Kitchen Life 2 Technical report

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KL2 involved collaboration between a wide range of organisations to design, deliver and review the study.

Basis Social were the lead partner and developed the overall study design, as well as delivered the survey, interviews, behavioural analysis and reporting. Special thanks goes to Darren Bhattachary, Mel Cohen, Rosemary Pierce-Messick, Dan Lemmon, Connie Flude, Emily Fu, Ingrid Broch-Due, Sheena Thakrar, and Matt Hellon.

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Smith and Geoff Beveridge.

An Advisory Group was formed to advise on the literature review and inform the study design. The Advisory Group comprised members from the Advisory Committee for Social Science (ACSS), external experts and FSA staff. It included Professor Julie Barnett, Professor Baruch Fischhoff, Professor Lynn Frewer, Julie Hill, Alec Kryakides, Professor Susan Michie, Dr Hannah Lambie-Mumford and Professor Kerrie Unsworth.

Finally, an ACSS Working Group was established to provide ad-hoc support on the study and particularly to review the reporting outputs from the study. Thanks are given to Professor Julie Barnett, Professor Fiona Gillison, Julie Hill and Dr Hannah Lambie-Mumford.

Background

Overview of Kitchen Life 2

The Food Standards Agency (FSA) commissioned Kitchen Life 2 (KL2) to understand food safety practices in household and food business operator (FBO) kitchens. The study aimed to provide observed behavioural data to inform risk assessment at the FSA, and actionable insights for policy and regulatory interventions through the application of behavioural science.

In 2013, the FSA worked with the University of Hertfordshire on a study - Kitchen Life - which sought to investigate, document, analyse and interpret domestic kitchen practices. The study generated insights about what goes on and why in UK domestic kitchens, to inform thinking about how to reduce the burden of foodborne disease.

KL2 was commissioned as digital technology provided new techniques for observing behaviour that were not available in 2013, which the FSA were keen to explore. Additionally, while the FSA had undertaken a range of research on consumer behaviour, such as through their flagship Food and You 2 surveys, this has focused on self-reported rather than observed behaviours.

KL2 was commissioned in February 2021 and completed in June 2023. The aims of the study were to identify:

- the key behaviours relating to food safety that occur in household and catering kitchens
- where, when, how often and with whom food safety behaviours occur and the key factors that influence these behaviours

KL2 had two main objectives:

- to provide highly detailed, real-life data for risk assessment at the FSA
- to inform future behavioural interventions research

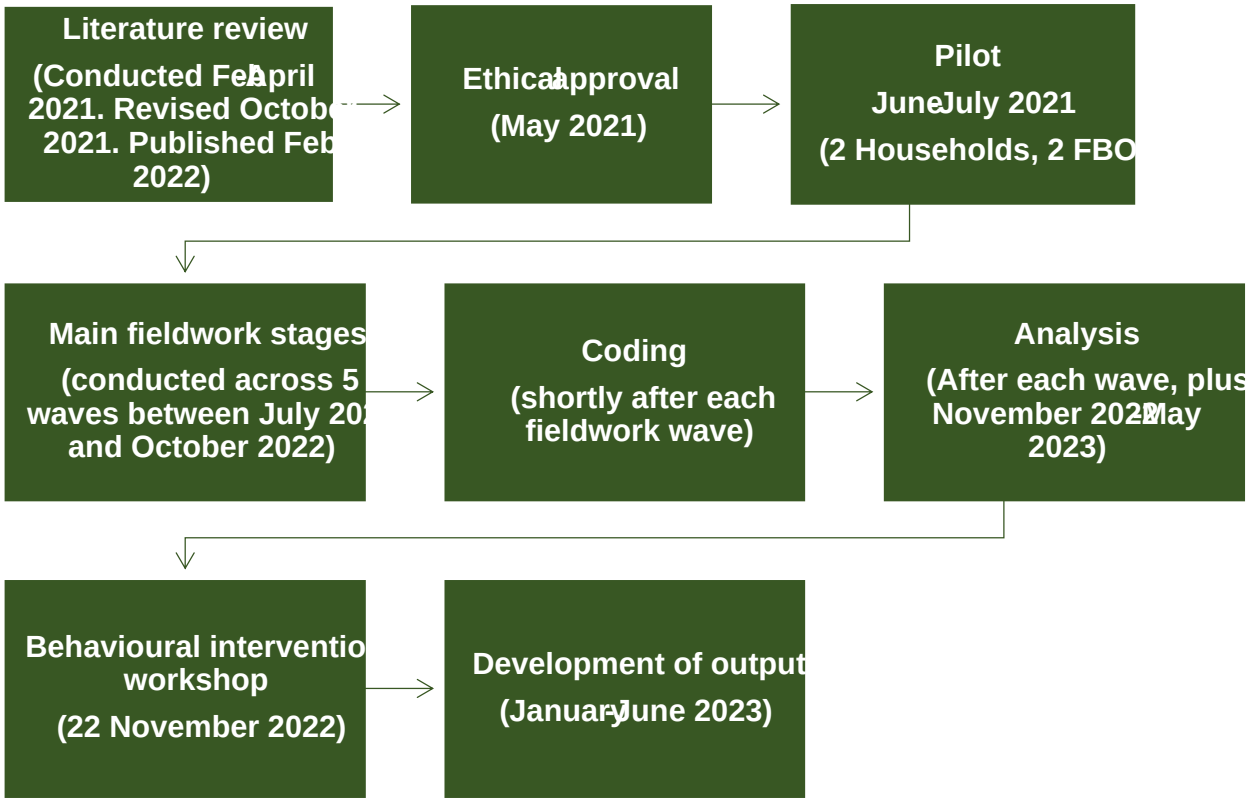
Overall, 101 kitchens participated in KL2, with 70 households and 31 food business operators (FBOs) taking part across England, Wales and Northern Ireland.

The study utilised a variety of data collection methods. After a literature review, ethics approval and pilot, the main fieldwork design involved the use of motion sensitive cameras to film participants in their kitchen over five days (in some kitchens, 7 days where technical issues impacted filming), with three days of footage analysed from this period.

The footage was coded, with analytical labels applied in terms of the behaviour (for example, washing hands with soap), person (for example, chef) and context (for example, sink, utensils). Surveys, interviews and observational methods were then used to understand influences on food safety behaviours – analysed using the COM-B behavioural model (footnote 1).

Experts in food safety policy, behavioural sciences and communications were then involved in a workshop to discuss findings and consider behaviours to target for future interventions.
The overall research process is summarised in figure 1.

Figure 1: The KL2 research process



Information about this report

This report provides detail of how the methodology was developed and delivered for KL2, together with the various processes used to quality assure the research. The report covers:

- project development, including the literature review, behaviours selected for research, the initial research design, and findings and recommendations from the pilot
- main fieldwork stages, including sampling, recruitment, and fieldwork design
- the coding and analysis of various data collected throughout the study, including use of the COM-B framework
- a behavioural workshop, involving specialists in the area of food safety, consumer behaviour and risk perception to develop hypotheses for future behavioural interventions research
- reporting and outputs
- ethical considerations and consent
- limitations of the method

The following research materials are available on request (please contact the FSA's Social Science team for further information):

- Screening materials
- participant consent forms and information sheets (for Households, FBO managers and FBO staff)
- exemplar interview topic guides (for Households and FBOs)
- survey questions (for Households and FBOs).

Project Development

Project set up

KL2 was commissioned in February 2021 and commenced with a 2-hour online set up meeting between Basis Social, the University of Leeds and the FSA's social science team. The meeting discussed:

- the aims and objectives for the study, with time spent understanding how outputs would be used to inform risk analysis, policy and behavioural interventions
- ethical implications of the research, together with data security and governance processes
- quality assurance processes and responsibilities for each partner
- the project delivery plan, key factors that will influence the project's success, and risks to be considered and addressed

After the set-up meeting, a project status document was developed and provided to the FSA on a weekly basis, to show progress against objectives and milestones. This was linked to weekly management meetings held between the FSA, Basis Social and Leeds University to discuss and resolve challenges in delivery.

After the project set up meeting, an Advisory Group was also established to feed into the literature review and inform the study design. The Advisory Group comprised:

- Professor Julie Barnett, ACSS member and Professor of Health Psychology at the University of Bath
- Professor Baruch Fischhoff, Howard Heinz University Professor in the Department Engineering and Public Policy and Institute for Politics and Strategy at Carnegie Mellon University
- Professor Lynn Frewer, Professor of Food and Society at the Newcastle University
- Julie Hill, ACSS member and Chair of the Waste and Resources Action Programme (at the time the Advisory Group was established)
- Alec Kryakides, Independent Food Safety Consultant and Chair of the British Retail Consortium Global Standards (BRCGS)
- Professor Susan Michie, ACSS member and Professor of Health Psychology, University College London
- Dr Hannah Lambie-Mumford ACSS member and Senior Lecturer, Department of Politics and International Relations, University of Sheffield
- Professor Kerrie Unsworth, ACSS member and Professor of Organisational Behaviour at Leeds University Business School
- Michelle Patel, Deputy Director of Science Evidence and Research, FSA
- Anthony J. Wilson, Microbiological Risk Assessment lead, FSA

In addition to the Advisory Group, an ACSS Working Group was also set up to provide ad-hoc support on the study and to help review outputs from the study, in particular the chapter reports. Members of the ACSS Working Group were:

- Professor Julie Barnett, ACSS member and Professor of Health Psychology at the University of Bath
- Professor Fiona Gillison, ACSS member and Professor of Health Psychology at the University of Bath
- Julie Hill, ACSS member and Chair of the Waste and Resources Action Programme (at the time the Working Group was established)
- Dr Hannah Lambie-Mumford ACSS member and Senior Lecturer, Department of Politics and International Relations, University of Sheffield

Specific activities of the Advisory Group and ACSS Working Group are discussed at relevant sections of this report.

Effective project management and quality assurance processes were fundamental to the delivery of KL2. Documents concerning the procedures and methods used in the research project were drafted to promote the integrity and security of the study. Different quality assurance protocols are discussed at relevant sections of the technical report.

Literature review

The first stage of the project involved a literature review, conducted by Leeds University Business School. The review was conducted to explore existing research on key behaviours relating to food safety that occur in household and FBO kitchens, as well as the factors that may reduce the likelihood to enact recommended food safety behaviours. The literature review ensured that the KL2 research design and fieldwork techniques accounted for existing key behaviours, actors, enablers, and barriers to food safety in household and business kitchens.

To identify relevant research papers, the Scopus and Web of Science databases were searched. The following keywords were used as search terms in the "title, abstract and keywords" function: "Food safety", "kitchen safety", "kitchen behaviour", "food hygiene", "kitchen hygiene", "foodborne illness", and, with additional search terms "risk behaviour", "risk perceptions," and "Covid*" (footnote 2). The date range was set from 2013 to 2021.

The search was confined to peer-reviewed empirical and review articles only, and excluded book chapters, dissertations, etc. Cited reference searches using Google Scholar were conducted on relevant articles, to identify other empirical and review papers that were not captured by the keyword searches. Inclusive of FSA reports, there were 1860 papers that met the search protocols. Further filtering was carried out to assess the suitability of the articles for inclusion in the literature review. For instance, articles that included technical food risk assessments, or highly specialised topics irrelevant to the enquiry were excluded from the literature review. Additionally, articles with a sample from outside of the UK, Europe, and North America were excluded. This screened the total number of relevant papers to 135.

Due to the limited number of relevant research papers published during the COVID-19 pandemic, the literature search was supplemented by conducting in-depth interviews with seven experts, to learn from their work and research-related knowledge and experiences during the pandemic. Four of the expert participants were academics working on food safety and risk assessment, whereas three others were practitioners working at the FSA. All of the participants had extensive experience with COVID-19 related research and/or practice on food safety behaviours in kitchens.

Interview participants gave informed consent prior to inclusion in the study. Interviews were conducted over Zoom and Microsoft Teams and lasted 45-60 minutes. As a thank you and appropriate recompense for their time, each participant was informed that they would be provided with an executive summary report detailing the findings of the literature review.
The expert interviews were structured by a topic guide. This started with a general question asking participants in what ways behaviour in household/business kitchens had changed during the COVID-19 pandemic compared to pre-pandemic, based on the work/research they have done and/or been aware of. This question was followed with probes about behaviours in relation to cleaning, cooking, cross-contamination, storage, and use-by dates. The interviews were digitally recorded and transcribed, with findings informing the literature review by identifying any changes to kitchen practices post COVID-19.

The draft literature review received feedback and comments from the Advisory Group in April 2021, before a second review process and final publication in February 2022.

Research design

In April 2021, the implications for the research design were considered, accounting for findings from the draft literature review. The research design initially proposed by the Basis Social team comprised the following:

- the development of sampling, recruitment, consent, and ethical protocols and materials
- the recruitment of 35 households and 35 FBOs to take part in the research, selected to reflect various demographic and firmographic characteristics (for details, see sample frame)
- the use of photographs taken of fridge and freezer interiors to understand how food was stored (with particular reference to the storage of raw and ready to eat or cooked foods in fridges)
- for households only, the use of food diaries and photographs of shopping receipts to verify what foods were cooked during the week
- the use of motion sensitive cameras, placed in household and FBO kitchens, to record visual and audio data (hereafter observed data) related to food safety behaviours
- the transfer and housing of observed data onto a secure and searchable platform
- the coding of observed data to identify behaviours and their context
- the export of observed data into a database, and development of a dashboard to enable the quantitative analysis of this data
- the use of surveys and interviews with the lead participant (footnote 3) in each household and FBO to understand the factors influencing behaviour
- analysis of the barriers and enablers to food safety behaviours, using the COM-B behavioural framework

After the literature review, and in discussion with the FSA's social science and risk assessment teams, two changes were proposed to the method.

First, evidence from the literature review showed that household fridge operating temperatures were often well above the recommended range, with associated risks for food safety. Consequently, a decision was taken to use thermometers to record fridge and freezer temperatures as part of the KL2 study .

Second, and inspired by papers in the literature review, the risk assessment team were keen to verify the impact of behaviour on food safety, in terms of measuring the microbiological load on various kitchen surfaces. After exploring feasibility, it was not deemed possible to conduct microbiological tests due to logistical, procurement and timing challenges.

In addition to feedback from the FSA teams, the Advisory Group met on the 12th April 2021 to discuss findings from the literature review and consider other implications for the study design. The meeting was held online on the Teams platform. The Advisory Group were asked to identify potential areas of focus for the research, accounting for risk to public health, across the following areas:

- food safety behaviours
- food categories (for example, meat, fish, poultry)
- participant characteristics
- the balance between observable and self-reported behaviours, as certain food safety behaviours would be challenging to identify using filmed footage (for example, checking use-by dates)

The Advisory Group identified 33 behaviours to form the focus for observations in the Kitchen Life 2 study. Each behaviour was then assigned a risk rating by experts from the FSA risk assessment team, according to the microbiological risk that each behaviour posed in relation to foodborne disease. The behaviours were classified into one of five domains:

- Cleaning (for example, washing hands after touching raw meat, fish, poultry)
- Handling (for example, reusing a tea towel or dishcloth)
- Cooking (for example, checking food is thoroughly heated throughout)

- Storing (for example, storing foods at an incorrect temperature)
- Consuming (for example, eating foods past a use-by date)

At this time, the Basis Social team also agreed with the FSA the criteria to select behaviours to focus on in greater depth in the qualitative interviews. They were:

- whether the behaviour was observed
- risk rating (as identified by the FSA's risk assessment team)
- coverage across the five domains

The full list of behaviours, linked to the corresponding domain, can be found in the Appendix.

Pilot

A pilot was set up in June and July 2021 to test the research materials. The pilot involved 2 households' and 2 FBOs' kitchens, with the following profiles (based on lead participant):

- Household 1: Age group 26–40, White, lives with partner with no children, lower income
- Household 2: Age group 26–40, White, lives with family including two children aged under five years, high income
- FBO 1: European restaurant, 5-10 staff, 4–5 Food Hygiene Rating Scheme (FHRS)
- FBO 2: Indian restaurant, less than 5 staff, 0–3 FHRS. English was not the main language spoken in this restaurant.

The pilot specifically tested the following:

Recruitment process: one of the key aims for the pilot was to establish whether it would be possible to recruit FBOs to take part in the study, given the kitchens would be filmed and the work was carried out on behalf of the FSA. The pilot tested the effectiveness of the invitation and information to take part in the study, as well as incentive amounts.

Consent process: the pilot tested whether consent materials were understood, including specific terms and their meaning, as well as whether the overall consent process was clear.

Language barriers: while language was not a sample quota, the pilot also aimed to test whether the consent and research materials were understood where English was not the first language spoken.

Logistics and operational factors: participants had to undertake several tasks relating to the set-up of cameras and thermometers for recording purposes. This included the camera being mounted in the correct position, ensuring that the camera was connected to the WiFi, and the process for camera return. It also included placing the thermometers in the fridge and freezer, and process for their return. Protocols to support participants to undertake these tasks were tested during the pilot.

Research instruments: the pilot tested whether the various research methods and materials were clear, were easy to use, and provided the data required for the study. This included:

- the ease of taking photos for participants, and photo quality in terms of showing fridge and freezer storage details, and (for households only) details of shopping receipts
- the quality of the filmed footage and the behavioural tags assigned to the footage, and the process for the export of observed data into a dashboard
- whether the use of audio was required to develop insight for the study
- survey and interview questions, including whether questions were easy to understand or answer from a participant perspective, and whether they provided relevant behavioural information

- a special technique called a cognitive interview, which uses memory elicitation cues to provide greater contextual insight around behaviours of interest

Learnings from the pilot

There were several learnings from the pilot, which are summarised in table 1.

Table 1: Findings and research implications arising from the KL2 pilot.

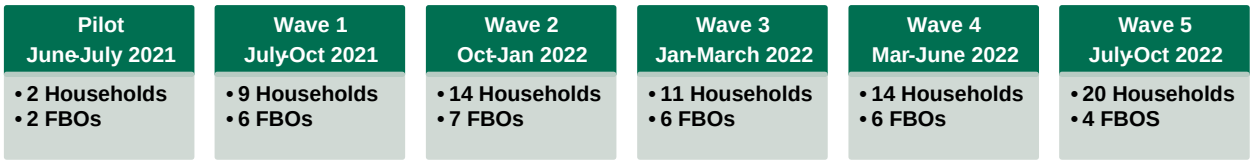
Issue	Findings	Research implications
Recruitment	While the consent materials worked, and were clear and easy for participants to understand, there were considerable difficulties in getting low FHRS FBOs to participate in the study.	To relax the quota for 1-3 FHRS rated FBOs to 5 in total and increase the incentive payments for FBOs.
Fridge Thermometers	The thermometers worked and were easy for participants to use. Data exports from the thermometers was simple, however, there were issues in correlating the temperature data to time stamps on the video footage.	A process was developed to enable time series correlation between the thermometers and footage.
Photos and food diaries	The photo and food diary tasks were easy for participants to complete. The photos provided useful contextual information on food storage. For households, photos of recipes, and food diaries were legible and provided helpful contextual information to verify the food groups identified in the coded footage.	Recommended to use fridge and freezer photos and (for households only) receipt photos and food diaries in the main study.
Observations and behavioural coding	The filmed footage was clear and captured a wide range of behaviours in the kitchen. However, contextual detail was needed to assist the analysis of behavioural codes in the platform.	Lifestream analysts were asked to produce descriptive notes of each cooking event to accompany coding. Given these notes contained personally identifiable information, they were only made available to the research team.
Audio	Audio provided invaluable context around the behaviours.	With participant consent, it was recommended to use audio in the main study. However, recording audio was not made a requirement for filming, and participants were allowed to opt out of audio recording and still take part in the research. A separate risk assessment was conducted by the FSA for the collection of audio data.
Survey and interviews	While survey and interview questions were mostly effective, in some instances questions were too broad to understand specific behavioural influences.	Changes to survey and interview questions were made to provide a more systematic focus on the capability, opportunity and motivation factors concerning behaviours of interest.
Cognitive interviews	It took a significant amount of time to conduct the cognitive interview, and there were specific issues around its effectiveness for FBOs.	Recommended not to use in the main study.

After the pilot, changes were made to the recruitment materials, data collection processes and research materials as noted above, including changes to the survey and discussion guides. The pilot was deemed successful by the FSA, and the target sample size was increased from an original target of 70 to 100 kitchens (see further details in the Sampling section).

Main fieldwork stages

A summary of the number of households and businesses engaged in each wave, together with the timing of fieldwork, is given in figure 2 below. Across the whole study, this was a total of 70 household and 31 FBO kitchens in the achieved sample captured between June 2021 and October 2022. Collecting data at different times of the year ensured that the project captured a greater range of cooking practices and meal types (for example, summer meals compared with winter meals).

Figure 2: Summary of research waves, dates and participant numbers



Sample

Following a successful pilot study, the target sample was increased from 70 to 100 kitchens in total (inclusive of the kitchens within the pilot study); with a target of 60 households and 40 FBO kitchens. However, due to challenges recruiting FBOs during fieldwork, the target sample size was changed to a 70:30 split respectively after wave 3 of the research. The increased sample size was believed to provide:

- a breadth of demographic and firmographic characteristics within the sample
- a depth of sample, to capture sufficient data on behaviours of interest (particularly raw meat, fish, poultry preparation) and their influences, and develop robust insights from the research
- value for money, relative to the budget for the study overall

A range of socio-demographic and firmographic variables were identified to recruit households and FBOs respectively (see tables 2 and 3). While household recruitment was successful, the challenges involved recruiting FBOs also meant that quotas on sample size and sample characteristics were relaxed for FBOs after wave 3 of the research. Specifically, the total sample size for FBOs was reduced to 30, and soft quotas (whereby a best effort was made to meet the quota) was introduced on three sampling characteristics:

- FHRS rating 0-3
- Location
- Inclusion of institutions such as schools or care homes

Further details on challenges with recruitment are discussed in research limitations and challenges section.

Table 2. Sampling considerations for households

Characteristics	Sampling considerations	Sample quotas used in the study
Age and gender	From the Food and You survey, males aged over 60 years and females aged over 75 years are likely to report less safe kitchen practices vs the Index of Recommend Practice (IRP) (footnote 4). Older people are also more likely to be vulnerable to food pathogens. Women are also more likely to prepare and cook food.	Age group was used as a recruitment quota. Gender of the lead participant, was used to ensure spread across the sample, though not used as a sample quota. The gender of each household participant was coded in the database.
Ethnicity	There are fewer practices in line with the IRP reported among non-white groups, defined as Black, Asian and Other, in the Food and You survey.	Ethnicity was used as a sample quota, focusing on White, Black and Asian groups.
Socio-economic variables	Socio-economic variables such as social class, education and income are not significant predictors of IRP score in the Food and You survey. However, FSA research on food insecurity has highlighted increasing numbers of consumers being forced to make difficult choices when it comes to food, which in turn may influence behaviours with regard to use-by dates.	Income (households with an income of less than £26,000 vs those above) was used as a sample quota.
Household composition	Food and You indicates that households with at least one child aged under 5 were more likely to report behaviours in line with the IRP than other households. Additionally, people who are single, widowed or divorced are less likely to report practice in line with the IRP than those married or living or cohabiting in a relationship. The Kitchen Life study also notes non-related multioccupancy households (for example, students or house sharers) as a noteworthy area for further Research.	Households with children (including those where at least one child was under 5 years), as well as single, cohabiting and muti-occupancy households were included as sample quotas.
Diet	FSA research shows a range of foodborne illnesses are specifically concerned with the handling, preparation, cooking, storage and reheating of meat, fish and poultry (MFP).	Diet of household members was used as a sample quota, with a minimum quota on households where at least one person ate MFP.
Groups with reduced immunity	FSA research (PDF) notes there are several 'reduced immunity' groups more vulnerable to food risks. These include cancer patients; patients undergoing immunosuppressive or cytotoxic treatment; unborn and newly delivered infants; people with food hypersensitivity; pregnant women; diabetics, and those with alcoholism and/or alcoholic liver disease.	Given their prevalence in the population, food hypersensitivity was selected as a sample quota.

Characteristics	Sampling considerations	Sample quotas used in the study
Region	The remit of the FSA cover England, Wales and Northern Ireland. Additionally, Food and You indicates people living in the North West, East Midlands and Northern Ireland all report behaviours more in line with recommended practice than those living in London.	Quotas were set for England, Wales and Northern Ireland.

Table 3. Sampling considerations for FBOs

Characteristics	Sampling and fieldwork considerations	Sample criteria used in the study
Food business type	Research (PDF) has shown that the type of food establishment and associated service models can influence food safety practices.	Quotas were set for different catering establishments, including restaurants, takeaways, catering establishment and institutions.
FHRS	FSA research shows that FBOs with higher FHRS ratings are less likely to have microbiological contamination or encounter outbreaks.	FHRS ratings (1-3 vs 4-5) were set as sample quotas.
Cuisine	It was hypothesized that cultural practices across different cuisines may also affect food safety.	Cuisine was monitored to ensure a diverse group of FBOs, though not set as a quota.
Size of business	Size of establishment was hypothesized to influence the extent to which food safety policies and procedures may be in place in FBOs.	No quotas were set for business size, though the sample was monitored to ensure a spread across micro, and small enterprises. Medium and large businesses were not included in the study due to challenges in gaining informed consent from all staff.

The final achieved sample was 70 households and 31 FBOs. For details on the achieved sample, see Appendix (tables 6 and 7).

Recruitment

All recruitment was undertaken by the recruitment agency Fieldsauce. For FBOs and households, Fieldsauce's proprietary contact databases were used in the first instance to contact via email or phone. This was supplemented by contacting participants face-to-face to boost numbers. Fieldsauce also worked with the recruitment agency Acumen to help recruit FBOs.

Incentives

Incentives were used to encourage participation in the research. Incentive payments were staged, and linked to the completion of the following tasks:

- completing filming and returning the camera hardware
- taking photos of a fridge and (for households only) completion of a food diary
- completing a survey
- completing an interview

If all tasks were completed, the incentive was £205 for households, and £490 for FBO managers/owners. Payment was handled by Fieldsauce, with bank details password protected and sent via secure transfer, and bank payments made directly by BACS.

An additional incentive for FBO staff was introduced to help boost FBO participation from wave 3 of the study onwards. Specifically, with each member of staff paid £50 for their participation or provided with a £50 gift voucher (depending on choice, to mitigate against participants with concerns about handing over bank details). Further information about recruitment is provided in the final chapter of this report 'Research limitations and challenges'.

Quality assurance and recruitment

Weekly updates were provided to the FSA on recruitment throughout the fieldwork period, and weekly discussions were held both with FSA and the research team to discuss progress and

recommend any changes to recruitment practices or quotas. Due to challenges recruiting FBOs, at the end of wave 3, a review was undertaken to identify specific points in the recruitment process where attrition was high, and develop solutions. As well as providing incentives for FBO staff, this also included the provision of anonymised testimonials from other businesses that had taken part in the research, and sub-contracting another fieldwork agency (Acumen) to support recruitment.

Records were kept of all participant consent materials, and held securely on a restricted drive with access only for the research team. A log was created to monitor whether consent had been achieved for each member of the household or food business. Logs were checked on a weekly basis by the Basis Social team.

Checks on the quality of the sample were also undertaken during the fieldwork period during interviews. As well as visual checks, quotas were also confirmed verbally via responses to various questions (for example, concerning household diet or composition, or FBO type or size of business). Protocols were in place to raise any discrepancies with the Project Director and discussed with the Fieldsauce team.

Fieldwork design and implementation: households

Fieldwork for households involved 5 stages, illustrated in figure 3.

Figure 3. Fieldwork in households

Camera and thermometer installation

The initial stage of the fieldwork involved setting up the hardware for the project. Cameras and thermometers were sent to participants via post, together with detailed instructions on how to set up and use each device.

As part of this process, tests were undertaken of household internet speeds to ensure videos could be streamed to Lifestream's servers. All household participants in the study had broadband speeds of 5.5 mbps or above allowing filmed data to be encrypted and uploaded on the secure video analytics platform in real time. This process eliminated the need to store the footage in a memory card, reducing the risk of footage being lost or stolen.

To capture relevant behaviours on film, the position of the camera was important. The field of view ideally needed to include the sink and the cooking areas, as well as food preparation and food storage areas (including the fridge). To locate the best position of the camera, at the recruitment stage, participants were asked to take a series of photographs of their kitchen which were sent securely to the recruitment agency Fieldsauce. At the point of set up, Fieldsauce telephoned the participant to advise on the correct position for the camera, before a live test was conducted, and any minor adjustments to the camera position made.

In three kitchens, due to their size or layout, capturing a range of kitchen areas within a single camera position was not possible, and cameras were moved during the week to a different

position.

Fridge and freezer thermometers were provided to participants to collect data on the temperature of both appliances. Thermometers were very easy to use and install and involved turning the devices on and placing separate devices on to the middle shelf of the fridge and freezer.

Instructions for the return of hardware were also provided. Return was pre-paid and participants were financially incentivised to complete this task within three days of filming completing.

Photographs of fridges, freezers and shopping receipts, and the completion of food diaries

After setting up the camera, household participants were also asked to complete two photographic tasks. The first was to take a photograph of the inside of their fridge and freezer. These photographs were used to understand the extent to which appliances may be crowded, which could potentially influence temperature of the appliance and space to store chilled foods. They were also used to examine whether raw and cooked or ready to eat foods were stored adjacent to one another, presenting risk for cross contamination.

The second photographic task was to take a picture of the receipt of the main weekly shop, or to email an electronic receipt in the case of online shopping. This was used, together with a food diary, to help verify the ingredients used for different meals, and to check coding of the filmed footage.

Households were also asked to complete a food diary. This used a very simple template comprising the day of the week and what was eaten on one of three meals - breakfast, lunch and dinner meal. Snacking behaviours were not recorded in the food diary.

Photos and the food diary were sent to Fieldsauce via WhatsApp, or electronic receipts sent via email, before being upload to a secure drive.

In terms of quality assurance, photos were assigned a participant ID and uploaded by Fieldsauce, and a log (Excel file) was used to record when the task was completed. Checks were made by the Basis Social team to ensure that all participants had completed the task, and that the photographs were accurate (i.e. of the correct item), and the images were clear and legible.

Filming of behaviours and monitoring of fridge and freezer temperatures

Filming was undertaken to record food safety behaviours in as close to real life settings as possible. Filming in households kitchen occurred over 5 days and included the weekend. Three days of footage was analysed, to limit the amount of data that needed to be coded, and also to reduce social desirability bias (with the first day of filming not used so that participants became more familiar with the presence of the camera in the kitchen). A spread of all weekdays was captured across all kitchens in the sample.

Cameras were motion sensitive and would record when any movement was detected in the kitchen and run for 30 seconds after the last movement was detected. Data was streamed in near real time to the Lifestream servers.

In terms of quality protocols for filming, checks on video footage during the fieldwork period were undertaken by Lifestream who viewed the footage to ensure image quality. Guidance was provided by telephone to participants in the event of a problem (for example, the need to reposition a camera).

Separate quality checks on video footage were undertaken by the Project Director at Basis Social at each wave, across a random sample of kitchens. This was to ensure protocols around image quality, camera angle, the exclusive observation of food behaviours, and privacy had been

adhered to.

Fridge and freezer temperature data was passively collected, stored on the device and downloaded after the device was returned to Lifestream. Fridge and freezer temperature data was collected for 65 households and 29 FBOs (with 5 households and 2 FBOs not installing the thermometer). Temperature data was collected throughout the whole five-day period, with a reading taken on the device every 10 minutes. In terms of temperature quality assurance protocols, for each household, Lifestream checked the temperature data after downloading to assess data coherence (see data analysis section).

Survey

After filming was completed, participants were asked to complete a household survey. This used closed answer questions to explore participants' understandings, beliefs and attitudes to a range of food hygiene issues.

Survey questions mainly related to capability and motivational influences on behaviour and focused on the following themes:

- Capability: How to judge when food is cooked (skills); how to judge when reheated food is hot enough to safely consume (skills), how to prepare raw foods (skills) understanding of how to use use-by dates (knowledge), and understanding of safe fridge and freezer temperatures (knowledge)
- Motivation: Attitudes to, and general beliefs about food safety including risks associated with specific foods; which sources of information on food safety participants trust; risks associated with various food preparation practices (for example, not washing hands after touching MFP, using the same knife to cut vegetables after cutting raw meat)

In addition, the survey was used to capture self-reported behaviours that were not amenable to being recorded on film. This included the frequency of washing tea towels, cloths, and sponges, which was often done out of the camera field of view. Additionally, it was not possible to verify using filmed observations whether use-by dates were read and how these were used, and survey information was collected on this.

In terms of quality protocols, survey questions were developed in collaboration with the FSA and Leeds University and, where possible, question wording was matched to existing FSA research (for example, Food and You 2) or other relevant academic studies.

The survey was administered to household participants via the SurveyMonkey platform and tested during the pilot phase. Survey responses were checked for flatlines, and verbal confirmation of certain responses were also checked in interviews. The length of the survey was less than 10 minutes.

Online interviews

The final stage in the fieldwork process involved an online interview with the lead participant in the household. Interviews lasted up to 90 minutes. The interview was used to understand broader contextual factors shaping food safety practices, and the barriers and enablers related to specific behaviours. Interviews also allowed researchers to compare perceived, self-reported behaviours with behaviours observed in the footage.

The interview was structured in two parts following a household discussion guide.

The first part of the interview used questions that were common across all households, and covered:

- the home context, such as who they live with, what they do, what their home is like
- attitudes to cleaning and food safety
- what food was cooked during a typical week
- the extent to which food safety was a concern

The second part of the interview used questions tailored to observations in each household and focused on three behaviours of interest.

To identify the behaviours and associated questions, the following 3-stage process was adopted.

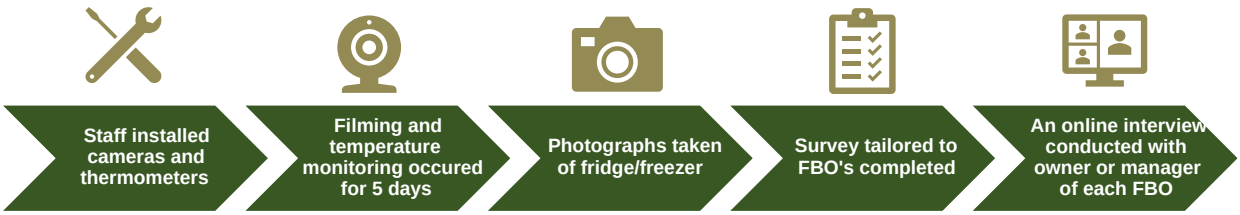
1. Post filming and the coding of the videos, a dashboard which displayed quantified observed data was used to identify candidate behaviours to deep dive into. Different behaviours in each household were selected in line with the criteria described in the research design section, namely: the frequency to which the behaviour was observed and the risk rating of the behaviour. Additionally, behaviours were checked against those covered in other interviews to ensure a coverage across the five domains of interest for the FSA (cleaning, handling, cooking, storing and consuming)
2. Three behaviours were selected to review in depth, and the footage of each behaviour was re-examined. This involved the researcher conducting the interview rewatching the cooking event repeatedly to understand the behaviour and its context. Videos could be paused or slowed down to observe filmed footage in detail and develop hypotheses on potential influences
3. Questions were then tailored to each behaviour of interest, using the COM-B framework (see the analysis section for details of how COM-B was used)

In terms of quality assurance, interviews followed a discussion guide that had been developed in partnership with Leeds University and approved by the FSA. As each interview would differ depending on the behaviours of interest, exemplar questions were developed to ensure consistency across the sample, and, when exploring influences on behaviour, to ensure different COM-B factors had been systematically covered. The Project Director undertook random spot checks on 5 interview recordings per wave.

Fieldwork design and implementation: FBOs

Fieldwork for FBOs also involved 5 stages, illustrated in figure 4.

Figure 4. Fieldwork for FBOs



The fieldwork process and quality assurance protocols for FBOs were the same as households with the following exceptions.

Camera and thermometer installation

For three FBOs, low internet speeds and/or the physical location of wireless router relative to the kitchen meant that the camera footage could not be streamed. These FBOs were provided with an encrypted 4G dongle and a memory card to capture footage. It was not possible to use encrypted memory cards, as they were not supported by the camera hardware. Instead, the memory card was sealed in the camera with tamper proof tape. Consent forms and participant information sheet were amended accordingly, based on guidance from the FSA's Knowledge and

Information Management team.

Additionally, several FBOs had more than one fridge or freezer. For the installation of thermometers, they were asked to select the appliance in the field of view of the camera. Where this was not possible, the fridges or freezers used for the storage of raw meats were selected. Thermometers were placed in the middle of the appliance.

Photographs of fridges and freezers

Photographs of fridge and freezer storage were collected from FBOs. However, other than filmed observations, no additional information was sought to verify the meals cooked. While collecting menu information was considered, this was rejected as it was not possible to clearly identify each ingredient or dish relative to a menu item. Asking FBOs to provide a record of all meals served was deemed too onerous by the research team.

Filming of behaviours and monitoring of fridge and freezer temperatures

Filming in three FBOs took place over 7 rather than 5 days. This was done in two ‘home catering’ FBOs that used a household kitchen to cook takeaway food. As the kitchen was used for a business purpose only on certain days of the week, filming had to be extended to capture these moments. Additionally, filming was extended in one FBO kitchen due to a limited number of food safety behaviours being captured on camera. The camera was repositioned to another part of the kitchen in this instance.

Camera angles were of particular concern within FBOs, due to the potential to inadvertently film customers or other members of the public during fieldwork. A three-stage process was put in place to ensure the camera was positioned to only film the kitchen area. This involved separate checks by the recruitment team at Fieldsauce, an analyst at Lifestream and a Director at Lifestream. For each FBO, the Project Director then reviewed the documented sign off process.

Additionally, FBOs were also asked to display notices that filming was taking place during the fieldwork period. The research team provided three notices to FBOs, and FBOs provided verbal and written confirmation that these notices had been displayed.

Survey

An FBO survey was administered to the FBO owner/manager after filming completed. Survey questions mainly related to capability, opportunity and motivational influences on behaviour and focused on the following themes:

- Capability: how to judge when food is cooked (skills); how judge whether foods are safe to eat (skills), understanding of anti-microbial resistance (knowledge)
- Opportunity: facilities present at the FBO, such as separate sinks for handwashing, blue roll, liquid soap, separate preparation areas for raw and cooked foods (physical opportunity); the use of food temperature probes (physical opportunity); whether the FBO offered or adopted various practices to promote food safety, such as the use of the Safer Food Better Business pack (physical and social opportunity), or staff training (physical and social opportunity)
- Motivation: attitudes to food safety and associated regulation, impact of COVID-19 on food safety practices (reflective motivation); attitudes to, and general beliefs about food poisoning (reflective motivation); risk associated with various food preparation practices (reflective motivation)

In addition, the survey was used to capture self-reported behaviours that were not amenable to being recorded on film. This included the frequency of washing tea towels, cloths, and aprons,

which was often done out of the camera field of view.

Survey questions were developed in collaboration with the FSA and Leeds University, and where possible, question wording was matched to existing FSA research (for example, Small and Micro Food business survey) or other relevant academic studies.

As with households, the survey was administered via the SurveyMonkey platform and tested during the pilot phase. Survey responses were checked for flatlines, and verbal confirmation of certain responses were also checked in interviews. The length of survey was less than 10 minutes.

Online interviews

The final stage in the fieldwork process involved an online interview with the owner or manager of the FBO. Interviews lasted up to 60 minutes (interview length was purposely reduced relative to households, so it was less onerous for FBOs to take part). The interview was used to understand broader contextual factors shaping food safety practices in the business, and the barriers and enablers related to specific behaviours. Interviews also allowed researchers to compare perceived, self-reported behaviours with behaviours observed in the footage.

Interviews were structured in two parts, following a FBO discussion guide.

The first part of the interview used questions that were common across all FBOs, and covered:

- about the business, including cuisine, number of staff, culture of the business, current trading
- what food was cooked during a typical week
- attitudes to food safety and the extent to which food safety was a concern

The second part of the interview used questions that were tailored to observation in each FBO, and focused on three behaviours of interest. To identify the behaviours and associated questions, the following 3-stage process was adopted, mirroring the process in households.

1. Post filming and the coding of the videos, the dashboard was used to identify candidate behaviours to deep dive into. Different behaviours in each FBO were selected in line with the criteria described in the research design section, namely: the frequency to which the behaviour was observed and the risk rating of the behaviour. Additionally, behaviours were checked against those covered in other interviews to ensure a coverage across the five domains of interest (cleaning, handling, cooking, storing and consuming) for the FSA

2. Three behaviours were selected to review, and the footage of each behaviour was re-examined. This involved the researcher conducting the interview rewatching the cooking event repeatedly to understand the behaviour and its context. As described for households, videos could be paused or slowed down to observe filmed footage in detail and develop hypotheses on potential influences

3. Questions were then tailored to each behaviour of interest, using the COM-B framework (see the data analysis section for details of how COM-B was used).

Data Analysis

In this section, the process of coding, analysing and interpreting data is described. There were three main types of data collected through the project:

1. observed data, collected via filming
2. passive data, collected through fridge and freezer thermometers

3. self-reported data, collected through photographs, food diaries, surveys and interviews

Coding of observed filmed data

Filmed footage was coded manually by analysts at Lifestream. This involved data labels being assigned to time stamped filmed footage. Each label corresponded to food safety behaviours and their context. The labels were derived from the list of FSA priority behaviours, as well as developed using a ‘bottom up’ approach, through analyst observations.

Data labels were produced on the following categories:

- Behaviours relating to food safety (for example, washing hands with soap, wiping hands on a cloth)
- Food groups (for example, meat, fish, poultry – MFP) and individual food items (for example, fish, white meat, red meat)
    - Note: “raw” and “cooked” MFP were not coded separately in the dataset
- Preparation, cooking and serving actions (for example, preparing food without heat, cooking with heat)
- Meal occasions (for example, lunch, dinner)
- Appliance (for example, oven, hob, microwave)
- Utensils (for example, knives, chopping boards)

In total,163 data labels were developed over the course of the project. These were tagged to 5,464 videos (footnote 5), with a total of 292,216 data labels applied to over 650 hours of footage across household and FBO kitchens.

There were several quality protocols in place to ensure videos were analysed accurately.

The first series of checks were undertaken by Lifestream’s Project Lead, together with their Content Analyst Team and Data Analyst. The process involved:

- a review and optimisation of the data label wording and how labels were assigned after Wave 1 of the research (conducted by the Project Lead, Content Analyst Team and Data Analyst). Specifically, for a random selection of labels, this looked at:
- the coherence between the name of the label and the footage to which the label had been assigned (for example, that the ‘cooking with heat’ label corresponded to footage of a participant using a hob or microwave).
    - consistency of how the label was applied (that the same types of behaviours were linked to a single label).
- a daily check on the data labels during coding and a review of notes written by analysts (conducted by the Content Analyst Team). This involved, for a random selection of labels:
    - a random check on the selection of labels to ensure they has been assigned correctly, and discussion of any clips of footage that analysts were unsure how or whether to code.
    - a review of how well the analyst notes provided a good overview of the recorded footage.
- a review of the total data set per wave, to include data labels, notes, and temperature data (conducted by the Project Lead, Content Analyst Team and Data Analyst). This involved:
    - a final check on labels to ensure their correct assignment for a random selection of labels.
    - exploring the distribution of temperature data from thermometers for the whole dataset and removing outliers in agreement with the Project Director.
- a review of the dashboard data (conducted by the Project Lead, Content Analyst Team and Data Analyst). This involved:
    - checking calculations within the dashboard with independent calculations from the raw data.

- ensuring filters within the dashboard selected the corresponding underlying data.

In addition to the quality protocols above, separate independent checks were performed on the accuracy of video coding by the Basis Social team. Specifically, in preparation for interviews, Basis Social researchers used labelled video data to identify behaviours of interest and review associated filmed footage in depth. For example, video labels were used to identify a food group (for example, MFP) and a behaviour (for example, washing hands with soap). Clicking on each label would select the corresponding video footage. Basis Social researchers were able to identify labels that may have been misassigned or that were missing by re-watching video footage. Any quality issues were highlighted to the Project Director and discussed with the Lifestream team and resolved appropriately.

Analysis of observed filmed data

Observed data was analysed through four approaches.

The first involved an ethnographic analysis of filmed footage and was undertaken at an individual participant level. As noted earlier, this involved watching three food safety behaviours per participants in depth, to both analyse the behaviour and make notes to inform the interview discussion guide. Footage of all incidents of the behaviour occurring in the household or FBO were reviewed, and notes made on various contextual factors, including:

- what the meal occasion involved (for example, type of food cooked, time of day)
- others present in the kitchen, and whether the behaviour of interest was discussed
- what else was happening in the kitchen (for example, a delivery, children playing).
- the layout and use of the kitchen, where relevant to the behaviour (for example, for handwashing behaviours, proximity to the sink, presence of soap, whether the sink was accessible and so on)
- the kitchen appearance (for example, whether the kitchen was cluttered or tidy, and the size of the kitchen)
- the emotional state of the participant, where this could be easily identified (for example, if participants appeared tired or distracted during food preparation)
- what happened immediately before and after the behaviour (for example, other items touched, handwashing etc)
- difference and similarities across the above during other observations of the same behaviour by the same participant

The second analysis of observed data involved the use of a dashboard. The dashboard was set up to visualise the frequency of different behaviours and their context. Analysis could be undertaken at both an individual and total household or FBO level.

For example, the labels ‘MFP’, ‘washing hands with soap’ and ‘washing hands without soap’ were used to calculate the frequency of all meal occasions where these behaviours occurred, as well as the duration of each behaviour. The dashboard also showed the frequency of households or FBOs where there was the absence of washing hands (with or without soap) during meal occasions where raw/cooked MFP was prepared.

By way of illustration, when exploring handwashing behaviours when preparing raw/cooked MFP in households, the following frequencies were established:

- the total number of households that prepared raw/cooked MFP (69)
- the number of meal occasions in households where raw/cooked MFP was prepared (308)
- of these 308 meal occasions:

o 119 occasions involved washing hands with soap. Washing hands with soap had an average duration of 16 seconds and occurred twice per meal occasion, on average

- 136 occasions involved washing hands with water only. Washing hands with water only had an average duration of 6 seconds and occurred three times per meal occasion, on average
- 80 occasions involved not washing hands for at least 45 mins

The third type of analysis of observed data involved the use of a sequencing tool developed especially for the project. Specifically, the tool applied algorithms to explore the temporal relationship between two behaviours (for example preparing raw/cooked MFP and washing hands with soap) and whether these two events occurred consecutively, or whether another behaviour occurred in between (for instance, touching a kitchen surface).

For example, of the 119 meal occasions mentioned above where households washed their hands with soap when preparing raw/cooked MFP, 77 meal occasions also involved a participant handling another item before they washed their hands with soap.

The Sequencing Tool was subject to a variety of checks against the underlying database by the statisticians from Analytical People who were involved in its development. It was also subject to extensive checks and reviews by the FSA's risk assessment and social science team.

A final set of checks was undertaken by the Project Director, comparing the behavioural frequencies calculated by the Sequencing Tool to that in the dashboard.

The fourth type of analysis of observed data involved a statistical analysis of 7 food safety behaviours. These form the focus of the KL2 chapter reports (footnote 6) and cover:

1. Not washing hands with soap after touching meat, fish and poultry
2. Reusing a chopping board after preparing meat, fish and poultry
3. Reusing a tea towel or cloth for multiple purposes
4. Storing chilled foods at incorrect temperatures
5. Not reheating leftovers until steaming hot throughout
6. Not checking use-by dates and consuming foods past use-by dates
7. The creation of food waste

Pearson correlations were used to explore the correlation between these 7 behaviours, as well as in relation to demographic and firmographic characteristics, and when the behaviour occurred. The correlations were based on whether the behaviour was ever observed. Where relevant, the results of this analysis is included within the KL2 chapter reports.

Analysis of passive data, collected through fridge and freezer thermometers

Fridge and freezer temperature data was collected for 65 households and 29 FBOs (with 5 households and 2 FBOs not installing the thermometer). Fridge and freezer temperature data was passively collected every 10 minutes, stored on the device and downloaded after the device was returned to Lifestream. A unique participant ID was assigned to the data to allow comparisons with survey, interview and observed footage. Data from thermometers included a time/date stamp, with temperatures recorded every hour across the full five-day filming period. The first 24 hours of data was excluded across all participants, to ensure any ambient temperature recordings resulting from transport and set up were excluded from the results. The data distribution at a total sample level was also checked post fieldwork by analysts from Lifestream, and outliers removed in consultation with the Project Director. Freezer data for kitchen "FSA110" was removed from the data due to anomalies that could not be reasonably accounted for (fridge data was unaffected).

A second round of checks were performed by the Project Director at Basis Social post fieldwork. These explored the temperature distribution across the total sample and the temperature distribution within any household or FBO where the average appliance temperature was above 8°C for fridges and -18°C for freezers. Advice was sought from the FSA as to whether to include in the findings where readings were particularly high, with 1 day of data excluded from 1 FBO in

this context.

The fridge and freezer temperature data was subject to two analyses.

The first involved a series of descriptive statistics using the dashboard. Temperature data could be filtered by households and FBOs, as well as other behavioural, demographic or firmographic characteristics.

For the total database or any given filter, the dashboard visualised and calculated:

- the total number of kitchens and days where temperature data was collected
- the minimum, maximum and average temperature separately for fridges and freezers across the selected sample
- the % of days and % of participants where the fridge or freezer was above the maximum recommended temperature (5°C for fridges, -18°C for freezers).
- the average temperature by hour of day and day of week for all fridges and freezers across the sample

A second analysis was undertaken on the raw temperature dataset to identify the total number of households and FBOs where the average operating temperature of the fridge was above 8°C for the entire fieldwork period, and where 8°C was exceeded for more than one hour. This temperature was selected as above this, the potential for bacterial growth is significantly elevated (footnote 7). For each household and FBO in this group, the overall temperature distributions, as well as the median temperature, was analysed.

Analysis of self-reported data, collected through photographs, food diaries, surveys and interviews

Self-reported data was subject to different levels of analysis, depending upon the data type.

Food diaries and shopping receipts were used to verify the meals consumed by household participants, providing context for analysts when exploring the survey, interview and observed data.

Verification was required as it was occasionally challenging to distinguish specific meal ingredients through filmed observations.

Photographs of fridge and freezer storage provided contextually relevant data on the fridge and freezer condition. They also provided partial evidence on whether chilled foods were stored in an overcrowded condition (however, the limitations of using a photo at a single point in time meant no clear conclusions could be drawn from this). Additionally, one of the main purposes of taking photographs of the interiors of fridges was to explore the storage of raw and cooked or ready to eat meals. However, this behaviour was not prioritised for reporting purposes and consequently not analysed during the reporting phase.

Survey data was subject to a simple frequency analysis in Excel. Specifically, distribution of answers to specific survey questions were analysed for all households and all FBOs. Low base sizes limited the scope for more sophisticated quantitative analysis of the survey data. However, frequencies derived from the survey data played a fundamental role in the COM-B analysis, described below.
Interviews were recorded on the zoom platform, and auto-transcription software used to aid analysis. Interviews were analysed through two main approaches. An analysis proforma was used to capture information on the behaviours of interest, together with contextually relevant data from the observations and survey. The proforma specifically captured information on:

- the household or FBO context
- understanding and beliefs about food safety in general

- other contextual factors relevant to food safety behaviours
- detail on each food safety behaviour of interest (for example, washing hands with soap when preparing MFP), including:
    - whether the behaviour occurred
    - the contexts in which the behaviour occurred
    - the factors influencing the behaviour, using the COM-B framework
- quotes that illustrated various understandings, beliefs and behaviours

Examples of completed proformas were used for training purposes and to ensure consistency in the analytical approach, and all analysis proformas were reviewed by the Project Director.

In addition to the proformas, which provided a detailed analysis at the participant level, an excel based ‘matrix map’ was also developed, which summarised the proforma information across the entire sample. Specifically, for the seven behaviours that formed the focus of the KL2 reports, a summary of barriers and enablers structured by COM-B factors was provided.

Analysis and the COM-B model

The overall analysis of the study was informed by the COM-B behavioural model. The COM-B model is a 'behavioural system'. It identifies three factors that need to be present for any behaviour to occur: capability, opportunity and motivation (footnote 8).

Capability refers to whether a person has the knowledge, skills and abilities required to engage in a particular behaviour. It comprises psychological capability, for example, a participant’s understanding of how to wash hands thoroughly; and physical capability, for example, whether a participant may have a skin condition that prevents washing hands with soap.

Opportunity refers to the external factors which make the execution of a behaviour possible. These include opportunities provided by the environment, such as time, location and resource, and also opportunities as a result of social factors, such as cultural norms and social cues. It comprises physical opportunity, for example whether a participant has access to a sink or soap or has the time to wash their hands; and social opportunity, for example, whether there are social norms in the household or FBO concerning handwashing.

Motivation refers to the internal processes which influence decision making and behaviours. These include values and beliefs, as well as automatic processes such as desires, impulses and inhibitions. It comprises reflective motivation, for example how a participant’s beliefs about the consequences of not washing hands with soap may influence their behaviour; and automatic motivation, for example, the habits and routines a participant has about washing their hands with soap.

These factors interact over time so that behaviour can be seen as part of a dynamic system with positive and negative feedback loops (see figure 5). For example, not having the capability or opportunity to perform a behaviour can make it more difficult to perform, decreasing a person’s motivation to perform the behaviour. Similarly, engaging in a behaviour is a form of practice, and as such can lead to increased capability and reduced time and energy costs (a form of opportunity) associated with performing that behaviour.

Figure 5. The COM-B behavioural model (footnote 9)

In the context of this research, for each behaviour of interest, data was drawn together from observations, the survey and the interviews to understand each of these factors and subfactors in depth.
The analysis specifically explored:

- the frequency of the behaviour of interest, through observations
- a participant's physical capability to perform a behaviour, through observations and interview questions
- a participant's psychological capability to perform a behaviour, through answers to the survey and interviews
- the physical opportunity for the behaviour, through observations, and verifying observations within interviews
- the social opportunity for the behaviour, through observations, and interviews
- the reflective motivation for the behaviour, through observations, the survey, and interviews
- the automatic motivation for the behaviour, through observations, and interviews.

At the end of each wave of research, workshops sessions were held with the Basis Social team to discuss findings across participants. The team used an online whiteboard to review each behaviour, discuss the main COM-B influences and explore the relationship between influences across behaviours (for example, exploring how social norms or beliefs shaped clusters of behaviours).

Prioritising behaviours for in-depth analysis and reporting

After the final wave of fieldwork in October 2022, a preliminary analysis was conducted to identify candidate behaviours to explore in depth in the reporting stage of the project.

The criteria and process for selecting the priority behaviours is shown in table 4.

Table 4: Criteria for prioritising behaviours for reporting in KL2

Criteria	Process
1. The behaviour needed to be rated as medium risk or higher by the FSA's risk assessment team.	Individual candidate food safety behaviours were checked against their risk ratings, which were provided by the FSA at the study design stage (see Appendix).
2. One behaviour had to be selected from each of the five behavioural categories of interest for the FSA - storing, reheating, cooking, cleaning, and handling.	Candidate food safety behaviours were checked against the behavioural categories.
3. The behaviour needed to have at least 50 or more observations in the KL2 dataset.	The dashboard was used to identify the total number of times a candidate food safety behaviour was observed.

A spreadsheet appraising each candidate behaviour relative to the 4 criteria above was developed by the Basis Social team in partnership with the social science team at the FSA. The appraisal was discussed with the FSA's risk assessment and policy teams, before a review by the ACSS working group.
From this process, the following behaviours were selected to focus on in depth in the workshop and reporting phase:

1. Not washing hands with soap after touching meat, fish and poultry
2. Reusing a chopping board after preparing meat, fish and poultry
3. Reusing a tea towel or cloth for multiple purposes (footnote 10)
4. Storing chilled foods at incorrect temperatures
5. Not reheating leftovers until steaming hot throughout
6. Not checking use-by dates and consuming foods past use-by dates
7. The creation of food waste (footnote 11)

Behavioural interventions workshop

After KL2 fieldwork was completed, a workshop was held with 21 participants with expertise in the behavioural sciences, food safety policy, risk assessment, and risk communication, to discuss the COM-B influences on each of the KL2 priority behaviours.

In the workshop, experts discussed each of the seven priority behaviours, and then considered the 'desired practice'; that is, the behaviour that households and FBOs should do to improve food safety. Once the 'desired practice' was established, the workshop then explored the specific behaviours to target, to encourage the desired practice. The workshop was not designed to develop detailed behavioural interventions, as this was outside of the scope of KL2.

In terms of the workshop process, participants were organised into four small groups, each exploring four priority behaviours in depth. For each priority behaviour, KL2 evidence was presented on each COM-B influence for households and FBOs respectively. Workshop participants were then asked to consider:

1. hypotheses concerning the drivers of the problem behaviour
2. ideas that could promote behaviours to encourage the desired practice
3. additional information and insights that could help develop interventions.

For each area, workshop ideas were captured on a flip chart, using post-it notes.

After the workshop, the Basis Social team reviewed each flip chart and used the ideas to inform the "Identifying Behaviours for interventions" section of each behavioural chapter.

Additional analysis of KL2 data (exploring food waste)

The creation of food waste was not an initial area of focus for the KL2 study. In 2022 the FSA expanded their strategy to include a focus on food being 'healthier and more sustainable'.

The FSA's ACSS Climate Change Working Group identified avoiding food waste as a consumer behaviour which was likely to influence what food they choose to consume, and how they store and prepare food in the home (footnote 12). There was also evidence of a potential conflict between food safety and food waste behaviours – for example around the use of use-by dates.

Consequently, the factors affecting the creation of food waste became a focus for the secondary analysis of KL2 data.

In total, 42 households, and 27 FBOs were selected for secondary analysis of food waste behaviours, as the bin could be clearly observed in these kitchens. Secondary analysis of observed filmed footage focused on whether food waste was produced. Specifically behavioural

codes were developed that identified:

- the food groups that were disposed of (where it was possible to visually identify these)
- whether food waste was disposed of during food preparation or after the meal
- whether the use of fridges or freezers proceeded the disposal of food waste
- the action prior to the disposal of food waste (for example, preparing food, cooking, clearing up).

Secondary analysis of existing KL2 interview and survey data (waves 1-4 of the study) were also used to explore attitudes and beliefs to food waste. Relevant transcript data from interviews and surveys predominantly focused on use-by dates (given the original focus of the KL2). To accommodate the focus on food waste, changes to the interview discussion guide were made in the final wave of research to explicitly explore the subject. This final wave of interviews involved 20 households and 4 FBOs.

In addition to re-analysing footage and interview data, the food waste study also involved desk research, reviewing 17 published research papers as well as grey literature on this issue. The desk research was used to supplement findings from KL2, especially as several behaviours related to food waste concerned meal planning and shopping, which were not a focus of observations in the KL2 study. The analysis of interviews and research papers involved the development of a coding frame which used COM-B – for example, the analytical codes included skills for judging portion sizes (psychological capability), the amount of fridge space for chilled foods (physical opportunity), and beliefs about food waste (reflective motivation).

Reporting and Outputs

The following outputs have been produced for the KL2 study:

1. A literature review. This was published on the FSA's website in February 2022 and was produced for a general audience. The literature review covered previous research conducted on food safety behaviours in households and FBO kitchens.

2. A dataset, comprising of five datafiles related to the descriptions of the data and the raw data from the observations. The datafiles are published on the FSA's website for researchers to use. The five datafiles comprise:

i. a dataset information file which describes the data labels and dataset structure
ii. a kitchen information file, which provides pseudo-anonymised demographic and firmographic data on each kitchen
iii. a label glossary file which lists all the individual data labels and categories of data labels, together with notes describing the data
iv. a labels data file, which comprises the raw data and timestamp codes for the observations.
v. a sensor data file, which comprises the raw fridge and freezer temperature data and associated timestamp codes.

3. A dashboard that visualises the datafiles, together with an associated user guide. The dashboard is for internal use by FSA policy, risk assessment and social science teams.

4. A 'Sequencing Tool' developed in Excel that enables the temporal relationship between behaviours to be explored (for example, whether a participant touched another kitchen item after preparing raw/cooked MFP but before washing their hands). The Sequencing Tool is for internal use by FSA policy, risk assessment and social science teams. An associated user guide was also produced for the Sequencing Tool.

5. A series of Chapter Reports exploring each of the seven priority behaviours, and the factors influencing them, in depth. The reports draw together findings from observations, surveys and

interviews and are based on analysis using the COM-B model of behaviour. Each report also includes a case study of both a household and FBO kitchen. The reports are published on the FSA's website.

6. A Technical Report describing the methodology and research tools. The technical report is published on the FSA's website.

The Literature review underwent a peer review process by the Advisory Group and members of ACSS KL2 working group.

The datafile and dashboard were reviewed by the team at Lifestream before a review from the Project Director at Basis. The sequencing tool was reviewed by the team at Analytical People before a review from the Project Director at Basis. The datafile, dashboard and sequencing tool were then subject to a further review by the FSA's risk assessment, policy, statistics, and social science teams.

The Chapter Reports were reviewed by Leeds University, members of the FSA's policy and social science teams, as well as members of the ACSS KL2 working group.

The Technical report was reviewed by members of the FSA's social science team, as well as members of the ACSS KL2 working group.

Ethic review and privacy impact assessment

At the research design stage, an ethics assessment was conducted to consider and manage the ethical and legal issues involved in the study. This included those arising from filming participants and obtaining consent, as well as wider issues (for instance observing harm) that may arise through the data collection process.

The FSA's Knowledge and information management team (KIMS) was also involved to develop a Privacy Impact Assessment (PIA). A PIA is a record of:

- what data will be captured, how it will be held and handled, and when it will be deleted
- the legal basis for data collection and intended use for the data, including responsibilities for the data controllers (the FSA and Basis were Joint Controllers) and data processors
- the range of assurances to protect participants
- how data breaches will be handled
- processes to identify and mitigate risks.

The ethical and legal considerations were considered throughout the research project. Where issues arose during the study, these would be discussed between Basis, Lifestream and the FSA's social science and KIMS team as appropriate. As required, further risk assessments or amendments to the original PIA, consent forms or recruitment practices would be made to reflect any new or emerging challenges from the project. These included for example:

- collecting data in schools (a separate risk assessment was conducted)
- obtaining consent to film in kitchens for 7 days, where extended filming was required (consent forms, participant information sheets and screeners updated)
- using memory cards to store footage in cameras, where Wi-Fi was impacting streaming quality (risks and mitigations discussed and recorded with FSA's KIMS team)
- capturing audio data (separate risk assessment undertaken, original PIA revisited and amended, consent forms and participant information updated)

Some of the main ethical challenges faced in the research and how these were mitigated are detailed below.

Collecting data: filming participants

The ethical issues associated with collecting personal data were a significant consideration for the study. Participants were identifiable in the video footage and may say or do things that they did not wish to be captured on film (for example, discussing credit card details, or being filmed naked). There was the potential to record incidents that related to a criminal offence or harm to others. Additionally, people may be caught on film who do not wish to give consent or who are not aware of filming taking place (such as members of the public, visitors, or delivery drivers).

To address these, first and foremost, the project obtained fully-informed, written consent from all participants known to be in the filming areas, such as members of the household or FBO staff. Participants were briefed not to discuss private information near cameras. They were also informed that any criminal or harmful acts observed would be reported if someone is in immediate danger, with the consent form confirming this. Researchers did not intervene if high-risk food safety practices were observed in either FBOs or households, as this was the primary focus of the study. Automatic obfuscation technology was applied to screen nudity, and cameras could be switched off by participants or remotely. Any incidental filming of behaviours not relevant to the KL2 project was deleted within 48hrs. All FBOs were required to display signage to indicate that filming was taking place. The use of signs was checked during the set-up process. As part of their consent process, participants provided separate consent for the collection of audio data, which was not a requirement of participation in the study. Participants also had the right to delete any given section of footage by contacting the research team, if they wanted to exclude it from analysis. Participants also had the right to withdraw completely from the study (up to the point of publication).

Data handling and access

Protecting an individual's privacy concerning how data was handled and accessed was a further concern for the study. Legally, the FSA could not use footage for regulatory purposes (as data was solely collected for research purposes) however, the FSA could potentially observe a breach of regulations in FBOs during the filming period. It was unethical for large numbers of FSA staff to see footage, without a reasonable need. The FSA may also wish to use the footage in promotional materials or presentations.

There were a range of controls set up to manage data access. Access to the video platform was restricted and permitted only to a small number of pre-assigned users. The FSA were only given access to household footage and needed to sign a Terms of Use document and attend training before viewing the platform. Removing FSA access to FBO footage was considered legally and ethically correct, as it meant that the FSA could not impose any means of regulation or enforcement on the businesses participating in the research. All video footage was 'locked' and could not be downloaded without access granted from the Project Director. All analysts at Lifestream and Basis Social were DBS checked. The dashboard, which would be accessed by a larger number of FSA users, only contained pseudonymised, non-identifiable data, and all analyst notes were removed.

To protect the identity of participants and FBOs further, if participants required more information about the study, a link was provided to an information page on the FSA website, which legitimised the research. The contact information provided for participants was for Basis and Lifestream research teams only (not the FSA), to ensure participants remained anonymous to the FSA.

Explicit consent was sought from participants for video footage to be used in presentations or other FSA materials (this was limited to 1 member of the public), and faces were obfuscated in this case.
In terms of setting clear boundaries concerning the research rather than regulatory focus of the project, no feedback was given to participants about the quality of their food safety practices to

avoid stepping over the line into ‘regulation’. The consent form also explicitly highlighted the focus of the project was for research rather than directly for regulatory purposes.

Specific issues for FBOs

In addition to these cross cutting ethical issues, there were several further considerations for FBO s. For example, the consent process may be coercive, or poorly managed by the business owner. Staff may not be legally working or be vulnerable for other reasons, which present barriers to consent. There was a risk of accidentally filming members of the public or where staff privacy is presumed (such as break areas). There was also a risk of the camera and associated footage being stolen or being used by the owner for management purposes. The business owner may learn about poor practices during the interview process, and this could have implications for staff who participated in the research.

To address these issues, separate consent was obtained for each staff member and from the business owner. A take home information sheet was provided for staff with FSA/Basis contact details. The consent process was confidential, with business owners not knowing which staff did or didn’t give consent. If any single member of staff did not provide consent, the business would not be included in the study.

Cameras were situated to minimise accidental filming of public areas and private staff areas, and signage was used at the entrance to inform people about filming. Incentives were provided to staff using gift certificate or BACS payment (further detail is given the incentives section). Individuals had the ability to request the deletion of timestamped video materials. Business owners were not given access to footage recorded, and interviews with owners did not directly reference specific instances of observed behaviour so that staff were not ‘singled out’ to the business owner for any food safety issues.

Wherever possible, data was streamed directly to Lifestream servers and were not stored locally on the camera so that footage could not be stolen or used by business owners. In a small number of FBOs where this was not possible (due to poor WiFi connection) a memory card was used to store the data. Tamper proof tape was used on the cameras to protect the memory card as encryption was not possible, and additional consent processes were undertaken in these cases.

Consent and right to withdraw

Significant time was spent developing the consent process and materials. Consent was freely given, and informed, with participants having the right to withdraw from research at any time up to the point of publication without it affecting any incentive payment. While signed consent was established at the start of the process during recruitment, consent was ongoing and checked at various points throughout the study (specifically at the survey and the interview stages). Separate information and consent forms were developed for households, FBO owners/managers and staff. For staff, the consent process was coordinated directly with the research team, rather than via managers at the FBOs. Significant effort was made to explain the project in plain English and the consent form clearly broke down various aspects of the study, including:

- the purpose of the research
- the voluntary nature of participation
- who would have access to the filmed material(footnote)
- confidentiality principles and data retention.

A Kitchen Life 2 webpage was also developed to provide participants with further information on the project and to encourage them to speak to the project team should they have any questions about participating.

A clear, auditable process for collecting signed consent forms was developed, with electronic versions of the consent form held securely for the Project Director to review.

Research limitations and challenges

There were four main research limitations that impacted on the delivery and insight developed from KL2 study. They are:

1. challenges recruiting FBOs
2. limitations in the data collection process
3. limitations related to data analysis
4. Sample size and generalisability of findings

Challenges recruiting FBOs

There were significant issues recruiting FBOs over the course of the study. Less than 3% of FBO s that were initially contacted to take part completed the research (1 in 32 businesses).
There were two main barriers to successful recruitment.

First, was the methodology and purpose of the study. FBOs were generally concerned about the use of filming to identify potential food safety risks for a project on behalf of the FSA. Despite redrafting information about the project post the pilot stage, the development of testimonials from other FBO participants, and increased incentives, it was very difficult to get FBOs to consider taking part.

Second was the consent process in FBOs. Signed consent had to be collected for every member of staff working in the business during the filming period. The consent process for each member of staff was undertaken in confidence and separate to the owner or manager of the business. For larger FBOs with many staff, those where English was not the first language, and food businesses employing casual labour, the consent process became logistically complicated and very lengthy. There were several FBOs keen to participate in the study where filming could not take place due to the project team being unable to gain written consent for all staff. Changing businesses circumstances, and in some instances ownership, also impacted on willingness to take part.

Low recruitment rates for FBOs had two main impacts on the study. The first concerned timing, with the overall study taking a year longer that planned from the initial timetable, with associated implications for resourcing (for example, weekly management meetings were maintained throughout the fieldwork period). The total number of waves of the research was increased from 4 to 5, with fewer FBOs participating per wave than originally planned.

The second was that it was not possible to meet the target quotas for the FBO sample. Despite extensive efforts, the research team were unable to recruit any FBOs in Scotland and Wales, and it was also only possible to recruit 3 FBOs that had a FHRS rating of 1-3. As behaviours recorded in FBOs were focused on kitchens with higher food hygiene ratings, it is likely that certain food safety behaviours and practices have been missed through the research.

It should be noted that, while not a simple process, there were only minor challenges related to filming in household kitchens – mainly relating to the engagement of older participants and issues recruiting in Wales and Northern Ireland (sample quotas were narrowly missed in these instances).

Finally, the study was not designed to be representative but rather quotas were used to improve range of the sample. While this is not a large sample from the point of view of quantitative research, for this type of observed ethnography it is reasonable, where depth is sought rather than breadth.

Limitations in the data collection process

The purpose of using motion sensitive cameras in kitchens was to film food safety behaviours in as close to real life settings as possible. On occasions participants were conscious of being filmed, for instance they could be observed looking straight into the camera, and this may have introduced social desirability bias into the study. However, based on observations, overall, such mode effects appear to be limited. The busy, habitual and distracted nature of many food preparation and cooking moments meant that participants were generally absent-mindedly absorbed in kitchen life, rather than being conscious of being observed. In interviews, participants noted that they routinely forgot that a camera was in the kitchen during the fieldwork period.
A greater limitation concerned the type of behaviours that could be filmed. For example, two behaviours explored in depth in the study had limited range of direct observational data to analyse. These were:

1. Not checking use-by dates and consuming foods past use-by dates. These behaviours were not possible to observe accurately, and the research team predominantly relied on self-reported behaviours.

2. The creation of food waste (footnote 13). While participants' food disposal behaviours could be observed in household kitchens, the creation of food waste was driven by factors (for example, how food was stored, whether foods had exceeded use-by dates, meal planning and food shopping) and these behaviours were not captured on camera. In FBOs, post meal waste was not captured on camera.

Additionally, there are a number of practices that occur outside of the kitchen, or outside of the filming period (5 days in most kitchens) that may be of interest to food safety. These include, for example, washing or replenishing tea-towels/cloths/sponges (which often occurred off-camera, or outside of the filming period) and eating food (often occurring in a separate dining space). As a result, it was not possible to gain an accurate understanding of these types of behaviour.

There were also limitations in survey and interview process.

For the survey, there was only a limited number of questions asked on the storing of chilled foods at incorrect temperatures and the creation of food waste. This was because these behaviours became areas of research focus as the study progressed. Survey questions were not changed after the pilot to enable comparison, meaning only limited information was collected on these behaviours.

In the interviews, one of the main limitations concerned only speaking to the owner or manager in the FBOs. Where behaviours of interest were observed in other members of staff, it was not possible to understand the extent to which cognitive factors, such as a staff member's psychological capability or reflective motivation, were influential in shaping behaviour.

Limitations in the analysis process

Firstly, despite increasing the sample size to include households who prepare raw fresh MFP (see the Sample section of this report), the coding applied to MFP in the KL2 dataset does not distinguish between "raw" and "cooked" items. This limits the insight that can be obtained from the quantitative data (counts from the video footage). However, surveys, interviews, and qualitative assessments of the data (such as behavioural analysis, and case studies) are not impacted by this, as researchers could accurately identify whether raw or cooked MFP was being prepared when visually reviewing the footage as part of the analysis process, and surveys and interviews clearly specified 'raw' when discussing the topic of MFP.

Additionally, during the study development, it was recognised that the dashboard only provided a partial understanding of food safety risks. The dashboard analysed behaviours at a meal

occasion level (for example, washing hands with soap when preparing raw/cooked MFP). For example, the dashboard identified whether hands were washed with soap at any moment during a meal where raw/cooked MFP was prepared. It did not, however, analyse when handwashing took place, and specifically whether any behaviours occurred after handling raw/cooked MFP but before washing hands with soap – which could present a risk of cross contamination.

The Sequencing Tool was developed to address this issue, with algorithms written to sequence the order in which behaviours occurred at a total dataset level. The Sequencing Tool works especially well for proximate behaviours that present a food safety risk - for example, handling raw/cooked MFP and touching another kitchen item before washing hands with soap. However, it is not effective at understanding risks between behaviours that have a significant separation in time. For example, in certain households, washing chopping boards after preparing raw/cooked MFP was occasionally not undertaken during or after the meal and could be left until the following day. There was not sufficient granularity in the coding or analytical processes to track cross contamination risks posed by kitchen items post the meal occasion.

Finally, the COM-B framework proved effective at structuring and analysing the influences on participants behaviour and considering implications across the sample as a whole. However, in applying the framework, some of the practicalities, complexities and messiness of everyday kitchen life may have been diminished in the analysis, especially in terms of the complex environmental and social interactions at play that influence behaviour.

Sample size and generalisability of findings

Whilst the sample size for Kitchen Life 2 (101 kitchens) might be considered small for quantitative research, this is a decent sample size for qualitative research. The size of the sample was primarily limited by budget, although difficulties recruiting FBOs was also a considerable factor as discussed above. The limited sample size means that it is not possible to say whether the findings are generalisable to a wider population level, and it is difficult to attribute precisely why or to assume that behaviours will be the same in a different context. Despite the overall sample size, Kitchen Life 2 did utilise quotas to ensure that the spread of kitchens/participants included in the study was diverse to reflect a wide variety of cooking practices and demographics. Although the sample size of the project is limited compared to a quantitative research approach, the richness and depth of data is highly valuable to understand behaviour in kitchen settings.

Concluding remarks

Despite the limitations outlined above, Kitchen Life 2 has allowed unprecedented access to real behaviours in real life kitchens. The richness and depth of data is highly valuable to the FSA's understanding of the risks that consumers and businesses undertake in their kitchens each day.

The other significant benefit of this research is the triangulation of a variety of different methodologies to understand behaviour, including observed footage, surveys, interviews and passive measures. This range of approaches allows the FSA to get as close as possible to how people truly behave, rather than relying solely on self-reported measures.

The FSA is proud to confirm that this research won the Analysis in Government 'Innovation Award' in 2022.

Appendix

Kitchen Life 2 technical report appendix

1. Michie, S, van Stralen, M. and West, R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implementation Science 2011, 6:42

2. The use of an asterisk (*) truncation instructs the database to search for the root of the word and retrieve any alternate endings (for example, COVID* would also return COVID-19)

3. The lead participant is the individual who was interviewed and surveyed as part of the KL2 study.

4. Index of recommended practice (IRP) comprises five domains of domestic food safety practice: Chilling, Cooking, Cleaning, Cross-contamination and Use-by dates.

5. Each video was recorded when motion was detected in the kitchen, and stopped after no movement was detected for 30 seconds. At a certain file size, the video was also broken into clips to enable it to be transferred easily.

6. The process for selection the behaviours is described in Prioritising behaviours for in depth analysis and reporting.

7. FSA (2020). 'Chilling'.

8. Michie, S, van Stralen, M. and West, R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implementation Science 2011, 6:42.

9. Adapted from Robert West, Susan Michie. (2020). A brief introduction to the COM-B Model of behaviour and the PRIME Theory of motivation. Qeios. doi:10.32388/WW04E6.2.

10. Wiping hands on a clothing/tea towels while preparing food was initially also identified as a candidate behaviour. However, the influences on this behaviour were found to be similar to those enabling the reuse a tea towel or cloth for multiple purposes, and findings were integrated into a single chapter on tea-towel reuse.

11. The research and analysis process concerning the creation of food waste differed from other behaviours in the study as is discussed in the section Additional analysis on food waste.

12. Impact of Climate Change on Consumer food behaviours (ACSS).

13. The research and analysis process concerning the creation of food waste differed from other behaviours in the study as is discussed in the section Additional analysis on food waste.