SEFARI Fellowship with Food Standards Scotland

Determining the lifestyle factors which cause particular members of the older population to become ill with foodborne illness

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Abstract

Foodborne illness remains a significant public health concern that disproportionately affects older individuals aged ≥65 years due to age-related immune decline, chronic conditions, and medication use. Despite representing 20% of Scotland's population, those aged ≥65 account for 68% of listeriosis, 23% of campylobacteriosis, and 60% of norovirus infections. The SEFARI fellowship, in collaboration with Food Standards Scotland, aims to identify the key lifestyle factors contributing to foodborne illness among individuals aged ≥65 years and provide recommendations to enhance food safety communication strategies.

This study utilised a qualitative research approach of undertaking online and in-person focus groups with individuals aged ≥65 and family caregivers to explore food safety perceptions, behaviours, and perceived vulnerabilities. Data collection was guided by a bespoke research framework that integrated the Health Belief Model with key determinants influencing food safety practices: biological, physical, psychological, economic, and social factors. A structured NVivo codebook was utilised for thematic analysis of focus group transcripts.

Results highlight a range of modifying factors that influence food safety behaviours. Biological determinants, such as mobility limitations and sensory impairments, impact food handling and storage. Physical determinants, including limited transport access and food deserts, affect shopping habits. Psychological factors, such as cognitive decline and motivation, shape food safety decision-making. Economic constraints influence food purchasing and storage practices, while social factors, such as living alone, contribute to unsafe food handling. Many of these factors are interconnected and have implications for food safety. Insights from the Health Belief Model reveal gaps in perceived risk, motivation, and behavioural evaluation that must be addressed in future Food Standards Scotland food safety messaging.

The findings indicate the need for tailored food safety interventions targeting individuals aged ≥65 years. Recommendations for Food Standards Scotland include revising consumer advice to enhance risk perception, addressing barriers to safe food practices, and employing behaviour-driven communication strategies. Future campaigns should integrate clear cues to action, and practical food safety guidance tailored to the needs of this vulnerable group.

1 Background

The Food Standards Scotland strategy (2021-2026) sets out a vision to create a safe, healthy and sustainable food environment that benefits and protects the health and well-being of everyone in Scotland (Food Standards Scotland, 2021). A key objective for delivering this vision and which is set out in the Food (Scotland) 2015 Act is to protect the public from risks to health which may arise in connection with the consumption of food.

Dissemination of food safety advice to consumers to reduce foodborne illness in Scotland is a key priority for Food Standards Scotland. However, the level of risk from foodborne illness is not equal across consumers, with vulnerable groups within society being more susceptible to or at greater risk of severity from acquiring food poisoning.

A recent comprehensive review undertaken on behalf of Food Standards Scotland consolidated available evidence (Evans & Ilic, 2024). The report summarised that people aged ≥65 years make up 20% of the population of Scotland (Scotland's Census, 2023), however 68% of listeriosis, 23% of campylobacteriosis and 60% of norovirus infections are among the age group. Although the report provides comprehensive information detailing why the age group are particularly susceptible to illness from foodborne illness (e.g. senescence, comorbidity and polypharmacy), completion of the study suggested the need to explore the perceptions and practices of this clinically vulnerable group along with their preferences for future food safety communication approaches (Evans & Ilic, 2024).

Therefore, the aim of this SEFARI fellowship with Food Standards Scotland is to determine the lifestyle factors which cause members of the older population to become ill with foodborne illness. The outputs of this independent, external review will provide the evidence needed to allow Food Standards Scotland to identify any areas of change in relation to current consumer advice. Ultimately, this will inform the updating of consumer advice and communications approach to target the clinically vulnerable consumer group within the Scottish population with relevant food safety advice routinely but also in response to foodborne incidents (SEFARI, 2023).

2 The appointed SEFARI Fellow – Dr Ellen Evans

My background as a Reader of Food Safety Behaviour at Cardiff Metropolitan University has nurtured a fascination with the intricate interplay between individuals and their relationship with food. Specifically, I am captivated by how knowledge, perceptions, and life circumstances shape behaviour and subsequently impact food safety. This intrigue extends across various contexts, from food handlers in the industry to consumers in domestic environments. However, it is the prevention of foodborne illnesses among clinically vulnerable groups, particularly older adults, that deeply resonates with me, which is why I was excited by this Fellowship opportunity.

I have a substantial portfolio of research experience and an extensive body of publications concerning the food safety behaviours of older adults and vulnerable populations. I have significant scientific expertise relating to key food safety risks specifically associated with older adults. Moreover, I have experience of engaging with older adult and relevant stakeholders for data collection purposes. As an experienced academic, I have experience of using desk-based methodologies to undertake evidence and literature reviews, I can capture, analyse, and report on new and existing data to explore this area further. I regularly prepare reports, research publications, and communicate with non-technical audiences.

Due to the shift in incidence of listeriosis from pregnant women (1980s – 1990s) (Tappero et al., 1995) to older adults (2000 onwards)(ACMSF, 2008; EFSA Panel on Biological Hazards, 2007; Public Health Laboratory Service, 2015), my PhD explored older adult (individuals aged ≥60 years) domestic food handling and storage practices associated with the risk of listeriosis (Evans, 2015). As part of the PhD, I undertook a desk-based review of consumer food safety research studies (*n*=165), which identified that the majority of studies reported knowledge and self-reported practices, and that data detailing older adult behaviours and attitudes were particularly lacking (Evans & Redmond, 2014). Consequently, I undertook extensive research with adults over the age of 60, including;

- Interviews regarding attitudes towards domestic food safety practices (Evans & Redmond, 2019c),
- Questionnaires concerning food safety knowledge and self-reported practices (Evans & Redmond, 2016a),
- Domestic kitchen food preparation sessions to observe food safety behaviours (Evans & Redmond, 2018a),
- Observation of storage practices in consumer domestic refrigerators (Evans & Redmond, 2015),
- Microbiological survey of domestic kitchens (Evans & Redmond, 2019a),
- Time-temperature profiling of domestic refrigerators (Evans & Redmond, 2016b).

A comparison of the results from these studies revealed that while older adults were knowledgeable of some food safety practices, disparities were identified between self-reported and observed behaviours, and many failed to express positive attitudes towards essential food safety practices (Evans, 2016a, 2016b). Although my research established that the identified malpractices significantly increased the growth rate of *Listeria monocytogenes* (Evans & Redmond, 2019b), the research does not tell us ***why*** these behaviours exist, which is why I felt compelled to undertake this Fellowship.

In addition to the described research with older adult consumers, I have recently undertaken a comprehensive review of the "clinically vulnerable groups" susceptible to foodborne illness on behalf of Food Standards Scotland (Evans & Ilic, 2024), which involved:

- Consolidating Scottish prevalence data to determine who are the clinically vulnerable groups in Scotland, with regards to Campylobacter, Salmonella, Shiga toxin-producing *Escherichia coli* (STEC), *Listeria monocytogenes* and norovirus.
- Collating additional evidence from comparable developed countries to undertake a systematic review of foodborne illness prevalence among clinically vulnerable groups.
- Undertaking a narrative review to obtain an in-depth understanding of the physiological background to susceptibility among clinically vulnerable groups.
- Identifying the current definitions of clinically vulnerable groups used by other food safety organisations to establish the groups most referred to as being clinically vulnerable.

Several of the findings from the comprehensive review report for Food Standards Scotland are also of benefit to this report and are referred to as necessary.

3 Introduction and background literature

The background literature focuses on the growing population of individuals aged ≥65 years globally and in Scotland. It emphasises the increased susceptibility of the population to foodborne illness and the prevalence of illness such as listeriosis, salmonellosis, campylobacteriosis and norovirus. The literature also examines underlying health conditions and medications such as cancer, diabetes, and proton pump inhibitors that further increase susceptibility.

Additionally, the literature includes consumer food safety research from the past decade, encompassing global, UK, and Scottish studies, and explores behavioural models in order to understand why certain food safety behaviour may exist. Cumulatively, the studies reviewed in the background literature provide a strong rationale for undertaking this body of work, and the need to better understand and reduce foodborne risks among individuals aged ≥65 years in Scotland.

3.1 Growing population of people aged ≥65 years

Older adult consumers remain an important group for food safety researchers. Globally, the proportion of people aged 60 years and older in the population is expected to increase from 12% to 22% between 2015 and 2050 (World Health Organization, 2022), and in 2020, for the first time in history, people aged 60 years or over outnumbered children under 5 years (United Nations, 2021). In the UK, the 2021 Census reported that there were over 11 million people in the older age groups, representing 19% of the total population, compared with 16% during the previous census in 2011 (Office for National Statistics, 2022). This now includes over half a million people who are at least 90 years of age (Office for National Statistics, 2022). As reported in Scotland's Census (2023), 20% of the 5,436,600 population are adults aged ≥65 years.

3.2 Increased susceptibility of people aged ≥65 years to foodborne illness

Senescence, defined as “biological ageing”, is the gradual deterioration of functional characteristics in the human body due to increasing age, the ageing immune system is less efficient in its response, increasing the risk of severe outcomes and invasive disease among older individuals (Chen et al., 2016; Parry et al., 2013; Scallan et al., 2015a, 2015b).

Ageing affects innate immunity; however, the underlying molecular events are not well understood (Goronzy & Weyand, 2013). Much more is known about adaptive immunity. Ageing results in slower production of T-cell and B-cells by immune system organs, causing the decline in immune system function (Montecino-Rodriguez et al., 2013). As the immune system progresses through senescence, older adults become more vulnerable to foodborne infections. In essence, the greater the age, the higher the risk of foodborne illness

In high-income countries, the greatest increases in the prevalence of multimorbidity commonly occur in two periods: between the ages of 50 and 60 years, and in advanced old age (≥70 years) (WHO, 2015). Indeed, the risk of severe outcome and incidence of invasive foodborne illness resulting in complications and mortality increase with age (Parry et al., 2013; Scallan et al., 2015a).

While ageing related changes are unavoidable, their timing varies widely among individuals. Furthermore, the incidences of chronic inflammatory diseases (e.g. cardiovascular disease, diabetes, cancers, etc.) also increase during this time. As described in the Food Standards Scotland report regarding clinically vulnerable groups (Evans & Ilic, 2024), the underlying conditions among older adults, and the medications used to treat or manage such conditions, increase susceptibility among older adults to foodborne illnesses even further. Ageing individuals are also likely to experience multimorbidity. Management of these conditions that occur more frequently in older individuals (adults aged ≥65 years) require chronic medications that reduce levels of stomach acid as a side effect (Dumic et al., 2019), such medications are also documented in the recent Food Standards Scotland report regarding clinically vulnerable groups (Evans & Ilic, 2024) as having a significant impact on the prevalence of foodborne illness.

Due to complex overall ageing processes involved, immune system senescence occurs at a different pace in individuals. However, in the literature, 60 is frequently cited (WHO, 2015) as the age when the immune system is considered senescent in most ageing adults. The age of 65 is commonly cited in the literature describing foodborne illness infection, however, this cut-off may not be aligned with the physiology of the ageing immune system (Evans & Ilic, 2024).

3.3 Prevalence of foodborne illness among adults aged ≥65 years

To enable an understanding of foodborne illness prevalence among older adults in Scotland, published data from Public Health Scotland and Food Standards Scotland were accessed. Additionally, unpublished reports and datasets were obtained from Public Health Scotland. Prevalence data from Scotland have been discussed alongside global data to gain an understanding of prevalence in Table 1. The incidence, hospitalisation and mortality rates from global studies have also been obtained to understand the susceptibility of adults aged ≥65 years to foodborne illnesses and to explore is if severity of illness varies according to age.

3.3.1 *L. monocytogenes* among adults aged ≥65 years

Listeria surveillance data obtained from Public Health Scotland indicate that 68% of the 166 laboratory confirmed cases of listeriosis between 2012 – 2022 were aged ≥65 years; the 75-79 age band accounted for 18% of the cases. Although data show an increase in prevalence after the age of 65 years, data indicate that 7.2% of listeriosis cases were among people aged 60 – 64 years, compared 3.6% among the 55 – 59 years age band. Of the 10 known deaths believed to be associated with listeria, nine were among those aged ≥65 years (Public Health Scotland, no date).

Numerous global studies also report that the median age of listeriosis cases is ≥65 years (Bennion et al., 2008; Charlier et al., 2017; Gillespie et al., 2009; Gori et al., 2020; Preußel et al., 2015; Suominen et al., 2023; Vallejo et al., 2022).

Prevalence data in global studies range from 30% of cases among people aged ≥65 years in Portugal (Almeida *et al.*, 2006) to 76% of cases in Germany (Wilking *et al.*, 2021), Australia (OzFoodNet Working, 2012) and England (Gillespie *et al.*, 2010). The incidence rate of listeriosis in Finland was reported to be 11-fold greater in those aged ≥75 years compared to other age groups (Suominen *et al.*, 2023). Similarly, in England, incidence rate for listeriosis

peaked in adults ≥60 years, which were 4.4 times the rate compared with children 0-4 years old (Scobie *et al.*, 2019). Furthermore, the mortality rate associated with listeriosis increased with age, those aged 60-69 years, the mortality rate was 30%; among those aged 70-79 years, it was 32%; and those aged 80+, it was 36% (Scobie *et al.*, 2019).

Although incidence of listeriosis is relatively low in comparison to other foodborne illnesses, severity of illness is high, and data suggest that adults aged ≥65 years are particularly susceptible and are disproportionately affected.

3.3.2 Salmonella among adults aged ≥65 years

Of the 3,726 laboratory confirmed cases of non-typhoidal Salmonella in Scotland over the period 2013-2017, 15% were among those aged ≥65 years (Public Health Scotland, Unpublished-d). Although data suggest a peak in young adults, an increase was observed in middle aged adults and a decline in older adults. Mean length of stay increased with age particularly among those aged over 74 years, with the highest proportion of hospitalisations among those aged ≥80 years (Public Health Scotland, Unpublished-d). The cost burden on hospitals from confirmed Salmonella cases increases with age due to the higher rate of hospitalisation and a longer hospital stay among the older adult cases. This increased length of stay may be associated with other conditions (Public Health Scotland, Unpublished-b).

Similar to data obtained from Scotland, global prevalence studies suggested that between 9 – 17% of salmonellosis cases were among older adults (Akil, 2021; Gradel et al., 2008; Graziani et al., 2015; Sala Farre et al., 2015; Tumuhairwe et al., 2008). Incidence rate in Australia increased from 2.4 per 100,000 for those aged 60-69 years to 5.2, and 4.8 per 100,000 for age groups 70-79 years and 80+ (Parisi *et al.*, 2019).

Although the reviewed studies do not suggest that older adults are disproportionally included in prevalence of Salmonella, the severity of illness was greater among adults aged ≥65 years, with the age group having the highest proportion of Salmonella infections requiring hospitalisation (Wilson *et al.*, 2018). The percentage hospitalised for Salmonella and the percentage who died from Salmonella was higher among adults aged ≥65 years than among children aged <5 years or people aged 5-64 years (Scallan et al., 2015b).

3.3.3 *E. coli* among adults aged ≥65 years

Fourteen percent of the 3,358 laboratory confirmed cases of *E. coli* between 2012 – 2023 in Scotland were aged ≥65 years (Public Health Scotland, Unpublished-a). Age distribution data of non-O157 STEC in Scotland during 2019 reported that 12% of cases were ≥65 years and 13% of *E. coli* O157 cases were ≥65 years (Public Health Scotland, 2020). These findings are comparable with global data that suggested between 7 – 17% of *E. coli* cases are among adults aged ≥60 years (Cleary et al., 2021; Gould et al., 2009; Hadler et al., 2018; Kappeli et al., 2011).

The incidence rate for *E. coli* among people aged ≥60 years were available for England and Wales (0.98 cases per 100,000 population) (Adams *et al.*, 2016) and the US (0.22 cases per 100,000 population) (Gould *et al.*, 2013), although these studies reported that crude incidence of *E. coli* infections decreased with increasing age as incidence was lowest among this age group compared to others. It must be acknowledged that the percentage of people hospitalised for *E. coli* O157 and the percentage who died was higher among adults aged ≥65 years than among children aged <5 years or people aged 5-64 years (Scallan et al., 2015b). Thus, indicating the increased severity of illness among the age group.

3.3.4 Campylobacter among adults aged ≥65 years

Between 2013 – 2017, 23% of 30,196 confirmed Campylobacter cases in Scotland were aged ≥65 years. Although those aged 60 – 69 years, 70 – 79 years, and 80+ years accounted for 16%, 11% and 5% of cases respectively, the highest percentage of cases was in the 50 – 59 age group (18%) (Food Standards Scotland, 2020a).

Despite lower incidence, the hospitalisation rate among older adults in Scotland increased with age (60-64 years 12%; 65-69 13%; 70-74 years 19%; 75-79 years 24%, and ≥80 years 33%), furthermore the mean length of stay also increased with age. Thus, demonstrating the increased severity of illness to adults aged ≥65 years.

Data from Scotland also indicated that severity of illness was greater among those of older age. Among the 101 cases admitted to an intensive care or high dependency unit for a Campylobacter related condition, 50% were aged ≥65 years (Food Standards Scotland, 2020b) and the mean age of 67.7 years for cases with a severe outcome was >20 years above the mean age for all Campylobacter cases (46.2 years). This may be attributed to the higher rates of underlying medical conditions among the older population. Over the 5-year period, 12 cases died with *Campylobacter enteritis* with a mean age of 75.5 years (Food Standards Scotland, 2020a, 2020b).

Similarly, in the US, although among adults aged ≥65 years, the rate of infection decreased with age for Campylobacter, the percentage hospitalised for Campylobacter and the percentage who died from Campylobacter was higher among adults aged ≥65 years than among children aged <5 years or people aged 5-64 years (Scallan et al., 2015b). Data from New Zealand also indicated a peak in hospitalisations from Campylobacter among people aged ≥70 years (Baker *et al.*, 2007) The case fatality rate from Campylobacter in the US was highest in persons aged ≥50 years (0.4%) (Vugia *et al.*, 2009).

3.3.5 Norovirus among adults aged ≥65 years

Data obtained from Scotland regarding the 15,725 confirmed norovirus cases between 2012 and 2023, reported that 60% of cases were among those aged ≥60 years.

There was a lack of comparable data globally, with only two of the reviewed studies including prevalence of norovirus among adults aged ≥65 years. These studies suggested that of 37 community acquired cases of norovirus in Italy, 22% were among people aged ≥69 years (Pagani *et al.*, 2018) and that the community incidence rate of norovirus in the US was reported to be 75.8 per 1,000 person-years (Grytdal *et al.*, 2016).

Table 1. Prevalence of foodborne pathogens among adults aged ≥65 years in Scotland and from global studies.

Pathogen	Scottish data	Global data
Listeria monocytogenes	68% of 166 cases (2012 – 2022) (Brownlie, 2024; Public Health Scotland, no date).	30% of cases in Portugal were aged >65 years (Almeida et al., 2006) 65 – 67% of cases in Italy were aged >65 years (Gori et al., 2020) 71% of notifications in Australia were aged >65 years (Leung et al., 2018). 71% of cases in Norway were aged >60 years (Antal et al., 2007). 74% of cases in Australia were aged >60 years and 40% were aged >75 years (Dalton et al., 2011). 76% of cases in Germany were aged >65 years (Wilking et al., 2021) 76% of cases in Australia were aged >60 years (OzFoodNet Working, 2012) 76% of cases in England were aged >60 years (Gillespie et al., 2010)
Salmonella	15% of 3,726 cases (2013 – 2017) (Brownlie, 2024; Public Health Scotland, Unpublished-d).	9% of cases in Denmark were aged >65 years (Gradel et al., 2008). 12% of cases in Spain were aged >65 years (Sala Farre et al., 2015) 16% of cases in US were aged >60 years (Akil, 2021; Tumuhairwe et al., 2008) 17% of cases in Italy were aged >65 years (Graziani et al., 2015). 65 – 67% of cases in Poland were aged >60 years (Milczarek et al., 2021)
Campylobacter	23% of 30,196 cases (2013-2017) (Brownlie, 2023; Food Standards Scotland, 2020a).	3% of cases in Spain were aged >65 years (Sala Farre et al., 2015) 14% of cases in US were aged >75 years (Armed Forces Health Surveillance, 2014)
Shiga toxin-producing *Escherichia coli*	14% of 3,358 cases (2012 – 2023) (Public Health Scotland, Unpublished-a).	7% of cases in Switzerland were aged >60 years (Kappeli et al., 2011) 10% of cases in US were aged >65 years (Hadler et al., 2018) 11% of cases in US were aged >60 years (Gould et al., 2009) 17% of cases in Ireland were aged >65 years (Cleary et al., 2021)
Norovirus	60% of 15,725 cases (2012 – 2023) (Public Health Scotland, Unpublished-c).	22% of cases were aged ⩾69 years (Pagani et al., 2018)

3.4 Underlying conditions among adults aged ≥65 that increase susceptibility to foodborne illness.

Data suggests that underlying conditions are important in relation to the occurrence of foodborne illnesses such as listeriosis. For example, it was reported that the increased incidence of listeriosis among patients ≥60 years old in England and Wales between 2001 and 2007 occurred in those with underlying conditions such as cancer or other conditions whose treatment included acid-suppressing medication.

Goulet *et al.* (2012) calculated that the risk of listeriosis was significantly greater among those with underlying conditions, for example, when compared with persons <65 years old with no underlying conditions, those with underlying conditions such as chronic lymphocytic leukaemia had a >1000-fold increased risk of acquiring listeriosis. Those with other conditions such as liver cancer; myeloproliferative disorder; multiple myeloma; acute leukaemia; giant cell arteritis; dialysis; oesophageal, stomach, pancreas, lung, and brain cancer; cirrhosis; organ transplantation; and pregnancy had a 100–1000-fold increased risk of listeriosis (Goulet *et al.*, 2012). It was also reported by Goulet *et al.* (2012) that clinically vulnerable groups whose underlying conditions were associated with the highest incidence of listeriosis accounted for 43% of cases and 55% of deaths, but only 1% of the total population, whereas groups with low incidence accounted for fewer cases (21%) and fewer deaths (21%), but represented 16% of the whole population. A meta-analysis on mortality risk factors for listeriosis reported that clinical predisposing factors included age ≥ 60 years, and predisposing comorbidities included non-haematological malignancies, alcoholism, chronic kidney disease, cardiovascular disease, and pulmonary disease (Huang *et al.*, 2023). Goulet *et al.* (2012) suggest that the population considered not at risk of listeriosis are those with no underlying condition and aged <65 years.

Elderly patients in Denmark with Salmonella had higher co-morbidity than their matched reference persons (Gradel *et al.*, 2008). Mean age of those with a severe outcome was >20 years above the mean age for all Campylobacter cases (46.2 years), this may be attributed to the higher rates of underlying medical conditions among the older population. Data from Denmark indicate that older adults with Campylobacter had higher co-morbidity than their matched reference persons (Gradel *et al.*, 2008).

The Food Standards Scotland comprehensive review of clinically vulnerable groups defined the groups at increased risk of foodborne illness, a number of these conditions are particularly prevalent among adults aged ≥65 years such as proton pump inhibitor use, diabetes, and cancer. Some of these in the context of foodborne illness are explored further:

3.4.1 Cancer

Cancer at a young age is rare, most cases of cancer are diagnosed among people aged ≥50 years, cancer rates are reported to increase with age, rising more steeply from around age 50-60. A third of all UK cancer cases are in people aged 75 and over (Cancer Research UK, 2023). Over time, the cells in the body become damaged. Cancer develops when damage in the same cells builds up. Some of this damage happens by chance during normal cell activity. But cell damage is also caused by things outside the body, such as the chemicals in cigarette smoke, alcohol and too much UV radiation from the sun. As a person ages, there is more time for damage in the cells to build up, making cancer more likely (Cancer Research UK, 2023).

There were 35,379 new cancers registered in Scotland in 2021, with a reported rate of new cancers of 644 per 100,000 population (Public Health Scotland & National Statistics, 2023).

The overall risk of developing cancer in 2021 was 30% higher in the most deprived areas compared with the least deprived areas of Scotland (Cancer Research UK, 2022). Incidence rates for cancer in the UK are highest in people aged 85 to 89, and 36% of all cancer cases in the UK are diagnosed in people aged ≥75 years (Cancer Research UK, 2024). In Scotland during 2021, 77% of cancer diagnoses were in people aged ≥60 years (Public Health Scotland & National Statistics, 2023).

In a person with cancer, disease biology causes immune system dysfunctions which reduces the ability to fight infection. For example T-cell responses are modified due to tumoral antigens, and diseases like Hodgkin's, T-cell lymphomas, leukaemia, myeloma, and chronic lymphocytic leukaemia cause defects in cell-mediated immunity (Evans & Ilic, 2024). Additionally, cancer treatments, lead to immune system dysfunctions. For example, chemotherapy is a cytotoxic drug that affects T-cells, monocytes/ macrophages, neutrophils, and the GI mucosa. Chemotherapy, targeted cell therapy, and some types of radiation temporarily reduce the number of neutrophils in the blood leading to increased risks of foodborne infections (Evans & Ilic, 2024). In a Food Standards Scotland review of 138 prevalence studies, there were 27 identified studies of listeriosis associated with cancer, which found that 8 – 31% of *L. monocytogenes* cases were among people with cancer and 5 – 14% of cases were associated with cancer treatment (Evans & Ilic, 2024).

3.4.2 Proton pump inhibitor use

Proton pump inhibitors (PPIs) are a class of medications used to treat pathologies related to stomach acid production including indigestion, heartburn, acid reflux, and to prevent and treat stomach ulcers. While the acidic environment of the stomach serves as a chemical barrier against bacterial infection, proton pump inhibitors prevent acid production, resulting in a decreased pH in the stomach which can lead to bacterial overgrowth, increased risk of bacterial aspiration, and changes in the gut microbiomes (Evans & Ilic, 2024).

Increased risk of infection over time has been demonstrated among people using PPIs (Yibirin *et al.*, 2021). Several infections have been linked to ongoing use of this group of medications, however, long-term susceptibility to infections due to past exposures to PPIs has been reported. Increased prevalence of *Clostridium difficile* infections has been shown in patients with current and past use of PPIs. PPIs are commonly prescribed to ageing adults (Dumic *et al.*, 2019), with 37% of PPI use in individuals aged 65 years and older (Shanika *et al.*, 2023). With ageing populations, the increasing prevalence of chronic diseases, and polypharmacy (simultaneous use of multiple medicines by a patient for their conditions), PPIs have become one of the most prescribed medicines in developing countries due to their effectiveness versus Histamine (Evans & Ilic, 2024).

In Scotland, a three-fold increase in PPI use has been seen between 2001 and 2017 (Godman *et al.*, 2018). During 2019/20 and 2020/21, omeprazole was the most commonly prescribed item in NHS Scotland, accounting for a total of 4.2 million items annually (Public Health Scotland, 2022). PPIs are reportedly overprescribed (Forgacs & Loganayagam, 2008) and are often taken for longer than needed (Farrell *et al.*, 2022). It has been suggested that 41% of older patients in Scotland are prescribed PPIs, 86% of which were inappropriately overprescribed PPIs (Jarchow-MacDonald & Mangoni, 2013).

Among the 138 studies reviewed in the Food Standards Scotland review of clinically vulnerable groups, twelve studies included data detailing the association between PPI use and prevalence of foodborne illness (Evans & Ilic, 2024). Between 16% of *L. monocytogenes* infections in Germany (Preußel et al., 2015) and 50% of cases in Finland (Suominen et al., 2023) were prescribed proton pump inhibitors in the 90 days preceding infection. In the

Netherlands, 9% of Salmonella cases were associated with PPI use (Doorduyn, Van Den Brandhof, et al., 2006). While in relation to Campylobacter, 8 – 13% of cases were associated with recent PPI use (Bouwknegt et al., 2014; Cribb et al., 2022; Doorduyn, Van Den Brandhof, et al., 2006; Tam et al., 2009).

3.4.3 Diabetes mellitus

Diabetes is a chronic inflammatory disease characterised by high blood glucose levels and the inability to produce or efficiently utilise insulin (Alberti & Zimmet, 1998). The mechanisms behind the impairment of the immune system in diabetes are multi-layered and have been only partially elucidated. High glucose and low insulin levels in diabetes lead to changes in the immune system. Dysfunctions of both innate immunity (neutrophils and macrophages) and adaptive immunity (loss of cytokines, impaired antibody production by T-cells) contribute to weak immune response against foodborne pathogens. Additionally, autonomic neuropathy in diabetes affects upper and lower GI tract, causing heartburn, nausea, vomiting, diarrhoea, constipation, and bloating, all leading to disruption of mucosal barrier and immune system dysfunction. Finally, microbiome dysbiosis also contributes to susceptibility to foodborne infections (Evans & Ilic, 2024). Diabetes is cited as a predisposing factor for listeriosis, salmonellosis, and other foodborne infections (Hu et al., 2013; Steinbrecher et al., 2023).

The Scottish Diabetes Survey reported that there were 339,018 people with diabetes in Scotland at the end of 2022. This represents 6.2% of the Scottish population (NHS Scotland & Scottish Diabetes Data Group, 2023). Type 1 diabetes accounted for 10.5% of all cases and type 2 diabetes accounted for 87.8% of all cases of diabetes in Scotland (NHS Scotland & Scottish Diabetes Data Group, 2023). Other forms of diabetes (e.g. gestational diabetes, latent autoimmune diabetes of adults, monogenic diabetes, maturity onset diabetes of the young, neonatal diabetes) are less common (1.7%) (NHS Scotland & Scottish Diabetes Data Group, 2023). It is estimated that a further 49,000 people have undiagnosed type 2 diabetes and that at least 620,000 people in Scotland are at high risk of developing type 2 diabetes (NHS Research Scotland, 2023). By 2035, it is estimated that more than 480,000 people in Scotland will be living with diabetes (Diabetes UK, 2024). It has been reported that prevalence of Type 2 diabetes (6% in 2022) increased with age from 1-5% of adults aged 16-54 to 10-16% of those aged 55 and above (Scottish Government, 2023).

Data detailing the prevalence of diabetes among foodborne illness in Scotland are available for *L. monocytogenes* and Salmonella. Of the 166 listeriosis cases in Scotland between 2012 – 2022, 10% were among people with diabetes, it was further reported that 94% of which were aged >65 years (Public Health Scotland, no date). European data suggest that 8 – 29% of listeriosis cases are associated with diabetes (Charlier et al., 2017; Doorduyn, de Jager, et al., 2006; Gerner-Smidt et al., 2005; Gillespie et al., 2009; Gori et al., 2020; Koch & Stark, 2006; Preußel et al., 2015; Suominen et al., 2023).

In relation to Salmonella, Turgeon et al. (2017) reported that 19% of Salmonella hospitalisations among older adults in Canada had both cardiovascular disease and diabetes as underlying conditions and Cummings *et al.* (2010) reported that 8% of Salmonella-related deaths in US had diabetes, 5% of confirmed Salmonella cases between 2013-2017 in Scotland were reported to have diabetes listed as an underlying condition (Food Standards Scotland, 2020a).

3.5 Domestic food safety practices of adults aged ≥65 years

As discussed in sections 3.2, 3.3, and 3.4, individuals over the age of 65 years have increased risk of foodborne illness, consequently, implementation of food safety practices by this group are of critical importance.

A systematic review by Evans and Redmond (2014) examined consumer food safety knowledge, attitudes, self-reported practices and behaviours. It was established that only 7% of research studies included food safety data for older adults. The reviewed studies suggested that older adults reported some potential food safety malpractices, and concluded that further in-depth research is needed to explore older adults' food safety attitudes, actual behaviours, and self-reported practices to gain a more comprehensive understanding of domestic food safety in this population (Evans & Redmond, 2014).

Given a decade has passed since the systematic review (Evans & Redmond, 2014), a comprehensive review of literature was undertaken to consolidate consumer food safety research undertaken with consumers aged ≥65 years since 2014, in addition to the studies undertaken by the fellow, a further 18 studies were identified.

3.5.1 Global food safety research involving older adults

Seven studies have been undertaken in the US; Kavanaugh, Fisher, and Quinlan (2021) used focus groups to identify food safety risks among older adults in the US. The study aimed to understand the barriers older adults face in adopting safe food handling practices. The findings revealed that older adults often engage in unsafe food practices due to limited knowledge or cognitive decline. For instance, they reported using outdated methods of food storage, such as keeping perishable items at improper temperatures, or not washing hands before handling food (Kavanaugh et al., 2022).

Yap et al. (2019) found that many older adults in the US fail to follow basic food safety guidelines, such as washing hands before preparing food, storing food at proper temperatures, and thoroughly cooking meat. These unsafe practices increase the risk of foodborne illness. Cognitive decline, physical disabilities, and lack of access to proper food storage facilities were identified as primary contributors to these risky behaviours and suggest that many older adults are unaware of the importance of these practices, and they often lack the ability to implement them consistently (Yap et al., 2020).

Kosa et al. (2019) reported that older adults were significantly less likely to follow safe handling practices, such as using separate chopping boards for raw poultry and other foods, washing their hands after handling raw poultry, and using food thermometers to ensure safe cooking temperatures than the parents of young children in the US (Kosa et al., 2019).

Jackey et al. (2017) explored food label knowledge, usage, and attitudes among older adults in the US and reported that many older adults struggle to understand food labels, especially information about expiration dates, ingredients, and food safety warnings. This lack of understanding can lead to improper food handling, such as consuming expired foods or misunderstanding storage instructions (Jackey et al., 2017).

Wunderlich et al. (2015) focused on food safety practices at congregate meal sites for older adults in the US. While the meal sites generally adhered to food safety standards, the study found that some older adults were unaware of or did not follow safe food handling practices, such as not consuming meals within recommended time frames or not refrigerating leftovers promptly (Wunderlich et al., 2015).

McWilliams et al. (2017) investigated the food safety practices of homebound seniors in the US who receive home-delivered meals, findings indicate that improper storage, delayed consumption, inadequate refrigeration, and poor reheating practices are prevalent among older adults (McWilliams et al., 2017).

Yu *et al.,* (2018) explored consumer food safety risk receptions in the US and reported that baby boomers (individuals over 60) were significantly less likely than millennials to pay a premium for fresh-cut produce with a lower risk of foodborne illness, suggesting generational differences in risk perception and food safety priorities (Yu et al., 2018).

In Italy, Laurenti et al. (2020) conducted a study to understand the factors that affect the ability of older adults to maintain a safe and healthy diet. The study found that older adults face numerous challenges, including a lack of knowledge about safe food handling practices, limited access to fresh food, and difficulties in meal preparation. Many older adults rely on prepared or processed foods. Social isolation and economic constraints were also identified as significant barriers to maintaining a healthy diet (Laurenti et al., 2020).

In a Canadian study, Thaivalappil *et al.* (2020) applied the Theory of Planned Behaviour to examine older adults' intentions to adopt safe food storage practices. The study found that older adults' intention to follow safe food storage practices was influenced by their attitudes toward food safety, perceived behavioural control, and subjective norms. Older adults with positive attitudes toward food safety were more likely to implement proper storage practices. However, the study also found that cognitive and physical limitations, as well as lack of knowledge, hindered older adults from adopting safe practices (Thaivalappil et al., 2020).

In another Canadian study, Tooby *et al.,* (2021) explored the consumption of high-risk Foods in the Canadian population which determined that older adults reported consuming high-risk foods of concern, including deli meats and soft cheeses (Tooby et al., 2021).

In Egypt, El Sakhy, Mohamed, and El Sherbini (2020) conducted a study on the food safety knowledge, practices, and attitudes of community-dwelling older adults. The study revealed that older adults had significant gaps in their knowledge about food safety. Many were unaware of proper food storage practices and did not follow guidelines on safe food preparation or cooking. Inadequate food safety knowledge, combined with limited access to resources and physical challenges, led to unsafe food practices (Sakhy et al., 2020).

In South Korea, Lee and Lee (2021) examined the food hygiene awareness, knowledge, and behaviours of older adults which determined gaps existed between knowledge and practice, and that while many older adults were aware of food safety principles, their actual behaviours do not always align with best practices.

In Germany, Berger *et al.* (2023) investigated older adults' risk perception, beliefs, and self-perception in relation to kitchen hygiene and food safety. Focus groups indicated that older adults had confidence in their food safety knowledge and skills (Berger et al., 2023).

3.5.2 UK-based food safety research involving older adults

Although research data detailing older adults' food safety practices exists globally, UK-specific data is essential to account for regional differences. During the past decade the SEFARI Fellow has published six empirical studies regarding the food safety perceptions and practices of older adults in Wales. These studies have shown that while older adults generally acknowledge the importance of food safety, they do not perceive themselves at risk of foodborne illness, and their self-reported practices do not always align with observed behaviours in kitchen settings. The studies have identified risky food handling, inadequate

storage practices in domestic refrigerators, and potential microbiological contamination in home kitchens (Evans & Redmond, 2015, 2016a, 2016b, 2018a, 2019a, 2019c). In addition to these six studies, four other food safety studies were undertaken in the UK that focused on older adult consumers.

Wills et al. (2015) explored the behaviours and practices of older people that might contribute to foodborne illnesses. The study found that older adults often did not recognise the risk of foodborne diseases because of their longstanding habits and assumptions about food safety. Even though many older adults believed they had never experienced foodborne illness, the study showed that their food safety practices, such as inadequate handwashing, improper storage of food, and undercooking, contributed to a higher risk of foodborne infections (Wills et al., 2015).

Dickinson et al. (2014) conducted the first Kitchen Life study to explore food safety and hygiene practices among older adults in the UK. The study found that older people often face barriers to safe food handling, particularly due to cognitive and physical impairments, such as memory loss, arthritis, and visual impairments. These factors made it difficult for older adults to maintain proper food safety practices, such as storing food at correct temperatures, checking food expiry dates, and following hygiene guidelines. The study also identified that social isolation and living alone were significant contributors to unsafe food practices, as older adults were less likely to seek advice or help with food safety (Dickinson et al., 2014).

Bloom et al. (2017) investigated factors influencing diet quality in older adults in the UK and also addressed food safety indirectly by exploring the food choices. The research revealed that older adults often made food choices that prioritised convenience over food safety, such as consuming ready-to-eat or pre-prepared meals that may not always follow the recommended food safety guidelines. Additionally, cognitive decline and health problems led some older adults to rely on unbalanced diets, which could contribute to poorer food safety outcomes.

Meah et al. (2017) examined the food safety behaviours of older consumers in the UK. The research determined that there was a significant gap in knowledge about food safety among older adults, particularly concerning food storage, handling raw meat, and recognising foodborne illness symptoms. The study also revealed that many older adults were not aware of the risks posed by improper food handling, and this lack of awareness increased their vulnerability to foodborne illnesses.

3.5.3 Food safety research involving older adults in Scotland

Like the global studies identified, the ten UK-based studies on older adults' food safety practices also highlighted cognitive and physical barriers, risky food handling behaviours, and reliance on convenience foods. None of the UK studies specifically refer to including participants from Scotland, most refer to a general UK populations or specific regions such as England. Although some of the studies may have included participants from different regions within the UK without explicitly isolating data from Scotland.

Although Food Standards Agency undertook research with people over the age of 60 years old in Scotland to explore views and behaviour in relation to their food hygiene at home. The research found that older adults in Scotland were confident in their food hygiene practices, the study concluded that more information on not washing raw poultry and adhering to use by dates was needed for the target audience (Food Standards Agency, 2014). This study

was undertaken in 2014, no further research has been undertaken with older adults in Scotland.

There is a need for more Scotland-specific research on older adults' food safety practices to address regional variations in diet, accessibility, socioeconomic challenges, and public health policies, ensuring that food safety education interventions are relevant to the Scottish population.

Having reviewed global, UK, and Scotland based food safety studies, it can be concluded that many of these studies capture data detailing the knowledge, attitudes, self-reported practices and observed behaviours of older adult consumers relating to food safety in the domestic setting. These studies indicate potential food safety challenges faced by older adults and suggest how cognitive decline, physical limitations, lack of knowledge, and social factors such as isolation and economic constraints may contribute to risky food handling and storage practices. Cumulatively, these studies indicate food safety malpractices among older adults, as they may not perceiving themselves as being susceptible to foodborne illnesses, however further exploration is required to understand why such perceptions and practices exist. To enable this there is a need apply an appropriate behavioural model.

3.6 Behavioural models

Using behavioural models to understand why certain food safety behaviours exist among older adults is essential, this is particularly important to enable the development of effective, targeted interventions to improve food safety practices among the target audience in the future.

The Health Belief Model (Rosenstock, 1974) suggests that specific health behaviours are influenced by an individual's perceptions of severity and personal susceptibility, combined with perceived benefits and barriers to that behaviour. For an individual to adopt a specific behaviour, the perceived threat and benefits must outweigh the perceived barriers. Personal factors, such as self-efficacy and cues to action are also frequently included in the model (Etheridge et al., 2023). One of the publications from my PhD (Evans & Redmond, 2019d) established that older adults expressed perceptions of invulnerability, optimistic bias, and the illusion of control regarding food safety; they perceived themselves to have lower levels of risk than other individuals, and perceived themselves to have greater levels of control and responsibility than others. We believe that such perceptions may undermine attempts to provide education regarding food safety (Evans & Redmond, 2019d).

Although some studies have utilised the Health Belief Model in the food safety context (Cho et al., 2013; Hanson & Benedict, 2002; Hanson et al., 2015; McArthur et al., 2006; Schafer et al., 1993; Wang et al., 2021), a recent study by Kavanaugh *et al* (Kavanaugh et al., 2022) utilised the Health Belief Model to explore food safety risks among older adults in the US, which determined that utilising the definitions of perceived barriers and cues to action appear applicable to older adults' food handling behaviours and suggested that the Health Belief Model could be utilised as a framework to develop future interventions for older adults. Nevertheless, they suggested that when the Health Belief Model is used with older adults for food safety research, there is a need to modify the perceived threat construct to not only include the perceived susceptibility and perceived severity, but the *perceived risk* that a food may be contaminated and cause illness (Kavanaugh et al., 2022).

Consequently, there is a need to understand the modifying factors that can influence people's perceptions and practices relating to food safety. Some previous non-food safety

studies, have demonstrated that modifying components of the Health Belief Model, including age, financial security, health literacy, and spirituality can impact upon health behaviours such as attending medical appointments (Cronin et al., 2018). Other models have been used to explore food safety among the group of interest. For example, safe food storage practices among older adults in Canada were explored using the theory of planned behaviour to determine which psychosocial factors predicts intentions to adopt safe food practices at home (Thaivalappil et al., 2019)

However, the research fellow believes that obtaining an understanding of the impact of these modifying factors is something that we can improve in food safety research, for this it was proposed that the Dimensions of Wellness could be utilised to give structure to identify the modifying factors that may influence food safety malpractices among older adults. People often think about wellness in terms of physical health, such as nutrition, exercise, and weight management, however “Wellness” is a holistic integration of eight mutually interdependent dimensions: physical, intellectual, emotional, social, spiritual, vocational, financial, and environmental (Stoewen, 2017). These dimensions could be used to describe some basic human needs, and have been used in research with older adults to explore how some of these dimensions may protect cognition in ageing (Strout & Howard, 2012). Although these dimensions are intended to focus on an individual’s wellbeing. The research fellow believes that these dimensions can be utilised to give us a defined structure to the modifying factors within the Health Belief Model to enable us to explore why certain food safety practices or malpractices are part of people’s lives.

4 Purpose of the SEFARI fellowship with Food Standards Scotland

The literature discussed in section 3 demonstrates that older adults (aged 65 and above) represent a growing and vulnerable demographic regarding foodborne illnesses. Age-related immune decline (senescence), coupled with multimorbidity and chronic conditions, significantly increases their susceptibility to pathogens like *L. monocytogenes,* Salmonella*, E. coli,* Campylobacter*,* and norovirus. Global and Scottish prevalence data show that older adults not only experience higher infection rates for some pathogens but also face more severe outcomes, including higher rates of hospitalisation and mortality. Medications and health conditions common in this age group further exacerbate these risks.

Research also highlights gaps in food safety practices among older adults, influenced by cognitive and behavioural factors. Addressing these gaps requires targeted interventions. For such initiatives to succeed, they must address the underlying perceptions and modifying factors that influence food safety behaviours. This SEFARI fellowship project aims to address this gap by obtaining insights from the consumer group and make recommendations for Food Standards Scotland on communicating risk of foodborne illnesses to this vulnerable population.

Therefore, the overarching aims and objectives of this fellowship are outlined below.

4.1 Aims

- Identify lifestyle factors which cause members of the older population to become ill with foodborne illness.
- Provide recommendations for Food Standards Scotland to enhance their consumer advice and communications strategies.

4.2 Objectives

- Create and refine a research framework to inform the development of data collection tools and data coding approaches.
- Obtain appropriate ethical approvals from institutional and governmental bodies before recruitment and data collection.
- Establish a participant inclusion criterion and implement a recruitment strategy for the recruitment of eligible participants to engage in the project via online, in-person or telephone methods.
- Conduct qualitative research through online and in-person focus groups and transcribe the audio files.
- Analyse focus group transcripts utilising a predefined structured codebook to identify key factors influencing food safety behaviour, vulnerabilities, and communication preferences.
- Formulate evidence-based recommendations for future food safety interventions and effective communication strategies for Food Standards Scotland.

5 Methodology

5.1 Development of a framework for the research

To provide structure for the data collection tool and the analysis planned for this study a model was developed that utilised the constructs of the Health Belief Model and the eight Dimensions of Wellness as the modifying factors within the Health Belief Model (physical, intellectual, emotional, social, spiritual, vocational, environmental and financial).

To assess the appropriateness of the model the proposed model was utilised to create an NVivo codebook, to analyse in-depth interviews undertaken by the researcher with adults over the age of 60 in Wales. Further information can be seen in Appendix 1. It was concluded that utilising the Dimensions of Wellness as the modifying factors of the Health Belief model were beneficial to explore why certain food-related behaviours may exist among older adults. As indicated in Appendix 1, when considering the risk of foodborne illness to a specific vulnerable population, we consider the food safety cognition, behaviour, and susceptibility of the target audience. However, it is also important to consider the modifying factors that impact these cognitions and behaviours. Having utilised the Dimensions of Wellness on a dataset that was previously captured, meaningful insight has been obtained. However, most importantly it identified methods to update the proposed model for application in this SEFARI fellowship project to explore the factors that influence food related behaviours and food safety practices, these included:

- Renaming the original “physical dimensions” as the “biological factors”, which would allow factors such as access to personal or public transportation and proximity to shops, time restraints and cooking skills and abilities to be classed as physical environment determinants.
- There may be a need to group the “intellectual dimensions” and “psychological dimensions” together for future research looking at the factors that influence older adult food related behaviours and food safety risks.
- “Financial dimensions” are easily identified and grouped, however, given that the occupational factors impact upon time and finance, it is best to avoid having a separate “occupational dimension”, therefore having “financial factors” would be appropriate.
- Perhaps elements of the “spiritual dimension” could be grouped with the “social dimensions” as “social environment factors”.

The suggested approach for classification of factors that influence food safety behaviour includes the five determinants of food safety risks, behaviours, and vulnerabilities, namely: Biological determinants, Physical determinants (e.g., the physical environment), Psychological determinants, Economical determinants, and Social determinants (e.g., the social environment).

Therefore, for the purpose of this SEFARI fellowship, a data collection tool based on the Health Belief Model with the five determinants of food safety risks, behaviours and vulnerabilities (as outlined in Table 2) to explore the modifying factors of behaviour will be utilised.

Table 2. Determinants of food safety risks, behaviours and vulnerabilities.

Determinant	Examples and areas that require exploration
Biological determinants	• Any disabilities or physical conditions such as arthritis or have had a stroke that impacts upon a person's physical ability to shop, prepare, cook, or eat food. • A medical condition, autoimmune disease or taking medication that suppresses immune function and increases susceptibility to foodborne illness. • Other abilities that may change with age that impacts upon the relationship with food such as eyesight, using glasses, sense of smell, taste, hearing, appetite, or hunger, influence the way a person shops, stores, cooks, and eats.
Physical determinants (e.g., the physical environment)	• The influence of time on shopping and cooking. • Location of where someone lives, distance to the shops, access to private or public transport. • Cookery knowledge, skills and abilities. • Access to equipment and appliances. • Power outages.
Psychological determinants	• Problems with memory. • Lost interest or patience with cooking. • Modified diet due to climate concerns e.g. following a plant-based diet. • The impact of mood, stress or guilt on food decisions.
Economical determinants	• The impact of the cost of food on purchase decisions and storage durations. • Food choices determined by availability or short-date food or food-bank availability. • Concerns regarding the cost of energy impacting refrigerator temperature and cooking methods.
Social determinants (e.g., the social environment)	• Cultural, religious, or family food practices or habits that influence the food that is purchased, method of storage and cookery. • Household structure and food preferences of other in household.

Utilising the five determinants of food safety risks, behaviours and vulnerabilities as outlined, would give a holistic understand of the factors that influence potential food safety malpractices and ensure that food safety interventions are targeted, appropriate and sensitive. Figure 1 demonstrates the model created for this study which incorporates the Determinants of food safety risks, behaviours and vulnerabilities as modifying factors in the Health Belief Model which incorporates perceptions of threat, motivation and expectations of the behaviour in addition to the cues to action that result in a food safety behaviour.

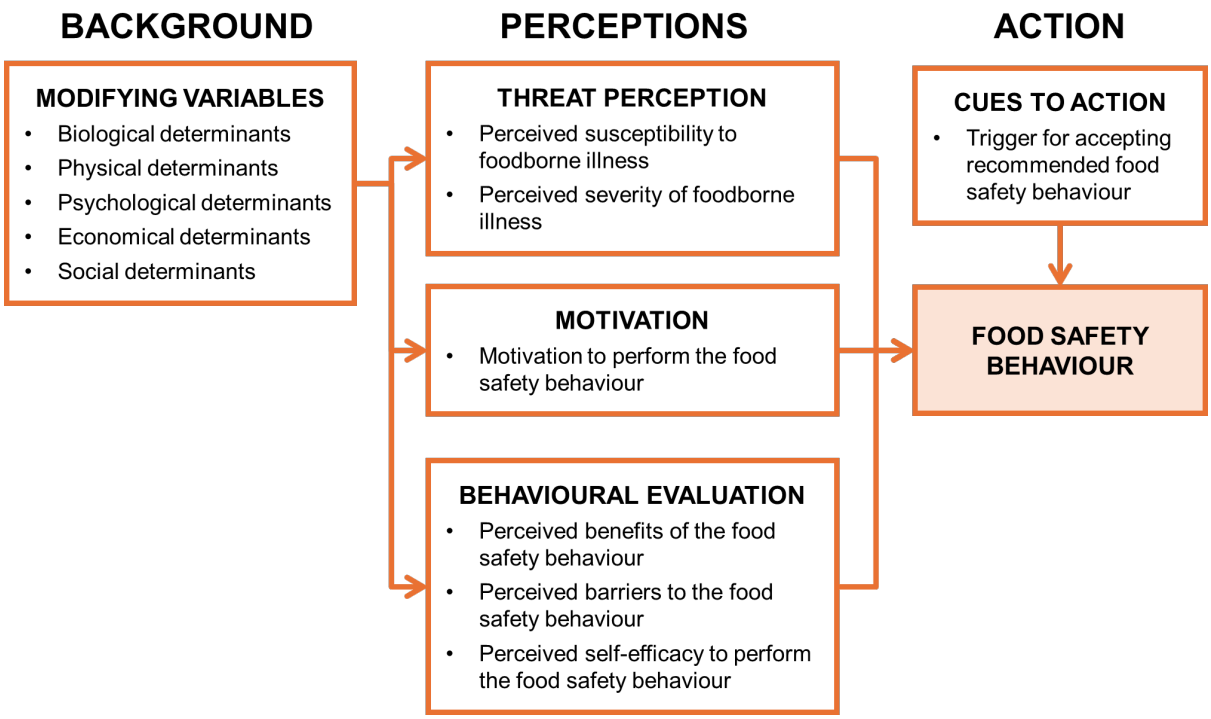

Figure 1. Determinants of food safety risks, behaviours and vulnerabilities as modifying factors in the Health Belief Model

5.2 Focus group discussion schedule

The constructs of the Health Belief Model and the "Determinants of food safety risks, behaviours and vulnerabilities" as described in Table 2 were utilised to inform the development of the focus group discussion guide.

Open ended questions for use in a group discussion scenario were devised to focus on key domestic food safety practices recommended by Food Standards Scotland such as cooking food, refrigerating and storage of food, cleaning and avoiding cross contamination (Food Standards Scotland, no date).

5.2.1 Preferences for communicating

To support the development of future food safety messaging interventions it is of importance to consider the preexisting perceptions and the communication preferences of the specific target audience (Evans & Redmond, 2022). Involvement of the target audience in intervention development is believed to increase potential effectiveness of interventions (Green *et al.*, 1996). A review of previous consumer food safety education interventions established that clinically vulnerable groups are under-represented as targets of interventions (Sivaramalingam *et al.*, 2015); furthermore, less than half of consumer food safety education interventions have engaged with the target audience in the development, delivery, and evaluation of interventions (Sivaramalingam *et al.*, 2015). Inclusion of the intended audience in the development of targeted interventions is essential (O'Cathain *et al.*, 2019); tailored interventions based upon a target audience's circumstances can be developed through co-creation with stakeholders (Leask *et al.*, 2017). The co-creation of

intervention development needs to consider the current practices, preferences and experiences of the intended audience (Ohern & Rindfleisch, 2010).

Three statements defining clinically vulnerable groups were developed. A standardised semi-structured interview schedule was created to explore preferences for wording and information. The interview schedule aimed to gather insights into the participants' communication preferences and perceptions regarding food safety messaging. To facilitate discussion and explore preferences for risk communication, three different risk statements regarding clinically vulnerable groups to listeriosis were developed:

- **Simple YOPI classification:** A short, straightforward statement based on the standard YOPI (Young, Old, Pregnant, Immunocompromised) categories.
- **Extended YOPI classification:** This statement included specific chronic illnesses and treatments/medications identified in this report that result in reduced immune function.
- **Detailed vulnerability explanation:** An extended statement that specifically defined why the listed groups are clinically vulnerable to foodborne illness, providing the most comprehensive information.

These statements were color-coded and presented to participants in ascending order of complexity during the discussion groups.

5.3 Recruitment of participants

5.3.1 Advertising the project

To ensure information regarding the project was distributed as wide as possible, recruitment activities were carried out both online and in the community.

An online advert was posted on the Food Standards Scotland Facebook page on 15th March 2024 (Appendix 2). The advert gave a brief description of the project, the inclusion criteria, details of the incentive and details on how to sign-up or how to get more information. The advert was live for 6 weeks. There was an option to boost visibility of the advert by means of sponsored posts specifically targeting specific areas and communities in Scotland to facilitate recruitment for the in-person focus groups. However sufficient sign-ups were achieved without the boost.

To ensure the project was visible to people who do not use social media, posters were displayed on community notice boards in shops, community centres, leisure centres and libraries in the areas surrounding the selected venues for data collection. The colour A4 posters (Appendix 3) included a brief description of the project, the inclusion criteria, details of the incentive, the date, location and duration of the in-person focus groups alongside details on how to sign-up or how to get more information. Pull-off tabs were included at the bottom of the posters which provided the study name, email and telephone number of the researcher along with the web address for the online sign-up page.

In addition to posters, A5 leaflets (Appendix 4) were displayed at the community venues where data collection would take place. The time of the focus groups were excluded from the community posters and leaflets to prevent individuals turning up on the day without registering.

Invitation letters (Appendix 5) and participant information sheets (Appendix 6) detailing the purpose of the study were sent out to Aberdeen City Voice panellists (*n*=90) with the quarterly Aberdeen City Voice newsletter to individuals who had previously indicated an interest in taking part in community research projects.

5.3.2 Participant sign-up

As a result of seeing the online or community adverts, those interested in participating followed the link to a Qualtrics page (Appendix 7) that provided information regarding the study by means of a participant information sheet (Appendix 6) and provided the contact details of the researcher in case of any questions.

The Qualtrics page received a total of 777 views. Those interested in taking part, signed-up by completing the online form which captured consent to participate (Appendix 8), basic demographic characteristics and allowed individuals to select a preferred date for participating. Individuals that did not have access to email and/or internet, contacted the researcher via telephone and the online form was completed over the telephone with the participant.

The dedicated Qualtrics page received 274 sign-ups. Eight of which were removed due to duplicate sign-ups (*n*=2), incorrect email addresses to send an invitation to the online discussion group and no response to telephone calls to obtain correct email (*n*=2) and fake participants, e.g. individuals not meeting the recruitment criteria and attempting to participate in the study to obtain the incentive offered to participants (*n*=4).

Of the eligible sign-ups (*n*=266), a suitable date or location prevented some from participating (*n*=90), nevertheless, they indicated an interest in participating in future research and completed the short online questionnaire.

A total of 176 people selected to participate in the study. After selecting their preferred time and location for participating, a confirmation email was sent confirming the arrangements, outlining participants should login or arrive 15 minutes prior to the start time and that if they were no longer able to participate, they were requested to inform the researcher at their earliest convenience to allow the space to be made available for others to participate.

Sign-up to online discussion groups were capped at 10 participants, while in-person discussion groups were capped at 12 participants.

Of those who signed up to participate, 14 cancelled in advance and 29 failed to show up on the day either online (*n*=19) or in-person (*n*=10). One person was not permitted to enter an online focus group due to them not logging-in during the specified 15-minute window. The focus group had commenced, housekeep rules had been discussed, all participants had introduced themselves and the recording had commenced. A total of 132 people participated in the study either online (*n*=78), via telephone (*n*=4), or in-person (*n*=50), giving a 75% turn-up rate.

5.4 Conducting discussion groups

5.4.1 Online discussion groups

Online focus groups with individuals over the age of 65 and those who support relatives over 65 years (*n*=80) were undertaken on Microsoft Teams. Participants were invited to log-in 15 minutes prior to the scheduled start time and were aware that late logins would not be permitted to participate or be eligible for the incentive.

To ensure participants were able to login to Microsoft teams, they were asked to check they could access the link in advance, and to notify the researcher if problems were experienced. In such instances the researcher would schedule a telephone call with the participant and talk them through the process of how to log-in to Microsoft Teams and checking they were able to hear and see the researcher on Microsoft Teams ahead of time.

Once the online focus groups started, the researcher shared a series of slides (Appendix 9) with the participants and followed a script, this included a welcome and outlining important information such as housekeeping information, consent, etiquette, and an opportunity to ask any questions prior to commencing data collection.

During data collection slides were not shared to enable participants to see each other in a gallery view, each session started with the participants providing a brief introduction about their normal food shopping, cooking and eating habits. Participants were given a 5-minute comfort break after completion of the first topic, which normally occurred within 45 – 60 minutes of the start time. Online discussion group durations ranged from 1h 49m to 2h 15m.

5.4.2 Telephone individual discussions

A small number of individuals expressed a preference for contributing to the research via a telephone interview rather than participating in an online discussion group. In response to these requests, individual telephone discussions were arranged at mutually convenient times.

At the agreed time, the researcher contacted each participant via telephone and conducted the discussion following the focus group discussion to ensure consistency across interviews and with the points discussed in the discussion group. With the participant's consent, a Dictaphone was used to record the conversation to enable a transcript to be generated for analysis. Each telephone discussion lasted between 41 and 47 minutes.

5.4.3 In-person discussion groups

Six discussion groups were scheduled in various locations across Scotland, including Stranraer, Glasgow (*n*=2), Aberdeen (*n*=2), and Inverness during May 2024 with a total of 50 participants.

Confirmation emails and letters sent ahead of the in-person discussion groups invited participants to arrive 15 minutes ahead of the scheduled start time, during this time, the researcher kept a register of the participants who arrived, and participants were provided with refreshments and light snacks before starting the discussion group.

As equipment varied in each location, no slides were used to provide background information or to guide the discussion. The researcher utilised a paper-based script (Appendix 11) to provide important information such as housekeeping information, location

of toilets and emergency exits, consent, etiquette and gave participants the opportunity to ask questions before commencing data collection. As with the online discussion groups, each session was audio recorded using two digital Dictaphones and multiple microphones and started with the participants providing a brief introduction about their normal food shopping, cooking and eating habits.

Participants were given a 10-minute break after completion of the first topic, which normally occurred within 45 – 60 minutes of the start time. In-person discussion group durations ranged from 1h 46m to 2h 01m.

5.4.4 Participant incentives

Following completion of the discussion group sessions, participants were provided with £25 vouchers for Amazon or a supermarket of their choice.

5.5 Data collection and analysis

All in-person discussion group sessions and telephone discussions were audio recorded using Dictaphones and subsequently transcribed. The online discussion groups were recorded on Microsoft Teams, the automated transcription was downloaded, checked and amended using the original recording.

Once transcription was complete, each transcript was carefully reviewed and cross-checked against the original audio or video recordings to verify accuracy. The researcher then conducted a systematic thematic analysis using NVivo, a qualitative data analysis software. Participant statements were coded according to a predefined codebook, with additional sub-nodes created where necessary to capture emerging themes and nuances in the data. NVivo facilitated the organization, retrieval, and comparison of coded data, enabling a structured approach to identifying patterns and key insights across the dataset.

5.6 Ethical approval

Prior to commencing data collection all project documentation were discussed with SEFARI and Food Standards Scotland colleagues. Documentation was reviewed and approved by the Healthcare and Food Ethics Committee at Cardiff Metropolitan University (Sta 8405) and social research approval was obtained from the Scottish Government Rural and Environment Science and Analytical Services Division (RESAS).

5.7 Participant demographic characteristics

A total of 132 people participated in the discussion groups, 50 participated in the in-person discussion groups while 82 participated in online or telephone discussions. The vast majority of participants (83%) were female (*n*=109) with 23 males participating. Of those that participated, only 1.5% described themselves as belonging to an ethnic group other than white.

The majority (86%) signed up to participate as a person over the age of 65, however many of these were also responsible for supporting the food related tasks of other individuals over the age of 65. The age range of the over 65 cohort were aged 65-69 years old (42%), 70-74

years old (30%), 75-79 years old (13%), 80-84 years old (2%) and 1 person was over the age of 90 years. The majority (73%) described themselves as being retired, while 8% reported being in full-time or part-time employment or education, and the remainder indicated being a carer or a volunteer. Half (54%) were married.

Eighteen participants signed-up as individuals who support a person over 65 with their food shopping and cooking; of these, 28% were aged 35 – 44 years, 28% were 45 – 54 years, and 44% were aged 55 – 64 years. Seventeen percent reported being retired, while 83% of these indicated being employed (part-time or full-time), being on maternity leave, being a stay-at home parent or carer. Two-thirds (67%) reported that they supported a parent, stepparent or a parent-in law, others supported their spouse or partner (11%), other relatives such as aunts and uncles, or neighbours. The frequency of support varied from multiple times a day to 2-3 times per month, and the types of support included driving them to/from the shop to do their food shopping, accompanying them in the shop whilst they do their food shopping, helping them to store the food after doing the shopping, assisting them with cleaning the kitchen, doing the food shopping for them, preparing and cooking the food for them, cleaning the kitchen for them, supporting them with eating, and providing company while they ate.

6 Results

As outlined in section 3.6, the Health Belief Model suggests that health behaviours are influenced by the "perceptions of severity" and "personal susceptibility", combined with perceived benefits and barriers to that behaviour (Rosenstock, 1974). More recent adaptations of the model, include "cue to action," which refers to a stimulus to undertake the behaviour; and "self-efficacy", which is confidence in one's ability to perform the behaviour (Etheridge et al., 2023). Furthermore, it is suggested that the modifying variables within the Health Belief Model, may facilitate or hinder health actions (Cronin et al., 2018) as modifying factors can influence individual perceptions and the perceived benefits. For the purpose of this study, five determinants were selected as the modifying variables.

Numerous studies have demonstrated how perceptions within the Health Belief Model influence action, however for the purpose of this study it is believed to be imperative to understand the background that can influence such perceptions, the findings are discussed in the context of the model as outlined in Figure 1.

Modifying factors are factors that enable an individual to engage in health behaviour. They are prerequisites for converting health attitudes into health behaviours (Kalua & Nyasulu, 2007), modifying variables within the Health Belief Model, may facilitate or hinder health actions (Cronin et al., 2018).

This section explores determinants that are seldom considered in consumer food safety research. As discussed in section 5.1 and presented in Table 2, five determinants were deemed appropriate for this study, namely physical, biological, social, psychological and economical. These determinants may hold important findings indicating why certain perceptions are held by consumers in relation to foodborne illness that may prevent food safety behaviours from being implemented. Such findings may be beneficial for targeting future food safety communication campaigns or provide insight to why food safety messaging may be disregarded. Although the variables are presented separately, they are often interlinked, as described by Participant 029:

"The big problem is it's a three-way contest between what I'm physical able to cook and prepare due to my reduce mobility, what I can afford to cook and prepare, and trying to buy the right foods for my condition and then add in the temptation of convenience and something nice. I'd just say for me the three things that are convenience and cost and health of the food. These are the three big influences that are all pushing in different directions in a way."

6.1 The impact of the physical environment on food-related behaviours

The World Health Organisation states that the physical environment can impact upon people's health, examples of which include having safe water and clean air, healthy workplaces, safe houses, communities, employment and working conditions (World Health Organization, 2017). The themes relating to the physical environment in this study related to time after employment/retirement for food related activities, access or distance to shops and supermarkets, and access to private or public transport. A summary of related quotes are presented in Table 3

6.1.1 Time

Many reported having time after retirement for food related activities and described changes in cooking and eating habits after retirement and the impact of increased free time on their diet. Participants describe having more time after retirement to focus on meal planning, healthier eating, and careful food preparation. One participant emphasised how this change has improved their diabetes management and allowed for a more mindful diet, while others described increased snacking due to boredom in retirement and having fewer activities to occupy their day. In general, many felt their diets had improved following retirement.

One participant discussed how they took over cooking responsibilities when they retired, and their spouse continued working. Though new to cooking, they enjoy the process and learning from mistakes, unlike their spouse, who grew tired of cooking after decades of doing it for the family. However, another participant mentioned that while they have more time, their lack of enjoyment in cooking and shopping remains unchanged.

6.1.2 Access or distance to shops

Access and proximity to shops was widely discussed and given that individuals had been recruited from across Scotland, there were diverse experiences related to shopping,

particularly in rural and semi-rural areas in comparison to those living in urban areas. Many emphasised the challenges of living far from supermarkets, often having to make long car journeys, and planning these for once a week. Others relied upon online deliveries or local services such as fish vans. Others discussed the use of local shops for top-up purchases, although these can be more expensive and offer limited variety. Some prefer supporting local butchers and bakers, valuing quality and freshness, despite acknowledging the convenience of larger supermarkets.

COVID-19 also influenced shopping habits, prompting a shift toward local shopping and home deliveries. Overall, shopping habits are shaped by factors like accessibility, costs, mobility, and the desire to support local businesses where possible, while also relying on larger supermarkets for variety and affordability. Discussions also related to the lack of choice and having a limited diet because of the availability of food in local rural shops.

Those reliant on online food deliveries discussed reoccurring problems, other described that the issues prevented them from using online food deliveries. Many participants expressed frustration with the inability to select their own items, particularly fresh produce, receiving products with short shelf-life, as well as concerns about substitutions:

"I would never trust someone else to pick out my fresh stuff." (Participant 8).

"Sometimes they'll substitute items, but it's not always something you would choose yourself." (Participant 15).

"I just feel that they'll be sending stuff that is out of date or nearly out of date." (Participant 22).

Some described overcoming these challenges by not purchasing fresh produce, and buying these locally, or having to freeze items that are about to pass the use-by date.

6.1.3 Access to private or public transport

The discussions highlighted some of the challenges faced by individuals, particularly those living in rural areas or with limited mobility when it comes to grocery shopping. Many participants rely on cars to maintain their independence and access supermarkets, but the rising cost of fuel and concerns about health-related driving limitations are common. Public transportation was often described as being inadequate, especially for those in rural areas, leading to isolation or reliance on others for help. Sometimes the practicalities of taking shopping bags on the bus was not feasible. There is also a sense of frustration in losing control over one's shopping decisions due to mobility or transportation issues.

Some acknowledged that it would be challenging to go shopping if they didn't have a car or were unable to drive, however many did not think about what they would do if they reached a stage that they were no longer able to drive, whereas other were concerned and planning. Some participants suggested that they would utilise online grocery shopping services but were mindful that this wouldn't replace the experience of in-person shopping. In general, participants didn't want to think about being in that situation.

6.1.4 Discussion and food safety considerations

Numerous studies have previously discussed food deserts and the impact of location upon access to healthy food and nutritional deficiency (Cummins et al., 2010; Janatabadi et al., 2024; Jin & Lu, 2021; Wrigley, 2002), however the impact of the physical environment upon the food safety context has not previously been considered, however it may be suggested that for some that are reliant on doing a once-weekly shop or utilising online grocery

deliveries may subject food to prolonged storage in the domestic kitchen, for this safe refrigeration temperatures are critical, and for those that are freezing foods, appropriate thawing and usage are essential.

Table 3. Physical environment determinants upon food shopping, storage, cooking and eating practices among adults over 65 in Scotland.

Theme	*Quotes*
Time for shopping and cooking	*"We had quite a big change because when we were both working very full time and you know, I could be working 60-65 hours a week. Snacking featured quite heavily in my diet and the meals were perhaps more convenient because the emphasis was on time, which now I have rather more of, thankfully. And being diabetic, then that wasn't in particularly good control in the work situation, but now that's much better. So, from retirement, having time to consider food, more care. Much more carefully." (Participant 003).* *"I used to teach up until about 2010 and then I was leaving at like quarter past seven in the morning, and when you get home at six, you haven't got the energy to cook, you really haven't. So now we have more time, we can juggle our time better, so I do a lot more home cooking now than I did when I was teaching." (Participant 129).* *"Food, it's something that has to be done because I have to eat, but I don't enjoy shopping. I don't particularly enjoy cooking and that hasn't changed even with more time. I just, I feel my time with other things I actually enjoy more." (Participant 004).* *"Yes, I quite enjoy cooking, but I have to say that I've only been cooking for maybe the last decade or so up until then my wife did all the cooking. But when I got to 59, I retired, and she was still working... So, because she was still working full time, I took over doing the cooking since then… and I've just carried on doing that and because I haven't done it a long time, I don't mind. Whereas I think my wife, because she'd got fed up… She'd been doing for 30 odd years, you know, initially for our children and then us, but I'm not at that stage. I still like cooking. I still like seeing what I can make you know; I have a lot of disasters. Some of them don't work out, you know, but. Do you know what? I've I learnt!" (Participant 002).* *"More time for food after retirement. Well, you're at home more, I think, and you can certainly do more snacking when you're at home. And I think to some extent when I was working, I came home and my tea was on the table, whereas at least now I get some input, I suppose." (Participant 085).* *"My husband and I are both veterans, and we both hate it, we both hate being retired and not being in work, it's affected us… So, we've got nothing to do all day so it's just a case of sitting there cooking and eating rather a lot through boredom." (Participant 087).* *"When I worked, I was very time poor and I didn't eat as nutritiously as I do now because I didn't have the time to... well, I chose not to spend as long timewise then." (Participant 131).* *"During the lockdown, I found it really convenient to get online shopping and I've continued to do it because as a full-time carer it saves me so much time. You know, I don't have to go around the supermarket for an hour doing shopping, just put it away so £3.00 a week gives me so much peace of mind. So that's my main shop. I very rarely go and buy anything else. It saves me money because you know, the more I go to the supermarket, the more I'm likely to bring home things I don't really need." (Participant 030).*
Access or distance to shops	*"I shop once a week online. I have it delivered because I have about a 30-mile round trip to the nearest supermarket." (Participant 4).* *"During COVID... we got all our food from local shops, and we've continued with a lot of that." (Participant 21).* *"I shop once a week and then top up using local specialist shops... where we stay with an excellent butcher and bakers." (Participant not specified).* *"I do a 50-mile round trip to a town, Dumfries, which is our nearest big town. I tend to do a big heavy shop with my car for things that are heavy... then shop at local shops for things like milk and bread." (Participant not specified).* *"We're a rural village... It's a 14-mile round trip to pop to the nearest supermarket. I would love to shop local but can't unfortunately." (Participant 97).* *"Where I am, you're limited to the supermarkets which are close by… We've only got two food shops really handy, Aldi's and Marks and Spencer's, and I very seldom go into Marks and Spencer's because I think the price of their food is a disgrace, it really is." (Participant 107).* *"I stay 7 miles away from the nearest shopping centre... I order my messages and go in and collect them." (Participant 109).* *"I do worry for my father because his local shop is a very small shop in a rural area…It is incredibly expensive and there's a lack of variety there. There's very little fresh fruit and veg options in these little shops as well, so I think there's a lot of restriction there just from being in in a certain location." (Participant 049).* *"Just that there's less than 1,000 people in the village that I live in. There's one tiny shop. There are a lot of older people in the village. I see that they generally just go to the local shop, so they have a very limited diet." (Participant 044).* *"We stay in a small village, and we have a supermarket. If we go to Stirling, I can get a supermarket. But I have to travel. I can't just walk up to the village. I can't get everything in the coop because they don't stock everything. It's too small a shop. So, if I need something special, more specialised, I have to go up to Stirling. And that involves the car. So, you know, that is one thing that does annoy me about foods not being available locally, like not being able to get what you need locally and having to go to the supermarket so that does annoy me." (Participant 026).*
Access to private or public transport	*"I have a car so it's easy for me to do a big shop my once-a-week shop. I do a 50-mile round trip. So, I wouldn't say that the distance really is a factor. It would be if I didn't drive, you know, because local transport just would not allow for you getting big heavy bags. And for the where you have to walk from bus stops and the frequency of buses. But because I have a car, I'm able to drive, I'm retired, I'm free to go when I like. I don't restrict my shopping trips to once a week, once a month I go when I realise, I'm needing a big top up." (Participant 070).* *"My mum is 80 this month and my dad is 82. Until last year, they were pretty much independent. My mum doesn't drive now, and they live outside a small village, and they have to drive to get to the nearest shop. They're not able to get on a bus because they're not able to physically able, that is, my dad fell, broke his hip." (Participant 006).* *"I live with my wife, but she's had to give up driving because she can't see, so I have to drive to the shop. It's 6 miles away. If I wasn't there, she'd really struggle. There are buses but like every four hours, which makes it an awful long shop, as well as carrying it back would be a problem. It's not a problem at the minute, but I can see very soon it could be." (Participant 085).* *"Until two years ago, we were in the heart of rural Aberdeenshire, isolated. Five miles to the nearest shop so everything had become a journey. We made a conscious decision to anticipate us not being able to use a car and moved into a village. Most of the things we want are in the village now… there is one or two buses a day out of the*

	village to somewhere, mainly to Aberdeen, not to the local shopping centres... We could cope but we would have to really think about our budget because the shops in the village are quite expensive." (Participant 127). *"So, we're not on a bus route, so if there comes a point where either of us, both of us, can't drive, that would be a big issue. There have been times when we haven't been able to get out because of the snow and the ice but we've got lots of wonderful neighbours who have got 4x4s. I wouldn't want to rely on them, of course, so yeah, it would be an issue and that's something that I haven't really thought about and don't want to think about yet." (Participant 130).* *"I've got Parkinson's and although I'm fine at the minute and I'm allowed to drive at the minute, it depends what happens further on, and I would really miss not driving." (Participant 091)* *"Very few of them have the means to get out of the village, to a supermarket and the public transport is very poor as well. You know, they would be looking at well during the middle of the day. The buses are two hours apart to get to the nearest supermarket. So, it's almost a day's trip. And then how would they carry everything home anyway, you know, and pensioners and what they have and the availability of taxis and, you know, a 10-mile journey is going to cost them £20 in both directions. For a lot of people that are close around us, it must be very, very difficult. And I would want to be in that position." (Participant 044).* *"I remember the time when I hadn't got use of a car that, I would have a rucksack on my back and go out and get all of the things I needed. It was really tough. I wouldn't like to go through that again, I don't know quite yet. I think I would probably have to do online stuff. But yeah, I'm not looking forward to thinking about that. Actually, that's gonna be a problem down the line, yeah." (Participant 039).*

6.2 The impact of the biological factors on food-related behaviours

Numerous biological determinants were discussed during the online and in-person discussion groups. However, more challenges were discussed by those individuals that were responsible for supporting their relatives with food related tasks. Biological determinants included health conditions and concerns associated with increasing age, the impact of mobility on food habits, changes in appetite and ability to eat, other sensory factors such as eye-sight and sense of smell and taste were also discussed. Some relevant quotes are presented in Table 4.

6.2.1 Health conditions and health concerns

The participants discussed how various age-related health conditions, such as diabetes, high cholesterol, and cancer, had significantly influenced their eating habits to improve nutritional intake. Many express a strong awareness of their dietary needs and the need for adaptation, the emotional and psychological aspects of dietary changes were discussed, with some participants expressing feelings of loss regarding previous food habits, such as a fondness for sweets and snacks. However, many also report positive outcomes from their dietary changes, such as feeling healthier. Health concerns were discussed by individuals and family-caregivers, some described the compromise between the quality and quantity of calories their relatives were eating. However specific health concerns regarding potential susceptibility to foodborne illness were discussed, as presented further in section 6.6.

6.2.2 Mobility and physical ability

Although some factors relating to mobility and the impact upon being able to go shopping were discussed in sections 6.1.2 and 6.1.3. During the discussion groups, the challenges faced by individuals over the age of 65, particularly those that were disabled, in managing daily activities like shopping, cooking, and mobility was explored. Many participants

described the physical limitations that hinder their ability to perform these tasks independently. Ageing parents, often with mobility issues like hip problems, arthritis, and Parkinson's, rely on family members for support, such as food shopping and meal preparation. These physical limitations also impact their social lives, reducing outings and making it difficult to maintain previous routines. Some participants noted that their relatives have difficulty accessing items in their homes, like food stored in under-counter fridges. Others use adaptive methods like prepared meal services to cope with physical challenges. Participants expressed frustration over the reliance on caregivers and the decline in independence, with some adjusting to the limitations by batch cooking or simplifying tasks. Despite the efforts of family members or carers, the physical and emotional toll on both individuals over the age of 65 and their family-caregivers are significant.

6.2.3 Appetite and ability to eat

Several individuals discussed how their appetite had reduced as they had become older. However the decline in appetite was widely discussed by those that cared for their relatives, they discussed witnessing how their relatives' appetites and interest in food had declined. Many family caregivers described their relatives as 'picky eaters' and how they were having to adapt to deal with this.

6.2.4 Eyesight

Some participants discussed the challenges they faced, or that their relatives faced in managing food and household tasks due to poor eyesight or vision loss. Several participants describe difficulties their ageing relatives encounter, such as being unable to read use-by dates and having trouble with small print on food packaging and cooking instructions. Some individuals are unable to cook due to visual impairments or health issues and rely heavily on ready meals or caregivers for assistance. One participant shared that they serve meals in a certain way to make it easier for their visually impaired relative to identify different foods. These points of discussion indicate the importance of accessibility in food storage, packaging, and preparation for those with declining eyesight.

6.2.5 Sense of smell and taste

The impact of diminished taste and smell on eating habits was widely discussed. Some participants mentioned losing their sense of taste which affected their relationship with food, while one participant noted that while their reduced taste makes it easier to eat repetitive meals, another expresses frustration in not being able to enjoy food, which also lead to concerns about not being able to taste if food has spoiled. Overall, the loss or alteration of taste and smell significantly affects these individuals' food choices.

6.2.6 Discussion and food safety considerations

A study of food insecurity amongst older people in the UK reported that within the older adult age group there are older people in very different circumstances for example 20% of people aged 75 years and older need support to leave their home (Purdam et al., 2019). This can have a dramatic impact on a person's ability to buy and transport food home, which has been explored in a food safety context in this study.

Family caregivers were particularly aware of reduced appetites and how this results in the same quantities of food being purchased but not being eaten and therefore being subject to

prolonged storage in the home, to ensure the safety of such food the use-by dates need to be adhered to, and refrigerators need to be operating at safe temperatures. Vision impairment also resulted in use-by dates being disregarded., or cooking instructions not being correctly implemented.

Table 4. Biological determinants upon food shopping, storage, cooking and eating practices among adults over 65 in Scotland.

Theme	*Quotes*
Health conditions and health concerns of individuals and family caregivers	*"My husband he has problems chewing, so you know, you have to buy things that will melt down or put it in the slow cooker so there's not much chewing to it, so that restricts what I cook. I don't make separate meals, but everything has got to be well cooked. That kind of annoys me sometimes because it takes the flavour of food and vegetables, it's all got to be mashed, carrots and things it's all got to be mashed down, so it takes the pleasure out of cooking and eating as well." (Participant 112).* *"I realised I was getting older, and I thought, "I don't want to be really, really obese." Even though I still am overweight just now for my height, as I say, I don't have any health conditions but I'm aware as you get older, you know, you need to be careful." (Participant 102).* *"But my mum is also diabetic. And has spent her life restricting the amount of sweet things that she eats. And now she just doesn't care. You know, she's literally got to the point where it's "if I want to have something sweet, I'm just going to have it". And I have to confess, I actually won't stop her now because I think. What's the point? You know, just eat what you want. I try my hardest to encourage fresh fruit and vegetables." (Participant 006).* *"My dad is a ravenous eater. I have to curtail his eating. Sometimes he does have a sweet tooth, and he is diabetic, which is an issue. He does drink too much, which is an issue as well." (Participant 049).* *"I recently was diagnosed with type two diabetes, so everything's changed and that in my whole diet… I have an exercise regime, and I try and buy fresh stuff every day I go and buy vegetables, and I cook every day. I tend to spend a lot more time in supermarkets because I'm struggling with reading the nutrition labels… I actually have had to change the whole way I eat. I feel as if I'm missing out on things, but I feel healthier than I've ever been in the past ten years or something. I lost, 2 stone. Obviously, I don't eat cakes, or sugar or like anything with fat on it so crisps… fried stuff, I don't eat any fried stuff anymore and I feel a lot better for it… I just thought that if I can get it under control that better it'd be." (Participant 098).* *"I lost both my parents to bowel cancer so trying to think of a healthy diet, high in fibre, low in fat. Some of the advice we were given, and I do think about it a lot, sometimes it just gets boring… Another thing that recently is an age thing I'm losing strength; I can't open some bottles and some jars… I'm perfectly healthy and that's good and I'm mobile but it's so restricting, for example, I've stopped buying jars, they just annoy me." (Participant 111).* *"Five years ago, I was diagnosed with breast cancer. So, I revisited my diet… I changed initially stopped dairy, and then I had my bloods taken to check and my calcium was really low, so I've just gone back to dairy. I started reading up about potential foods that might help reduce a recurrence. So, for example, with there's evidence that cruciferous vegetables in high doses can reduce reoccurrence… And also now what I do is intermittent fasting because the tablets I'm on, I'll be on them for 10 years because I'm at high risk of recurrence and they tend to put on weight… so I don't have breakfast anymore, but I have breakfast at lunchtime, and that was something that was quite difficult for me because I love breakfasts, so I now rather than just missing out breakfast, I just had breakfast at lunch time, and then we would have a normal dinner and then I don't snack in the evening." (Participant 021).* *"How I eat has change dramatically over the last few months because I've been diagnosed with microscopic colitis. And the type of food that I can eat is very limited now… I'm not able to eat at the moment, so a huge change." (Participant 072).* *"I've had inflammatory bowel disease since I was in my teens. And that's had a major impact on my diet throughout my whole life… My wife is celiac as well, so that has a profound influence on what we both eat, really. So, our household is a gluten free household… So obviously when you go to buy anything, you're either heading for that section in the supermarket or you're looking very carefully at the ingredients of what you're buying… You're constantly monitoring, what's in what you're buying? Make sure you're not inadvertently buying something that's going to cause problems… Having ruled out things that we know that we can't eat, we then have to look at the ones that we can eat and make sure we buy the right version of it so it as time goes on, you do get used to it. I mean it's not a major difficulty, but there are oftentimes when you look at stuff in a supermarket shelf and think, "oh, I'd fancy that akh", but don't bother because you can't!" (Participant 008).* *"Well, I have given up driving because I get migraine, which would be quite dangerous if I was driving a car, but I have a husband who will take me anyway. He works part time, but obviously if we want to go shopping, we go shopping and it's just a day out." (Participant 040).*
Mobility	*"Well, how I go shopping? I can't. I'm 94 and I've I'm not able bodied. I can only walk holding on to something and so shopping is done for me by someone who was appointed as my carer when COVID started. And he does shopping once a week for me and I give him an order of the things I want, and he gets them. I also buy other food online. I both have difficulties in cooking, and the time it takes. If I'm cooking a meal that's that is an all-day affair. That's why I get Wiltshire farm foods." (Participant 20).* *"I've got lung problems, and I do find it difficult to get around the store, which is why I only go once a month, that's about as much as I can take. So, it's difficult. In the kitchen, I have a chair that I use to sit down, after a while I get breathless. But yeah, my husband and I do it between us. We usually batch cook so that on days where we're both good… so on days when we're both feeling down we've got that in the freezer that we can fall back on." (Participant 87).* *"I've had really poor health the last 15 years, so my husband took over a lot of the shopping, a lot of the time, I still like to get to a supermarket… if you don't actually get to the shops you run out of ideas… then it was coming back to the same thing." (Participant 112).* *"Her physical ability just because of her age has diminished. So, she tends to find that she can't walk far. Now she's got problems with her hips and her knees. So, she neither has the motivation to stand long, nor is she able to because of the pain that she's in. So, that has had a big effect on the range of foods they eat and the healthiness of what they're eating. So that that's definitely had an impact... The other thought I had was about their fridge. My mum's fridge is absolutely stuffed full of things, but it's an under the counter fridge, which she can't reach. You know, she can't get down to it. So, it's actually makes it really difficult for her to know what's there, and to put her hand on it when she wants. I think that partly relates to why, you know, there'll be a mouldy onion, or you know, three leftover bits of cucumber that she didn't know she had because she can't reach them." (Participant 006).* *"She can't stand to cook for herself. She's got a profound scoliosis, so she's quite physically disabled. She can't stand for any length of time." (Participant 047).* *"Mum was recently diagnosed with primary lateral sclerosis, and she's totally wheelchair bound, and their house and car and everything really just isn't suitable for someone in a wheelchair, so my dad has to do everything now, all the shopping and cooking, which he never really did before, they had very traditional roles. It's a huge change for them." (Participant 083).* *"So I take her once a week to do a supermarket shop. She does occasionally go to the local shops, but she's becoming less physically able to do that. So, if she needs things in between the supermarket shops, I tend to pick that up for her and deliver it round to her, because I think her biggest issues are physical mobility. Now. She's still a relatively independent in the house in terms of food prep." (Participant 005).*
Appetite and ability to eat	*"But as my mum got into her 90's, her relationship with food changed. Her portion size decreased greatly and that's not just dementia that does that, it's just natural aging. You're not expending as much energy, so you don't need to eat as much. Her taste became different as well. So, also as well, the gullet, the oesophagus it changes. The muscle groups stop working, so the food has to become softer*

Theme	*Quotes*
	and smaller, so my mum stopped being able to eat. She couldn't eat chops, stews, no matter how soft they were cooked, so there was a big change. So, she couldn't eat whole potatoes, they were always mashed. She stopped being able to eat rice, pasta, she couldn't eat because she had to watch chocking." (Participant 093). *"My husband's mum wasn't eating properly so we got Wiltshire farm food meals... and sometimes she just didn't fancy that so that would sit in the fridge for how long and then she would eat it. But she's spent her money on it, and she was going to do what she wanted with it... whereas with the care staff now they, as I say, it's part of their role to chuck it out. It's hard, it's a hard one. (Participant 131).* *"But I just eat for the sake of it, basically, I never feel hungry, which I feel is not right." (Participant 107).* *"Since I've come out of hospital I've been put on medication and I've lost my appetite and I'm thinking, "Why is this?" I think you have to eat properly, you have to fuel your body, you know, you have to keep well." (Participant 103).* *"And you need to be thinking about the nutrients she's getting. It's all pretty challenging because she's not got a big appetite anyway, and the less you eat the appetite goes down." (Participant 048).* *"The appetite has shrunk, but then I think she's doing less. Which I think the two seem to correspond." (Participant 005).* *"She just cooks the same amount as she's always done, but the food just lasts so long because they eat such tiny quantities now as well." (Participant 006).* *"I think for me, I don't know about others, but as I get older, I don't want to eat as much or as regularly as perhaps previously." (Participant 41).* *"As I get older, we do both eat less, as we've got older, we generally just have breakfast and evening meal." (Participant 044).* *"I think probably as you get older you just get more fussier. You know you sort of revert back to your childhood in terms of your food. You just get more attuned to what your body can take and what it needs and wants. And you don't buy or eat the things that you know you don't want to eat. Well, I do anyway." (Participant 054).*
Eyesight	*"I can't read instructions and storage information on packaging now. And you know that's with glasses. I often use my camera phone to take a picture and expand it. Some kind of magnifier. Yeah, the size of the dates is a particular issue for me, but also preparation instructions. You know if you're trying to put something into the oven at this temperature for this number of minutes on some packaging, it's really hard to work out what temperature is, usually it's 180, but if they're saying 20 minutes or 30 minutes, they're going to look really similar. If you're trying to see them, so you might not cook food for long enough." (Participant 005).* *"She's got partial vision loss as well. So, she can't always see what's on her plate. So, trying to make sure I've got a dark coloured plate so she can see light coloured foods on it rather than the white plates that you would normally put things on." (Participant 047).* *So yeah, there's definite differences and that would be over the last few years, just a few years, I would say, for my folks as their eyesight has deteriorated. So, my parents can't read the writing on things 'cause it's always so small, so they don't. They sometimes they struggle to even see the use by date or the eat by date… You know they're not big and bright. So simple things like that." (Participant 006).* *"I think, this one has to take into account is that as we get older, our mental faculties do deteriorate and people become less aware of what's in the fridges because of their eyesight, you know, poor lighting. Your eyesight isn't as good as it was or your memory. So, people take more chances without even being aware of it." (Participant 064).* *"Up until last year, I was a carer for my father-in-law when he died, he was 102, and he lived next door, and he was on his own all that time. He wanted to keep cooking for himself as long as possible, and I used to take him shopping, but then I suddenly realised because of his poor sight, he was eating things that were out of date. I mean, he loved raspberries in his porridge every morning. And sometimes I would have a look, and they would be mould, and he wouldn't see." (Participant 033).*
Sense of smell and taste	*"Actually, before COVID arrived, I lost my sense of taste. I don't know why, but it might just be an ageing processor part of the ageing process. I don't know, but it's never quite been the same since then and that's kind of it's made it easier for me to repetitively eat the same things over and over. It doesn't really bother me because I've kind of forgotten in a way. I don't really notice that I'm missing out on something." (Participant 002).* *"One of my health issues, is I have a diminished sense of taste, and I've got chronic catarrh. I have minimal sense of taste much of the time, which I find very frustrating because I love food. It doesn't stop me eating food, unfortunately (laughs), I still eat it, but for me it's a life sentence because I really enjoy food. I'm putting more salt into food, which I know I shouldn't but it's giving it a taste. You know, I love homemade soup, but I have to say to my husband, "Does that taste nice?" and that's very frustrating. I'm quite anxious about food poisoning because of my lack of sense of taste because I'm not necessarily able to taste if something's off." (Participant 105).*

6.3 The impact of the social environment on food-related behaviours

Social environment determinants discussed during the focus group discussion included how others influenced people's relationship with foods. As indicated in Table 5, one of the widest discussed social determinants was the impact of living alone on the relationship with food shopping, cooking and eating. The social environment of individuals has a significant impact upon their psychological factors, combined these can significantly impact upon food shopping, storage, cooking and eating practices among adults over 65 in Scotland.

6.3.1 Presence of others

The presence of others significantly influences participants' cooking and eating habits. Many participants describe how they cook more or put in extra effort when cooking for someone else, such as a spouse, child, or grandchild. Some participants shared that cooking becomes a social activity, particularly when family members cook together, bringing enjoyment to the process. Social interactions and having family or friends visit to cook for seemed to inspire more effort and enjoyment in meal preparation.

6.3.2 Living alone

The loss of a spouse or the absence of loved ones often resulted in a decline in cooking enjoyment and eating habits, with some relying on others to help with meals. For example, when living alone, participants expressed a decline in motivation to cook elaborate meals for themselves, often opting for quicker, simpler options like snacks, toast, or ready meals. For those who used to cook more frequently, especially for a spouse or family, cooking had become less appealing after losing a partner. Some participants reported feeling that cooking for one lacked purpose or that it had become a monotonous task and often resulted in preparing the same quantity of food as when cooking for two resulting in eating the same thing over a prolonged period of time. Often, living alone leads to reliance on batch cooking, frozen meals, or external help like food deliveries from family members. The overall theme is that food and cooking are not just about sustenance but are deeply tied to social interaction,

companionship, and care. A sense of loneliness or a change in lifestyle, exacerbated by factors like mobility issues or the impact of COVID-19, has influenced their eating habits and overall attitudes toward cooking and food shopping.

6.3.3 Discussion and food safety considerations

It has previously been suggested that the Health Belief Model overly emphasises cognitive constructs, neglecting emotional and social factors by overlooking cultural and social influences on health behaviours and assumes rational decision-making, ignoring emotional complexities (Alyafei & Easton-Carr, 2024). Therefore, by incorporating social determinants of health into the model it may give a deeper understanding of changing human behaviour (Resnicow et al., 1999), consequently by taking that approach in this project the findings highlight the impact of the social environment on shaping food-related behaviours among adults over 65 in Scotland. Indeed, factors such as living alone and social interactions impact motivation to prepare food, food handling practices, food storage habits, and overall dietary choices, which in turn may pose potential food safety risks.

One key concern is the reduced motivation to cook and eat fresh meals among those living alone. Participants often reported opting for ready meals, batch-cooked frozen meals, or repetitive food choices, which could increase the risk of improper food storage, inadequate reheating, and prolonged food consumption beyond safe storage durations.

Conversely, those who regularly cook for others exhibited higher motivation to engage in safe food handling and meal preparation, reinforcing the role of social support as a cue to action in the Health Belief Model (Rosenstock, 1974). Shared meal preparation and social interactions appeared to encourage safer food practices, this could be through peer reinforcement or having a sense of responsibility and accountability. However, even in social settings, misconceptions about food safety and habits can influence behaviours (Anderson et al., 2011).

Understanding how the social environment influences food safety behaviours is essential for developing targeted food safety messaging aimed at older adults. Further research is needed to explore how the social environment can be utilised to improve safe food handling and consumption practices among older adults.

Table 5. Social determinants upon food shopping, storage, cooking and eating practices among adults over 65 in Scotland.

Theme	*Quotes*
Living alone	*"Well, I live in my own, so it's very easy to go to the tea and toast option, which I don't do. But you know it would be quite easy to do that. It's very easy when you're on your own, just to have something quick. Sometimes I think by the time you've cooked it you're fed up of it. I might have a dish which I would have the same dish over two nights. So, the first day I've cooked it, and the next day I'm just reheating, and that doesn't bother me because the second day is quite easy because the dishes are done." (Participant 001).*
	"My mum is still a relatively independent in the house in terms of food prep, and she does take the ready meals off of like Wiltshire Farm Foods, which reduces some of the food prep because she tends to find that, but this is a more symptom of living in her own now my dad died, she did used to cook more for herself, but I think as time goes on, it's less appealing to do that because, for example, if she made herself roast beef, she'd be eating roast beef for three days, because that's not something you can prepare in small quantities. When it was mum and dad, there'd be a lot more fresh stuff she would buy from the butchers. She'd be down the street two or three times a week. She'd be buying fresh stuff from the butchers, the green grocers, etcetera in the village. But now there's less fresh. Anything that takes a lot of prep, she'd rather buy oven chips than buy potatoes. So, it's things that need a lot of preparation. She just doesn't do anymore… So yeah, I think it just becomes monotonous cooking for one." (Participant 005)
	"Because always living alone, cooking for one, it's a thing you develop early on. Because, yes, I enjoy a bit of roast beef, but a tiny piece of roast beef doesn't roast well, you don't want a big piece of meat or you're eating it forever more, and a big fish you're left with it. So, I maybe grill a piece of steak. And fortunately, the butcher does excellent cold meats, unlike the supermarket stuff, which is horrible." (Participant 080).
	"I live alone, and I cook far too much. I can't stop shopping for food. And I lost my husband, and I just cannot do portion control for myself." (Participant 092)
	"I live on my own just outside of the town and I shop maybe two or three times a week. I cook for myself obviously. I sometimes get free meals from other people but, I can't be bothered cooking just for me." (Participant 088).
	"I live on my own and I love grocery shopping, but I don't like cooking, but I like to bake but I don't have many opportunities to bake because nobody wants to eat it, they're all healthy eaters". (Participant 091).
	"I loved cooking for myself and my husband and then when he died everything has changed since then and I think I just can't afford food, but I do make an effort." (Participant 096).
	"I live on my own, and I like cooking, but I prefer to cook a few things at once, I put them in the freezer so that you are not cooking all the time. For me, if I'm cooking, I don't want to eat it then because you're sort of standing there cooking, it's like you've already eaten while you're cooking so it's nicer to get things out the freezer when you want to eat." (Participant 099)
	"I live by myself so I tend to do a lot of batch cooking, because one night you might feel like, you know, a stir-fry one night but you can't be bothered getting all the ingredients together for one meal. So, I think batch cooking for someone on their own is a good idea." (Participant 104).
	"I'm single, I live on my own, but I also live next door to my sister. I've sort of slotted into an odd situation where my brother-in-law is a fabulous cook, and he cooks dinner every night, so I have my food cooked for me every night and its beautiful food. But the rest of the day I tend not to eat. I do have breakfast stuff, but unfortunately, I tend to sleep so late that I never have breakfast, and I end up having a pie and beans or something for brunch, you know, so that's probably not very healthy. I do the washing-up because I feel thankful." (Participant 105).
	"My husband passed away two years ago, and I've been very, neglectful eating since then, I never seem to feel hungry at all, whereas before when it came breakfast or lunch time, dinner time I always had a meal, but now I'm finding the day's gone on and on and it's maybe about eight o'clock at night before I want something to eat. And then I just eat anything that's handy because I'm not a good cook either, I'm a hopeless cook, and I hate cooking, and I hate shopping for food. But I just eat for the sake of it, basically, I never feel hungry, which I feel is not right." (Participant 107)
	"Well, I've been on my own for nearly eleven years in July and it took me a long while to get used to it because me and my husband always used to sit down at night and have our meal and a glass of wine, but then when he died it's, you know, your tin of soup, make yourself a sandwich. I like chicken, but you buy a chicken, you're eating chicken all week." (Participant 108).
	"Since I've been on my own which is about eight years now, my attitude has changed to shopping and cooking… I was rather spoiled, my husband, his way of relaxing when he came home was to cook a meal. So, he cooked Monday to Friday and then I did the weekends. So, I'm enjoying having the seven days in which to cook now. I went through a period of being very bored with it and then I tried to do a bit of thinking about why I was bored because I was still buying the same things, and I realised it was the lack of company because I'm on my own and that's what it was. So, I thought behave yourself, get on, you've still got a lovely meal. But now I've got a very good daughter-in-law who occasionally brings me food parcels, so that's good as well, they go straight in the freezer. I still enjoy it, so long may that last." (Participant 115).
	"So, I've been on my own now for two years. And as a result of that, I found it so liberating to eat exactly what I felt like eating." (Participant 055).
	"If you're having to cook just for yourself and nobody else, it's really very difficult to cook for one, even if you did a stir fry by the time you've got a quarter pack mushrooms, half a carrot, etcetera, before you know it, it's massive." (Participant 052).
	"I find that because I do live on my own, I do have a lot of waste because you can't freeze everything if you are fed up of having it. And all the packages are always aimed at families and more than one. You're not always able to buy small because things are in packages and even like meat or even like vegetables or even like pasta, everything's big and I just find that I do have a lot of food waste." (Participant 058).
	"I've seen couples where one the person who's been in charge of cooking and has done all the shopping has died. And I think that has a major impact on the partner that's left behind. I visited a friend a bit after his wife had died and I had to empty the fridge and say "you can't eat any of this. It's all way beyond the dates, even I won't eat it"." (Participant 063)
Presence of others	*"If I am cooking for somebody, I'll definitely put more effort in. I would say if my granddaughter maybe comes round for her tea, I'll have it planned out, what I'm going to have and, you know, be more than I could for myself. I'm happy to see her. I enjoy it." (Participant 001)*
	"I don't particularly enjoy shopping; however, I enjoy eating so it's a necessary evil. I do a lot of cooking. And I enjoy cooking when I have visitors." (Participant 076)

	“But my grandson comes down to visit and he always cooks the meals at night, he’s a great cook, and I do enjoy his meals, but the washing-up he leaves you with is horrendous (laughing), But I do enjoy my meals getting made but he uses every pot in the house.” (Participant 107). *“Living with some, it certainly influences the way that I shop and cook and eat because I would be a tea and toast person if I was just living on my own. It's the fact that I have somebody else who, you know, who needs fuel. Because he certainly wouldn't do with tea to start. He doesn't do hungry so.” (Participant 004).* *“Well, I find if you’re on your own you make the meal and you’ve eaten it and it’s only taken ten minutes, whereas if there’s two of you it’s taken an hour, and I don’t know why, it just takes a lot longer when there’s two people sat there. Whether you’re talking in between or whatever, it’s much more of a social occasion. If you’re home on your own, you make a meal, you’ve eaten it and you’ve finished and you think, “Oh that was a waste of time almost.” (Participant 085).* *“I will make lunch and dinner, whereas if I was on my own, I wouldn't necessarily bother with that. I probably eat more because I'm in a relationship and we have that sort of structure all day in a way. I don't think my husband would like to miss a meal, but I could.” (Participant 040).* *“If I was on my own, I would eat less. But we find that you know, dinner in particular in the evening is a social event. It's we're both working part time still. So, at the end of the day, it's a chance to talk over a meal. But I know that I would definitely eat less if we didn't have that situation.” (Participant 044).*

6.4 The impact of psychological factors on food-related behaviours

Numerous points of discussion related to the psychological determinants, for example the groups with people over the age of 65 commonly discussed meal planning, lack of motivation and food enjoyment, other groups discussed cognitive decline among their loved ones. Examples of quotes are given in Table 6.

6.4.1 Complex relationships with food

Some participants discussed having complicated relationships with food which often existed from childhood, with some describing self-destructive and self-sabotaging behaviours such as compulsive overeating or excessive snacking, while others simply viewed food as fuel.

6.4.2 Motivation and inspiration

A lack of inspiration and motivation to cook was often linked to living alone, as discussed in 6.3.2. Many participants express difficulty with meal planning. Participant 002, a vegetarian, finds it challenging to prepare diverse meals due to complex recipes and limited ingredients, leading to repetitive eating. Many participants shared their frustration with falling into routines and missing spontaneity in meal preparation, this was particularly the case for participant 112, who in section 6.2.2 had previously described how mobility problems prevented them from gong to the supermarket. Several participants mention a decline in their enjoyment of food and cooking over time. Convenience was a key factor for several participants, with some opting for ready-made meals or simple, repetitive dishes due to exhaustion or lack of interest in cooking, or simply not being bothered to cook.

6.4.3 Alzheimer's disease, dementia and memory

Although Alzheimer's disease is a physical illness, that damages the brain it could be classified as a biological condition, however because it causes progressive memory loss and cognitive decline, for the purpose of this analysis it has been grouped as a psychological factor. Nevertheless, for future iterations of the model, it is suggested that all psychological factors and biological factors are grouped as health factors.

In the general discussion groups, some expressed concerns about memory loss affecting their ability to manage food. Some forget to buy essential items, while others may forget about leftovers or fail to plan meals adequately. However, in the discussion groups with individuals who supported relatives over the age of 65 with related tasks, cognitive decline was a key theme. The discussions focused on how ageing and memory issues, especially related to dementia and Alzheimer's, had a significant impact on food management and eating habits.

Cognitive decline was a recurring issue, with participants mentioning that loved ones with dementia struggle to remember what they've eaten or how to prepare food. This has led to instances of unsafe food storage, like leaving food out for days or misusing kitchen appliances, necessitating external help from carers or family members.

There was widespread concern among family caregivers about how dementia and Alzheimer's was affecting the food related behaviours of their loved ones. Significant discussions were also held regarding the impact of caregiving and being the sole food provider of family caregivers. This was often balanced with full time work and younger families.

6.4.4 Discussion and food safety considerations

Psychological factors significantly impact food safety behaviours among older adults. Low motivation, difficulty with meal planning, and cognitive decline can lead to unsafe food storage, improper reheating, and increased reliance on ready meals. Cognitive decline, including dementia and Alzheimer's, further exacerbates food safety risks, with reports of forgotten meals, improper food storage, and unsafe appliance use. Family caregivers face challenges ensuring food safety while balancing other responsibilities. Addressing these issues requires clear food safety reminders, meal planning support, and caregiver assistance programs to promote safe food practices for older adults.

Table 6. Psychological determinants upon food shopping, storage, cooking and eating practices among adults over 65 in Scotland.

Theme	*Quotes*
Complex relationships with food	*"I'm fussy about food, but I view food as fuel. That's exactly what I do because I'm a runner. I go running. A lot. I run about 6 or 7 miles, maybe four times a week. And so, I look at food as being fuel. Quite often, my wife and I have a joke about it because I'll do things like I'll eat my pudding before my main meal kind of thing, you know? And she laughs about that. She says, why can't you eat things in order, you know?" (Participant 002).* *"Food is only important to me to keep me alive." (Participant 008).* *"Well, I just eat food for the sake of it. I like any kind of food but I'm not too fussy about what I eat as long as I've got a meal in front of me." (Participant 107).* *"I've got not a love hate relationship with food, but I find food difficult and that's been from childhood and family factors, various family factors. I have type two diabetes, and I find it quite difficult, but my difficulty is my relationship with food. I'm an emotional eater and I've been on numerous diets from as early as the age of eight, etc, etc. Cabbage soup diet, Weight Watchers, Slimming World, you name it and I've come to the realisation I can do it for a short time and then I self-sabotage and at the moment I've just signed up for a CBT course to try and help so that I can stop this but it's, I'm 66 and I've tried throughout my life and it's just so, so difficult. So, so difficult." (Participant 094).* *"I am definitely an emotional eater, hence where I am, and I am not a fussy eater... I can't buy four ice creams because you can guarantee that I will eat all four. I head off on Saturday to deal with the family drama and I've noticed that in the last week that I've eating, erm, self-destructing. I've been doing self-destruct as if I'm ready for the dramas. It's really strange, isn't it? You think that you'd be eating good stuff, and you get yourself ready for it but, erm, no." (Participant 100).* *"I've got a love/hate relationship with food. I've struggled with my weight for most of my life. I've been a lot, lot heavier than I am just now but I've also been a lot lighter. I find it quite tough when it comes to food choices. Personally, for myself I'm quite bad at snacking, that's my downfall. I do eat a lot of healthy food. Every day I'll eat lots of fruit and veg but I'm finding that where I'm sitting at home and, you know, just boredom sometimes, it's just I go in the cupboard. And I shouldn't do it, it's just wrong snack choices for me." (Participant 102).* *"Mum is quite rigid with what she eats. When she's sitting watching the telly at night, she'll maybe have a bag of crisps, or she buys herself wrap chocolates like Roses or Quality Street or something. But don't know whether she does that as a treat because it's nice, or whether it's just a kind of routine subconscious… Is that because of given enjoyment or is that unconscious eating." (Participant 005).* *"Food, I've got a relationship with food. I'm not a great lover of vegetables. For some reason, I don't know why, I don't like the textures, you know, when I put it in my mouth, I don't like the feeling of some foods, so I won't eat them. So, my family has always struggled to get me to eat vegetables." (Participant 103).* *"I've always had a fight with food all my life. I have had bulimia in the past. Struggles with over-eating, up and down. I've got more of an even keel. I eat pretty healthily but I also like snacking. And I find particularly if you take alcohol the weight goes up. Also, empty calories but also, I think if you have alcohol you say, "Oh I'll just have another packet of crisps," you know, because the inhibitions go." (Participant 105).*
Motivation and inspiration to cook	*"Well, the main difficulty I have is being a vegetarian, my diet has become very narrow trying to figure out what meals to prepare. You look at most of the online recipes they involve, sometimes twenty ingredients, and if you don't have one or two key ingredients, you know going out shopping just to buy those one or two ingredients is off-putting and over time I started off really good doing lots of lots of different recipes. But over the last couple of years, I'm getting very repetitive about what I'm eating now. That's not a difficulty, because to be honest, I could eat the same thing three meals a day." (Participant 002)* *"I would say I enjoy food less now. Some of it is boredom, we do tend to eat the same things all the time because my husband buys the same things all the time and by the time you get home from work because I'm still working, you're tired, and just can't be bothered to stand there and create something wonderful." (Participant 110)* *"My husband needs to take me shopping, because I can't push the trolley and sometimes, I can't walk very far, but then a lot of the time I just can't go, so I just send him off with a list… if you don't actually get to the shops, you run out of ideas… You also get fed up of your routine, although I enjoy the food. I used to make my own coleslaw, and we'd have coleslaw maybe five times a week because it was healthy, but then my husband went off it, so it's like now what do we do now? So yeah, I get frustrated, I would like to be my old self and be able to be creative and whip up something but it takes a lot of planning, so I have to send him with a big list, "Okay, I need all these things," and then on a good day I can make this and my freezer is filled with stuff but it's still nice to be spontaneous, so I've kind of lost that." (Participant 112).* *"I like shopping but sometimes, you know, you'll go, "What will I buy?" You get fed up of the same things." (Participant 108)* *"I just eat anything that's handy because I'm not a good cook either, I'm a hopeless cook, and I hate cooking, and I hate shopping for food… Sometimes I buy ready-made meals that just need to be heated because they're nice and easy and tasty" (Participant 107).* *"I sometimes just resent the fact, you know that I'm doing the shopping or the cooking. My husband is still working. So, it's kind of, you know, you think I don't really want to do this and if someone else would come in and make my meal for me, I would be absolutely delighted. But because as I see it, it's for me. It's just something that has to be done and it just happens to be me that I'm the one that that does it that… I tend to be cooking for four people and then freeze half of it for another meal. Then on the days where I really think to myself, I just cannot be bothered cooking something then it's always there that can come out the freezer. And so, the days where I really just don't want to do it, I take out the freezer and reheat." (Participant 004)* *"I can give you examples of some of the things my mum and dad buy that I think are odd and less healthy, so they may have had one jar of jam a month previously. Now they're buying a jar of jam a week. So, I cannot imagine how anyone on the planet could get through that much jam, but they're just having bread and jam, you know. So, if we're not there, they might have bread and jam for lunch, just because it's easy. I can't get my head around it, it's so sad." (Participant 006).* *"Over the last couple of months on teatime what I'm going to have in the freezer, you know you've got heaps of food, in the cupboard you've got heaps of tins and I end up making a cheese toastie because I don't want a meal, I just can't be bothered cooking, just a cheese toastie out of the grill and that's that, two slices." (Participant 118).*
Alzheimer's, dementia and memory	*"I can forget what I need. My phone has not like you can. I can't create a list, so for now I run out of something. I've usually got my phone in pocket, so I put it on the list so that by the time I go to the shops I know I know what I need." (Participant 001)* *"The only things I worry about that go in the fridge are maybe things that I've cooked that haven't been completely used. Whereas sometimes I forget about them when they sit in a pot on the on the cooker. I try more often now to remember to put them in a dish into the fridge to be used the next day. I think the thing that worries me, not at the moment, but I think in the future and I'm coming up for, I'm 67 and I think to myself. At some point in the future. I might start getting forgetful. And that's what worries me is just generally not paying enough*

attention to looking after the food and preparing the food that I'm eating. That worries me a bit in the for the future, it doesn't worry me just now because I'm quite fussy about checking things, but I can see how easily. That could happen and without me actually noticing." (Participant 002).

"I look after my mum, who is now 90 and she has come complex medical conditions and comorbidities along with dementia that she was diagnosed four years ago with vascular dementia. She is also a very fussy eater… I started caring for my father in 2016 when he was diagnosed with dementia, and it's just followed on after his death, just basically taking on everything from my mother as she was very reliant on my dad." (Participant 47)

"I think for me, with her dementia. Basically, she wouldn't eat if there wasn't somebody there. So, you know, she forgets if she's even had breakfast or she's, you know, so she couldn't be left unattended. It has to be very structured." (Participant 048)

"So, we because of mother-in-law's dementia, we've had to have a Gas Safe lock fitted, so the cooker is no longer usable by her. She filled the house with gas, it wasn't a great situation. So, we thought the carers would continue to like heat if she just cooks up the fried egg or boiled egg or something like that to be told that they're not allowed to actually cook. They're only allowed to supervise her cooking. My mother-in-law would say she's eaten, and she hadn't, and we've had quite a battle with carers that we've now got a meal plan that I've spent hours on, placed in the kitchen to ensure that they give her things that we know she will eat. They weren't giving her, like proper portion size because they worked on the fact that she's a tiny little free little for 84-year-old, and we actually ended up with a quite a serious admission in December time when we thought she was going to die because of her general condition, but it was just her saying she's eaten and refusing. So, now we've got the carers on board we just make it, put it on the table, don't enter a conversation. And even if she says she's had, she's not hungry. She has the option to eat it, and she always does." (Participant 046)

"I'm at home with my husband and two kids. This last four years, we moved my in-laws over to be closer to us. They are 89 and 90, both got Alzheimer's, and I do a weekly shop for all of us, click and collect at the nearest big supermarket. It's been a challenge [laughs]. I had to learn very quickly, and I do cook every day for us and again, I will put a piece away for them in our freezer and take it down, we deliver meals so that I know they've got something quick and easy. Yes, pretty much, I've just been through, my mother-in-law's always cooked with gas and that's what she knows, and when they moved they had to have gas put in, and that's lasted three years and then this year, she started to have the accidents, where she's leaving stuff on the hob and so the social worker asked us to get the gas cut off, so we've had to do that. So, she's had to learn how to use an air fryer, which has been interesting. She's putting stews in it, which is not ideal as we've seen, stuff that she'd normally put in the pressure cooker so it's still a bit of a challenge. I don't know how much longer that's going to last. She won't go on to Wiltshire Farm Foods, she doesn't like ready meals. She can't cook it in the slow cooker, I think she does recognise the slow cooked as item to use, so I'm now going to have to cook those at home and then take them down frozen and then put them in, but that's fine, it is what it is. She remembers what she's cooking for dinner, by getting it out to defrost and then it will sit out on the side of the kitchen it can be sat there for days." (Participant 097).

"I think, this one has to take into account is that as we get older, our mental faculties do deteriorate and people become less aware of what's in the fridges because of their eyesight, you know, poor lighting. Your eyesight isn't as good as it was or your memory. So, people take more chances without even being aware of it." (Participant 064).

6.5 The impact of the economic factors on food-related behaviours

Many of the participants discussed the impact of finance on their food shopping and cooking habits. Discussions related to the increasing cost of food and the increasing cost of fuel and energy required to heat homes and cook food. Food insecurity because of the cost-of-living crisis was a concern to many participants in most of the groups. Many recalled how costs increased during the Covid-19 pandemic, but had remained high, others were concerned about the cost of heating and the cost of petrol, all of which impact on available finance for food:

"I think the supermarkets used the pandemic to throw their prices up unnecessarily and they're not bringing them down and that's wrong. But there's nothing we can do about it; we need food to eat. So, they've made a lot of stuff extortionate prices, but you still need to eat so you've got to buy it." (Participant 118).

"Last winter, when the energy costs were just going up… It did impact on everything else because my fuel bill, I have a husband at home who's not a well man so, so heat for him is an essential. It's not something you can do without. But it impacted on everything that I did because mine went from, £100 to £350 a month. That's a massive increase which impacted on every other area of my life, including food. So, before that, if my husband said, "oh, I think I fancy a steak tonight", that was easy, I'd go get one, but not now... Although t's coming down in July, then it's going to start going back upwards from October. Now, I'm very conscious of that fact, but it definitely impacts on what you've got to spend on other things, especially on food." (Participant 121).

"I realised that when petrol prices just went sky high, I was really conscious about how often I used my car. So, I am much more conscious of how much I pay for food than I ever have done largely because even though I'm still working my income has reduced and so I cut my cloth accordingly. It's not that we starve at all, it's just that I'm careful about what I buy." (Participant 130).

As a result of this, many cost-effective decisions were made both when out shopping for food (Table 7), and when cooking food at home (Table 8). For example, some suggested prolonged storage of foods with short shelf life, whereas other chose to freeze such foods, in relation to this, there is a need to ensure cooking temperatures and appropriate thawing methods are followed.

There was a great deal of discussion regarding changing the type of supermarket where they purchase groceries from, for example opting to shop at discount supermarkets such as

Lidi and Aldi, instead of the 'big four' supermarkets – Tesco, Sainsbury's, Asda and Morrisons. Some described visiting multiple supermarkets to benefit from offers and discounts and described buying some items in bulk to benefit from such offers. While some described meal planning before going shopping, others described meal planning while shopping as a result of what was on offer in the supermarket.

When preparing food at home, many described using smaller cooking appliances such as air friers, pressure cookers and microwaves instead of using larger appliances such as the oven. Nevertheless, some discussed that if they were using the oven, they would use it to batch cook multiple items and utilising the freezer for storage.

It is evident that at times, people have to make challenging decisions that are based on economic determinants, for example, deciding between eating something that is potentially unsafe (e.g. beyond the use by dates) or wasting that food and going hungry. For future campaigns, it is important to be personable and acknowledge the situation that individuals may be in and present options to mitigate food safety risks or food wastage at an earlier point, e.g. utilising the freezer.

Although some batch cook for convenience, others do this to spread the cost of food purchase and reduce energy costs.

However, people need to have the space to store what has been batch cooked:

"I can't batch cook because I just don't have the room for it, it's going to go into the fridge and sit there for three days and then I've kind of got a dilemma that I have to use it and always eating the same thing (Laughs)." (Participant 084)

"Well food will last in the fridge for up to five days if you cook it as batch cooked, as long as you don't mind eating the same thing." (Participant 090)

Although some described themselves as "yellow sticker aficionados" as a money saving approach, others felt that they no longer provided value for money, particularly if the food has to be consumed promptly:

"I do feel though, yellow stickers don't really have much value anymore because it seems to only be a few pennies, whereas before it was seen silly money you were getting off things because they were close to their use by date. But now you know, it's very close to the original price. And the value in that is reduced if it's only got, you know, 12 hours where you can use it." (Participant 049).

Some participants were aware of food safety; however, finance had the biggest impact on food choice:

"My husband is also diabetic, and he's also prone to infections and then my daughter with her autoimmune disease she does, so we've noticed a real difference, which is why we tend to be careful, but finances dictate what we can afford to buy in terms of food, so we buy the cheap stuff but try and keep an eye on it." (Participant 110)

Although many were concerned about the cost of food and the cost of energy to cook or heat their homes, some such as participants 041 and 027, indicated that economic factors did not impact on their food shopping decisions.

"I think I'm in a fortunate position, the cost-of-living crisis doesn't really affect us, it certainly doesn't affect me, but it is money, and I'm aware of a lot of people who have a very tight budget and that's not me. I'm lucky and it has a huge effect on what they're able to buy." (Participant 041).

"I still work part time, and my husband has his own business, so we're not getting any issues with finance. So, I generally just buy, you know, if I want something, I will get it." (Participant 027).

6.5.1 Discussion and food safety considerations

Food safety considerations are increasingly impacted by economic factors such as financial constraints, as participants adapt their shopping, storage, and cooking habits due to rising costs. Many prioritised affordability by shopping at discount supermarkets, buying in bulk, and seeking discounted short-dated foods, which raises concerns about safe storage durations and food safety. Freezing food is a common strategy, but ensuring safe thawing and cooking methods is essential.

With the shift towards using smaller and more energy-efficient cooking appliances, such as air fryers, microwaves, and pressure cookers, unfamiliarity with these devices could pose food safety risks. Individuals who have cooked using traditional methods, may have difficulties in adapting to new cooking methods that increase the risk of foodborne illness, for example, using an air fryer or pressure cooker without knowing the appropriate settings for different types of food may result in uneven cooking, particularly if cooking times and temperatures are not well understood, and especially in the absence of cooking instructions specifically for air fryers. Therefore, it is important to provide clear guidance on how to safely use these appliances but also ensuring that future food safety messaging refers to reaching safe internal temperatures to prevent the risk of foodborne illness.

The preference for batch cooking to save on both time and energy may result in foods being subject to prolonged storage, repeated reheating or unsafe thawing practices.

Financial pressures sometimes lead to difficult choices, such as consuming food beyond its use-by date or relying on food banks with limited cooking resources. Future food safety campaigns should acknowledge these economic realities and provide practical guidance on minimising food waste while ensuring food safety.

Table 7. Impact of economic determinants upon food shopping, purchase decisions, food storage and eating practices among adults over 65 in Scotland.

Theme	*Select quotes*
Transitioning to discount supermarkets	*"I think in the last year I've been much more aware of the cost of things and that's led to much more planning. Before I would be doing more shopping in the local shops. But now because the cost ALDI is so much cheaper." (Participant 076).* *"Now I always shop in Lidl, that's my go-to shop for value and reasonable quality because we can't afford to do the big-name brand shopping." (Participant 095)* *"I do the bulk of my shopping at Lidl because it is cheaper. In a way it almost took me a while to get into this mindset of going to Lidl because there was a bit of snobbery around it. Then you find everybody's going there 'cause of the price." (Participant 129).*
Purchasing items from multiple supermarkets	*"What we've noticed in the local Tesco's that my husband uses is that they had done away with a lot of the lower priced range, so the shelves are virtually empty but the ones that are there are Finest ones, the expensive ones, and you are kind of forced to buy it. So, he is now shopping much more at Aldi than he did at Tesco's. We've changed, we're doing Aldi and Lidl a lot more, we do Home Bargains for household products and things like that." (Participant 110)* *"Shopping-wise, we have a couple of supermarkets, neither of which are particularly cheap, so I try and get to one of the discount supermarkets once a month to stock up." (Participant 119)*
Purchasing discounted short-dated foods	*"If you can get it cheaper at some point I'll get the big joint of meat, freeze it." (Participant 089).* *"Lidl do these… I don't know if you've seen them, they do veg boxes, £1.50, full of veg, it's a great big box. Can't wait to get them because the value is unbelievable, but that's all-fresh stuff that tends to need cooking or whatever. And they're out of their sell by date but they're certainly fit to use for a long time to come. You need to be there by nine o'clock in the morning." (Participant 085).* *"He's very money-orientated, so he will buy the cheapest and cheap and I say, "Don't buy this because it's cheaper," and he'll look at all the bargains. So, our meals often turn out to be a surprise." (Participant 117).* *"We have a woman who does Ollio, which gives away things for free to reduce food waste. She works at Tesco and there's a certain day that she has all the food that is 'sell by' from that day and she offers it free. And we also have Big Blue Bus which is food waste, and they collect food from all the different supermarkets including Marks and Spencer, it's absolutely brilliant. And they come twice a month to our local village hall, and you pay £2.50, and we can take loads of stuff. I've maybe got £25 worth of stuff. That's kind of an added bonus really." (Participant 130)* *"I'll quite happily buy it with a yellow label on it and eat it. The cheaper the better, to be very honest." (Participant 067).* *"If I do see some bargains in the yellow sticker area and they're looking fresh, I'll pop them into the freezer and take them out and make use of them that way." (Participant 036).* *"So, they're very tempting because they have a lot of yellow stickers items. And you go in, and you're infatuated by all these yellow stickers, and often I don't have enough room in the freezer for enough yellow stickers that I bought. It's very, very tempting. I think I could have that for lunch, and I could have that for tea. I have that tomorrow and so on for days. And really a lot of them obviously are today's date so you have to eat them really quickly." (Participant 025).*
Bulk buying foods on offer	*"So I was up at Tesco's, and they had jumbo sausages, one pack £4.50, two packs £8.00, so I took them, split them into threes and froze them; I've always got a minimum of two months' food in the house… I also get a lot of my meat from Iceland, but I buy volume packs, ten chicken breasts or something in a pack and some days they've got them on special offer, buy one get the second one half-price. Although I've got a big fridge freezer, I bought a tabletop freezer as well and I have that stuffed up with stuff as well." (Participant 118)* *"My husband works very close to a big superstore, so he tends to do the shopping, which is wonderful, and he's actually very, very good at hunting out the cheaper things, the marked-down, sell by dates, whatever, they see him coming and they just make way, and he just piles up with whatever he thinks he needs and we use the freezer to store stuff and he does stock up as well, anything that's cheap or special offer he gets it, so we'll have cupboard fulls of something until we get fed up with it and that's how we do it." (Participant 110).*
Meal planning	*"I find that I plan the monthly menu, and we shop for the month, and I find it actually saves us money because we can reuse what we've bought. Because I find the packets are too big for the two of us and I'm left with leftover stuff would sit in the fridge for three days, so I batch cook it and then freeze it, so it goes with what we've got." (Participant 087).*
Not buying certain foods or brands or buying cheap cuts	*"I think that money-wise with us, if there's something that you really want you would have it but sometimes just seeing the price of a joint or a leg of lamb, I couldn't justify paying that much money for a leg of lamb. I like some seafood, prawns, but, again, the price of them. Before, we'd buy them, every weekend and have a treat at the weekend, but now it's no." (Participant 089).* *"You buy Heinz, and you buy this or that, the cheaper stuff is just as good as the dearer stuff…so you're paying a fortune for the name." (Participant 108).* *"I used to buy jumbo cod steaks, right, I used to get two boxes of four for £5. Now you're £5.30 for one box and I won't buy it, I'm not paying that." (Participant 118).* *"My mum used to always buy Lurpak butter, Kellogg's cornflakes, of course Heinz beans, she wouldn't possibly look at anything else and that stays with you for a long, long time and I think it was when Lurpak butter was at £4, I thought 'no, I cannot buy that'. Then you try the own brands and some of them are actually okay... But beans I would like to go back to Heinz beans. The children don't notice any difference, but I do so I'd probably rather do without the beans. But it's interesting when you do make the compromises, but I guess we all have a line whatever your income is that you say, 'I'm not paying that, no'." (Unknown participant, transcript 020).* *"Well, I think I've always been aware of the cost of food. I've been through really tough times and all sorts of things, you know, and had family. And I'm by myself now. But I think about the cost when I'm getting things in the way I choose things, So I don't eat much meat. Well, I eat it occasionally because I don't want my body to sort of not know how to cope with it. I eat fish occasionally but just mostly sort of vegetables and pulses and sort of things like that. But yeah, I'm aware of the cost, I just try to buy sensibly." (Participant 039).* *"I think ideally, I would like to buy organic fruit and vegetables and meat, etcetera. But it's far too expensive. It is available here, but I do go there periodically but it is double the price of the supermarket, but my budget would not stretch to doing shopping organically, sadly." (Participant 034).* *"We have really nice fish fan that comes around and the fish now is getting to the point where sometimes I'm not buying it because it's so expensive, even though I realise it's nutritional value and my brain will be fantastic, and I'll be so intelligent. It's a price I can't afford and also steaks as well. I used to buy them regularly and now the price, sometimes I think, well, maybe I won't. So, there are some products now which I could still afford, but then I think maybe that's a bit extravagant and so maybe have these for special occasions, but I'm annoyed about the fish though, because I really like fish and that's a part of my diet I miss." (Participant 028).*
Using food banks, community	*"I just can't afford food, but I do make an effort… but I also use a 'food pantry'… it's not a 'food bank', you get donations from organisations; Marks & Spencer are wonderful, and you get up to £15 worth of food for £2.50. It's not a food bank because we contribute." (Participant 096).*

cupboards/pantries and warm spaces	*"For the older people that come to the community cupboard, obviously cold things are what they want. I know one lady she was eating condensed soup cold out of a can, that was what she was having and slices of bread. That's what she survived on for about two weeks. It was that she had got problems with gas and electricity bills. It makes me feel angry. Angry in that it's happening and it's happening to people round about me that you wouldn't classify as being in food poverty or in fuel poverty or any type of poverty because like myself I've got the house, have cars but they would appear to be fine, thank you. Also, it's about finding a way that's acceptable for people to get help to people in a way that they can feel happy about it. But there's quite a few places now that people can go to and there's a community vibe about it and they can come and meet the people and sit down and share a hot meal." (Participant 131).* *"We had a 90-year-old lady in here at the food bank over the winter. Absolutely horrific. Never had to use a food bank in her life, never had benefits in her life. And what put her into food poverty was the energy bills. Her energy went through the roof and basically, she couldn't afford to do it. They were charging her three or four hundred pound a month, and basically that was the lady's food money. So, she wasn't living. She ends up in £3000 worth of debt on her energy bill, and she doesn't want to tell a soul that she was doing it. So, we were feeding her from the food bank. Sometimes it takes a few weeks for people to open up and give you the full story. It's not necessarily people come in and they tell you straight away. You know, we know they're in food poverty." (Participant 132).* *"I think the situation where so many people are using food banks now and so they're not making the food from scratch. Unfortunately, fuel poverty is meaning that perhaps they're not heating things up enough, or the type of foods that they're having to get from a food bank are not the nutritious, and they're saving the food for the next day and not having the skills to make it safe." (Participant 067).*

Table 8. Impact of economic determinants upon food shopping, storage, cooking and eating practices among adults over 65 in Scotland.

Themes	Quotes
Using smaller cooking appliances	*"I have concerns about the cost of energy. I've moved to an air fryer. A ninja. We've got to the top of the range. A "Which recommended thing" because I had no idea. So, I sought guidance and that has knocked electricity down by £10 a month. Because we just don't use the oven, it just seldom goes on. There's only two and they the ninja does more or less everything. Don't even need the grill on because it has a grill as well" (Participant 003).* *"My husband bought a Ninja; I wouldn't have bothered but he got it half price. When it arrived, well I just thought, what's that? How can you cook a dinner in that? But actually, you can, and it is a lot cheaper… So instead of heating your oven you're actually heating this small space." (Participant 121).* *"I've been retired for 20 years and since I've retired, I've got lazier and lazier, so I mostly eat microwave meals and more so since the electricity went up in price and that and also its less waste because I'm on my own and I don't have as much waste now on food and now I enjoy my microwave meals." (Participant 128).* *"Yeah, I've stopped using the oven. I'm using the slow cooker more. I'm not using the oven nearly as much as I used to, and I was always economical enough with it. I wouldn't put it on for just one thing, but I don't use it now, because of the cost." (Participant 038).* *"In terms of cooking, I am debating with myself and with friends about the issue about air fryers. And I think I'm seriously considering it now when a friend actually said the instructions for cooking something on the food package include air fryers. So, it seems as if air fryers are now part one of the essential utensils in your kitchen. I think it's the fact that they're now including instructions on the packet as an indicator that air fryers are not one of these fads that we have seen I'm sure a lot of people have a whole range from ice cream makers, of these kind of stuff, whatever was the new thing that everybody bought and then it gets in the back of the cupboard." (Participant 034).* *"It's because of the cost of the gas… And I think my gas bills are horrendous. Well, my husband's sits about, so he gets cold, we keep the house warm. The gas bills are so high that I thought maybe I should stop putting things in the oven. And that's why I've been putting things in the microwave. I'm a wee bit weary of what the plastic packaging might be doing to the food in the microwave, so that was why I thought about an air fryer. I need to know more about them. I need to know what I can cook in it, and I don't want to fry everything and that's what's always put me off with the name being an air fryer, you know." (Participant 035).* *"I use my ninja Air fryer a lot and I think because I live in my own, it's really easy to cook, you know, a salmon fillet or a piece of steak or whatever in the air fryer rather than heating up the whole oven, I mean, I do have a range cooker with three ovens and yet I cook in my air fryer and my slow cooker almost all the time. I do have a pressure cooker as well, which I haven't used for a wee while, but I quite like the heating up a small appliance instead of a whole oven for one person. And I think it seems wasteful of energy and money if you're just heating something small up." (Participant 022).* *"We have an air fryer, and it's used, not quite every day, but certainly every second day and we use it for just about everything. It is effective, we've got a smart metre, and we've registered the cost on the smart metre the cost of heating the oven up and then we've done it as well with the air fryer and it was half the price, less than that it was a lot cheaper anyway than heating up the big oven so." (Participant 026).* "That's one thing that I do find with the slow cooker is that I can use a cheaper cut of meat because it's sort of long and slow cooking." (Participant 024).
Batch cooking and freezing	*"Our reason for cooking in large quantities and freezing is because it makes better use of the energy. You know, it takes as much energy basically to cook 3 lbs of mince as it does to cook 1 lb of mince, so it makes more sense. Our cooking is all done on an oil-fired Rayburn." (Participant 008).* *"Definitely my batch cooking had kept my bills down. Well, when I was working, we'd come home, both of us, and it would be something quick, something easy, and now we batch cook and freeze, so the oven is full. If we cook the oven is on and it's full. Unless it's full we don't use it. So, in the long run I suppose it does save money." (Participant 087).* *"Certainly, the cost of meat means we probably eat less and spread it further. I like cooking one day and heating it up the next to spread it out and to save on the energy." (Participant 003).* *"The cost of energy as well. Well, I do try and save by cooking things together. I try and work out also having to use the oven and do it so that I can put several things together and not have to put things separately." (Participant 020).* *"I find if I've always been very conscious, if I put the oven on, I don't put it on for one thing, I think about what I'm going to cook. So, if it is, I say, for example, a casserole, I'll do potatoes, I'll do vegetables. I might even do a dessert as well. I really use the oven to its full capacity. So, I'm conscious because that is a big expense." (Participant 034).*

6.6 Perceived threat of foodborne illness

There is conflict in research regarding the two constructs that contribute to perceived threat (Jones et al., 2015), some suggest that perceived susceptibility is a better predictor of perceived threat than perceived severity (Janz & Becker, 1984), as perceived severity often has insufficient variance (Carpenter, 2010). Others suggest that combining perceived susceptibility and perceived severity as a single construct is beneficial (Champion & Skinner, 2003). These points of view were considered by the researcher, although many studies do not utilise the Health Belief Model in its entirety (Jones et al., 2014), it was decided that the data would be coded according to the two constructs that make up threat perception and discussed accordingly.

From the discussion groups, it is evident that perceived susceptibility to foodborne illness and the perceived severity of foodborne illness varied between individuals over the age of 65 and those who support relatives over the age of 65. As can be seen in the sentiments below, family caregivers perceive that their relatives are not only more susceptible to foodborne illness but that the consequences of such illnesses could be significantly more severe due to age-related frailty or pre-existing health conditions. The perceived threat of foodborne illness among family caregivers had a positive impact on food safety practices being reported.

6.6.1 Perceived susceptibility to foodborne illness (among individuals over 65)

In the Health Belief Model, the perceived susceptibility is defined as an individual's belief about the likelihood of getting an illness, disease or condition (Glanz et al., 2015). For example, in a food safety context, a person must believe that they are at risk of foodborne illness before they are willing to act by implementing recommended food safety practices.

Very few people over the age of 65 believed themselves to be susceptible to foodborne illness. Many stated they did not think they were at risk and indicated a perception of invulnerability (Table 9). It was perceived that foodborne illnesses were most likely of being acquired because of food consumed away from the home.

Many were not aware of immune system changes associated with age, however when provided with such information they were able to understand why susceptibility to foodborne illness increased with age.

For example, Participant 121 perceived her husband to be susceptible to foodborne illness because of cancer treatment and did not perceive herself as susceptible despite having diabetes, using proton pump inhibitors and being over the age of 65.

"My husband would be at risk of food poisoning, because he has cancer. But he's never been ill with anything like that. It wouldn't apply to me, but the possibility would be there for him..."

However, when provided with information about immune system changes resulting from medication, underlying conditions and age-related changes, participant 121 was able to comprehend her susceptibility to foodborne illness and believed that knowledge was power to facilitate behaviour change:

"...The thing is with this, I came in here, I've never even considered my immune system. I fit four of those categories, I'm not pregnant, it's the only one I'm excused from [laughter]. Now whilst I know that he is more vulnerable, I've always assumed he's vulnerable because he's got cancer and he's having ongoing treatment. I've never ever applied that to me, and I've got three things there that applies that to me. So perhaps I ought, you know, I see it slightly differently to you, I think information is power. If you don't know something, you can never choose to take steps whereas if you do know something."

Conversely, some individuals were already aware of their susceptibility of having a foodborne illness as a result of previous illness, this resulted in the implementation of some food safety practices as described by participant 001 (Table 8). Similarly, there were some individuals who were aware of their susceptibility to foodborne illness due to underlying autoimmune diseases such as type-1 diabetes and rheumatoid arthritis or medications.

When prevalence of foodborne illness was shared with participants, some were shocked:

"I was quite shocked to hear that. That it's that older generation because I'm made the assumption wrongly, maybe that it would be younger people. But I was quite shocked to hear that it is the older generation that are such a high level of it." (Participant 035).

6.6.2 Perceived susceptibility to foodborne illness (among family caregivers of individuals over 65)

Perceptions were different among family caregivers, although participant 049 believed their father was *"completely unaware of his vulnerability to food poisoning"*, likewise participant 006 deliberated regarding her parents that

"I don't think mine have a clue that they are at an increased risk of becoming ill, no. I think they're aware that if they have a bug or something that it's much harder to shake it off. I don't think they're aware of potential food poisoning or their immune system being less robust." (Participant 006).

Whereas others suggested their relatives maybe aware of the susceptibility, for example, participant 005 described that their mother was particularly susceptible to foodborne illness, and believed their mother was aware of her susceptibility and this resulted in a behaviour change to ensure the safety of food:

"I would say my mum she is more susceptible of becoming ill. In terms of her physicality. I think that might be one of the reasons that she's more prone to buy things that can be frozen and aren't fresh, for longer storage. My mum's quite different now, in that she reads every date. She'll throw something away that's showing that date, even if it doesn't look bad to me. She's very worried about things upsetting her tummy now, more so than she ever was. She wouldn't use to bother with use by dates or whatever… So, she's very cautious now, she's more aware that she's at risk and more cautious

and I think that's why she's much more cautious about things that are out of date and how she stores food. Her fridge is actually quite bare compared to what she used to have in it, everything's in the freezer now. And I think that in her mind is one way of controlling all of that, keeping it very fresh and not letting things go off and upsetting her tummy." (Participant 005).

Similarly, participant 047 suggested that their mother may have an awareness of her vulnerability to illness due to visible physical changes.:

"So, I was going to say my mum is aware of her vulnerability now, maybe two or three years ago, perhaps less so, but certainly now she's got a physical marker because she started falling, so that's raised her awareness. She's also seen just how much weight she's lost since October, which is a stone and 1/2 to take her down to 7 stone. And I suppose because I have continually harped on about food hygiene, she has kind of adopted that mindset. She's got no sense of taste or smell, but she'll hand me the milk jug, you know, and she'll say "What do you think? Do you think that's ok?", so I say "Well, for reassurance, mum, let's tip it." So yeah, I think she is now aware of her vulnerability." (Participant 047).

Several participants who provided food for relatives over 65 were aware of their increased risk of foodborne illness. As a result, they avoided certain food choices or practices they might use for themselves and their families. This caution was due to their awareness of their older relatives' immunosuppression and frailty (Table 9). Some were aware of frailty as they could visibly see this decline in their relatives, others had become aware as a result of their carers such as participant 049 who was a chef and Participants 047 and 046 who were both healthcare professionals, and Participant 131 volunteered to cook at community lunches at a church.

6.6.3 Perceived severity of foodborne illness

Perceived severity refers to a belief about how serious an illness or condition is, including the consequences of contracting it or leaving it untreated (Glanz et al., 2015). When applied to a food safety context, this relates to an individual's belief of the physical consequence of contracting a foodborne illness such as duration of illness or outcomes such as death, disability, pain or social consequence such as the ability to work.

As indicated in Table 10, family caregivers often exhibited a strong awareness of the potential severity of foodborne illness, particularly when it comes to the vulnerability of their elderly relatives. Similar to the points raised regarding perceived susceptibility to illness, caregivers recognise that foodborne illness could have serious or even life-threatening consequences for their loved ones. For example, Participant 048 expressed concern about the potential impact of foodborne illness on her mother-in-law, stating that *"she's of a certain age, getting food poisoning, I wouldn't like to think what the consequences [would be] because as I say, there's not enough reserves to fight that."* This statement reflects an acute awareness of the diminished physical resilience that often accompanies ageing, implying that even a relatively common illness like food poisoning could result in dire consequences for someone with limited physical reserves.

Participant 046 was particularly aware of the potential severity of foodborne illness to her ageing mother due to her specific health conditions stating, *"food poisoning is not something she would survive, you know, she just she's got kidney failure".* Similarly, Participant 047 emphasised that her mother *"is not in a fit state to withstand that type of insult,"* indicating the frailty and compromised health of her elderly parent. The use of the word "insult" in this context highlights the belief that any illness, particularly one like foodborne illness, would be a significant and harmful burden on her mother's already fragile condition. Participant 047 went on to describe that because of having worked in an intensive care unit, she was aware of how severe foodborne illness could be among older people, she compared how

symptoms may be mild for younger individuals or those without a compromised immune system and that people were generally unaware of the potential severity.

Although those with underlying conditions discussed their susceptibility to foodborne illness, with the exception of Participant 031, the perceived severity of foodborne illness was not discussed among individuals over the age of 65. The findings from the discussion groups indicate the significant concerns family caregivers have regarding the potential impact of foodborne illnesses on their vulnerable ageing relatives.

Table 9. Perceived susceptibility to foodborne illness among family-caregivers and adults over 65 in Scotland.

Perceptions	*Quote*
Perceived sense of invulnerability among individuals aged over 65 years	*"Well, I've got diabetes Type 2, but food poisoning doesn't worry me. Well, if you've eaten in some of the places in the world, I've eaten you become immune to these sorts of things. I think I've got more chance of being bitten by a daffodil than getting listeria." (Participant 088)* *"I don't feel I'm at risk. I'm over 65. And I think, I'm careful so it won't happen to me." (Participant 085)* *"I disagree. I'm not vulnerable. Not really, maybe for a cold it takes you a wee bit longer but apart from that I couldn't give it a second thought." (Participant 109)* *"I wouldn't get food poison, I'm sure I've never had it. I'm 76 years old, if I was going to get it by now because of my habits, I would have had it but in restaurants, I think there's much, much more likelihood of people being taken sick in any restaurant, not just Chinese. I know they have the reputation for it but in any restaurant because mainly." (Participant 121).* *"I suppose the older you get you're more vulnerable to everything so it's just one of those things, I guess. It's not something I've really thought about. To be honest I don't feel vulnerable yet but then, the first time I was aware of things was when I was pregnant and things I would obviously be much more careful then. But I don't feel vulnerable myself, but whether that's because you don't like to admit that you're getting older and of that generation, I don't know." (Participant 129).* *"I was surprised when you said the percentage of people, older people, who are affected by Listeria, I don't feel vulnerable either." (Participant 130).* *"Children. Pregnant mothers are most likely of getting food poisoning." (Participant 002).* *"I think the more you eat out, the more you're liable to maybe pick up something. Not the same at home." (Participant 038).* *"I've only had food poisoning once and that was from a Chinese restaurant. But since then, we don't eat out very often, but we're quite careful about the places we choose to go, we may have fish and chips, but we never have carry out meals now because we're worried about the hygiene. The sort of how long the food is being prepared, how long it's been sitting. We just feel we don't want to risk it and carry out meals are no longer a cheap option." (Participant 061).* *"No, food poisoning, it doesn't worry me. I mean, it will happen at some stage, quite probably. But yeah, there's no point in worrying about it... It really never occurs to me, you know, it's not something that I worry about." (Participant 37).*
Awareness of immune system changes among individuals aged over 65 years	*"I didn't know that the immune system changes as we get older. I knew that pregnant had to avoid soft cheese and all that sort of stuff because of listeria but I didn't realise that people over 65 were more susceptible." (Participant 113).* *"As we get older, our immune system isn't as good as it was when we were younger. So, we're much more susceptible to picking up various illnesses, whether they be bacterial or viral. And you know, I suppose the other thing is we've got to think of our own age group is who do we communicate with. Generally, they are people of our own age. So, you know, the fact that some of these things are very communicable then, you know, it's very easy to pass them on or have it passed on to you." (Participant 044).* *"Yes, I think immune system is the same as it always has been. I don't think it's changed. I suspect I've just been really lucky actually." (Participant 055).*
Perceived susceptibility among individuals aged over 65 years with underlying conditions	*"I wouldn't choose anything that's past its sell by date. Because just in case, it's because I probably would be ill, because I've been ill. I do sometimes, buy food, and then I find I'm not hungry or I don't use it, and it's unfortunately wasted. And that really annoys me because I'm wasting food. But then I'd rather throw it out then. Yeah. I would rather waste it. Because I've sepsis. So that's an infection. So, I'm now constantly on the lookout for another infection. I think subconsciously I don't want to get ill again, in my head you just don't want to risk it." (Participant 001).* *"I'm taking Biologics for rheumatoid arthritis, so I've got to be really careful with what I eat and infections generally." (Participant 112).* *"My immune system isn't working as well as when I was younger, it isn't. It's the diabetes, I'm prone to infections, even a cat scratch takes ages to heal, I heal very slowly, I've lost two toes, I don't want to lose anymore. My husband is also diabetic, and he's also prone to infections and then my daughter with her autoimmune disease she does, so we've noticed a real difference, which is why we tend to be careful." (Participant 110).* *"Well, I'm part of a liver group because we're all on immunosuppressant tablets, so we have to sort of keep ourselves as safe as possible and avoid infections where we can. So again, I'm very wary of eating out and things like that." (Participant 120).* *"I'm interested in what you were saying about your immune system. I mean, I had to go through chemotherapy and radiotherapy recently. And apparently, I'm immunosuppressed or something. But I haven't felt any difference. Now that my appetite is back, I don't worry about what I'm eating." (Participant 051).* *"I'm a bit more cautious because there are some things I was told not to have when I'm on set medications. So I'm careful on dates of things, their use by date because I don't want to risk having an upset stomach, and I have a friend who regularly does all her shopping by yellow stickers, and she will put down a cream cake that's three days out of date and expects me to eat it, even though I tell her every time I can't have them. I then just have a digestive biscuit because I can't risk being sick. I just won't do that. It's not worth it." (Participant 068).*
Perceived susceptibility among family caregivers	*"I think of my mum's frailty all the time. She's vulnerable. I mean, things like the skin is so thin. It's like the body in old age is just slowing down until obviously there's no more. So, you know that the immune system's not the way it was… I'm not religious with food dates, for our own family. But I certainly wouldn't take chances with her. You know, she's at the stage now in her life, she's immunosuppressed, she's very frail. It's simply not worth it in the long run for her health… Food waste does bother me, but it would bother me far more to have mum vomiting rings around herself." (Participant 047).* *"So, last year, as a chef I done an advanced diploma in food hygiene, so I'm very aware that this age group is particularly vulnerable when it comes to the effects of food poisoning, but also vulnerable to getting food poisoning… I do worry that when I cook something I have to deliver it quite quickly because I don't know how long he's going to leave it before he eats it and hope to God it's not too long… I know, he's more vulnerable, so yeah, when I do his shopping, I tend to shop from the back of the shelf so that it's got a longer date." (Participant 049).* *"For myself and my family, if something was 'use-by' the day before, I'm less concerned about it. But for my mother-in-law, I know that when you're that vulnerable, when you don't have much reserves, you can't fight things, I don't think you should take any chances, so I do treat her a bit different. I'm not saying we eat a lot of out-of-date food because I try and make sure that nothing goes to waste. But I do think for that age group, when they've got, illnesses they're just vulnerable generally. I personally would take risks." (Participant 048).*

Table 10. Perceived severity of foodborne illness among family-caregivers and adults over 65 in Scotland.

Perceptions	*Quote*
Perceived severity of foodborne illness among individuals aged over 65 years	*"I think age isn't kind. Food poisoning would probably be a bit more severe. Especially, you know my situation being diabetic, it would certainly upset all sorts of balances. It doesn't really matter who we are, except of course, if we're older and we do have some chronic conditions, then maybe we're going to suffer more. I don't know, maybe it's a reflection, but generally as we get older, we are more cautious, much more cautious and much more aware of food hygiene, particularly when we're out." (Participant 031)*
Perceived severity among family caregivers	*"It's quite a thought, isn't it? What would happen if they got food poisoning? Well, if my mum was ill, then my dad wouldn't eat. The consequences for my dad are really significant. If mum had to go to hospital, for example, my dad would have to go into care. We have carers going four times a day for my dad. So that would, really be massive. So yeah, the impact the risks associated with food could have a massive impact if they're not careful. For my dad, if he had an upset tummy, he just wouldn't eat. You know he would just not eat for 48 hours, and it wouldn't bother him as much because he doesn't like food as much as my mum. Dad doesn't need it as much. Although the food poisoning could be something serious, and if he went to hospital, that would be the end of him. You know, he he's so frail and so clueless about where he is and things like not having his familiar people and familiar things around him would be devastating, truly devastating for him if it was serious, yeah. With how frail they are, I don't think you'd get them out of hospital if they went in with food poisoning now. So that's quite a risk actually. I never thought about it in that way." (Participant 006).* *"I think given the age, her years and you know, she's pretty healthy for her age, but I think anything she gets, she gets quite severely, and I think if she was to get food poisoning that would be quite challenging for her. And I think that's, as I say, maybe that's part of why she's so cautious." (Participant 005).* *"Again, it's the nursing in you, she just couldn't cope with food poisoning. You know, she gets a sniffle, we end up in hospital. We just we have to be very, very careful generally. But you know, food poisoning is not something she wouldn't survive, she just she's got kidney failure. The more the health deteriorates you get access to the medical records and know things you probably never wanted to know, but with the young and the old, you don't have an option to keep them all safe." (Participant 046).* *"I worked in ITU, and children will be poorly, but they usually bounce back. Older people do not bounce back, and you sometimes only have a very short window of opportunity to try and correct the catastrophic damage to major organs. That can happen as a result of food poisoning... So, I know it's for us, it's maybe a touch of diarrhoea and a bit of vomiting and after a couple of days we're right as rain. That is not the case for the elderly… Now, I don't think people are aware of how severe food poisoning can be for the elderly no, no. And I actually think a lot of people are not aware of just how vulnerable the elderly are to say catastrophic organ failure with quite a mild infection. I mean a pneumonia will wipe them out. Again, it's something that you and I would cope with. Antibiotics, you can chuck as many antibiotics as you like at the elderly if you have crossed that bridge, they're on the way down. They don't come back up, and I don't think people realise that at all. And you don't want to frighten people, you don't want to do that, but I know that food poisoning in the elderly can be fatal" (Participant 047).*

6.7 Evaluation of the food safety behaviour to counteract the threat of foodborne illness

Perceived benefits are the beliefs about positive features or advantages of recommended action to reduce threat. For example, the recommended practice may reduce the threat, however there may be other tangible benefits. Perceived barriers are defined as possible obstacles to implementing the recommended action, or can refer to the perceived negative consequence of the action (Glanz et al., 2015).

A meta-analysis of the effectiveness of the variables of the health belief model in predicting behaviour, benefits and barriers were consistently the strongest predictors of behaviour (Carpenter, 2010), furthermore, perceived benefits and perceived barriers may be able to better predict behaviour when the perception of threat is greater (Jones et al., 2015).

In a food safety context, the evaluation of behaviour incorporates the perceived benefits of the food safety practice and the perceived barriers to the food safety practice, it also incorporates the perceived self-efficacy to perform the behaviour.

As with other constructs, differences were established in the evaluation of behaviour to counteract the threat among individuals over the age of 65 and family-caregivers. Often people evaluated the perceived benefits and discussed them in contrast to the negative consequence or barriers. For example, in the context of following storage duration and date labels, often the behaviour to counteract the threat of foodborne illness was to dispose of the unused opened food or food beyond the use by date, the negative consequence of this was food waste and the perceived waste of money resulting from this, however the perceived benefit was the avoidance of foodborne illness.

6.7.1 Perceived benefits of food safety practices

The perceived benefits of food safety recommendations, related to specific practices, rather than food safety as a broader concept. Several participants perceived the benefit of following food safety guidance to be the prevention of foodborne illness, this was often indicated to be

the motivation, for example, some reflected on previous experiences of foodborne illness and not wanting to experience such illness again (see motivation section 6.7.4 and Table 14). Despite having not experienced foodborne illness, Participant 020 described not taking risks with food to avoid food poisoning.

Some of the perceived benefits of food safety practices that were discussed were often aligned with the motivations of individuals to adhere to such practices. Motivations are discussed in section 6.7.4. As indicated in Table 11, Participant 103 shared some of her food safety practices along with the perceived benefits and barriers, she believed that not consuming food beyond the use by date was potentially preventing illness, but discussed the opposition she faced from friends and family as they perceived the practice to be wasteful.

After stating they follow the use by dates on foods, Participant 031 was asked what they believed the benefits were from following the use by dates, they stated that it gave them *"more confidence in using the product."* Similarly, Participant 035 believed that a temperature probe would be beneficial to avoid foodborne illness and give confidence that the food was safe to eat.

Family caregivers' perceived benefits were closely linked to their understanding of their loved ones' susceptibility to illness and the severity of its impact.

It was of interest that because of the discussion groups, some participants, such as Participant 006, could now perceive benefits in certain food safety practices such as using a refrigerator thermometer and considered purchasing one.

6.7.2 Perceived barriers to food safety practices

Potential barriers to food safety practices in the discussion groups related to various factors, including lack of knowledge, complacency, historical attitudes, financial constraints, and emotional resistance.

Although there was much discussion about the benefits of food safety tools such as temperature probes and refrigerator thermometers, some participants expressed uncertainty about such food safety tools. For instance, Participant 004 discussed that they would consider using a temperature probe if provided with one but went on to indicate they lacked the knowledge of what temperatures to aim for in cooking. Indeed, others also suggested they would use one if they were provided with one, suggesting that in addition to a lack of awareness regarding recommended cooking temperatures, access to such tools may be a potential barrier. Likewise, Participant 001 indicated an interest but stated that they had never have thought about using a temperature probe, and Participant 005 also indicated she would consider buying a temperature probe if she had clarity around risks (Participant 005).

For some, there was a misunderstanding regarding food safety practices, for example the researcher asked how many people washed raw meat and poultry, as indicated in the passage below. Participant 002 admitted to having previously washed raw chicken in an attempt to make it cleaner, this points to a potential lack of understanding of proper food handling as a barrier, the conversation indicates the specific cues to action that resulted in the appropriate food safety practice being adhered to:

"I used to always be washing a bit of chicken" (Participant 002)

"What was your reason for doing that?" (researcher).

"Trying to make it cleaner" (Participant 002).

"Did you think you were achieving that?" (researcher).

"No, I definitely wasn't. You know, I was just spreading the germs all around the sink. Just a lack of knowledge really. I know I've I stopped doing that because my wife told me I was just spreading the germs all over the sink" (Participant 002).

"Was that information credible enough to make you stop doing it?" (researcher).

"Absolutely. Yeah. I mean, I've learned later on, I've read articles in newspapers and so on that that was quite a dangerous thing to do, you know" (Participant 002).

As indicated in Table 12, Participant 001 also discussed previously washing raw chicken in an attempt to remove salmonella from raw chicken.

Discussions highlighted that longstanding attitudes and mindsets can be barriers to following food safety recommendations, such as adhering to use-by dates. Participant 110 reflected on childhood experiences and how they influenced their views on food safety. They also mentioned that financial constraints can make it difficult to avoid consuming food past its use-by date.

For future food safety education campaigns, it is important to recognize that financial limitations may prevent people from discarding expired food. Some may see disposal as financially unfeasible or wasteful. To address this, consumers should be made aware of strategies to avoid this dilemma, such as using freezers to extend food shelf life.

Significant barriers to ensuring food safety practices were discussed among the family caregivers, for example, many of the family caregivers didn't live with those they cared for and were unable to check as frequently as they might like to. They also found it challenging disposing of expired food, when it wasn't their food, particularly when parents were aware of the food being disposed of and the family caregiver felt that they didn't have the authority to dispose of the food as discussed by Participant 045.

Table 11. Perceived benefits of food safety practices among family caregivers and adults over 65 in Scotland.

Perceptions	*Quote*
Perceived benefits of following food safety practices among individuals	*"I have an oven attached to the wood-burner and it's incredibly difficult to gauge the temperature, so I don't know what temperature it is at, the temperature control is a bit hit or miss so I use this electronic thermometer thing just to make sure that anything I do cook has reached its temperature and is safe to eat" (Participant 106).* *"Now, see, when I go and buy anything I usually look at dates and go to the back. The furthest away date, you know? When it says, 'use by', and it's on that date, I won't touch it, it goes in the bin because I think, "I am not going to be sick, I am not going to have an upset stomach. My insides need to work correctly." So, I just bin it. And people will say, "You shouldn't be doing that, you're wasting money," and I say, "Excuse me, who pays for the food? So, if I don't want it and I buy it, it has nothing to do with you, it's not your house." So, they get really irate at me, but I think, "No, it's my choice, they're not paying my food bill," so…" (Participant 103).* *"More confidence in using the product." (Participant 031).* *"No experience of it (food poisoning) I hope that remains, I do. So, I've been cautious over such things. Occasionally, something goes off before I eat it, and I add it to the compost bin by my back door. I don't take risks with food. I need to avoid getting myself poisoned with anything." (Participant 020).* *"A turkey or a chicken, they're much more difficult to find out if they're definitely cooked right through. So, we've got a wee small one (referring to temperature probe) that I keep in the kitchen drawer. And that's when I use it just to check that they've thoroughly cooked through."* *"I think I like the sound of the probe that (referring to Participant 33) is talking about, so I might invest in one of those, because then it would give me confidence that the food was cooked well enough and that we'd run likely to be poisoned by it.*
Perceived benefits among family caregivers	*"I think there's a lot of food waste because we ditch things rather than have mum poorly. It's just not worth it." (Participant 047)*
Perceived benefits resulting from group discussions	*"I think I would quite like a fridge thermometer now because when I turn the dial up, the fridge freezes up and I get annoyed at it. And then there's a lot of moisture and that's really annoying as well. So, I think thermometer could be quite useful." (Participant 006).*

Table 12. Perceived barriers to food safety practices among family-caregivers and adults over 65 in Scotland.

Perceptions	*Quote*
Lack of awareness or unfamiliarity with food safety tools e.g. temperature probes	*"I think I would probably use one (referring to temperature probe) it's just a case of probably getting used to it and like if you've got a table that tells you what temperature things should be because I would have no idea what temperature something was actually supposed to be. But I can see if it's not cooked. You know if you you've cut it in half, I can tell. So, I don't think I would rush out and buy one, but if someone gave me one, I would probably use it. But I'm quite happy I've not poisoned my husband yet." (Participant 004).* *"It's just I've never thought about using a meat probe. I mean, I'm interested in this, but I've never thought about it. I mean, because I'm only cooking small amounts, so I suppose it's less likely that mine is not going to be cooked, because it's a smaller amount. But I would have never thought to do that. I certainly would check to see it was cooked sort of checked by eye." (Participant 001).* *"I prepare meat for them (referring to parents), but I don't have a temperature probe, I would just go by the length of time it had been cooked and how it looked. I would consider buying a temperature probe if I had clarity around that risk. It's never really something that had occurred to me before." (Participant 005).*
Misunderstanding of food safety concepts	*"Yes, I would have washed raw chicken as well and I stopped doing it. I mean, I thought I was being good because it was chicken, it was supposed to be salmonella, and it was on the outside and you were washing it. That was my theory. But then I found out that was just entirely wrong. The wrong thing to do... it was quite easy to stop washing it. I don't like handling it, so you know. One less thing that I'm quite happy not to do that." (Participant 001).*
Longstanding attitudes and mindsets	*"We'll use things that are past their date quite regularly and I go by the sniff test. I mean my mother, I was one of five, she would buy her cheese a big block, we didn't have a fridge, we had a cold shelf in the larder, and she would go to it and if there was a bit of blue on the end, chop it off and she would carry on eating. We grew up like that perfectly healthy. So, I've gone back to that a bit really to avoid wastage. I can't stand wastage…" (Participant 110)*
Finance	*"… I can't see me changing now, no. I'm probably too set in my ways. You're limited by finance as well, so if I had a lot of money maybe I might change." (Participant 110).*
Perceiving the food safety practice to be of greater benefit for others, or of no benefit to them	*"I quite like the idea of trying something new, I want to be open to try things. I don't know about this (referring to a temperature probe) I mean, my son, he he's got a meat thermometer, but then he does a lot of barbecuing, so maybe that it's more necessary for him than for my cooking possibly. He uses his constantly, but I've never thought in my situation that I needed it." (Participant 001).* *"I think for the things that we are keeping in the fridge. I don't really feel the need for one (referring to a refrigerator thermometer). I think if the drinks are feeling cold, and in this house, food doesn't really last very long it disappears rather rapidly. So, there is nothing really that's in the fridge for very long apart from jars of stuff." (Participant 004).*
Barriers faced by family caregivers	*For myself, I got no issues with yellow stickies, and I don't read too much into dates. But from my parents, you just wouldn't want that on the on your conscience. But ultimately, because I'm not there every single day. Even if you buy in their food, there's no guarantee that they will use that at the time required. I think Fridge management is a massive thing. I mean, for my parents, it's going back to that frugal nature. There's a lot of dairy products which are out of date and things, and they've had this attitude that "it's fine", so you just try and eliminate it, but as you say there, there's always resistance if you try and do too much and throw things out, then you don't feel like you've got the right to do so. It's not your property to dispose of, which is a potential issue as well." (Participant 045)*

6.7.3 Perceived self-efficacy of existing food safety related behaviours

Many participants did not believe that foodborne illness was likely to occur as a result of food consumed in their own home, that the domestic environment was the least likely location, and they had confidence in their ability to prevent foodborne illness:

> *"I feel it is quite unlikely to happen at home… but it's much more likely to be from food that isn't vegetarian or eaten out." (Participant 020).*

Although perceived self-efficacy relates to a person's belief and confidence in their ability to perform the behaviour, in the context of food safety, it may be suggested that overconfidence from cooking experience may prevent recommended food safety practices being adhered to, again this was often in relation to using food safety tools such as temperature probes. For example, some participants expressed confidence in their cooking abilities and relied on their experience rather than tools (Table 13). Participants 028, 081 and 110 mentioned that they do not use a thermometer, believing they can assess if food was cooked based on their experience, they were confident that they had the ability to ensure food safety without food safety tools. This complacency and overconfidence can lead to overlooking proper safety measures and may be a barrier to people accepting food safety educational messages in future, therefore it is important to address and acknowledge the confidence that people have in their abilities, but that it may not be sufficient to ensure food safety. Similarly participant 001, believed that her food was less likely of being undercooked than others and indicated confidence in relation to this as she was "*only cooking small amounts".*

Self-efficacy in their own judgment of determining food safety often meant use by dates were disregarded when people believed they could tell that food was safe to eat via appearance, taste or smell, this confidence was often based on their experience of cooking and using *"common sense"* as discussed by Participants 004, 082, 091. Further to this, participants 054 and 055 discussed becoming more relaxed about food safety practices with age and experience.

Table 13. Perceived self-efficacy of implementing food safety practices among family-caregivers and adults over 65 in Scotland.

Perceptions	*Quote*
Self-efficacy in being about to determine safe cooking temperature	*"I don't use the thermometer. I think there is this complacency that comes into cooking, or is it just through experience? I don't check that something is cooked, I just do it. Although I'll roast a chicken, and I'll pull the leg away from the body and then check down there as that where you usually get the red meat, so I look for blood. But with meats other than chicken, I don't eat a lot of pork or bacon, things like that. So really the food I eat, I don't think there's a high risk of food poisoning, except chicken that's always cooked well, so I don't check the temperature." (Participant 028).* *"I think when I'm following recipes for chicken specifically, the chicken has to be cooked, so to use a thermometer seems a pointless step, it's just I seem to know, I mean, you get to a certain age, and you know when the chicken's done [laughter]." (Participant 101).* *"It's just I've never thought (using a temperature probe). I mean, I'm interested in this now that I've heard about it, but I've never thought about it, because I'm only cooking small amounts, so I suppose it's less likely that mine is not going to be cooked, you know, because it's a smaller amount. But I would have never thought to do that (use a temperature probe)." (Participant 001)* *"And as for meat, I will check it with a fork or something just to see if it is cooked and if necessary, I will give it more time to ensure that there isn't any blood coming out of the chicken, that kind of thing. So, I use lots of things to check, but not a thermometer. I use my senses." (Participant 034).* *"But generally, you sort of can tell… Cooking for so many years, you know how long certain things take to cook." (Participant 081).* *"I think you tend to cook for that many years you know when it's done." (Participant 096).* *"I can tell when food is safe to eat because of my experience. I can tell if it looks cooked." (Participant 118)*
Self-efficacy about being able to determine the safety of food by relying on senses	*"For me, I mean, there's nothing that prevents me using the use by dates, but I use my own experience in common sense, if it doesn't smell right, it's not right. Regardless of what the use by date says you know." (Participant 004).* *"Its common sense, and what it looks like, and what it smells like and what it is. I mean, I would be happier without the dates." (Participant 082)* *"A lot of the things it's just common sense; you just think about what you're doing." (Participant 091)* *"Sometimes I have to just pick mould off the crust and toasted it and I lived to tell the tale. You know, I look at my parents and think, well, they came through the war and all of that and it is about common sense and smelling it and if ham is green then it goes in the bin. (Participant 130).* *"It's a bit of common sense that says if it's a day over the date then I would open it and I smell and you know the actual colour, the sight of it. You know, I think you can tell whether or not it's OK and I would probably use it that day. If it was longer than that, if it looked like the colour was a bit odd or the smell wasn't right, then I just wouldn't use it. But I think the older you get and the more exposure you have to food, I think you know whether something is off or not without a date telling you it's too old to use." (Participant 004).*
Complacency about current practices and not following fod safety practices	*"What I notice about myself is that the older I get, the more relaxed I am about following rules and regulations kind of on the basis that the older you are, the less risk there is in doing things that younger people perceive as being either at worst, dangerous, or at best, careless… So, there is maybe something in older people, you know, as I say, just not being quite so precious about following healthy eating habits in terms of following dates and so on." (Participant 055)* *"I think the older you get, the more risky you are. And I remember sort of 20 years ago going down to my mother's and, raiding the fridge and saying, "this is absolutely ridiculous, this is 2 months out of date", whereas if you look at my fridge now, there's loads of stuff in there that's two months out to date. And really it doesn't actually do me any harm. So, she was right after all, as all mothers do tend to be." (Participant 054).*

6.7.4 Motivations to implement food safety behaviours

It is easier for health educators to design behaviour change programs if the recipient's motives and attitudes to changes in health habits are known. It has been suggested that understanding the motivations for food safety behaviours has the potential to improve the quality and effectiveness of educational programs in the future (Schafer et al., 1993).

Motivation for change depends on the presence of a sufficient degree of perceived risk in combination with sufficient self-efficacy. Perceived risk without self-efficacy tends to result in defensive cognitive coping, such as denial, rationalization, and projection, rather than behaviour change (Snetselaar, 2001).

During the group discussions, a number of different motivations to implement food safety practices were discussed, these ranged from personal experience to the practical benefits and were broadly related to previous experience with foodborne illness or having underlying health conditions and taking medications that impact upon immune function. Whereas for some they were motivated by an interest in food safety gadgets such as temperature probes and thermometers.

As indicated in Table 14, previous experience of a foodborne illness motivated individuals such as Participants 024, 032 and 035 to be more cautious in relation to food safety practices in the home, whereas Participant 067 discussed not being bothered about food safety practices because they hadn't experienced foodborne illness and consequently weren't motivated to follow some recommended food safety practices.

Participant 066 discussed that their motivation to use a refrigerator thermometer and ultimately purchase a new fridge was to ensure the safe storage of medication, nevertheless a benefit of this was ensuring that food was safely stored. Some, such as Participant 080 was aware of the importance of fridge temperatures, she had not been motivated to purchase one until she saw a refrigerator thermometer for sale and believed it would be useful for her.

The purchase of an air fryer motivated participant 024 to purchase a temperature probe. Whereas it was of interest that Participant 057 described that when she was cooking meat for herself and her family, she sometimes wasn't sure if chicken was always cooked, but she wasn't overly concerned, however when her children were learning to cook, she advised them to use a probe, and also adopted the practice herself:

"When the children got a wee bit older and they were cooking for themselves, it was "how do we cook chicken?", "How do we do it?" And I said, "Well, if you really want to be sure it's cooked, get a probe." And I got one as well." (Participant 057).

As previously stated, the perceived benefits and motivations are often linked. As discussed in the section describing perceived benefits of food safety practices, Participant 20 described being motivated to not taking risks with food to avoid food poisoning.

In their role as family caregivers, some participants felt motivated to take responsibility for ensuring the safety of their loved ones' food, as they believed their relatives were no longer capable of doing so themselves.

Some participants, such as Participant 105, lacked motivation for food safety practices, viewing them as unnecessary or burdensome. For example, skipping the use of separate chopping boards despite understanding the potential benefits.

Despite the lack of clarity in findings between perceived benefits and perceived motivations, these findings provide valuable information into personal motivations for improving food safety behaviours in the home, these can indeed be utilised by Food Standards Scotland to help inform the development of future food safety campaigns, such as: utilising personal stories of foodborne illness experiences to highlight the severity of illness. The findings also show the motivation of those individuals who are aware of their personal susceptibility to foodborne illness and infections due to underlying health conditions or medications, this indicated the need to facilitate widespread communication of who the clinically vulnerable groups are, this is particularly important as many who had certain underlying conditions were not aware of their increased susceptibility to illness.

Given the interest and willingness to engage with gadgets, there are opportunities to encourage the use of refrigerator thermometers and temperature probes that simplify safe cooking and storage practices in the home, these need to be more visible for consumers and need to be normalised as part of everyday cooking.

It may be suggested that focusing on relatable experiences, emphasising the practical benefits, and increasing accessibility of key food safety tools could effectively motivate individuals over the age of 65 years to prioritise food safety practices in the domestic kitchen as part of daily life.

Table 14. Motivations of individuals aged ≥ 65 years in Scotland to implement recommended food safety practices.

Motivations	*Quote*
Previous experience of foodborne illness motivating food safety practices	*"I didn't used to pay too much attention to food poisoning, and then I think I gave myself a dose of food poisoning. And it was my own fault, because I should have put something in the fridge overnight, but I thought it would be fine leaving it in the cool kitchen. And it might just be coincidental, but I've not done that again and I'm paying much more attention to how I'm dealing with food. I changed some things. I'm not leaving it out overnight, I'm paying a bit more attention to use by dates. So yeah, I'm more likely to use or throw out if it's getting too close to its use by date." (Participant 024).* *"I've had food poisoning twice, but it wasn't in my own home. It was when I ate out, when I was younger and it did affect my confidence with food, especially eating out, and it affected my confidence with meats like chicken reheating things as well like rice. So, I'm very, very wary. The practices I have at home with cooking are wearing gloves or making sure if the kids are helping just with bacon, hands are washed, certain chopping boards for certain things. I'm very weary because I'm the main person that cooks and also it does not help like when I think if I have to eat out which is very rare. Well, I hope it's been thoroughly cooked especially with like meats." (Participant 032).* *"Because I've had food poisoning and it was horrendous and I don't want either of us to get it, so I'm really a bit OTT about dates and things." (Participant 035).* *"Well, I would never reheat rice. Now that is because I've had quite bad sickness experiences when I've had rice that has obviously been reheated, and I'm very nervous about rice for that reason. (Participant 069).* *"But having known what proper food poisoning is like, it has since then changed the way I look at food and cook it and store it. You store things correctly in your fridge, you put your raw stuff at the bottom and other stuff at the top, etcetera, I'll always wash fruit and vegetables because my way of thinking is you don't know who's picked an apple in the supermarket and put it back." (Participant 089).* *"I now feel very guilty because it doesn't bother me in the slightest. It doesn't bother me if I reheat food. It doesn't bother me if it doesn't get cooled straight away. If I'm going to get food poisoning, I'm going to get food poisoning. I suppose as I'm getting older, I should be more vigilant, but it's not something I've had, it doesn't bother me in the slightest." (Participant 067).* *"I think I'm quite fussy, I've had food poisoning once and it's not a pleasant experience at all. Probably that's why I don't use stuff after the sell by date, you know, because I'm thinking I never want to feel like that again because it's just not a nice feeling. It's just a horrible thing to go through. So, I think that that, influenced me." (Participant 001).*
Underlying conditions and medications	*"Because I've got ulcerative colitis, the medication I'm on, it's injections I take, and they're required to be stored between two and eight degrees, so I actually have to have a thermometer in the fridge to make sure that the fridge is staying between those temperatures and I've got to say, I knew my fridge freezer was 24 years old at that point in time and the temperature wasn't quite right. So, I bought myself a new fridge freezer. Keeping my medication safe, that's the main motivation, but it also allows me to see that my food's been stored at the correct temperature." (Participant 066).* *"I'm a bit more cautious because there are some things I was told not to have when I'm on set medications. So I'm careful on dates of things – the use by date – because I don't want to risk having an upset stomach, and I have a friend who regularly, in fact, she does all her shopping by yellow stickers, and she will put down a cream cake that's three days out of date and expects me to eat it, even though I tell her every time I can't have them. I then just have a digestive biscuit because I can't risk being sick. I just won't do that… When I first took methotrexate, there was things I was told not to eat, and I avoided them for a long, long time. I just listened to them as a new patient, newly diagnosed getting told this I took it on, and it just stayed with me. I suppose I've had an autoimmune condition for 20 years, so it does make me really cautious." (Participant 068).*
Using new equipment	*"I got a food thermometer when I got the air fryer just to make sure that I was heating the meat properly, I like my meat well done, but I was aware with the air fryer it could look as if it was well done, but it might not be, so I got the thermometer for that one. If I'm reheating on the hob, that's brilliant because you can see it's boiling. You can boil it for however long. If I'm doing it in the microwave, I find that more problematic because I need to make sure that I am stirring it and testing it with the thermometer just to make sure that it has cooked thoroughly throughout the whole dish, because I find if I don't do that, you can get boiling hot spots and cold spots. (Participant 024).*
Lack of motivation	*"I know people who use different chopping boards for different kinds of food, you know, coloured ones, a red one for this and a blue one for this. But we don't, no... (when asked "why?") … I can't be bothered (Laughs)." (Participant 105).*
Addressing other benefits to motivate behaviour change	*"So yeah, my mum could be persuaded to use it too, I think what would motivate her to use a fridge thermometer I think it would be talking about things keeping fresh and making sure that things remained fresh. It's a relatively old fridge now. I think like a lot of older people, you know, she's had her fridge for 20 years at least. And I think to say to her, you know, just to make sure it's performing optimally, given its age and to make sure everything was staying fresh. Because she's not very hygiene orientated. I think that would be easier." (Participant 005).*
Interest in gadgets	*"I just think about the time that you've cooked it for. Look at it, smell it. Does it look right? Is it the right temperature. Yeah, you should use a probe if you're cooking meat. I think it's mostly meat that we will use it for meat or chicken or lamb. Fish, no I don't… A present for my husband's birthday one year was a cookery school course, and they used a temperature probe, and he came back and said it's fabulous. it's brilliant, and as gadget people that like things that make your life easier and safer, he went and bought one, so we've used it ever since and it's been fabulous. So that was our motivation." (Participant 026).* *"I have a thermometer. It sits on the shelf so that when I open the door, I can see it. It's designed for fridges. It just sits on the top shelf there about eye level. I've had it for a long time I saw it one day somewhere and said. "That's a good idea, yeah", bought it and took it home. I'm aware that fridge temperature will have a big impact on how well the food keeps. If the temperature is too high, it's going to go off. You might think "Oh, it's not going to have gone off". If the food has been in the fridge and the fridge temperature isn't right, which is why you don't put hot things in the fridge to cool down, you let them cool down before you put them in the fridge, you could increase the temperature and something else goes off." (Participant 080).*
Family caregivers	*"We have to assume that responsibility for her when she's really no longer thinking along those lines." (Participant 047)*

6.8 Cues to Action for adopting food safety behaviours

Cues to action are the stimulus needed to trigger the decision-making process to accept a recommended health action (Glanz et al., 2015). Cues to action include a range of triggers to the individual taking action and are commonly divided into factors which are internal or external to the individual (Meillier et al., 1997), the later can include mass media campaigns or advice from others (Janz & Becker, 1984). However, responses to cues-to-action vary among individuals, it may be suggested that the lifestyle factors and the perceptions of individuals may impede or help facilitate food safety practices (Meillier et al., 1997). It has been previously suggested that perceived susceptibility and perceived benefits are only relevant when activated by other factors termed as cues to investigate action (Glanz et al., 2015).

In the food safety context, cues to action refer to triggers for accepting recommended food safety practices. Previous research identified three key cues to action in relation to food safety behaviours, these included; media such as mass media or printed media; communication such as interactions between parents, peers or teachers; and food labelling found on food packaging (Shafiee et al., 2014). Communication researchers hypothesise external cues such as campaign exposure as the predictor variable (Jones et al., 2015).

One of the most widely discussed cues to action in this study were Food Standards Scotland media campaigns to discourage the practice of washing raw meat and poultry to prevent cross contamination of the domestic kitchen environment, as previously mentioned, in relation to perceived barriers to positive food safety practices, some people believed they were doing the *"right thing"* in washing raw poultry to *"make it cleaner"* or *"remove the germs"*. As indicated in Table 15, information regarding the cue to action are shared, how credible information meant it was easy for some people to stop the practice. Some could recall the importance of the messaging, whereas the visuals used remained with others.

For the development of future effective food safety campaigns, there are opportunities to learn from previous campaigns that acted as cues to specific action. However, in the context of stopping the behaviour of washing raw poultry it is very different to adopting a new food safety behaviour. Although some were glad to stop the practice of washing raw meat as they disliked handling raw meat and saw it beneficial in having one less food preparation task,

others described the change in behaviour being challenging as they were so familiar and accustomed to implementing the practice.

Previous research with older adults with chronic illness suggests that cues to action which provide information, having underlying knowledge and consulting with others can trigger adoption of self-care (Chou & Wister, 2010).

Table 15. Cues to action that have resulted in adopting food safety behaviours among family-caregivers and adults over 65 in Scotland.

Cues to action	*Quote*
Media campaigns to discourage the practice of washing raw meat and poultry to prevent cross contamination	*"I would have washed raw chicken as well and stopped doing it. I mean, I thought I was being good. Because it was chicken. It was supposed to be salmonella, and it was on the outside and you were washing it off. That was my theory. But then I found out that was just entirely the wrong thing to do, it's quite easy to stop washing it. That mean I don't like chicken. Anyways, I don't like handling it, so you know. One less thing that I'm quite happy not to do that…I think it was on an article on the TV. I think it was a programme on the TV about it, about food safety and I picked it up there and then I think it was then picked up in the newspapers, and just other people saying to me, "oh did you watch that programme about chicken?" I think there should be more of that. It was quite easy to stop once I got the logic of a thing, so if I know why, it's easy to follow, I think, its important knowing why you should or shouldn't do something." (Participant 001).* *"Yeah, I'm sure there was a television thing a couple of years ago that said, they have the chicken under the sink, and they showed you the bacteria right round the sink that not to wash. Just the fact it's quite clear that you know that it did show you that the bacteria, I think it one of these infrareds and they showed you the bacteria. So, it was quite clear for people to see what could happen if you washed it" (Participant 067)* *"I never wash my meat. I might take a bit of paper towel and sort of mop it if it was a bit damp or whatever or a bit bloody, but wash it? No, certainly not poultry. It doesn't do any good, and all it does is, if there's anything nasty on it, which can be on chickens in particular, all you do is spread it around the kitchen, absolutely, because every tiny splash of water just spreads the bugs around. I mean, it gets reinforced in press articles and things, it comes up every now and again, particularly around Christmas time, you'll see a bit saying, don't wash it. Don't wash it. If there's anything on it, it will be killed off when you cook it." (Participant 080)* *"I used to wash a chicken and then I specifically heard a lot on the news, I mean, we're going back a few years but I haven't washed a chicken before it gets cooked now for quite some time, in case the juices that are in the packaging drip, and if you just happen to wipe it up quick with a cloth and not hot-rinse the cloth then you're just spreading it. So, you take it from as near your packaging into whatever container you're cooking." (Participant 089)* *"No. I don't wash chicken. They tell you not to wash chicken. Well, they say it can give you food poisoning. I probably read it somewhere because I read everything and anything. It tells you on the packet don't wash the chicken." (Participant 107).* *"I used to buy chickens years ago, they always had giblets inside in a bag, so I think I used to pull that out, bin it and then wash the chicken and it was definitely online, I think it was on television as well, usually in the run up to Christmas and turkey. I definitely read online: do not wash and the danger is greater of you spreading germs than those you think you're trying to eliminate. I was really glad to stop washing it, I hated it. I think one of those lights that shows up, is that a blue light or something like that so they washed it and then they showed you where the splatter was, I think I remember that… it was a slightly scary campaign in that you're trying to do something good, but you're actually doing something very silly so stop it." (Participant 117).*
Advice from others	*"Yes. I would have always washed chicken in the past, but I don't do it now, that's five years I would say. I think the young one said, "For goodness' sake, you don't want chicken anymore, because it goes everywhere". But we always did and then patted it dry on a tissue. It was quite difficult to change that because I'd done it for years, always washed chicken." (Participant 116).*
Requirements from future campaigns	*"I don't have a temperature probe; I just go by the length of time it has been cooked and how it looks. I would consider buying a temperature probe if I had clarity around that risk. It's never really something that had occurred to me before. And about the increased risk when you're older, this has been an interesting discussion from that point of view because I hadn't really kind of clarified and won't mind that increased risk of illness." (Participant 005)*

6.9 Preferences for future food safety education and communication

In addition to ensuring food safety messaging include cues to action it is essential that future food safety campaigns are delivered in appropriate and effective ways to the target audience. Therefore, during the groups discussions preferences for future food safety education and communication were explored.

Many referred to trusted sources of information such as medical professionals, Food Standards Scotland, and the NHS website to provide clear, factual information. It was suggested that all communication from FSS needs to be evidence based, if statistics are broad or specific it doesn't matter but they need to be backed in evidence. Although some the need to avoid overly alarming language or statistics that could cause unnecessary fear. Others believed this to be necessary to ensure the impact of the messaging.

Participants discussed the importance of delivering short, sharp messages through traditional media such as campaigns on TV, radio and other media including the printed press and social media to raise awareness. In addition to advert type messaging, many discussed they would also like to receive written information in the form of booklets or leaflets, many discussed that receiving a paper-based information resource was preferable as it would be revisited. Some mentioned using social media would make it feel *"right in your face"* and more and more older people are using these social media platforms. Many believed that there would be value in using a variety of different approaches to get the message across.

It was suggested that there was a need to focus on educating younger generations about food safety practices, rather than just targeting older adults. Some participants suggested that food safety education needs to come at an earlier age, not just delivered when individuals are at a stage of increased susceptibility, many suggested that food safety should be incorporated into the school cuticular, particularly as many children wouldn't receive such information at home.

Once again, concerns regarding the lack of food safety awareness among carers and care providing companies:

"I just feel that some of the carers and some of the companies don't train their staff well enough in food safety and food hygiene, nor do they have time when they go and visit people" Participant 066

It was discussed that there is a need to tailor the information to address specific conditions or vulnerabilities that increase susceptibility to foodborne illness, why individuals are at risk and what they can do to reduce the risk of foodborne illness.

6.9.1 Targeting individuals aged ≥65 years

There was a great deal of discussion regarding targeting individuals aged ≥65 years with some suggesting a preference for 'older people' rather than 'elderly'

"If you want older people to read it, you need to say older people. Because if you say elderly. That's my grandma, you know. If it says elderly on it, I just won't pay any attention to it".

"I would take notice of older, but definitely not elderly and what really annoyed me is when you say over 65 and the government wants people to work until 67 and 70" (Maureen)

The consensus was that resources should refer to people over the age of 65, explain why they are susceptible, how this increases with age, to ensure clarity without using a term that

may be derogatory for some. Some suggested the need for resources that susceptibility isn't something that 'suddenly happens on your 65th birthday', but a gradual progression with age.

6.9.2 Categorising clinically vulnerable groups

During the in-person discussion groups, participants were presented with the three different risk statements regarding clinically vulnerable groups to listeriosis. These ranged from the shortest and the least complex statement which was a variation on the standard YOPI categories (Figure 2), an extended YOPI classification which defined specific chronic illnesses and treatments/medication identified in this report that result in reduced immune function (Figure 3) and a statement providing extended YOPI categories specifically defining why the listed groups are clinically vulnerable to foodborne illness which contained the most information (Figure 4). The statements were colour coded and presented to the participants in the ascending order of complexity.

The first statement reviewed during the six in-person discussion groups was the variation on the standard YOPI categories (Figure 2).

Some people are more vulnerable to listeria infections, including those over 65 years of age, pregnant women and their unborn babies, babies less than one month old and people with weakened immune system.

Figure 2. Pink risk statement (a variation on the standard YOPI categories) presented to the focus groups.

Although some participants liked the simplicity of the pink statement (Figure 2), the general consensus among the groups was that the statement was *"too generic"* and did not provide sufficient information. Several participants suggested that the generality of it would result in it being disregarded. This can be illustrated by the comment made by a participant in group 3:

"I feel I would disregard it… I think it's because it's so general. There's so many things that they warn you about, it's if you're pregnant, if you're over 65, and really, I would just look at that and think, "Oh yeah, just another one"." (Group 3, Respondent 3)

The second statement reviewed during the discussion groups was the extended YOPI classification which defined specific chronic illnesses and treatments, or medication identified in this report that result in reduced immune function (Figure 3).

Some people are more vulnerable to listeria infections due to reduced immune function, these include:

- Pregnant women and their unborn babies, and babies less than two months old.
- People with chronic illnesses such as cancer, diabetes, inflammatory bowel disease, rheumatoid arthritis, or other autoimmune conditions.
- People receiving treatment and medications such as chemotherapy, proton pump inhibitors and immunosuppressants.
- People over 65 years of age.

Figure 3. Blue risk statement (extended YOPI categories defining chronic illnesses and treatments that result in reduced immune function) presented to the focus groups.

In comparison to the pink statement (Figure 3), the blue statement was more widely discussed. Many preferred the inclusion of specific conditions and medications that result in

reduced immune function. Some suggested that this would catch their attention as is refers to specific conditions.

"I would take far more attention of this because it mentions several things that are important to me. I'm on immunosuppressants. So, there are things there that trigger me so I would immediately read that with more interest and take more consideration of it." (Group 3, Respondent 5).

"And the list of all of the people who can be affected, detailed list, because I don't think I would have associated diabetes when I read the first one and I have a friend with diabetes, and I definitely didn't know that." (Group 4, Respondent 5).

However, several individuals suggested that they may not take notice and did not perceive themselves to be vulnerable, even though they had underlying conditions listed in the risk statement. This was often accompanied by the false sense of acquired immunity, or perceptions of invulnerability and optimistic bias. As previously discussed, such perceptions may undermine food safety messaging (Evans & Redmond, 2019c) and future messaging needs to combat such perceptions.

"Well, I've got diabetes Type 2, but it doesn't worry me… Well, if you've eaten in some of the places in the world, I've eaten you become immune to these sorts of things." (Group 1, Respondent 5).

"I'm over 65. And I think you think, "Well I'm careful so it won't happen to me. I wash my hands; I look after my food." And that may be why, I don't know, people over 65 maybe are more susceptible, like living on their own, having foods that have maybe got out of date because they can't afford to, you know, buy things frequently or just because they don't eat it fast enough. I don't know if that's what makes people over 65 more vulnerable." (Group 3, Respondent 4).

"Well, I tick a lot of those boxes. I didn't realise that. Does it make me think that I am more susceptible? Well, I'm going to say no to that" (Group 5, Respondent 3).

"…if somebody who's diabetic, that's a healthy diabetic, would read it and think, that's rubbish I'm diabetic, I'm fine, so it's not that easy. I know it's not that easy, but I think that has to be addressed somewhere" (Group 6, Respondent 3).

Although some participants acknowledged the need for more information regarding vulnerable groups, they were concerned that the level of information in the blue statement would prevent people from engaging with it:

"The blue statement tells it like it is. I find that that pink one is basically sugar-coating things, isn't it, and people need to know this. I think between the two statements, one is shorter and easier to read, who is going to take the time to read the whole of the blue. So, it's, there's more information in the blue but many people get that, they won't get past the first paragraph, and they will just go hmm and wander off." (Group 5, Respondent 5).

It was concluded that although the blue statement provided more information about who's vulnerable, it did not make individuals over the age of 65 years, with listed underlying conditions believe that they were susceptible to foodborne illness.

"It's obviously got a lot more information there. I still don't feel vulnerable." (Group 6, Respondent 1).

"Doesn't make me feel more vulnerable either." (Group 6, Respondent 2).

The final risk statement that was discussed during the six discussion groups provided the extended YOPI categories which specifically defined why the listed groups are clinically vulnerable to foodborne illness (Figure 4).

Certain groups are more vulnerable to listeria infections:

- **Pregnant women, unborn, and newborn babies.** During pregnancy, the immune system undergoes changes to support the foetus, allowing bacteria to bypass antibodies, cross the placenta and infect the baby.
- **People with chronic conditions.** People with cancer, diabetes, inflammatory bowel disease, rheumatoid arthritis, or other autoimmune conditions have impaired white blood cell production making it harder to fight infections.
- **People receiving chemotherapy treatment and immunosuppressants.** These treatments reduce the number of immune cells in the blood stream available to fight infection.
- **People using proton pump inhibitors.** Proton pump inhibitors, used to treat heartburn block stomach acid production, which allows bacteria to grow and cause infections.
- **People over 65 years of age.** Aging weakens the immune system, leading to fewer antibodies and increased susceptibility to infections. In general, the greater the age the higher the susceptibility. Additionally, older adults often have more chronic conditions and need more medications, which further increases their susceptibility.

Figure 4. Yellow risk statement (Extended YOPI categories defining why the listed groups are clinically vulnerable) presented to the focus groups.

Although some believed the description to be too long, others felt it to be important and informative. It was discussed that the visual presentation of the information (bold and bullet pointing) made the statement accessible and allowed for a quicker summary by the individuals who felt that the statement was too long:

"Sorry, I fell asleep. It's far too long." (Group 2, Respondent 3).

"I find it very interesting actually, very informative. What you're saying is all these conditions have impaired white blood cell production, which I just find interesting finding out things like that." (Group 3, Respondent 4).

"I think it very much depends on the communication. I like the blue one because it's quick and easy but it's still comprehensive, and there is lots of things in it that I can go and look up. The yellow one is obviously much better but it's longer and people do tend to have very short attention spans these days. So, you might not read it and then not go and investigate." (Group 3, Respondent 5).

"It's comprehensive, isn't it but you can pick it, it's got the highlighted bits." (Group 5, Respondent 3).

"So, you can look at the bullet points and say well, that doesn't affect me, that would affect me… and then you don't waste time reading all the bits that you don't need, you know, and you just go straight to the one that you do." (Group 5, Respondent 6).

"I like it because it explains why these people are vulnerable." (Group 2, Respondent unknown).

Many of the participants expressed that they have related to the statement and were surprised to learn that they were at an increased risk of foodborne illness:

"So that's new to me, a person over 65... I didn't know that." (Group 2, Respondent 4).

"I didn't know that. I knew that pregnant had to avoid soft cheese and all that sort of stuff because of listeria but I didn't realise that people over 65 were more susceptible." (Group 4, Respondent 5).

"I fit three of those, and my husband and I between us fit four of those. I'm not pregnant. It's the only one I'm excused from [laughter], but we fit four of those. Now whilst I know that he is more vulnerable,

I've always assumed he's vulnerable because he's got cancer and he's having ongoing treatment. I've never ever applied that to me, and I've got three things there that applies that to me. So perhaps I ought… I think information is power. If you don't know something, you can never choose to take steps whereas if you do know something, you could either – react by ignoring it or you can act… you have a choice. Yes, you have a choice about how you deal with the situation, and I think, always think, knowledge is power. It does have a scary side, no question but that's just what it is." (Group 5, Respondent 3).

"I have never thought I was vulnerable, but I think as you get older, you don't really want to think you're getting older. You still think you've still got that same constitution as you had when you were young but it will make me … because I'm a wee bit, let's say, you know, I'm a bit kind of slapdash with things, that is, like, keeping temperature but it will make me think about it more carefully in future and I think that's education, and I'm quite aware of the connection" (Group 5, Respondent 6).

Many believed that the yellow and blue statements could be used depending on the audience and situation. Nevertheless, one participant did not believe the statements to be educational, with others disagreeing with the statement suggesting that the statement was educational and necessary:

"Unfortunately, all I can see is that you're going to scare people. Whatever you want to do, its scaring people, they're just going to go, what?" (Group 5, Respondent 7).

"It's the education that's necessary." (Group 5, Respondent 6).

6.10 Supporting people over the age of 65 in relation to food provision.

Eighteen participants signed-up as individuals who support a person over 65 with their food shopping and cooking, nevertheless some of the individuals who signed up to participate as individuals over the age of 65 themselves, also provided food support for relatives or had done so until recently and were able to reflect on their experiences.

The freezer was frequently referred to by informal caregivers as enabling them to batch cook for those, they care for to ensure they would be able to have a hot meal. Potential food safety risks appear different, with many saying that those they support would no longer be cooking a large piece of meat or a whole chicken, instead buying ready-cooked chicken portions and adding them to a sauce, discussions suggested an increased reliance on ready-to-eat and ready-to-heat foods among this group for convenience for both parties.

Another potential food safety risk may exist as relatives could say their parents' appetites had declined and were eating much smaller portions, this resulted in the prolonged storage of food, and for those that were widowed relatives described the widowers not adapting to shopping and cooking for one which also resulted in prolonged storage, repeated food consumption and a lack of variety in the diet.

Caring for a relative and providing food related support had a huge impact on the informal caregivers, many of whom had their own families and full-time jobs. It was a change to support parents to maintain their independence and interest in food shopping and cooking, ensuring a good diet and not over-stepping. The change in relationship and family dynamics is a challenging one for people to adapt to. Many relatives described the compromise between the quantity and quality of calories, as much as they wanted their relatives to consume a healthy nutritious diet, this was not always possible due to the desires of the person they support, often this compromise was discussed and was something relatives had to stop worrying about.

Participant 053, who supports her mum with food provision described: *“It's like getting that role reversal.”*

Table 15 summarises some of the comments shared about the impact of being responsible for the provision of food for relatives over the age of 65 years. These sentiments reflect a broader understanding among family caregivers that their relatives are not only more susceptible to illness but that the consequences of such illnesses could be significantly more severe due to age-related frailty or pre-existing health conditions. This heightened perception of risk integrates two critical components of the health belief model: perceived susceptibility and perceived severity. Caregivers recognize both the likelihood of their relatives contracting an illness, particularly one related to food safety, and the potentially severe outcomes due to their loved ones’ vulnerable health status.

In this way, family caregivers’ views on foodborne illness are shaped by a keen awareness of the potential harm that such an illness could cause, emphasising the critical role that health status and physical resilience play in shaping perceptions of risk. Their concerns are not merely about the possibility of illness, but rather the potentially devastating consequences such an event could have on individuals whose bodies are already compromised, reinforcing the need for careful food safety practices in caregiving environments.

These findings indicate the importance of ensuring any future food safety information resources are also appealing, accessible and useful for family- caregivers who support a person over the age of 65 with food related practices.

Table 16. Impact of being responsible for food provision of relatives upon family caregivers.

Theme	*Quotes*
Adapting	*"So, my sister and I are heavily involved. And it's just been an interesting journey watching the changes. Everything has just completely changed over a really, really short period of time. And my sister and I are being sucked into this kind of support mode. You know, we'll, we'll do it happily. But it's just such a big change and it's really weird to see it happen so completely suddenly. I think my sister and I thought the world had ended to start with. You know, we were never going to have any time to ourselves. But, you know, you gradually everybody just forms a new normal and you just adapt to it. You know, you just anticipate the next thing happening where they can't feed themselves or, you know, whatever the next awful thing is that's going to happen. But this is just the new normal now. I think we're good at adapting as beings. Yeah." (Participant 006).* *"I'm at home with my husband and two kids. This last four years, we moved my in-laws over to be closer to us. They are 89 and 90, both got Alzheimer's. It's been a challenge [laughs]. I had to learn very quickly." (Participant 097).*
Change in relationship	*"I think it can be quite difficult to strike the balance between doing what needs to be done because things need to be done but also knowing where the line is and not infantilising. If there's reluctance, sometimes it's easier and quicker to just do it, and then you get to a point where you're thinking actually, would it be better in the long run for me to do less and try to practice a bit of tough love? And then you feel guilty… I think generally it is a difficult thing to accept that your relationship with parents' changes. It does, it changes the dynamic. But it does put additional pressure on you, when they were doing their own thing fending for themselves to suddenly have that added on to the list. Not insurmountable, but it's it is an extra thing to then have to think about." (Participant 005).* *I can't get my head dry into it. You know, it's so sad. Whereas previously it would have been huge quantities of vegetables to make homemade soup, and my mum would always have a giant pot of soup on the cooker, and you could always have a thick bowl of it when you would go to visit. But now I'm taking the soup to her just to make sure that they're both getting something decent for their lunch. So yeah, it's all changed completely. Yeah." (Participant 006).* *"It's like getting that role reversal." (Participant 053).*
Impact on caregiver and their family	*Oh yeah, absolutely, I feel resentment. I'd be lying if I said no. And I love my mum very dearly and I love my dad too. But yeah, I mean it's taking its toll on me, I do have a brother who is absent most of the time. And that also plays into resentment as well, because I just think it's all on me. But it's, you know, it is what it is so. Another part of me, there's a resentful part, part that I just have to go home. It is what it is. I just crack on with it because actually feeling resentful is such a disruptive emotion, and it's also an exhausting emotion. So, I try to limit myself indulgence with resentment, shall I say." (Participant 047).* *"I think it's a wave of emotions, though. You know, sometimes you just feel so sad for them when you think about what lies ahead, and I'd want somebody to be compassionate to me. So, like with anything you have moments of frustration and anger. But on the whole, I'm so happy you know that she's still here and you know, I'm able to do that care for her. It's not ideal, you know, because obviously it's very restrictive for around my family and things like that. But I try and kind of bear that in mind that it's not her fault either. And you know, everybody's going to get old and we're all going to need some kind of help." (Participant 048).* *"Whilst I do feel some resentment, it's mainly not towards my father, I have siblings, and they don't tend to help. But I actually think in most cases it tends to be women who this a responsibility falls to. It seems to be the women who do caring, the shopping, the cleaning, the cooking. It's bittersweet in so many ways. I'm not terribly resentful to my father because one day I hope that my children will look after me and I'm setting a good example." (Participant 049).* *"So, for me, what's had a huge impact, so I cared for mum. So, my cortisol just took off as well. I felt useless as well, I developed stress eczema… I had high blood pressure, never had an issue in my life and all of that was around personal stress and emotional stress, also as well, when you're caring for someone, when you're maybe moving through your caring role is that you don't develop time to eat. You're thinking because your main concern is that person, that they get nourishment to take them through their journey." (Participant 093).*

7 Discussion

7.1 Summary of modifying factors that impact food-related behaviours and food safety

The findings from this study highlight the complex interplay of physical, biological, social, psychological, and economic factors that shape food-related behaviours, particularly among older adults.

- **Physical Environment:** The physical environment, particularly food deserts, impacts access to healthy food, and the context of food safety hasn't been explored much. For individuals relying on weekly shopping or online grocery deliveries, improper storage, refrigeration, and thawing of food in domestic kitchens can pose safety risks.
- **Biological Factors:** Biological factors, like age and health conditions, affect food safety behaviours. Older adults, especially those with reduced mobility or vision impairment, may struggle with buying, transporting, and preparing food. Family caregivers face challenges ensuring food safety, as reduced appetites and improper use of food storage or cooking instructions are common among older adults.
- **Social Environment:** The social environment greatly influences food-related behaviours, especially for older adults. Social isolation, like living alone, may reduce motivation to prepare fresh meals, increasing reliance on ready meals and frozen foods, which can lead to unsafe food practices. Social interactions and cooking for others can encourage safer food handling practices. Understanding these dynamics is essential for developing targeted food safety messaging for older adults.
- **Psychological Factors:** Psychological issues like low motivation, cognitive decline, and dementia increase the risk of unsafe food practices. Older adults with cognitive impairments may forget meals or mishandle food storage. Caregiver support and clear food safety reminders are essential to address these challenges.
- **Economic Factors**: Economic pressures influence food safety behaviours, as people prioritize affordability and may purchase discounted or bulk foods with concerns over safe storage. The use of smaller appliances, like air fryers and microwaves, can also create food safety risks due to unfamiliarity with their proper use. Financial constraints may also lead to unsafe practices, such as consuming food past its use-by date or using limited resources from food banks. Future food safety campaigns should consider these economic factors and offer practical advice on ensuring food safety.

7.2 Learning from the application of the Health Belief Model

- **Threat perception:** The findings highlight differences in the perceived threat of foodborne illness between individuals over 65 and their family caregivers. Many older adults did not perceive themselves as susceptible to foodborne illness, often associating it with food consumed outside the home and not recognizing the impact of age-related immune changes. However, when informed about these changes, some acknowledged their increased vulnerability. Family caregivers, in contrast, were more aware of the heightened risk their elderly relatives faced due to frailty or health conditions, which influenced their food safety practices. Caregivers also exhibited a stronger understanding of the potential severity of foodborne illness, recognising its serious or life-threatening consequences for older adults. These

findings emphasize the need for targeted education on food safety to increase awareness and improve practices among both older adults and caregivers.

- **Motivation:** Some individuals were motivated by personal experiences with foodborne illness, while others, especially those with underlying health conditions, were motivated by the need to protect themselves or family members. For instance, individuals who had experienced foodborne illness were more cautious about food safety practices, whereas some participants who hadn't had such experiences didn't prioritize food safety as much. Additionally, family caregivers were particularly motivated to ensure food safety for their loved ones, especially if they believed their relatives were no longer capable of managing it themselves. There were also differences in the use of food safety gadgets, with some participants showing interest in tools like refrigerator thermometers and temperature probes, while others were less inclined to use them, viewing such practices as unnecessary or burdensome.
- **Behavioural evaluation:** The evaluation of food safety behaviours reveals that perceived benefits, such as preventing foodborne illness and increasing confidence in food safety, play a crucial role in motivating individuals to adopt food safety practices. However, these benefits are often weighed against perceived barriers, including financial constraints, lack of knowledge, complacency, and emotional resistance. Motivations for food safety behaviours vary greatly, influenced by personal experiences, such as previous foodborne illnesses, underlying health conditions, and practical considerations like the use of food safety tools (e.g., temperature probes and refrigerator thermometers). Additionally, for some individuals, cultural attitudes and misconceptions, such as disregarding use-by dates or overconfidence in cooking abilities, can act as barriers to adhering to recommended practices. Understanding these factors, particularly in groups like the elderly or family caregivers, can help inform the development of more effective food safety education campaigns that emphasize relatable experiences, practical benefits, and the accessibility of key tools.
- **Cues to action**: Cues to action, such as media campaigns, personal communication, and food labelling, serve as triggers that encourage individuals to adopt recommended food safety behaviours. However, responses to these cues vary based on individual perceptions and lifestyle factors. For instance, media campaigns have been effective in altering behaviours, like discouraging the washing of raw poultry to prevent contamination, while other individuals may resist changing ingrained practices. The effectiveness of cues to action can be enhanced by providing clear, relevant information tailored to specific groups, such as older adults or individuals with underlying health conditions. Additionally, future food safety education should include diverse communication methods to reach wider audiences, focusing on providing evidence-based, relatable content.

7.3 Informing the development of future Food Standards Scotland food safety messaging

The cumulative findings of this study confirm the need for Food Standards Scotland food safety educational resources for clinically vulnerable groups, such as older adults. The findings from this study can be utilised to inform the development of future food safety messaging approaches. It is clear from the body of work undertaken that there is a need to create Food Standards Scotland food safety campaign messaging to communicate who is at an increased risk of illness, why they are susceptible and how to reduce the risks.

To enable this there is a need to utilise the overarching constructs of the Health Belief Model, namely threat perceptions, motivation, behavioural evaluation and cues to action as indicated in Table 17.

Table 17. Considerations for future Food Standards Scotland food safety messaging.

Constructs of the Health Belief Model	Considerations for Food Standards Scotland food safety messaging
Threat perceptions	• Ensure that people believe that they personally are at risk of foodborne illness. • Highlight how severe illness can be, that illness can be prolonged and difficult to treat.
Motivation	• Highlight the impact of foodborne illness among relatable individuals in personal stories to emphasise the severity of foodborne illnesses. • Target clinically vulnerable groups to enable them to self-identify their susceptibility to foodborne illness.
Behavioural evaluation	• To increase an individual's belief about the effectiveness and benefit of specific food safety actions, there is a need to demonstrate how simple food safety steps can reduce risks. • Address the perceived challenges or barriers about concerns such as time, cost or inconvenience of food safety practices.
Cues to action	• Campaign messaging to help turn awareness into action.

In addition to utilising the Health Belief Model, there is a need to incorporate the modifying variables discussed in this report. However, despite initially proposing the five separate modifying variables for the purpose of this research, analysis of the data and reflection of the findings suggest that these are not individual factors, they are in fact three factors, namely health, finance and environment that are often interconnected, individually, or combined, they can influence the perceptions that lead to food safety actions as demonstrated below in Figure 5.

This proposed model needs to be utilised to help inform the development of future Food Standards Scotland food safety information resources.

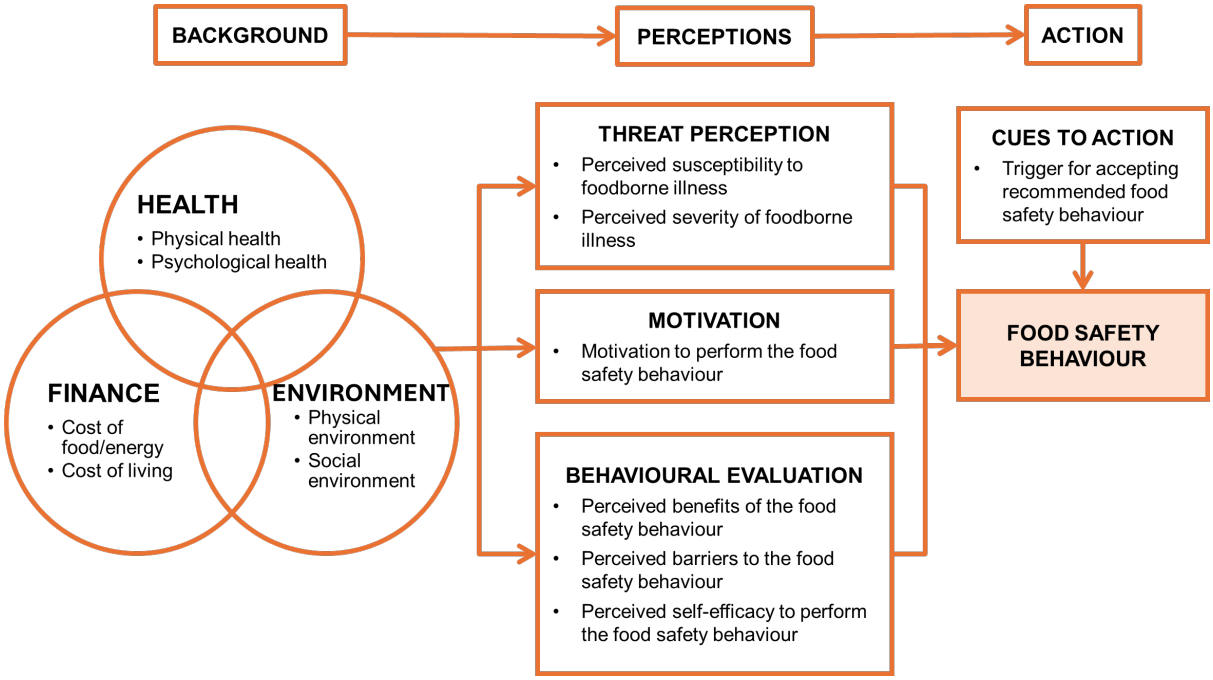

Figure 5. Proposed model to inform the development of future food safety interventions.

8 **Further research:** Distribution of food safety tools to facilitate behaviour change among individuals aged ≥65 years

8.1 Background

During the online and in-person group discussions, many participants discussed the importance of temperature to ensure food safety however suggested potential gaps in practices in ensuring safe refrigerator temperatures and safe cooking temperatures. In one particularly group with children that supported their parents with food related tasks, ideas for the distribution of thermometers were discussed, therefore thoughts of the thermometry study were formed:

"You know, I might be more aware of the risks and yeah, but being older, your immune system is more compromised and be more cautious about things I suppose. And I could persuade my parents to even have a fridge thermometer on the basis of there'll be less food waste. You know, if the fridge was at the right temperature, then they would waste less so. It's about appealing to something that concerns them, not necessarily what you or I might be concerned about. And if I said I'd received a free fridge thermometer through the post, then you know, even if I'd had to go out to Lakeland and buy it. But I told her I got this free thermometer she should use that." (Participant 006).

"I think also making it sound more fun. "Here's another obligation for you" isn't maybe the way forward. But things like the food temperature of things, you know, making it sound more like curiosity "How can you find out if…" and the making them available, the thermometer type thing. You know saying about fridges operating at right temperature and meat being cooked to the right temperature, making it more engaging a curiosity thing. Rather than here's another obligation, "you've got to make sure that your parents don't get food poisoning as well". Something else got to worry about as opposed to, you know." (Participant 005).

"But you know, in the way that if you have a baby, you get a baby box. Maybe it's a case of when you get your pension, you get your healthy ageing box, you know, why is that not prioritised over a baby box? In a way, it's probably more important. I know that a good start in life is really important. But now that people are living longer than an old ageing well box might be a good thing with your fridge thermometer and your food probe or whatever it is and some information." (Participant 006).

"I just wonder whether that could be part of, like, an intervention that you can pick up a free fridge thermometer or something because, you know, the really basic ones are not expensive. And if the Food Standards could somehow, I don't know how they would target it, but maybe lunching clubs, churches, that sort of thing with an iPad with a video of keeping things cool, like an advert. And then they could have a box of just those cheap-as-chips fridge thermometers and say, "you know you've watched this now so here's a fridge thermometer for you to have"." (Participant 21).

Consequently, reinvestment funding was secured from the Cardiff School of Sport and Health Science, Dean of Enterprise and Innovation, to purchase and distribute temperature probes and refrigerator thermometers to participants. To facilitate this additional research, an amendment to the initial ethics application was approved, allowing for the implementation of a follow-up thermometry study.

8.2 Methodology

To conduct the study, an email invitation was sent to all participants (*n*=132) from the initial cohort, inviting them to take part in a home kitchen thermometry assessment. The email included an information sheet detailing the study objectives and procedures (Appendix 14).

Participants interested in receiving a free temperature probe and refrigerator thermometer were asked to provide their postal address through an online sign-up form (Appendix 15).

Upon confirmation, temperature probes and refrigerator thermometers were posted to participants in padded envelopes, accompanied by detailed instructions on their use (Appendix 16) and guidelines on safe cooking and refrigeration practices as recommended by Food Standards Scotland (Appendix 17) (Food Standards Scotland, no date).

A specifically designed data capture platform was developed using Qualtrics, allowing participants to upload images demonstrating their use of the temperature probes and thermometers, as well as to report their food safety practices (Appendix 18). As described by Duong and colleagues, most thermometer usage studies rely upon self-reported data, which can be subject to social desirability biases (the tendency for people to present a favourable image of themselves (van de Mortel, 2008) by giving socially desirable responses instead of choosing responses that are reflective of their true feelings or behaviours (Barros et al., 2003), in a food safety context, this may take the form of over reporting positive practices and underreporting malpractices (Evans & Redmond, 2018b)), whereas by utilising citizen science methods that including the capture of pictures as a verification method the potential biases associated with self-reporting of data by research participants can be overcome (Duong et al., 2019).

The methodology utilised in this follow up study replicates those previously used by the research fellow and colleagues in prior citizen science studies (Evans & Mayho, 2024). Upon completion of data collection, quantitative data were exported to SPSS and Excel for statistical analysis, while qualitative data were analysed using NVivo software.

8.3 Results

8.3.1 Response rate

A total of 69 people signed-up to participate in the thermometry study and received temperature probes and refrigerator thermometers. In the 30 days after receiving the participant packs, 49 people uploaded images of the temperature probes and refrigerator thermometers being using in their homes and provided self-reported data. This giving a response rate of 71%, this is significantly higher than has been achieved in previous citizen science research studies undertaken by the research fellow 12 – 39% (Evans & Mayho, 2024).

8.3.2 Refrigerator thermometer usage

Sixty-one percent reported adjusting the temperature of their fridge since receiving the thermometer as the refrigerator was previously running above 5°C, consequently 79% had refrigerators operating at a safe temperature of 5°C or less, 21% had their refrigerator still running above temperature of 5°C or more, of these 50% were “somewhat concerned and would consider adjusting the temperature” and 50% were “very concerned and would be readjusting the fridge temperature”. Examples of the images uploaded to the platform are shown in Figure 6 below. As a result of taking part in the study 93% reported knowing the recommended operating temperature for the refrigerators and the same proportion believed that having a fridge at the recommended temperature would reduce food waste, while 100% believed it would reduce the risk of food poisoning.

Figure 6. Examples of thermometers in participant refrigerators.

8.3.3 Use of temperature probe when cooking

Examples of the temperature probes being used to determine cooking adequacy are show in Figure 7. It was determined that 92% knew the recommended cooking temperature because of taking part in the study and 97% believed that using the probe would reduce the risk of food poisoning. During the study 32% reported that the food had not reached 75°C when they initially checked, all these participants said they then continued cooking until the temperature was above 75°C. The majority, 95% reported that they will continue to use the probe after participating in the study.

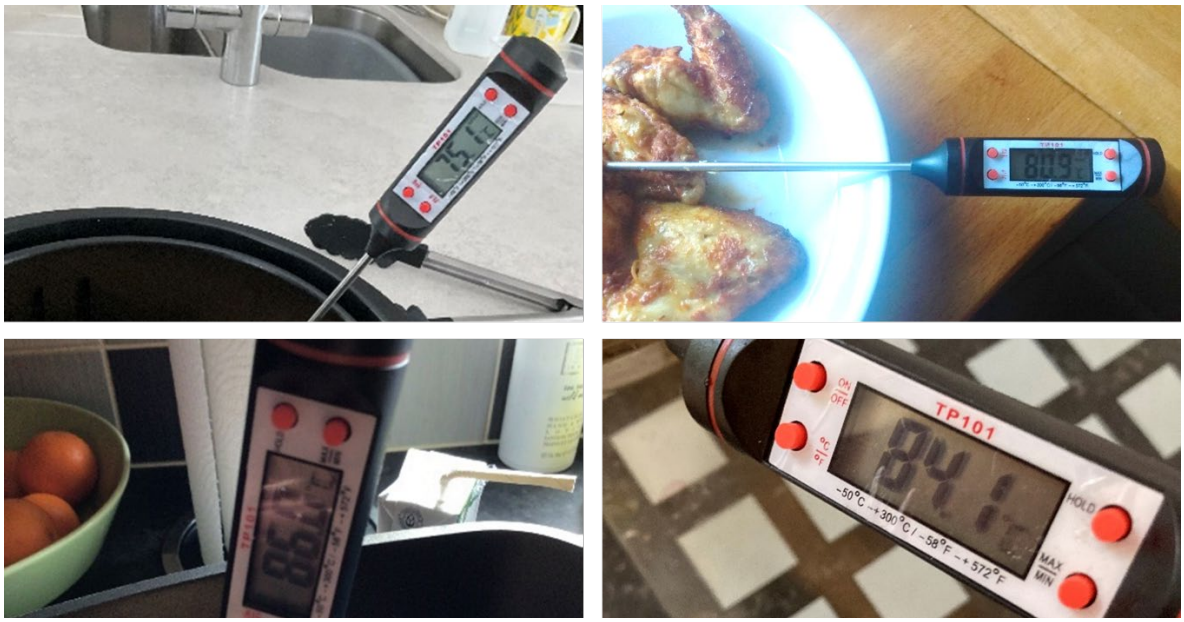

Figure 7. Examples of temperature probes being used by participants.

8.3.4 Motivation for taking part in the thermometry study

Participants were asked to state their motivation for participating in the thermometry study, the statements related to five themes, some of which was related. For example, food safety as a concern was described as motivation for some to participate:

"I want to avoid infections from food. My husband has a compromised immune system, so I need to be extra careful"

"I like to use up leftovers and avoid food waste and wanted to be sure I was doing it safely. Food poisoning is not funny"

Others described seeing the thermometry project as an educational opportunity:

"I am interested in how food affects our well-being and wanted to have more information about how to maintain a healthy lifestyle."

"I'm interested in learning more"

Some described having a general interest in participating in research studies, and would participate in research as and when opportunities allowed:

"I am always interested in studies for future research. It's a learning curve every time."

"Had taken part in previous research so wanted to assist further"

The opportunity to get a free cooking probe and fridge thermometer was perceived as a benefit of taking part in the study and was the motivation for some to participate:

"To be honest it was the 'free' thermometer!"

"Chance to get a fridge thermometer and temp probe. For both it was the advice that came with the items"

Whereas other described their motivation to participate in the thermometry study was because they had been involved with the initial project:

"Follow on from very informative workshop held in Govanhill Glasgow. Wanted to ensure fridge was at correct temp to reduce food waste."

"Having taken part in the discussion group, I was keen to follow up with the temps of fridge and cooking meat"

It was interesting that none of the statements referred to the opportunity to win one of four £25 vouchers as the motivation to participate.

8.4 Conclusions

Completion of this follow-up study demonstrates the receptiveness and willingness of the target audience to engage and embrace essential food safety tools to ensure domestic food safety and reduce the risk of foodborne illness

9 **Further research:** Intervention to support self-identification of susceptibility to foodborne illness

9.1 Background

As a result of this SEFARI Fellowship and the Food Standards Scotland review of clinically vulnerable groups, it is evident that there is a need to enable individuals to identify their susceptibility to foodborne illness and be aware of the food safety practices to reduce their risks. Consequently, it was established that there is a need to co-create food safety information resources with the target audience for Food Standards Scotland.

To facilitate this research, a grant application was submitted in collaboration with Dr Sanja Ilic at the Ohio State University and Food Standards Scotland to the UK Food Safety Research Network, this was awarded and has successfully been undertaken.

9.2 Research approach and outcomes

In Phase 1, we consolidated findings from previous collaborative research regarding who the clinically vulnerable groups are in Scotland, we explored the preferences of individuals aged ≥65 years in Scotland for receiving food safety information as determined in this report and met with Food Standards Scotland to explore their communication requirements. To create the for the resource messaging, we utilised existing food safety messaging from Food Standards Scotland and incorporated the proposed model to inform the development of future food safety interventions (Figure 5).

During Phase 2, we undertook the co-creation of food safety information materials. Collaboration with a graphic designer resulted in the creation of a multi-resource approach including multiple versions of A5 information booklets, A3 posters, a food safety tool pack, refrigerator magnet, information videos, and interactive infographics. Each resource emphasised why individuals could be at risk of foodborne illness, explore susceptibility across a lifespan, gave physiological and pharmacological reasons to increased susceptibility according to certain underlying medications and conditions and advised of necessary food safety practices.

Online focus group discussions with individuals aged ≥65 (*n*=45) were undertaken, their feedback was utilised to refine the materials with the graphic designer to ensure the campaign resonated with the audience's needs and preferences.

In Phase 3, the refined resources have been distributed to individuals aged ≥65 years (*n*=100) to assess the acceptability of the resources through an online evaluation questionnaire. The final resources include:

- A3 sized poster to be displayed in health care settings (Appendix 19).
- A silent slideshow to be show in information screens in healthcare settings (Appendix 20).
- A5 sized twelve-page booklet (Appendix 21).
- In-home reminder fridge magnet Appendix 22
- Food safety tool pack containing temperature probe, fridge thermometer, date labelling stickers and instruction sheet (Appendix 23).

- Interactive infographic for us no Food Standards Scotland website (see here).

We are currently awaiting the completion of this phase.

Finally in phase 4, we will be preparing a comprehensive report, outlining the campaign's impact and scalability. The research team will undertake discussions with key stakeholders to explore funding opportunities to enable implementation at a national level.

9.3 Conclusions

Cumulatively, these activities have contributed to developing an accessible and evidence-based food safety campaign, enhancing awareness and promoting behaviour change among older adults. The groundwork established through this project paves the way for larger-scale interventions, potentially reducing foodborne illness rates across the UK.

The project partners from ZERO2FIVE Food Industry Centre, The Ohio State University and Food Standards Scotland are exploring funding opportunities to further enhance the resources and undertake a pan-Scotland campaign to evaluate the impact and effectiveness of the information resources on food safety cognition and behaviour among the target audience. Examples of the resources can be seen in

10 Dissemination of findings to participants

The European Citizen Science Association ten principles for good practice in citizen science, suggests that citizen scientists should receive feedback from projects they have contributed to (European Citizen Science Association, 2015). Following completion of the project, a one-page information sheet detailing the key findings from the discussion groups and the follow-up project has been prepared and shared with Food Standards Scotland and SEFARI for approval ahead of distribution. The sheet thanks the individuals that participated in the study. Signposting follow up information to key food safety information from Food Standards Scotland was also included. Given some of the points of discussion that arose from the discussion groups, details of organisations that may provide support or information were provided, such as Overeaters Anonymous, Age UK, Diabetes UK, and Citizen Advice Bureau.

11 Limitations and strengths of the research

Focus groups allow for the collation of multiple individual reactions, the conversational nature allows individuals to explain their thoughts and the reasons behind their thoughts and provide in-depth exploration (Okoko et al., 2023). A focus group study with a sample size of 132 people is substantial, however there are some limitations that need to be considered, for example, focus groups do not provide statistically representative data that may not be generalisable to the wider population. Additionally, group discussions can lead to "groupthink", whereby some participants conform to dominant opinions rather than expressing their true beliefs (Okoko et al., 2023). To prevent this, the researcher had experience in moderating focus groups to ensure that some personalities don't take over

12 Impact of the research on participants

It was of interest to the researcher that numerous participants left comments on the original Facebook advert (Appendix 12) or emailed the researcher (Appendix 13) after participating to state that they had enjoyed the discussion or had found it interesting.

Many of the participants in the caregiver groups built a rapport with one another during the discussions. At the end of the group discussions with carers, some utilised the time to share advice with others that were at earlier stages of caring for their relatives, many found this useful and beneficial and thanked the researcher for the opportunity to meet with other caregivers to see that they weren't the only one experiencing these challenges and feelings. Other participants exchanged contact details to enable them to keep in contact.

13 Recommendations

Recommendations for future research and interventions by Food Standards Scotland and other organisations have arisen because of the research undertaken:

- Future food safety communication campaigns should consider the points of discussion in this report.
- Dissemination of food safety tools to the target audience successfully resulted in behaviour change, furthermore, the majority reported that they would continue to utilise these tools, there is a need for future research to establish the longevity of this behaviour change. This will establish if the provision of food safety tools is a sufficient cue-to-action to facilitate food safety behaviour change.
- Given the findings of this SEFARI fellowship have been combined with the data captured in the Food Standards Scotland systematic review of foodborne illness prevalence among clinically vulnerable group to create a data-driven infographic intended to communicate clinically vulnerable groups that are susceptible to foodborne illness, future research needs to be undertaken to assess the acceptability, understandability and potential effectiveness of the infographic on communicating why certain groups of the population are particularly susceptible to foodborne illness.
- The researcher believes there is a need to develop Continuing Professional Development (CPD) opportunities for healthcare professionals such as dietitians to identify individuals that are susceptible to foodborne illness and enable them to educate service users of their susceptibility to foodborne illness and of appropriate food safety practices to reduce risks by applying constructs of the health belief model to facilitate behaviour change.

14 Conclusions

This project has successfully addressed the aims of the fellowship to identify lifestyle factors which cause members of the older population to become ill with foodborne illness and to provide recommendations for Food Standards Scotland to enhance their consumer advice and communications strategies to provide targeted food safety information for clinically vulnerable groups such as older adults.

The findings from this study highlight the complex interplay of health, social and financial factors that shape food-related behaviours among older adults. These insights can be used to inform the development of future Food Standards Scotland food safety messaging aimed at addressing threat perceptions, motivation, and behavioural evaluation. Understanding how environmental factors, such as access to healthy food and safe storage, alongside individual factors like age, cognitive decline, and social isolation, impact food safety practices, enables the creation of more targeted and effective communication strategies.

The project has confirmed the need to inform older adults of which groups are susceptible to foodborne illness, why they are susceptible and how to reduce the risk of foodborne illness through promoting food safety practices.

Future food safety messages should focus on raising awareness of potential risks, particularly around improper food storage, handling, and reheating, by directly addressing perceived threats and highlighting the consequences of unsafe practices. To enhance motivation, messaging should consider the emotional and social influences on food behaviours, such as the role of caregivers, social interactions, and financial constraints. Additionally, by evaluating current food handling behaviours and offering practical, actionable advice, future campaigns can better guide individuals towards safer food practices. By incorporating these findings, food safety messaging can be tailored to the unique needs and circumstances of older adults, ultimately encouraging safer behaviours and reducing foodborne.

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Acknowledgement is given to the UK Food Safety Research Network for funding the co-creation of Food Standards Scotland food safety materials to safeguard clinically vulnerable older adults from foodborne illness and the involvement of Dr Sanja Ilic (Ohio State University) in that work.

All decorative images used in this report are royalty-free and were obtained using the Cardiff Metropolitan University institutional license with Adobe Stock.

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17 Appendices

Appendix 1. Piloting of the proposed model on previously captured data.

1 General Interest Article prepared for Journal of Food Protection

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3 **REVISITING MY PHD RESEARCH A DECADE ON: PROMPTING A CALL FOR NEW**
4 **INQUIRY ON THE MODIFYING FACTORS THAT INFLUENCE OLDER ADULTS' FOOD**
5 **SAFETY PERCEPTIONS AND PRACTICES.**

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SUMMARY

In this general interest article, I reflect on the cognitive, behavioural, and microbiological research I undertook as part of my PhD, although the findings suggest behavioural malpractices are widespread among older adult consumers (which may increase the risks of foodborne listeriosis), the published work does not give insight as to why some of these behaviours exist.

We know that to facilitate behaviour change, we need to utilise a behaviour change model such as the Behaviour Change Wheel or the Health Belief Model to understand the existing behaviours and to develop effective interventions. In recent years, I have spent time contemplating that we may not pay sufficient attention to the modifying factors in the Health Belief Model to enable us to acquire that comprehensive insight of why such perceptions and subsequent practices may exist in the first place so we can appropriately address these in our tailored and targeted interventions.

I first learned of the Dimensions of Wellness, albeit only four of the dimensions in relation to basic health needs, whilst studying health and social care studies at secondary school. As part of this article, I revisit the qualitative data captured as part of my PhD that was not utilised, analysed, or published, and apply the Dimensions of Wellness as the modifying factors in the Health Belief model to explore older adult consumers relationships with food that may impact upon food safety.

OVERVIEW

Why am I interested in older adult consumers?

Senescence, a cellular response that limits the proliferation of aged or damaged cells, is reportedly implicated in causing age-related disease, and contributes to a decline in immune function known as immunosenescence *(24)* which causes a deterioration in the ability of the immune system to respond to infections *(2)*. Consequently, older adults are highly susceptible to foodborne infection due to decreased immune function *(31)*.

Older adult consumers remain an important group for food safety researchers. Globally, the proportion of people aged 60 years and older in the population is expected to increase from 12% to 22% between 2015 and 2050 *(37)*, and in 2020, for the first time in history, people aged 60 years or over outnumbered children under 5 years *(35)*. Here in the UK, the 2021 Census reported that there were over 11 million people in the older age groups, representing 19% of the total population, compared with 16% during the previous census in 2011 *(26)*. This now includes over half a million people who are at least 90 years of age *(26)*.

Due to the shift in incidence of listeriosis from predominantly pregnant women (1980s – 1990s) *(34)* to older adults (2000 onwards) *(1, 5, 27)*, my PhD explored *"older adults' domestic food handling and storage practices associated with the risk of listeriosis" (9)*.

What did I do for my PhD?

I commenced my PhD in 2010 under the direction of Dr Elizabeth Redmond, Professor Adrian Peters, and the late Professor Louise Fielding. As the title of my thesis suggested, I focused on adults over the age of 60, and their domestic food safety practices associated with reducing the risk of listeriosis, namely temperature control (≤5°C), use-by date adherence, and avoiding prolonged storage of opened ready-to-eat (RTE) foods.

As a starting point, I undertook a desk-based review of published consumer food safety research studies (n=165), which identified that the majority of consumer food safety research studies reported

knowledge and self-reported practices, and that data detailing older adult behaviours and attitudes were particularly lacking, especially in relation to the practices associated with preventing listeriosis *(13)*. Consequently, I undertook extensive research with adults over the age of 60 (n=100), including;

- Interviews regarding their attitudes towards domestic food safety risks *(19)*, which established that older adult consumers expressed perceptions of invulnerability, optimistic bias, and the illusion of control regarding food safety.
- Questionnaires concerning food safety knowledge and self-reported practices *(15)*, determined that many were knowledgeable of some key practices, however many older adults self-reported potentially unsafe practices when storing RTE foods at home.
- Food preparation sessions in our research kitchen to observe food safety behaviours *(17)*, identified key behavioural malpractices that increase the risk of foodborne illness.
- Observation of refrigerator storage practices in older adult consumer homes *(14)*, established that the majority of opened RTE foods had been, or were intended to be stored beyond the recommended two-days after opening.
- Microbiological survey of domestic kitchens *(7)*, determined Listeria to be infrequently isolated in domestic-kitchens (2%).
- Time-temperature profiling of domestic refrigerators *(16)* documented that mean temperatures exceeding 5.0°C were recorded in 91% of refrigerators in older adult domestic kitchens.

A cumulative comparison of the results from these studies revealed that while older adults were knowledgeable of some food safety practices, disparities were identified between self-reported and observed behaviours, and many failed to express positive attitudes towards essential food safety practices *(10, 11)*. Although my research established that these malpractices (prolonged storage and at temperatures exceeding the recommended temperature of 5°C) significantly increased the growth rate of *Listeria monocytogenes (18)*, the research does not tell us ***why*** these behaviours may exist among older adults.

As part of my data collection, I had interviewed the older adult participants using an in-person computer-assisted interview technique, which combined verbal questioning and visual aids on a large screen such as five-point Likert-type scales to determine agreement and perceived importance, and a variation of a 10-point visual analogue scale to establish likelihood. During the interviews, quantitative responses to questions were encouraged followed by any qualitative comments when appropriate. As detailed in the publications detailing knowledge, attitudes and self-reported practices *(15)*, and perceptions of risk, control and responsibility *(19)*, the quantitative data were entered into a specifically designed database and exported for statistical analysis. Although the audio files were transcribed, the qualitative data were not analysed or included in the publications. Consequently, I recently immersed myself in the transcripts from the interviews, to see if I could find out more about why some of the behaviours may exist. For this a created a codebook based on the Health Belief Model and the Dimensions of wellness.

What is the Health Belief Model?

The Health Belief Model *(29)* suggests that specific health behaviours are influenced by an individual's perceptions of severity and personal susceptibility, combined with perceived benefits and barriers to that behaviour. For an individual to adopt a specific behaviour, the perceived threat and benefits must outweigh the perceived barriers. Personal factors, such as self-efficacy and cues to action are also frequently included in the model *(6)*. One of the publications from my PhD *(8)* established that older adults expressed perceptions of invulnerability, optimistic bias, and the illusion of control regarding food safety; they perceived themselves to have lower levels of risk than other individuals, and perceived themselves to have greater levels of control and responsibility than others. We believe that such perceptions may undermine attempts to provide education regarding food safety *(8)*.

Although some studies have utilised the Health Belief Model in the food safety context *(3, 20, 21, 23, 30, 36)*, a recent study by Kavanaugh *et al (22)* utilised the Health Belief Model to explore food safety risks among older adults in the US, which determined that utilising the definitions of perceived barriers and cues to action appear applicable to older adults' food handling behaviours and

suggested that the Health Belief Model could be utilised as a framework to develop future interventions for older adults. Nevertheless, they suggested that when the Health Belief Model is used with older adults for food safety research, there is a need to modify the perceived threat construct to not only include the perceived susceptibility and perceived severity, but the *perceived risk* that a food may be contaminated and cause illness *(22)*.

I agree with this and further believe there is a need for us to understand what some of the modifying factors are that can influence people's perceptions and practices relating to food safety. Some previous non-food safety studies, have demonstrated that modifying components of the Health Belief Model, including age, financial security, health literacy, and spirituality can impact upon health behaviours such as attending medical appointments *(4)*. However, I think that understanding of the impact of these modifying factors is something that we can improve in food safety research, for this I propose utilising the Dimensions of Wellness *(12)* to give structure to identify the modifying factors that may influence food safety malpractices among older adults.

What are the Dimensions of Wellness?

People often think about wellness in terms of physical health, such as nutrition, exercise, and weight management, but it is so much more *(32)*. "Wellness" is a holistic integration of eight mutually interdependent dimensions: physical, intellectual, emotional, social, spiritual, vocational, financial, and environmental *(32)*. These dimensions could be used to describe some of our basic needs, and have been used in research with older adults to explore how some of these dimensions may protect cognition in aging *(33)*. Although these dimensions are intended to focus on an individual's wellbeing. I feel that these dimensions can be utilised to give us a defined structure to the modifying factors within the Health Belief Model to enable us to explore why certain food safety practices or malpractices are part of people's lives.

What did this new exploration discover?

To enable me to consider the factors that can influence older adult consumer food safety practices, I coded the interview transcripts according to the eight Dimensions of Wellness: physical,

intellectual, emotional, social, spiritual, vocational, financial, and environmental using NVivo, this exercise has provided some interesting and informative findings.

Physical factors: It is well documented that physical changes in older age can result in the immune system deteriorating *(24)* this makes older adults highly susceptible to foodborne infection due to decreased immune function *(31)*. However, other physical changes may also change people's relationship with food which may have subsequent impact on food safety practices. During the interviews, many of the participants described how physical factors were having an impact upon their relationship with food, for example, participant 66 and participant 84 described an increased concern for health due to increasing age, *"so, what or who influences the food that we buy? I would say medical conditions"* (P066), *"now I'm older, so I'm more health conscious."* (P084), this often resulted in dietary changes, for instance participant 77 described that her and her husband had *"health concerns now, high cholesterol for both of us, high blood pressure and diabetes for husband."*. Participants 10 and 70 both described how their diets had also changed *"years ago we often had hard cheese, fresh cream, cakes, and biscuits. Now we have those as occasional treats and try to eat healthily and watch our weight"* (P070) *"I want less convenience foods because I now have the time to think more about my diet and healthy eating in general"* (P010).

Furthermore, in relation to age related physical changes – eyesight deterioration was widely discussed by participants, in particular this was often discussed in relation to date labelling on food products, some were light-hearted regarding this, for example participant 15 humorously described *"use by dates are usually too small for me to read too, with increasing age, letters are getting smaller, or my eyes are getting worse!"*, participant 26 indicated that such issues were overcome by using glasses *"date labels on food are too small to read with my naked eye, but with my spectacles I'm alright"*. However, the impact of not being able to see date labelling, storage and cooking instructions meant that some consumers, such as participant 38, reported not paying sufficient attention to this information, *"I can't be bothered looking for my glasses to have a look at labels when I'm making food. You know when you're in the kitchen and your glasses get all steamed up, and the information is too small on the packaging, and half the time you can't read it anyway, so I just don't bother looking*

188 *at it."* Similarly, participant 27 described following their own intuition *"the dates are so small. I need*
189 *a magnifying glass! I go by the light; I can't read it. Sometimes I can't read it at all, because it's so so*
190 *small… So, I just do what I want. I do my thing then because I can't see it."*

191 The predominant physical factors in this exploration that had potential impact upon food
192 related behaviours and food safety practices of older adult consumers related to medical conditions
193 requiring dietary modification and eyesight. There may also be other sensory changes associated with
194 age that have impact upon a person's relationship with food such as sense of smell and taste. It must
195 be acknowledged that because the older adults that participated in the multi-phased study were
196 responsible for their own food shopping and cooking, and were physically capable of attending
197 university, it is likely that other physical conditions can impair upon an individual's physical ability to
198 go shop, prepare, and cook food, the potential impact of such physical factors warrant future
199 exploration.

200 **Social factors.** Many participants indicated that a change in their family and household
201 structure or living arrangements had resulted in a change in food shopping habits as described by
202 participant 35, this often occurred as a result of children leaving home, *"I had a family to feed. I*
203 *shopped weekly in a supermarket, almost always cooked from fresh, rarely used convenience foods. I*
204 *had to look for bargains as money was tight, and planned meals for the week"*. Participant six also
205 described how she had *"once shopped for children and husband. Now alone"*, and participant 94
206 explained that *"my family have grown and left home, there was more processed food when they were*
207 *young e.g., fish fingers, pizza etc. and I made more roast dinners"*. This often resulted in a change in
208 approach to shopping and food preparation. Participant 27 discussed that she found cooking for fewer
209 people difficult, and continued to prepare the same quantities, therefore her and her husband consume
210 the leftover food over a longer period of time *"there was seven of us. So, I was cooking a lot more*
211 *food, obviously I don't have to do so much now. So consequently, I will cook a Sunday roast and my*
212 *husband will make it into things on Monday, Tuesday, Wednesday. Some things like that I found quite*
213 *difficult to adapt, I suppose initially it was 'how many potatoes do I need?', 'how many carrots do I*

need to prepare' that sort of thing. So instead, the roast is more or less the same size, just goes on for longer".

Participant 89 who became divorced after the age of sixty described how she now had a busy social life which resulted in a change in her relationship with food at home; *"I lead a very active busy life. And there are days when I won't find time to prepare a meal because I'd rather be doing something else. So, I'll buy a cooked chilled meal and have that, but I'll always supplement it with fresh vegetables"*. Conversely, widowers, particularly men, described how their relationship with food changes after the loss of their wives; participant 13 shared that he *"use to share mealtimes with my wife when she was alive. After her death I eat out and have takeaways etcetera. I cooked for others when there were others to cook for. Now I'm alone, I don't cook as much"*, and participant 25 described how he *"did not shop years ago, my wife did"*. Most described a loss of interest and enjoyment in cooking when eating alone after the loss of a spouse. Whereas participant 90 described that she continued to cook for two, *"Since my husband's died, I've prepared for two, so then I can put it in the fridge. It's just that you get forgetful how many you're preparing for"*.

It was evident that household size, and changes to household structure had an impact upon the way people approached food preparation and cooking, and in particular stored foods for prolonged periods of time. As previously noted, the older adults that participated in the research were living independently and self-reliant, however it is likely that there will be many older adults that are also living at home but are solely reliant on family caregivers for food provision, likewise, this requires further research.

Spiritual factors. Participant 45 was Jewish and described how her belief influences her relationship with food, *"certainly religion is a big factor in what I eat. I buy only kosher foods for the house. The food I enjoy to prepare, food that's easy for me, that's quick"* she described in detail the efforts she went to *"to keep Kosher"* due to not having easy access to kosher food in the region in which she lived *"if I go to London I buy kosher meat or anything, to bring it back I'll use a coolbag."* She went on to describe that some food safety malpractices that are observed among some older adults such as washing raw poultry, where not followed *"I don't wash the meat or anything because*

the kosher butcher does everything." Participant 19 also discussed how her belief influences her food choices, and that she would visit the fishmonger every week *"I buy the fish fresh every Friday because I'm catholic"*. Previous research has described differences in food safety malpractices according to different ethnic groups, further exploration is required to explore if similar trends exist according to different religious beliefs.

Environmental factors. It would be anticipated that some people may modify their diet due to environmental concerns, however, at the time of data collection, this was not the case among those interviewed. The discussions that related to environmental factors that influences food related behaviours were regarding the environments in which they lived having an impact on the provision of food. For example, some such as participant 19 described that when they were younger, they would visit multiple shops to purchase all of their groceries *"years ago you'd go to the local butcher, bakery, and greengrocer. I'd go most days. They've all closed. I now go to that large supermarket once a week"*, others described having embraced technology to purchase foods, as participant 38 stated *"nowadays, we can simply order our groceries online, and they are delivered to the door."* While other, such as participants 59 and 60, described the convenience of local shops previously delivering food: *"when I was younger and with 4 children to rear, I shopped at a local BOB shop that delivered everything. Also, a local butcher would deliver my meat. It seemed much easier then!"* (P059), *"now I have to visit the shop. Previously someone would call and take the order and then deliver, always then paid in cash. Now use car and card"* (P060).

Many, including participant 38 described how technological advancements had also changed the environment at home and this had a significant impact upon their food related behaviours; *"I remember when we didn't have a fridge, we just had a pantry, everyone had a pantry in them days"* and many, such as participant 49 recalled a time that they didn't have a refrigerator, *"we didn't have a fridge, we had a pantry. So things were always used that day. Everything was fresh, you know, and we didn't have a lot of packaging stuff, because if you went to the butcher it was wrapped up in grease proof"*. Participant 90 described many of the environmental changes that had impacted on their food related behaviours *"so we used to have a local shop where you would buy things every day and we*

used to have a pantry with a cold shelf, cold slab. No fridges! We did have a meat safe, to stop the flies getting in. Whereas now we've been we can store them. I didn't have a fridge before I was married, we didn't have a fridge until about 1960 I suppose, didn't feel it was necessary because we had a pantry, and we should do the shopping locally. Other people had mentioned 'oh you ought to have a fridge', I got one to benefit me."

In addition to not owning a refrigerator, many recalled not having a freezer. Participant 92 described how freezer ownership came after refrigerator ownership, *"we certainly didn't have a freezer when I was married and that was until 1974, I didn't have a freezer until about the 1980s"*. Having the ability to store foods for prolonged periods of time was a comfort for some, participant 90 described that *"people said 'you ought to get a big chest freezer', well I'd fall into a chest freezer, but I realised my freezer wasn't big enough, so I bought another one. So, I've got two, one in the garage, one in the kitchen, they are full up. If there is a siege, I'm alright!"*.

The factors that were categorised as environment related to the environment in which the older adults were living in and included technological advancements. Given the time that has passed since the interviews were undertaken, it may be that people's perceptions and practices have changed in attempts to protect the environment, for example following plant-based dates or going to lengths such as not adhering to date labelling on food to reduce the impact of food waste on the climate. The surrounding environment is likely to differ according to where people live, given the research was undertaken in Cardiff, most participants lived in urban areas with easy access to supermarkets, local shops and markets, however access and availability to food may differ for older adults that live in rural locations or have limited access to transportation, these specific factors relating to the physical environment require further exploration.

Occupational factors. Although the sample were people over the age of 60, and classed as older adults, many still worked, participant 45 described how work often didn't give sufficient time to prepare and enjoy food. *"I'm living on my own and I do work full time, so I do take into consideration that I have less time because when I could have been at work all day I don't necessarily want to stand in the kitchen all night, and I do like to entertain quite a bit, but I fit that in when I'm not at work on*

the weekends". Participant 89, who had retired, reflected on the time that they did work, stating *"things are quite different when you work. There were days when I wouldn't find time to prepare a meal"*.

Post-retirement discussions indicated a change in behaviour; participant 91 eluded to their initial concerns regarding budgetary changes post-retirement *"we've just retired. So we thought that budget, that's going to become an issue. But actually, we find we eat far less. We eat better and we eat less. So we actually spend less. So cost obviously is a factor. But it's quite possible to eat well, without having to spend a lot of money. I suppose if I were buying a joint of meat, I would buy the best that I could afford to. And I want my food to be processed as little as possible. And then it's naturally as possible"*. What we must consider is that everyone is different, some people were eating more after retirement because of boredom and availability, whereas others ate less because they were busy with new hobbies. Although occupational factors has an impact on the affordability of food, it also has an impact upon the time an individual can spend shopping and cooking. Given that work has an impact on an individual's available time and finance to purchase and prepare food, future exploration may be best separating to those specific financial and time factors, rather than having occupation as an additional factor.

Psychological factors: Some psychological factors were identified that related to food safety, for example, participant 65 described having obsessive compulsive disorder and was frequently washing hands and being mindful of pathogens; *"I have OCD, I think kind of just aware that there are probably germs on the on the hand towel, there probably isn't, but I'm quite obsessive I'm obsessively clean about my hands, I'm a paragon of virtue"*. Whereas others, such as participant 41, described forgetting to do key tasks such as covering food, putting food in the refrigerator, or remembering how long foods had been stored for; *"It's very easy to do the wrong thing. I mean, it's very easy to forget to do things. I'm sure I do"*. Participant 37 went on to describe *"because I'm retired, I seem to lose track of the days, and I forget how long things have been in the fridge for"*. Future research also needs to consider how factors such as mood and stress impact upon food decisions which may have impact on

food safety practices, increasing age it associated with cognitive decline *(25)*, therefore there is a need to consider the impact of this upon people's shopping, storage and preparation of food in the home.

Intellectual factors. Learning about changing risks and making the decision whether to engage with food safety advice or not was another theme that arose and related to the intellectual dimension. For example, many including participant 89 indicated how people were now more aware and possibly more interested in food safety; *"as news items come up, I suppose over the years I've taken more notice of food hygiene. I think because hygiene has become more important than it was say 40 years ago when I first started cooking, I've learnt and changed."* Multiple participants also discussed how they disliked packing 'telling them when to consume foods', because they could establish that themselves, based on their own judgement and experience; participant 89 went on to describe *"I think it's quite funny that we're a bit more cautious and conservative nowadays. I think it's all a bit too much. But I think there are times when it's probably necessary, but I can make a choice as to whether I want to adhere to the advice or not. I think the biggest issue I've got is this best before dates, which to me are totally irrelevant if I've got dried pasta or rice in my cupboard and it's three months out of date I don't see any harm in eating it and I will eat it, okay the nutritional value may have decreased somewhat but I don't feel there's any sort of food safety risk with eating foods beyond the best before."* Participant 70 described being disillusioned with date labelling on food products *"I do tend to use my own brain before we had anything on packaging, we didn't die. You know what I mean? So I just make my own decisions, but I don't keep things hanging around. I always shop for a week you know, and that gets used and I don't waste anything ever. So it's all fresh."*

When approaching the development of interventions, there is a need to consider the intellectual abilities of the target audience, which will impact upon factors such as their interest in the topic, their engagement with the message and their willingness to change behaviour. Given the importance of intelligence in psychology, future exploration may warrant grouping intellectual factors with psychological factors.

Financial factors. Some of the previous factors alluded to finance, for example, a change in income as a result of retirement reportedly had also changed participants shopping habits; some

reported an increased budget, whilst others reported a reduction in budget available to spend on food. For example, those such as participant 87 with more money post-retirement were buying what they wanted and not using it promptly, stating; *"now I am able to afford what I want to buy."* Participant 37 also indicated having more money *"I've got more money now and obviously don't have to shop for my children, so I can more or less please myself what I buy."* as did participant 14 due to feeding fewer people *"I now shop generally for two whereas years ago it was for six. Money constraints were more of an influence on purchases then."* Whereas those with less income such as participant 31, was recently retired, was purchasing large quantities of foods at the expiry date because of the reduced cost and making such food last as long as possible *"I am living on a fix income which requires that the price I pay for food is very important."*

It is evident that the cost and affordability of food has a significant impact upon food related behaviours, we known that practices taken by food insecure populations can have significant upon on food safety, furthermore, since completing the research, the UK has experienced a cost-of-living crisis, therefore it would be anticipated that financial factors such as the cost of food and the cost of energy to run appliances in the home may further impact upon practices, for example, people may use different cooking methods such as microwaving or air-frying to avoid having the oven on for long durations, however unfamiliarity with different cooking techniques may result in unsafe cooking, similarly some people may choose to run their refrigerators at a warmer temperature to avoid wasting energy. Given the potential impact of the cost-of-living crisis in the UK, financial factors should be incorporated into future research.

CONCLUSIONS

This reflection has utilised the Dimensions of Wellness to explore why certain food-related behaviours may exist among older adults. The analysis has given an interesting insight to how the way in which people purchase, store, and cook food has changed over the years, and what some of the influencing factors are, and how these may impact upon food safety. Some of the prominent findings related to how financial changes and changes in living situations resulted in food related behaviour changes which may result in food being subjected to prolonged storage.

When considering the risk of foodborne illness to specific vulnerable population, we consider the food safety cognition, behaviour, and susceptibility of the target audience. However, it is also important to consider the modifying factors that impact these cognitions and behaviours. Future consumer food safety research needs to do much more than just establish the knowledge, attitudes, self-reported practices and observing behaviours of a target population. It is important to understand the factors that influence our relationships with food and ultimately food safety practices. Having utilised the Dimensions of Wellness on a dataset that was previously captured (not using the Dimensions of Wellness), meaningful insight has been obtained, however, most importantly recommendations for future exploration can also be made to simplify or clarify the groupings of factors that influence food related behaviours and food safety practices, for example renaming the physical factors discussed in this study as the biological factors, which would allow factors such as access to personal or public transportation and proximity to shops, time restraints and cooking skills and abilities to be classed as physical environment determinants.

There may be a need to group the intellectual psychological dimensions together for future research looking at the factors that influence older adult food related behaviours and food safety risks. Financial factors are easily identified and grouped, however, given that the occupational factors impact upon time and finance, I believe it is best to avoid having a separate occupational category. Perhaps elements of the spiritual dimension could be grouped with the social environment. Therefore, a suggested approach for future classification of factors that influence food safety behaviour includes the five determinants of food safety risks, behaviours, and vulnerabilities: Biological determinants,

395 Physical determinants (e.g., the physical environment), Psychological determinants, Economical

396 determinants, and Social determinants (e.g., the social environment).

397 *Table 1 Determinants of food safety risks, behaviours and vulnerabilities.*

Determinant	Examples and areas that require exploration
Biological determinants	• Any disabilities or physical conditions such as arthritis or have had a stroke that impacts upon a person's physical ability to shop, prepare, cook, or eat food. • A medical condition, autoimmune disease or taking medication that suppresses immune function and increases susceptibility to foodborne illness. • Other abilities that may change with age that impacts upon the relationship with food such as eyesight, using glasses, sense of smell, taste, hearing, appetite, or hunger, influence the way a person shops, stores, cooks, and eats.
Physical determinants (e.g., the physical environment)	• The influence of time on shopping and cooking. • Location of where someone lives, distance to the shops, access to private or public transport • Cookery knowledge, skills and abilities • Access to equipment and appliances • Power outages
Psychological determinants	• Problems with memory • Lost interest or patience with cooking • Modified diet due to climate concerns e.g. following a plant based diet. • The impact of mood, stress or guilt on food decisions.
Economical determinants	• The impact of the cost of food on purchase decisions and storage durations. • Food choices determined by availability or short-date food or food-bank availability. • Concerns regarding the cost of energy impacting refrigerator temperature and cooking methods.
Social determinants (e.g., the social environment)	• Cultural, religious, or family food practices or habits that influence the food that is purchased, method of storage and cookery.

398

399 We must consider that this study doesn't give the full picture of older adults as participation in the

400 study included numerous phases of data collection which required participants to visit the university

401 and take part in a food preparation session, suggesting that all were able to leave their homes.
402 However, a study of food insecurity amongst older people in the UK reported that within the older
403 adult age group there are older people in very different circumstances for example 20% of people
404 aged 75 years and older need support to leave their home *(28)* this can have a dramatic impact on a
405 person's ability to buy and transport food home which needs further exploration in a food safety
406 context. Although the eight dimensions of wellbeing will give food safety researchers useful insight,
407 as an outcome of revisiting this dataset and applying the dimensions, I believe that utilising the five
408 determinants of food safety risks, behaviours and vulnerabilities as outlined in table 1, would give a
409 holistic understand of the factors that influence potential food safety malpractices and ensure that food
410 safety interventions are targeted, appropriate and sensitive.
411

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Appendix 2 Recruitment advert on Food Standards Scotland Facebook page

Appendix 3. Example of A4 community recruitment poster with pull-off tabs

PEOPLE NEEDED FOR RESEARCH:

WHAT INFLUENCES THE WAY PEOPLE OVER THE AGE OF 65 SHOP, COOK AND EAT?

Who can take part?

- Individuals aged 65 and above regardless of their level of involvement in food shopping and cooking.
- Individuals aged 18 and above who provide support to relatives or neighbours (aged over 65) with their food shopping and cooking.

What does the study involve?

- Attending a 2-hour group discussion to share your experiences at the **Spectrum Centre, Inverness** on **Friday, 31st May 2024**.

What is the benefit of taking part?

- You will be contributing to an important piece of research for Food Standards Scotland.
- You will receive a £25 supermarket voucher or charity donation of your choice for taking part.

How to take part or find out more information?

- Please contact: Dr Ellen Evans at elevans@cardiffmet.ac.uk on 07867176544, or sign-up online at https://tinyurl.com/Over65Food

Food Standards Scotland

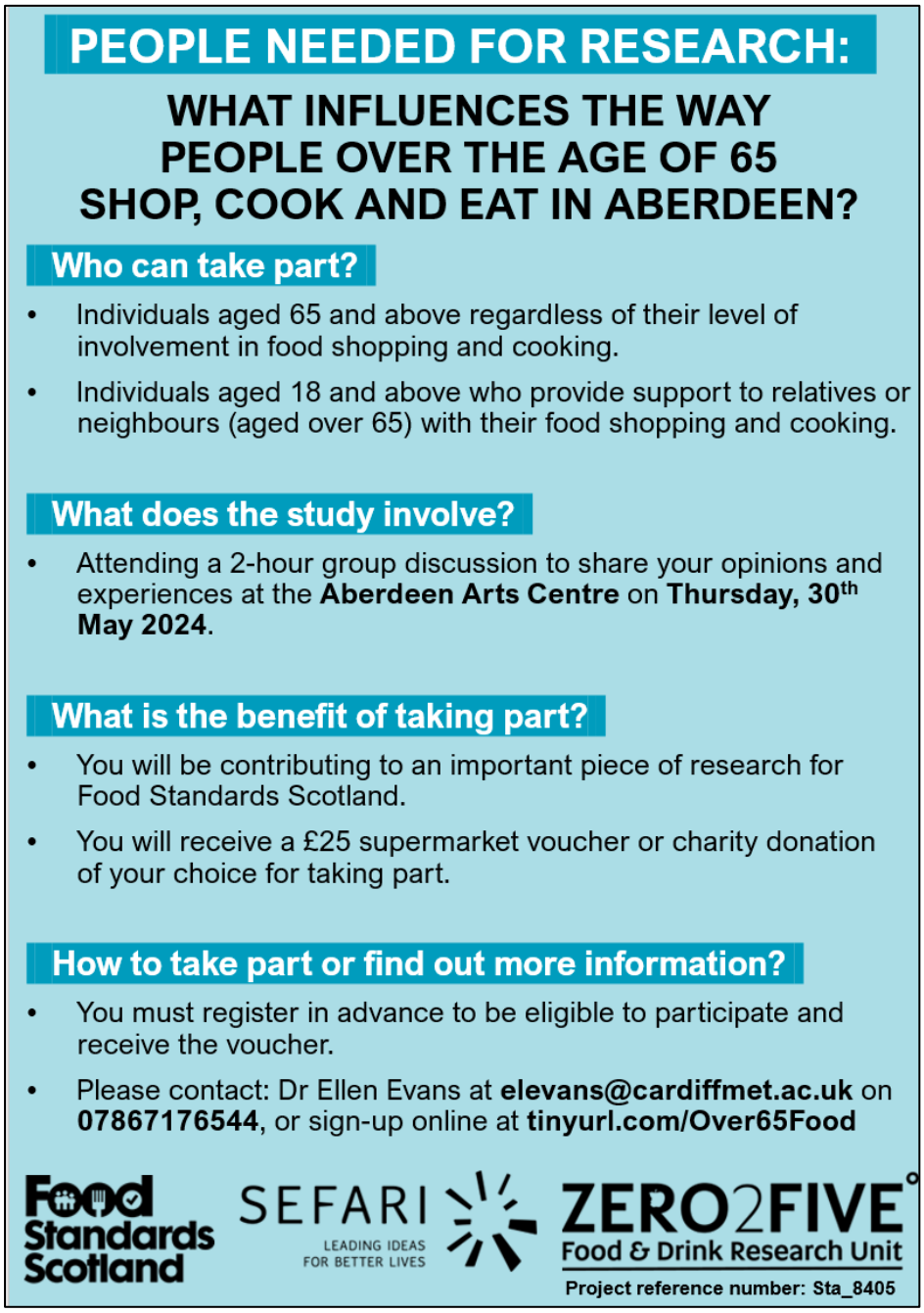
SEFARI LEADING IDEAS FOR BETTER LIVES

ZERO2FIVE° Food & Drink Research Unit

Project reference number: Sta_8405

Food influences of people over 65 in Scotland research:
elevans@cardiffmet.ac.uk
07867176544
tinyurl.com/Over65Food

Appendix 4. Example of A5 recruitment leaflet



PEOPLE NEEDED FOR RESEARCH:

WHAT INFLUENCES THE WAY PEOPLE OVER THE AGE OF 65 SHOP, COOK AND EAT IN ABERDEEN?

Who can take part?

- Individuals aged 65 and above regardless of their level of involvement in food shopping and cooking.
- Individuals aged 18 and above who provide support to relatives or neighbours (aged over 65) with their food shopping and cooking.

What does the study involve?

- Attending a 2-hour group discussion to share your opinions and experiences at the **Aberdeen Arts Centre** on **Thursday, 30th May 2024**.

What is the benefit of taking part?

- You will be contributing to an important piece of research for Food Standards Scotland.
- You will receive a £25 supermarket voucher or charity donation of your choice for taking part.

How to take part or find out more information?

- You must register in advance to be eligible to participate and receive the voucher.
- Please contact: Dr Ellen Evans at **elevans@cardiffmet.ac.uk** on **07867176544**, or sign-up online at **tinyurl.com/Over65Food**

Food Standards Scotland

SEFARI LEADING IDEAS FOR BETTER LIVES

ZERO2FIVE Food & Drink Research Unit

Project reference number: Sta_8405

Appendix 5. Invitation letter sent to Aberdeen City voice panel members

Subject: Invitation to participate in research to understand the impact of lifestyle on food choices among people over 65 in Scotland.

Dear Aberdeen City Voice Panel member,

I hope this letter finds you well. My name is Ellen Evans, I am a researcher specialising in food behaviour at the ZERO2FIVE Food and Drink Research Unit. As a valued member of the Aberdeen City Voice Panel with an expressed interest in research participation, I am reaching out to extend an invitation to an exciting research project.

Our study aims to delve into the experiences and habits of individuals aged 65 and above in Scotland concerning their food choices and how these may evolve with time. We are interested in exploring factors that influence these choices positively or negatively, including health conditions such as diabetes or visual impairments, changes in living arrangements such as living with adult children, or navigating life after the loss of a partner/spouse. Additionally, we will delve into practical and financial aspects of food shopping.

We are looking for individuals aged 65 and above, regardless of their level of involvement in food shopping and cooking, as well as individuals who provide support to people aged 65 and above with their food shopping and cooking. A participant information sheet detailing what is involved is included for your information.

Your unique perspective and insights are invaluable to the success of this study. Therefore, we cordially invite you to participate in a two-hour group discussion scheduled to take place at the Aberdeen Arts Centre, 33 King Street, Aberdeen, AB24 5AA, on Thursday, 30th May 2024, with sessions at 10:00 am or 1:00 pm.

We understand that your time is precious, and as a token of appreciation for your participation, you will receive either a £25 supermarket voucher or a charitable donation of your choice.

Should you be interested in joining us, please contact me using the information provided below to reserve a space. Your prompt response would greatly assist us in organising and planning for this research. Should you have any inquiries or require further information, please do not hesitate to get in touch.

Thank you for considering this invitation. We truly value your potential contribution and eagerly anticipate your involvement in advancing our research efforts.

Warm regards,

EW Evans

Dr Ellen Evans – Senior Researcher – ZERO2FIVE Food and Drink Research Unit
Telephone: 07867176544
Email: elevans@cardiffmet.ac.uk
Online sign-up: https://tinyurl.com/Over65Food

Appendix 6. Participant information sheet

PARTICIPANT INFORMATION SHEET

Understanding the Impact of Lifestyle on Food Choices Among People Over 65 in Scotland.

This research is being undertaken by Dr Ellen Evans, Reader in Food Behaviour at ZERO2FIVE Food & Drink Research Unit. Funded by the Scottish Environment, Food, and Agriculture Research Institutions (SEFARI) in collaboration with Food Standards Scotland.

Introduction:

You are invited to participate in our research study, which seeks to explore the factors that influence the food choices of people over 65 in Scotland. Before deciding, we want to ensure that you have a clear understanding of the study's purpose, what your participation will involve, and the safeguards in place to protect your privacy.

Purpose of the study:

Our research aims to gain insights into the experiences, perceptions, and practices of adults aged 65 and above in Scotland regarding their food habits and how these may evolve over time. We want to understand the factors that positively or negatively impact your relationship with food. This includes the influence of health conditions, such as diabetes or visual impairments, as well as changes in living situations, like living with adult children or coping with the loss of a partner/spouse. We will also discuss practical and financial aspects of food shopping. Your unique experiences are valuable to us.

Who can participate?

We are seeking two groups of participants:

1. **People aged 65 and above:** Individuals aged 65 and above living in Scotland, regardless of your level of involvement in food shopping and cooking.
2. **Supporting Individuals:** Those who provide support to people aged 65 and above in Scotland with their food shopping and cooking.

Study involvement:

We are seeking people to participate in one of the three ways, which include:

- **Online discussion groups:** Approximately 1.5-hour to 2-hour sessions.
- **In-person discussion groups:** Approximately 2-hour sessions face-to-face discussion sessions taking place:
  - Tuesday 28th May. Stranraer Millennium Centre, 75 George Street, Stranraer, Dumfries and Galloway, DG9 7JP.
  - Wednesday 29th May. Govanhill Neighbourhood Centre, 6 Daisy St, Govanhill, Glasgow G42 8JL.
  - Wednesday 29th May. Netherton Community Centre, 358 Netherton Road, Glasgow G13 1AX.
  - Thursday 30th May. Aberdeen Arts Centre, 33 King Street, Aberdeen, AB24 5AA.
  - Friday 31st May. Spectrum Centre, 1 Margaret Street, Inverness, IV1 1LS.
- **Telephone discussion:** If you would prefer not to participate in an online or in-person groups discussion, please contact the researcher to schedule a one-to-one telephone discussion Approximately 45 minutes.

While we have prepared questions to guide our discussions, our primary goal is to have open and honest conversations about your experiences with shopping, cooking, and eating.

Participant information sheet (page 2)

SEFARI Food Standards Scotland For safe food and healthy eating ZERO2FIVE Food & Drink Research Unit

PARTICIPANT INFORMATION SHEET

Understanding the Impact of Lifestyle on Food Choices Among People Over 65 in Scotland

Participant benefits:

As a token of our gratitude for your participation in an interview or group discussion, you will receive a £25 voucher that can be used at various shops or a charitable donation to a cause of your choice.

Data privacy and protection:

Participation in this study is entirely voluntary. We will request you to complete a Participant Consent Form before your involvement. All information collected during this study will be kept confidential, and any data reported will be anonymized. You will be assigned a unique participant ID number, ensuring that your name and personal information remain confidential. After the study's completion, all participant information will be securely disposed of. A copy of the research findings will be available upon request.

Withdrawal from the study:

If you participate in interviews, you can stop at any time. After the interview, you will receive a transcript for review. You can withdraw your data from the study within seven days of receiving the transcript, but please note that this will result in the forfeiture of the reward. For group discussions, withdrawal may not be possible once the discussion has started due to the group setting.

Risks and ethical approval:

A thorough risk assessment has been conducted, and the study has been reviewed and approved by the Research and Ethics Committee at Cardiff Metropolitan University (Reference number Sta-8405). The project has also been reviewed and received Scottish Government social research approval. We do not anticipate any physical risks. However, some topics may be emotionally sensitive for certain participants, so please consider your comfort level before participating.

Use of research results:

The findings of this research will be utilized by Food Standards Scotland to develop strategies for disseminating food safety information to relevant groups in Scotland. Additionally, the results will contribute to the development of journal articles, conference presentations, and future research initiatives.

How to participate or obtain more information:

If you would like to participate or have any questions about the study, please contact the principal investigator, Dr Ellen Evans, at elevans@cardiffmet.ac.uk or call 07867176544. Your participation will help us gain valuable insights into the food choices and habits of people over 65 in Scotland. To select a time that is convenient for you to take part in the study, please visit: https://tinyurl.com/Over65Food

Appendix 7. Online sign-up page

Understanding the Factors that Influence Food Choices Among People Aged 65 and Over in Scotland.

Introduction: You are invited to participate in our research study, which seeks to explore the factors that influence the food choices of people aged over 65 in Scotland. Before deciding to take part, we want to ensure that you have a clear understanding of the study's purpose. Please read the participant information sheet. If you have any questions please contact the researcher.

Purpose of the study: Our research aims to gain insights into the experiences, perceptions, and practices of adults aged 65 and above in Scotland regarding their food habits and how these may evolve over time. We want to understand the factors that positively or negatively impact your relationship with food. This includes the influence of health conditions, such as diabetes or visual impairments, as well as changes in living situations, like living with adult children or coping with the loss of a partner/spouse. We will also discuss practical and financial aspects of food shopping. While we have prepared questions to guide our discussions, our primary goal is to have open and honest conversations about your experiences with shopping, cooking, and eating. Your unique experiences are valuable to us.

Who can take part: We are seeking two groups of participants:

- **People aged 65 and above:** Individuals aged 65 and above living in Scotland, regardless of your level of involvement in food shopping and cooking.
- **Supporting Individuals:** Individuals aged 18 and above who provide support to people aged 65 and above in Scotland with their food shopping and cooking.

PLEASE NOTE - YOU MUST LIVE IN SCOTLAND TO BE ELIGIBLE TO TAKE PART IN THIS STUDY.

Study involvement: Attend one in-person discussion group (around 2-hours in duration).

Benefits of taking part: As a token of our gratitude for your participation in the group discussion, you will receive a £25 voucher that can be used at various shops or a charitable donation to a cause of your choice.

Researcher contact details: Dr Ellen Evans, at elevans@cardiffmet.ac.uk or call 02920205836 or 07867176544.

Which of these describes you?

- ☐ People over the age of 65 in Scotland
- ☐ People who support a person over 65 with their food shopping and cooking

Next →

Appendix 8. Online participant consent form

Thank you for agreeing to participate in one of the discussion groups. Please complete each section below to confirm that you consent to participate in the study.

- ☐ I confirm that I live in Scotland.
- ☐ I confirm that I have read and understood the information sheet for this study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
- ☐ I understand that my participation is voluntary and that I am free to stop participation at any time during data collection without giving any reason.
- ☐ I understand that due to the nature of a group discussion, withdrawal of individual data may not be possible once the audio recording of the discussion has started as it will not be possible for the researcher to distinguish your voice from others on the audio recording or to identify you in the anonymised transcript. I note the indicative timescale for the data collection phase of this project is February - March 2024.
- ☐ Following the data collection phase of this project, I understand that all data will be anonymised, and data analysis will commence, once data analysis commences it will not be possible to withdraw my data. I further understand that after the end of the data analysis phase it will be necessary for the university to retain non-personal data for verification purposes until the research has been published. I note the indicative timescale for the data analysis phase of this project will commence March 2024.
- ☐ I understand that GDPR states that research studies are exempt from the right to be forgotten where this is "likely to render impossible or seriously impair the achievement of the objectives" and that any request I make to invoke my right to be forgotten will be considered by the University with this in mind. The University will endeavour to take every possible measure to comply with the request without impairing the research.
- ☐ I agree to take part in the above study.
- ☐ I agree to complete a short questionnaire.
- ☐ I agree to the group discussion being audio recorded.
- ☐ I agree to the use of anonymised quotes in publications.

For us to organise the discussion group, please provide the following information:

Name

Email address

Telephone number

Postcode

Each person that has participates in the discussion groups will be sent a £25 e-gift card or a donation made to the charity of your choice. Please indicate your preference below:

- ○ Amazon e-voucher
- ○ One4all gift card
- ○ Tesco voucher
- ○ Asda voucher
- ○ Morrisons voucher
- ○ Charity donation (please provide the name of the charity)

After taking part in the study, do you wish to receive any of the following?

- ☐ A summary of the research findings
- ☐ Information about future research studies

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Appendix 9. Online discussion group slides

Appendix 10. Online discussion group script

SEFARI Food Standards Scotland ZERO2FIVE Food & Drink Research Unit Uned Ymchwil Bwyd a Diod

ONLINE DISCUSSION GROUP SCHEDULE

Understanding the Impact of Lifestyle on Food Choices in Older Adults in Scotland

Welcome:
Welcome to our online group discussion. My name is Ellen, and I'll be facilitating this group discussion today. On behalf of the researcher funders the Scottish Environment, Food and Agriculture Research Institutions we appreciate your participation and valuable insights that you will provides us with today.

Today we are going to discuss some of the lifestyle factors that impact upon your food choices.

Housekeeping:
Please ensure that you keep your camera on throughout the discussion group, but please ensure that you are in a quite space so that background noise doesn't disturb the other participants. We will have a short comfort break in about 40 minutes, however, if you need a break, please feel free to step away from the online discussion group whenever necessary.

I appreciate that some topics may be emotionally sensitive for some participants therefore if anyone needs to take a little break from the discussion group for whatever reason please step away or mute your microphone and switch off your camera and rejoin if you are comfortable to do so.

Consent:
You all received a copy of the participant information sheet and have completed the online consent form.

Please be assured that participation in this online group discussion is entirely voluntary. All information collected during this study will be kept confidential, and any data reported will be anonymised. You will be assigned a unique participant ID number, ensuring that your name and personal information remain confidential.

The focus group will take around 90 minutes and will be audio recorded to ensure accuracy. Please understand that due to the nature of a group discussion, withdrawal of individual data may not be possible after completing the group discussion as it may not be possible for us to distinguish your voice from others on the audio recording or to identify you in the anonymised transcript once analysis has started.

Anonymous quotes may be used for presenting research findings, no names or identifiable information will be attributed to these quotes. After the study's completion, all participant information will be securely disposed of. A copy of the research findings will be available upon request.

Etiquette:
To ensure that we have a productive and respectful discussion, please keep the following ground rules in mind:

- Be respectful and courteous to one another.
- Listen actively and avoid interrupting others.
- Share your honest opinions and experiences, if you disagree with a point that has been made, please discuss this – there are no wrong or right answers.
- Stay on topic and let me guide the discussion.
- Please don't worry if I move the discussion along, it is important that we try and cover all the topics today, there will be time at the end to discuss anything that you didn't have the opportunity to mention, so make a note.

Questions:
Does anyone have any questions before we begin? **[answer any questions].**

Recording:
I will now start the audio recording. **[Start recording].**

Appendix 11. In-person discussion group script

IN-PERSON DISCUSSION GROUP SCHEDULE

Understanding the Impact of Lifestyle on Food Choices Among People over 65 in Scotland

Welcome:

Welcome to our group discussion. My name is Ellen, and I'll be facilitating this group discussion today. On behalf of the researcher funders the Scottish Environment, Food and Agriculture Research Institutions we appreciate your participation and valuable insights that you will provides us with today.

We are here to discuss some of the lifestyle factors that impact upon the food shopping, preparation, cooking and eating habits of people over the age of 65 in Scotland.

Housekeeping:

The toilets are located [mention the location]. We will have a short comfort break in about 45 minutes, however, please feel free to leave the room whenever necessary. Please remember to maintain confidentiality during breaks. Avoid discussing the discussion group topics or other participants with anyone outside of this room, if you think of anything relevant when you are outside of the room, please feel free to share upon your return.

We have refreshments available, please help yourself whenever you'd like.

As far as I'm aware, there isn't a fire drill planned. Therefore, in the unlikely event of a fire alarm or emergency. Please follow my instructions promptly. Please leave your belongings in the room, we will evacuate the building immediately following the emergency exit route. Once outside, we will gather at the designated assembly point, which is [mention the specific location for your focus group]. We will only re-enter the building when permitted by the fire wardens to do so.

I appreciate that some topics may be emotionally sensitive for some participants therefore if anyone needs to take a little break from the focus group for whatever reason there are a couple of chairs outside of the room where you can have a breather before returning in.

Consent:

You have all completed the online consent form or agreed to the audio recording when signing up on the phone. As I mentioned on your arrival, please ensure that you have read and understand the information sheet, did anyone have any questions about today's group discussion?

Please be assured that participation in this group discussion is entirely voluntary. All information collected during this study will be kept confidential, and any data reported will be anonymised. You will be assigned a unique participant ID number, ensuring that your name and personal information remain confidential.

The focus group will take up to 2 hours and will be audio recorded to ensure accuracy, please ensure that you don't cover the microphones on the table; the audio file will be saved on a password protected computer. Please understand that due to the nature of a group discussion, withdrawal of individual data may not be possible once the audio recording of the discussion has started as it may not be possible for us to distinguish your voice from others on the audio recording or to identify you in the anonymised transcript once analysis has started.

Anonymous quotes may be used for presenting research findings, no names or identifiable information will be attributed to these quotes. After the study's completion, all participant information will be securely disposed of. A copy of the research findings will be available upon request.

Etiquette:

To ensure that we have a productive and respectful discussion, please keep the following ground rules in mind:

- Be respectful and courteous to one another.
- Listen actively and avoid interrupting others.
- Share your honest opinions and experiences - there are no wrong or right answers.
- Stay on topic and let me guide the discussion.
- Please don't worry if I move the discussion along, it is important that we try and cover all the topics today, there will be time at the end to discuss anything that you didn't have the opportunity to mention, so make a note on your note pad.

Questions:

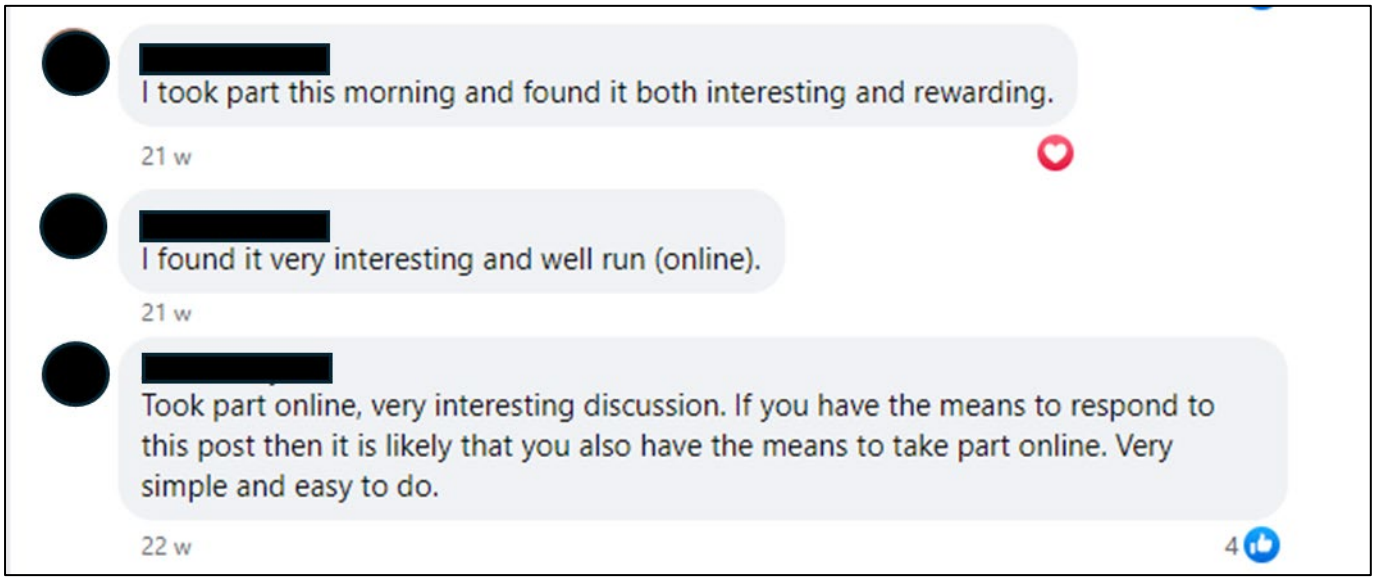
Does anyone have any questions before we begin?

Start of recording:

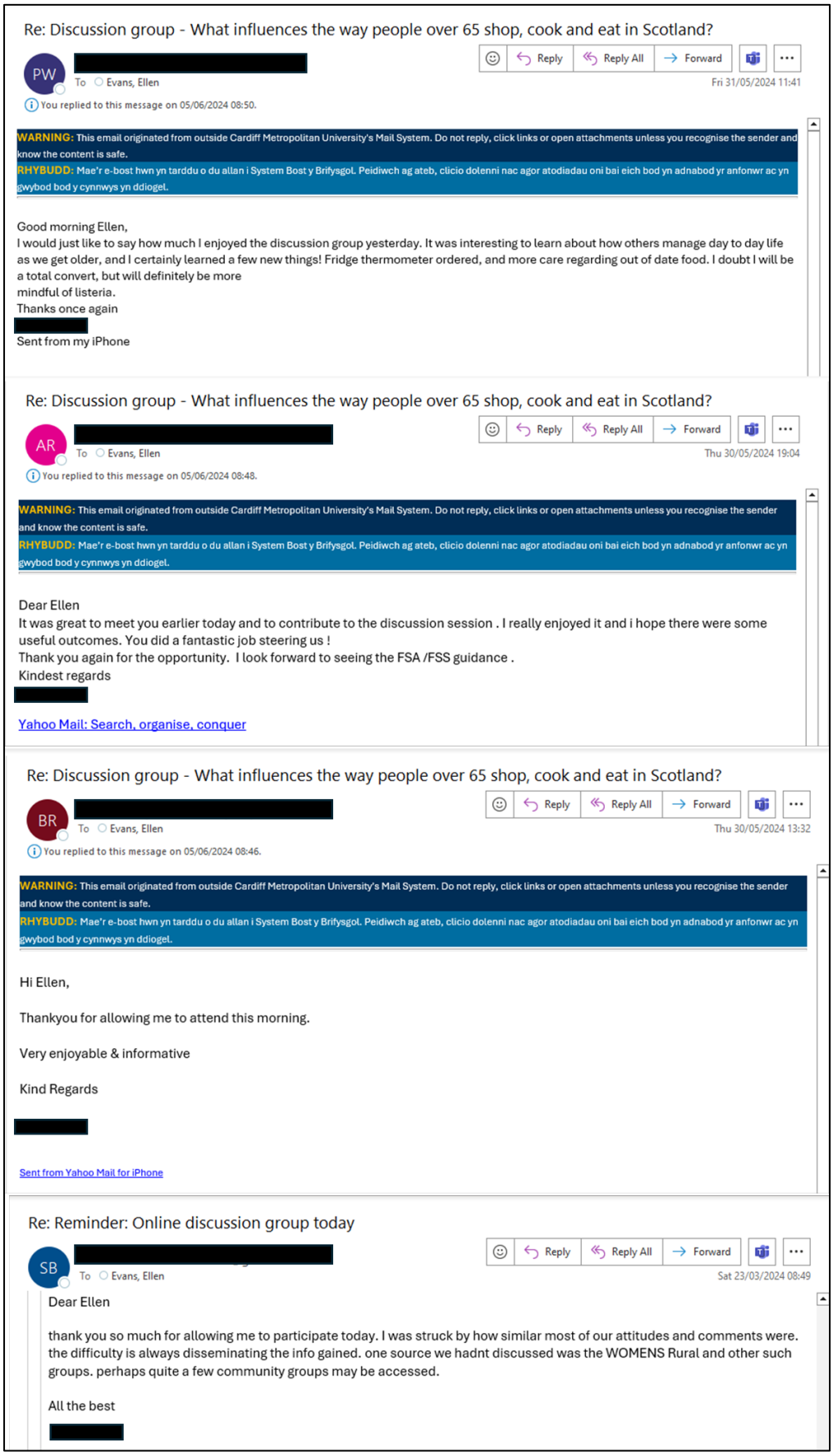
I will now start the audio recording. [Start recording].

To get started, let's go around in a clockwise direction starting with me and introduce ourselves. Let's keep our introductions concise to our name and how we normally shop, cook, and eat.

Appendix 12. Examples of feedback provided by participants on Facebook.



Appendix 13. Examples of feedback provided by participant via email



Re: Discussion group - What influences the way people over 65 shop, cook and eat in Scotland?

PW [redacted]
To Evans, Ellen
Reply | Reply All | Forward
Fri 31/05/2024 11:41
You replied to this message on 05/06/2024 08:50.

WARNING: This email originated from outside Cardiff Metropolitan University's Mail System. Do not reply, click links or open attachments unless you recognise the sender and know the content is safe.
RHYBUDD: Mae'r e-bost hwn yn tarddu o du allan i System Bost y Brifysgol. Peidiwch ag ateb, clicio dolenni nac agor atodiadau oni bai eich bod yn adnabod yr anfonwr ac yn gwybod bod y cynnwys yn ddiogel.

Good morning Ellen,
I would just like to say how much I enjoyed the discussion group yesterday. It was interesting to learn about how others manage day to day life as we get older, and I certainly learned a few new things! Fridge thermometer ordered, and more care regarding out of date food. I doubt I will be a total convert, but will definitely be more
mindful of listeria.
Thanks once again
[redacted]
Sent from my iPhone

Re: Discussion group - What influences the way people over 65 shop, cook and eat in Scotland?

AR [redacted]
To Evans, Ellen
Reply | Reply All | Forward
Thu 30/05/2024 19:04
You replied to this message on 05/06/2024 08:48.

WARNING: This email originated from outside Cardiff Metropolitan University's Mail System. Do not reply, click links or open attachments unless you recognise the sender and know the content is safe.
RHYBUDD: Mae'r e-bost hwn yn tarddu o du allan i System Bost y Brifysgol. Peidiwch ag ateb, clicio dolenni nac agor atodiadau oni bai eich bod yn adnabod yr anfonwr ac yn gwybod bod y cynnwys yn ddiogel.

Dear Ellen
It was great to meet you earlier today and to contribute to the discussion session . I really enjoyed it and i hope there were some useful outcomes. You did a fantastic job steering us !
Thank you again for the opportunity. I look forward to seeing the FSA /FSS guidance .
Kindest regards
[redacted]

Yahoo Mail: Search, organise, conquer

Re: Discussion group - What influences the way people over 65 shop, cook and eat in Scotland?

BR [redacted]
To Evans, Ellen
Reply | Reply All | Forward
Thu 30/05/2024 13:32
You replied to this message on 05/06/2024 08:46.

WARNING: This email originated from outside Cardiff Metropolitan University's Mail System. Do not reply, click links or open attachments unless you recognise the sender and know the content is safe.
RHYBUDD: Mae'r e-bost hwn yn tarddu o du allan i System Bost y Brifysgol. Peidiwch ag ateb, clicio dolenni nac agor atodiadau oni bai eich bod yn adnabod yr anfonwr ac yn gwybod bod y cynnwys yn ddiogel.

Hi Ellen,

Thankyou for allowing me to attend this morning.

Very enjoyable & informative

Kind Regards

[redacted]

Sent from Yahoo Mail for iPhone

Re: Reminder: Online discussion group today

SB [redacted]
To Evans, Ellen
Reply | Reply All | Forward
Sat 23/03/2024 08:49

Dear Ellen

thank you so much for allowing me to participate today. I was struck by how similar most of our attitudes and comments were. the difficulty is always disseminating the info gained. one source we hadnt discussed was the WOMENS Rural and other such groups. perhaps quite a few community groups may be accessed.

All the best

[redacted]

Appendix 14. Home kitchen thermometry study information sheet.

PARTICIPANT INFORMATION SHEET

Project Title: Home kitchen thermometry study

Project aim: The goal of this study is to help people ensure their home fridges are running at a safe temperature and that food is cooked to a safe temperature.

Invitation to participate: We are looking for volunteers to take part in our research study. Before you decide whether you want to take part or not, it is important for you to understand why the research is being done and what it will involve. Please therefore take time to read the following information carefully.

What is the purpose of the study? Our previous research found that many people over 65 in Scotland are concerned about fridge and cooking temperatures. This study aims to provide tools to check fridge and cooking temperatures, helping people ensure food safety at home.

Who can take part?

- People over the age 65 years in Scotland
- Individuals who assist people over 65 with food-related activities

What does the study involve?

1. **Sign-up to participate:** Provide your postal address after agreeing to participate.
2. **Receive the participant pack:** A participant pack containing a temperature probe, a fridge thermometer and instructions for use will be sent to you in the post in early August 2024.
3. **Taking part in the study:** To participate in this study you will need access to a smart phone.
    - Take a picture of the temperature probe in your cooked food (e.g., meat or poultry) showing the temperature.
    - Take a picture of the fridge thermometer in your fridge door storage area showing the temperature.
    - Upload the pictures to an online portal (link will be provided in the participant pack). Portal closes on September 30, 2024. Submissions imply your consent to participate.
4. **Incentives for taking part:** Four participants will be randomly selected to win £25 vouchers. You can keep the temperature probe and fridge thermometer after the study.

How will my data and my privacy be protected? Taking part is entirely voluntary. All information gathered from this study will remain confidential and any data reported will be anonymous. Submitting the image and answering the accompanying questions implies your consent to participate in the study. Any images that make you identifiable will be excluded from the study. The information you share will be given a participant ID number. All participant information will be securely disposed of following completion of the work; a copy of the research findings will be available by informing the researcher that you are interested in receiving the research findings. Participants have a right to withdraw from the project at any time, a Participant Withdrawal Form is available and includes more details of what actions the University will take following a request to withdraw. However, please be aware that once your data have been anonymised and analysed, it is often not possible to extract a specific participant's data.

Are there any advantages to taking part? You will receive a free temperature probe and a free fridge thermometer which you can keep after participating in the study. As a token of thanks for participating in the study all participants will be entered into a prize draw to win one of four £25 vouchers. Your participation will be informing future food safety education activities and research. Being able to check cooking adequacy of meat and poultry products and check fridge operating temperatures will help you to reduce the risk of foodborne illness.

Are there any risks associated with taking part? A risk assessment has been undertaken and the study has been reviewed and approved by the research and ethics committee. There are no physical risks anticipated from your participation in this study. We recommend that the temperature probe and fridge thermometer are kept out of the reach of children.

Has the study been approved? The project has been assessed and approved by the Research and Ethics Committee at Cardiff Metropolitan University. A copy of the approval is available from the research team.

What will happen to the results of the research project? The results of the research will be used to inform the development of a journal article and will inform the development of future research.

How do I take part or get more information about the study? If you want to take part or have any questions regarding the study, please contact the researchers, Dr Ellen Evans at elevans@cardiffmet.ac.uk

Appendix 15. Home kitchen thermometry study sign-up form.

Home kitchen thermometry study

Project aim:
The goal of this study is to help people ensure their home fridges are running at a safe temperature and that food is cooked to a safe temperature.

Invitation to participate:
We are looking for volunteers to take part in our research study. Before you decide whether you want to take part or not, it is important for you to understand why the research is being done and what it will involve. Please therefore take time to read the participant information sheet carefully.

What is the purpose of the study?
Our previous research found that many people over 65 in Scotland are concerned about fridge and cooking temperatures. This study aims to provide tools to check fridge and cooking temperatures, helping people ensure food safety at home.

Who can take part?

- People over the age 65 years in Scotland
- Individuals who assist people over 65 with food-related activities

What does the study involve?

1. *Sign-up to participate:* Provide your postal address after agreeing to participate.
2. *Receive the participant pack:* A participant pack containing a temperature probe, a fridge thermometer and instructions for use will be sent to you in the post during August 2024.
3. *Taking part in the study:* To participate in this study you will need access to a smart phone.
    - Take a picture of the temperature probe in your cooked food (e.g., meat, poultry or plant-based meat replacement) showing the temperature.
    - Take a picture of the fridge thermometer in your fridge door storage area showing the temperature.
    - Upload the pictures to an online portal (link will be provided in the participant pack). Portal closes on September 30, 2024. Submissions imply your consent to participate.
4. *Incentives for taking part:* Four participants will be randomly selected to win £25 vouchers. You can keep the temperature probe and fridge thermometer after the study.

Need more information?
If you have any questions please contact Dr Ellen Evans on elevans@cardiffmet.ac.uk

As a volunteer for this home kitchen thermometry study, do you agree to upload a pictures of the temperature probe and fridge thermometer being used to an online platform using a smartphone?

- (●) Yes
- ( ) No

Please provide your name and postal address for us to send the participant pack out to you in the post

Name	
Address line 1	
Address line 2	
Town	
County	
Postcode	

Please provide your email address:

Appendix 16. Home kitchen thermometry study temperature probe and refrigerator thermometer instructions for use.

Thank you for volunteering to take part in this thermometry research study.

HOW TO USE THE COOKING TEMPERATURE PROBE:

1. When a piece of meat comes to the end of the cooking time stated on the packaging, remove it from the oven.
2. Turn on the probe by pressing the 'On/Off' button. Press the '°C/°F' button so the probe measures temperature in Celsius (°C).
3. Insert the probe into the meat:
   - If cooking a whole bird, insert the probe into the thickest part of the breast, the innermost portion of thigh and the innermost portion of the wing.
   - If you are cooking a joint of meat such pork or ham, insert the probe into the centre of the joint.
   - Make sure the probe does not touch the bone or roasting tin.
4. Wait at least 20 seconds for the temperature to stabilise:
   - If the temperature is below 75°C in any part, remove the probe and return the meat to the oven to continue cooking.
   - If the temperature is 75°C or above, it doesn't need to be cooked any longer.
5. When your meat is 75°C or above, take a picture of the probe in the meat clearly showing the temperature.
6. Ensure that you clean the probe after each use to avoid cross-contamination. Use hot soapy water or an antibacterial wipe and dry with kitchen paper. Do not immerse the probe in water.




HOW TO USE THE FRIDGE THERMOMETER:

1. Put the thermometer in the fridge door storage area.
2. Leave the fridge door closed for at least 15 minutes.
3. Check the temperature on the thermometer. If your fridge is above 5°C, gradually adjust the dial, and re-check in a few hours. Adjusting the dial too quickly may result in freezing.
4. Once your fridge is running at a temperature of 5°C or below, take a picture of the thermometer in the fridge clearly showing the temperature.

HOW TO TAKE PART IN THE RESEARCH STUDY:

- Go to **www.tinyurl.com/temperature-research** or scan the QR code with your smartphone to upload pictures of the temperature probe and the fridge thermometer to the online portal and answer a few questions.
- The portal will close on 30 September. Four people will win £25 vouchers.

If you have any questions, please contact Ellen on elevans@cardiffmet.ac.uk

For food safety information visit: www.foodstandards.gov.scot/consumers/food-safety/at-home

Submission of a picture implies consent to participate and is required to be eligible to win a voucher.
Ethical approval has been obtained from Cardiff Metropolitan University (Ref: Sta-8405).

SEFARI LEADING IDEAS FOR BETTER LIVES

Food Standards Scotland

ZERO2FIVE Food & Drink Research Unit

Appendix 17. Food safety information regarding safe cooking and refrigeration (extracted from (Food Standards Scotland, no date))

Information about safe cooking and refrigeration

Food Standards Scotland

ZERO2FIVE° Food & Drink Research Unit

Cooking food safely:

You can avoid getting food poisoning by cooking your food carefully, following cooking instructions and cooking food for the correct length of time and temperature. This ensures that any harmful bacteria in the food are killed. Here's some tips:

- A food thermometer can be used to check food is cooked thoroughly, food should be 75°C or above in the thickest part. Some foods change colour when they are cooked so you can check this too.
- Always check your food is steaming hot in the middle.
- Make sure frozen vegetables are cooked before you eat them. If intending to use cold, cook first, cool quickly and store in the fridge for up to two days.
- If you are cooking a large dish you may have to check in more than one place that it is cooked properly.
- Always follow cooking instructions on labels.
- Don't reheat food more than once.
- When reheating, take extra care your food is heated all the way through.

Cooking meat:

When cooking certain meats they should be cooked thoroughly all the way through. To check that meat is cooked properly it is a good idea to use a food thermometer. Alternatively, the meat should also be steaming hot when you cut into it, the juices run clear and there should be no pink meat. This advice applies to cooking poultry, pork, minced meat products such as burgers, sausages and kebabs.

If you're cooking a whole chicken or other bird, pierce the thickest part of the leg (between the drumstick and the thigh) with a clean knife or skewer until the juices run out. The juices shouldn't have any pink or red in them and reach a temperature of 75°C, when using a food thermometer. Kidneys, liver and other types of offal should be cooked thoroughly until they're steaming hot all the way through.

Rare meat:

Meats such as steaks and joints of beef or lamb, can be served rare as long as the outside has been properly cooked or sealed to kill the bacteria. But that doesn't apply to all joints: rolled joints need to be cooked all the way through and checked using the juices and core temperature method.

Refrigeration:

Your fridge is a weapon in the battle against germs, but it must be used effectively. Some foods need to be kept in the fridge to help stop or slow down bacterial growth and keep them fresh and safe for longer. Generally, the colder the temperature the slower bacteria will grow, but cold temperatures don't always stop bacteria growing altogether.

Here are a few useful things to remember about chilled foods and your fridge:

- Look out for 'keep refrigerated' on labels.
- Keep your fridge between 0°C and 5°C – and regularly check the temperature with a thermometer. You can use the built in dial/gauge inside the fridge to change the power setting (typically the higher the value the more power the fridge uses to take the temperature down; if in doubt, check the manufacturer's instructions for your fridge). Note: this built in dial/gauge does not represent the temperature in °C.
- Wait for food to cool down before you put it in the fridge (do not let it sit at room temperature for longer than 1-2 hours).
- If your fridge is full, turn the temperature down, but it is best to leave space as this allows air to circulate and maintain the set temperature.
- Don't leave the fridge door open.
- When you're eating outside at a barbecue or picnic, use a cool bag or cool box.
- If you're putting out food for a party, don't leave it out for more than four hours.

Leftovers:

If you have cooked food that you aren't going to eat straight away, cool it as quickly as possible (ideally within one to two hours) and then store it in the fridge.

To make sure your leftovers are safe to eat:

- Don't keep them for longer than two days.
- Don't keep rice for longer than 24 hours and only reheat it once.
- When reheating food, make sure it's steaming hot all the way through.
- Don't reheat food more than once.

One of the main reasons for food waste is because people make more than they need. If you cook too much food, using leftovers is a good way to reduce the amount of food you waste and save money too, just make sure you do it safely.

Appendix 18. Online submission for home kitchen thermometry study.

Thank you for volunteering to take part in this home kitchen thermometry research study.

The goal of this study is to help people ensure their home fridges are running at a safe temperature and that food is cooked to a safe temperature.

Please ensure that you have read and understood the participant information sheet before taking part.

Please note that uploading images implies consent for the image to be used for research purposes, this may include presentation at conferences, or in research journal publications. Any images that make you identifiable will be excluded from the study.

If you have any questions please contact Dr Ellen Evans on elevans@cardiffmet.ac.uk

This portal will close on 30th September. Four people will receive £25 vouchers as a token of thanks for taking part.

Please indicate what images you are uploading:

- ☐ Refrigerator thermometer temperature
- ☐ Cooking probe temperature

→

Appendix 19. A3 poster

Are you at risk of food poisoning?

You may be at higher risk if your immune system is weakened due to your life stage, underlying health conditions, or medications.

Susceptibility across a lifespan

Pregnancy

During pregnancy, immune changes allow some food poisoning bacteria to cross the placenta, and infect the baby.

Children

Children under 5 years are more prone to food poisoning due to an under-developed immune system.

Adults with underlying conditions

Despite a strong immune system, adults can still get food poisoning, especially those with underlying health conditions or are on certain medications.

People over 65

Aging slows down the immune system. Although these changes vary by individual, the risk of food poisoning worsens with increasing age.

Conditions and Medications

Cancer

Some cancers alter the immune system, making people more susceptible, chemotherapy weakens the immune system, making food poisoning harder to fight.

Gastric acid inhibitor use

Medications like omeprazole, lansoprazole, esomeprazole, and rabeprazole eliminate stomach acid allowing food poisoning bacteria to survive and cause infection.

Diabetes

White blood cell production is impaired, making it harder to fight infections. Diabetic neuropathy affects the gut, increasing the risk of food poisoning.

Inflammatory bowel disease

The immune system and gut microbiome are disrupted, reducing defenses against food poisoning.

Rheumatoid arthritis

Faster immune aging and medications such as corticosteroids and TNF- inhibitors both increase food poisoning risk.

HIV/AIDS

Crucial infection-fighting cells are destroyed leading to sever risk of food poisoning

Organ transplants

Anti-rejection drugs lead to severe risk of food poisoning.

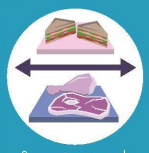
How to avoid food poisoning

Food safety is vital for all, especially if you are at high risk, as illness can be more severe and harder to recover from.

Wash hands thoroughly when preparing food

Wash fresh fruit and vegetables before eating

Do not wash raw meat and poultry



Separate raw and ready to eat food

Cook food to a safe temperature (75°C or above)

Refrigerate foods at a safe temperature (5°C or below)

Follow the use-by date on food

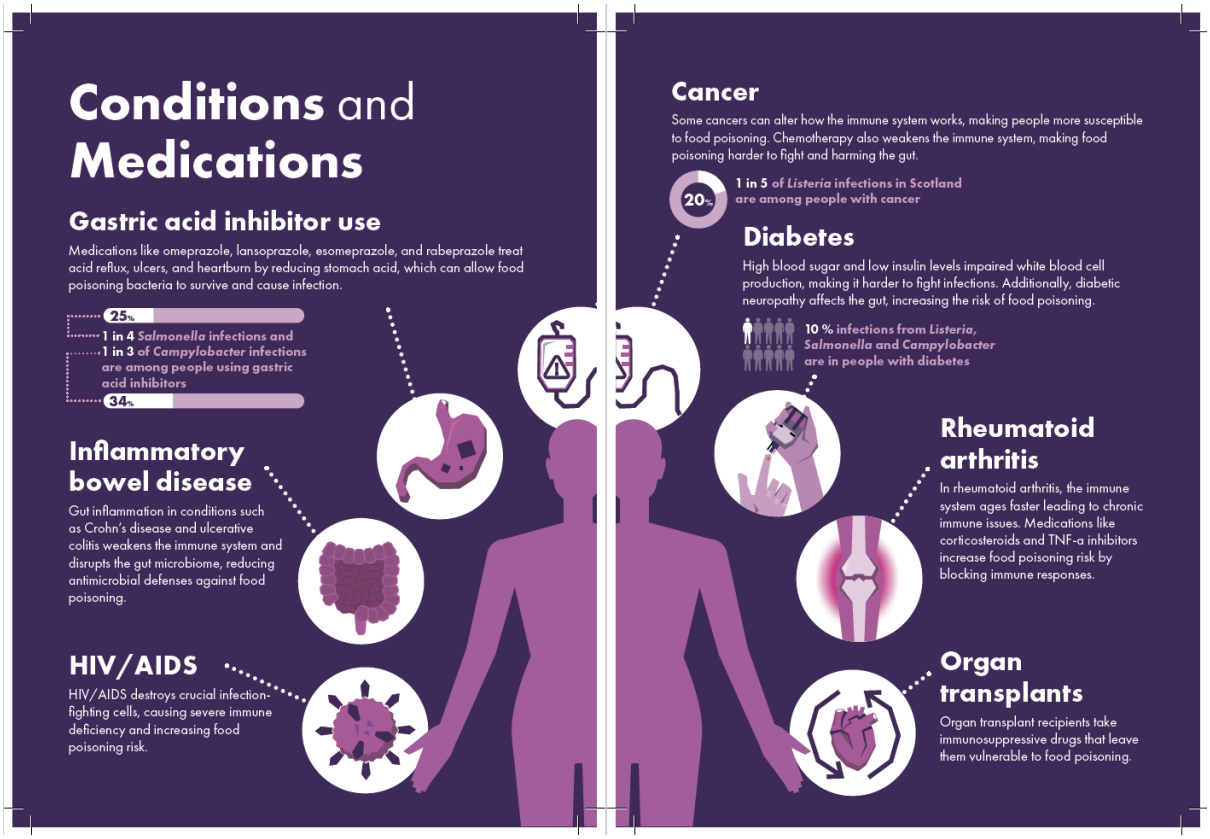
Food Standards Scotland
For safe food and healthy eating

This resource was co-created with public input for Food Standards Scotland in collaboration with food safety experts Dr Sanja Ilic (Ohio State University) and Dr Ellen Evans (ZERO2FIVE Food Industry Centre) and funded by the UK Food Safety Research Network.

Appendix 20. Silent slideshow


How to avoid food poisoning
Food Standards Scotland
For safe food and healthy eating
Food safety is important for everyone, but it's crucial for you if you are susceptible to food poisoning. Illness can be more severe, and harder to recover from.
These simple tips will help keep you safe from food poisoning:
Wash hands when preparing food
Wash fresh fruit and vegetables before eating
Do not wash raw meat and poultry
Separate raw and ready to eat food
Follow the use-by date
Cook food to a safe temperature (75°C or above)
Refrigerate foods at a safe temperature (5°C or below)
Food Standards Scotland
For safe food and healthy eating
Taking these precautions ensures food is safe for everyone
Food Standards Scotland
For safe food and healthy eating
This resource was co-created with public input for Food Standards Scotland in collaboration with food safety experts Dr Sanja Ilic (Ohio State University) and Dr Ellen Evans (ZERO2FIVE Food Industry Centre) and funded by the UK Food Safety Research Network.
ZERO2FIVE
The Ohio State University

Appendix 21. A5 12-page booklet


Conditions and Medications
Gastric acid inhibitor use
Medications like omeprazole, lansoprazole, esomeprazole, and rabeprazole treat acid reflux, ulcers, and heartburn by reducing stomach acid, which can allow food poisoning bacteria to survive and cause infection.
25%
1 in 4 Salmonella infections and 1 in 3 of Campylobacter infections are among people using gastric acid inhibitors
34%
Inflammatory bowel disease
Gut inflammation in conditions such as Crohn's disease and ulcerative colitis weakens the immune system and disrupts the gut microbiome, reducing antimicrobial defenses against food poisoning.
HIV/AIDS
HIV/AIDS destroys crucial infection-fighting cells, causing severe immune deficiency and increasing food poisoning risk.
Cancer
Some cancers can alter how the immune system works, making people more susceptible to food poisoning. Chemotherapy also weakens the immune system, making food poisoning harder to fight and harming the gut.
20%
1 in 5 of Listeria infections in Scotland are among people with cancer
Diabetes
High blood sugar and low insulin levels impaired white blood cell production, making it harder to fight infections. Additionally, diabetic neuropathy affects the gut, increasing the risk of food poisoning.
10 % infections from Listeria, Salmonella and Campylobacter are in people with diabetes
Rheumatoid arthritis
In rheumatoid arthritis, the immune system ages faster leading to chronic immune issues. Medications like corticosteroids and TNF-a inhibitors increase food poisoning risk by blocking immune responses.
Organ transplants
Organ transplant recipients take immunosuppressive drugs that leave them vulnerable to food poisoning.

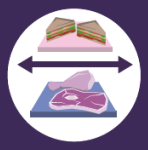

How to avoid food poisoning!
Food safety is important for everyone, but it's crucial for you if you are susceptible to food poisoning. Illness can be more severe, and harder to recover from.
These simple tips will help keep you safe from food poisoning:
Wash hands when preparing food
Keep yourself and your kitchen clean by washing and drying your hands thoroughly:
before preparing food
after touching raw food, especially meat
after going to the toilet
1. Wet hands
2. Apply soap
3. Rub all parts of hands and fingers for 20 seconds
4. Rinse hands
5. Dry hands using a clean towel
1
2
3
4
5
Wash fruit and vegetables before eating
The environments which are used to grow fruit and vegetables can sometimes carry harmful bacteria. Although food producers have good systems in place to clean produce before it reaches the consumer, the risk can never be entirely eliminated.
Extra care should be taken when handling loose produce as these tend to have more soil attached to them than pre-packaged fruit and vegetables.
When handling raw fruit and vegetables, remember to:
keep unwashed raw fruit and vegetables separate from ready-to-eat food during storage and preparation
use different chopping boards, knives and utensils for unwashed raw vegetables and ready-to-eat foods or wash equipment thoroughly in between uses
always wash hands thoroughly before and after handling raw food, including vegetables
check the label - unless packaging around vegetables says 'ready-to-eat' you must wash, peel or cook them before eating
When washing raw vegetables, it's important to avoid cross-contamination. Rub them under water, for example in a bowl of fresh water, to help to reduce splashing. Try to wash the least soiled items first and give each of them a final rinse. Brushing off dry soil before washing may help reduce the amount of washing required to clean the vegetables thoroughly.

Do not wash raw meat and poultry

Cross-contamination is the spread of bacteria around your kitchen, from food to surfaces and from surfaces to food. It can be a major cause of food poisoning. It's particularly important to be aware of cross-contamination when preparing and storing food.

Don't wash meat before cooking it. It won't get rid of the harmful bugs and you could splash these bugs onto other areas of the kitchen or onto yourself.

You shouldn't wash raw chicken or any other raw meat before cooking. Washing won't get rid of any harmful bugs that could be present, only proper cooking will. If you wash meat before cooking it, you could splash harmful bugs onto hands, work surfaces, ready-to-eat foods and cooking equipment. These bugs could then cause food poisoning.



Separate raw and ready to eat food

It's important to keep worktops and chopping boards clean because they can easily transfer bacteria.

Remember to:

- always wash worktops before you start preparing food
- wipe up any spilt food straight away
- always wash worktops thoroughly after they have been touched by raw meat, including poultry or raw eggs
- never put ready-to-eat food, such as salad, bread or fruit, on a worktop or chopping board that has been touched by raw meat or poultry unless you have washed it thoroughly first
- keep raw meat in a clean, sealed container on the bottom shelf of the fridge so that it doesn't touch or drip onto other food

Follow the use-by date on food

Food Standards Scotland
For safe food and healthy eating

There are a number of things you need to be aware of to store food safely. Storing food properly helps to:

- keep you and your household safe from food poisoning
- reduce food waste
- save you money by preventing food from spoiling

Always check food labels so you're sure about the right way to store your food. Check the food label to confirm:

- use by and best before dates
- if you need to store it in the fridge
- if you need to store it in the fridge once it's been opened – often special packaging keeps these foods fresh for longer, but they'll go off quickly once opened, for example, those that say 'eat within two days of opening'
- if food is 'ready-to-eat' – if not, make sure you wash, peel or cook it before eating

If the label doesn't show any storage instructions and it's a type of food that goes off quickly, put it in the fridge and eat it within two days. Use by dates are not to be confused with best before dates:

- Use by dates are an indicator of food safety and are found on perishable products such as meat, and ready-to-eat food. Even if the food looks, smells, or tastes fine, it may still be unsafe to eat.
- Best before dates are a measure of food quality rather than safety. They appear on longer-lasting products such as tinned foods, pasta, and dry snacks. Food past its best before date may lose freshness, texture, or flavour but is generally still safe to eat.

Unlike best before dates, ignoring a use by date can lead to serious illness from food poisoning.

Cook food to a safe temperature (75°C or above)

You can avoid getting food poisoning by cooking your food carefully to ensure that any harmful bacteria are killed.

Here are some tips:

- A food thermometer can be used to check food is cooked thoroughly, food should be 75°C or above in the thickest part. If you are cooking a large dish you may have to check in more than one place that it is cooked properly.
- If you're cooking a whole chicken or other bird, pierce the thickest part of the leg (between the drumstick and the thigh) with a clean knife or skewer until the juices run out.
- Meat should also be steaming hot when you cut into it, the juices run clear and there should be no pink meat.
- Make sure frozen vegetables are cooked before you eat them. If intending to use cold - cook first and cool
- Always follow cooking instructions on the label.
- Don't reheat food more than once.
- When reheating, take extra care your food is heated all the way through.

Meats such as steaks and joints of beef or lamb, can be served rare as long as the outside has been properly cooked or sealed to kill the bacteria. But that doesn't apply to all meat: offal and rolled joints need to be cooked all the way through and checked using the juices and core temperature method.

Refrigerate foods at a safe temperature (5°C or below)

Some foods need to be kept in the fridge to help slow down bacterial growth and keep them fresh and safe for longer. Generally, the colder the temperature the slower bacteria will grow.

Here are a few useful things to remember about chilled foods and your fridge:

- look out for 'keep refrigerated' on the food label
- keep your fridge between 0°C and 5°C – and regularly check the temperature with a thermometer. You can use the built in dial/gauge inside the fridge to change the power setting (typically the higher the value the lower the temperature. Note: this built in dial/gauge does not represent the temperature in °C.
- wait for food to cool down before you put it in the fridge (do not let it sit at room temperature for longer than 1-2 hours)
- if your fridge is full, turn the temperature down, but it is best to leave space as this allows air to circulate
- don't leave the fridge door open
- eat leftovers within two days
- if you're putting out food for a party, don't leave it out for more than four hours

Storing food in the freezer:

- freezing acts as a 'pause' button prior to any use-by date expiring and most bacteria cannot grow at these low temperatures.
- your freezer should be around -18°C.
- defrost food in the fridge so that it doesn't get too warm
- use food within one to two days after it's been defrosted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For safe food and healthy eating
The Ohio State University
ZERO2FIVE
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Appendix 22. In-home fridge magnet reminder

Appendix 23. Food safety tool pack instruction sheet

A guide to using your food safety tools

Food Standards Scotland

Temperature probe:

A temperature probe ensures safe cooking or reheating of meat or vegetarian dishes in any oven, air fryer, or microwave.

1. **After cooking or reheating food:**
   - Turn on the probe by pressing the 'On/Off' button.
   - Set the probe to Celsius (°C) by pressing the '°C/°F' button.
2. **Insert the probe:**
   - **Whole birds (chicken, turkey):** Insert into the thickest part of the breast, the innermost thigh, and the innermost wing.
   - **Joints and smaller cuts of meat:** Insert into the centre of the thickest part.
   - **Ready-meals, leftovers and batch-cooked food:** Insert into the middle of the dish or the centre of the thickest part.
3. **Check the temperature:**
   - Wait at least 20 seconds for the reading to stabilise.
   - If any part is below 75°C, continue cooking/heating.
   - If all parts reach 75°C or above, the food is safe to eat.

Tip: To prevent cross-contamination between use, wipe the probe with soapy water or an antibacterial wipe, and dry with kitchen paper.

Fridge thermometer:

1. Put the thermometer in the fridge door storage area.
2. Keep the fridge door closed for at least 15 minutes.
3. Check the temperature on the thermometer:
   - **If 5°C or below:** Your fridge is at a safe temperature, no action needed.
   - **If above 5°C:** Adjust the dial gradually to avoid freezing and check again in a few hours.

Tip: On most fridges, a higher dial number lowers the temperature, and the digital display shows the set temperature, not the actual internal temperature.

Date labels:

1. **Leftover ready-to-eat food:** After opening, cover or store in a container. Label with the **"Opened on"** date. Check storage guidance (e.g., use within 2 days) and write the new **"Use by"** date, ensuring it does not exceed the original date.
2. **Leftover cooked food:** After cooking, cool at room temperature for up to 2 hours. Label with the **"Cooked on"** date and a **"Use by"** date (within 2 days). Store covered or in a sealed container in the fridge.

Tip: If you run out of date stickers use blank labels or write on the packaging with the marker pen.

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Prifysgol Metropolitan Caerdydd

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