

REVIEW ARTICLE

A Systematic Review of Food Hygiene Control in Food Service Providers: Review from 2000 - 2022

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ABSTRACT

From production through the intake, food hygiene particularly applies to the situations and processes that must be followed from production to consumption to guarantee the safety of the food produced. Food contamination may occur throughout the butchering or collecting, manufacturing, storage, distribution, transportation, and preparation processes. Food hygiene is described as "all circumstances and measures required throughout production, processing, storage, distribution, and preparation to guarantee the food is clean, healthy, and edible" Foodborne infections and even death can result from proper food hygiene. Around the world, contaminated food causes 600 million cases of foodborne disease and 420,000 deaths each year. Nearly 30% of all foodborne deaths worldwide occur in children under five. *Campylobacter* and norovirus are the main culprits found in most foodborne cases reported. Therefore, this research aims to assess food service providers' food hygiene knowledge, attitude, and practice at various phases of food supply. Moreover, this research also focused on different parts of the food supply chain, such as processing, manufacturing, and cooking. This review will also help develop stricter regulations and guidelines for food service providers to prevent more foodborne diseases.

Keywords: food hygiene; foodborne diseases; food service providers; food handlers.

INTRODUCTION

Currently, the world's demand for food is rising as the world's population increases yearly. It is expected to reach 9.7 billion people by 2050. This rise, together with growing affluence in developing countries that generate dietary changes such as consuming more protein and livestock, pushes global food consumption. It is expected that food demand worldwide will increase up to 98% by 2050¹. This growing demand for food encouraged much personnel to start food companies to accommodate the theirds. Thus, resulting in a surging amount of food providers around the world.

For example, in Southeast Asian countries, there are many food variations and choices. This is due to the multiracial environment, especially in Malaysia and Singapore. As time passed by, people's eating behaviour around the world changed. Nowadays, people are more time-constraint and seek more convenient ways to purchase foods, such as night markets, online delivery, and ready-to-eat foods in convenience stores. The surging of ways to get food has become a public concern regarding hygiene and food safety among these food service providers during food preparation. Moreover, the public does not know the information about safety and hygiene during food processing at various phases.

Approximately one in every ten individuals worldwide becomes sick due to consuming spoiled food each year. According to worldwide statistics, about 600 million cases are reported, with 420,000 fatalities due to foodborne diseases. Based on current data, a significant percentage of foodborne illnesses is caused by food workers' poor hygiene. Inappropriate meal preparation procedures will result in foodborne disease². This surging number of incidences of foodborne disease is distressing as it might impact substantial costs to personnel, the food industry, and the economy³.

Besides, routine dietary habits have evolved because of people's lifestyles⁴. People nowadays are more encouraged to eat out of home due to the mushrooming number of street vendors, restaurants, and fast food restaurants. The emergence of various food delivery services also influenced food preparation at home. The rising number of individuals eating out and less food preparation at home has resulted in the growth of foodborne diseases due to unsanitary cooking and a lack of personal hygiene awareness.

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MATERIALS AND METHODS

Research Design: A systematic review was chosen as the study design for this investigation.

Search Strategy: We did a thorough search of the following databases: PubMed, Cambridge, Science Direct, NCBI and ResearchGate. A precise blend of food hygiene-related phrases (e.g., food safety, food hygiene), society terms (e.g., consumer, delivery, home), and outcome terms are used in the search algorithm (e.g., behaviour, knowledge, attitudes). Additional searches in Google Scholar are conducted using basic search terms to discover grey literature (e.g., published research). In addition, we examined English-language publications published between 2000 and 2022. Likewise, we looked through the reference lists of the retrieved papers to find more relevant material.

Selection Process: The review authors will separately screen the search results' titles and abstracts against the inclusion criteria. We will obtain complete reports for any titles that appear to fulfil the inclusion and exclusion criteria or where there is any doubt. Review author pairs will screen the full-text reports to determine if they meet the inclusion criteria. We will request more information from research authors as needed to address eligibility concerns. We will settle our differences via discussion. We will keep track of the grounds for trial exclusion. Neither of the review writers will be blind to the journal names or the authors or institutions of the studies.

Data Collection and Synthesis: Ethics exemption from the Universiti Teknologi MARA research ethics committee is required before data collection. The UiTM Research Ethics Committee approves this report with the approval code of REC/07/2021 (EX/120). After UiTM Research Ethics Committee approved the ethics exemption, the data collection was started by screening all the research collected. All disagreements are resolved through discussion. At least two review writers independently determined inclusion and exclusion decisions through screening titles, abstracts, and full-text reports. Data for all eligible trials are retrieved separately by three review writers. Full papers of relevant publications will be retrieved and validated for relevance by extracting essential information such as the study's goal and where it will be conducted, as well as the socio-demographics of the target population, the study methodology, and the data collection procedures.

Quality Assessment: Every relevant research will be rigorously evaluated using the criteria quality evaluation form. The criteria are adopted from critical appraisal tools for systematic research investigations that had previously been developed: Critical Appraisal Tools by Joanna Briggs.

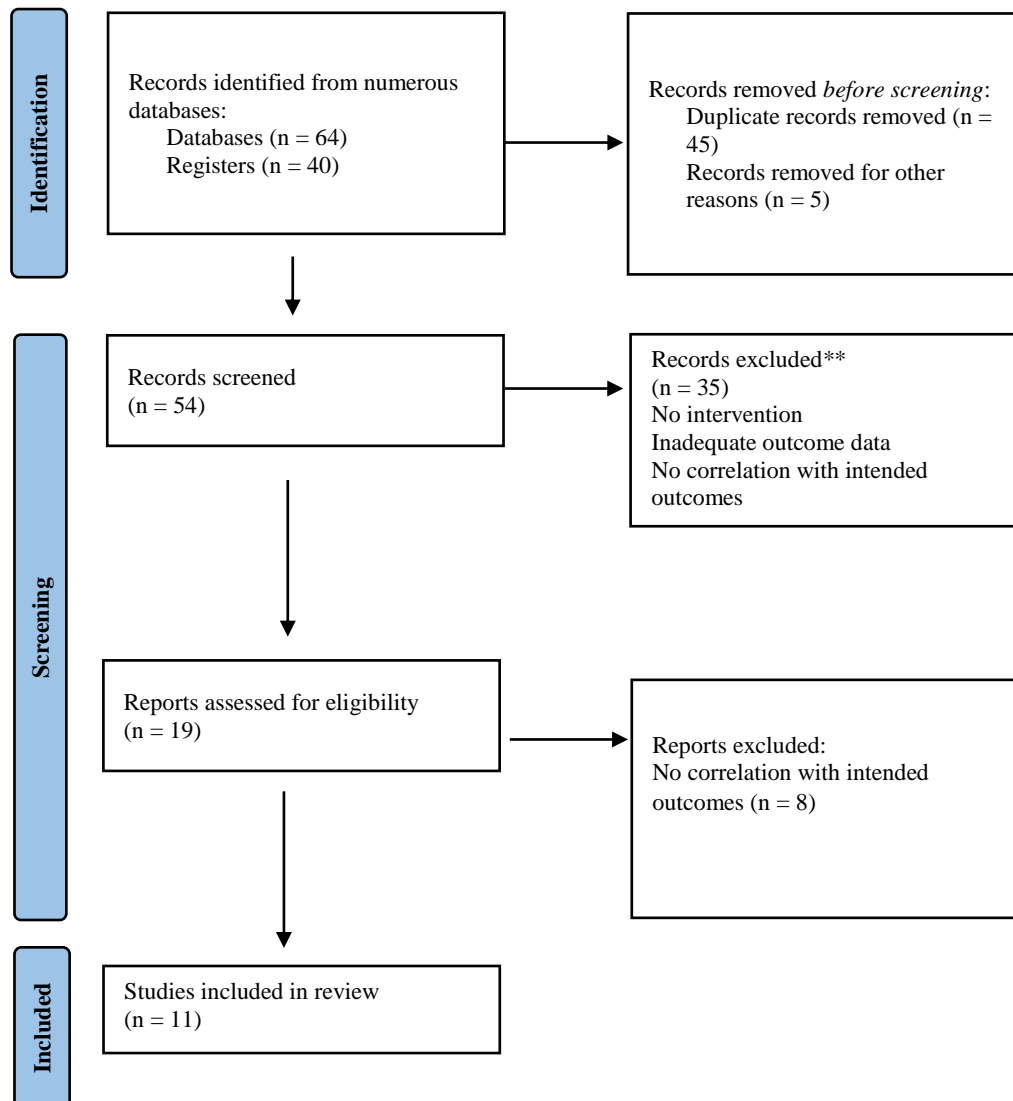
Assessment of Risk of Bias: This systematic review may be biased due to the likelihood of bias in the included papers. Two reviewers independently and blindly assessed the quality of the included papers, and any discrepancies were addressed through discussion. The Joanna Briggs Institute Critical Appraisal Tools (analytical cross-sectional research, case-control studies, and cohort studies) are employed to assess the quality. The articles are assigned a 'yes', 'no', 'unclear', or 'not applicable' rating. Articles with more than 50% will be included with a 'yes' vote.

Study Characteristics: Many papers are published in the database regarding food hygiene among consumers and food handlers. However, based on past research, the primary goal of this study is to measure food hygiene levels among food service operators. Therefore, we only chose the papers that were appropriate to our focus. We discovered 104 papers during our first search. Our database is then reduced to 54 publications after removing duplicated and unrelated research. After evaluating the data, we excluded 35 additional studies and applied inclusion and exclusion criteria. Only 19 papers are subjected to full-text examination and quality assessment. However, only 11 papers are qualified for inclusion in this research when the quality assessment is done. The selected papers were published from 2012 - 2022.

Eleven papers are included in this research. Each of the papers went for the quality assessment using JBI Critical Appraisal Tools by 2 authors. Most of the research is conducted in Malaysia (n=5) and other developing and developed countries such as Portugal (n=1), United Arab Emirates (n=1), Taiwan (n=1), China (n=1), Thailand (n=1), Greece (n=1), Poland (n=1) and Pakistan (n=1). The target population for all the selected papers are the food service providers of various places in the food chain, such as school canteens, food street vendors and restaurants (n=10). The prevalence of antimicrobial resistance of *Staphylococcus aureus* among food handlers is also included to assess the practice of food hygiene (n=1).

RESULTS

Study Selection: The first search was performed in August 2022 with 54 related papers. The last search in the database for related research was in October 2022. The final search record is 104 papers. After the screening and quality assessment process based on abstract and full-text papers, only 11 papers are included in this thesis. These judgements are made based on food hygiene amongst food providers.



Outcomes of Selected Studies

Reference	First author, year	Study design	Location, Setting	Food hygiene behaviour identification	Sample N	Outcomes	JBI assessment (%)
1	Tan et al., 2013	Cross-sectional	Malaysia School	Food workers' hand hygiene knowledge, attitudes, and practises from 38 elementary schools	85	Knowledge: mean hand hygiene knowledge percentage, 85.35 ± 9.44 Attitudes: mean hand hygiene attitudes percentage, 87.59 ± 8.45 Practices: mean hand hygiene practices percentage, 93.75 ± 4.57	100 (8/8)
2	Saad et al., 2013	Cross-sectional	Malaysia Government Institutions	Assesses food handlers' degree of food hygiene procedures.	318	Hygiene practices ranged between 3.24 to 5.73, indicating that good hygiene has been practised in the institutions.	87.5 (7/8)
3	Martins et al., 2014	Cross-sectional	Portugal Nursing homes & Kindergartens	Food handlers at elderly homes and kindergartens were tested for food hygiene expertise.	335	Food hygiene knowledge; 13.9 (± 3.65SD)	100 (8/8)
4	Sani N. A. & Siow O. N., 2013	Cross-sectional	Malaysia Restaurants	To examine food safety knowledge, attitudes, and behaviours among food handlers in food service operations on UKM	112	Knowledge (%): personal hygiene (96.4), Cross-contamination (44.6), foodborne disease definition (66.1), time and temperature control (58.7), Staphylococcus aureus agent (28.6) Attitudes mean scores: 89.26 ± 8.66 Practices: poor personal hygiene practices whereby only 46.6% maintained safe practices	100 (8/8)
5	Taha et al., 2021	Cross-sectional	United Arab Emirates Restaurants	i) Food handlers' communication, employee participation, dedication, training perspective, and hygienic procedures in Dubai, United Arab Emirates (UAE). ii) the influence of management strategies on food handler commitment, food safety training perception, and, finally, hygiene practise through communication and employee participations.	995	Demographic: i) Respondents who were educated beyond high school had significantly (P = 0.006) better food safety conduct (87.5%) ii) Respondents with a work experience of >6 years scored a higher mean percentage (78%) (P = 0.006) In summary, management practices have a significant and positive relationship with the training perception and commitment of food handlers.	87.5 (7/8)
6	Lee et al., 2012	Cross-sectional	Malaysia Military canteens	Assessment of the food hygiene practices among food handlers in a military food service institution that has been trained with food safety practices and knowledge.	222	The scores for each dimension are higher than other reported studies showing that food handlers adhere to food hygiene in military camps.	87.5 (7/8)
7	Sun et al., 2011	Cross-sectional	Taiwan Night markets	Assessment of food hygiene practices in tourist night markets.	120	Food safety knowledge: Low due to no assistance from the government in controlling food-related certificates or licenses of vendors in night markets. Personal hygiene: ignored personal hygiene like hand washing due to a lack of infrastructure. Hygiene knowledge and practices: Street vendors were aware of proper hygiene knowledge but rarely put them into practice	87.5 (7/8)
8	Abdul Aziz S. A & Dahan H. M., 2013	Cross-sectional	Malaysia School	Assessment of food handlers' attitude toward food safety and their belief and perceived	363	Attitudes on food safety: agree that adhering to school canteen management guidelines will reduce food poisoning (M=5.99, S.D.=1.204). Relationship between attitude and safe food handling: coefficient between compliance and safe food handling is r = .065, p>.01 perceived barrier and safe food handling are r = .084, p>0.01	87.5 (7/8)
9	Trafialek et al., 2017	Cross-sectional	China, Thailand, Greece, Poland Street food vendors	According to the Codex code of practice general principles on food hygiene, the assessment of street food vendors hygienic practices in four Asian and the EU countries	440	Hygiene of equipment and food preparation: The significant and consistent manner was strongly influenced by three characteristics: country of vendor's placement, type of facility and number of employees. Personal hygiene: significant influence of the same characteristics similar to equipment and food preparation hygiene.	100 (8/8)
10	Ahmed et al., 2021	Cross-sectional	Pakistan Small-scale restaurants, hotels, and eateries	Evaluation of the food safety knowledge, attitudes and practices of food handlers currently working in different restaurants, hotels, and eateries in two towns within Lahore city of Pakistan.	202	Food safety knowledge: 4.38 ± 2.25 (43.8%) was considered a poor score (below 50%). Food safety attitudes: 12.00 ± 4.00 (75%), which is considered a good score Food safety practices: 5.88 ± 3.02, which was characterised as a low score (50–70%)	100 (8/8)
11	Seow et al., 2021	Prevalence study	Malaysia Food premises in Klang Valley	To identify the prevalence of Staphylococcus aureus and its antimicrobial resistance profile among food handlers and cooked food in Klang Valley, Malaysia.	200 hand swabs, 100 food handlers	Prevalence of S. aureus and MRSA: 95(95%) 95(100%) Prevalence of S. aureus and MRSA in cooked food: 50(50%) 4(8%)	88.88 (8/9)

Food Hygiene Knowledge: Knowledge of food hygiene among food handlers is one aspect that might help understand the food safety issues inherent in the food industry, promoting a good attitude toward food safety⁵. Five studies investigated food hygiene knowledge among food handlers. Based on the previous research, it has been discovered that the hand hygiene knowledge of food handlers at primary schools in Hulu Langat, Malaysia is at a good level (85.35 ± 9.44) (6). Moreover, food handlers that participated in safe food handling training for the past 12 months scored higher in food hygiene knowledge than those who did not (p < 0.001)⁷. This result strengthened the judgment that the education and training of food handlers serve a vital impact on food handlers' knowledge and attitude⁸. Other than that, it was discovered that many food handlers (21.3%) did not get formal education⁽⁹⁾. This might jeopardise food hygiene due to a lack of knowledge and proper safe food handling training. Moreover, the local government's lack of records and support in regulating certifications or permits for food handlers became one reason why food hygiene knowledge among food handlers is low¹⁰.

Food Hygiene Attitudes: Food hygiene attitudes are an important aspect that can impact food safety behaviour and practice, reducing foodborne infections. Many elements must be focused on to have a good food hygiene attitude among the food handlers. Four studies assessed the food hygiene attitudes among food handlers in the school canteen and food courts in university compounds (UKM). Two studies^{6,10} reported that attitudes of food handlers toward food hygiene are quite high, with the mean score of 87.59 ± 8.45 and 89.26 ± 8.66, respectively. This showed that the food handlers' attitudes towards food hygiene are good. Moreover, many food handlers positively concurred to enhance their understanding of food hygiene. It was found that about 76.8% of the food handlers showed interest in participating in food safety training if they were allowed to (4.08 ± 1.17)¹⁰.

Food Hygiene Practices: Food hygiene practice is a critical component taken seriously to ensure that food production is safe for consumers. When hygiene procedures are not adequately followed, food can be contaminated by bacteria, viruses, and other diseases, causing persons who consume the infected food to get

ill. Six studies examined the hygiene practices among food handlers in various compounds. A study done at primary schools in the Hulu Langat district discovered that hand hygiene practices are regarded favourably, with a mean percentage score of 93.75 ± 4.57^6 . In addition to this, it is reported that hygiene practices in government institutions in Malaysia are at a satisfactory level, with mean scores and SD of 3.24 to 5.73 and 0.87 to 2.15, respectively. This showed that hygiene practices comply with the Food Hygiene Regulations of 2009 and the Food Act of 1983¹¹.

Even though most studies discovered that food handlers practised good hygiene practices, some found the reverse. For example, based on the survey conducted previously, it is found that food safety attitudes and practices are adequate. However, their food safety knowledge is lacking due to demographic characteristics (working experience, educational level, present working tenure, and professional classification) substantially associated with food safety attitudes ($p < 0.05$)⁹. According to the previous study, limited food safety and hygiene knowledge resulted in the night market street food vendors. This resulted in foodborne diseases in night market street food vendors around Tainan City, Taiwan¹².

Prevalence of Staphylococcus aureus: The test is performed among cooked food and food handlers to identify the presence of Staphylococcus aureus (*S. aureus*) or its enterotoxins to confirm that *S. aureus* is the causative agent of foodborne diseases, to determine if food is a potential source of "stap" food poisoning, and to show post-processing contamination, which is usually affected by people touch or polluted culinary areas. According to a previous study, *S. aureus* is a prominent cause of gastroenteritis caused by contaminated food. It is one of the most common bacteria in foodborne diseases¹³. In addition, one study performed in Klang Valley, Malaysia, is included to observe the prevalence of *S. aureus* in cooked food and handlers. According to a survey conducted, *S. aureus* is found in 95(95%) of food handlers, and 95(100%) of *S. aureus* strains are methicillin-susceptible *S. aureus* (MSSA). This showed a high amount of *S. aureus* detected among food handlers compared to previous studies. This remarkable result might indicate that food hygiene practices are not fully enforced¹⁴.

Management Practices Impact on Hygiene Practices: The assessment of food handlers' knowledge, Attitude and Practice (KAP) regarding food hygiene is not enough to get satisfactory results for hygiene practice. Therefore, some researchers changed their focus to other variables that might impact the attitudes and behaviours of food handlers, such as the organisation's management practice and safety culture. This research includes one study that was performed to assess the impact of management practices. According to a previous study, it was discovered that manager-employee communication had a significant effect on hygiene practices ($p < 0.05$)¹⁵. Following that, the latest research also disclosed that communication between the management and employee significantly affected food safety practices¹⁶⁻¹⁸.

DISCUSSION

This systematic review's primary goal is to examine food hygiene knowledge, attitude, and practice among food service professionals. Based on our study, we discovered several findings regarding food hygiene knowledge, attitude, and practice of food handlers in various food settlements such as school canteens, street food vendors and restaurants. We disclosed that the food hygiene attitudes of food handlers are acceptable and appropriate, with a high number of studies showing the same result. However, there is a poor result regarding food hygiene knowledge among food handlers within the included studies. Consequently, we ascertained that food hygiene practices are not fully adhered to by the food handlers. We also found that other variables also significantly affected the hygiene practices of food service

providers. The prevalence study of *S. aureus* among food handlers is also included to evaluate food hygiene practices.

Food hygiene knowledge of food handlers is decided as poor due to some factors that directly influenced the results. One of the major factors is the educational level of the food handlers themselves. The academic level is very important as it will decide the overall knowledge and attitude of the food handlers towards safe food handling. There are numerous studies conducted that have proven the significant effects of educational level on food hygiene practices. Other than that, the level of education of food handlers is the most significantly linked with food hygiene knowledge, followed by food hygiene attitudes and practices⁹. To support this, previous studies also stated that they had discovered that educational level had a statistically significant effect on food hygiene knowledge^{7,19}.

Apart from that, we also found that food handlers' hygiene attitudes were acceptable. Based on included studies, we discovered that most food handlers had satisfactory results regarding hygiene attitudes. Moreover, most food handlers' attitudes are permitted due to the high mean score and SD of the questionnaire related to hygiene attitudes^{6,10}. Most food handlers involved in these studies know the risk of cross-contamination and their responsibilities toward safe food handling during food processing procedures. Moreover, based on the survey conducted, it is discovered that the hygiene attitudes of food handlers comply with school canteen management guidelines and Food Act 1983 regulations²⁰. According to the findings of this study, adherence to school canteen guidelines and authorities laws significantly influenced food workers' attitudes regarding proper food handling. This strengthens our judgements regarding hygiene practices among food handlers.

Lastly, we discovered that food hygiene practices are not fully adhered to by food handlers. Two studies identified that hygiene practices among food handlers are not satisfactory. According to the survey conducted previously, it has been discovered that food safety practices are very poor, with only 5.88 ± 3.02 (mean score \pm SD)⁹. To support this, it is also summarised that street food vendors' overall hygiene practices and food safety adherence are insufficient, according to a study done in four nations²¹. Moreover, it was also found that limited food safety and hygiene knowledge resulted in poor hygiene practices by the night market street food vendors¹². Other than that, a prevalence study conducted by Seow WL,⁴ on *S. aureus* among food handlers and cooked food detected a high amount of *S. aureus* among food handlers. This remarkable outcome has raised many questions regarding properly enforcing hygiene practices in food vendors.

Furthermore, the previous study revealed that the prevalence of *S. aureus* is higher compared to other studies¹⁴. Moreover, most Methicillin-resistant Staphylococcus aureus (MRSA) is low among food handlers. MRSA is responsible for infections in people that are difficult to cure. Although the prevalence of MRSA is lower than *S. aureus*, it might indicate poor hygiene practices among food handlers. Next, a lack of supervision by the local authorities also influenced hygiene practices among food handlers. Besides, insufficient government aid towards safe food handling has caused poor hygiene knowledge among food handlers in food street compounds¹². The government should broaden their focus toward all sectors of the food chain. The reason for this is that according to the studies conducted previously, it has been found that hygiene practices are excellent because both study locations had constant supervision by the government^{8,11}. This proves that continuous care from the government had an extraordinary effect on the hygiene practices of food handlers.

There are a few limitations that we identified throughout the study process. The major restriction we encountered is the differences in data such as study location, data collection and a multi-sociodemographic component of studies included. Other than that, insufficient research on food hygiene among food service providers resulted in a low number of studies included in this

research. In addition, a self-reported technique used in several included studies has bothered the overall findings of certain criteria. This technique caused a risk of bias in the results as most of the food handlers did not want to give a bad perception of their workplaces.

CONCLUSION

This study concluded that food hygiene attitudes were acceptable; however, food hygiene knowledge and practices were poor. Furthermore, additional research should be conducted to assess the impact of coronavirus disease 2019 (COVID-19) on food safety knowledge, practices, and attitudes of food handlers.

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