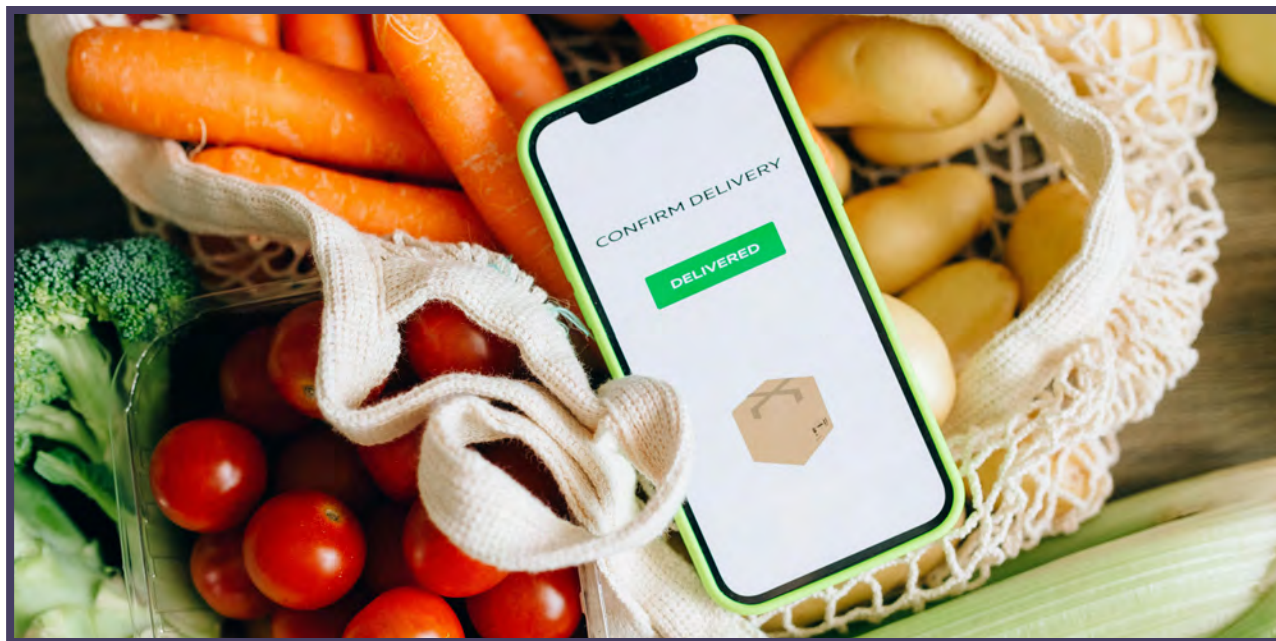




Meal Kits and Food Safety Unboxed: Understanding Consumer Perceptions and Stakeholder Roles

ABSTRACT

Meal kits are boxes of fresh and shelf-stable foods, delivered directly to homes with ice packs, ready for home storage and recipe cards for meal preparation. Limited UK research has been undertaken to understand consumer use of meal kits, and studies have yet to explore consumers' experiences with meal kits at home. This study aimed to establish UK-based meal kit consumers' experiences of meal kit use and associated food safety perceptions, attitudes, and self-reported practices. Additionally, the study explored stakeholders' roles within the meal kit industry. Interviews were conducted with meal kit consumers ($n=27$) and meal kit stakeholders ($n=6$). Thematic analysis was utilised to identify key themes. Stakeholders had various roles within the industry, while discussions focused on risk mitigation through cold chain temperature control and validating systems. Consumers indicated a favourable opinion of the delivered foods and cooling materials, with most consumers following some recommended food safety practice during meal kit handling and recipe preparation. While there were positive perceptions concerning

inclusion of food safety guidance directly on recipe cards, consumers did not necessarily believe this would impact behavior. Further research is required to explore how food safety guidance on recipe cards impacts observed behaviour during meal kit preparation.

INTRODUCTION

Meal kits, sometimes referred to as recipe boxes, are typically ordered online, usually through a subscription service, and contain fresh, measured ingredients for delivery directly to the consumers' home in a cardboard box (17, 40, 54). Most contain recipe cards and perishable ingredients, including raw animal proteins, for the consumer to handle, prepare and cook during meal preparation (54). Meal kits travel extended distances, through ground transportation, from distribution centres and courier depots, directly to the consumers' home, where cooling materials, such as ice packs, are included in the recipe box to maintain chilled temperatures throughout the supply chain (40, 56, 59).

In North America, food safety studies focusing on meat vendors and meal kits have concentrated on time-

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temperature control of animal proteins after leaving the cold supply chain (38, 39, 57). Through a survey, Hallman et al. (39) found that consumers had a positive perception towards raw meat delivered via an online purveyor, with the majority being satisfied with the quality and believing that receiving food via a package delivery service is safe. Some concerns raised in the study focused on the lack of appropriate coolants and meat being delivered at unsafe temperatures. Similarly, Mickanuck (57) explored the surface temperatures of high-risk food delivered by meal kit delivery services. The study determined that, on average, the surface temperatures of meat, poultry, and fish products (72%) over an 8-hour period were above the recommendations of 4°C (39°F).

Studies have reported the lack of food safety information available to consumers via recipe cards and providers' websites (38, 54, 57). Given the novelty of meal kits posing unique food safety challenges within the food industry, there is an opportunity to investigate the role of industry stakeholders in maintaining the safety of meal kits before reaching the consumer. Although there is a substantial body of research on consumer food safety, there remains an opportunity for contemporary research to explore consumers' experiences with meal kits. Undertaking exploratory research in this area is essential to develop insights into meal kits and food safety from the consumer and stakeholder's perspective and identify gaps in current research and opportunities for future research (22, 76). Stakeholders can be considered any group or individual with an interest and can affect or be affected by a business, organisation, or system (16, 52). These can be internal or external interests such as employees, traders, government agencies, consumers, and suppliers (16, 21, 51). Stakeholders can be helpful in research by developing knowledge through the contribution of unique perspectives from individuals who are directly interested in research findings (21, 51, 67).

Using exploratory interviews for qualitative research is beneficial for collecting opinions, emotions, feelings and experiences and can be more detailed and in-depth for the researcher to analyse (11, 22). Within qualitative research, thematic analysis is a widely used analytical method where themes are developed within a data set and reported on (5, 10, 36, 77).

Meal kits often contain perishable ingredients that require appropriate refrigeration over extended delivery distances (56). Studies have shown that consumers have limited knowledge of food safety, associate minimal risk with food delivery services and perceive low susceptibility to foodborne illness during domestic meal preparation (26, 68, 81). These factors suggest a need to examine meal kits within the scope of food safety. Therefore, the study aimed to explore consumers' experiences, perceptions, and self-reported food safety practices using meal kit recipe boxes at home and investigate stakeholder food safety roles in the industry.

MATERIALS & METHODS

Scope and ethical considerations

This study has utilised qualitative methods to explore the experiences, perceptions, and self-reported food safety practices of UK-based consumers who use meal kits for meal preparation in the domestic kitchen; it also explores stakeholder roles relating to food safety within the meal kit industry.

For this study, industry stakeholders were considered individuals with an internal or supporting role within the meal kit industry, while consumers referred to those who have purchased and have experience with using meal kits at home.

The Healthcare and Food Ethics Committee at Cardiff Metropolitan University granted ethical approval for conducting the interviews with industry stakeholders (PGR-6048) and consumers (PGR-6281) before data collection.

Consumer interview schedule development

An experiential approach utilising a Constructivist paradigm (19) was undertaken to explore consumers' perceptions, experiences, and self-reported food safety practices when using a meal kit box before and during meal preparation. The paradigm allowed for the co-constructing of meanings between the researcher and the consumers' individual, subjective experiences (1) of domestic food safety and meal kit use by seeking to "...understand how individuals make sense of their everyday lives in their natural setting" (3).

The semi-structured interview schedule was developed using the Health Belief Model (HBM) and the Food Standards Agency (FSA): The 4 Cs of food hygiene. HBM has been widely applied in health-related studies, including food safety research, to assess beliefs and behavior intentions related to threat perception and behavioral evaluation (2, 82). This study used the model to develop questions to determine consumers' self-efficacy, cues to action and perceived susceptibility, severity, barriers to foodborne illness, and benefits of food safety practice when engaging with meal kits at home.

While commonly used in supporting small businesses in the food industry, the 4 Cs of food hygiene are also communicated to consumers to promote safe food handling behaviors at home (28, 31). Questions regarding domestic food preparation behavior were developed to cover the core food safety messaging related to cleaning, cross-contamination, cooking, and chilling. The FSA guidance is available to individuals in England, Wales and Northern Ireland; therefore, the framework was supplemented by Food Standards Scotland (FSS) (32) to cover Scotland.

Stakeholder interview schedule development

The same Constructivist paradigm (19) was applied when investigating industry stakeholders' roles due to the differing roles within the meal kit industry, which allowed for more

flexibility when performing thematic analysis, allowing themes to emerge based on the subjective meanings of individual stakeholders. The rationale for implementing the same paradigm for both interviews was continuity, as the primary focus was to explore consumers' experiences, and the industry stakeholders' discussions were to be supplementary to those interviews.

To understand the various roles within the industry involving meal kits and food safety, the semi-structured interview schedule was developed using three frameworks: the Food Industry Guide to Good Hygiene Practice: Mail Order Food (48); Global Food Safety Initiative (GFSI) Food Safety Culture framework (34) and the Partnership for Food Safety Education (PFSE) '*Safe Recipe Style Guide*' (62).

Two of the frameworks related to meal kits and food safety were highlighted in previous research (54, 56). For example, Mail order guidance covers transporting goods, including perishable food items that require refrigeration over extended distances (48). The PFSE '*Safe Recipe Style Guide*' was designed by food safety experts and journalists to encourage recipe writers to include food safety prompts in written communication (e.g., recipe cards) (63). Questions covered in the schedule were developed to understand the practicalities for safe transportation of foods and some of the legislative requirements; explore the food safety culture within the organisation, mainly related to the vision and mission and the relationship and roles of suppliers and food handlers (34); and examine the design and development of recipe cards. The semi-structured interview allows for flexibility and a flow of conversation that the interviewer can adapt (47, 65) —for example, gaining insights from a stakeholder regarding the cold supply chain who may not be able to offer an understanding of the development of recipe cards. Therefore, due to the limited number of respondents and varying roles within the industry, the interview schedule was refined as the interview progressed with the industry stakeholders.

Consumer recruitment, piloting, and data collection

For the consumer interviews, convenience and snowball sampling were used to recruit members of the UK public who were over 18 years old, regularly prepared meals at home (at least twice a week) and used meal kits at least twice, to participate in a discussion regarding experiences with meal kits and meal preparation at home. Due to the study's exploratory nature, the target sample size for the current study was 20-30, based on previous literature discussing qualitative sample size and data saturation (6, 11, 72).

Convenience and snowball sampling are non-random sampling methods utilized for selecting a population for data collection (41). Convenience sampling refers to a population that is close at hand to the researcher, allowing easier access for data collection (66). Additionally, snowball sampling is a form of referral sampling where participants who are already

recruited for the study, identify additional people who fit the criteria who may be willing to participate in the research (41, 66). As the study was exploratory, the sampling methods were suitable within the qualitative paradigm to limit time-constraints for accessing the target population, for being cost-effective, and analysis did not make any generalizations about the population sample (35, 41, 66, 71). While the number of older adults online is increasing, there have been studies indicating that usage still lags behind younger demographics (4, 18). Therefore, snowball sampling was considered a supplementary recruitment method to potentially target individuals, in an older population, who may not be available via online methods.

Questions relating to meal kit use and food safety practice at home, were drafted, reviewed and refined by the research team. Additionally, the schedule was expanded to include additional question prompts, an 'opening' introductory question, and a 'clean-up' question (e.g., "We have covered all the areas that we wanted to discuss with you today. Do you have any other comments regarding any of the issues we have discussed today?") while ensuring a sequential flow to the interview schedule (11). The consumer interview schedule was piloted using 'acquaintance interviews' (11) whereby respondents ($n=3$) known to the lead researcher, who met the inclusion criteria, were interviewed to help determine an approximate duration and ensure questions provided valuable data. Due to the broad and exploratory nature of the interviews, piloting was viewed as an 'iterative process' (49). The interview schedule was improved after the initial discussions to include an additional question related to 'chilled' food safety practices due to responses offered during this preliminary stage. Responses from the pilot were incorporated into the final thematic analysis.

A call-to-action was shared online via Microsoft Viva Engage (formerly Yammer) and distributed to individuals known to the research team, either personally through WhatsApp or email, where respondents from previous projects had signed up to hear about opportunities to participate in further research. Overall, respondents were recruited through MS Viva Engage ($n=7$), personally through the research team ($n=10$), through other participants ($n=7$) and by email regarding opportunities for further research ($n=3$). For the consumers, a £15 e-gift card was offered as a token of thanks after participating in the interview. One researcher conducted and recorded the interviews online ($n=22$) or over the telephone ($n=5$), recording via a Dictaphone (Olympus Digital voice recorder WS-852), between February- April 2023, with the discussions lasting between 18-63 minutes.

Stakeholder recruitment and data collection

Convenience and purposive sampling were also used to identify and recruit industry stakeholders due to the limited number of primary sources (i.e., meal kit providers).

Purposive sampling is a form of non-random sampling where the researcher uses judgment to select specific individuals who may fit the criteria, or know the subject area, to participate in research (41, 66). To understand the meal kit providers' responsibility concerning food safety and recipe card development, individuals who worked in the 'Technical' or 'New Product Development' departments were desired. However, inclusion criteria were broad for the interviews and included any individuals working at a meal kit company or in a supporting role for meal kit companies in some capacity (e.g., providing external validation in a separate organization) that may be able to provide insight.

The primary recruitment method was to distribute a call-to-action on LinkedIn to invite UK-based industry stakeholders to participate in the interviews. Prior studies have indicated that LinkedIn, and social media in general, can be a useful recruitment method for engaging participants for research (20, 75), but perhaps should not be relied upon as the sole method of recruitment (23). Various industry stakeholders ($n=39$) were identified through job profiles on LinkedIn as eligible for participation, and a direct invitation was sent to participate in an online discussion regarding the roles and responsibilities in the industry. After a low response to the advert ($n=1$) and direct messaging ($n=1$), the remaining industry stakeholders ($n=4$) were recruited via networking within the research team. Stakeholders were not reimbursed for study participation.

One researcher conducted and recorded the interviews between October 2022 and April 2023 via Microsoft Teams ($n=5$) and over the telephone ($n=1$) by recording via a Dictaphone (Olympus Digital voice recorder WS-852), with the discussions lasting between 20 and 55 minutes.

Data handling and analysis

Audio files (MP3) were backed up on Microsoft OneDrive with unique identifiers. The audio was transcribed verbatim using a transcription service (Temi, San Francisco, CA) between April 2023 and January 2024 for both sets of interviews ($n=33$). The audio file transcripts were checked for accuracy and sent back to participants for content approval, giving one week to respond if any feedback or clarification was required on the transcription. None of the participants withdrew from the study.

The thematic analysis utilised Braun and Clarke's (12) six-phase analytical process of: (1) familiarization, (2) coding, (3) generating initial themes, (4) developing and reviewing themes, (5) refining, defining and naming themes, and (6) reporting results. Using NVivo 13 R1 (2020) (QSR International, Doncaster, Australia), the lead researcher utilised inductive reasoning and semantic level analysis to code and categorise the data to identify and develop initial themes. A 'topic summary theme' is a theme focused on a specific 'topic' within the data, which summarises what participants report, in relation to that topic (13). For the

context of this research, the topic was food safety. Subthemes emerged from both data sets relating to the topic and were reviewed by the research team for consideration for grouping into overarching key themes.

RESULTS AND DISCUSSION

The current study explored perceptions and beliefs around the food safety practices of meal kit consumers, including perceived benefits such as reducing the risk of foodborne illness (FBI):

C009: "Ooh, reduce the risk of, um, illness from food. Yeah. Particularly if you're immunocompromised for any sort of reason" or barriers that could prevent recommended food safety practice:

C001: "Um, most likely probably the size of our kitchen is quite small, so having to use different equipment, especially with raw and cooked foods, um, it's a challenge...".

But the primary key themes that emerged from the discussions centred around consumers' attitudes towards and self-reported practices regarding food safety, particularly about the 'chill' and 'cook' aspects. Additionally, the discussions determined consumer perceptions and motivations for using meal kit recipe cards.

Several subthemes were identified in the stakeholder interviews, with a notable emphasis on risk mitigation during the cold supply chain and validation of systems, including cooking meal kits at home, with an overarching key theme of ensuring food safety (see Table 2).

Demographics, consumer meal kit interest and stakeholder roles

Demographics of the consumers ($n=27$), relating to factors of living arrangements, employment, age and location, are indicated in Table 1. Most participants were part of a couple with dependent children, who were in full-time employment and resided in South Wales. Due to the open-ended introductory question asked of consumers, demographics related to gender and race were not details offered by the participants and were not considered relevant follow-ups (33) to this particular research question within this qualitative paradigm (19).

As seen in previous literature, company names and demographics were not collected for industry stakeholders for confidentiality purposes (61). Industry stakeholders that participated in the interviews had roles directly within the meal kit sector relating to technical, supply chain, and operations ($n=4$), with industry stakeholders ($n=2$) from external companies having supporting roles related to assurance programs and providing technical and operational services. Meal kit recipe boxes are a pick-and-pack operation and do not typically involve ingredient manufacturing (see Table 2). Raw materials, such as animal proteins and fresh produce, are manufactured, packaged, and supplied by another company. While the industry stakeholders' roles

TABLE 1. Demographics of the final consumer sample for the discussion related to meal kits with the number of participants (*n*). Full-time employment included hybrid working (31%), and some students also worked part-time (42%)

Factor	Description	<i>n</i>	%
Living arrangements	Couple with non-dependents (no children or children have left home)	5	<19
	Couple with dependents (children under the age of 18)	13	48
	Living alone	4	15
	Lone-parent family (with dependents)	1	4
	Shared accommodation (e.g., student accommodation)	4	15
Employment	Full-time employment	13	48
	Part-time employment	3	11
	Stay-at-home parent	2	>7
	Student	7	26
	Retired	2	>7
Age	Under 25	3	11
	25-34	8	<30
	35-59	5	<19
	60+	3	11
	Undisclosed	8	<30
Location	England	9	33
	Wales	18	67

were broad and multifaceted; within food safety, meal kit providers' responsibilities included temperature control and cross-contamination prevention.

Motivation for using meal kit recipes

Meal kits require an online account to purchase either a one-off recipe box or sign up for a subscription, where the frequency of delivery can be amended as per the consumer's preference (42). When exploring the experiences of meal kit consumers, the reasons for purchasing meal kits were asked of participants, who discussed 'convenience', 'offers' and 'variety' as influencing purchasing intentions, with consumers typically discussing signing up for an account to utilise the offers. However, while meal kits were primarily viewed favorably, 'environmental' and 'affordability' reasons were factors in why consumers had reservations about retaining an active subscription and would stop using meal kits regularly and pause or cancel the subscription after an introductory period.

Results from the current study support 'convenience' and (menu) 'variety' as beneficial factors for purchasing meal kits, as noted in previous qualitative and quantitative meal kit literature from Denmark and the US, alongside UK market research (73, 74, 80). Furthermore, Shin et al. (73) surmised that any perceived environmental benefits (e.g., food waste)

might be considered insignificant in consumers' attitudes towards meal kit use due to the perception of packaging not being 'ecologically appropriate', corroborating the current study's findings. 'Affordability' or reasonable pricing is a key attribute as to why consumers would start, or continue to, purchase meal kits (17, 73), which has been substantiated in the results of this study.

Refrigeration: Mitigating risk, consumer food safety practice and meal kit use

Stakeholder discussions related to validation systems and risk mitigation, with temperature control a crucial aspect in keeping meal kit recipe boxes safe (see Table 2). Validating for worst-case scenarios and considering the weather forecast supported a theme of concern in warmer weather, an issue some consumers considered (see Table 3). While in the UK there have been no reports of foodborne illness (FBI) associated with meal kits, there have been food recalls of ingredients supplied in meal kits (58, 78, 79). To avoid increasing the risk of potential temperature abuse and FBI, the recipe box ingredients should be refrigerated as soon as possible.

When discussing the refrigeration of meal kit ingredients, consumers reported putting items in the refrigerator when the recipe box was opened. However, an extended period

TABLE 2. Stakeholder discussions related to supporting roles within the industry, with a particular focus on risk mitigation through temperature control

Theme: Ensuring Safe Food in the Meal Kit Industry

Subtheme	Supporting Quotes
Roles in the meal kit industry	Stakeholder 004: "So if you think of recipe box manufacturers, actually, we don't manufacture anything, and there's no time or temperature processing. It's all actually about temperature control and cross-contamination, in reality."
	S006: "... And although we're in essence a pick and pack operation, you know... only open food would be fruit and vegetables. Um, you know, it's still important that we have those processes in place. It would then also include some elements around cross-contamination."
'Worst-case scenario' and risk mitigation	S001: "And basically, ensuring that whatever temperature is supposed to be at, is at that temperature when the consumer gets it and puts it in their own freezers or chillers ... There would be, well, this is what we will deal with general worst-case scenarios."
	S005: "So, what I always suggest to our suppliers is that they test products at the very worst-case scenario... Prove to me that, that product is still safe when the customers had it in their fridge for six days, eight degrees. And that's what I always say to our... suppliers. Always, always, always test it worst-case scenario."
	S004: "... but the whole thing is about the chilled chain from when it leaves the factory and that chilled box, staying at the desired temperature for the elapsed time to get to consumers house-plus X amount of hours, to make sure that the chicken stays beneath five degrees all the time ... That we then take temperature calls, which is very similar to all supermarket chains, that when it breaches another amount of ambient temperature call that we would look to the Met Office, for the UK. We'll then increase the amount of- really scientific- we'll put more chilled packs in it. But that's all temperature validated."
	S006: "... where they will look at daily, they will look at the forecast for the subsequent days. So, we're constantly looking at the forecast and then adjusting our ice matrix accordingly. So, to your point, where we've, you know, there might be a heatwave coming next week, the team will be ready for that. And they will increase the number of ice packs that go into a box."
The choice of cooling method is optional, as long as it is effective	S002: "... as long as it's effective, they're able to show validation to an auditor, that it's effective through the distribution supply chain and that should be good enough."
	S003: "If you, look at the ice pack range, there's lots of people flogging these ice packs and different gels and everything else- it's there just to make sure the product, it's transported and kept at that temperature really... Hopefully the ice packs would generate enough ... lower temperatures to cover your product."
Validating cooking instructions and anticipating consumer behavior	S004: "It's an ongoing debate we have, it's like, I cannot cook my chicken til it's not pink within, like five minutes. What the hell? You know [laughs]. So, it's like where have you got this bit of data that says cook until no longer pink, five minutes later and your recipes supposed to take 10 minutes, and it takes you like 25. Like, come on ... But-it's very difficult to apply a time to that because it depends on you know, are you on an electric hob, is it gas, what temperature setting you've got it on. You know, it's so variable ... So, we're trying to look at some of those descriptive elements as to how do you make them a bit better, because you could follow the cooking instructions and get ill, let's be honest ... So, there is scope to improve that. But yeah, we've got the right people looking at that."
	S006: "We would use much more subjective, I think the real-, you know, I don't think there's an expectation that every consumer would have a probe and, and use it ... And then I think the other thing to add to that all of those recipes are also validated themselves. So, our teams have done lots of work in that, you know, if it says cook for 10 minutes, then we know that if it's cooked for 10 minutes in the way that we said it should be, then it will be cooked adequately."

Continued on the next page.

TABLE 2. Stakeholder discussions related to supporting roles within the industry, with a particular focus on risk mitigation through temperature control (cont.)

Theme: Ensuring Safe Food in the Meal Kit Industry

Subtheme	Supporting Quotes
While it is important to communicate food safety guidance, the recipe card itself is not a legal document.	S004: "Not the recipe cards, um, it tends to be on the packaging, because the packaging is the legal document in reality. Our-from my experience- actually, our recipe cards are maybe not doing enough, to be quite honest... where previously, it was looked after by a proposition team of development chefs and stuff like that, they don't actually know as much around the legalities of label [decks] ... Most of the recipe cards are cooking instructions as opposed to legal declarations ...
	S006: "So, while at the company, I think there's always been a message on there around [food safety guidance] ... And then as we've, you know, we've evolved those as well, as we've learned from, um, from our customers ..."

could have elapsed when the courier delivered it and when it was collected and unpacked by the consumer (see Table 3). In the current study, response bias was considered as one of the limitations, including recall bias, where the participant may omit details or have a poorer memory when recalling events (15). Occasionally, it was found that a participant would refer to 'always' being at home when the meal kit was delivered and then later recall arriving home to collect it, which could be explained by consumers' discussing typical behavior as opposed to a one-off event; however, this could still be a bias of the discussion.

When exploring consumers' attitudes towards the cooling materials, such as the ice packs and delivered perishable foods, attitudes were generally favourable, with few discussing any issues (see Table 3). Discussions related to the food feeling 'cold', with a similar term (cool) highlighted by Hallman et al. (38) as a poor indicator of whether a food is being held at a safe temperature. Later research by Hallman et al. (39) investigated consumers' experiences and expectations with online meat vendors, which found that consumers had positive perceptions and perceived a low risk associated with fresh or frozen products delivered by a package delivery service. Furthermore, a European study examined the subjective experience of consumers' tactile senses around refrigerated foods, concluding that consumers should not rely on tactile senses (touch) to measure refrigerated foods. Consumers could not always distinguish between 4°C and 8°C (39-46°F) (8), increasing potential risk as low temperatures can still harbour or accelerate the growth of specific pathogens (38).

Regarding the cooling method, discussions indicated that ice packs are typically used with an insulated box, bag or, sometimes, sustainable packaging such as wool; while any cooling method could be used as long as temperatures were kept at recommended levels and passed validation (see Table 2). While temperature fluctuations may occur through

operational activities such as distribution, food must be supplied at recommended levels that are unlikely to support pathogenic growth, the formation of toxins, or give rise to a health risk (48, 56). Previous research in North America examining meat vendors and meal kits has indicated that surface temperatures of animal proteins often exceeded recommended safety temperatures (39, 57), potentially increasing the risk of pathogenic growth (14).

Given the possible temperature fluctuations, extended transportation of foods, and an increased likelihood of ingredients not being refrigerated immediately following delivery, a study determining the surface temperatures of perishable ingredients upon delivery of meal kit recipe boxes, which has yet to be conducted in the UK, could prove insightful.

Cooking with meal kits: Perspectives on subjective indicators and temperature probe usage

Previous research indicated that subjective indicators for cooking meat were the primary communication on UK meal kit recipe cards, as opposed to recommending internal cooked temperatures (54), which is more commonly found on the US meal kit recipe cards (55). Industry stakeholders acknowledged the subjective cooking instructions on UK meal kit recipe cards (see Table 2), supporting consumers' preference for subjective indicators rather than using a meat thermometer to assess when meat is safe to eat (see Table 4). The most common indicator for checking 'doneness' of meat, discussed by consumers in the current study, were typically visual cues:

C005- "...I would just go by kind of go by eye and experience"
C019- "...it's not pink in the middle"

Earlier literature has indicated that subjective indicators are unreliable for assessing when meat is cooked fully (43, 46, 70).

TABLE 3. Consumer attitudes and perceptions regarding the ice packs and chilled food delivered via meal kits, including ordering meal kits during the warmer months and unboxing perishable foods at home

Theme: Chilled Food Safety Practice

Subtheme	Supporting Quotes
Perception of the cooling media, insulation and chilled foods	C012: "I think so, yeah. Every time. Like if they weren't, if I was picking out meat- out that box and it didn't feel very cold, I'd have noticed that, you know, that's, that's something that I'd be like 'yikes', you know, that, that would've put me off very quickly. Um- but it, the way it's packaged and all that it does, you feel relatively, uh, you know, and I've never had a problem ..."
	C022: "No, never, no. They've always been intact, and my food is always cold when it comes."
	C027: "And it's, it's got all the ice packs in there anyway, so, you know, it was kept cold ... Even if you do miss the delivery or you're not in and it's on your doorstep you know it's the, they do tend to pack them well with enough of them. And, and the size of them is good, so."
Questions raised about warmer weather	C003: "However, I was ordering in December and January and time of the year with frost and cold weather. I didn't mind, but if I was doing through summer months, I had a question mark on the refrigeration or storage of that product specifically for me because I'm not at home during the day."
	C013: "I've never opened something and thought, 'oh, this smells off', or, you know, 'I'm worried about this' ... I would have to say when it's very hot in the summer ... I wouldn't order them if I knew I wasn't gonna be in."
	C014: "So, if it was a hot summer's day for example, I think we'd be a lot more like 'we need to get it in quickly'. But over the winter and stuff, it's been absolutely fine."
Food safety behavior related to unboxing the meal kit	C004: "But either way, if I'm home or if I'm not home, once I've received the delivery notification it's there, I bring it in and just unpack it on the table, make sure everything's there, and then pack it away in the fridge and stuff."
	C007: "Yeah, it'll depend what time of the day it's delivered at. So sometimes I'll take it in, set it in the kitchen and then leave it there for a few hours without actually unpacking it. Just if I'm busy or whatever ... and then when I open it, I always put the chilled items into the fridge first."
	C020: "Um, not particularly. I just, uh, no. Unless there's sort of a- if there's stuff that needs to go in the fridge. We know that then, possibly. But usually, it just sits on the side. It's a fairly cool kitchen, so..."
	C025: "Well, everything's seems to be that chilled when you take it out and the ice packs are still frozen. And in fact, we've taken stuff, so we've had a delivery one day and then the following morning we've taken it on holiday with us without unpacking."

Prior observational research from the US and Europe, including cooking beef patties and poultry, indicated low rates of thermometer usage among consumers (7, 9, 27, 64). All commented on consumers relying on visual indicators of doneness for meat and poultry. However, in the current study, using a meat thermometer was not completely ruled

out, but use was mostly infrequent, and the preference appeared to be for larger cuts of meat rather than smaller cuts of meat typically included in a meal kit recipe box (see *Table 4*). When providing consumer food safety advice for cooking, the UK guidance encourages using a meat thermometer as best practice to determine when high-risk food products are

TABLE 4. Consumer food safety attitudes and behavior towards using a meat thermometer and assessing when meat is cooked

Theme: Food Safety Practice & Cooking

Subtheme	Supporting Quotes
Using a meat thermometer was primarily either non-existent or preferred for larger cuts of meat	C010: "I can tell if it's cooked by other means. I don't need a probe to tell me that."
	C012: "If I was cooking like a big leg of lamb or a big joint of meat, I might, I'd do that if I was roasting something, I'd use, you know, if I had one, I'd use it."
	C016: "No, not unless I'm doing like a massive joint on the weekend. Nothing to do with these sorts of meals, no."
	C024: "No. Only a turkey at Christmas."
Preference to rely on subjective indicators of 'doneness'	C006: "Depending on what it is, obviously things like steak you can tell by cutting it and checking the color. Everything I cook, I sort of cut in half and see if it's cooked through so making sure it's the color it should be and [inaudible] if it's hot, it's cooked."
	C008: "So yeah, I would, if I was cooking chicken, then I would, just kind of stick a knife in and check the middle, make sure that the, that it's not pink, that the juices are running clear. Um, I would do steak, kind of cook medium rare anyway, so I wouldn't worry about that too much."
	C011: "Uh, no, I don't have anything that fancy; I just sort of cut it open if it, you know, if it's minced meat, it's, you know, you can see, and in chicken, as long as it's all white the whole way through, I sort of go by that."
	C017: "But I think it's, yeah, just experience and confidence with, with food that I kind of know my times."

adequately cooked (29, 32). Typically, the recommendation is above 75°C (167°F) for 30 seconds; but other time and temperature combinations can destroy harmful bacteria to prevent foodborne illness (29). However, visual and physical subjective indicators related to colour and 'piping hot' are also recommended. There are gaps in UK research regarding thermometer usage among consumers (24), and it would be interesting to explore, through an intervention study, whether including food safety guidance related to meat thermometer usage on meal kit recipe cards would impact behavior.

Concerning the recipe cards, industry stakeholders emphasised cooking validation, with one further explaining the difficulties that can occur due to the variables associated with consumers' cooking at home (see Table 2). Roccato et al. (69) followed label instructions for determining whether various heat treatments were sufficient for destroying pathogens in poultry cooking. The European study discovered that, while most label instructions provided safe poultry-based meal preparations, the application of insufficient cooking treatments did not result in the complete elimination of the

pathogen. The study concluded that an educational campaign could be recommended to promote safe cooking and time-temperature combinations to consumers (69). Given consumers' and industry stakeholders' reliance on subjective indicators to determine when meat or poultry is sufficiently cooked, it could be worthwhile to investigate whether the meal kit recipe cards are an adequate source of food safety information for cooking meat adequately.

Recipe card communication and engagement

One stakeholder acknowledged that more could be done to improve food safety communication, while another explained that there has been ongoing improvement, particularly in terms of consumer feedback (see Table 2). However, recipe cards are not legal documents and, while practical for providing food preparation instructions, do not require the same consideration that food packaging does from a legal perspective (25).

Previous research regarding UK meal kit recipe cards found that food safety guidance needed to be improved on

TABLE 5. Themes from consumer discussion focused on attitudes towards interacting with the recipe card and perception towards food safety guidance being communicated on the recipe card

Theme: Attitudes towards the Recipe Cards and Impact on Food Safety Behavior

Subtheme	Supporting Quote
Usually did engage with the recipe card but engagement may drop off with familiarity	C001: "Uh, I can be quite flexible sometimes if I prefer something done a certain way, then [laugh] I might do that instead. But yeah, it's, normally I'll look at the instructions and then I'll be like, okay."
	C003: "Yes, so, I do nine times out of ten. If there's something on there that I'm familiar with- if there's an ingredient or cooking that I'm not familiar with, yes, I would follow it. Or what I would tend to do is follow it for the first one and then once I get into swing of things, then just wing it."
	C027: "Yeah, for me, I just follow them anyway, even if I've done it a few times. But with [wife] once she's used it once or twice. She just does her own thing then and freestyles [laugh]."
Thought that Food Safety guidance on the recipe card could be relevant but may not necessarily influence behavior	C005: "So may- I say, 'Yes, I would.' But perhaps actually, I would just think to myself, well, I know. I know how to be safe. So, I don't think it'd be a bad thing for them to be on there, that's for sure. But I don't think I would necessarily act any differently just by reading them."
	C011: "I'll be honest with you, it probably depends how much information is there, if there's just like concise. But like I said, I noticed the keep refrigerated on the basil packets or the sell by, if you start putting reams and stuff on there, I'm not gonna read and it's probably not very responsible. But..."
	C016: "Um, just 'cause I read the recipe because there's a habit, I guess. So, if they were on there, I'd probably be like 'oh that would remind me.' Do you know what? It does say at the beginning 'Wash your fruit and vegetables' but I quite often do skip that, but [laugh] maybe they should put that in bold [laugh]."
	C020: "Uh, probably not, because I think a lot of its common sense."

meal kit recipe cards, and when it was present, it needed to be more detailed (54). For example, regarding handwashing, while advice was sometimes present on the recipe cards, the food safety information did not discuss best practice recommendations on how to perform handwashing and why it is an essential aspect of food preparation in reducing cross-contamination (30). Non-response bias was considered a limitation of the present study. While every effort was made to reach out to various industry stakeholders to explore roles within the meal kit industry, a low response rate to the call-to-action and direct messaging on social media resulted in lower numbers than anticipated. A more detailed perspective, particularly concerning the recipe cards, could have proven beneficial.

Consumer discussions indicate that individuals willingly engage with the recipe card during meal preparation, although with occasional flexibility, but after more familiarity,

engagement may drop off (see Table 5). When exploring whether food safety advice on the recipe cards would influence behavior, while the consensus was that including food safety advice could prove beneficial, consumers discussed how it might not necessarily influence behavior (see Table 5). However, previous literature has discussed when food safety guidance related to handwashing and thermometer use was inserted into a generic recipe; the observed consumer food safety behavior was significantly ($p < 0.05$) impacted (50). While familiarity may result in an engagement drop-off over time, there is the opportunity to build good habits related to recommended food safety practices. Mullan et al. (60) discussed an intervention study where cues to action and reminders encouraged recommended food safety behaviors to prevent cross-contamination, resulting in a sustained behavior change maintained over time.

Cooking skills can be learned, appropriated, and reassessed from various sources (37, 44, 53). It could be beneficial for meal kit recipe cards to include recommended food safety advice to consumers as an educational tool, which aligns with recommendations from previous literature that recommended food safety advice in popular cookbooks (45). Additionally, Maughan et al. (50) reported the positive impact that written communication had on influencing food safety practices during an observational study in the US. Building upon this, future observational research could be conducted in the UK to explore whether meal kit consumers engage with food safety guidance provided on UK meal kit recipe cards and whether this positively impacts consumer food safety behavior.

CONCLUSION

Despite the steady growth of meal kits in the UK, there has been limited exploration of food safety experiences and behavior in the present context. This research aimed to offer insights into the consumer perspective when engaging with meal kits and recipe cards in the domestic setting. Consumers explained their food safety practices when interacting with the meal kit at home. While one-off events or atypical recommended food safety behavior was sometimes discussed, most reported performing food safety practices positively. However, there were fewer indications of applying recommended safe cooking practices by utilising a meat thermometer to ensure a safe core temperature, preferring to rely on subjective indicators of 'doneness'. Many consumers positively perceived the cooling methods (e.g., ice packs) for keeping perishable foods cold. Furthermore, the study explored the roles of meal kit industry stakeholders who discussed their roles broadly, but also within the scope of food safety, including risk mitigation through temperature control and cross-contamination prevention.

Considering the study relied on self-reported food safety practices and attitudes towards engagement with the meal kit recipe card, it would be worthwhile undertaking observational research to investigate consumers' observed food safety behaviors within a domestic environment

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when engaging with meal kit recipe cards. Furthermore, while the study explored more in-depth experiences of meal kit consumers, it cannot make any generalisations towards the larger UK population of meal kit consumers. Consequently, utilising quantitative research methods to determine compliance with recommended food safety practices among meal kit consumers would be informative. The approach could highlight areas of improvement and help develop further educational food safety prompts to guide the consumer in making more informed choices when storing, preparing, and cooking meal kits at home.

The current study supports previous qualitative research on consumer food safety, in which consumers self-report mostly adhering to recommended food safety practices at home. However, previous research has established that self-reported food safety practices and observed behaviors do not always align. Therefore, there is a need for observational research to determine whether meal kit consumers engage with food safety guidance on meal kit recipe cards during meal kit preparation. This comparison can highlight areas where meal kit providers could improve guidance during meal preparation or provide additional resources to consumers.

ACKNOWLEDGMENTS

The research team wishes to thank the consumers and industry stakeholders who dedicated their time to the study. There is no contract between the meal kit providers and Cardiff Metropolitan University. Companies have not been named to maintain anonymity, and any conclusions made are based on the cumulative findings of the study.

CONFLICTS OF INTEREST

There are no conflicts of interest to report.

FUNDING

The study received funding from the ZERO2FIVE Food and Drink Research Unit PhD Studentship.

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IS YOUR PROGRAM CRUMBINE WORTHY? SUBMIT. SUCCEED. SHINE.

The Samuel J. Crumbine Consumer Protection Award for Excellence in Food Protection at the Local Level is seeking submissions for its 2026 program.

All local environmental health jurisdictions in the U.S. and Canada are encouraged to apply, if they meet the following basic criteria:

- Sustained excellence over the preceding four to six years, as documented by specific outcomes and achievements, and evidenced by continual improvements in the basic components of a comprehensive program;
- Demonstrated improvements in planning, managing, and evaluating a comprehensive program;
- Innovative and effective use of program methods and problem solving to identify and reduce risk factors that are known to cause foodborne illness; and



- Providing targeted outreach; forming partnerships; and participating in forums that foster communication and information exchange among the regulators, industry, and consumer representatives.

The award is sponsored by the Conference for Food Protection, in cooperation with the American Academy of Sanitarians, American Public Health

Association, Association of Food and Drug Officials, Food Marketing Institute, Foodservice Packaging Institute, International Association for Food Protection, National Association of County and City Health Officials, National Environmental Health Association, and NSF International.

For more information on the Crumbine Award program and to download the 2026 entry guidelines, please go to www.crumbineaward.com. **Deadline for entries is March 15, 2026**