

Assessment of Food Safety Practices of Older Adults (>60 years) in a Model Kitchen.

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Introduction

The domestic kitchen is an important point of origin for foodborne disease, with data indicating $\geq 95\%$ of all foodborne illnesses to be sporadic¹. This significant source is believed to result from consumer implementation of unsafe food handling and storage practices^{2,3} suggesting improvements of such behaviours are needed to reduce the risk of illness.

The likelihood of illness and potential mortality from foodborne pathogens such as *Campylobacter* spp., *Clostridium perfringens*, *Escherichia coli*, *Salmonella* spp., *Listeria monocytogenes* and *Staphylococcus aureus* is reported to be greater among older adults (≥ 60 years of age) than the general population⁴. European data suggests that foodborne disease associated with older adult consumers has increased by up to 50% over the last decade⁵, as older adults are more susceptible and are at an increased risk of foodborne illness as a result of age-associated weakened immune function⁶.

Previous consumer food safety based research suggests that inadequate domestic food safety practices may be greatest among older adult consumers⁷. Behavioural data such as self report and knowledge provide important information about consumer food safety, however are reported to provide an over optimistic portrayal of actual behaviours⁸.

Determination of actual food safety behaviours implemented by older adult consumers and of actual microbiological contamination of contact surfaces will better our understanding of the potential risks that may increase foodborne disease within this age group.

Aim

This study aims to determine food safety behaviours implemented by older adults using observation and compare observed food handling practices with actual microbiological contamination of the food preparation environment.

Methods

Development of methods

A literature review of consumer food safety studies and domestic microbiological surveys was undertaken to determine unsafe domestic kitchen practices implemented by older adults that may result in contamination and increase the risk of foodborne disease in addition to identifying commonly contaminated domestic kitchen surfaces.

This informed the development of data collection methods, which were subsequently subject to a pilot study. All methods and documentation used in the research study were approved by the Cardiff School of Health Sciences (Cardiff Met) Ethics Committee (Ref 2221).

Participant recruitment

One hundred adults aged ≥ 60 years were recruited according to predetermined criteria from South Wales, UK to participate in a food preparation session.

Food preparation sessions

Participants were requested to prepare a set meal of chicken and ham salad and a selection of sandwiches which included foods commonly associated with pathogen contamination and methods that allowed opportunities for high-risk practices.

Model domestic kitchen

Food preparation sessions were conducted in a model domestic kitchen in the Food Industry Centre which took ~ 60 minutes to complete. Food safety behaviours were observed using ceiling mounted digital cameras (See Figure 1) and recorded using a predetermined behavioural checklist.

Microbiological sampling

Prior to food-preparation, food contact surfaces were cleaned according to a validated-protocol to achieve $< 8.0 \times 10^3$ cfu/cm².

Post food-preparation, surfaces were immediately sampled to determine Aerobic Plate Count (APC) *Enterobacteriaceae* and *Staphylococcus aureus* contamination.

Data analysis

Microsoft Office Excel 2007 and Microsoft Office Access 2007 were used to analyse the data.

Figure 1. FIC model domestic kitchen ceiling mounted digital camera views



Results and Discussion

Participant profile:

Age: 65% 60-69 years, 28% 70-79 years, 7% ≥ 80 years.

Employment: 86% retired, 14% employed/semi-retired.

Food preparation frequency: 52% daily, 29% 4-6 times weekly, 14% 2-3 times weekly, 5% once a week.

Household: 56% living with families/partners, 44% living alone. None lived in residential care homes.

Gender: 80% female, 20% male.

Social group: 85% ABC1, 15% C2DE.

Hand washing and drying

Adequate hand washing and hand drying is required to control the spread of microorganisms^{9,10}. Recommended 'adequate' hand washing and drying practices include the use of hot water and soap, the rubbing of hands and palms together, cleaning between fingers and rinsing hands followed by drying in either disposable kitchen paper or a clean hand towel¹¹.

During food preparation sessions (n=100) a total of 639 hand cleaning attempts such as before starting food preparation, after handling raw chicken or handling raw chicken packaging, were observed.

- Data presented in Table 1 indicate 61% of hand washing attempts did not include use of hot water and only 16% of attempted included the use of soap.
- 4% of older adults were observed implementing adequate hand washing practices for each attempt.
- Although 51% of hand drying attempts were considered 'adequate', many preceded hand washing attempts which were 'inadequate', this could result in cross-contamination of microorganisms on to hand towels⁷.
- 14% failed to use hot water for any hand cleaning attempts.
- 46% of older adults failed to use soap during the food preparations session.
- Table 2 indicates the proportion of older adults who failed to implement adequate hand washing/drying practices during food preparation which may result cross-contamination, particularly after handling raw chicken.
- 87% of older adults on one or more occasions during the food preparation session failed to implement hand drying after hand washing.

Inadequate hand washing and/or drying after handling foods such as raw chicken may result in contamination of surfaces subsequently touched. Data in Figure 2 indicates potential contamination routes during food preparation of surfaces resulting from contact with potentially contaminated hands as a result of inadequate hand washing and/or drying after handling raw chicken.

- Following inadequate hand washing and/or drying, kitchen surfaces most frequently touched with potentially contaminated hands were tap handles (79%) and refrigerator-door handles (65%).
- Post food-preparation microbial analysis of such surfaces indicated contamination with $< 2.08 \times 10^4$ cfu/cm² APC; $< 4.75 \times 10^3$ cfu/cm² *Enterobacteriaceae* and $< 2.59 \times 10^3$ cfu/cm² *S. aureus*.

Figure 2. Observed hand washing / drying practices immediately after handling raw chicken compared with post food-preparation microbial contamination of kitchen surfaces.

Participant details	Observed hand washing practice	Observed hand drying practice	Potential contamination route	Surfaces contacted with potentially contaminated hands	Post food-preparation microbial analysis
MP019 - Female, 70-79 years, lives alone	Hands held under cold water only. No soap was used	Hands were dried on apron	Potential contamination route	Refrigerator door handle	3.86×10^4 cfu/cm ² APC
MP044 - Female, 70-79 years, lives with family	Hands washed in cold soapy water	Dried in disposable kitchen paper		Tap handle	4.75×10^3 cfu/cm ² <i>Enterobacteriaceae</i>
MP013 - Male, 60-69 years, lives alone	Hands held under hot water only. No soap was used	Dried in disposable kitchen paper		Refrigerator door handle	2.59×10^3 cfu/cm ² <i>S. aureus</i>

Chopping board and knife cleaning

During food preparation sessions (n=100) 696 attempts to wash and dry food preparation equipment such as chopping boards and knives were observed. Data presented in Figure 3 indicate examples of observed failure to implement adequate washing/drying of food preparation equipment compared with post food-preparation microbial analysis which may have resulted as a consequence of inadequate cleaning.

- 82% chopping boards and 85% knives used to prepare ingredients during food preparation were inadequately washed and/or dried.
- Post food-preparation microbiological analysis of these surfaces resulted in up to $< 1.73 \times 10^6$ cfu/cm² APC; $< 1.82 \times 10^4$ cfu/cm² *Enterobacteriaceae* and $< 1.75 \times 10^3$ cfu/cm² *S. aureus*.

Figure 3. Observed food preparation equipment washing / drying practices compared with post food-preparation microbial contamination of equipment.

Participant details	Observed equipment washing	Observed equipment drying	Potential contamination route	Equipment	Post food-preparation microbial analysis
MP092 - Female, 60-69 years, lives alone	Visible food debris removed, wiped with hot water & detergent	Dried with kitchen paper	Potential contamination route	Chopping board	1.73×10^6 cfu/cm ² APC
MP033 - Female, 60-69 years, lives alone	Wiped with damp cloth & detergent	Dried with used hand towel		Knife	5.23×10^3 cfu/cm ² <i>Enterobacteriaceae</i>

Food storage

Ensuring adequate storage practices such as refrigeration prevent increased microbial growth rates¹² and covering foods reduces the potential of cross-contamination. During food preparation sessions (n=100), cooked chicken and ham salads (18%) and sandwiches containing RTE fish, meat and dairy products (21%) prepared were inadequately stored by older adults for consumption >4hours later.

- Up to 18% of older adults failed to refrigerate RTE foods for consumption >4hours later and 8% failed to cover for storage (Table 3).
- No participants stored leftover RTE food out of the refrigerator, however, up to 62% failed to cover RTE-foods such as smoked salmon and sliced cooked ham.
- 59% of those that had raw chicken remaining post-food preparation, failed to cover it for refrigerated storage.

Observed storage practice	(n=100)
Failure to cover left-over RTE food	<62%
Failure to cover left-over raw chicken (n=62)	59%
Inadequately stored prepared food for consumption in 4 hours time	<21%
- Failure to refrigerate	<18%
- Failure to cover	8%

This study addresses a lack of observational data detailing older adult consumers' food safety practices. Findings from this study correspond with previous consumer food safety research:

- Behavioural results indicates that consumers fail to implement adequate hand washing before commencing food preparation¹³, fail to adequately wash hands after handling raw chicken¹⁴ and fail to implement adequate storage for food for later consumption¹⁵.
- Microbiological results correspond that consumer food handling and hygiene practices may result in domestic kitchen contamination⁷.

Implementation of such unsafe food handling and storage practices by older adults can potentially result in cross-contamination of pathogens and may increase risk of foodborne disease to older adults in the home.

- Observational findings indicates that a considerable proportion of older adults implement unsafe food handling and storage practices during food preparation.
- Microbial findings indicate older adults' do not implement sufficient washing/drying practices of food handling equipment and hands.
- Food handling malpractices have been compared to microbial contamination of kitchen surfaces and potential contamination routes suggested.
- Findings suggest a need for targeted risk communication and has implications for future consumer food safety education initiatives.

Conclusions

References

1. FSA, Foodborne Disease: Developing a strategy to deliver the agency's message. Paper/ISA 00/05/02, 2000.
2. Redmond, E.C. and C.J. Griffin, Consumer Food Handling in the Home: A Review of Food Safety Studies. *Journal of Food Protection*, 2003, 66, p. 130-161.
3. Scott, C., Foodborne disease and other hygiene issues in the home. *Journal of Applied Microbiology*, 1998, 86(1), p. 5-6.
4. Smith, L.L., Foodborne illness in the elderly. *Journal of Food Protection*, 1998, 61(10), p. 1229-1230.
5. Gilman, J., et al., Changing Pattern of Human Infections, England and Wales, 2005-2006. *Emerging Infectious Diseases*, 2008, 12(9), p. 1301-1306.
6. Kendall, P.A., V. Jai Niles, and L.C. McEvoy, Food Safety Guidance for Older Adults. *Clinical Infectious Diseases*, 2006, 42(10), p. 1208-1209.
7. Redmond, E.C., et al., Microbiological and observational analysis of cross-contamination risks during domestic food preparation. *British Food Journal*, 2004, 106(10), p. 581-597.
8. Redmond, E.C. and C.J. Griffin, A comparison and evaluation of research methods used in consumer food safety studies. *International Journal of Consumer Studies*, 2003, 27(1), p. 57-63.
9. Centers, C.A., C.J. Griffin, and P. Price, Consumers' attitudes, knowledge, self-reported and actual hand washing behaviour: a challenge for designers of intervention materials. *International Journal of Consumer Studies*, 2003, 27(1), p. 221-224.
10. Anli, A., et al., Effect of hand hygiene on infectious disease risk in the community setting: A Meta-Analysis. *American Journal of Public Health*, 2008, 98(10), p. 1372-1381.
11. WHO, *WHO on hand washing for the general public*, 2011. Available from: <http://www.who.int/topics/handwashing/en/>. C11181872102002.
12. Madsen, L.M., et al., Home Storage Temperature and Consumer Handling of Refrigerated Foods in Sweden. *Journal of Food Protection*, 2004, 67, p. 2076-2077.
13. Woodhead, D. and C.J. Griffin, Assessment of the Standard of Consumer Food Safety Behaviour. *Journal of Food Protection*, 1997, 60, p. 109-109.
14. Redmond, E.C. and C.J. Griffin, A pilot study to evaluate the effectiveness of a social marketing based consumer food safety initiative using observation. *British Food Journal*, 2006, 108(9), p. 753-770.
15. Woodhead, D. and C.J. Griffin, Food safety behaviour in the home. *British Food Journal*, 1997, 99(1), p. 97-104.