theory with practical skill development.

During the COVID-19 pandemic, webinars and group discussions improved practices in Iran (Mohammadi-Nasrabadi et al., 2021). Visual tools like posters are effective in multilingual contexts (Rajagopal et al., 2019). Furthermore, long-term programs produce more sustainable behavioral changes than short-term ones (Sanlier et al., 2020). High KAP levels are often linked to Hazard Analysis and Critical Control Point (HACCP) systems in hotel and hospital settings (Al-Akash et al., 2022). In the dairy industry, training grounded in the Theory of Planned Behavior utilized practical demonstrations. Results showed that videos and social pressure effectively influence hygiene behavior (Ledo et al., 2021). Beyond industrial settings, virtual platforms like WeChat proved useful for rural households (Archila-Godínez et al., 2022; Guo & Bai, 2024). Finally, integrated toolkits improved consumer trust and vendor practices (Madjidian et al., 2024).

#### 4. Methodology

This review followed PRISMA guidelines and is registered in PROSPERO (CRD42024575260). This framework ensures the methodological reliability of the literature examination. **Quality was ensured through strict inclusion criteria: only peer-reviewed articles from high-impact journals with complete statistical (mean and standard deviation) data were selected.** The following databases were consulted: PubMed, Cochrane Controlled Register of Trials (CENTRAL), Scopus, and Web of Science. The search strategy followed the PICO (Population, Intervention, Comparison, Outcome) framework. Specifically, the population consisted of food handlers; the intervention included food safety and hygiene training; the comparator involved partially trained or untrained groups; and the outcomes focused on changes in KAP. This review only considered articles published in English between 2019 and 2024. The final search was executed in November 2024. The studies selection process consisted of two stages. First, reviewers screened titles and abstracts against the inclusion criteria. Second, the team conducted a full evaluation of the papers to

confirm eligibility. Figure 1 presents the selection process flowchart.

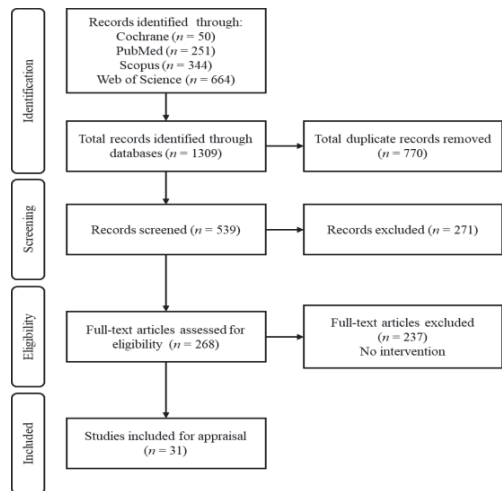


Fig. 1. PRISMA flowchart.

Studies evaluated food handlers across the entire food production chain. These settings included restaurants, hospitals, hotels, universities, street vendors, and households. Interventions included any food safety or hygiene training delivered through lectures or other communication methods. This training covered handwashing, cross-contamination, temperature control, and sanitization. The review considered randomized controlled trials (RCT), cross-sectional (CS) studies or controlled before-and-after (CBA) designs. Furthermore, studies assessed changes in KAP using questionnaires, observation surveys, or checklists. Research focusing on consumers, transporters, or students was also omitted. Finally, papers focused on the microbiological evaluation of food or surfaces were excluded. From each article, the following data were extracted: authors' names, year of publication, setting, country of origin, title, methodology, study design, primary intervention, data collection instrument, study summary (including sample, size, duration, and demographic characteristics of participants), evaluated KAP score, along with the reported mean and standard deviation.

#### 5. Results

The initial search yielded 1,309 articles. After removing duplicates, 539 remained for screening.

A total of 268 full-text articles were assessed, resulting in 31 selected studies. Findings showed improvements in knowledge (28), attitudes (17), and practices (21). Most research occurred among street vendors (9/31), restaurants and hotels (7/31), hospitals (4/31), and educational or military settings (3/31). Sample sizes ranged from 10 to 390 participants. Interventions included face-to-face sessions (7), in-service coaching (5), and virtual platforms (4). Designs comprised cross-sectional studies (17), randomized controlled trials (3), and pre-post assessments (11). Questionnaires and surveys were the primary assessment tools. Regarding demographics, 15 studies reported a male majority and 10 a female majority. Details are summarized in Table 1. The review identified critical reliability gaps in pathogen knowledge and storage temperatures. System integrity is degraded by improper thawing, lack of handwashing, and inadequate PPE use (De Lima et al., 2019). The "knowledge-practice gap" is driven by low-risk perception and poor motivation, acting as performance barriers. Therefore, the study recommends behavior-focused interventions and properly equipped facilities. Effective structured training, including lectures, case studies, and virtual modules, is essential to improve human reliability standards.

## 5. Discussion

This systematic review analyzed 31 peer-reviewed studies published between 2019 and 2024. The research examined the effects of educational interventions on food handlers' KAP. These interventions took place in restaurants, cafeterias, street vendors, households, and industrial environments. Results were associated with significant improvement in knowledge. Moderate gains appeared in attitudes and self-reported practices. However, no significant changes occurred in directly observed practices. These findings suggest that knowledge transfer alone is insufficient for sustained behavioral change. *Although most of the studies utilized CS designs, they provide a necessary baseline to identify immediate reliability failures and the knowledge-practice gap across diverse settings.* For instance, da Cunha (2021) emphasizes that strategies based solely on the KAP model often fail. Such models may ignore underlying organizational and environmental factors. These

elements include worker fatigue, demotivation, task complexity, and job dissatisfaction. These variables act as performance shaping factors that influence the translation of knowledge into practice. Clark et al. (2019) highlighted the role of organizational culture in safe food handling. This perspective advocates for managerial support and the systematic reinforcement of safe behaviors. The review indicates that reinforcement of attitudes requires additional strategies. These include ongoing supervision, periodic training, and behavioral monitoring to ensure human reliability. Effective education should ideally focus on mechanisms that enhance knowledge retention and practical application (Marzban et al., 2020). Discrepancies between self-reported and observed practices underscore the need for triangulated evaluation methods (Aquad et al., 2019). Ultimately, food safety training is encouraged to build a "culture of prevention". Integrating educational efforts with supportive workplace structures ensures lasting behavioral change and system integrity (Pattono et al., 2023).

## 6. Conclusion

Despite regulations, foodborne diseases remain a global issue. This review suggests that food handlers are safety-critical components; thus, improving their KAP levels is vital for system reliability. Results identify *a predominant trend between knowledge and practice, driven by factors like poor hygiene and inadequate techniques. Addressing these requires ongoing supervision and context-specific training. Future programs are encouraged to promote a robust food safety culture aligned with operational goals like efficiency and sustainability. Strengthening safety behaviors enhances business resilience and public health. This review offers a novel contribution by adopting a systemic perspective, framing food handlers as safety-critical components and identifying behavioral gaps. This approach provides a basis for future studies to integrate human performance modeling into food safety risk management.*

## Acknowledgement

This project is co-financed by the Consejo Nacional de Ciencia y Tecnología (CONACYT) with the support of FEEL. This publication has been prepared with the support of CONACYT. The contents of this publication are the sole responsibility of the authors and can in no way be taken to reflect the opinion of CONACYT.

Table 1. Summary of findings.

Study, Year	Setting, Location	Main Intervention	Study Overview	Outcome	Summary of Findings Mean (SD)
De Lima et al. 2019	Food trucks, Brazil	Development of an action plan for good hygiene practices Food safety expert assistance	RCT; nc = 28	Observed practice score	Pre 49.11 (19.46), Post 58.93 (25.19); (p = 0.0001)
			RCT; ni = 25	Observed practice score	Pre 53.67 (24.95), Post 93.00 (11.22); (p = 0.0001)
Aquad et al. 2019	Food trucks, Brazil	Food safety training	CS; nc = 18, ni = 22; participants = 20% female	Knowledge score	Untrained 7.00 (2.14); Trained 7.41 (1.44); (p = 0.638)
				Attitude score	Untrained 6.39 (1.29); Trained 7.23 (1.02); (p = 0.033)
				Mean score in self-reported practice	Untrained 7.28 (1.41); Trained 8.09 (1.27); (p = 0.085)
Ma et al. 2019	Street vendors, China	Food safety training	CS; nc = 70, ni = 30; participants = 62.8% fem	Knowledge score	Untrained 56 (16); Trained 60 (16); (p = 0.287)
				Attitude score	Untrained 63 (15); Trained 59 (16)
Phyu et al. 2019	University canteen, Thailand	Hygiene training	CS; nc = 22, ni = 68; participants = 76.7% fem	Knowledge score	Untrained 54.29 (12.47); Trained 55.71 (17.03)
				Attitude score	Untrained 76.13 (11.18); Trained 77.66 (11.64)
				Observed practice score	Untrained 66.36 (10.13); Trained 69.19 (9.08)
Rajagopal et al. 2019	Food service workers, USA	Food safety training (handouts and presentation)	Pre-post study; n = 56	Knowledge score	Pre 12.87 (2.72), Post 28.50 (1.01); (p < 0.001)
Jubayer et al. 2020	Baking industry, Bangladesh	Food safety training	CS; nc = 55, ni = 160; TL = 2 days; participants = 36.3% fem	Knowledge score	Untrained 9.8 (0.23); Trained 33 (0.09); (p < 0.001)
				Attitude score	Untrained 10.4 (0.26); Trained 14.8 (0.03); (p < 0.001)
				Self-reported practice score	Untrained 5.9 (0.33); Trained 10.6 (0.25); (p < 0.001)
Kılıçhan et al. 2020	Hotels, restaurants, and public institutions, Turkey	Food safety training	CS; nc = 22, ni = 86; participants = 11.1% fem	Attitude score	Untrained 3.9747 (0.76975); Trained 4.4154 (0.56329); (p = 0.003)
				Self-reported practice score	Untrained 3.5727 (0.83391); Trained 4.2427 (0.65263); (p = 0.000)
Marzban et al. 2020	Catering, Iran	Food safety training	Pre-post study; n = 55; participants = 67.30 % female; TL = 32 hours	Knowledge score	Pre 19.32 (3.15), Post 25.07 (3.51); (p = 0.007)
				Attitude score	Pre 22.69 (4.99), Post 35.21 (2.64); (p < 0.001)
				Self-reported practice score	Pre 13.20 (1.74), Post 17.40 (3.48); (p < 0.001)
Sadeghizadeh-yazdi & Rahaei 2020	Confectionery, bakery, restaurant, Iran	Food safety training (lectures)	Pre-post study; n=120; participants=29.16 % fem; TL = 40 h	Attitude score	Pre 25.60 (3.87), Post 25.81 (5.61); (p = 0.010)
Sanlier et al. 2020	Hotels and restaurants, Turkey	In-service food safety training	CS; ni1=385, ni2=390, nc = 375; participants=15.3 % fem; TL=184h (long-training), 8h(short-training)	Knowledge score	Long-Term trained 1.354 (0.362); Short-Term trained 1.607 (0.433); Control 1.725 (0.440); (p = 0.000)
				Self-reported practice score	Long-Term trained 1.356 (0.313); Short-Term trained 1.624 (0.363); Control 1.847 (0.354); (p = 0.000)
Wickramatilake et al. 2020	Food establishments, hospital kitchen, health inspectors, agricultural workers, Sri Lanka	Interactive teaching-learning program	Pre-post study; n = 49	Knowledge score	Pre 17.6 (3.3), Post 20.9 (1.6); (p = 0.001)
Yu et al. 2020	Food handlers, United States	Food safety training (lecture, PowerPoint presentation)	RCT; n = 161; participants = 60% female	Knowledge score	Pre 7.78 (1.91), Post 10.97 (2.10)
Ghezzi et al. 2021	Food trucks, United States	Food safety training	CS; nc = 51, ni = 82; participants = 22.5% fem	Knowledge score	Untrained 6.33 (2.89); Trained 9.75 (4.07); (p < 0.001)
Ledo et al. 2021	Dairy farming, Tanzania	Food safety training (slides, group discussions, videos, pictures, story analysis, practical demonstrations)	Pre-post study; n = 107; TL = 3 days	Knowledge score	Pre 13.8 (4.0), Post 18.4 (2.1)
Malavi et al. 2021	Orange-fleshed sweet potato purée processing, Kenya	Food safety training (theory classes, pictorial, video and practical demonstrations)	Pre-post study; n = 14; participants = 28.6% female	Knowledge score	Pre 79.6 (15.0), Post 91.8 (8.2); (p = 0.002)
				Self-reported practice score	Pre 76.9 (26.6), Post 94.5 (9.3); (p = 0.017)
Mohammadi-Nasrabadi et al. 2021	Restaurant, Iran	Health & food safety training during COVID-19 (presentation, videos/webinar, group discussion, booklet)	Pre-post study; n = 159; participants = 26.4% female; TL = 200 min	Knowledge score	Pre 3.23 (0.89), Post 3.69 (0.57); (p < 0.001)
				Attitude score	Pre 9.26 (1.74), Post 10.75 (1.70); (p < 0.001)
Zanin et al. 2021	Army food service, Brazil	Food safety culture assessment	Longitudinal and Pre-post study; nc=39, ni=29; 0% fem; FU=10 mo.	Self-reported practice score	Pre 49.83 (4.02), Post 53.44 (4.01); (p < 0.001)
				Knowledge score	Pre 5.8 (1.9), Post 7.2 (1.5); (p = 0.007)

Table 1. Summary of findings (continued).

Abid et al. 2022	Street food vendors, Bangladesh	Food safety training	CS; nc = 292, ni = 10; participants = 22.5% fem	Knowledge score	Untrained 8.94 (0.24); Trained 5.31 (1.68); (p = 0.279)
				Attitude score	Untrained 8.46 (3.48); Trained 8.40 (4.37); (p = 0.954)
				Self-reported practice score	Untrained 17.66 (5.60); Trained 21.20 (8.62); (p = 0.056)
Al-Akash et al. 2022	Hotel and hospitals, Jordan	Online food safety training	Pre-post study; n=380; 59% fem; TL=30 h	Knowledge score	Pre 78.50 (13.69), Post 85.48 (17.07)
Al Banna et al. 2022	Hospitals, Bangladesh	Food safety training	CS; nc = 82, ni = 108; participants = 9.4% female	Knowledge score	Untrained 8.95 (2.46); Trained 12.13 (2.78); (p < 0.001)
				Attitude score	Untrained 7.24 (2.11); Trained 9.15 (1.34); (p < 0.001)
				Self-reported score	Untrained 43.94 (10.70); Trained 54.81 (4.82); (p < 0.001)
Archila-Godínez et al. 2022	Low-income households, USA	Virtual food safety educational program (pre-recorded slides)	Pre-post study; n = 60; TL = 2 hours; participants = 97% female	Knowledge score	Pre 5.32 (1.62), Post 7.43 (0.85); (p < 0.001)
Ferreira et al. 2022	School food services, Brazil	Food hygiene training	CS; nc = 19, ni = 123	Attitude score	Pre 30.12 (3.27), Post 33.02 (1.85); (p < 0.001)
				Self-reported practice score	Pre 24.78 (4.10), Post 29.30 (4.14); (p < 0.001)
Guenouni et al. 2022	University hospital, Morocco	Food safety training	CS; nc = 32, ni = 40; participants = 72% female	Knowledge score	Untrained 67.43 (16.66); Trained 72.95 (14.86); (p = 0.141)
				Self-reported practice score	Untrained 74.51 (17.39); Trained 82.16 (10.39); (p = 0.008)
Meher et al. 2022	Street food vendors, Bangladesh	Training in Food Safety-Hygiene	CS; nc = 249, ni = 17; participants = 7.14% female	Knowledge score	Untrained 0.50 (0.14); Trained 0.57 (0.15); (p = 0.045)
				Attitude score	Untrained 71.84 (10.37); Trained 73.39 (7.54); (p = 0.546)
				Self-reported practice score	Untrained 73.66 (7.24); Trained 77.18 (8.72); (p = 0.057)
		Training on Food Preparation-Preservation	CS; nc = 238, ni = 28; participants = 7.14% female	Knowledge score	Untrained 54.79 (15.01); Trained 63.86 (13.71); (p = 0.016)
				Attitude score	Untrained 71.66 (10.41); Trained 74.32 (8.08); (p = 0.193)
				Self-reported practice score	Untrained 73.50 (7.18); Trained 77.18 (8.30); (p = 0.012)
Wan et al. 2022	Food truck vendors, Malaysia	Food safety training during COVID-19	CS; nc = 114, ni = 282; participants = 34.6% fem	Self-reported practice score	Untrained 54.59 (14.96); Trained 61.99 (14.65); (p = 0.017)
				Knowledge score	Untrained 75.01 (11.144); Trained 80.39 (7.696); (p=0.001)
				Attitude score	Untrained 90.70 (7.545); Trained 96.52 (4.949); (p = 0.001)
Yakubu et al. 2023	Street food vendors, Ghana	Food safety training	CS; nc = 224, ni = 200; participants=83.5% female	Self-reported practice score	Untrained 83.13 (7.490); Trained 85.27 (6.137); (p = 0.007)
Alzhrani & Shatwan 2024	Restaurants, Saudi Arabia	Food safety training	CS; nc = 87, ni = 118; participants=majority male	Observed practice score	Untrained 11.24 (2.67); Trained 12.02 (2.6); (p = 0.002)
				Knowledge score	Untrained 9.4 (1.6); Trained 9.2 (1.8); (p = 0.49)
				Attitude score	Untrained 9.4 (1.3); Trained 9.3 (1.3); (p = 0.91)
Guo & Bai 2024	Households, China	Online and offline sessions (printed materials and videos)	Pre-post study; n = 139; participants=64.7% female	Self-reported practice score	Untrained 8.9 (1.1); Trained 8.9 (1.2); (p = 0.18)
				Knowledge score	Untrained 8.9 (1.1); Trained 8.9 (1.2); (p = 0.18)
Madjadian et al. 2024	Street vendors, Burkina Faso	Food safety training (tool package)	RCT; nc = 90, ni = 72; TL = 15 h	Knowledge score	Pre 13.71 (4.47), Post 21.43 (5.78)
Siddiky et al. 2024	Institutional food handlers, Bangladesh	Food safety training	CS; nc=369, ni=39; participants=71.3% female	Knowledge score	Control 6.7 (2.2); Intervention 8.2 (1.6); (p = 0.000)
				Self-reported practice score	Untrained 16.04 (2.75); Trained 16.69 (2.78); (p = 0.128)
Wahab et al. 2024	Restaurants, Malaysia	Food safety training	CS; nc = 40, ni = 77; participants = 9.4% fem	Knowledge score	Untrained 9.38 (1.99); Trained 11.51 (1.79); (p = 0.000)
				Attitude score	Untrained 65.76 (14.88); Trained 66.13 (13.57); (p = 0.894)
				Self-reported practice score	Untrained 80.22 (15.39); Trained 79.22 (17.38); (p = 0.758)
				Self-reported practice score	Untrained 68.12 (14.97); Trained 64.93 (16.58); (p = 0.310)

Note. SD (standard deviation); RCT (Randomized-controlled-trials); CS (cross-sectional); TL (training length); FU (follow-up); n (sample number); nc (number of control group); ni (number of intervened group); h (hours); min (minutes); fem (feminine).

## References

- Abid, M. T., M. H. A. Banna, M. Hamiduzzaman, A.-A. Seidu, S. Kundu, H. Rezyona, T. R. Disu, N. Akter, M. Khaleduzzaman, B. O. Ahinkorah, and M. S. I. Khan (2022). Assessment of food safety knowledge, attitudes and practices of street food vendors in Chattogram city, Bangladesh: A cross-sectional study. *Public Health Challenges* 1(3), e16.
- Al Banna, M. H., M. S. I. Khan, H. Rezyona, A.-A. Seidu, M. T. Abid, T. Ara, S. Kundu, B. O. Ahinkorah, J. E. Hagan, Jr., M. A. Tareq, M. R. Begum, M. F. T. Chowdhury, and T. Schack (2022, June). Assessment of Food Safety Knowledge, Attitudes and Practices of Food Service Staff in Bangladeshi Hospitals: A Cross-Sectional Study. *Nutrients*, 14(12), 2540.
- Al-Akash, H., A. Abu Arrah, F. Bhatti, R. Maabreh, and R. Abu Arrah (2022, February). The effect of food safety training program on food safety knowledge and practices in hotels' and hospitals' food services. *Italian Journal of Food Safety* 11(1), 9914.
- Alemu, M., A. Motbianor, D. Birhanu, and A. Birara (2023, January). Food Safety Practice and Associated Factors of Food Handlers Working in Food Industries in Bahir Dar City, Amhara Regional State, Northwest Ethiopia, 2021. *Environmental Health Insights* 17, 11786302231167742. eprint: <https://doi.org/10.1177/11786302231167742>.
- Alzhrani, W. F., and I. M. Shatwan (2024, July). Food Safety Knowledge, Attitude, and Practices of Restaurant Food Handlers in Jeddah City, Saudi Arabia. *Foods* 13(14), 2176.
- Archila-Godínez, J. C., H. Chen, L. Klinestiver, L. Rosa, T. Barrett, S. C. Henley, and Y. Feng (2022, January). An Evaluation of a Virtual Food Safety Program for Low-Income Families: Applying the Theory of Planned Behavior. *Foods* 11(13), 355.
- Auad, L. I., V. C. Ginani, E. Stedefeldt, E. Y. Nakano, A. C. S. Nunes, and R. P. Zandonadi (2019, August). Food Safety Knowledge, Attitudes, and Practices of Brazilian Food Truck Food Handlers. *Nutrients* 11(8), 1784.
- Clark, J., P. Crandall, and J. Reynolds (2019, January). Exploring the influence of food safety climate indicators on handwashing practices of restaurant food handlers. *International Journal of Hospitality Management* 77, 187–194.
- da Cunha, D. T. (2021, December). Improving food safety practices in the foodservice industry. *Current Opinion in Food Science* 42, 127–133.
- Dapari, R., M. H. Mahfot, M. 'A. I. A. Zamzuri, Z. M. Isa, M. R. Hassan, N. C. Dom, and S. S. S. A. Rahim (2024, January). Theory-Based Intervention Module on Occupational Safety and Health (TRIMOSH) in improving knowledge, attitude, and practice among food industry workers: Study protocol for a randomised controlled trial. *PLOS ONE* 19(1), Public Library of Science, e0295771.
- De Lima, D. P., C. O. Medeiros, F. D. Dardin, and L. Stangarlin-Fiori (2019). Implementation of good hygiene practices in food trucks with and without the intervention of a food safety expert. *Journal of Food Safety* 39(3), e12637.
- Ernawati, K., Q. Nadhifah, A. Muslikha, M. Hidayat, T. E. B. Soesilo, F. Jannah, D. Widiati, and Y. Yusnita (2021, June). Relationship of knowledge and attitude with food handling practices: A systematic review. *International Journal of Public Health Science (IJPHS)* 10(2), 336–347.
- Ferreira, J. d. S., M. d. P. N. Araújo, R. B. A. Botelho, R. P. Zandonadi, E. Y. Nakano, A. Raposo, H. Han, M. Nader, A. Ariza-Montes, and R. d. C. C. d. A. Akutsu (2022, September). Factors interfering with the adoption of good hygiene practices in public school food services in Bahia, Brazil. *Frontiers in Public Health* 10, 975140.
- Ghezzi, S., B. Ayoun, and Y. M. Lee (2021, September). Food safety knowledge, training methods, and barriers to training: An examination of the U.S. food truck industry. *Journal of Foodservice Business Research* 24(5), Routledge, 534–553.
- Guennouni, M., A. Gharniti, S. El-Yadri, M. Ennaji, and K. S. Belghyti (2022, April). Knowledge and Practices of Food Safety among Health Care Professionals and Handlers Working in the Kitchen of a Moroccan University Hospital. *Journal of Food Protection* 85, 676–685.
- Guo, Z., and L. Bai (2024, May). The effect of online versus offline interventions on food safety and handling knowledge of household food handlers: A continuous experimental design. *Food Control* 159, 110280.
- Jubayer, M. F., M. S. Kayshar, M. S. Hossain, M. N. Uddin, M. Al-Emran, and S. S. Akter (2020, September). Evaluation of food safety knowledge, attitude, and self-reported practices of trained and newly recruited untrained workers of two baking industries in Dhaka, Bangladesh. *Heliyon* 6(9), e05021.
- Kılıçhan, R., H. Çalhan, and M. Umur (2020, May). Food safety attitudes and practices of chefs in Cappadocia region, Turkey. *Journal of Foodservice Business Research* 23(3), 193–215.

- Ledo, J., K. A. Hettinga, J. Bijman, J. Kussaga, and P. A. Luning (2021, June). A tailored food safety and hygiene training approach for dairy farmers in an emerging dairy chain. *Food Control* 124, 107918.
- Ma, L., H. Chen, H. Yan, L. Wu, and W. Zhang (2019, August). Food safety knowledge, attitudes, and behavior of street food vendors and consumers in Handan, a third tier city in China. *BMC Public Health* 19(1), 1128.
- Madjdian, D. S., M. van Asseldonk, G. Ilboudo, M. Dione, A.-A. Ouedraogo, K. Roesel, D. Grace, E. F. Talsma, T. J. D. Knight-Jones, and E. de Vet (2024, September). Training and tool supply to enhance food safety behaviors among ready-to-eat chicken vendors in informal markets in Ouagadougou, Burkina Faso: A randomized-controlled trial. *Food Control* 163, 110510.
- Malavi, D. N., G. O. Abong', and T. Muzhingi (2021, January). Effect of food safety training on behavior change of food handlers: A case of orange-fleshed sweetpotato purée processing in Kenya. *Food Control* 119, 107500.
- Marzban, A., V. Rahmadian, M. Shirdeli, F. Jafari, and M. Barzegaran (2020, August). The Effect of Education on Knowledge, Attitude, and Practice of the Catering Staffs about Food Hygiene and Safety in Yazd City. *Journal of Nutrition and Food Security* 5(3), 266–273.
- Meher, M. M., M. Afrin, A. K. Talukder, and M. G. Haider (2022, December). Knowledge, attitudes and practices (KAP) of street food vendors on food safety in selected areas of Bangladesh. *Heliyon* 8(12), e12166.
- Mohammadi-Nasrabadi, F., Y. Salmani, and F. Esfarjani (2021). A quasi-experimental study on the effect of health and food safety training intervention on restaurant food handlers during the COVID-19 pandemic. *Food Science & Nutrition* 9(7), 3655–3663.
- Pattono, D., M. Petey, A. M. Covarino, M. Gea, and T. Schilirò (2023, January). Training for Food Handlers at Production Level in Italian Regions. *International Journal of Environmental Research and Public Health* 20(3), 2503.
- Phyu, T. M., A. Chaoruangrit, and P. Pasuwa (2019, June). Food safety assessment of food handlers in the canteens of Khon Kaen University. *Asia-Pacific Journal of Science and Technology* 24(2).
- Rajagopal, L., J. Reynolds, and D. Li (2019, October). Visual-Based Minimal-Text Food Safety Training Tools for Chinese-Speaking Food Service Workers. *Journal of Extension* 57(5).
- Sadeghizadeh-yazdi, J., and Z. Rahaei (2020, June). The Effect of Training Courses on Awareness, Attitude, and Performance of Confectionery, Bakery, and Restaurant Workers in Yazd City. *Journal of Environmental Health and Sustainable Development*.
- Sanlier, N., Ü. Sormaz, and E. Güneş (2020, December). The effect of food safety education on food safety knowledge, attitudes, behaviors of individuals who work in food and beverage departments in Turkey. *International Journal of Gastronomy and Food Science* 22, 100259.
- Segbedzi, C. E., E. W. Ansah, and D. Apaak (2024, January). Assessing the Safety of Hotel Food: Knowledge, Attitude, and Practices of Food Handlers. *Journal of Food Quality* 2024(1), 7361284.
- Siddiky, A., K. Mollick, Md. Aktarujjaman, F. Islam, M. A. Mamun, and N. Roy (2024, February). Determinants of food safety knowledge and practices among food handlers in Bangladesh: An institution-based cross-sectional study. *Heliyon* 10(4), e25970.
- Wahab, S. A., S. A. Mutalib, C. L. Ching, and R. Sedek (2024). Knowledge, Attitude and Practice (KAP) among Foreigner Food Handlers at Restaurants with Long Operating Hours in Lembah Klang, Malaysia. *Malaysian Journal of Medicine and Health Sciences* 20(2), 127–134.
- Wan Nawawi, W. N. F., V. Ramoo, M. C. Chong, N. H. Zaini, P. L. Chui, and Z. Abdul Mulud (2022, May). The Food Safety Knowledge, Attitude and Practice of Malaysian Food Truck Vendors during the COVID-19 Pandemic. *Healthcare* 10(6), 998.
- Wickramatilake, C. M., C. J. Wijesinghe, W. M. D. G. B. Wijayaratne, V. Tillekeratne, and J. M. Dolamullage (2020). Outcome and acceptability of an educational intervention programme on food-borne diseases and food safety behaviour for food handlers and related sectors in Sri Lanka. *Journal of Food Safety and Food Quality-Archiv für Lebensmittelhygiene* 71(1), IMR Press, 16–20.
- World Health Organization (2007). *Manual sobre las cinco claves para la inocuidad de los alimentos*. Ginebra. Departamento de Inocuidad de los Alimentos, Zoonosis y Enfermedades de Transmisión Alimentaria.
- Yakubu, M., P. K. Gaa, G. L. S. Kalog, and V. Mogre (2023, January). The competence of street food vendors to provide nutritious and safe food to consumers: a cross-sectional survey among street food vendors in Northern Ghana. *Journal of Nutritional Science* 12, e83.
- Yu, H., J. Ma, P. Liu, and S. A. Sirsat (2020, October). Investigating the effects of explanatory-based food safety training: A model of domain knowledge theory perspective. *International Journal of Hospitality Management* 91, 102688.
- Zanin, L. M., E. Stedefeldt, S. M. da Silva, D. T. da Cunha, and P. A. Luning (2021, February). Influence of educational actions on transitioning of food safety culture in a food service context: Part 2 - Effectiveness of educational actions in a longitudinal study. *Food Control* 120, 107542.