# Food Safety Attitudes, Knowledge, Self-reported Practices and Observed Behaviour of Food-Service Employees: Triangulation of Findings in Published Research.









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### Introduction

Food-service employees are at the final stage of food production and service and thus they play a vital role at safeguarding consumers' health. Working in a food-service establishment requires specific knowledge and correct implementation of food safety practices such as: appropriate personal hygiene; prevention of cross contamination; temperature control; correct storage of food; cleaning and sanitizing procedures (45). In addition, such work involves multitasking, time management and effective communication with customers and colleagues. Therefore, it is important that the food handlers have a positive attitude towards food safety and are motivated to ensure that the food is safe.

Failure to implement appropriate food safety practices may lead to foodborne illness and presently, it is estimated that about a half of foodborne illness outbreaks may be attributed to food-service establishments (26). Thus, understanding cognitive and behavioural factors that may influence food safety compliance is essential for improving food safety in food-service establishments.

Previously conducted quantitative review of research methods in published studies (n=118) revealed that there is a lack of triangulation in food safety research (11). The importance of method triangulation has been widely acknowledged (25), as the singlemethod derived results may be less reliable and more susceptible to bias (16). There is a need to triangulate research findings to have a better understanding of food handler food safety behaviour.

### Purpose

The purpose of this review was to triangulate data across primary studies to gain deeper understanding of food handler food safety behaviour and cognition.

### Methods

The methods used for this review are as follows:

- . A systematic keyword search was conducted to obtain primary peer-reviewed studies published in English in the last 20 years (2001-2021).
- Data was collated and recorded using a Qualtrics Database created for the purposes of this review.
- Findings detailing handwashing, preventing cross-contamination and temperature control were gathered. A qualitative content analysis of collated data (n=118) regarding food handler food safety behaviour and cognition (e.g., knowledge, attitude, self-reports) was undertaken.
- . Collated data were triangulated using an interpretative approach and narratively described.

Ethical approval for the study was obtained from the Cardiff School of Sport and Health Sciences Ethics Committee (Project Reference Number: PGR-4434).

### Breakdown of reviewed studies

Quantitative analysis (11) of the studies (n=118) has shown that a third (34%) was published in the years 2019-2021, and the majority was conducted in the United States (29%), Brazil (17%) and United Kingdom (7%). Multiple food-service settings were investigated, with the majority of studies conducted in restaurant establishments (70%) and in university (school) food service facilities (31%).

### Results of data triangulation

Measures investigated in reviewed literature

Food handler behaviour was most often investigated through the assessment of cognitive measures, such as knowledge (58%) and attitude (41%) and behavioural performance was assessed through self-

Food safety practices investigated the most in the research sample included prevention of crosscontamination, hand hygiene and temperature control, as seen in Figure 1.



#### Hand hygiene

Hand hygiene practices performed by food-service employees have been extensively investigated in the reviewed studies.

Handwashing occasion: As indicated in Table 1, many food handlers demonstrated good knowledge of the appropriate handwashing occasions and expressed positive attitudes towards the importance of handwashing at such occasions (5, 8, 13, 20, 21, 29). Despite this, many self-reported failing to wash hands before handling food, after using the restroom or after handling raw meat (9, 23, 30, 32, 38). Additionally, observational data demonstrated food handlers' lack of handwashing before handling food, after coughing or sneezing and after touching their phone (18).

Handwashing process: Table 2 indicates that confusion existed among food handlers in relation to appropriate process (10, 36, 40, 44), especially highlighting the lack of knowledge about the recommended handwashing steps (43).

Handwashing duration: As indicated in Figure 1, observational data detailing handwashing duration, are particularly lacking. Such data were reported in only one study, confirming that the average duration of handwashing, performed by the food-service food handlers was shorter than recommended 20 seconds (24).

The observational data in the reviewed research highlight the possibility of social desirability bias in self-reported data, where food handlers may be over-reporting hand hygiene practices.

Table 1. Triangulation of cognitive and behavioural findings regarding the handwashing occasions in the reviewed literature (n=118).

landwashing occasion	Positive attitude	Knowledge	Self-reported practice	Observed behaviour
efore handling food	<b>100</b> % ( <i>5</i> )	<b>97</b> % (13)	<b>18-99%</b> (1, 22, 23, 38)	<b>14-21%</b> ( <i>12, 39</i> )
ods	<b>97%</b> (5)	<b>90-100%</b> (8, 20)	<b>64-97</b> % ( <i>9</i> , <i>23</i> , <i>30</i> , <i>32</i> , <i>38</i> )	No data.
fter using the toilet	<b>100%</b> (5)	<b>58-87%</b> (21, 29)	<b>20-95</b> % (1, 13, 22, 29, 32, 35)	No data.
fter touching the hone	No data.	No data.	<b>42</b> % ( <i>34</i> )	<b>14%</b> (18)
After coughing or neezing/blowing nose	<b>89%</b> ( <i>30</i> )	94% ( <i>44</i> )	<b>96%</b> ( <i>6</i> )	<b>10%</b> (18)

Attributes of nandwashing process	Positive attitude	Knowledge	Self-reported practice	Observed behaviour
Jsing soap and water	<b>41%</b> ( <i>30</i> )	<b>32-38</b> % (10, 44)	<b>20-87</b> % (3, 13, 22, 30, 44)	<b>61%</b> ( <i>12</i> )
Following steps nvolved in the nandwashing process	No data.	<b>9-15%</b> ( <i>36, 40</i> )	No data.	<b>0-44%</b> (24, 40)





#### Preventing cross-contamination

Different practices for prevention of cross-contamination were investigated in the reviewed research studies. Triangulation of findings has demonstrated the following:

- Food handlers were generally aware of the risk of food cross-contamination, but lacked knowledge regarding the need to avoid bare hand contact with food, especially when wearing jewellery was shown (7, 40), as indicated in Table 3.
- The use of colour-coded boards and separate knives for raw and cooked foods was selfreported, but the proportion of food handlers observed implementing such practices was low (9), as indicated in Table 3.
- Majority of food handlers were aware of the need to clean food contact surfaces and equipment (4) and knew how to perform appropriate cleaning procedure (33, 38). And whilst majority self-reported practicing the use of clean equipment (3), only a small proportion of food handlers was observed maintaining the cleanliness and hygiene of the surfaces that come in contact with food (2, 14), as indicated in Table 3.

wearing jewellery, the use of same utensils for raw and ready-to-eat food and failure to maintain cleanliness and hygiene of food contact surfaces.

Table 3. Triangulation of cognitive and behavioural findings regarding food safety practices implemented to avoid crosscontamination, in the reviewed literature (n=118).

Food safety practice	Attitude	Knowledge	Self-reported practice	Observed behaviour
Avoiding hand-food contact	95% thought bare hand contact with food was unacceptable (44).	No data.	48-71% reported never using bare hands to probe or touch ready-to-eat food (5, 36).	25% did not have direct contact with food during food preparation (27).
Avoiding wearing jewellery	No data.	39-98% knew that food should not be handled by someone wearing jewellery (7, 40).	91% reported to never wear jewellery when handling food (40).	73% did not wear jewellery when handling food (40).
Using separate utensils for raw and cooked foods	45% agreed that vegetables and raw meat should not be cut on the same chopping board (22).	85% knew that raw vegetables and meat should not be cut using the same knife (17).	59-83% reported a system of colour coded boards ( <i>9</i> , <i>36</i> ). 25% reported a two -knife system ( <i>36</i> ).	36% observed use of a two-knife system (9). 25% were observed using colour coded knives (9).
Cleaning food contact surfaces	94% agreed that knives and cutting boards should be properly sanitized (4).	31-75% knew food contact surfaces should be washed with water and soap, then sanitized (33, 38).	70% practiced the use of clean equipment (3).	11-30% maintained good hygiene of equipment, utensils and work stations (2, 14).



#### **Temperature Control**

In this review, the control of temperature during food preparation has been highlighted as an area of food safety concern for the following reasons, as seen in Table 4:

- There is an overall lack of food handler knowledge about the Danger Zone temperatures (45) in the reviewed literature (3, 19, 20).
- Although food handlers reported awareness of the need to measure internal temperature of food when cooking, not many self-reported implementing this practice (9, 34, 36, 38). Observational data confirmed the use of sensory and visual clues for temperature control by the food handlers (9), and the fact that food produced using these methods may not be reaching required cooking temperatures (14).

Moreover, many demonstrated insufficient knowledge of correct thawing procedures and many self-reported thawing foods at room temperature (9, 10, 15, 35, 36).

Observational findings confirmed that the foods requiring refrigeration may sometimes be stored at improper temperatures (28), despite food handlers' knowledge of correct refrigeration temperatures and positive attitude towards the correct practice.

Food handlers' lack of comprehension of why the temperature control is important and how to correctly implement it, may have a negative influence on the actual practices.

Table 4. Triangulation of cognitive and behavioural findings regarding food safety practices implemented to control temperature, in the reviewed literature (n=118).

Food safety Aspect/ practice	Attitude	Knowledge	Self-reported practice	Observed behaviour
Danger Zone	37% were aware of the importance of time and temperature control (5).	29-36% knew the Danger Zone temperature range (3, 19, 20).	33% reported that they kept and cooked food at safe temperature (2).	26% cooked food and kept it at safe temperature (2).
Measuring internal temperature when cooking	73% considered measuring the internal temperature of food important. (20).	31-36% knew the required internal temperature the foods should reach during cooking (33, 34).	3-40% reported using a thermometer to check if poultry or meat is fully cooked (9, 34, 36, 38).  27% reported using 'touch' (9).  13% reported using specified period of time (9).	43% of cases had food that reached a minimum required internal temperature (14).  Cooking controlled by means of preparation time, individual cooking experience and sensory evaluation (37, 41).
Thawing	No data.	18-68% did not know the correct safe thawing practice (19, 34, 37, 42).	13-73% reported thawing frozen foods at room temperature (9, 10, 15, 35, 36).	20% were observed to not adequately thaw frozen food (31).
Refrigeration	40-98% recognized that it is important to know the temperature of the refrigerator/ freezer (10, 23).	72-78% knew the correct temperature for a refrigerator (10, 20, 31).	21-70% checked the temperature of the refrigerator regularly (20, 22, 32, 42).	In 23% of the restaurants visited, refrigerated food was held at proper temperatures (28).

## Significance of study

This review determined discrepancies between cognitive and behavioural data in published literature:

- Findings regarding cognitive measures (knowledge and attitude) did not correspond to findings regarding the behavioural measures (self-reports and observation) for most of food handler food safety behaviours. Thus, it is suggested that a positive attitude and adequate knowledge do not guarantee the actual performance of food safety practices by the food handlers.
- Discrepancies between the self-reported data and observed behaviours indicate potential presence of social-desirability bias, resulting in inaccurate representation of actual food safety behaviour.
- . This review has determined that the data about food handler food safety practices may be best obtained through a combination of methods, assessing cognitive and behavioural measures and triangulating the findings to ensure validity and to avoid

A lack of behavioural data detailing specific food safety practices was determined:

- . There is a need for comparative observational data detailing practices to gain an accurate representation of food handler behaviour.
- . There is an overall lack of data related to food handler practices when managing allergens and when handling raw meat products.

This review has also demonstrated the need for food handler educational interventions, which would help food handlers understand the reasons behind the implementation of food safety practices and improve risk perception.

Future research based on triangulated research methods will address these issues and provide an in-depth understanding of food handler cognition and behaviour.

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