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1 *This is the Author's Accepted Manuscript version of the article: Lavelle F, McKernan C,*
2 *Murphy B, & Dean M (2023). Food Safety and convenience meals: Consumer's actual and*
3 *perceived behaviours – a mixed methods study. British Food Journal. Accepted for*
4 *publication on 14 December 2022.*

5

6 **Title: Food Safety and convenience meals: Consumers' actual and perceived**
7 **behaviours – a mixed methods study**

8

9 **Abstract**

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

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

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

31 *Originality:* Mixed methods approach investigating consumers' real and perceived food
32 safety behaviours.

33 **Keywords:** Consumers, Food Safety, Behaviour, convenience foods, producer
34 recommendations

35

36

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38

39

40 **1.0 Introduction**

41 Foodborne disease (FBD), commonly known as foodborne illness or food poisoning remains
42 a significant public health threat and cause for concern. In 2010, the World Health
43 Organization estimated more than 23 million people fell ill from eating contaminated food,
44 resulting in an estimated 4654 deaths in European regions (WHO, 2017). More recent
45 estimates in the UK indicated that 2.4 million cases of FBD occurred in 2018, with 222,000
46 doctor presentations and 16,400 hospital admissions (Food Standards Agency [FSA], 2020).
47 The FSA reports that up to 64% of foodborne illness in the EU originates from the home
48 environment (FSA, 2020). Subsequently, the domestic kitchen can be considered a high-risk
49 area in which we are exposed to a broad diversity of microbes (Flores et al, 2013). Despite
50 studies emphasising the correlation between FBD and the home environment, the majority of
51 consumers display optimistic bias (Optimistic bias is defined as a cognitive bias causing an
52 individual to underestimate the possibility of a negative event in the future whereby they
53 believe that they themselves are less likely to experience a negative event [Sharot, 2011])
54 and consider the home as an unlikely source of FBD (Fein et al., 1995, FSA, 2019; FSA,
55 2020; Byrd-Bredbenner et al., 2013; Lee et al., 2017, Redmond and Griffith 2003; Redmond
56 and Griffith 2004). In addition, Yeung and Morris (2001) highlight that although consumers
57 may be able to distinguish between sources of food safety risk, such as microbiological,
58 chemical and technological factors, they may not understand them. Consumers' food safety
59 risk is influenced by perceptions of exposure and consequences of the hazard, and in terms
60 of food, they apply a greater weight of severity to the potential for unhealthy food rather than
61 exposure to safety risks (Yeung and Morris, 2001). Consumers' risk perceptions are also
62 heightened by unknown characteristics which have a greater association with chemical and
63 technological factors, rather than the microbiological factors found in kitchen environment
64 (Yeung and Morris, 2001).

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

75

76 A substantial shift in lifestyle demands and priorities over the last 10-20 years has changed
77 the type of food being prepared in the kitchen environment. Changes in family structure,
78 family food preference, more women joining the workforce, lack of time, and generational
79 decline in cooking skills underpins the increased use of convenience products and meals
80 (De Boer et al., 2004; Buckley et al., 2005; Brunner, Van der Horst, and Siegrist, 2010;
81 Hartmann, Dohle, and Siegrist., 2013; Lavelle et al., 2016). Recent results from the Food
82 Safety Authority of Ireland (FSAI) (FSAI, 2019), highlighted an increased reliance on
83 convenience meals in Irish consumers, with 84% of consumers stating that they purchase
84 convenience products (ready-to-eat or pre-prepared) products, and 36% of consumers
85 purchasing these products at least once a week (FSAI, 2019). While there were reported
86 increases in cooking from basic ingredients during the pandemic (Murphy et al., 2021), it is
87 expected with the return to in-office working and reductions in free time, these products will
88 be relied on again. In response to consumers' preferences, the provision of pre-prepared
89 meals (chilled meals that require little preparation/processing in the home) are diverse in

90 size, nutritional composition, and cuisine to cater to consumers demands, e.g. high protein,
91 or calorie counted products. However, due to the availability of the varied products on the
92 market such as uncooked, partially cooked, or fully cooked, different preparation/heating
93 procedures must be undertaken by the consumer in the home environment to ensure the
94 quality and safety of the prepared meals. While the quality and safety of the food may be
95 considered by the consumer at the point of purchase, (Röhr et al., 2005; Grunert, 2005; Van
96 Rijswijk and Frewer, 2008), the consumer may not consider their role in the home
97 environment. Additionally, as these products can be produced by a range of producers from
98 small scale, e.g. an on-site small business or shop, to large-scale producers, the level of
99 detail provided on products can vary dramatically. The European Food Safety Authority
100 (2017) have acknowledged the difficulties faced by small retailers in the application of food
101 safety management systems, and have provided guidance for ensuring food safety,
102 including a prerequisite programme activity around 'product information and consumer
103 awareness.' However, how well these are implemented is unclear, specifically in relation to
104 products prepared on site. For example, smaller producers may not provide the same level
105 of detail as larger producers who undergo greater levels of scrutiny by regular external food
106 safety audits; this lack of detail on some of the products may cause consumer confusion or
107 result in incorrect heating practices. Further, as consumers may ignore, misunderstand or
108 misinterpret label/manufacture preparation instructions, as food safety is not a priority after
109 purchase (Röhr et al., 2005; Grunert, 2005; Van Rijswijk and Frewer, 2008) or in the kitchen
110 (Byrd-Bredbenner et al., 2013; Lee et al., 2017, Redmond and Griffith 2003; Redmond and
111 Griffith 2004). Therefore, it is vital that consumer understanding and behaviour in relation to
112 prepared convenience foods are explored.

113 At present, there is limited research around consumer actual use of convenience meals, as
114 most studies tend to focus on understanding the rationale behind consumer usage and the
115 health implications of their usage (Scholliers, 2015; Buckley et al., 2007; Brunner et al.,
116 2010). As lifestyles return to pre-pandemic levels the use of convenience products as part of
117 consumers cooking repertoire (Lavelle et al., 2016; Wolfson et al., 2016) is likely to return to
118 pre-pandemic levels. Thus, it is essential to understand consumers' use of convenience
119 meals as they are perceived as a low-risk product prepared in a perceived low risk
120 environment. In addition, as highlighted, consumers' food safety perceptions do not
121 automatically translate into their actual behaviours. Therefore, it is essential to understand
122 both consumers' perceptions and their actual behaviours around food safety practices in
123 relation to convenience meals. To address this, using a mixed methods approach, the study
124 aimed to explore consumers' real and perceived food safety behaviours in relation to the use
125 of convenience meals.

126

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

136

137 **2.0 Materials and Methods**

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

149

150 2.1 Participant Selection and recruitment

151 Participants were recruited by the researchers using a combination of convenience and
152 snowball sampling. The participant sample selection criteria aimed to recruit a wide range of
153 participants and included the following: jurisdiction on the IOI (50% NI: 50% ROI), location
154 (50% Urban: 50% rural), gender (50% male: 50% female), usage of prepared convenience
155 foods (60% frequent users – greater than or equal to once a week) and age (50% under 60
156 years old: 50% over 60 years old). Once recruited, participants were given information about
157 the study and given time to consider their participation and ask questions they had about the
158 research. Following this, arrangements were made to conduct the observation and interview
159 at a time convenient to each participant. On the day of the data collection, written consent
160 was obtained from participants before commencing the observation study and interview.
161 Participants received a £60/€70 honorarium to compensate for their time and costs incurred
162 from partaking in the study (for example electricity charges).

163

164 2.1.1 Product Selection for Observations & interviews

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

182

183 2.2 Procedure

184 One experienced researcher conducted all observations and interviews (XX). Participants
185 were given five products in total for the observation, advised to behave as if they had
186 purchased products and told to prepare the products in the manner they normally or typically
187 would. Products were provided to each participant in a randomised order. The participant
188 then prepared each product individually without knowledge of the other products. The
189 researcher recorded the participants' actions for each product on a behaviour checklist.
190 Upon completion of all five products, the participants undertook an interview with the
191 researcher. Interviews lasted 9 – 42 minutes (Mean 17.18, SD 6.50) and were audio-
192 recorded. All interviewees were encouraged to provide their opinions about the tasks.
193 Finally, the participants completed a short survey (recording their sociodemographic
194 characteristics).

195

196

197 2.2.1 Behaviour Checklist & Interview guide

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

215 *<Insert Table 1 here>*

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

221 *<Insert Table 2>*

222

223 2.3 Data Analysis

224 The observation behaviour checklist data was inputted by an independent researcher (XY)
225 into a specifically designed database using SPSS V25 (IBM Corporation, Armonk, NY, USA).
226 All statistical analysis was conducted using SPSS V25. The data was summarized using
227 descriptive statistics (means, standard deviations [SD], and percentages).

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

244

245 2.4 Ethical approval

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

249

250 3.0 Results

251 In total, 50 participants aged 18–67 years old ($M = 46.6$, $SD = 16.45$) completed the
252 observation and interviews (see **Table 3** for sociodemographic details). In terms of
253 education, 44% of participants had less than university level education. In terms of gender,
254 52% of participants identified as female. Half the participants were from rural areas (50%).
255 Over half the participants (60%) were frequent users of prepared convenience meals.
256 Participants had an average Food Safety Knowledge score of 7.24 ($SD 1.65$).

257 *<Insert Table 3 here>*

258

259 3.1 Observations

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

263 3.1.1 Hand Washing

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

268

269 3.1.2 Use-By dates

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

273

274 3.1.3 Reading instructions & Storage

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

280

281 3.1.4 Heating

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

292

293 3.1.5 Use of Leftovers

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

303

304 3.1.6 Identification of food safety hazard

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

308

309 <Insert Table 4 here>

310

311 3.2 Interviews

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

318

319 3.2.1 Using pre-prepared convenience meals: a quick and easy solution

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

329

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

333

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

340

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

343

344 3.2.2 Food safety & convenience: compliance, behaviour and responsibility

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

349

350 Adherence to cooking instructions in relation to the time of cooking was claimed to be high
351 and especially for larger portioned meals such as lasagne. However, there were two
352 distinctive types of participants, those that complied with the times exactly and those that

353 viewed the times stated as a minimum and would often add extra time. Participants that
354 followed the time instructions to the letter believed that manufacturers had tested the
355 products thoroughly and if followed the product will be cooked safely.

356

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

360

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

363

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

366

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

373

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

377

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

390

391 *“Because of health and safety and it could make you sick? Give you a Dicky stomach, you
392 know all those things. So, with reheating food you have to be very, very careful. ”* (ROI05, F,
393 Older)

394

395 Some respondents were also willing to eat leftovers product cold, although many participants
396 threw away leftovers product or gave it to a pet. To prevent food waste and to avoid
397 reheating products, a number of participants pre-divided the meals, so that they were able to
398 cook it in two portions. However, there were no instructions on how to do this, and
399 participants relied on their experience to cook the smaller portions.

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

408

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

411

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

426

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

436

437

438 3.2.3 Product instructions: current grievances and future recommendations

439 The final theme includes participant perceptions around the information and instructions
440 provided on prepared convenience meals and their recommendations for improvements.

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

445

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

449

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

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

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

465 *“It does say reheat for four minutes, but you know, that's you don't have is it a 650 watt or*
466 *1000 wattage microwave. So again, your kind of if you're not clever enough, you would put*
467 *that in for four minutes. If it's a low watt microwave, it's not gonna come out cooked correctly.*
468 *So only that I suppose for my age I would know over the years that you know, the wattage*
469 *shows different microwave, so it needs to be checked it needs to be sure it does say you*
470 *know until piping hot. But again, if you're in a rush, and it's convenient, and you throw it in for*
471 *four minutes and you take it out over 650-watt microwave, it might not be cooked. So, I think*
472 *it's very very vague.”* (ROI12, F, Younger).

473

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

479

480 *“Basically, to let you know whether you can or can't freeze them yeah because it doesn't tell*
481 *you”* (NI07, F, Older).

482

483 Other aspects highlighted by the participants as important factors were nutrition, allergens
484 and environmental impact. Some of the products included claims about the healthiness of
485 the products, specifically that they were “healthy and lean”. While participants identified that
486 they were more likely to purchase these products out of a desire to be healthy, they believed
487 that these claims were unsubstantiated and misleading.

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

491

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

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

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

500

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

503

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

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

511

512 3.3 Difference between actual and perceived food safety behaviours

513 The main difference between participants' actual and perceived behaviours related to the
514 use-by date. While the majority of participants reported complying to the use-by date, there
515 actual behaviours showed that they may not pay as much attention to the use-by date as
516 they think. For actual behaviours, they may be more accustomed to checking use-by dates
517 at the point of purchase, however, it is considered good practice to double check the date
518 before initiating the preparation process. The level of instruction on the packaging influenced
519 participants' actual behaviours relating to use of the leftovers. The lack of clarity of the
520 instructions was highlighted as influencing their actual behaviours and limiting their capacity
521 to ensure the safe preparation of the meal and may have contributed towards participants
522 reporting that would add additional time to the instructions. For example, when no detail was

523 provided on timing for the specific microwave wattage, participants were unsure if this was
524 sufficient for their particular microwave.

525

526 **4.0 Discussion**

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

532 Participants in this study demonstrated poor handwashing behaviours prior to the
533 preparation of the products. In a real-life situation, this kind of behaviours carries a potential
534 risk, albeit small, for cross contamination between the packages of different products as well
535 as the food. Thus, it is good practice to wash hands prior to any type of meal preparation. A
536 lack of handwashing before the preparation of ready-to-eat products has been previously
537 noted (Clayton et al., 2003), especially in comparison to the preparation of raw food
538 products. Researchers note that handwashing compliance is difficult to achieve, with
539 educational campaigns yielding limited results (O'Boyle et al., 2001; Redmond and Griffith,
540 2004). Clayton and colleagues (2003) suggest the role of habit needs consideration, as
541 handwashing is a behaviour performed not solely in meal preparation. However, throughout
542 the COVID-19 pandemic, increased handwashing practices have been extensively
543 encouraged by authorities (WHO, 2020; 2019). Habit formation ranges from 18 to 254 days
544 to embed (Lally et al., 2009), so it is reasonable to suggest that participants would have
545 increased their handwashing behaviours during the pandemic to habitual levels. While
546 behaviour fatigue may have impacted the participants handwashing behaviours, optimistic
547 bias may have a higher role than habit for this behaviour.

548 It has been repeatedly shown that consumers do not associate at-home food handling
549 practices with foodborne illness (Altekruse et al., 1995), and this may further be exasperated
550 as participants in this study considered the convenience meal products as 'low-risk' products
551 for foodborne illness. Tackling optimistic bias for in-home meal preparation and food safety
552 is a key area for focus for future studies, with this study highlighting that product optimistic
553 bias may have a significant influence. Furthermore, only an extremely small minority of
554 participants identified the planted food safety hazards such as damaged packaging or
555 expired products, despite consumers being aware that damaged food packages are a food
556 safety hazard (Ergönül, 2013). Patil et al. (2005) showed that while consumer knowledge of
557 the potential hazard associated with damaged packaging is high, only one third of
558 participants report checking product packaging for damage. While some participants may
559 have been trying to be polite in not highlighting the damage, it is possible that this behaviour
560 is generally done at the point-of-purchase and not before food preparation. It is worth noting
561 that damage to packaging could occur in transit and/or storage and products should be
562 checked before their use/consumption. There is however a growing movement for the use of
563 food products with damaged packaging to prevent food waste (do Carmo Stangherlin et al.,
564 2019; Verghese et al., 2015; De Hooage et al., 2017). While this is a positive strategy for
565 sustainability; it is essential that this strategy is only used for superficial damage and not
566 where the seal of the food product has been broken as in this case there is a potential for
567 microbial contamination of the food product or increase the accidental introduction of foreign
568 bodies (plastics/ insects). Additionally, participants did raise sustainability concerns about
569 these products and their packaging, which is another issue for consideration. While the
570 packaging needs to be fit for purpose and safely protect the food, package reduction and

571 alternative packages were points raised in this study as well as in previous studies
572 (Licciardello, 2017).

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

603 Caution around chicken also arose when using leftovers, with the highest percentage of
604 participants disposing of this product correctly, either with waste disposal or feeding it to an
605 animal. Similarly, the interviews highlighted participant caution around chicken and rice when
606 it came to the use of leftovers and reheating. Both in their actual behaviours and their
607 reported behaviours participants were more likely to reheat the oven product, which they
608 perceived this as less risky, considering it to be similar to 'real' cooking. Additionally, some
609 participants believed products requiring cooking in an oven meant that it was not pre-
610 cooked, i.e. the product was raw, and therefore they would be able to reheat it again. Both
611 the NHS and FSA recommend that leftover products including meat and poultry should only
612 be reheated once (FSA, 2018; NHS, 2020) and reheating of products should be avoided as
613 the more times you cool and reheat food, the higher the risk of food poisoning where
614 bacteria can multiply when cooled too slowly or reheated insufficiently (NHS, 2020).
615 Participants showed an overall aversion to food waste, even when disposing of food that
616 they felt was too risky to reheat, so they tried to give the 'safer' food to animals. They also
617 highlighted waste reduction strategies such as dividing up portions prior to initial heating to
618 prevent reheating food. However, the lack of information on what should be done with the
619 leftovers of convenience meals was highlighted throughout the observations and interviews.
620 Participants wanted this information to be provided on the packages as there was

621 uncertainty around what was the correct method for the use of leftovers. A further waste
622 reduction strategy that the participants requested was to clarify if products were suitable for
623 freezing. A small minority of participants reported that they would freeze these products,
624 however, on majority of products it was unclear whether this was a safe practice.

625 The lack of detailed instructions on convenience meal products was apparent throughout the
626 observations and interviews. Overall, participants demonstrated good safety behaviours in
627 relation to the actual heating of the product, as far as possible, with the level of instruction
628 provided to them. They made every effort to comply with the preparation instructions during
629 the observation, and it was noted in the interviews that the majority of the participants
630 followed the instructions or added additional time to the provided instructions. Participants
631 wanted more details to be provided on the preparation instructions, for example the amount
632 of time required for the wattage of the microwave and whether the product should/should not
633 remain in the packaging during heating. Additionally, the clarity, visibility and location of the
634 instructions were all highlighted as problematic. Finally, while nutrition information such as
635 the traffic light system, was portrayed as useful for consumers and something that would be
636 beneficial on these convenience meal products, the participants displayed skepticism around
637 some of the current health claims presented on the products. Health claims skepticism has
638 been found previously (Benson et al., 2019) and those who believed the health claims
639 selected bigger portions (Benson et al., 2018), which is similar to here, where participants
640 indicated that the claims would play on their desire to be healthy and therefore influence
641 their purchasing behaviours.

642

643 *4.1 Theoretical Contributions*

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

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

662

663 *4.2 Recommendations for producers*

664 To ensure future consumer safety in the preparation of these convenience meal products,
665 some recommendations, for the producers/manufacturers of these products, derived
666 primarily from the qualitative findings, are offered. While these products may be produced by

667 retailers/smaller producers and may be more difficult/time consuming, they will help to
668 enhance consumer experience with the use of the products as well as contributing towards
669 consumer safety.

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

681

682 *4.3 Strengths and limitations*

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

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

708 **5.0 Conclusions**

709 With the reduction in time due to a return to in-office working after the pandemic, it is likely
710 that there will be an increased use of convenience meal products again. Consumers'
711 perceive both the kitchen environment and convenience meals as low risk in terms of food
712 safety, and therefore it is vital to understand consumers' food safety behaviours in relation to

713 these products, to ensure consumer safety. While participants general food safety
714 behaviours in this study may be suboptimal, such as a lack of hand washing and use-by date
715 checking, participants conscientiously followed or exceeded cooking instructions, and unsafe
716 preparation behaviours tended to be due to a lack of information on the products. Therefore,
717 it can be said that compliance with cooking instructions for these products is only as good as
718 the information provided. Consumer-informed recommendations for producers of these
719 products have been provided, such as more detailed preparation, storage and disposal
720 instructions. Following these recommendations will enhance consumer experience with the
721 use of the products as well as contributing towards ensuring consumer safety.

722

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725

726

727

728

729 **6.0 References**

730 Abbot, J.M., Byrd-Bredbenner, C., Schaffner, D., Bruhn, C.M. and Blalock, L., 2009.

731 Comparison of food safety cognitions and self-reported food-handling behaviors with
732 observed food safety behaviors of young adults. *European journal of clinical nutrition*, 63(4),
733 pp.572-579.

734 Almanza, B. A., Namkung, Y., Ismail, J. A., & Nelson, D. C. 2007. Clients' safe food-handling
735 knowledge and risk behavior in a home-delivered meal program. *Journal of the American*
736 *Dietetic Association*, 107(5), 816-821.

737 Altekruise, S.F., Street, D.A., Fein, S.B. and Levy, A.S., 1996. Consumer knowledge of
738 foodborne microbial hazards and food-handling practices. *Journal of food protection*, 59(3),
739 pp.287-294.

740 Benson, T., Lavelle, F., Bucher, T., McCloat, A., Mooney, E., Egan, B., Collins, C.E. and
741 Dean, M., 2018. The impact of nutrition and health claims on consumer perceptions and
742 portion size selection: Results from a nationally representative survey. *Nutrients*, 10(5),
743 p.656.

744 Benson, T., Lavelle, F., McCloat, A., Mooney, E., Bucher, T., Egan, B. and Dean, M., 2019.
745 Are the claims to blame? A qualitative study to understand the effects of nutrition and health
746 claims on perceptions and consumption of food. *Nutrients*, 11(9), p.2058.

747 Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research*
748 *in psychology*, 3(2), 77-101.

749 Brunner, T.A., Van der Horst, K. and Siegrist, M., 2010. Convenience food products. Drivers
750 for consumption. *Appetite*, 55(3), pp.498-506.

751 Buckley, M., Cowan, C., & McCarthy, M. 2007. The convenience food market in Great
752 Britain: Convenience food lifestyle (CFL) segments. *Appetite*, 49(3), 600-617.

- 753 Buckley, M., Cowan, C., McCarthy, M. and O'Sullivan, C., 2005. The convenience consumer
754 and food-related lifestyles in Great Britain. *Journal of Food Products Marketing*, 11(3), pp.3-
755 25.
- 756 Byrd-Bredbenner, C., Maurer, J., Wheatley, V., Cottone, E. and Clancy, M., 2007. Observed
757 food safety behaviours of young adults. *British Food Journal*.
- 758 Cates, S. C., Morales, R. A., Karns, S. A., Jaykus, L. A., Kosa, K. M., Teneyck, T., ... &
759 Cowen, P. 2006. Consumer knowledge, storage, and handling practices regarding *Listeria* in
760 frankfurters and deli meats: results of a Web-based survey. *Journal of Food*
761 *protection*, 69(7), 1630-1639.
- 762 Clayton, D.A., Griffith, C.J. and Price, P., 2003. An investigation of the factors underlying
763 consumers' implementation of specific food safety practices. *British Food Journal*.
- 764 Daniels, S., Glorieux, I., Minnen, J., Van Tienoven, T.P. and Weenas, D., 2015.
765 Convenience on the menu? A typological conceptualization of family food expenditures and
766 food-related time patterns. *Social Science Research*, 51, pp.205-218.
- 767 De Boer, M., McCarthy, M., Cowan, C. and Ryan, I., 2004. The influence of lifestyle
768 characteristics and beliefs about convenience food on the demand for convenience foods in
769 the Irish market. *Food quality and preference*, 15(2), pp.155-165.
- 770 De Hooge, I.E., Oostindjer, M., Aschemann-Witzel, J., Normann, A., Loose, S.M. and Almlí,
771 V.L., 2017. This apple is too ugly for me!: Consumer preferences for suboptimal food
772 products in the supermarket and at home. *Food Quality and Preference*, 56, pp.80-92.
- 773 do Carmo Stangherlin, I., Ribeiro, J.L.D. and Barcellos, M., 2019. Consumer behaviour
774 towards suboptimal food products: a strategy for food waste reduction. *British Food Journal*.
- 775 EFSA Panel on Biological Hazards (BIOHAZ), Ricci, A., Chemaly, M., Davies, R., Fernández
776 Escámez, P. S., Girones, R., ... & Bolton, D. 2017. Hazard analysis approaches for certain
777 small retail establishments in view of the application of their food safety management
778 systems. *EFSA Journal*, 15(3), e04697.
- 779 Evans, E. W., & Redmond, E. C. 2015. Analysis of older adults' domestic kitchen storage
780 practices in the United Kingdom: identification of risk factors associated with
781 listeriosis. *Journal of Food Protection*, 78(4), 738-745.
- 782 Evans, E. W., & Redmond, E. C. 2016. Older adult consumer knowledge, attitudes, and self-
783 reported storage practices of ready-to-eat food products and risks associated with
784 listeriosis. *Journal of Food Protection*, 79(2), 263-272.
- 785 Evans, E. W., & Redmond, E. C. 2018. Behavioral observation and microbiological analysis
786 of older adult consumers' cross-contamination practices in a model domestic
787 kitchen. *Journal of Food Protection*, 81(4), 569-581.
- 788 Ergönül, B., 2013. Consumer awareness and perception to food safety: A consumer
789 analysis. *Food control*, 32(2), pp.461-471.
- 790 Fein, S.B., Lin, C.T.J. and Levy, A.S., 1995. Foodborne illness: perceptions, experience, and
791 preventive behaviors in the United States. *Journal of Food Protection*, 58(12), pp.1405-1411.
- 792 Flores, G.E., Bates, S.T., Caporaso, J.G., Lauber, C.L., Leff, J.W., Knight, R. and Fierer, N.,
793 2013. Diversity, distribution and sources of bacteria in residential kitchens. *Environmental*
794 *microbiology*, 15(2), pp.588-596.

795 Food Standards Agency (FSA) (2018). *Cooking your food: How to cook your food to prevent*
796 *food poisoning*. Accessed <https://www.food.gov.uk/safety-hygiene/cooking-your-food>

797 Food Standards Agency (FSA) (2019) The Food And You Survey: Available at:
798 [https://www.food.gov.uk/sites/default/files/media/document/food-and-you-wave5-combined-](https://www.food.gov.uk/sites/default/files/media/document/food-and-you-wave5-combined-report-web-version_1.pdf)
799 [report-web-version_1.pdf](https://www.food.gov.uk/sites/default/files/media/document/food-and-you-wave5-combined-report-web-version_1.pdf)

800 Food Standards Agency (FSA) (2020) Foodborne Disease Estimates for the United Kingdom
801 in 2018. Available at: [https://www.food.gov.uk/sites/default/files/media/document/foodborne-](https://www.food.gov.uk/sites/default/files/media/document/foodborne-disease-estimates-for-the-united-kingdom-in-2018_0.pdf)
802 [disease-estimates-for-the-united-kingdom-in-2018_0.pdf](https://www.food.gov.uk/sites/default/files/media/document/foodborne-disease-estimates-for-the-united-kingdom-in-2018_0.pdf)

803 Food Safety Authority Ireland (FSAI), 2019. *New National Roadmap for Consumer*
804 *Protection in Relation to Food Safety*. accessed on: [New FSAI strategy launched](#)

805 Gong, Z., Su, L.Y.F., Zhang, J.S., Chen, T. and Wang, Y.C., 2022. Understanding the
806 association between date labels and consumer-level food waste. *Food Quality and*
807 *Preference*, 96, p.104373.

808 Grunert, K. G. 2005. Food quality and safety: consumer perception and demand. *European*
809 *review of agricultural economics*, 32(3), 369-391.

810 Hartmann, C., Dohle, S. and Siegrist, M., 2013. Importance of cooking skills for balanced
811 food choices. *Appetite*, 65, pp.125-131.

812 Hessel, C. T., de Oliveira Elias, S., Pessoa, J. P., Zanin, L. M., Stedefeldt, E., & Tondo, E. C.
813 2019. Food safety behavior and handling practices during purchase, preparation, storage
814 and consumption of chicken meat and eggs. *Food Research International*, 125, 108631.

815 Lally, P., Van Jaarsveld, C.H., Potts, H.W. and Wardle, J., 2010. How are habits formed:
816 Modelling habit formation in the real world. *European journal of social psychology*, 40(6),
817 pp.998-1009.

818 Lavelle, F., McGowan, L., Spence, M., Caraher, M., Raats, M.M., Hollywood, L., McDowell,
819 D., McCloat, A., Mooney, E. and Dean, M., 2016. Barriers and facilitators to cooking from
820 'scratch' using basic or raw ingredients: A qualitative interview study. *Appetite*, 107, pp.383-
821 391.

822 Lee, H.K., Abdul Halim, H., Thong, K.L. and Chai, L.C., 2017. Assessment of food safety
823 knowledge, attitude, self-reported practices, and microbiological hand hygiene of food
824 handlers. *International Journal of Environmental Research and Public Health*, 14(1), p.55.

825 Licciardello, F., 2017. Packaging, blessing in disguise. Review on its diverse contribution to
826 food sustainability. *Trends in Food Science & Technology*, 65, pp.32-39.

827 Meah, A., 2014. Still blaming the consumer? Geographies of responsibility in domestic food
828 safety practices. *Critical Public Health*, 24(1), pp.88-103.

829 Murphy, B., Benson, T., McCloat, A., Mooney, E., Elliott, C., Dean, M. and Lavelle, F., 2020.
830 Changes in consumers' food practices during the COVID-19 lockdown, implications for diet
831 quality and the food system: a cross-continental comparison. *Nutrients*, 13(1), p.20.

832 NHS 2020. [Food safety](#) Accessed: <https://111.wales.nhs.uk/Foodsafety/>

833 Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving
834 to meet the trustworthiness criteria. *International journal of qualitative methods*, 16(1),
835 1609406917733847.

836 O'Boyle, C.A., Henly, S.J. and Larson, E., 2001. Understanding adherence to hand hygiene
837 recommendations: the theory of planned behavior. *American journal of infection*
838 *control*, 29(6), pp.352-360.

839 Patil, S.R., Cates, S. and Morales, R., 2005. Consumer food safety knowledge, practices,
840 and demographic differences: findings from a meta-analysis. *Journal of food*
841 *protection*, 68(9), pp.1884-1894.

842 Redmond, E.C. and Griffith, C.J., 2003. Consumer food handling in the home: a review of
843 food safety studies. *Journal of food protection*, 66(1), pp.130-161.

844 Redmond, E.C. and Griffith, C.J., 2004. Consumer perceptions of food safety risk, control
845 and responsibility. *Appetite*, 43(3), pp.309-313.

846 Röhr, A., Lüddecke, K., Drusch, S., Müller, M. J., & Alvensleben, R. V. 2005. Food quality
847 and safety—consumer perception and public health concern. *Food control*, 16(8), 649-655.

848 Scholliers, P., 2015. Convenience foods. What, why, and when. *Appetite*, 94, pp.2-6.

849 Secondi, L., 2019. Expiry dates, consumer behavior, and food waste: how would Italian
850 consumers react if there were no longer “best before” labels?. *Sustainability*, 11(23), p.6821.

851 Sharot, T., 2011. The optimism bias. *Current biology*, 21(23), pp.R941-R945.

852 Taché, J. and Carpentier, B., 2014. Hygiene in the home kitchen: Changes in behaviour and
853 impact of key microbiological hazard control measures. *Food Control*, 35(1), pp.392-400.

854 Tomaszewska, M., Trafialek, J., Suebpongsang, P., & Kolanowski, W. 2018. Food hygiene
855 knowledge and practice of consumers in Poland and in Thailand-A survey. *Food Control*, 85,
856 76-84.

857 Van Boxstael, S., Devlieghere, F., Berkvens, D., Vermeulen, A. and Uyttendaele, M., 2014.
858 Understanding and attitude regarding the shelf life labels and dates on pre-packed food
859 products by Belgian consumers. *Food Control*, 37, pp.85-92.

860 Van Rijswijk, W., & Frewer, L. J. 2008. Consumer perceptions of food quality and safety and
861 their relation to traceability. *British Food Journal*.

862 Verghese, K., Lewis, H., Lockrey, S. and Williams, H., 2015. Packaging's role in minimizing
863 food loss and waste across the supply chain. *Packaging Technology and Science*, 28(7),
864 pp.603-620.

865 Watson, M. and Meah, A., 2012. Food, waste and safety: Negotiating conflicting social
866 anxieties into the practices of domestic provisioning. *The Sociological Review*, 60, pp.102-
867 120.

868 Wilcock, A., Pun, M., Khanona, J., & Aung, M., 2004. Consumer attitudes, knowledge and
869 behaviour: a review of food safety issues. *Trends in food science & technology*, 15(2), 56-66.

870 Wolfson, J.A., Bleich, S.N., Smith, K.C. and Frattaroli, S., 2016. What does cooking mean to
871 you?: Perceptions of cooking and factors related to cooking behavior. *Appetite*, 97, pp.146-
872 154.

873 W.H.O., 2020. technical guidance-coronavirus disease (COVID-19). URL: [https://www.who.](https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it)
874 [int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-](https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it)
875 [thecoronavirus-disease-\(covid-2019\)-and-the-virus-that-causes-it.](https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it)

- 876 World Health Organization, 2020. *Water, sanitation, hygiene and waste management for*
877 *COVID-19: technical brief, 03 March 2020* (No. WHO/2019-NcOV/IPC_WASH/2020.1).
878 World Health Organization.
- 879 WHO (2017) The Burden Of Foodborne Diseases In The WHO European Region. Available
880 at: [50607-WHO-Food-Safety-publicationV4_Web.pdf](#)
- 881 Yeung, R.M. and Morris, J., 2001. Food safety risk: Consumer perception and purchase
882 behaviour. *British food journal*.
- 883 Zoellner, C., Wiedmann, M., & Ivanek, R. 2019. An assessment of listeriosis risk associated
884 with a contaminated production lot of frozen vegetables consumed under alternative
885 consumer handling scenarios. *Journal of food protection*, 82(12), 2174-2193.