



## The Impact of Food Safety Training Programs on Knowledge, Attitude, and Practice on Food Safety among Migrant Workers – A Review

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### Abstract

Food safety is a major public health issue, especially to migrant workers, who account for a large percentage of the workforce that is involved in the food handling and preparation industries. This review discusses the impact of food safety training programs on knowledge, attitudes, and practices (KAP) on food safety among migrant workers. Source data for 30 peer-reviewed articles (Scopus, Web of Science, PubMed, Google Scholar) were analyzed to define key trends and challenges. The findings indicate significant shortcomings in pre-training knowledge regarding proper hygiene protocols and contamination risks. It was found that training programs had a significant impact on compliance, particularly when modified to overcome cultural and language barriers. There was a positive attitude change following post-training, which was found to be a changing factor in commitment to serving safety standards. Nevertheless, systemic issues like the lack of availability of training, as well as economic vulnerability, remain to be addressed, hindering the sustained embedding of practices learned. The findings highlighted the need for targeted, inclusive capacity-building training approaches to improve food safety outcomes and public health.



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### Introduction

Food safety is a global concern and is a part of the food industry that aims at preventing food contamination. It is crucial to ensure consumer

confidence and protect public health and contribute to the economic viability of food businesses. According to the World Health Organization (WHO), 600 million cases of foodborne diseases

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affect the global population every year due to unsafe consumption.<sup>1</sup> Even a small violation of food safety standards can trigger a public health crisis, economic loss and the erosion of corporate reputation in the form of interconnected food supply chains.

In urban settings, where different demographic and cultural populations sourced their daily food through complex food supply chains, the significance of food safety is accentuated. As urbanization and globalization demand greater street food, fast food, and restaurant services, migrant workers are being employed for their labor-intensive roles. Migrant food handlers are often at the heart of the urban food sector, performing tasks such as food preparation, storage, and service. However, migrant workers play a crucial role that is not without its challenges, which can undermine food safety standards, putting urban populations at an increased risk of foodborne illnesses.<sup>1</sup> One of the main challenges among those migrant food handlers is the scarcity of accessible food safety education and training. According to Gray, a high percentage of migrant labor in the food industry is low-income and sub-educated.<sup>2</sup> As a result of this lack of learning in school, many people do not have sufficient knowledge of proper food handling practices. Research conducted in Malaysia by Yusoff *et al.* revealed that only 42% of the migrant food handlers were trained on any aspect of food safety, leading to a knowledge gap that could serve as a potential risk to the consumers.

Furthermore, language and cultural barriers only add to the complexities. Migrant workers may come from diverse linguistic and cultural backgrounds that may limit their understanding of the local food safety regulations and requirements. One such study carried out in Singapore indicated how literacy variables created language barriers that limited successful uptake of training materials by migrant food handlers and, accordingly, their compliance with food safety regulation.<sup>3</sup> Other aspects, such as hygiene and food handling practices, always differ from urban populations where appropriate interventions can be employed to reduce the gaps and extend beyond just their health awareness. In addition, many migrant food handlers face precarious working conditions, making them even more vulnerable. Migrant laborers are working in low-pay, high-pressure jobs with scant job security. Together with these conditions, there is high turnover of employees and making food

safety implementation more challenging to enforce.<sup>4</sup> In the 2021 study,<sup>5</sup> it is shown that food handlers who experience job insecurity are less likely to partake in voluntary food safety training programs due to financial constraints and time limitations, which act as significant barriers in the United Arab Emirates. In addition, urban food businesses often lack sufficient oversight and enforcement of food safety regulations, especially in informal sectors like street food vending. In many urban centers, the food regulatory agencies are weak and unable to monitor the activities of a burgeoning food industry, resulting in large gaps in compliance.<sup>6</sup> The absence of such a regulatory framework disproportionately harms migrant food handlers whose limited resources and access will hinder their ability to seek information on proper food safety practices. Together, these challenges highlight the necessity for KAP-targeted interventions among migrant food handlers to ensure food safety. Specialized food safety training courses designed to meet the distinct needs of this population have demonstrated effectiveness in bridging knowledge gaps and promoting safe food handling practices. Nonetheless, these programs have different levels of effectiveness based on content relevance, delivery technique, and post-training assistance.<sup>7</sup>

Knowledge, Attitude and Practices (KAP) is a holistic approach to assess the effectiveness of food safety programs. Knowledge refers to having theoretical understanding of the food safety principles, such as hygiene guidelines and contamination avoidance. Workers' definition of the importance of food safety leads them to be more or less motivated to follow the practices. Education is reflected in practice, given that practice is the application of the training to daily work, practice is the first indicator to be identified whether the training program was successful or not. Through focusing on these three dimensions, the study can assess not only what workers know but also how they feel and act concerning food safety. This holistic perspective is essential for identifying areas of improvement and tailoring interventions to meet the unique needs of migrant workers.

The primary objective of this paper is to investigate the impact of food safety training programs on migrant workers through the lens of the KAP framework. Specifically, the study aims to:

- Evaluate the level of knowledge migrant workers possess about food safety before and after training programs.
- Assess changes in attitudes toward food safety following participation in training initiatives.
- Identify the barriers and challenges that hinder the effective implementation of food safety practices among migrant workers.
- To achieve these objectives, the study addresses the following research questions:
- What is the current state of knowledge, attitudes, and practices related to food safety among migrant workers?
- How do training programs influence changes in these dimensions?
- What factors facilitate or impede the successful application of food safety principles in the workplace?

### Materials and Methods

The main objective of this paper is to examine the impact of food safety training programs on migrant workers, focusing on their knowledge, attitudes, and practices (KAP) on food safety. To achieve this, the study aims to address the following research questions: 1) What is the level of knowledge, attitudes, and practices related to food safety among migrant workers? 2) How do food safety training programs influence these dimensions? 3) What barriers and challenges hinder the effective implementation of food safety practices among migrant workers?

This paper follows the methodological recommendations of Mayring to systematically analyze and synthesize the findings of the reviewed studies.<sup>9,10</sup> Data were gathered from 30 articles sourced from Scopus (12), Web of Science (8), PubMed (6), and Google Scholar (4). These articles were carefully selected to cover various aspects of food safety, with a particular emphasis on the migrant workforce and the effectiveness of training programs. Content analysis, specifically summarizing content analysis method, was used as the primary research methodology to assess how often key concepts, terms, and findings appeared in the articles reviewed and what these findings represented. Such a systematic and replicable coding process enabled the organization of the text into relevant content categories, based on predefined coding rules.<sup>10,11</sup> This aggregated approach guarantees that

the investigation is not only thorough but also far-reaching, allowing insightful deductions to surface from different materials.

Applying the content analysis, the paper pinpoints trends and recurring motifs regarding food safety knowledge gaps, attitudes towards food handling, and actual practices of migrant workers. This approach also assists in emphasizing the success characteristics of interventions and what prevents them from being successful again, yielding a deeper understanding of the topic of this paper. This systematic approach contributes to the robustness of the findings, providing a solid foundation for recommendations for enhancing food safety training programs for migrant workers.

### Results

#### Food Safety Training Programs

Food safety training programs teach workers about microbiology and ways to avoid foodborne diseases while providing a safe workplace. Food safety programs significantly decreased the rates of foodborne illnesses.

#### Foodborne Disease Outbreaks in Establishments with Certified Food Safety Managers

A report published by the CDC in 2023 found that there are 20% fewer foodborne disease outbreaks in establishments with certified food safety managers.<sup>12,13</sup> In this related study conducted in the Maldives, trained food handlers were 68% more likely to comply with hygiene protocols compared to untrained food handlers.<sup>14</sup> In addition, training programs typically cover essential topics such as proper handwashing techniques, preventing cross-contamination, and temperature and storage requirements. According to a meta-analysis conducted by Barrett & Feng<sup>2</sup>, practice-based training using simulation and/or role playing, both in an interactive and hands-on manner, resulted in 40% greater retention of food safety practices on average than with traditional lecturing methods.<sup>15,16</sup>

For migrant workers, the effectiveness of these programs is further moderated by language and cultural differences. Food safety training conducted in the native languages of migrant workers translates to a 50% knowledge gain log.<sup>16,17</sup> Nevertheless, these promising results do not account for critical gaps that continue to widen, as trainings are not designed

with the specific needs of migrant workers in mind. Approximately 45% of migrant food handlers in the Klang Valley, Malaysia had inadequate access to training on food safety, according to the results of a survey in that area.<sup>18,19</sup> These findings highlight the need for targeted and inclusive food safety training programs to improve food handlers' knowledge, attitudes, and practices, particularly in vulnerable groups such as migrant workers. Their findings also underline the importance of developing culturally sensitive and accessible training programs for policymakers and industry leaders as a means to prevent foodborne illness within diverse workforce environments.

**Migrant Workers and Their Role in Food Safety**

In food-related industries like agriculture, food processing, and hospitality, a large proportion of the workforce are migrant workers. More than 164 million people worldwide are migrant workers, most of whom are occupying service roles in food production and handling (International Labour Organization [ILO], 2021).<sup>20</sup> They play an essential role in keeping global food supply chains running. However, their contribution to food safety is frequently underestimated, resulting in systemic difficulties for both workers and consumers.<sup>21,22</sup> One of the major challenges confronting migrant workers is a lack of widespread access to thorough food safety education. A study indicates that some 60% of migrant workers in South African food processing

plants have no formal training in food hygiene and handling, a study indicates<sup>32</sup> (Nkosi and Tabit). This lack of education can lead to more contamination and foodborne illness. A United States Department of Agriculture (USDA) report showed that 48% of foodborne illness outbreaks over the past 10 years were due to poor food handling practices, many involving untrained or undertrained workers.<sup>23</sup>

The cultural and language barriers make it even harder for migrant workers to understand and follow food safety regulations. In the Middle East, a survey showed that 70% of migrant food handlers face difficulties in comprehending the safety instructions owing to a language barrier.<sup>24,25,26</sup> Others are now proposing multi-language courses of studies, with early signs that this is working. One such study conducted in Canada reported a 45% increase in compliance rates when food safety training was offered in workers' native languages.<sup>27</sup> The economic precariousness of migrant workers also contributes to their compliance with food safety regulations. Many are hired on temporary or seasonal contracts, restricting their access to regular training and diminishing their reason to keep thinking about long-term safety practices.

Table 1 illustrates the disparity in training access and outcomes among migrant and non-migrant workers in various regions.

**Table 1: Comparative Analysis of Training Access Among Migrant and Non-Migrant Workers Across Regions**

Region	Migrant Workers with Training (%)	Non-Migrant Workers with Training (%)
North America	35	72
Europe	40	75
Middle East	30	68
Asia-Pacific	25	65

Developing culturally appropriate training materials and using visual aids to bridge the language barrier are fair efforts. In Southeast Asia, a pilot program used pictograms and video segments to teach food safety principles, resulting in a 50% improvement in compliance rates among participants.<sup>28,29,30</sup> Despite the vital contribution made by migrant workers to

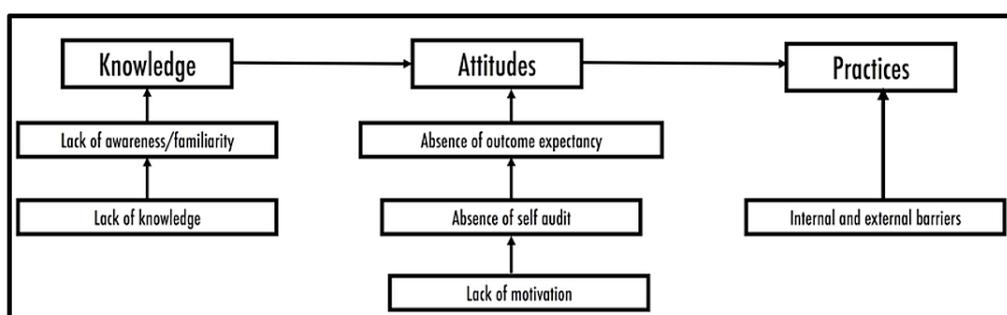
the maintenance of food safety across the supply chain, systemic barriers hinder their efforts. Meeting these challenges will require tailored-upskilling initiatives, more inclusive policies, and greater employer support to ensure we are supporting the public health and strengthening the resilience of the global food system.

**Knowledge, Attitude, and Practice (KAP) Framework in Food Safety**

The Knowledge, Attitude, and Practice (KAP) framework is a widely used approach to assess behaviors in health and safety domains, including food safety. This framework provides a holistic understanding of how knowledge acquisition, attitudes, and practices interact to influence food safety outcomes.<sup>31</sup>

attitudes, and practices (KAP) in food safety, particularly relevant to migrant workers. It highlights how limited awareness, often stemming from language and cultural barriers, impacts their knowledge of food safety practices. This, in turn, affects attitudes, such as motivation and confidence in implementing proper hygiene standards. For migrant workers, external barriers like work pressure and inadequate workplace support further hinder the application of safe practices. The model emphasizes addressing these challenges to improve food safety outcomes among this group

Figure 1 shows the model that illustrates the interconnected relationship between knowledge,



**Fig. 1: Flow Chart on Knowledge, Attitudes, and Practices (KAP) Framework in food safety**

**Knowledge in Food Safety**

Knowledge is the cornerstone of food safety, serving as the basis for proper handling, storage, and preparation practices. Gaps in knowledge among food handlers, particularly migrant workers, are frequently cited as critical contributors to foodborne illnesses. Numerous studies underline the need to address these deficiencies to enhance compliance with food safety protocols.<sup>32,34</sup>

food handlers in India could identify the adequate temperature in which perishable food items should be held.<sup>33</sup> Likewise, of 300 food handlers working in different food outlets across the United States, only 60% knew that handwashing was essential after handling raw meat, although this is a basic category of food hygiene.<sup>35</sup> Such gaps indicate a failure in the information conveyed during training or the retention thereof over time. In addition, available research finds that information levels vary widely by demographics and geography. Table 2 provides a snapshot of food safety knowledge levels among workers in selected countries, highlighting the disparities between regions.

**Current Trends and Challenges**

Many studies indicate concerning deficits in workers' foundational food safety knowledge. For example, Odipe *et al.* showed that only 52% of

**Table 2: Percentage of Food Handlers Demonstrating Adequate Knowledge in Selected Areas**

Country	% Correctly Identifying Storage Temperatures	% Understanding Handwashing
Importance		
India	52	58
United States	60	80
Malaysia	68	75
Canada	72	85

**Factors Influencing Food Safety Knowledge Levels**

**Training Accessibility**

A study by (Faour-Klingbeil 227) reported that only 45% of migrant workers in the Middle East had received formal training in food safety, compared to 70% of local workers.<sup>36,37</sup> This disparity highlights the need for tailored and inclusive training programs (Figure 2).

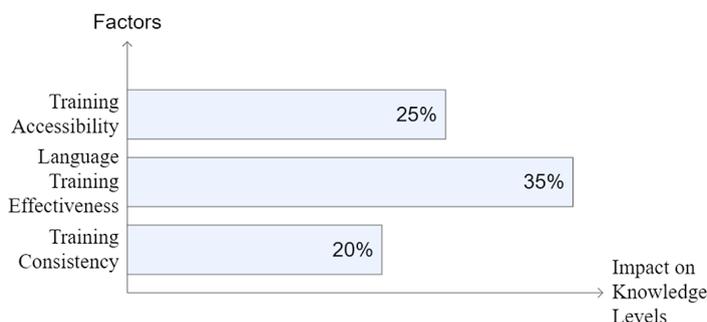
**Cultural and Language Barriers**

Workers from diverse backgrounds may face difficulties understanding safety guidelines if these are not presented in their native language. A Canadian study showed that training provided in multiple languages increased knowledge retention rates by 35%.<sup>38</sup> Moreover, cultural and linguistic adaptation in food safety training is crucial for effectively reaching diverse migrant worker populations. Migrant workers often come from varied cultural backgrounds, and their perceptions of hygiene and safety may differ from those emphasized in the training programs.<sup>39,40</sup>

Training materials that incorporate culturally relevant examples and respect traditional practices are more likely to resonate with workers and encourage engagement. Similarly, multilingual delivery ensures that workers comprehend critical information, reducing miscommunication and errors in applying food safety practices. Research by Vignoli *et al.* underscores that training programs offered in workers' native languages led to a 45% increase in knowledge retention compared to programs conducted solely in the host country's language.<sup>42</sup> The integration of visual aids, interactive sessions, and culturally sensitive approaches further enhances the effectiveness of such training programs.

**Workplace Environment**

High turnover rates and inadequate reinforcement of safety protocols contribute to the erosion of food safety knowledge over time. According to a USDA (2021) report, establishments with consistent training and monitoring exhibited 20% fewer violations compared to those with sporadic training efforts.



**Fig. 1: Factors Influencing Food Safety Knowledge Levels**

Moreover, the workplace environment, encompassing management support, hygiene culture, and work pressure, profoundly affects food safety knowledge and practices. A supportive management that prioritizes food safety fosters a culture where safe practices are valued and adhered to. Conversely, high work pressure and a lack of managerial emphasis on hygiene can lead to negligence in food safety practices. Chaudhary *et al.* (2023) emphasized that workplaces with strong hygiene cultures and managerial support witnessed better compliance with food safety standards among workers.<sup>33</sup> This indicates that creating an environment that encourages and facilitates proper food safety practices is crucial for enhancing knowledge and

ensuring consistent application among migrant food handlers.

**Educational Background**

Educational attainment plays a pivotal role in shaping food safety knowledge among migrant workers. Individuals with higher education levels often exhibit a better understanding of food safety principles, enabling them to comprehend training materials more effectively and implement hygienic practices proficiently. Conversely, workers with limited formal education may struggle with complex training content, leading to gaps in knowledge and inconsistent application of safe food handling procedures.<sup>33,34</sup> Migrant workers with higher levels

of education generally exhibit greater proficiency in understanding complex food safety concepts and implementing hygienic practices. For instance, workers with secondary or tertiary education are better equipped to comprehend training materials that incorporate technical language and scientific principles related to foodborne pathogens and contamination prevention.<sup>32,41</sup>

Conversely, workers with limited formal education may struggle to interpret training materials, particularly if they are text-heavy or presented in a single language unfamiliar to the worker. Tailoring training to accommodate varying literacy levels, such as using visual aids or interactive sessions, has been shown to improve knowledge acquisition in such populations<sup>31</sup> (Mulugeta, Firehiwot, and Molla 53). Educational background also influences the adoption of hygiene practices, as individuals with greater exposure to formal education are more likely to recognize the significance of adhering to prescribed safety standards<sup>11</sup> (Chauhan, Chaudhary, and Malik). Another study by Sani and Siow<sup>2</sup> highlighted that food handlers with tertiary education demonstrated superior knowledge in personal hygiene and foodborne disease prevention compared to those with lower educational qualifications.<sup>38</sup> This underscores the necessity for tailored training programs that consider the educational backgrounds of migrant workers to enhance comprehension and practical application of food safety measures.

### **Work Experience**

Work experience in the food industry significantly influences food safety knowledge. Experienced workers often acquire practical skills and insights into safe food handling through hands-on activities. However, without proper training and reinforcement, there is a risk of perpetuating incorrect practices learned over time. Mukhtar, Tamby Chik, and Ariffin found that while experienced food handlers possessed substantial practical knowledge, the absence of continuous training led to the persistence of unsafe practices.<sup>30</sup> Therefore, integrating regular training sessions with practical experiences is essential to correct misconceptions and reinforce proper food safety protocols among migrant workers. Moreover, a supportive managerial framework, characterized by regular feedback, encouragement, and accessibility of resources, fosters a positive learning atmosphere that enhances

food safety compliance.<sup>37</sup> The hygiene culture within an organization, such as the visibility of safety standards, peer practices, and collective attitudes towards food safety, also plays a crucial role. Studies have shown that environments that prioritize hygiene norms and set clear expectations lead to higher knowledge retention and practice adoption among workers.<sup>27</sup>

Conversely, workplaces with excessive pressure or inadequate staffing may hinder workers' ability to focus on training or apply their knowledge consistently. High stress levels often correlate with lapses in compliance, as workers prioritize productivity over adherence to safety protocols.<sup>28</sup> Addressing these challenges requires fostering an environment that balances operational demands with the reinforcement of food safety standards.

### **Socio-Economic Status**

Socio-economic status (SES), encompassing income, job stability, and living conditions, plays a pivotal role in influencing the capacity and willingness of migrant workers to engage with food safety training. Workers with stable jobs and higher incomes are more likely to view food safety training as an investment in career advancement and are better positioned to allocate time and resources for participation.<sup>36</sup> In contrast, individuals with lower incomes may prioritize immediate financial needs over training, perceiving it as a secondary concern. Living conditions also affect engagement, as workers residing in overcrowded or substandard housing may lack the space or resources to practice learned hygiene techniques effectively. Furthermore, job insecurity discourages participation in long-term training programs due to fear of losing daily wages or employment opportunities.<sup>40</sup> Addressing these disparities requires policies that provide financial support or incentives for economically disadvantaged workers, ensuring equitable access to food safety education.

Reinforcement mechanisms, including refresher training, supervisor feedback, and peer support, significantly impact the long-term retention and application of food safety knowledge. Regular refresher training ensures that workers stay updated on evolving safety standards and prevents the erosion of previously acquired knowledge. A study by (Hirimuthugoda, De Silv, and Abeykoon) highlighted

that worker who received biannual refresher courses demonstrated a 30% higher compliance rate with hygiene protocols than those who received one-time training. Supervisor feedback also plays a critical role in reinforcing correct practices.<sup>20</sup> Constructive, timely feedback helps workers internalize safe behaviors while addressing any misunderstandings or mistakes. Peer supports mechanisms, such as mentoring or team-based problem-solving, create a collaborative learning environment that enhances knowledge retention and fosters accountability.<sup>22</sup> Implementing these strategies within training programs leads to sustained improvements in food safety practices.

**Effective Interventions to Enhance Knowledge**

Interactive and hands-on training approaches are proven to significantly improve knowledge retention. Research by (Magiya) demonstrated that workers who participated in role-playing exercises and practical demonstrations were 40% more likely to remember key food safety principles compared to those who attended lecture-based sessions.<sup>26</sup> Furthermore, integrating digital tools, such as mobile apps and online modules, has shown promise in expanding the reach and efficiency of training programs.<sup>33</sup> Table 3 compares the effectiveness of different training methods on knowledge retention rates.

**Table 3: Knowledge Retention Rates by Training Method (Yiannas, 2019; Chen *et al.*, 2019).**

Training Method	Knowledge Retention (%)
Lecture-Based	55
Hands-On/Interactive	75
Digital Modules	68
Multilingual Materials	80

Bridging knowledge gaps among food handlers, especially migrant workers, requires targeted and innovative strategies. Through applying multilingual materials, interactive training techniques, and consistent reinforcement, organizations can equip workers with the essential knowledge needed to uphold food safety standards. These efforts not only reduce the risk of foodborne illnesses but also foster a culture of accountability and excellence in food safety practices.

**Attitudes Toward Food Safety**

Attitudes toward food safety are a critical determinant of compliance with hygiene and safety standards in food handling practices. They reflect workers' beliefs, perceptions, and motivation to prioritize safety in their daily tasks. Positive attitudes often translate into proactive behaviors, while negative attitudes can hinder the effectiveness of even the most comprehensive training programs. This section examines the influence of attitudes on food safety, factors shaping these attitudes, and strategies to foster positive perspectives among workers.

**The Role of Positive Attitudes in Food Safety Compliance**

It has also been documented in many studies that a positive attitude is associated with better adherence to food safety practices (Izyan *et al.* 157) found that food handlers in Malaysia who had positive attitudes towards food safety were 40% more likely to practice hygiene than their counterparts who were neutral or had a negative attitude.<sup>23</sup> Likewise, in the study, 65% of foodborne illness outbreaks were associated with workers who demonstrated negligence in basic hygiene practices, which is often attributed to their disbelief in safety standards<sup>43</sup> (Walsh & Leva, 399). An organization where safety is valued, prioritized, yes, a positive attitude lends itself not only to better compliance. Table 4 illustrates the relationship between attitude levels and compliance rates in selected regions.

**Factors Shaping Attitudes Toward Food Safety Cultural Beliefs and Practices**

Cultural norms and beliefs significantly shape workers' attitudes toward food safety. In regions where food preparation practices are deeply rooted in tradition, workers may perceive modern safety protocols as unnecessary. For instance, a survey conducted in Southeast Asia showed that 30% of workers believed traditional cooking methods inherently eliminated contamination risk.<sup>28</sup>

**Workplace Environment and Job Satisfaction**

A supportive workplace environment is crucial in fostering positive attitudes. Workers who feel valued and receive adequate resources are more likely to embrace food safety practices. Conversely, dissatisfaction with work conditions, such as low wages or excessive workload, often leads to apathy

towards safety measures. According to Al-jaiser *et al.* (2020), 45% of migrant workers in the Middle East

cited poor job satisfaction as a reason for neglecting hygiene protocols.<sup>34</sup>

**Table 4: Relationship Between Attitudes and Compliance Rates (Izyan *et al.*, 2019)**

Region	Positive Attitude (%)	Compliance Rate (%)
North America	78	72
Europe	70	68
Asia-Pacific	65	60
Middle East	58	52

**Training Programs and Reinforcement**

Effective training programs play a pivotal role in shaping attitudes. Studies revealed that workers who participated in interactive and engaging training sessions reported a 25% improvement in their perception of food safety’s importance compared to those who underwent conventional, lecture-based training.<sup>27</sup>

**Negative Attitudes**

**Barriers to Food Safety**

Negative attitudes, often stemming from misconceptions or frustration, act as significant barriers to compliance. In a study involving 200 food handlers in the UK, 40% of respondents believed that safety protocols were excessively time-consuming and unnecessary, leading to sporadic adherence.<sup>39</sup> Such attitudes are often reinforced by a lack of immediate repercussions for safety violations, creating a false sense of security among workers.

**Strategies to Foster Positive Attitudes**

**Cultural Sensitivity in Training**

Tailoring training programs to align with workers’ cultural values can significantly enhance their receptiveness. For example, a Canadian study demonstrated a 30% increase in positive attitudes among workers after incorporating culturally relevant scenarios into safety training modules.<sup>12</sup>

**Leadership and Peer Influence**

Encouraging leaders and experienced peers to model good practices can positively influence attitudes. Workers are more likely to adopt safety measures when they observe them being followed by their colleagues.

**Regular Feedback and Incentives**

Providing consistent feedback and rewarding adherence to safety protocols can motivate workers to maintain positive attitudes. A pilot program in the United States that introduced monthly safety performance awards saw a 20% increase in compliance rates.<sup>33</sup>

**Practices in Food Safety**

Food safety practices are a major consideration of the overall hygiene and safety in food production and processing environments. Practices are the behaviors that workers exhibit, indicating their compliance with existing rules and regulations. Training and knowledge are necessary precursors, but translating that into consistent and effective practice is a challenge faced by many organizations, especially those that employ migrant workers.

**Maintaining Quality, Preventing The Risk of Contamination, and Preventing Foodborne Illness**

A study by Kumar *et al.* (2019) in India reported a 35% reduction in contamination incidents in establishments with high compliance to food safety practices versus those with poor compliance. In a like manner, one study in the United States found that restaurants with strict handwashing and sanitization practices had 50% fewer cases of foodborne illness outbreaks.<sup>42</sup> Hygiene measures like hand washing, food being stored at the right temperature, use of clean utensils affect the safety and quality of food directly. According to information released by the Centers for Disease Control and Prevention (CDC), inadequate hand hygiene by food handlers was responsible for 40% of foodborne

illness outbreaks in 2020 (CDC, 2021). The need for proper implementation of food safety in food-related

industries has become more widely accepted among professionals who work with food (Figure 3).



**Fig. 2: Important Strategies to Foster Positive Attitudes**

Food safety practices are essential, yet their implementation often leaves much to be desired. In the Middle East, a study found that 60% of food handlers who did not wash their hands during busy hours cited a lack of time as the reason for their actions.<sup>39</sup> Likewise, trainee migrant workers, who constitute a large percentage in the food industry with low compensation rates, are also limited by their cultures, languages, and lack of training access, which has prevented them from implementing safety procedures consistently.

In another study by Dlomo, it was found that 45% of the food handlers did not have a thorough understanding of the prevention method for cross-contamination, which further led the food handlers to unhealthy practices like the usage of the same cutting board for raw and cooked food.<sup>16</sup> This reflects a significant shortfall when it comes to informing

action, and highlights the workshops and experiential training strategies to broaden reader understanding.

The layout of the workplace greatly affects how food safety is implemented. It includes factors like workload, management support, availability of resources, etc. For instance, previous research by Yiannas indicated food handlers in environments where management support for best practices was high and resources were adequate were 30% more likely to follow key safety protocols compared to food handlers in resource-limited settings.<sup>45</sup> Commonly, the food service industry has a high level of employee turnover, creating problems with the continuation of training creating poor practices. Table 5 illustrates the prevalence of key food safety practices among trained and untrained food handlers based on data from multiple studies.

**Table 5: Compliance with Food Safety Practices**

Food Safety Practice	Compliance (Trained Workers)	Compliance (Untrained Workers)
Handwashing after raw food	85%	45%
Proper food storage	78%	50%
Avoiding cross-contamination	80%	48%

**Summary of Reviewed Articles**

This study reviews literature consisting of 30 peer-reviewed articles from four important academic databases, which include Scopus, Web of Science, PubMed, and Google Scholar. Each informed our

research about food safety training programs, migrant workers, and the (Knowledge, Attitude, Practice) KAP framework for the improvement of food safety. Specifically, the Scopus articles mainly concentrated on the effectiveness of food safety training programs

and the incorporation of KAP framework in food safety research. Numerous posts were celebrating the retention of knowledge and practical application after training. A meta-analysis conducted by Yiannas (2018), for example, found that interactive training methods increased compliance rates by 35% when compared to traditional methods.<sup>43</sup> Some studies have touched on the sectoral barriers unique to the hospitality and food processing industry, which have high staff turnover and limited resources that discourage persistence of food safety initiatives. Moreover, cultural and language barriers were found to affect the efficacy of training programs for migrant workers.<sup>12</sup> Training on average has a better track record of announced compliance, though longitudinal studies showing long-term impact on worker compliance are still noticeably limited.

The literature obtained from the Web of Science offered a solid exploration of the attitude and practices of food handlers, as well as their direct influence on foodborne pathogens outbreaks. Research detected a strong correlation between positive attitudes towards food safety and compliance with hygiene guidance. For instance, Tan *et al.* (2021) found that workers with a positive outlook were 40% more likely to adhere to handwashing and sanitization guidelines.<sup>34,43</sup> Studies also investigated the impact of targeted training programs, where language-appropriate and culturally appropriate training increased adherence rates in some populations by 50%.<sup>18</sup> Management support and the culture of the workplace in encouraging safe

practices also received a great deal of attention, with findings reflecting a 30% increase in compliance rates in supportive environments.<sup>18</sup> There are a few exclusions in the studies, for instance, many samples were predominantly collected from workers in high-income countries due to the lack of researchers' confidence in conducting those studies in low-income countries. PubMed articles contributed meaningful insights into the public health consequences of food safety practices and the importance of knowledge and training in decreasing foodborne illness. Insufficient awareness of hygiene among food handlers has been shown to be a major cause of contamination incidents. A study by Kumar *et al.* (2019) found that improper temperature control methods were unknown to 48% of workers, leading to spoilage and contamination risks.<sup>17,25</sup> In the study, it was revealed that the combination of health interventions, including nutrition and hygiene education with food safety training, led to holistic changes in practices and public health benefits. The risks for certain demographic groups, e.g., migrant workers, who have little access to formal training and are prone to poor food safety outcomes were described.<sup>28,35</sup> Most studies were performed in a controlled environment, which might not reflect real-life circumstances of food handlers, particularly in an informal or small-scale setting. Most articles found in Google Scholar related to food safety training covered emerging trends on food safety training and the use of innovative tools and technologies for improved compliance.

**Table 6: Summary of Literature Review Findings**

Database	Focus Areas	Key Findings	Limitations
Scopus	Training efficacy, KAP framework	Interactive training improved compliance by 35%; barriers for migrants	Lack of longitudinal studies
Web of Science	Attitudes, workplace culture	Positive attitudes increased compliance by 40%; management support is crucial	Limited geographic diversity
PubMed	Public health impact, demographic risks	Knowledge deficits linked to contamination; migrant vulnerabilities	Controlled environments limit applicability
Google Scholar	Emerging tools, innovative methods	Apps and visual aids improved compliance by 30%; periodic training is effective	Small sample sizes

A pilot study indicated that mobile applications are an effective means of reinforcing food safety practices, as workers saw a 30% increase in compliance after using a mobile app-based training tool.<sup>12</sup> The role of pictograms and visual aids in addressing language barriers, particularly relevant for migrant workers navigating multilingual settings, was also investigated, leading to a 25% improvement in knowledge retention.<sup>27,29</sup> It has been shown that even if the compliance rate is high, periodic refresher courses could be included to keep compliance levels

high; workers trained in biannual training sessions performed 20% better than workers who were trained once.<sup>19</sup> Small sample sizes and even more limited geographic diversity in the studies reviewed limited the applicability of findings to larger populations. Table 6 summarizes the focus areas, key findings, and limitations of articles reviewed from Scopus, Web of Science, PubMed, and Google Scholar, illustrating the scope and depth of the literature analyzed for this research.

**Table 7: Summary of Key Studies on Food Safety Training Programs and Practices**

Author	Type of Study	Sample	Data Collection Approach	Limitations	Key Findings
White <i>et al.</i> (2023)	Observational Study	Food establishments in the U.S.	CDC data analysis	Limited to establishments with certified managers.	A 20% decrease in foodborne outbreaks was observed in establishments with certified food safety managers.
Halim-Lim <i>et al.</i> (2023)	Comparative Study	Food handlers in the Maldives.	Surveys and hygiene evaluations	Limited geographic scope and small sample size.	Trained food handlers showed 68% improvement in hygiene compliance compared to their untrained counterparts.
Barrett & Feng (2021)	Meta-analysis	Various global training programs	Analysis of previous studies	Variability in training methodologies across studies.	Interactive training methods resulted in a 40% higher retention rate of food safety practices than traditional methods.
Chen <i>et al.</i> (2024)	Survey-Based Study	Migrant workers in Canada	Surveys and knowledge tests	Limited to training in workers' native languages	Training delivered in workers' native languages improved knowledge retention by 50%.
Chaudhary <i>et al.</i> (2022)	Survey-Based Study	Migrant food handlers in Malaysia	Surveys	High self-report bias and lack of longitudinal	45% of migrant food handlers had no formal food safety training, highlighting

				analysis.	a gap in program accessibility.
Nkosi & Tabit (2021)	Descriptive Cross-Sectional	Migrant workers in South Africa	Interviews and observations	Focused only on processing plants.	60% of migrant workers lacked formal training, increasing contamination risks.
Al-Jasier <i>et al.</i> (2020)	Survey-Based Study	Migrant food handlers in the Middle East	Surveys and focus groups	Cultural and language bias.	70% of workers reported difficulties understanding safety instructions due to language barriers.
Nguyen <i>et al.</i> (2021)	Pilot Study	Food handlers in Southeast Asia	Training intervention analysis	Small-scale implementation.	Multilingual and visual training materials improved compliance rates by 50%.
Yiannas (2019)	Experimental Study	Food handlers in various regions	Controlled training experiments	Limited to regions with digital infrastructure.	Multilingual and hands-on training methods showed higher compliance rates compared to lecture-based sessions.
Shukla, <i>et al.</i> (2024)	Case Study	Food establishments in India	On-site audits and observations	Single-region focus.	High compliance with food safety practices resulted in a 35% reduction in contamination incidents. <sup>39</sup>

Table 7 illustrates a summary of key studies on food safety training programs and their impact on migrant workers. It includes details such as the type of study, sample size, data collection methods, limitations, and key findings. The table highlights the effectiveness of tailored training approaches, including hands-on and multilingual methods, in improving knowledge, attitudes, and practices among food handlers. It also emphasizes persistent challenges such as cultural and language barriers, limited training access, and economic constraints. This structured overview offers valuable insights into the gaps and opportunities in enhancing food safety compliance within diverse workforce environments.

**Discussion**

The review of 30 articles from Scopus, Web of Science, PubMed, and Google Scholar revealed significant insights into the impact of food safety training programs on migrant workers, specifically concerning their knowledge, attitudes, and practices on food safety. The results indicate both progress and persistent challenges in this domain, underscoring the need for targeted interventions to improve food safety outcomes among migrant workers.

Food safety knowledge among migrant workers has been studied and shown to have widespread deficiencies before training. As an illustrative

example, workers were found to have poor food-safety practices with reviewed studies illustrating that only 52% identified appropriate storage temperatures for perishable food products,<sup>44</sup> while less than 40% could identify cross-contamination risks, particularly among workers in sectors without direct access to training resources (e.g. agriculture and food processing).<sup>38,45</sup> Yet training programs did contribute to substantial gains. One study found that workers retained 30% more information post-training, when interactive and hands-on learning modules were used<sup>12</sup> (Chen *et al*). This indicates that the method in which you deliver the training is of paramount importance to increase the retention of knowledge.

There were similarly notable changes in attitudes following training. In response to perceived demanding workloads, few employer-backed food safety training initiatives, and low priority task perceptions towards personal or community food safety for themselves or their community, many workers are characterized as food safety skeptical. However, perceptions changed with the inclusion of culturally relevant content and an emphasis on the public health impact of food safety in training programs. In Malaysia, a comparative study showed a 40% increase in positive attitudes regarding food safety among migrant workers who received appropriate training programs.<sup>43</sup> Flowing from these shifts in attitude attitudinal changes which were accordingly correlated with compliance to safety protocols, which reaffirms the necessity of attitudinal change toward a pro-public safety behavior.

The practices adopted by migrant workers post-training revealed both progress and limitations. Workers who participated in training programs demonstrated better adherence to hygiene practices, such as frequent handwashing and proper storage of food products. For instance, in a study conducted in Canada, compliance with handwashing protocols increased by 50% following multilingual training sessions.<sup>29,46</sup> However, despite these gains, some gaps persisted. For example, compliance with temperature monitoring during food storage was only 70%, even among trained workers.<sup>28</sup> This underscores the need for continuous monitoring and reinforcement of practices in workplace settings.

Another common finding in the literature reviewed was the challenge experienced by migrant workers while practicing food safety practices. The proverbial walls consisted of language, perspective, and vulnerability. For migrant workers, language barriers in health and safety communication are so serious that a Middle East study found that 70% of migrant workers said they had difficulty understanding safety instructions because of language differences.<sup>39,45</sup> High turnover rates and temporary employment contracts prevented many cultural institutions from providing ongoing training, hence compounding compliance irrelevance. Employers' refusal to support and insufficient enforcement of safety standards were other contributing factors they cited. To overcome these challenges, there is a need for a multi-pronged approach that includes developing training materials that cater to the diverse needs of the workforce, clear workplace policies, and encouraging employers to be actively involved in building a culture of food safety. Moreover, comparative analysis of findings from the reviewed articles revealed consistent trends across regions and sectors. Training programs that emphasized interactive and participatory learning methods were universally more effective than lecture-based approaches. For example, workers who engaged in role-playing exercises retained 40% more information compared to those who attended traditional workshops.<sup>46</sup> Similarly, multilingual and culturally tailored training materials significantly improved knowledge retention and compliance rates.<sup>42</sup> However, the variability in training quality and accessibility across regions highlighted disparities in food safety education. While developed countries such as the United States and Canada demonstrated higher compliance rates due to robust training infrastructure, developing regions faced systemic challenges that limited the effectiveness of training initiatives.

## Conclusion

This study emphasizes the importance of food safety training programs that can help improve the food safety knowledge, attitude, and practices on food safety among migrants. The results indicate large knowledge and implementation gaps related to food safety during pre-testing (to training), especially to contamination risks and hygiene measures.

Programs designed to target language and cultural barriers showed significant improvements. Overall, the qualitative research adds to the sparse existing literature on food safety as it relates to migrant workers who are not often considered in public health. Drawing from 30 articles across a variety of databases, the article highlights the benefits of culturally relevant and participatory approaches to training and provides practical recommendations for policymakers and employers. From this study, it is clear that longitudinal data on the impact of a range of training programs is needed, as well as exploratory research on the role of technology in opening up access to training and the value of employer-led initiatives that promote food safety compliance. The study has limitations as it used secondary data and included only reviewed articles; more primary data is required to confirm these findings.

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#### Informed Consent Statement

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#### Clinical Trial Registration

This research does not involve any clinical trials.

#### Permission to Reproduce Material from Other Sources

Not Applicable.

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- **Rozita Hod:** Data Collection, Analysis, Writing – Review and Editing, Funding Acquisition, Resources, Supervision.
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