Review of International Food Safety Research Studies in Catering and Manufacturing Environments.

Ellen W. Evans[1*] Rebecca L. A. Evatt[2] & David C. Lloyd[1]

[1]ZERO2FIVE Food Industry Centre, Cardiff Metropolitan University, Cardiff, United Kingdom.
[2]Cardiff School of Sport and Health Sciences, Cardiff Metropolitan University, Cardiff, United Kingdom.
*Corresponding author: elevans@cardiffmet.ac.uk

Introduction

Foodborne illness outbreaks associated with manufacturing and catering environments remain a public health concern. The food handler is often identified as one of the key causes of foodborne illness,[1] and has been frequently cited as a significant contributory factor for foodborne illness in restaurant-associated outbreaks.[2]

Internationally, cross-contamination, insufficient heat treatment of foods, inadequate refrigerated storage of food, inadequate hand decontamination practices and improper cleaning of food contact surfaces are the most common contributory factors associated with the transmission of foodborne infection.[3, 4]

Consequently, the UK Food Standard Agency have recommendations in place for food businesses to ensure food safety relating to the four key areas of cross-contamination, cleaning, chilling and cooking.[5] Food-handler implementation and adherence of such recommendations are essential.

Subsequently, there is a need to assess the food safety cognition and behaviour of professional food handlers in the food sector. Numerous studies have been conducted involving professional food-handlers, however, to date, a review of the food safety knowledge, attitudes, self-reported practices and observed behaviours of professional food handlers in the food sector has not be conducted.

Purpose

The purpose of the study was to review the methods and measures utilised in research studies to assess the food-safety awareness and practices of professional food-handlers in catering and manufacturing environments.

Methods

Data Collection: An inclusion exclusion criteria was devised to identify primary research studies suitable for inclusion. Professional food-handlers were defined as those that are responsible for the preparation, service or sale of food products to/for consumers, are likely to have undergone food safety training and food handling occurs outside of the domestic environment.

Data capture: A database was devised to capture primary research data regarding the food safety knowledge, self-reported practices, attitudes and behaviour of professional food handlers. Identified research studies were reviewed, and findings were summarised and recorded using the database.

Ethical Approval: Approval was obtained from the Health Care and Food, Ethics Panel at Cardiff Metropolitan University.

References

1. Roberts, D. (1990). "Sources of infection: food." The Lancet **336**(8719): 859-861.
2. Gould, L. *et al.* (2013). "Contributing Factors in Restaurant-Associated Foodborne Disease Outbreaks, FoodNet Sites, 2006 and 2007." Journal of food protection **76**(11): 1824-1828.
3. Public Health England. (2015). "PHE Gastrointestinal Infections Data. Summary of eFOSS data, 2013." Retrieved 6th July 2015, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/426019/eFOSS_surveillance_tables_for_Web.pdf.
4. FSA. (2016). "Safer food, better business for caterers." Retrieved 27th April 2017 from https://www.food.gov.uk/business-industry/caterers/sfbb/sfbbcaterers.
5. U.S. Food and Drug Administration. (2000). "Report of the FDA Retail Food Program Database of Foodborne Illness Risk Factors. FDA Retail Food Program Steering Committee." Retrieved 13th September 2016, from http://www.fda.gov/downloads/Food/GuidanceRegulation/UCM123546.pdf.
6. Smigic, N. *et al.* (2016). "The level of food safety knowledge among meat handlers." British Food Journal **118**(1): 9-25.
7. Sani, N. and O. Siow (2014). "Knowledge, attitudes and practices of food handlers on food safety in food service operations at the Universiti Kebangsaan Malaysia." Food Control **37**: 210-217.
8. Al-Shabib, N., *et al.* (2016). "Cross-sectional study on food safety knowledge, attitude and practices of male food handlers employed in restaurants of King Saud University, Saudi Arabia." Food Control **59**: 212-217.
9. Liu, S., *et al.* (2015). "Knowledge, attitude and practices of food safety amongst food handlers in the coastal resort of Guangdong, China." Food Control **47**: 457-461.
10. Kunadu, A., *et al.* (2016). "Food safety knowledge, attitudes and self-reported practices of food handlers in institutional foodservice in Accra, Ghana." Food Control **69**: 324-330.
11. Clayton, D. & C. Griffith (2004). "Observation of food safety practices in catering using notational analysis." British Food Journal **106**(3): 211-227.
12. Robertson, L. *et al.* (2013). "Educational needs assessment and practices of grocery store food handlers through survey and observational data collection." Food Control **34**(2): 707-713.
13. Jean, H. & B. Deborah (2007). "An assessment of food safety knowledge and practices of catering employees." British Food Journal **109**(7): 562-576.
14. Jevšnik, M., *et al.* (2008). "Food safety knowledge and practices among food handlers in Slovenia." Food Control **19**(12): 1107-1118.
15. Rebouças, L., *et al.* (2016). "Food safety knowledge and practices of food handlers, head chefs and managers in hotels' restaurants of Salvador, Brazil." Food Control.

Handouts

All posters from the ZERO2FIVE Food Industry Centre are available for download from: www.cardiffmet.ac.uk/health/zero2five/research

Results

A total of 20 studies detailing professional food-handler food-safety data were identified and reviewed. Half (50%) of the research studies were published between 2013 – 2017. Countries where data collection was conducted included Austria, Brazil, China, Ghana (*n*=2), Lebanon, Malaysia, Portugal, Saudi Arabia, Serbia, Slovenia (*n*=2), Spain, UK (*n*=2), USA (*n*=4) and Vietnam.

Research study settings

As indicated in Figure 1 all food handling settings were included in the reviewed studies. The majority of studies (75%) included catering establishments. However, fewer studies were found to have been conducted in retail and high-risk institutional food service environments, such as schools, nursing homes and hospitals (15% of studies). This study determined a lack of research detailing food-handler food safety practices in the food and drink industry sector such as in food manufacturing and processing environments (10%).

Given the volume of food produced by this sector, research exploring the cognition and behaviour of these food-handlers is required.

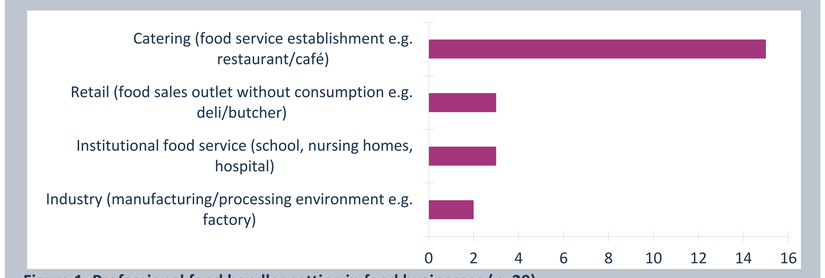

Figure 1. Professional food handler setting in food businesses (*n*=20).

Research study sample sizes

The utilised data collection method can also influence the sample size achieved. In the reviewed food-handler studies, survey methods such as questionnaires and interviews obtained the highest sample sizes (< 2,176 food-handlers).

Methods that can be more time consuming and costly to administer such as observation of behaviour and focus groups obtained lower sample sizes (< 120 food-handlers).

Table 1. Sample sizes obtained from data collection methods in reviewed studies

Details of methods utilized	No. of participants
Questionnaire (*Self-complete paper-based)*	50 – 2,176
Interview *(Face-to-face and over the telephone)*	60 – 278
Observation *(Covert researcher, covert remote and overt observation)*	15 – 115
Focus group *(In person, guided interview)*	80 – 120

Research methods

Figure 2 illustrates that survey methods of data collection were most frequently used in the reviewed studies, which included self-complete questionnaires (80% of studies) and interviews (35%). Observation of behaviour was less frequently used (30%). Only one study utilised focus groups as a method of data collection.

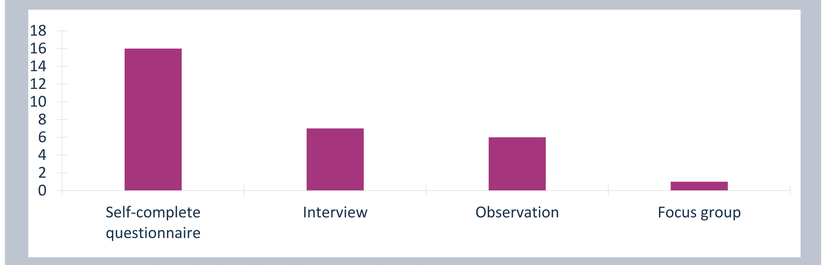

Figure 2. Research methods utilised in reviewed studies (*n*=20).

Research measures

Research methods influence the data that can be measured. Given questionnaires were most frequently used, assessment of knowledge and self-reported practices were most frequently determined (figure 3).

Determination of attitudinal data, actual behaviour along with microbiological and temperature data were less frequent in reviewed research studies.

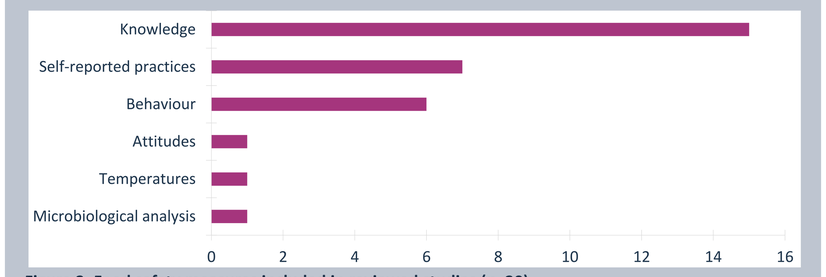

Figure 3. Food safety measures included in reviewed studies (*n*=20)

Food safety practices included in food handler food safety studies

The most frequently included food safety topics in the reviewed studies relate to the areas of cleaning, cooking, chilling and separation. Data detailing freezing practices, HACCP principles and personal protective equipment (PPE) were less frequently collated (Figure 4).

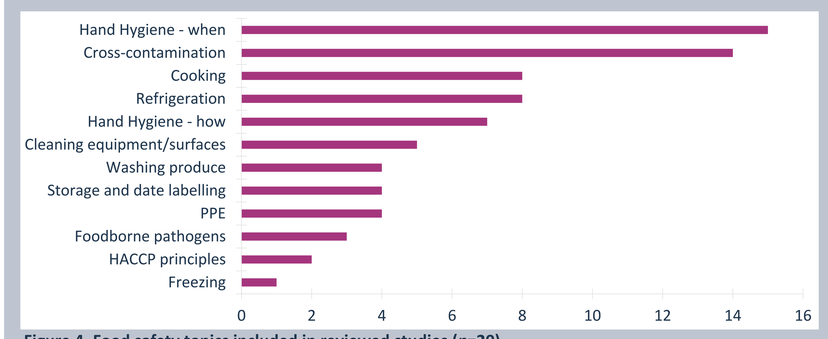

Figure 4. Food safety topics included in reviewed studies (*n*=20)

As indicated in Table 2, food-handlers were most knowledgeable of cleaning and separation practices. However, findings indicate that food-handlers may implement behavioural malpractices.

Findings suggest discrepancies may exist between knowledge, self-reported practices and observed behaviour, for example >90% were aware of occasions requiring handwashing and reported washing hands at such occasions, however, observational data suggest the majority fail to implement adequate handwashing attempts.

Table 2. Comparison of food safety knowledge, attitudes and observed behavioural data from reviewed studies (*n*=20).

	Knowledge	Self-reported practices	Observed behaviour
Cleaning	90 – 99% aware of occasions that required handwashing [6, 7]	92 – 95% reported washing hands before/after specific occasions [8, 9, 10]	14% performed adequate hand hygiene practice [11]
Cooking	38% aware of the correct temperature to cook raw poultry [12] 25% not aware of safe holding temperature [13]	50% reported implementing a corrective action when internal temperature were too low [13]	Failing to check cooking temperature was the most frequent violation [14]
Chilling	44 – 87% aware of the safe refrigeration temperature [12, 13, 15]	*No data available*	*No data available*
Separation	89 – 97% aware of the need to separate raw and cooked food [6, 9, 13]	36% reported that they use separate utensils to prepare raw and ready-to-eat food [10]	61% used different utensils between raw and cooked foods [11]

Significance of study

- It must be acknowledged that numerous food-handler food safety studies, far exceeding those included in this study have been conducted, however a comprehensive review of the methods and measures utilised in such studies has not been conducted. Completion of this review has identified the need for an in-depth systematic literature review to further explore the topic.
- Although vast research exists in relation to food-handler food safety, there is a lack of research conducted in food manufacturing environments, the majority of research focuses on retail catering and hospitality, furthermore, the majority of research incorporates the measures of food safety knowledge and self-reported practices suggesting there is a lack of observational data.