Determination of Microbiological and Behavioural Risks Associated with Listeriosis in Older Adults' (>60 Years) Domestic Kitchens.

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Introduction

The pathogenic bacterium *Listeria monocytogenes* is ubiquitously distributed in the environment (Conly and Johnston, 2008) and is described as being psychrotrophic in nature as it has the ability to grow at refrigeration temperatures (Ryser and Marth, 2007). *L. monocyogenes* is the foodborne pathogen responsible for human listeriosis (Farber and Peterkin, 1991).

Listeriosis has the highest rate of reported hospitalisations (91% - 95%) (HPA, 2008; Jemmi and Stephan, 2006) and related mortality (20% - 40%) of foodborne diseases internationally (Kirk *et al.,* 2012; Scallan *et al.,* 2011; Mook *et al.,* 2012). European incidence has doubled since 2001, almost exclusively among adults aged ≥60 years, with two-thirds of reported cases in 2007 associated with older adults aged ≥60 years (HPA, 2008).

Cases of listeriosis are reported to be largely sporadic (Gillespie *et al.,*2006) and data indicates ≥95% of all foodborne illnesses are sporadic (FSA, 2000), many of which are believed to be associated with consumers' homes resulting from unsafe food handling practices (Redmond and Griffith, 2003; Scott, 1996). Many cases of listeriosis are reported to be related to the consumption of extended shelf-life (usually refrigerated) ready-to-eat (RTE) foods commonly associated with *L. monocytogenes* (Gombas *et al.,* 2003) such as soft cheeses, smoked seafood, cooked meat products and pâtés (Gombas *et al.,* 2003; Wagner *et al.,* 2007).

As the foodborne pathogen has the ability to multiply at refrigeration temperatures, implementation of adequate storage practices are necessary to maximise food safety and reduce risk of listeriosis. Practices recommended for consumers to prevent listeriosis include the following (HPA, 2006; DoH and FSA, 2008):

- ***Adhere to 'use-by' dates on RTE foods***
- ***Ensure safe refrigeration temperatures***
- ***Following storage guidelines for opened RTE foods***

Recently the Advisory Committee on the Microbiological Safety of Food reported on the increased incidence of listeriosis among older adults in the UK and identified a need for information on the food consumption, handling and storage behaviours in the in the domestic kitchens of older adults to determine to factors contributing to the risk of listeriosis in the home (ACMSF, 2008).

Research Aim

This study aims to evaluate microbiological risks factors in older adults' domestic kitchens that may contribute to risks associated with listeriosis.

Methods

A systematic review of literature was conducted to identify key behaviours associated with listeriosis and determine domestic kitchen sites commonly contaminated with *L. monocytogenes* to inform content of the 'in home' study to determine older adult domestic food handling, storage and consumption habits.

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

Participants were recruited according to predetermined criteria. Older adults' (≥60 years) domestic kitchens (n=99) were visited following a parallel study (Evans *et al.,* 2012) conducted in the Food Industry Centre. This 'in home' study included a microbiological analysis of kitchen surfaces, observation of older adults' storage practices supported by self-reported storage times and recorded refrigerator temperatures:

- Pre-determined food contact surfaces, including refrigerator shelves and salad drawers (n=984) were sampled to assess the presence of *Listeria* spp. and *L. monocytogenes* using HPA National Standard (HPA, 2009).
- Domestic kitchen refrigerator operating temperatures were recorded using calibrated probes (ITS P 300W Temp) from a central location and from the door.
- Storage of foods associated with listeriosis were observed in older adults' home kitchens. Subsequent questioning determined self-reported lengths of storage times and intention for further storage and consumption.
- Cumulative findings were compared with recommended storage practices and safe refrigeration temperatures (≤5°C) (DoH and FSA, 2008)

Participant profile

Age: 65% 60-69 years, 28% 70–79 years, 7% ≥ 80 years.
Gender: 80% female, 20% male.
Social class: 85% ABC1, 15% C2DE.
Employment: 86% retired, 14% employed/semi-retired.
Prepare food: 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. (No participants lived in residential care homes).

Results

Isolation of L. monocytogenes from older adults domestic kitchens

Of the older adults' domestic kitchens sampled in this study (n=99), a small number were found to be contaminated with *Listeria* spp. and *L. monocytogenes*.

- *Listeria* spp. was isolated in 7% of domestic kitchens predominately from wet environments including the sink and dishcloth.
- *L. monocytogenes* was isolated in 2% of older adults' domestic kitchens, from hand contact surfaces such as a refrigerator door handle and a hot water tap handle.
- *Listeria* spp. and *L. monocytogenes* were not isolated from refrigerator shelves or salad drawers.

Refrigerator operating temperatures

The majority of refrigerators in this study operated at temperatures in excess of recommended safe refrigeration temperatures as seen in Figure 1.

- 85% of older adults' domestic refrigerators operated at temperatures >5°C.
- Temperatures ranged from 0.5 °C to 17.4 °C (mean temperature 6.2°C).

Storage of foods associated with L. monocytogenes

Foods associated with *L. monocytogenes* were stored in the majority (70%) of older adults' homes. Such foods found in older adults' domestic kitchens and the reported storage length or conditions that do not comply with recommended practices can be found in Table 1.

- 54% had been reportedly stored by older adults for longer than the recommended 2 days after opening.
- 43% of foods were beyond the 'use-by' dates, and were reportedly intended for consumption.
- 15% of older adults in this study were observed to store foods associated with listeriosis such as soft cheese, butter and cooked meats at ambient temperature for reportedly up to 4 weeks.

Figure 1. Distribution of older adults' domestic refrigerator temperatures

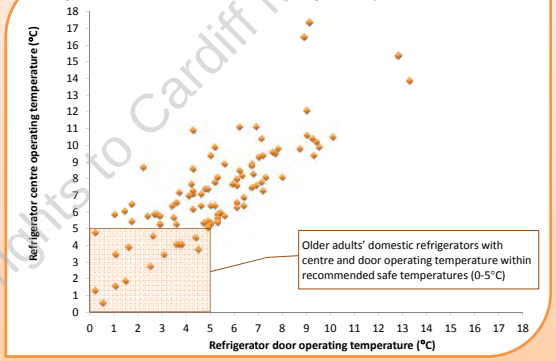

Table 1. Storage of foods associated with *L. monocytogenes* in older adults' domestic kitchens

Participant details	Food type	Reported length of opened storage	Reported intention of further storage	Recorded/observed storage conditions
MP010 Female 60 - 69 years	Soft cheese	2 weeks ago	Up to 4 weeks	Covered in refrigerator (9.2°C)
MP038 Male 60 - 69 years	Cooked meat	3 days ago	1 day	Covered in cupboard at ambient temperature
MP073 Female 70 - 79 years	Butter	2 weeks	2 weeks	Covered butter dish at ambient temperature
MP044 Female 70 - 79 years	Pâté	3 days	1 day	Covered in refrigerator (5.3°C)

Discussion

Cumulative behavioural and microbiological findings indicate that older adults may be at an increased risk of listeriosis from failing to ensure adequate storage practices for foods associated with *L. monocytogenes*.

Findings from this study correspond with previous research that:

- Domestic refrigerators in the homes of older adults' operate at temperatures in excess of recommended safe temperatures (Johnson *et al.,* 1998).
- Older adults subject RTE foods associated with listeriosis to prolonged storage times after opening (Terpstra *et al.,* 2005).
- 'Use-by' dates are frequently not adhered to by older adults (Hudson and Hartwell, 2002).

Conclusions

- *Listeria* spp. *and L. monocytogenes* was isolated from older adults domestic kitchens.
- Foods associated with *L. monocytogenes* are commonly consumed by older adults that are stored at temperatures exceeding recommendations over prolonged periods of time or beyond 'use-by' dates.
- Overall findings from this study suggest older adults frequently implement unsafe food storage practices in the domestic kitchen, that may increase the risks associated with listeriosis.

Findings may be used to inform the development of targeted consumer food safety interventions to improve safe food handling and storage behaviours among older adults.

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