

# Older Adults (≥60 Years) Storage of Ready-to-Eat Foods; Knowledge, Attitudes, Self-Reported Practices and Actual Domestic Refrigerator Temperature Profiles

Ellen W. Evans\*, David C. Lloyd & Elizabeth C. Redmond

Zero2five° Food Industry Centre, Cardiff School of Health Sciences, Cardiff Metropolitan University, Wales, United Kingdom.

\*Corresponding author: elevans@cardiffmet.ac.uk

## Introduction

Market intelligence indicates that consumer demand for refrigerated ready-to-eat (RTE) foods has increased in recent years, particularly among older adults (aged ≥ 60 years) whom are reported to be the greatest consumers of such foods (Mintel, 2009; Mintel, 2012).

With the association of RTE foods with *L. monocytogenes* and given the pathogens ability to multiply at refrigeration temperatures there is a need for consumers to implement safe storage practices in the domestic kitchen to ensure the microbial safety of such food products. Practices recommended for consumers to prevent listeriosis include, among others, ensuring safe refrigeration temperatures ( $\leq 5^{\circ}\text{C}$ ) (HPA, 2006; DoH and FSA, 2008).

Currently a lack of cognitive and behavioural data relating to older adults implementation of the recommended practices to reduce the risks associated with *L. monocytogenes* in the domestic kitchen exists (ACMSF, 2008), particularly regarding refrigeration; such research is necessary, particularly given the significant increase of listeriosis among older adults in recent years. Such data may inform the development of future targeted risk communication.

## Research Aim

This study aimed to evaluate older adults' knowledge and attitudes towards safe refrigerated storage in the domestic kitchen, and to determine the actual domestic refrigerator temperature profiles and self-reported refrigeration practices.

## Methods

A literature review was conducted to identify food handling and storage practices related to reducing the risks associated with *L. monocytogenes* to inform the development of the survey used.

Time-temperature profiles of refrigerators ( $n = 43$ ) in older adults' domestic kitchens were determined using Signatrol SL52T self-contained button dataloggers (Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , accuracy:  $\pm 0.5^{\circ}\text{C}$ ) over 136 hours.

Older-adults ( $n = 43$ ) documented self-reported refrigerator usage during profiling; quantitative survey techniques determined knowledge, attitudes and self-reported practices of refrigerated storage practices in the domestic kitchen.

All methods and documentation used in the research study were approved by the Cardiff School of Health Sciences Ethics Committee (Ref 2221). A pilot study was undertaken to assess feasibility and reliability of the data collection methods.

## Participant profile

**Age:** 61% 60-69 years old; 30% 70-79 years old, 9% ≥ 80 years old.

**Gender:** 77% female, 23% male.

**Social class:** 85% ABC1, 15% C2DE.

**Employment:** 86% retired, 14% employed or semi-retired.

**Prepare food:** 52% daily, 29% 4-6 times weekly, 14% 2-3 times weekly, 5% once a week.

**Household:** 60% living with families or partners, 40% living alone. (No participants lived in residential care homes).

## References

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## Findings

### Knowledge & Attitudes

Although older adults had positive attitudes towards the perceived importance of refrigeration in relation to food safety and were aware of practices to ensure the refrigerator remains cold; however, knowledge of the recommended operating temperature was lacking and as presented in Table 1, attitudes towards checking the refrigerator operating temperature were negative.

Table 1. Attitudinal responses to domestic refrigeration practices

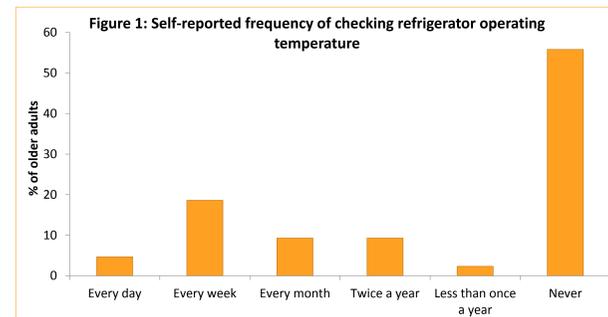
	n	Positive	Neutral	Negative
The need to check the actual temperature of the refrigerator	43	26	21	53
Ensuring a refrigerator is cold enough is essential for safety	41	80	17	2
Concerned about the length of time the refrigerator door is open for	43	84	7	9

- 80% of older adults believed that refrigeration was essential to ensure the safety of food.
- 84% did not know the maximum recommended temperature ( $5^{\circ}\text{C}$ ) for safe food storage.
- 74% failed to express a positive attitude towards the need to check the actual temperature of their refrigerator.

### Self-reported practice

The majority (70%) of older adults in this study reported that they did not know the operating temperature of their own domestic refrigerator.

Furthermore, as indicated in Figure 1, the majority (56%) of older adults in this study reported that they 'Never' check the operating temperature of their domestic refrigerator.



### Actual Domestic Refrigerator Temperature Profiles

The age of domestic refrigerators in older adults kitchens ranged from 4 months up to 30 years, no statistical differences ( $p > 0.05$ ) were determined between operating temperature and temperature fluctuation according to refrigerator age. The majority (70%) of refrigerators were free-standing non-integrated, no significant differences were determined in refrigerator performance according to type ( $p > 0.05$ ) and no significant differences ( $p > 0.05$ ) were determined between refrigerator operating temperatures and participant demographic.

#### Temperature ranges

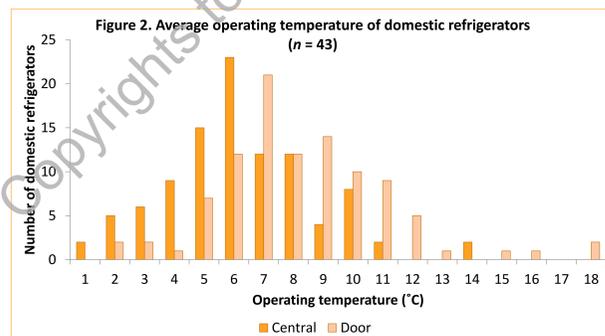
As indicated in Table 2, refrigerator operating temperatures ranged from  $-0.15^{\circ}\text{C}$  to  $17.9^{\circ}\text{C}$ , an average difference of  $1.94^{\circ}\text{C}$  was determined between refrigerator doors and central storage locations operating temperatures.

Table 2. Domestic refrigerator temperature ranges ( $^{\circ}\text{C}$ )

	Door temperature	Central temperature	Door / central difference	Temperature fluctuations
Min	-0.15	-1.72	0.02	1.505
Max	17.90	16.91	4.51	6.03
Mean	7.84	5.88	1.94	3.47

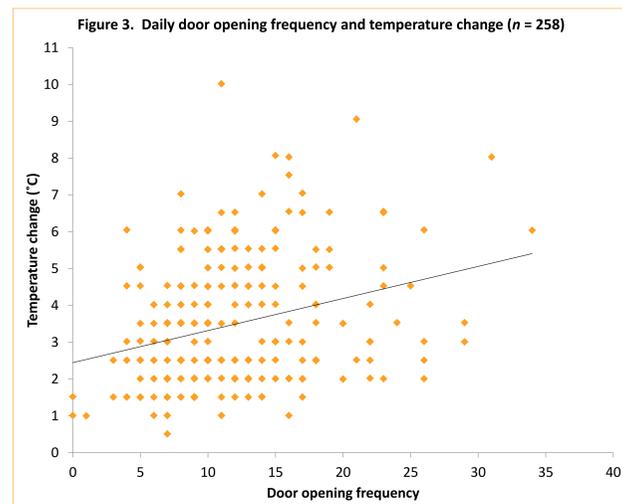
Figure 2 illustrates the average operating temperature of refrigerators; although 21% of refrigerators had average safe operating temperatures, time-temperature profiling determined that:

- 67% refrigerator doors and 40% central storage locations were operating at unsafe ( $> 5^{\circ}\text{C}$ ) temperatures for the duration of the datalogger study (136 hours)
- No refrigerator doors or central storage locations were discovered to operate at  $\leq 5^{\circ}\text{C}$  for the duration of the study
- 9% had a door and central temperature that were  $\leq 5^{\circ}\text{C}$  for 75% of the study



#### Temperature changes

Temperature fluctuations as indicated in Table 2. were determined to be on average  $3.47^{\circ}\text{C}$  each day. Although a relationship between the ambient temperature of the kitchen and the temperature of the refrigerator was determined ( $r = 0.786$ ,  $n = 8192$ ,  $p < 0.005$ ); a positive correlation between temperature change and door opening frequency ( $r = 0.29$ ,  $n = 258$ ,  $p < 0.005$ ), as illustrated in Figure 3, a greater temperature change was observed when a greater number of door opening frequencies was reported.



Changes in the operating temperature of refrigerators were also determined at the times older adults reported putting food in the fridge after returning home from food shopping.

On average a temperature change of  $1.92^{\circ}\text{C}$  at the centre of the refrigerator was noted, when food shopping was reported to be placed in the refrigerator, however this ranged from an increase of  $7.05^{\circ}\text{C}$  to a decrease of  $2.01^{\circ}\text{C}$ .

## Discussion

The findings from this study indicate that although older adults are aware of the importance of refrigeration to ensure the safety of food and had positive attitudes towards ensuring safe refrigeration practices; older adults' knowledge of recommended refrigeration temperatures was lacking and negative attitudes were held towards checking the operating temperature of refrigerators. Such practices may have consequences for food safety by failing to ensure the safe storage temperature for the storage of RTE foods.

Although previous consumer food safety research suggests that knowledge does not transpose to self-reported or actual behaviour (Clayton *et al.*, 2003, Patil *et al.*, 2005), however in this study a Chi-Square (with Yates continuity correction) determined a significant difference in safe/unsafe average operating temperatures of domestic refrigerators according to older adults' knowledge of the recommended maximum operating temperature  $\chi^2(1, n = 43) = 5.442$ ,  $p < 0.05$ ,  $\phi = 0.437$ , with 57% of older adults that knew the safe temperature having refrigerators with an average operating temperature of  $\leq 5^{\circ}\text{C}$ , whilst 89% of those that did not know the maximum recommended temperature having refrigerators with an average operating temperature of  $> 5^{\circ}\text{C}$ .

Refrigerator temperatures in older adults domestic kitchens were determined to be worse (9% operated  $0-5^{\circ}\text{C}$  for 75% of time) than determined in the kitchens of general consumer (10% operated  $0-5^{\circ}\text{C}$  for 90% of the time) (FDI-IEHO, 1994). Temperature changes were found to be significantly correlated with door opening frequency resulting from heat gains during door openings (Saidur *et al.*, 2002).

## Conclusions

- ✓ Although older adults were aware of the importance of refrigeration to ensure food safety, knowledge of safe refrigeration practices was lacking, attitudes towards checking temperatures were negative and the majority reported to 'never' check the temperature.
- ✓ Temperature profiles indicate that majority of older adults store RTE foods at unsafe temperatures which may increase risk of listeriosis in the domestic kitchen.
- ✓ Knowledge of recommended refrigeration temperature has been statistically associated with safe refrigeration temperatures.
- ✓ Findings highlight the need for older adult to improve domestic kitchen refrigeration practices.
- ✓ Data from this study may be used to inform development of targeted food-safety strategies.