Title: Food Safety and convenience meals: Consumers’ actual and perceived behaviours – a mixed methods study

Abstract

Purpose: Foodborne disease remains a significant public health threat and cause for concern. Despite numerous studies indicating that the domestic kitchen is a high-risk area for foodborne illness, consumers believe it is low-risk. The type of food being prepared in the kitchen has drastically changed, with an increased use of convenience products, perceived low-risk products. Little is known about consumers’ behaviours with convenience meals. Therefore, it is essential to understand actual and perceived food safety behaviours in their use.

Methodology: A mixed methods approach using in-home observations and semi-structured interviews was undertaken with participants from the UK and the Republic of Ireland (N = 50). Observational data was summarized using descriptive statistics and an inductive thematic analysis was conducted to interpret the qualitative data.

Findings: In this study general food safety behaviours, such as hand washing, use-by date checking, as well as identifying obvious safety hazard were suboptimal. However, participants’ convenience meal safety behaviours were as optimal as possible with the provided instructions. The qualitative data supported the participants’ struggle with the provided on-packet instructions. They also displayed participants’ uncertain perceptions around different products, for example whether oven-products could be reheated multiple times, and varying levels of safety concerns around meat and dairy products. Consumers urged for more detailed and clearer instructions with these products. Recommendations for producers are provided to enhance consumer experience with the use of the products as well as contributing towards ensuring consumer safety.

Originality: Mixed methods approach investigating consumers’ real and perceived food safety behaviours.

Keywords: Consumers, Food Safety, Behaviour, convenience foods, producer recommendations

1.0 Introduction
Foodborne disease (FBD), commonly known as foodborne illness or food poisoning remains a significant public health threat and cause for concern. In 2010, the World Health Organization estimated more than 23 million people fell ill from eating contaminated food, resulting in an estimated 4654 deaths in European regions (WHO, 2017). More recent estimates in the UK indicated that 2.4 million cases of FBD occurred in 2018, with 222,000 doctor presentations and 16,400 hospital admissions (Food Standards Agency [FSA], 2020). The FSA reports that up to 64% of foodborne illness in the EU originates from the home environment (FSA, 2020). Subsequently, the domestic kitchen can be considered a high-risk area in which we are exposed to a broad diversity of microbes (Flores et al, 2013). Despite studies emphasising the correlation between FBD and the home environment, the majority of consumers display optimistic bias (Optimistic bias is defined as a cognitive bias causing an individual to underestimate the possibility of a negative event in the future whereby they believe that they themselves are less likely to experience a negative event [Sharot, 2011]) and consider the home as an unlikely source of FBD (Fein et al., 1995, FSA, 2019; FSA, 2020; Byrd-Bredbenner et al., 2013; Lee et al., 2017, Redmond and Griffith 2003; Redmond and Griffith 2004). In addition, Yeung and Morris (2001) highlight that although consumers may be able to distinguish between sources of food safety risk, such as microbiological, chemical and technological factors, they may not understand them. Consumers’ food safety risk is influenced by perceptions of exposure and consequences of the hazard, and in terms of food, they apply a greater weight of severity to the potential for unhealthy food rather than exposure to safety risks (Yeung and Morris, 2001). Consumers’ risk perceptions are also heightened by unknown characteristics which have a greater association with chemical and technological factors, rather than the microbiological factors found in kitchen environment (Yeung and Morris, 2001).

Furthermore, inconsistencies between perceived behaviours, food safety knowledge and actual practices are reported in the USA, where only 50% of participants adhered to general recommended food safety practices (Byrd-Bredbenner et al., 2007; Abbot et al, 2009). Similarly, numerous studies have identified that consumers’ intention and knowledge of appropriate food safety practices within the kitchen does not result in the implementation of recommended behaviours (Redmond and Griffith 2003; Redmond and Griffith 2004; Abbot et al., 2009; Wilcock et al., 2004). Unsatisfactory general food hygiene practices coupled with optimistic bias in consumers, a low perceived risk of food poisoning in the home, creates a behavioural challenge whereby safety practices in meal preparation are not a priority (Taché, J. and Carpentier, B., 2014).

A substantial shift in lifestyle demands and priorities over the last 10-20 years has changed the type of food being prepared in the kitchen environment. Changes in family structure, family food preference, more women joining the workforce, lack of time, and generational decline in cooking skills underpins the increased use of convenience products and meals (De Boer et al., 2004; Buckley et al., 2005; Brunner, Van der Horst, and Siegrist, 2010; Hartmann, Dohle, and Siegrist., 2013; Lavelle et al., 2016). Recent results from the Food Safety Authority of Ireland (FSAI) (FSAI, 2019), highlighted an increased reliance on convenience meals in Irish consumers, with 84% of consumers stating that they purchase convenience products (ready-to-eat or pre-prepared) products, and 36% of consumers purchasing these products at least once a week (FSAI, 2019). While there were reported increases in cooking from basic ingredients during the pandemic (Murphy et al., 2021), it is expected with the return to in-office working and reductions in free time, these products will be relied on again. In response to consumers’ preferences, the provision of pre-prepared meals (chilled meals that require little preparation/processing in the home) are diverse in
size, nutritional composition, and cuisine to cater to consumers’ demands, e.g. high protein, or calorie counted products. However, due to the availability of the varied products on the market such as uncooked, partially cooked, or fully cooked, different preparation/heating procedures must be undertaken by the consumer in the home environment to ensure the quality and safety of the prepared meals. While the quality and safety of the food may be considered by the consumer at the point of purchase, (Röhr et al., 2005; Grunert, 2005; Van Rijswijk and Frewer, 2008), the consumer may not consider their role in the home environment. Additionally, as these products can be produced by a range of producers from small scale, e.g. an on-site small business or shop, to large-scale producers, the level of detail provided on products can vary dramatically. The European Food Safety Authority (2017) have acknowledged the difficulties faced by small retailers in the application of food safety management systems, and have provided guidance for ensuring food safety, including a prerequisite programme activity around ‘product information and consumer awareness.’ However, how well these are implemented is unclear, specifically in relation to products prepared on site. For example, smaller producers may not provide the same level of detail as larger producers who undergo greater levels of scrutiny by regular external food safety audits; this lack of detail on some of the products may cause consumer confusion or result in incorrect heating practices. Further, as consumers may ignore, misunderstand or misinterpret label/manufacturer preparation instructions, as food safety is not a priority after purchase (Röhr et al., 2005; Grunert, 2005; Van Rijswijk and Frewer, 2008) or in the kitchen (Byrd-Bredbenner et al., 2013; Lee et al., 2017, Redmond and Griffith 2003; Redmond and Griffith 2004). Therefore, it is vital that consumer understanding and behaviour in relation to prepared convenience foods are explored.

At present, there is limited research around consumer actual use of convenience meals, as most studies tend to focus on understanding the rationale behind consumer usage and the health implications of their usage (Scholliers, 2015; Buckley et al., 2007; Brunner et al., 2010). As lifestyles return to pre-pandemic levels the use of convenience products as part of consumers’ cooking repertoire (Lavelle et al., 2016; Wolfson et al., 2016) is likely to return to pre-pandemic levels. Thus, it is essential to understand consumers’ use of convenience meals as they are perceived as a low-risk product prepared in a perceived low risk environment. In addition, as highlighted, consumers’ food safety perceptions do not automatically translate into their actual behaviours. Therefore, it is essential to understand both consumers’ perceptions and their actual behaviours around food safety practices in relation to convenience meals. To address this, using a mixed methods approach, the study aimed to explore consumers’ real and perceived food safety behaviours in relation to the use of convenience meals.

Following an overview of the methods is presented including participant selection and recruitment, product selection, instrument development and procedures, as well as information around analysis. Then the results are provided. A descriptive overview of actual food safety behaviours in relation to five convenience products is given. In addition, the three qualitative themes, ‘Using prepared convenience meals: a quick and easy solution,’ ‘Food safety & convenience: compliance, behaviour and responsibility’ and ‘Product instructions: current grievances and future recommendations’ are presented. A discussion of the results in relation to the relevant literature and recommendations for producers of these products for enhancing consumer experience and ensuring consumer safety follows.

2.0 Materials and Methods
In-home observations were conducted with consumers to investigate actual handling/storage/preparation (including leftover use) on five pre-selected convenience meals. For the purposes of this project, prepared convenience foods will be comprised of a prepared meal (and not a single ingredient), be chilled (not frozen), and require the consumer to carry out a treatment step at home (e.g. heating). Following the observations, interviews were used to explore participants’ perceived behaviour around the handling, storage, and preparation of prepared convenience meals as well as their reported usage and perceptions of the on-pack/manufacturer instructions. Observations and interviews were conducted between August 2021 and November 2021 and were conducted in line with Covid-19 regulations in both jurisdictions (Northern Ireland and Republic of Ireland) at that time.

2.1 Participant Selection and recruitment

Participants were recruited by the researchers using a combination of convenience and snowball sampling. The participant sample selection criteria aimed to recruit a wide range of participants and included the following: jurisdiction on the IOI (50% NI: 50% ROI), location (50% Urban: 50% rural), gender (50% male: 50% female), usage of prepared convenience foods (60% frequent users – greater than or equal to once a week) and age (50% under 60 years old: 50% over 60 years old). Once recruited, participants were given information about the study and given time to consider their participation and ask questions they had about the research. Following this, arrangements were made to conduct the observation and interview at a time convenient to each participant. On the day of the data collection, written consent was obtained from participants before commencing the observation study and interview. Participants received a £60/€70 honorarium to compensate for their time and costs incurred from partaking in the study (for example electricity charges).

2.1.1 Product Selection for Observations & interviews

Ten products were selected to represent a range of risks, different heating appliances, as well as difference in required recommended times. The five products selected for the observation part of the study were: 1) chicken product (bacterial hazards: Salmonella, Campylobacter); 2) rice product (bacterial hazards: Bacillus cereus & Staphylococcus aureus); 3) Mince product (need for thorough cooking process, bacterial hazards: E. Coli, Salmonella, Listeria monocytogenes); 4) Beef product (bacterial hazards: E. Coli, Salmonella, Listeria monocytogenes); 5) Oven product (different heating appliance). The remaining five were selected to be used during the interviews to illicit participant’s perceptions and perceived behaviours around prepared convenience foods. In addition to food products that are viewed as ‘risky’ such as chicken and meat, products were selected to encompass factors that may impact perceptions around food safety, such as packaging, instruction detail, and appliance for heating. The five products selected included: 1) Biodegradable packaging [cardboard] (may not be seen as safe packaging); 2) Plastic Tupperware container (less detailed instructions provided); 3) An oven-based product (perceptions around appliances); 4) A larger portioned product (behaviours may differ for quantities); 5) Vegetarian product (may be seen as ‘less risky,’ thus behaviours may be more lenient).

2.2 Procedure
One experienced researcher conducted all observations and interviews (XX). Participants were given five products in total for the observation, advised to behave as if they had purchased products and told to prepare the products in the manner they normally or typically would. Products were provided to each participant in a randomised order. The participant then prepared each product individually without knowledge of the other products. The researcher recorded the participants’ actions for each product on a behaviour checklist.

Upon completion of all five products, the participants undertook an interview with the researcher. Interviews lasted 9 – 42 minutes (Mean 17.18, SD 6.50) and were audio-recorded. All interviewees were encouraged to provide their opinions about the tasks. Finally, the participants completed a short survey (recording their sociodemographic characteristics).

2.2.1 Behaviour Checklist & Interview guide

As there were no existing behavioral checklist relating to prepared convenience meals, an observational checklist was designed, developed, and piloted to record safe and unsafe handling, storage, preparation and use of leftovers in relation to prepared convenience meals. The checklist was devised to record attempts and adequate or inadequate implementation of practices. Eight key practices incorporated into the checklist included hand decontamination practices (washing hands), assessing product use-by dates, reading of storage and preparation instructions, correct appliance chosen, correct time and temperature applied, removal of product packaging and use of leftovers. Additionally, a safety hazard was purposely planted, for example a hole in product packaging or an out-of-date product. Participant identification of this safety hazard was also assessed. The behaviour checklist was based on a literature review and an audit of on-pack/manufacturer instructions on prepared convenience meals available in shops and food establishments on the island of Ireland (unpublished). It was then piloted with two participants (one male, one female, one under 60 and one over 60) for clarity and flow during the observation procedure and no further adaptions were undertaken. The semi-structured interview topic guide (Table 1) was also informed by a review of the literature in relation to convenience food and the audit.

The interview guide was refined and redrafted in an iterative process. The interview guide was piloted with the same participants after the pilot observation. Pilot interviews indicated that the topic guide questions were clear to understand and sufficiently open to elicit responses, therefore no adjustments were required. The topic areas of both the behavioural checklist and interview topic guide in relation to the source can be found in Table 2.

2.3 Data Analysis

The observation behaviour checklist data was inputted by an independent researcher (XY) into a specifically designed database using SPSS V25 (IBM Corporation, Armonk, NY, USA). All statistical analysis was conducted using SPSS V25. The data was summarized using descriptive statistics (means, standard deviations [SD], and percentages).
The interviews were professionally transcribed verbatim and checked for precision (XZ).

Inductive thematic analysis was used, as it is considered to be flexible yet structured in terms of accommodating theoretical perspectives, highlighting commonalities and differences in a data set and generating insights (Braun & Clarke, 2006). The 6-step trustworthiness criteria (Nowell et al., 2017) was utilised to establish trustworthiness and a procedural methodology for inductive thematic analysis. This entailed: (1) achieving data familiarisation by repeatedly rereading transcripts (2) generating initial codes, highlighting words/phrases relevant to the research questions; (3) Organising codes into subthemes; (4) arranging sub themes into overarching themes and (5) defining final overarching themes (Nowell et al., 2017). These data rounds were then discussed by the two researchers and presented to members of the wider interdisciplinary research team for further analytical discussion. The iterative rounds continued until there was agreement that no new data, or no new themes, emerged from the transcripts. Quotations are provided to support the findings. Data saturation was considered achieved when no new codes were identified in the final 15 transcripts. By using inductive thematic analysis, the analysts were able to compare the themes developed (XZ, XX).

2.4 Ethical approval

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by XXX (blinded for review).

3.0 Results

In total, 50 participants aged 18–67 years old (M = 46.6, SD = 16.45) completed the observation and interviews (see Table 3 for sociodemographic details). In terms of education, 44% of participants had less than university level education. In terms of gender, 52% of participants identified as female. Half the participants were from rural areas (50%). Over half the participants (60%) were frequent users of prepared convenience meals. Participants had an average Food Safety Knowledge score of 7.24 (SD 1.65).

3.1 Observations

Table 4 below provides an overview of the different behaviours observed during the preparation task and the percentage of participants that performed the correct behaviour for each product during the observation.

3.1.1 Hand Washing

In general, participants did not wash their hands prior to taking part in the task or between the products. While the participants did not have direct contact with the food during the task, if consuming the product participants would have touched some of the food such as the bread that accompanied the meals.

3.1.2 Use-By dates
Approximately one third of participants checked the use-by date of the products. However, it was noted that this step would more commonly take place at the point of purchase in the shop or supermarket, rather than in the home environment or after storage in the fridge.

3.1.3 Reading instructions & Storage

The majority of participants read the heating instructions before preparing the products. The majority of participants would store each of the products in the fridge for up to two days or until the use-by day. A small minority of participants said they would store the products in the fridge for a week. Additionally, a minority would store the products in the freezer, with the duration varying from a week to two months.

3.1.4 Heating

The majority of participants chose the correct appliance for the heating of the different products and set the correct temperature. Additionally, the majority of participants removed the packaging in line with the instructions, however, the clarity of the instructions was highlighted as an issue. Furthermore, some products provided no information regarding removal/opening products for heating. Approximately, one fifth of the participants did not set a sufficient time for heating the products in line with the provided instructions. While some participants suggested that they just 'knew' when the product was fully heated, others stated that would check if it was hot and would heat further if needed. Additionally, the majority of products did not provide instructions on whether they should be left to stand after heating, to allow for full heat dispersal, or as to whether they were to be consumed straight away.

3.1.5 Use of Leftovers

The products provided no information on what to do with leftovers of the meals. The majority of participants for the chicken (72%), rice (66%), mince (60%), and the beef (68%) would dispose of leftovers or give them to a pet, however, a minority of participants (46%) would dispose of the oven product using these methods. Using the oven to prepare the oven product was seen more as 'cooking' and this was provided as a rationale by some participants justifying why they would then re-use leftovers. For the participants that did not dispose of leftovers, the majority reported that they would store them in the fridge and reheat them either the same day or within 24 hours. A small number said they would eat the product cold.

3.1.6 Identification of food safety hazard

For each observation, one safety hazard, for example a hole in the product packaging or an out-of-date product was added. Only a minority of participants (8%) successfully identified the safety hazard.

<Insert Table 4 here>
3.2 Interviews

Three overarching themes, 'Using prepared convenience meals: a quick and easy solution,' 'Food safety & convenience: compliance, behaviour and responsibility' and 'Product instructions: current grievances and future recommendations' were identified. The themes focused on the rationale behind the use of prepared convenience meals, their beliefs and behaviours around food safety and what they saw as the next steps for developing better ways for food safety in prepared convenience meals.

3.2.1 Using pre-prepared convenience meals: a quick and easy solution

Overall, consumers described their experience of using prepared convenience meals as straightforward and considered the instructions to be clear and easy to implement. This was similar for both frequent and irregular users of convenience meals. Some participants highlighted that their use of prepared convenience meals has decreased since COVID-19, due to lessened time pressures. Participants used prepared convenience meals for multiple reasons, most commonly, convenience, the products were a quick solution when participants were under time pressure, and they supplemented gaps in participants’ food planning. Prepared convenience meals were also used as lunch or snack meals and when participants only had limited access to cooking appliances, such as microwaves in work environments.

"Because everything was done for me. It was all prepped. I didn't have to think. It was just all done" "Because it's so easy for work. It's portioned out for me. It's much handier and I can cook it in five minutes and eat it in ten" (NI03, F, Younger)

However, some participants did not use prepared convenience meals regularly and did not see them as part of their food planning. These individuals preferred their own cooking or fresh food, saw themselves as fussy about food and viewed prepared convenience meals as overly processed, or had previous negative experiences with prepared convenience meals. Prepared convenience meals were believed to be inferior to fresh food as they lacked 'substance' and 'colour,' and to deli food which came hot.

"Because we prefer to cook our own would just be more if I didn't want to cook dinner and I don't know want all preservatives and stuff." (NI09, M, Older)

3.2.2 Food safety & convenience: compliance, behaviour and responsibility

Participants’ discussed adherence to cooking instructions, their strictness on use by dates, their reheating/food portioning behaviours and what prepared convenience meals and ingredients carried the highest levels of risk. The theme encompasses the perception of safety of prepared convenience meals and where the responsibility for safety lay.

Adherence to cooking instructions in relation to the time of cooking was claimed to be high and especially for larger portioned meals such as lasagne. However, there were two distinctive types of participants, those that complied with the times exactly and those that
viewed the times stated as a minimum and would often add extra time. Participants that followed the time instructions to the letter believed that manufacturers had tested the products thoroughly and if followed the product will be cooked safely.

“Because they've tried and tested these and this is, so I'm just going for convenience really? That I don't want to think about that. That it's like 25 minutes, that's what they say and that's that - no thinking.” (NI14, M, Younger)

Those participants that went above and beyond the time instructions had concerns around variations in appliances and preferred to overcook the product to ensure its safety.

“Sometimes until I know it's piping hot. I probably got more nervous.” (Why they go beyond the minimum) (NI13, F, Younger)

Again, the majority of participants reported a high compliance to use-by dates and claimed they would dispose of prepared convenience meals if the use-by date had passed. However, some participants perceived the use-by date as a guide rather than a strict rule, but were reluctant to go past the use-by date by more than 2 days. These participants tended to apply a 'smell test' or inspected the appearance of a product to assess whether the product had spoiled.

“If they still smell okay and that there yeah, if they still look and smell okay some things I would. Like ham or crisps and stuff like that never anything like dairy products or anything like that.” (NI15, F, Younger)

Participants were particularly careful with chicken products in terms of use-by dates with the majority claiming to be especially strict with these products. This was consistent even when they were not strict (i.e., willing to go a day or two over the use by date) on other products. Interestingly, the vegetarian option with cheese was another product that many participants were wary about due to fears about the dairy/cheese spoiling and the firmness/integrity of the vegetable. Meat products, in particular the lasagne was more likely to be deemed safe to consume after the use-by date. Participants commented on the difficulty of finding use-by dates on some products. Several participants viewed reheating meat (especially chicken) and rice as extremely unsafe practices. Product quality and a decline in taste, particularly if the product was highly processed (such as the Tupperware meal) was also highlighted as problematic in terms of reheating. However, if the participants originally heated a product in the oven, it was felt that it was more acceptable to reheat this product.

"Because of health and safety and it could make you sick? Give you a Dicky stomach, you know all those things. So, with reheating food you have to be very, very careful." (ROI05, F, Older)
Some respondents were also willing to eat leftovers product cold, although many participants threw away leftovers product or gave it to a pet. To prevent food waste and to avoid reheating products, a number of participants pre-divided the meals, so that they were able to cook it in two portions. However, there were no instructions on how to do this, and participants relied on their experience to cook the smaller portions.

In terms of risks, participants believed prepared convenience meals containing rice and chicken a heightened risk of food poisoning. The mince meatballs dishes were also highlighted as a potential safety hazard. There were some discrepancies as to whether products produced in factories (largescale distribution) or “in store” had more risk of food poisoning. Where the food came from was important to consumers and their safety rating of the products was framed by this. Interestingly, many participants based their risk perception of chicken and rice as more at-risk products from their upbringing, but lacked the actual knowledge of why they are potentially dangerous food safety risks.

“I’m always wary of chicken. For whatever reason, don’t know whether it was brought up and always careful of chicken. You’re brought up to believe.” (ROI08, M, Older)

Overall, participants viewed prepared convenience meals as safe. The majority had little concern around the safety of the food products provided they were stored correctly, and the cooking instructions and use-by dates were followed. Participants saw it as their role to ensure that prepared convenience meals were safe. Prepared convenience meals were viewed as an established component of the food chain, and a sector, which undergoes extensive testing, and quality control/compliance checks to ensure their safety. Participants believed it was the producers’ responsibility to ensure standards were followed in their factory/manufacturing facility and were following food safety regulations/procedures. While the primary responsibility for ensuring product safety was with the producer and consumer, the retailer and the governmental bodies were also seen as accountable parties in the prepared convenience meal food chain. Retailers had the responsibility to ensure the correct storage of the products and governmental bodies provide food hygiene ratings and set the rules for manufacturing. In general, there was the more holistic perspective that it requires input and responsibility from all parts of the food chain to ensure food safety.

“I think it’s whoever is producing and making these products has the duty to make sure that they are producing food in a safe way but then you also have to rely on the store. I suspect that these meals are not necessarily made all of them are not made up in store. Some maybe, some may not be and so there is, you know, then the responsibility of, you know, the transport and logistics and also the store itself to make sure that they’re storing things at the correct temperature in those fridges or on their counters whatever way they do it but there’s also a personal responsibility on the person that’s buying it. So, you don’t want to buy that and then leave it lying in your car for two or three hours and then try and reheat it.” (NI01, F, Younger).

3.2.3 Product instructions: current grievances and future recommendations
The final theme includes participant perceptions around the information and instructions provided on prepared convenience meals and their recommendations for improvements.

The majority of the participants, especially older participants, raised the issue of small writing affecting their ability to read the cooking instructions, and this reduced the likelihood of them adhering to the instructions. Increasing font size, capitalised writing and emboldening important parts were solutions offered by some participants.

“The writing is quite small. I mean, I get my glasses or magnifying glass. Without glasses I’m struggling here. Now, if I’d seen that before I could probably guessimate what’s expected but seeing that for the first time, so I have to read it quite intensely.” (NI05, M, Older).

Additionally, the location of the instructions was a point of frustration for the participants. Some of the products placed their instructions on the underside of the container, meaning that participants had to turn the product on its back to view the instructions, reducing the visibility of the instructions and potentially spilling or spoiling the products. Once opened they were not able to look again at the instructions without a lot of care. Placing the instructions on the top of the product (most preferred) or on the side were the solutions envisioned by the participants.

“I had to turn one upside down to read it which means the food dropped”. (ROI23, M, Older)

More detailed instructions were strongly suggested by the participants. One of the products used was encased in tinfoil and could be cooked in the microwave or the oven. However, on the packaging, there was no recommendation that the tinfoil casing must be removed before being place in the microwave. This is despite the dangers of microwaving metal objects. More information was desired on microwave instructions specific to the wattage of the microwave. As many microwaves range from 650w to 1000w, it was important to clarify the timings to ensure that the product was cooked safely.

“It does say reheat for four minutes, but you know, that’s you don’t have is it a 650 watt or 1000 wattage microwave. So again, your kind of if you’re not clever enough, you would put that in for four minutes. If it’s a low watt microwave, it’s not gonna come out cooked correctly. So only that I suppose for my age I would know over the years that you know, the wattage shows different microwave, so it needs to be checked it needs to be sure it does say you know until piping hot. But again, if you’re in a rush, and it’s convenient, and you throw it in for four minutes and you take it out over 650-watt microwave, it might not be cooked. So, I think it’s very very vague.” (ROI12, F, Younger).

As many of the products came in boxes, whether the lid should be kept on during the microwaving process or not, was raised by multiple participants and was desired as information. Additionally, the majority of participants wanted further information on whether prepared convenience meals could be reheated or frozen for later consumption, as this was unclear for many of the products.

“Basically, to let you know whether you can or can’t freeze them yeah because it doesn’t tell you” (NI07, F, Older).
Other aspects highlighted by the participants as important factors were nutrition, allergens and environmental impact. Some of the products included claims about the healthiness of the products, specifically that they were “healthy and lean”. While participants identified that they were more likely to purchase these products out of a desire to be healthy, they believed that these claims were unsubstantiated and misleading.

“The stickers for the lean and healthier, whatever, it gets a bit misleading sometimes because ah, this low fat but it's terrible in all the other ways and high salts or whatever but, yes. Some of those I don't like.” (NI02, M, Younger).

However, greater nutritional information was seen as a positive for the products and the utilization of traffic light labelling was considered a positive development, which could be incorporated in the future.

“I think the traffic light labels would be because I think then they show how healthy and lean they are.” (NI06, F, Older).

While the products included in the observation had allergen information on their packaging, the importance of clear allergen labelling was emphasised by some participants, even if they did not have food allergies themselves.

“I was saying about that Natasha's laws so for anybody who’s resistant or will flare them up, just so that it's all labelled” (NI09, M, Older).

A number of participants raised concerns about the environmental impact of prepared convenience meals with many products in single use plastics and non-recyclable materials. Similarly, the issue of unnecessary packaging was raised. One of the products used was housed in biodegradable material, and some participants as more environmentally friendly than the black plastic containers used for other products.

“Sometimes I think there’s a lot of unnecessary packaging, but they're not, they're not too bad. And I'm not sure those there are recyclable? “ (NI19, F, Younger)

3.3 Difference between actual and perceived food safety behaviours

The main difference between participants' actual and perceived behaviours related to the use-by date. While the majority of participants reported complying to the use-by date, there actual behaviours showed that they may not pay as much attention to the use-by date as they think. For actual behaviours, they may be more accustomed to checking use-by dates at the point of purchase, however, it is considered good practice to double check the date before initiating the preparation process. The level of instruction on the packaging influenced participants' actual behaviours relating to use of the leftovers. The lack of clarity of the instructions was highlighted as influencing their actual behaviours and limiting their capacity to ensure the safe preparation of the meal and may have contributed towards participants reporting that would add additional time to the instructions. For example, when no detail was
provided on timing for the specific microwave wattage, participants were unsure if this was sufficient for their particular microwave.

4.0 Discussion

To the best of our knowledge, this is one of the first studies to explore consumers’ food safety behaviours using convenience meals. In addition, this research used a mixed method approach to provide insights into both consumers’ actual and perceived food safety behaviours and offers guidance around instructions provided on these products to enhance consumer experience.

Participants in this study demonstrated poor handwashing behaviours prior to the preparation of the products. In a real-life situation, this kind of behaviours carries a potential risk, albeit small, for cross contamination between the packages of different products as well as the food. Thus, it is good practice to wash hands prior to any type of meal preparation. A lack of handwashing before the preparation of ready-to-eat products has been previously noted (Clayton et al., 2003), especially in comparison to the preparation of raw food products. Researchers note that handwashing compliance is difficult to achieve, with educational campaigns yielding limited results (O’Boyle et al., 2001; Redmond and Griffith, 2004). Clayton and colleagues (2003) suggest the role of habit needs consideration, as handwashing is a behaviour performed not solely in meal preparation. However, throughout the COVID-19 pandemic, increased handwashing practices have been extensively encouraged by authorities (WHO, 2020; 2019). Habit formation ranges from 18 to 254 days to embed (Lally et al., 2009), so it is reasonable to suggest that participants would have increased their handwashing behaviours during the pandemic to habitual levels. While behaviour fatigue may have impacted the participants handwashing behaviours, optimistic bias may have a higher role than habit for this behaviour.

It has been repeatedly shown that consumers do not associate at-home food handling practices with foodborne illness (Altekruse et al., 1995), and this may further be exasperated as participants in this study considered the convenience meal products as ‘low-risk’ products for foodborne illness. Tackling optimistic bias for in-home meal preparation and food safety is a key area for focus for future studies, with this study highlighting that product optimistic bias may have a significant influence. Furthermore, only an extremely small minority of participants identified the planted food safety hazards such as damaged packaging or expired products, despite consumers being aware that damaged food packages are a food safety hazard (Ergönül, 2013). Patil et al. (2005) showed that while consumer knowledge of the potential hazard associated with damaged packaging is high, only one third of participants report checking product packaging for damage. While some participants may have been trying to be polite in not highlighting the damage, it is possible that this behaviour is generally done at the point-of-purchase and not before food preparation. It is worth noting that damage to packaging could occur in transit and/or storage and products should be checked before their use/consumption. There is however a growing movement for the use of food products with damaged packaging to prevent food waste (do Carmo Stangherlin et al., 2019; Verghese et al., 2015; De Hooage et al., 2017). While this is a positive strategy for sustainability; it is essential that this strategy is only used for superficial damage and not where the seal of the food product has been broken as in this case there is a potential for microbial contamination of the food product or increase the accidental introduction of foreign bodies (plastics/ insects). Additionally, participants did raise sustainability concerns about these products and their packaging, which is another issue for consideration. While the packaging needs to be fit for purpose and safely protect the food, package reduction and
alternative packages were points raised in this study as well as in previous studies (Licciardello, 2017).

Participants reported a high level of compliance with use-by dates of products, approximately only one third of participants checked the use-by date in the observation. It is worth noting that participants did mention that checking use-by dates is a practice usually conducted at the point-of-purchase, and participants were instructed to behave as if they had purchased the products. However, these behaviours are in line with a recent study that found Irish consumers participate in risky food usage behaviours in the home, with 45% of consumers not adhering to ‘use-by’ dates and the majority (72%) of consumers admitted to consuming food after its ‘use-by date’ (FSAI, 2019). Although during the interviews, the majority of participants reported complying with the use-by dates on convenience meals, and only a minority stated that they may use it after an extra couple of days. Those that were lenient on use-by dates perceived the dates as guidance and/or relied on their sensory capacities to determine if the food was edible. The use of use-by dates as guidelines or reference points coupled with incorporating experiential and sensory knowledge has been found before (Meah, 2014; Watson and Meah, 2012; Secondi, 2019; Gong et al., 2022), and it is not borne out of ignorance or defiance to regulations and in some instances is used as a food waste reduction strategy. However, it is worth noting that some pathogens are undetectable by smell and invisible to the human eye (Meah, 2014), which could leave these individuals vulnerable to risk of foodborne illness. Interestingly, within this study, participants were stricter on use-by dates of certain products such as the chicken products and the vegetarian option that included dairy. A Belgian study found that one third of consumers were willing to consume refrigerated ready-to-eat products past their use-by dates but only a quarter of consumers were willing to consume ready-to-eat meals past their expiration (Van Boxtstael et al., 2014). Over half the consumers in the Belgian study were willing to consume dairy products past their use-by (Van Boxtstael et al., 2014), whereas the participants in this study were more cautious around convenience meals including dairy. Additionally, less than a quarter of the Belgian participants were willing to consume meat past its expiration, however, the participants in this study highlight how they have differing perceptions around risk depended on the type of meat, i.e. they are more cautious around chicken. This highlights that when assessing consumers’ willingness to exceed expiration dates, extra consideration needs to be given to the categorization of different foods.

Caution around chicken also arose when using leftovers, with the highest percentage of participants disposing of this product correctly, either with waste disposal or feeding it to an animal. Similarly, the interviews highlighted participant caution around chicken and rice when it came to the use of leftovers and reheating. Both in their actual behaviours and their reported behaviours participants were more likely to reheat the oven product, which they perceived this as less risky, considering it to be similar to ‘real’ cooking. Additionally, some participants believed products requiring cooking in an oven meant that it was not pre-cooked, i.e. the product was raw, and therefore they would be able to reheat it again. Both the NHS and FSA recommend that leftover products including meat and poultry should only be reheated once (FSA, 2018; NHS, 2020) and reheating of products should be avoided as the more times you cool and reheat food, the higher the risk of food poisoning where bacteria can multiply when cooled too slowly or reheated insufficiently (NHS, 2020). Participants showed an overall aversion to food waste, even when disposing of food that they felt was too risky to reheat, so they tried to give the ‘safer’ food to animals. They also highlighted waste reduction strategies such as dividing up portions prior to initial heating to prevent reheating food. However, the lack of information on what should be done with the leftovers of convenience meals was highlighted throughout the observations and interviews. Participants wanted this information to be provided on the packages as there was
uncertainty around what was the correct method for the use of leftovers. A further waste
reduction strategy that the participants requested was to clarify if products were suitable for
freezing. A small minority of participants reported that they would freeze these products,
however, on majority of products it was unclear whether this was a safe practice.

The lack of detailed instructions on convenience meal products was apparent throughout the
observations and interviews. Overall, participants demonstrated good safety behaviours in
relation to the actual heating of the product, as far as possible, with the level of instruction
provided to them. They made every effort to comply with the preparation instructions during
the observation, and it was noted in the interviews that the majority of the participants
followed the instructions or added additional time to the provided instructions. Participants
wanted more details to be provided on the preparation instructions, for example the amount
of time required for the wattage of the microwave and whether the product should/shou
remain in the packaging during heating. Additionally, the clarity, visibility and location of the
instructions were all highlighted as problematic. Finally, the traffic light system, was portrayed as useful for consumers and something that would be
beneficial on these convenience meal products, the participants displayed skepticism around
some of the current health claims presented on the products. Health claims skepticism has
been found previously (Benson et al., 2019) and those who believed the health claims
selected bigger portions (Benson et al., 2018), which is similar to here, where participants
indicated that the claims would play on their desire to be healthy and therefore influence
their purchasing behaviours.

4.1 Theoretical Contributions

This research provides further evidence towards the role of habitual behaviour and optimistic
bias in the area of food safety. When targeting consumer behaviours to enhance food safety,
methods for overcoming these factors need consideration, not just providing consumers with
knowledge through education. Additionally, within optimistic bias, the products were seen as
low risk as well as the commonly reported home environment, further exasperating the
problem. Furthermore, differences between associated risk and the food ingredients within
these products were acknowledged, and this supports the need for specifying food type and
ingredients when considering food safety behaviours of consumers.

Consumers in this study were supportive of sustainability practices and reducing packaging.
However, this study also highlighted that they were limited in identifying damaged packages.
This highlights a lack of awareness around package damage, considering there is growing
literature to support using products with damaged packaging for sustainability reasons, there
needs to be clear advice around type of package damage that can be used. The potential for
product contamination and food safety risk should be considered alongside sustainability.
While some differences were seen between real and perceived behaviours, problems with
compliance also arose from poor product instructions. This supports the literature around the
multiple stakeholders involved ensuring end consumer food safety practices, instead of
placing sole responsibility on the consumer (Meah, 2014).

4.2 Recommendations for producers

To ensure future consumer safety in the preparation of these convenience meal products,
some recommendations, for the producers/manufacturers of these products, derived
primarily from the qualitative findings, are offered. While these products may be produced by
retailers/smaller producers and may be more difficult/time consuming, they will help to
enhance consumer experience with the use of the products as well as contributing towards
consumer safety.

- A clear statement of ingredients and all allergens on all prepared convenience
  meal products
- Larger writing (emboldened and capitalized) for the instructions
- Clear freezing and reheating instructions or information that the product is
  unsuitable for these processes
- Placement of cooking instructions on the front/top/side of the container, rather
  than the underside of the container
- Use-by dates in a clear and obvious place on the front/top of the container
- Further detail on the cooking instructions, e.g. wattage for microwave products
  and whether product needs to stand
- Where possible, provide nutritional information such as the traffic light system

4.3 Strengths and limitations

An important strength of this study is that it used a mixed methods approach to explore both
real and perceived food safety behaviours in the same participants, not often studied in the
same group. The qualitative findings assisted in understanding actual behaviours performed
by the participants. Furthermore, a wide range of participants from both the UK and the
Republic of Ireland were included in this study. Additionally, as one researcher conducted all
observations, there is no risk of inter-rater bias.

A few limitations deserve consideration. Although a wide range of participants from varying
backgrounds were sought for inclusion in this study, there may be some cross-cultural
differences in the findings. As inherent in qualitative research generalisability may be limited,
however the relatively large sample size for qualitative research and broad range of
participants may help to reduce this. Additionally, despite our efforts to recruit a range of
education levels, the majority of participants had university level education. This may limit
the transferability of our findings to those with lower levels of education. However, Daniels et
al. (2015) found no difference in consumption patterns of convenience products between
different levels of education, which may indicate that all behaviours relating to these
products could be similar across differing levels of education. Finally, a unique limitation due
to the COVID-19 pandemic is worth highlighting. While older participants were recruited for
this study, due to this population often living on their own, a barrier to full meal preparation
(Lavelle et al., 2016) and being a vulnerable population for FBD, no participants over the age
of 70 years could be recruited. At the time the study was being conducted, the over 70 years
population was classed as a vulnerable population for COVID-19, in line with the Declaration
of Helsinki, it was deemed at the time that the potential risk of spreading COVID-19 to this
population did not outweigh the potential benefits of the project. Therefore, future research
should target this older population to understand if their behaviours differ greatly from those
over the age of 60 years.

5.0 Conclusions

With the reduction in time due to a return to in-office working after the pandemic, it is likely
that there will be an increased use of convenience meal products again. Consumers’
perceive both the kitchen environment and convenience meals as low risk in terms of food
safety, and therefore it is vital to understand consumers’ food safety behaviours in relation to
these products, to ensure consumer safety. While participants general food safety
behaviours in this study may be suboptimal, such as a lack of hand washing and use-by date
checking, participants conscientiously followed or exceeded cooking instructions, and unsafe
preparation behaviours tended to be due to a lack of information on the products. Therefore,
it can be said that compliance with cooking instructions for these products is only as good as
the information provided. Consumer-informed recommendations for producers of these
products have been provided, such as more detailed preparation, storage and disposal
instructions. Following these recommendations will enhance consumer experience with the
use of the products as well as contributing towards ensuring consumer safety.

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