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Evaluation of changes in the dietary methodology in the National Diet and Nutrition Survey Rolling Programme from Year 12 (2019 to 2020)

Stage 1

NatCen Social Research

MRC Epidemiology Unit

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Contents

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Executive summary

This report describes the changes in dietary methodology in the National Diet and Nutrition Survey rolling programme (NDNS RP) implemented from fieldwork year 12 (2019 to 2020), sets out the plan for evaluating the impact of the changes on participation in the survey and the resulting data, and presents findings from the first stage of this evaluation.

The NDNS RP is a continuous cross-sectional survey, jointly funded by Public Health England and the UK Food Standards Agency and carried out by a consortium comprising NatCen Social Research and the MRC Epidemiology Unit, University of Cambridge. It is designed to assess the diet, nutrient intake and nutritional status of the general population aged 1.5 years and over living in private households in the UK.

For fieldwork years 1 to 11 (2008 to 2019) dietary assessment was based on a food diary completed over 4 consecutive days. This used paper-based open-text entry by participants with review by interviewers and retrospective coding of foods and portions by trained coders. In 2018 the decision was taken to move to an automated data collection method with the potential to improve data quality and reduce costs. Following a review of available automated tools and full evaluation of 3 shortlisted tools, Intake24 was selected to replace the paper food diary in the NDNS RP.

Intake24 is a web-based automated self-administered 24-hour dietary recall tool. Participants are asked to record everything they ate and drank the previous day. The tool includes an embedded database of foods with linked portion sizes and corresponding nutrient composition data from which dietary intakes are automatically calculated.

A number of developments were made to Intake24 and to the underlying data before it was used in NDNS, to enable it to meet requirements. These included updates to the tool functionality and addition of questions to provide supporting contextual information. Work was also undertaken to update the food lists from which participants select the foods and drinks they consumed and to rationalise and update the linked nutrient composition information in the NDNS nutrient databank. This aimed to achieve a comprehensive and up to date database of foods to adequately reflect the heterogeneity of foods in the UK while remaining manageable for participants. This included creation of new generic food codes, mainly for sandwiches and salads which were not required before Year 12 as these items were previously coded as individual components.

Following a dress rehearsal, NDNS fieldwork was launched for Year 12 using the new tool in October 2019. Participants were asked to complete 4 recalls on non-consecutive days, the first with the interviewer present and the remainder independently. All face to face fieldwork was carried out at a single household visit, except for households where participants needed assistance with completing the recalls.

The move to a web-based recall from a paper diary is a significant method change for NDNS as it puts the onus on participants to use the tool to select the foods most appropriate to their consumption rather than their written entries being retrospectively coded. This requires a much reduced level of interviewer involvement with fewer interviewer visits to the household, and a new approach to dietary data processing and analysis.

It had been planned to evaluate the new method over Year 12 (2019 to 2020). However Year 12 fieldwork was suspended as a result of coronavirus (COVID-19) in March 2020 with dietary data collection about half completed, and was not restarted. Year 13 fieldwork began 3 months later than planned and incurred delays due to COVID-19 restrictions. Due to the limited data collected in Year 12 and the ongoing impact of COVID-19 on fieldwork, it was decided to conduct the evaluation in a staged approach over a longer period. This first stage report is based on data collected during the 6 months from October 2019 to March 2020. It includes:

- overall response to the survey in Year 12, participation rates for completing recalls and representativeness of days of the week
- measures around use of Intake24, including, completion time, number of foods reported
- impact of rationalisation and updating of the nutrient databank on resulting dietary data
- impact on continuity of the NDNS trend data series

Findings of stage 1 evaluation

Response and data quality

Forty percent of the selected households that were eligible to take part yielded at least one selected participant completing at least one recall, The majority of participants who completed one recall went on to complete all 4 recalls . The Year 12 data included a total of 2036 recalls with 284 children and 290 adults completing at least one recall. The survey design was intended to achieve equal representation of recalls across days of the week but delivered a lower proportion of recalls on Fridays and Saturdays due to the first recall being completed at an interviewer visit, which was less likely to take place at weekends.

A number of quality checks were carried out on the recalls to identify any issues with tool functionality and usability and any issues in the underlying datasets. The median recall completion time was 15 minutes. Forty-one per cent of recalls were completed in 10-19 minutes while 25% were completed in under 10 minutes. Only 6 recalls were completed in under 3 minutes. Some very long completion times reflected the functionality allowing a participant to leave a recall part way through and return to it later. In most age groups completion times reduced with each successive recall, suggesting a learning effect. The number of items recorded was broadly similar to that recorded in the paper diary in previous survey years and there was no clear relationship between number of items recorded and completion time.

The proportion of recalls with very high and low energy intakes was small with 0.8% of recalls recording energy intakes below 400kcal per day and 1.9% recording energy intakes above 4000kcal per day. The proportion of recalls with energy intakes above 4000kcal per day was lower in the paper diary (0.5%).

Impact of nutrient databank rationalisation

The impact of rationalising and updating the NDB was assessed by recalculating dietary data from NDNS RP Year 10 (2017 to 2018) after matching paper diary entries to the foods available in the Year 12 rationalised NDB. The move to using more generic recipes resulted in a decrease in mean fruit and vegetable intake of 0.2 portions per day and small increases in energy and total fat intake.

Impact on monitoring trends over time

Generally the spread of energy and nutrient intake data for Year 12 was similar to that for Years 1 to 11. There was evidence of a fall in Year 12 in the percentage of participants who reported taking vitamin D or folic acid supplements. This is thought to be a problem with the tool functionality for recording supplement use.

There was evidence of lower reported vegetable intakes in Year 12 with fewer high intakes. This may in part be due to the move from recording individual recipes to greater use of generic recipes. A drop was seen in the percentage of consumers of sugar and chocolate confectionery and buns, cakes and pastries in children 4 to 10 years but not in biscuits, crisps or snacks.

Some changes were observed for soft drinks and fat spreads which may result from misclassification of some products due to the range available on the market and the common use of inaccurate colloquial descriptors, such as “butter” used to describe a fat spread.

Conclusions and next steps

Overall, this first stage of the evaluation, based on a limited amount of data, indicates that the introduction of Intake24 as a new dietary assessment tool is compatible with NDNS RP requirements. While overall comparability with the previous method appears to be good, a number of issues have been identified that require action to ensure and maintain the robustness of the data collection.

The next stage of the evaluation will incorporate additional data from Year 13 fieldwork into the analyses, and address and report on issues identified in the Stage 1 analysis. The next stage of the evaluation will also include doubly labelled water (DLW) analysis to assess the degree of misreporting of energy intake and compare differences in misreporting between Intake24 and the paper diary.

1. Introduction

The National Diet and Nutrition Survey Rolling Programme (NDNS RP) is a continuous cross-sectional survey, designed to assess the diet, nutrient intake and nutritional status of the general population aged 1.5 years and over living in private households in the UK. Results are used by government to monitor progress toward diet and nutrition objectives of UK Health Departments and to develop policy interventions. The NDNS RP is a government commissioned survey, jointly funded by Public Health England (PHE) (4) and the UK Food Standards Agency (FSA). The NDNS RP is currently carried out by a consortium comprising NatCen Social Research (NatCen) (5) and the MRC Epidemiology Unit, University of Cambridge (6, 7).

In Years 1 to 11 (2008 to 2019) of the NDNS RP, dietary data was collected over 4 consecutive days using a paper food diary with estimated portion weights. The CAPI (Computer Assisted Personal Interview) program randomly assigned 4 consecutive days as the food diary recording period, with the aim that across the annual survey sample all days of the week were represented equally. Interviewers made 2 visits to each household to carry out the CAPI interview and physical activity questionnaires, take height and weight measurements, collect a spot urine sample, place, review and collect the food diary and introduce the nurse visit (primarily for collection of a blood sample). An additional midweek food diary check was also carried out by the interviewer by telephone or in person. Further details on full survey protocols for the first 11 years can be found in appendix A and B of the NDNS RP Years 9 to 11 report (8).

In 2018, the consortium, in conjunction with PHE and FSA, undertook a review to appraise whether the NDNS dietary assessment method continued to remain optimal from both a scientific and financial point of view. Considerations included identifying where existing approaches should be retained to ensure data quality and continued efficiency and stability for the NDNS RP, and where opportunities for improvement existed to evolve and modernise the methodology, improve quality, maximise value and provide scope to expand the potential of the NDNS in the future. As a result, the introduction of an online dietary assessment tool was proposed to provide an automated data collection method, compatible with new technologies and with potential to improve data quality and reduce costs. This method change was implemented in Year 12 (2019 to 2020) along with the introduction of a more cost-efficient model for the selection of participants within a household. These 2 modifications led to a redesign of the NDNS RP fieldwork model, including the number of interviewer visits required to complete survey components. Oversight of these changes was provided by a Project Advisory Group with membership from the consortium, PHE and FSA who were consulted throughout the process and reported back to the NDNS Project Board.

This report sets out the changes in dietary methodology implemented from Year 12 (2019 to 2020), the plan for evaluating their impact on participation in the survey and resulting survey data, and presents findings from the first stage of this evaluation.

2. Changes in methodology

2.1 Introduction of an online dietary data collection tool

A formal review and evaluation of available automated dietary assessment tools was undertaken in 2018. The objective was to identify an automated tool, based on a proven dietary assessment method, capable of meeting NDNS data requirements. These included the ability to collect detailed quantitative dietary data over several days across adults and children in the UK, and to be implementable within the existing NDNS RP interviewer home-visit based fieldwork model.

The review process initially involved the identification and screening of the breadth of automated dietary assessment tools available at the time to identify those with potential for NDNS RP. Four tools were shortlisted for full evaluation which was carried out based on a framework of criteria adapted from Illner and others (9). Given the nature and complexity of the NDNS RP, the evaluation framework encompassed broad criteria to assess overall suitability, including technical capabilities, fit and potential to meet NDNS data requirements, operational feasibility, the contracting or partnering basis and costs, as well as scientific evidence for the validity and reliability of the tool. The evaluation process found that 3 tools had merit and offered potential for the NDNS RP. All 3 tools would need further development and refinement to meet specific NDNS requirements, and each had different access, cost and contracting or partnering models. Following further review, and discussions with the tool providers, the online 24-hour recall tool, Intake24 was selected to replace the paper food diary in the NDNS RP.

Both the food diary and dietary recall are well established dietary assessment methods and recognised as broadly comparable in terms of providing individual, detailed, quantitative dietary information, although the former is prospective and the latter retrospective (10, 11). An NDNS study in 2007 preceding the start of the rolling programme, indicated minimal differences in energy intake between the self-completed diet diary and interviewer-led 24-hour recall methods when assessed by comparison with total energy expenditure using doubly labelled water (DLW) (12).

Intake24 is described below. Details of the food diary can be found in appendix A of the NDNS RP Years 9 to 11 report. Table 2 in section 2.4 gives an overview of the main differences between the 2 methods in the NDNS RP.

Intake24 is a web-based, automated, self-administered 24-hour dietary recall tool based on the multiple pass method. It was originally developed by Newcastle University and Food Standards Scotland. The tool has been validated against interviewer-led 24-hour recalls in young people and doubly labelled water in adults (13, 14, 15). Participants are asked to record everything they ate and drank the previous day (midnight to midnight). The tool includes an embedded

database of foods with linked portion size estimation and corresponding nutrient composition data from which dietary intakes are automatically calculated.

Participants are guided through Intake24 webpages using a 'multiple pass method' in the following order (each is described in more detail below):

1. Meal based ‘quick list’
2. Detail pass
3. Meal gap review
4. Last chance review

The tool displays pre-defined meal and snack times in chronological order, for example, breakfast at 08:00. However, the user can choose to complete entries in any order they wish, change the eating occasion time and can add or delete eating occasions where required.

Foods and drinks (hereafter referred to as food or foods) are first entered as free text in the ‘quick list’ phase of the dietary recall. This is to collect a list of foods and drinks consumed during the previous day.

In the 'detail pass’ stage, the participant is then taken through their ‘quick list’ foods, and for each reported item is asked to select from a list of matching foods linked to food and nutrient codes within Intake24. If they cannot find an exact match for the food consumed the tool prompts them to choose the closest matching item where possible. If the participant still cannot find a suitable match they can report their food (by food name or by providing ingredients of a recipe) as a missing food which can be manually coded later by the research team.

Once a food is selected, participants are presented with portion size estimation options appropriate to the particular item. The majority of foods and drinks in Intake24 have a range of photographic portion-size images (some of which are displayed as ‘served’ and ‘leftovers’) that the participant can review and select accordingly for their portion size. If there is no photo image, there is the option to report portion size as household measures such as individual items, different spoon sizes, or small, medium or large servings. Some foods offer both photo and household measure options. Drinks can also be reported by a range of glass, cup and bottle sizes, often including a slider to indicate how much was consumed.

Intake24 includes a custom spell checker which works to correct both phonetic misspellings and typing errors in the free text to enable comprehensive search functionality. The tool also prompts participants for items commonly consumed together, for example, milk in tea or coffee.

In the `meal gap review` stage the tool prompts for missing foods and drinks if there are long time gaps between reported eating occasions or where only a few foods have been reported.

When the participant has finished entering their foods they are asked to review their entries alongside a list of commonly forgotten foods such as biscuits, condiments (`last chance review` stage).

Participants are encouraged to complete their recall in one sitting, but to provide flexibility to encourage response the decision was taken to enable participants to leave their recall and come back to it, or to log out and log back in without losing any data. Participants can complete recalls using any online device including mobile phones, although they are encouraged to use devices with larger screens. They can also access a partially completed recall from different devices. However, participants must submit their recall before midnight. After midnight the tool resets because it is a new 24-hour period and data entered but not submitted is deleted.

For children aged 10 years or younger, a parent or carer is asked to complete the dietary recall with input from the child as appropriate. Children aged 11 years and older can complete the recall themselves with details confirmed with others where necessary.

Intake24 also provides the option for participants to view automated individualised dietary feedback which is displayed at the end of a specified number of recalls. For NDNS RP, participants completing 4 recalls are able to view their dietary feedback if they wish.

A Demo version of Intake24 is available.

2.2 Development of Intake 24 for the NDNS RP

Intake24 is maintained and provided for NDNS RP (and other research) from Cambridge University in collaboration with Newcastle University (Open Lab) for technical input. The tool selection process and the Year 12 dress rehearsal (see section 2.5) identified that a number of developments were needed in order to meet the requirements for NDNS RP. These included addition and modification of questions to obtain supporting details about the recall, and updates to tool functionality such as the ability to gather information on dietary supplements and to provide the option for participants to return to partially completed recalls. A major update of the food databases within Intake24 was also required in order to align these with the most up-to-date food composition data used for NDNS RP (see section 2.3). Alongside this work, the opportunity was taken to update portion estimation options for some foods. Updates made prior to launching Intake24 in Year 12 are listed in Table 1.

Due to the complexity of the Intake24 programming code it was not feasible to fully implement some of the desired changes prior to starting data collection for NDNS RP in October 2019. This included the ability for participants to download, save or print their dietary feedback, optimisation of Intake24 functionality on smaller screens (for example mobile devices) and configuration of some new questions (for example dietary supplements). In some cases short-term solutions were implemented pending further modification to refine functionality.

A programme of work to upgrade and standardise the programming code of the tool was also launched to enable easier customisation in future. This major tool development programme is being undertaken in parallel with NDNS RP data collection and is expected to be completed by early 2022.

Table 1. Updates to Intake24 for NDNS RP prior to Year 12 (2019 to 2020) data collection

Addition or modification of questions about food intake
• Prompt to record if the day`s intake was the same as usual or more or less than usual (and if more or less than usual, the reason why) • Record if on any special diet • Report type of oil usually used for cooking (if any) • Report where food for each meal was obtained to identify out of home consumption
Dietary feedback
• Changes to content of dietary feedback • Ability to return to online personalised dietary feedback page following completion of 4 recalls
Updated features or functionality
• Option to report use of dietary supplements (by adding as a new meal) • Saving partially completed recalls back to server (to allow participants to complete their recall over the course of the request day and over different devices) • Displaying recall number (so participant knows which recall they are completing) • Displaying participant name on start screen (where consent is provided) to minimise mix-ups in multi-participant households • Capturing if recall has been completed by proxy (for example parent of young child) • Updated video tutorial
Update to food databases
• Expansion and update of the Intake24 food list • Update to align with most up-to-date food composition data • Update of portion estimation options for some foods (for example new images)

2.3 Rationalisation of the NDNS Nutrient Databank and update of the food databases for Intake24

Dietary data for the NDNS RP is linked to food composition values in the NDNS nutrient databank (NDB) to produce estimates of nutrient intakes. The NDB is compiled with information from the UK Composition of Foods Integrated Dataset (CoFID) (16) supplemented by manufacturers' data gathered through food labels and web information and from the FSA Food Recipes Database (17). The NDB contains a range of food codes, including manufactured products, homemade recipe dishes and dietary supplements. Each year a programme of updates and revisions are made to the NDB including the addition of new food codes as well as the revision of data for existing food codes so that the databank is up-to-date and, as far as possible, reflects the nutrient composition of the food supply for each survey year reported. Further details of the NDB can be found in the NDNS RP Year 9 to 11 (2016 to 2019) report (8).

For the previous fieldwork model based on the paper diary, the food codes and associated nutrient composition data were imported from the NDB into the dietary coding software programme, DINO (Diet In Nutrients Out) (18). Participants recorded their foods and drinks and amounts consumed as free text in the diary and these were retrospectively coded by trained staff using DINO. For Intake24, the food codes and associated nutrient composition data are also imported from the NDB into databases that sit in the tool. Participants are required to search and then select from pre-defined lists of foods and drinks and assign a portion size from a range of available options). The foods listed are linked to food codes, so when a participant selects their foods and drinks these are automatically coded in the tool at the point of data entry.

Before being introduced into the NDNS RP, Intake24 already contained a list of foods with food codes linked to the NDNS NDB, but an earlier version (Year 4, 2011 to 2012). A major review of the food databases to be included in Intake24 was undertaken with the aim to provide comprehensive, yet simple food lists linked to the most up to date nutrient composition information. The food lists needed to be easily usable for participants to efficiently navigate and find their food while reflecting as far as possible the heterogeneity of the food supply in the UK. All foods had to be linked to appropriate portion options and nutrient composition values in the most current NDB. This review process also provided an opportunity to rationalise the NDB, which had grown unsystematically over many years to contain over 5,500 foods and drinks, to enable more efficient management of updates in future years of NDNS RP.

The NDB review and rationalisation was undertaken using the following approach. The first 10 years (2008 to 2018) of NDNS RP dietary intake data were examined to identify reported consumption rates (frequency and amount) for foods included in the NDB (n=6,098). Other factors were also taken into consideration including whether the product was still available on the market and variations between different brands and food preparations. All foods were then allocated to one of the following categories:

Retain	Foods that are frequently consumed or foods which are not necessarily reported frequently but are essential as they are not represented by other retained foods, for example, fortified or 'free-from' foods
Exclude	Foods that have been coded only a few times or have not been used or are no longer available
Represent	Foods that could be represented by another food: similar foods have been represented by a retained code, for example, canned crab represented by boiled crab
Ingredient	Foods that are used to build recipes in the NDB or likely to be required by participants if they report their recipes, for example, flour, baking powder

Overall, the numbers of foods assigned to each category were:

- Retain – 2016 (33%)
- Exclude – 1542 (25%)
- Represent – 2208 (36%)
- Ingredient – 332 (5%)

Following this approach, those food codes in the Exclude and Represent categories were decommissioned in the NDB (61% of codes). New generic food codes (n=114) were created to allow a single code to represent a range of similar foods. These were mainly new generic codes for sandwiches and salads which were not required before Year 12 as these items were previously coded as individual components. This resulted in a final database of 2,462 foods with linked nutrient composition data. The next stage was a review and update of the food lists in Intake24. Foods visible to respondents in Intake24 were linked to associated food codes in the NDB and to new or existing relevant portion size descriptors and a systematic, representative, user friendly and standard convention was applied to naming the foods.

2.4 Overview and implications of the methodological changes

Implementation of the new dietary assessment tool (Intake24) represents a significant method change for the NDNS RP. The move to online recall from paper diary put the onus on participants to use Intake24 to select the foods most appropriate to their consumption rather than their written entries being coded and this resulted in a new approach to dietary data processing and analysis. It also resulted in a much reduced level of interviewer involvement and a new fieldwork model with a single main household visit for the majority of participants instead of 3 visits or contacts. The differences between the 2 methods are set out in Table 2.

While the paper diary was completed over 4 consecutive days, recalls were completed on 4 non-consecutive days. It is expected that the move from consecutive to non-consecutive days of recording might lead to more variation in data collected with Intake24 compared with the diary. Consecutive days increase the likelihood of seeing the same foods consumed (participants may eat leftovers from the previous days) or eating to compensate for the number of calories or amount or type of food eaten the day before.

With the introduction of Intake24, all dietary data collected was included in the reporting dataset, that is data from participants who completed at least one recall. Including all recalls maximises the data available for dietary analyses and does not waste any of the data collected from participants. In Years 1 to 11, only participants who completed 3 or 4 diary days were included in the reporting dataset as a diary with fewer than 3 days was considered incomplete. A higher proportion of participants completed fewer than 4 days with Intake24 than with the diary, so restricting the dataset to participants who had completed 3 or 4 recalls would result in the loss of a lot more data. However 4 days of data collection is likely to capture more variety than one or 2 days and this can affect the calculation of average daily intakes and reduce the likelihood of extreme values. For example, if those who only complete 1 or 2 recalls consume a food on both recall days their average daily intake of that food would be higher than if they complete 3 or 4 recalls and consume the food on 2 of those recall days. In the future, adjustment methods (19) could be applied to estimate usual intakes rather than simply taking the average of the recording days for each participant individually.

Along with the change in dietary assessment method, the other major change has been the introduction of a more cost-efficient model for the selection of participants within a household. As in previous NDNS RP years, the aim is to achieve a representative sample of 500 adults (aged 19+ years) and 500 children (aged 1.5 to 18 years) from the core UK sample To achieve these numbers in previous years, one adult and one child were selected in around one-third of addresses and one child (no adult) in around two-thirds of addresses. From Year 12, the protocol has been amended to allow the selection of up to 2 adults and one child from around one-third of addresses and up to 2 children from the remaining two-thirds of addresses (child boost addresses) (20).

Table 2 gives an overview of the main methodological changes.

Table 2. Summary of changes introduced from Year 12 (2019) of the NDNS RP

	Years 1 to 11 (2008 to 2018)	**From Year 12 (2019)**
Dietary assessment method	Prospective using estimated (unweighed) diary	Retrospective using multiple pass 24-hour recall
Data collection	Paper-based, open-text entry with retrospective food and portion coding into the dietary assessment system DINO (Diet In Nutrients Out) by trained coders. Participants encouraged to report recipes, ingredients and, to aid coding, provide food packaging.	Online tool where participants search for foods and select best match for food names and portion options; auto-linked to food codes and portion amounts; nutrient information calculated within the tool Participants encouraged to match to pre-defined list of foods. Limited reporting of recipes or individual ingredients. Option to report a missing food if match cannot be found
Recording days	Consecutive over 4 days	Non-consecutive, total 4 days
Portion size assessment	Portion sizes mainly reported as household measures, often as small, medium or large servings. Limited number of portion size photos available.	A large proportion of food codes in Intake24 are linked to a range of portion-size photos from which the participant can select their portion size. Household measures also available for some foods.
Food coding	Individual coding of food items. Very few generic codes for mixed dishes for example all reported recipes and sandwiches entered as individual ingredients or components.	Pre-set food list and embedded coding. More generic codes to allow a single code to represent a range of similar foods for example one code for a cheese sandwich.
Supplement coding	Individual coding of dietary supplements reported by free text description.	Pre-set supplement list and embedded coding. More generic codes. Option to report a missing supplement if match cannot be found.

Dietary dataset	Dataset only includes participants with 3 or 4 diary days.	Participants are asked to complete 4 recalls but dataset includes all participants with at least one recall.
Interviewer visit	Two to 3 visits to each household to complete all interviewer stage components. Additional visits only for participants requiring assistance.	Single visit to household to complete all interviewer stage components. Additional visits only for participants requiring assistance or with no internet.
Interviewer involvement or support	Diary introduced at first visit and then reviewed at a mid-diary visit or telephone call. Reviewed and information clarified on third visit.	First recall completed by participant during interviewer visit, where possible reviewed by interviewer before submission. Subsequent recalls completed independently with no interviewer involvement.
Participant selection	One adult and one child selected in around one-third of addresses and one child (no adult) in around two-thirds of addresses.	2 adults and one child selected in around one-third of addresses and up to 2 children from the remaining two-thirds of addresses.

2.5 Dress rehearsal

Ahead of Year 12 fieldwork commencing in October 2019, the consortium ran a dress rehearsal (DR) in April to June 2019. This was designed to:

- test technical and operational aspects of the revised fieldwork model design
- evaluate the impact of amalgamating all interviewer components into a single visit with increased numbers of participants per household
- evaluate the acceptability and usability of Intake24 for participants, fieldworkers and research teams

The DR fieldwork model was designed to mirror as closely as possible the intended model and protocols for Year 12. The DR was not powered to assess response nor to provide a comparison of dietary data from Intake24 and the diary – these factors would form part of the

planned formal evaluation during Year 12. Forty-two participants (17 adults and 25 children) were recruited. Data was collected on participation rates for the different elements of the survey including number of recalls completed. Feedback was sought from participants, interviewers and nurses and the research teams so that elements of survey protocol could be refined and improved where required.

Overall the DR demonstrated that the new fieldwork model worked well for participants and fieldworkers and was not considered too burdensome. Intake24 was also shown to be acceptable to participants and fieldworkers with no major issues. Some adjustments to the fieldwork protocol and Intake24 were implemented to address practical issues identified (see section 2.2). The version of Intake24 used in the DR did not include the updated rationalised food list which was still in development at the time and implemented for the start of Year 12.

2.6 Evaluation of the methodological changes

Given the purpose of the NDNS RP is to provide trend information on food and nutrient intakes for the UK population, the implications of the methodological changes for data interpretation are important to understand. Alongside evaluating the ability of the new tool to effectively capture dietary intake in the national survey setting, an assessment of the implications of these methodological changes on the quality, coverage (for example spread of days of the week) and detail of nutrient data collected and comparability of results with previous years is also needed. Furthermore, the evaluation should build on the work of the dress rehearsal to monitor the effectiveness of the fieldwork model and participation rates in various elements of the survey.

Therefore the primary objectives of the evaluation of the changes in dietary methodology in the NDNS RP setting are to:

- describe how the new dietary method is performing in the NDNS RP
- identify aspects of data discontinuity and assess the feasibility of continuation of the time series dataset for monitoring ongoing trends over time
- assess the degree of misreporting of energy intake (EI) using the online 24-hour recall tool Intake24 in the NDNS RP compared with total energy expenditure (TEE) measured by the objective biomarker doubly labelled water (DLW)
- compare differences in EI:TEE between Intake24 and the previous diary method

A further objective of the evaluation is to identify opportunities to enhance performance of the tool and thereby improve data collection.

2.7 Evaluation plan and contents of this report

Originally the evaluation was planned to be conducted within NDNS RP Year 12 (2019 to 2020). However face-to-face fieldwork was suspended in March 2020 when the first UK lockdown

came into force. At this point data collection for Year 12 was about 50% complete. It was subsequently decided not to restart Year 12 and the start of Year 13 fieldwork was delayed by 3 months with a further period of suspension in late 2020. As Year 12 was not a complete year and the pace of Year 13 fieldwork is slower due to COVID-19, the evaluation is being conducted over a longer period in a staged approach with evaluation reports published at appropriate intervals This approach aims to promote an early understanding of the implications of the method change and identify any amendments required in a timely way. It is anticipated there will be 3 key stages.

Stage 1 of the evaluation uses data from all Year 12 participants (October 2019 to March 2020). This report presents results from this first stage and includes initial findings on:

- overall response to the survey in Year 12, participation rates for completing recalls and representativeness of days of the week
- measures around use of Intake24, for example, completion time, number of foods reported
- impact of rationalisation and updating of the nutrient databank on resulting dietary data
- impact on continuity of the NDNS trend data series

The second and third stages of the evaluation will be reported over the next 18 months and will include:

- Stage 2 – findings from the DLW analysis and an update to the Stage 1 evaluation using all available data at completion of the DLW fieldwork (21)
- Stage 3 – evaluation updated to include all participants from NDNS RP Years 12, 13 and 14 (2019 to 2022) and an assessment of the impact of selecting more individuals from within the same household

A follow up study of previous NDNS participants was carried out in August to October 2020 and will be published later this year. The study used Intake 24 as the dietary assessment tool and this evaluation will aid interpretation of the findings.

3. Measures of response in Year 12

3.1 Overview of fieldwork in Year 12

In the fieldwork model for NDNS RP Year 12, interviewers carried out a single household visit, with all selected participants in the household interviewed during the same visit (where possible). This included collecting the CAPI interview, physical activity questionnaire, height and weight measurements, spot urine and providing information about a nurse visit to take a blood sample. For those who agreed to a nurse visit this was arranged once the first recall had been completed by all participants in a household, hence there was a short gap between the interviewer and the nurse visit.

Interviewers introduced Intake24 and provided participants each with a unique URL that would be used to access Intake24 for completion of all of their recalls. After advising participants to watch a short tutorial video about Intake24, the first recall was then completed with the interviewer present. Interviewers were asked to review this first recall before submission if possible. Subsequent recalls were completed independently by the participant (and hence were not reviewed by an interviewer) and participants were notified when their next recall was due by text or email, randomly allocated 2 to 6 days after the previous recall. They were also sent up to 4 reminders if the recall was not completed at the requested time. If a participant required assistance with their recalls (including those not confident to complete the recall independently, those with no internet access or no ability to receive invitations and reminders via email or mobile phone) further interviewer visit(s) were arranged.

Year 12 fieldwork began in October 2019 and was due to run across 9 months until June 2020. However, interviewer and nurse fieldwork was suspended on 18 March 2020 due to COVID-19. This resulted in just over half of the planned Year 12 interviewer fieldwork and a quarter of the nurse fieldwork being completed.

This chapter looks at response to the survey in Year 12 (October 2019 to March 2020) including participation rates, the number of recalls achieved and the spread across days of the week to assess how the revised fieldwork model was working.

3.2 Household level response

Overall, of the 2533 addresses issued to interviewers during the Year 12 fieldwork period prior to the suspension due to COVID-19, 39% were eligible for household selection. The majority (85%) of ineligible addresses were addresses selected for the child boost sample that were screened out because they did not contain any children in the eligible age range (1.5 to 18 years). The remainder included vacant or derelict properties and institutions. A further 111 addresses, 4% of all addresses issued, were issued to interviewers but the eligibility of these addresses was not attained prior to the suspension of fieldwork. (Table 3).

Household selection was carried out at 97% of eligible addresses. The individuals in the remaining 3% of addresses declined to participate before the household selection could be carried out.

Table 3. Summary of achieved response rate at household (HH) level (Year 12, October 2020 to March 2021)

		Total	
		N	%
Issued addresses with outcomes	Ineligible[1]	1443	57%
	Issued but eligibility not assessed prior to COVID-19 suspension	111	4%
	Eligible	979	39%
	Total	2533	100%
Eligible addresses	Declined HH selection	28	3%
	Selected HHs	951	97%
	Total	979	100%
Selected Households	Productive HHs[2]	385	40%
	Unproductive: Non-contact	55	6%
	Unproductive: Declined (all selected participants)	347	36%
	Unproductive: Not interviewed prior to COVID-19 stoppage	74	8%
	Unproductive: Other reasons[3]	90	9%
	Total	951	100%

1 Includes child boost screened out addresses
2 Includes HHs that are fully productive (all participants completed recall one) and partially productive (at least one but not all selected participants completed at least one recall)
3 Other reasons for unproductive include proxy refusals, broken appointments and so on
4 Percentages may not add up to 100 due to rounding

Of the households in which the household selection was carried out, 385 (40%) were productive (at least one selected participant in the household completed at least one dietary recall). The other 566 households (60%) were unproductive for the following reasons; 347 (36%) declined to take part, 55 (6%) were households in which contact could not be established again for participant selection, 74 (8%) were households in which the household selection was carried out but fieldwork was suspended before an interview could take place, and 90 (9%) had other

reasons for being unproductive (including refusals on behalf of selected participants and broken appointments).

Caution should be used in making comparisons between NDNS Year 12 response figures and the most recently published response figures in NDNS Years 9 to 11 due to the COVID-19 pandemic truncating Year 12 fieldwork (resulting in small numbers). However, response figures are broadly similar to household level response seen previously in the NDNS RP (22). This suggests that the change to the fieldwork model did not have a negative impact on household response.

3.3 Dietary recall response

Table 4 shows that Year 12 (prior to early termination of fieldwork due to COVID-19) produced a total of 574 fully productive individuals (those who completed at least one recall), 284 children and 290 adults. The majority of productive individuals went on to complete all 4 dietary recalls; 467 (81%) completed all 4 recalls, 14 (2%) completed a total of 3 recalls, 33 (6%) completed 2 recalls only and 60 (10%) completed one recall only.

Direct comparisons to response rates achieved in past NDNS RP years have not been made here due to the low numbers achieved for year 12 (as a result of suspension of fieldwork due to COVID-19). Further consideration of response rates will be possible as more data (from Year 13 onwards) becomes available.

Table 4. Number of completed recalls – all participants (Year 12, October 2020 to March 2021)

						Total[2]	
		Total Children		Total Adults			
		N	%	N	%	N	%
Number of recalls completed	Completed one recall only	36	13%	24	8%	60	10%
	Completed 2 recalls only	18	6%	15	5%	33	6%
	Completed 3 recalls only	6	2%	8	3%	14	2%
	Completed 4 recalls only	224	79%	243	84%	467	81%
	Productive participants[1]	284	100%	290	100%	574	100%

1 Productive participants are those who completed Recall 1

2 Percentages may not add up to 100 due to rounding

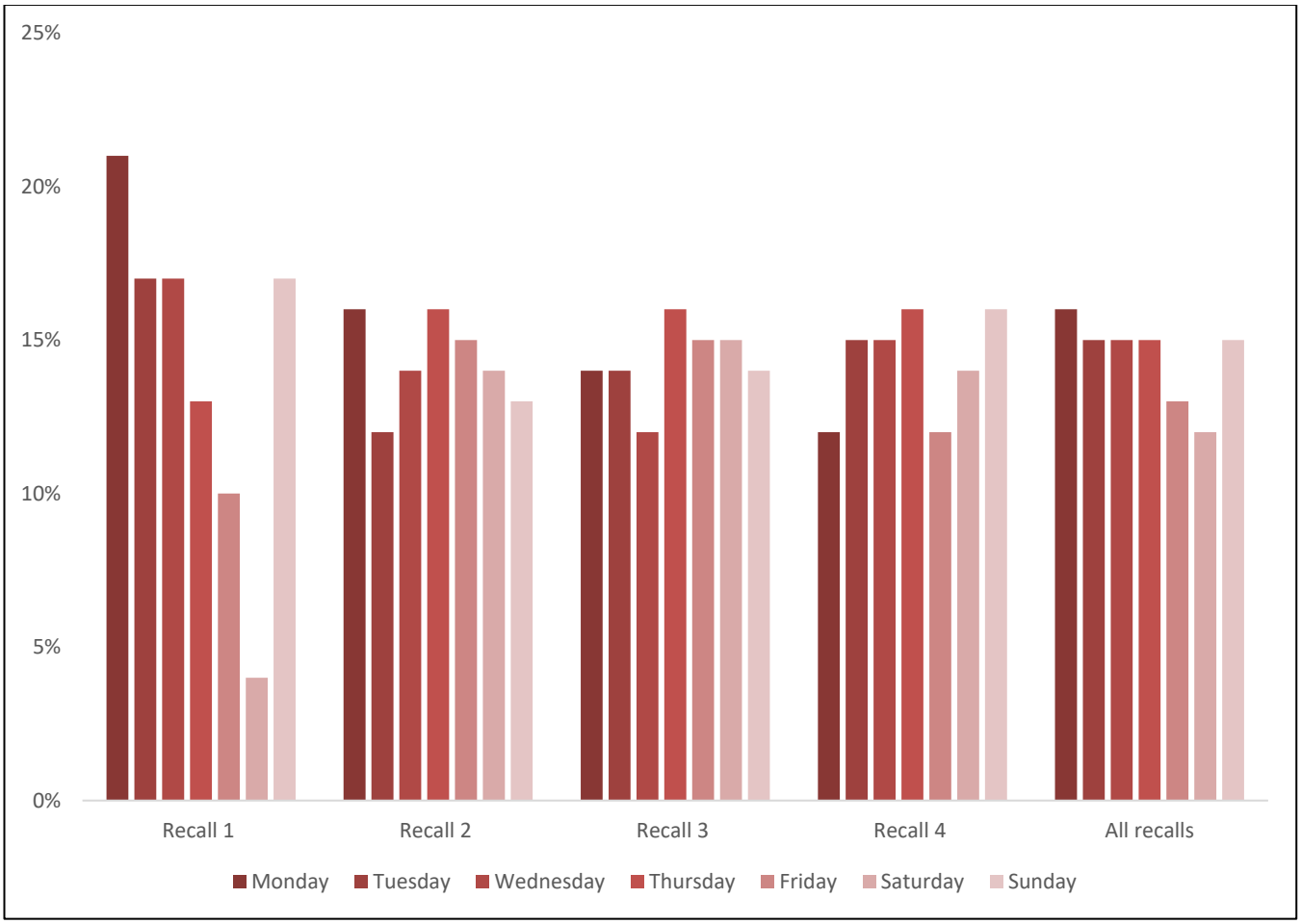
3.4 Recalls by day of the week

The NDNS RP study design aims to provide an even representation of all days of the week in the dietary dataset each fieldwork year. In Years 1 to 11 (2008 to 2019), the food diary could start on any day of the week and would run for 4 consecutive days. At the first interviewer visit, the CAPI program randomly assigned the diary start day for each participant. In Year 12, the first recall was completed at the main interviewer visit (which could take place any day of the week but was less likely to take place at the weekend) and dates for subsequent recalls were randomly allocated within the next 2 to 6 days by the recall invitation system. If a participant did not complete their recall on the requested day, the recall invitation system sent up to 4 reminders (firstly in the evening of the initial requested day and then over the next 9 days), always requesting completion of the recall for the preceding day. It should also be noted that some participants completed their recalls on a date that was different from the one they were allocated.

Figure 1 shows the percentages of recalls for each day of the week by recall number for Year 12. Data are shown for the day of the week the recall represents, rather than the day it was completed on (as each recall represents the diet of the previous day). Overall the percentage of recalls for weekdays were roughly equal (range between 15% and 16% for each day). However the proportion of recalls for Fridays and Saturdays was lower (13% for Fridays and 12% for Saturdays). This was mainly due to the lower proportion of first recalls (Recall 1) completed on weekends (representing dietary data collected for Friday and Saturday) reflecting the pattern of interviewer fieldwork. First recalls were completed on the same day as the interview and less interviewing tends to take place on weekends, hence this difference.

In an attempt to more evenly balance out the days of recall completions, an adjustment has been made to the recall invitation system for Year 13 so that third and fourth recall invitations were sent on the weekend if the participant had yet to complete a recall on a weekend day. The effect of this change will be reported in the next stage of the evaluation.

Figure 1. Percentage of recalls by days of the week (n=2036) (Year 12, October 2019 to March 2020)



4. Use of Intake24 in Year 12

This chapter describes how the new dietary method was performing in the NDNS RP by looking at indicators that help determine whether participants are using Intake24 as intended.

4.1 Data processing and quality checking

Intake24 automatically assigns food codes and gram weights to the foods and portion sizes selected by participants allowing the tool to auto-generate nutrient data. For dietary data processing, the raw Intake24 output was imported into a bespoke database to facilitate data checks and to assign foods reported as missing to an appropriate food code and portion size, using the original free text search term and missing food details provided by the participant.

The Year 12 data included a total of 2036 recalls. Across all age groups 12% of recalls had at least one food reported as missing by participants: 16% of first recalls had at least one missing food with 11% for recall 2, 9% for recall 3 and 10% for recall 4 (23). Sixty-one percent (211) of missing foods could be matched to an existing food code in Intake24. Similar percentages were seen when split by age group except for children aged 4 to 18 years where around 50% of foods reported as missing could be matched to existing food codes (24). Matching of missing foods was carried out by the research team.

For those missing foods that could not be matched to existing codes, new food codes were created or the food was allocated a temporary ‘closest match’ code. Monitoring these ‘closest match’ codes is an ongoing task so that a decision can be taken as to whether a new food needs to be added in Intake24 at a later stage based on the amount and frequency of consumption. This ensures that the food databases in Intake24 reflect general consumption patterns within the population.

In addition to processing missing foods, the Year 12 recall data were examined in relation to a set of checks informed by the research team’s experience with processing and checking dietary data, published studies using Intake24 and other similar dietary assessment methodology. Dietary recalls were checked if:

- there were fewer than 10 items (excluding dietary supplements and associated foods that are entered in Intake24 as a result of automated probing questions for common companion foods, such as asking if milk was added to breakfast cereal or used in tea and coffee)
- there were 3 or fewer eating or drinking occasions (occasions when a participant reported consuming only a drink without food were included in the count)
- there was a completion time of under 3 minutes

- total energy intake was less than 400kcal or more than 4,000kcal and the participant had not stated that they consumed “less than usual”, “more than usual”, or that they were on a weight gain or weight loss diet
- the participant had written multiple food items in their search term, for example “toast, cereal, yoghurt” but only one food item was coded
- there were inconsistencies between the search term and the food code selected, for example they searched for chicken stir-fry but selected prawn stir-fry
- there were ‘orphan’ foods (a reported food that appeared to have been eaten on its own, for example beef steak when it would commonly be eaten with other foods such as chips or potatoes or salad)

Undertaking and reporting on these checks aimed to describe the baseline for ongoing monitoring of Intake24 and for NDNS RP data, identify potential issues and improvements for tool functionality and usability, and identify and resolve any issues in the study dietary datasets. As a result of the checks above, a number of improvements were made to Intake24 during Year 12 data collection, for example, additional food prompt questions, improved portion estimation, clarification around the naming of foods.

At the end of data collection, and when all missing foods had been coded, boxplots were generated by NDNS standard sex and age groups (1.5 to 3 years, 4 to 10 years, 11 to 18 years and 19 years and over) to review portion sizes and to identify any extreme outliers within each food group (25). Extreme outliers were identified from the boxplots as individual data points separate from the box and whiskers since they were more than 1.5 x IQR (Inter-quartile range: 75th percentile to 25th percentile) from the nearest quartile for that intake (either the 25th or 75th percentile). These were examined on a case-by-case basis and reviewed in the context of the participant’s overall consumption. Portion sizes that were considered to be implausible, and potentially the result of errors in portion size selection, were adjusted. Adjustments were carried out in the bespoke dietary database by changing the portion code at the individual recall level.

Finally, boxplots were generated by age group to identify any infeasible or extreme energy and nutrient values. As with portions, extreme outliers were looked at on a case-by-case basis. Extreme intakes that were considered to be the result of errors in portion size or food composition in the NDB were adjusted, otherwise values were left in the dataset as they were assumed to reflect consumption by participants.

As a result of the extreme outlier checks for portion size, energy and nutrients, 14.6% of food items in Year 12 were adjusted. No Year 12 recalls were excluded from the evaluation or the NDNS dietary dataset as a result of these checks.

4.2 Recall completeness

Some of the data checks described in section 4.1 were considered alongside other measures such as recall completion times to provide an indication of recall completeness. The purpose of

this analysis was observational rather than statistically assessing any associations. It should be noted that there is only 6 months of data for Year 12 (October 2019 to March 2020) and so participant and recall numbers are small in some age groups, particularly when split by recall number.

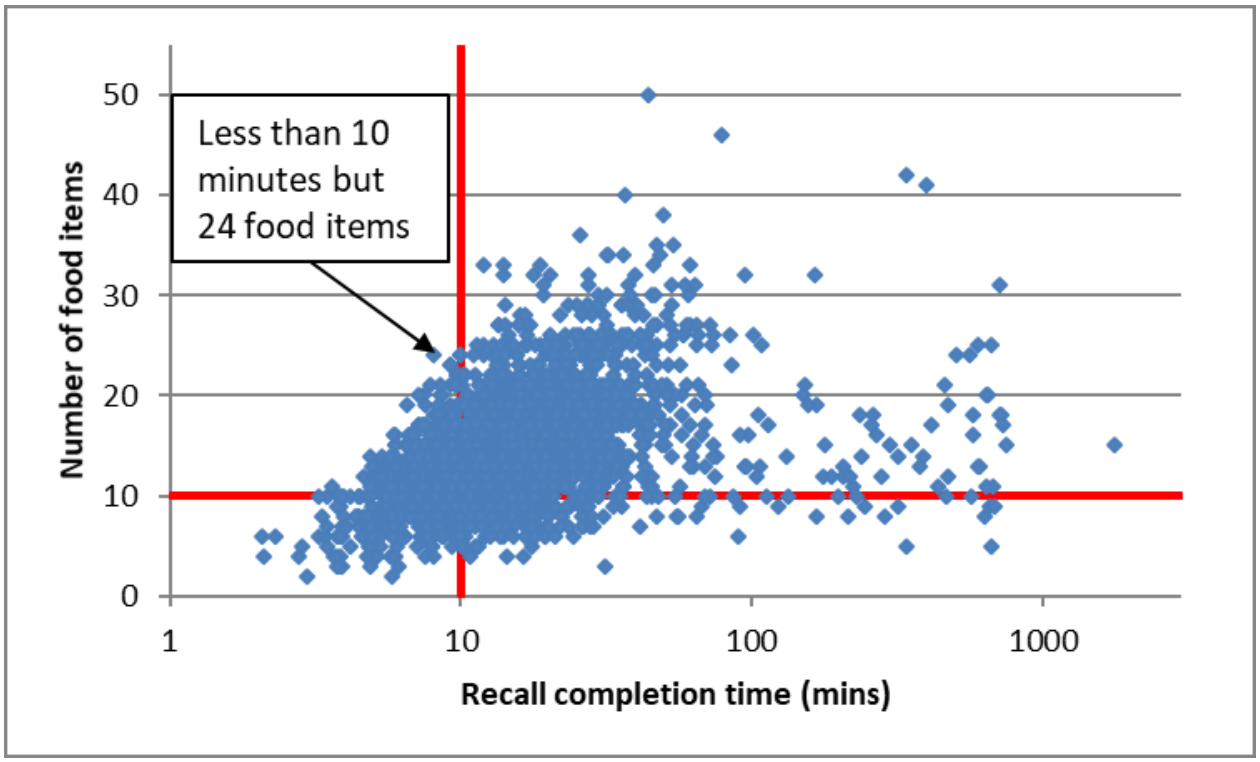
The median recall completion time was 15 minutes (mean was 32 minutes). A previous study testing Intake24 in a national survey setting had an average completion time of 14 minutes.[26] Online recall dietary assessment tools MyFood24 and ASA24 have mean completion times of 16 and 24 minutes respectively (27, 28). Completion times are taken from the time stamps within the Intake24 system, which are recorded when a participant logs in and when they log out or submit their recall so if a participant takes a break before submitting their recall and leaves their device logged onto Intake24, this will be included within their completion time. Some long completion times were seen in Year 12 (12% of recalls took between 30 to 59 minutes and 6% of recalls took more than 60 minutes); these have been included in the analysis but they do not necessarily reflect the time actively spent on recall completion.

Forty-one percent of recalls were completed within 10 to 19 minutes while 25% of recalls were completed in less than 10 minutes (ranging from 5% for adults aged 65 years and over to 35% for children aged 11 to 18 years). Only 6 recalls (0.3%) were completed in under 3 minutes. Overall, the proportion of participants completing the recall in less than 10 minutes increased for each successive recall. For example, 7% of participants took less than 10 minutes for the first recall while 39% took less than 10 minutes for the fourth recall. This pattern was different for adults aged 65 years and over where there was very little change in the proportion completing the recall in less than 10 minutes between the first recall (1%) and the fourth recall (7%).

The reduction in completion time from recall 1 to 4 is unlikely to be related to participant fatigue since there was no decrease in the number of food items for each successive recall (the proportion of recalls with fewer than 10 food items were 20%, 17%, 20% and 18% respectively from recall 1 to 4). However, the reduced completion time with successive recalls could be related to a learning effect and this has been observed in similar tools.[29] It should also be noted that the first recall took place with the interviewer present who was instructed to view the entries before the recall was submitted and this is likely to have increased the time taken. Subsequent recalls were completed independently unless participants requested further assistance from interviewers.

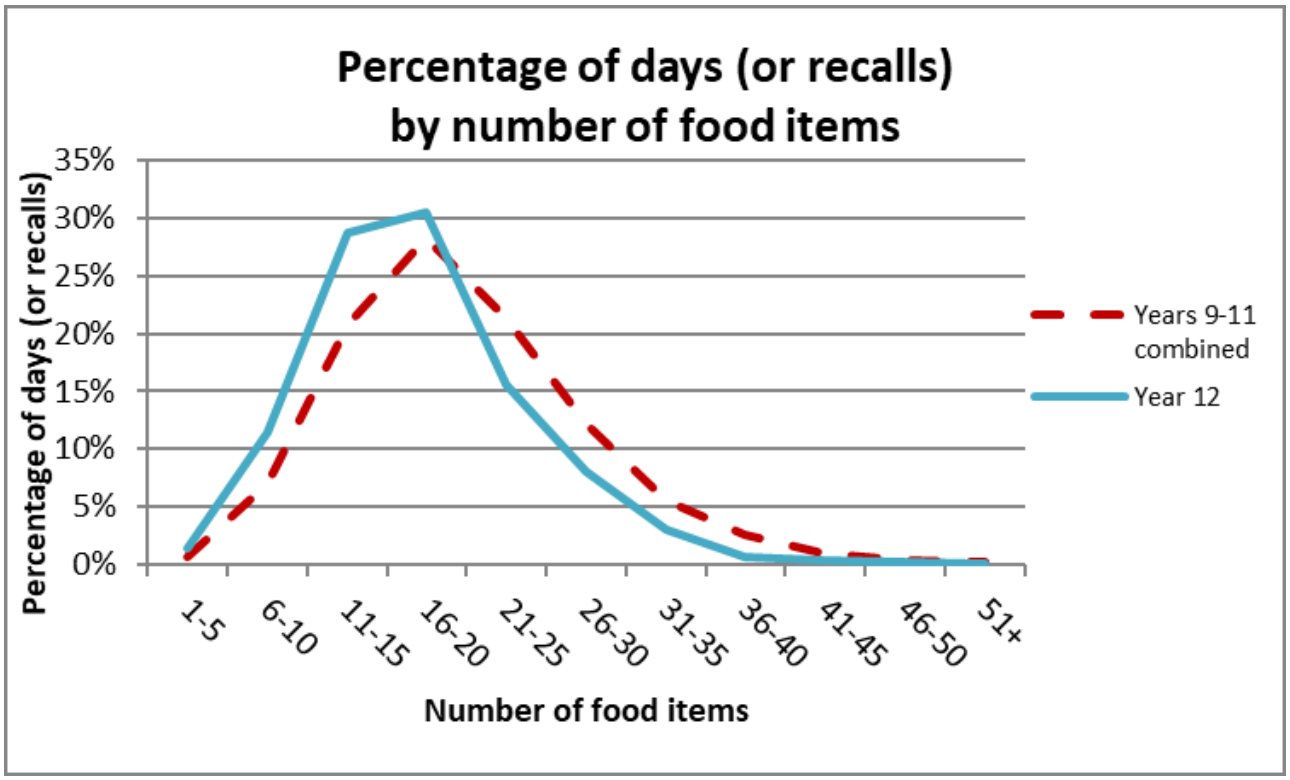
Figure 2 shows completion times and number of food items reported plotted against each other for all recalls. The vertical red line indicates the cut off at 10 minutes and the horizontal red line indicates the cut off at 10 food items. The plot shows that while 41% of the recalls that were completed in less than 10 minutes had fewer than 10 food items, up to 24 items were being recorded in under 10 minutes. While children aged 11 to 18 years had the lowest mean number of food items (12 per recall) and 31% of recalls for this age group had fewer than 10 items, the spread of data for this age group was similar to that seen overall in Figure 2 with 51% of recalls completed in less than 10 minutes having fewer than 10 food items.

Figure 2. Recall completion times and number of food items – all recalls (n=2036) (Year 12, October 2019 to March 2020)



Consideration was also given as to whether participants reported a similar number of food items using Intake24 compared to the paper diary. From Year 9 (2016 to 2017) it was possible to count DINO coded food items in a way that was similar to counting items collected through Intake24 in Year 12. Figure 3 shows that the distribution of number of food items per recall in Year 12 appears to be similar to the number of food items reported per diary day in Years 9 to 11 (combined) (2016 to 2019); the mean number of food items per recall in Year 12 was 18 while the mean number per diary day in Years 9 to 11 (combined) was 20 items. There was a higher proportion of recalls at the lower end of reported number of food items in Year 12, with 10% of recall days with fewer than 10 food items compared to 5% of diary days in Years 9 to 11 (combined). At least some of this difference is to be expected given the revised coding approach with Intake24 and the rationalisation of food codes described in section 1.3.1. For example, in the paper diary a cheese sandwich would be coded as at least two food items (bread and filling) whereas in Intake24, a generic cheese sandwich code would be selected and the sandwich would be coded as one item.

Figure 3. Percentage of recalls by number of food items (Years 9 to 11, 2016 to 2019 (n=14140) and Year 12, October 2019 to March 2020 (n=2036))



It was considered that one strategy participants might use to speed up recall completion would be to aggregate several different eating occasions together, for instance recording all food items under breakfast and evening meal rather than reporting them at different times across the day. If this was the case then the data might show fewer eating occasions for recalls completed in less than 10 minutes, perhaps along with an increase in the number of food items per eating occasion. However, the mean number of eating occasions was 4.4 and 5.2 for recalls completed in less than 10 minutes and 10 or more minutes respectively and the mean number of food items per eating occasion was 2.5 and 3.2 for recalls completed in less than 10 minutes and 10 or more minutes respectively. This suggests that this strategy was not being used.

The data checks described in section 4.1 revealed some exceptionally high energy intakes in Y12, attributable to implausibly large portion sizes of pizza being recorded. After review, this was determined to be likely due to an ambiguous questioning pathway in the tool which was subsequently rectified (30). To reduce the effect of these large pizza portions at the group level within the data analysis for the evaluation winsorization was applied (31), which involves recoding extreme values to the nearest ‘reasonable’ value. In this case, a 1000g cut off was applied based on the pizza portion data from Years 1 to 11.

Overall the proportion of recalls with very high and low energy intakes was small. Figure 4 shows the proportions of recalls in Year 12 compared with comparative diary data from the previous NDNS RP (Years 1 to 11 combined). For Year 12, 17 recalls (0.8%) had energy

intakes <400kcal per day, in 9 of which the participant reported eating less than usual. The percentage of paper diary days below 400kcal in Years 1 to 11 (combined) was similar (0.6%). After winsorization of pizza portions, 32 recalls (1.6%) had energy intakes >4000kcal per day in Year 12, in 12 of which the participant reported eating more than usual, slightly more than the percentage above this cut-off for diary days (0.5%). The majority of the 32 recalls with energy intakes >4000kcal per day in Year 12 were in the 11 to 18 years (10 recalls) and 19 to 64 years (18 recalls) age groups (equivalent to 2.9% and 2.3% of each respective age group). These age groups also made up the majority of diary days with energy intakes >4000kcal in Years 1 to 11.

Figure 4. Percentage of recalls with very high and low energy intakes (Years 1 to 11, 2008 to 2019 (n-14140) and Year 12, October 2019 to March 2020 (n=2036))

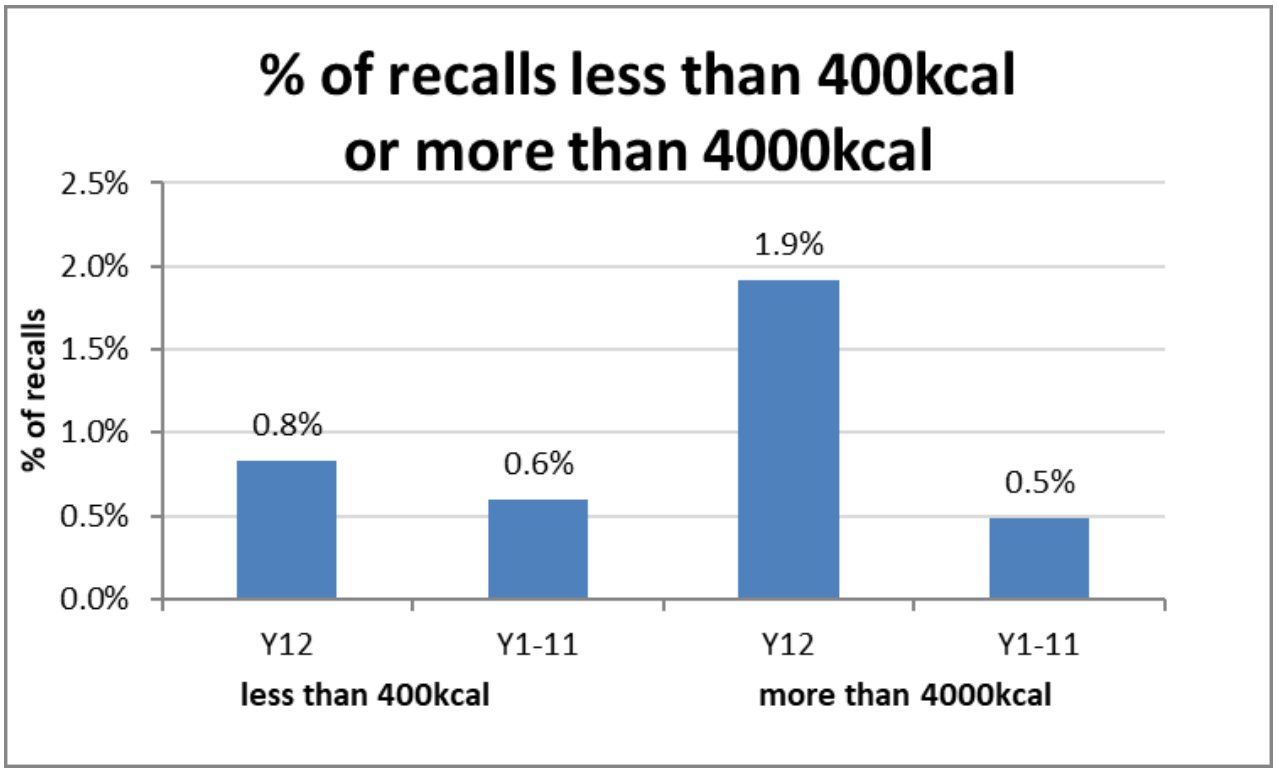
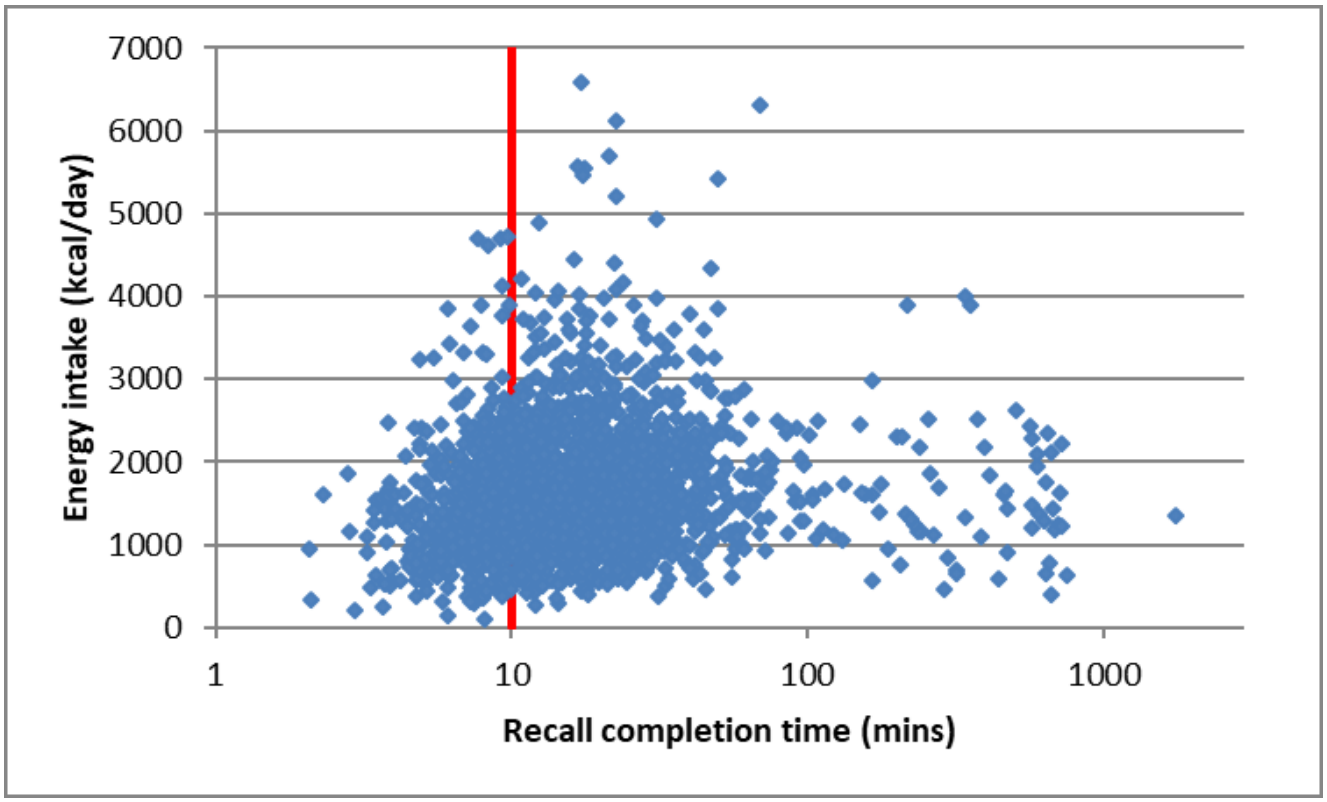


Figure 5 shows completion times and energy intake plotted against each other for all recalls. The red line indicates the cut off at 10 minutes. It shows a wide spread of energy intakes for recalls completed in under 10 minutes. This pattern was similar across all age groups.

Figure 5. Recall completion times and energy intake – all recalls (n=2036) (Year 12, October 2019 to March 2020)



The analyses and observations summarised in this section did not indicate any major concerns about recall completion; however the data is based on relatively small numbers at this time. This will be monitored and reviewed again with larger numbers in subsequent reports.

5. Evaluating impact on dietary data

Continuity in reporting of dietary data is important in the NDNS RP in order to monitor trends over time. This chapter considers aspects of data discontinuity and assesses the feasibility of continuation of the time series dataset for monitoring ongoing trends over time.

The changes in methodology are summarised in section 1.4. How much of any differences seen in the dietary data is due to these changes is difficult to quantify, but this evaluation can look at the overall impact and consider possible reasons behind changes observed. Measurement error applies across all self-report dietary assessment methods and it is important to note that the paper diary used in Years 1 to 11 of the NDNS RP has not been similarly assessed or evaluated. The objective of this evaluation is not to align the data collected using the two methods but to understand any differences and therefore any potential implications for continuing the NDNS trend data series.

5.1 Evaluating the rationalisation and updating of the Nutrient Databank

As described in section 2.3, the development of Intake24 for the start of Year 12 required a major review and rationalisation of the NDNS nutrient databank (NDB) to reduce the overall number of food codes and update the food lists in Intake24.

In order to measure the impact of this rationalisation and update of the NDB on monitoring trends over time, dietary data from NDNS RP Year 10 (2017 to 2018) was recalculated after matching paper diary entries to the foods available in the Year 12 rationalised NDB. This exercise aimed to test if any future changes observed could be the result of changes in the food codes used as opposed to a genuine change in reported dietary intake or other aspects of method change. For example if there were no changes in Year 10 energy intake when calculated using the rationalised NDB, a change in Year 12 energy intake data compared to previous NDNS RP data could be due to the other factors linked to the change from paper diary to online Intake24, or a genuine change in reported energy intake. A similar approach has been followed in other studies (32, 33).

The recalculation of Year 10 dietary intake data using the Year 12 rationalised NDB followed the steps listed below:

Step 1 Single food match

Foods reported as consumed in Year 10 were matched to a suitable food code available in the rationalised NDB (see section 2.3). Where the food consumed in Year 10 had been categorised as a Represent code in the rationalised NDB the Retain code was used for matching. If the food consumed in Year 10 was an Exclude code in the rationalised NDB it was matched to a similar

Retain food code based on food name. For example, a specific ice cream reported in Year 10 might be matched to a more generic ice cream code retained in the rationalised NDB. In the recode, 20% of Year 10 food item codes were replaced with different codes.

Step 2 Recipe match

The combinations of foods that were coded as a recipe in Year 10 were matched to a single food code available in the rationalised NDB (for example chicken, vegetables, oil and spices consumed as part of a recipe in Year 10 was linked to a generic chicken curry dish in the rationalised NDB). Due to complexity and the large number of recipes in Year 10, most recipes were matched based on similarities in food name rather than on composition. In the recode, 25% of Year 10 food item codes were replaced with generic recipe codes.

Step 3 Sandwich match

Foods that were identified as consumed as part of a sandwich in Year 10 were matched to a single sandwich food code available in the rationalised NDB. Due to the coding approach used for the food diary, foods consumed as sandwiches were not linked or identifiable as sandwiches in the Year 10 dataset so assumptions had to be made through a review of Y10 data. For example, bread, cheese and spread coded at the same time slot for the same participant in Year 10 was assumed to be a cheese sandwich and coded as such in the rationalised NDB. In the recode, 5% of Year 10 food item codes were replaced with new single sandwich codes.

Following a review of the data, 50% of Year 10 food item codes did not need to be recoded as the code in Year 10 was the same as in the rationalised NDB, for example tap water, banana.

After the matching process, the Year 10 dietary data was recalculated. The mean daily intake of selected foods and nutrients using the original Year 10 data was compared with the daily intake for the rationalised NDB Year 10 data for all ages combined. The comparisons made were not statistically tested. Plots are presented in Appendix A and show the mean (indicated by the red dot) and spread of the original Year 10 data compared to the mean and spread of the data for each of the 3 steps of rationalisation and for all changes combined:

- single foods – replacement of only single foods
- recipes – replacement of only recipes
- sandwiches – replacement of only sandwiches
- all changes – replacement of all foods

The dashed blue horizontal line represents the mean for the original and can be used to assess changes. In summary, for all ages combined, with the single food and sandwich code replacements, no clear differences were observed in mean intake or spread of the data. A few relatively small differences were observed following the recipe food code replacement (figures 6a to c): an increase in mean total energy intake (47kcal per day), an increase in mean total fat intake (2.8g per day or 0.6% of total energy) and a decrease in mean fruit and vegetable intake (13g per day or 0.2 portions per day).

In relation to recipes, the differences seen between the original Year 10 diary data and the re-matched Year 10 data (using the rationalised NDB) may be because some of the generic recipes used as replacements did not represent the range of content reported in the paper diaries where recipes were individually and specifically coded. In addition, the recipe matching was cruder compared to single food matching due to the complexity and large number of recipes. While no major differences were observed following the Year 10 code replacement, particularly for sandwiches and single foods, a review of codes used for recipes may be beneficial to improve the representation of foods and their constituent components. This will be considered and be taken forward.

Figure 6a. Mean daily total energy intake (across all age groups) using the original Year 10 data and the matched daily intake for the rationalised NDB Year 10 data

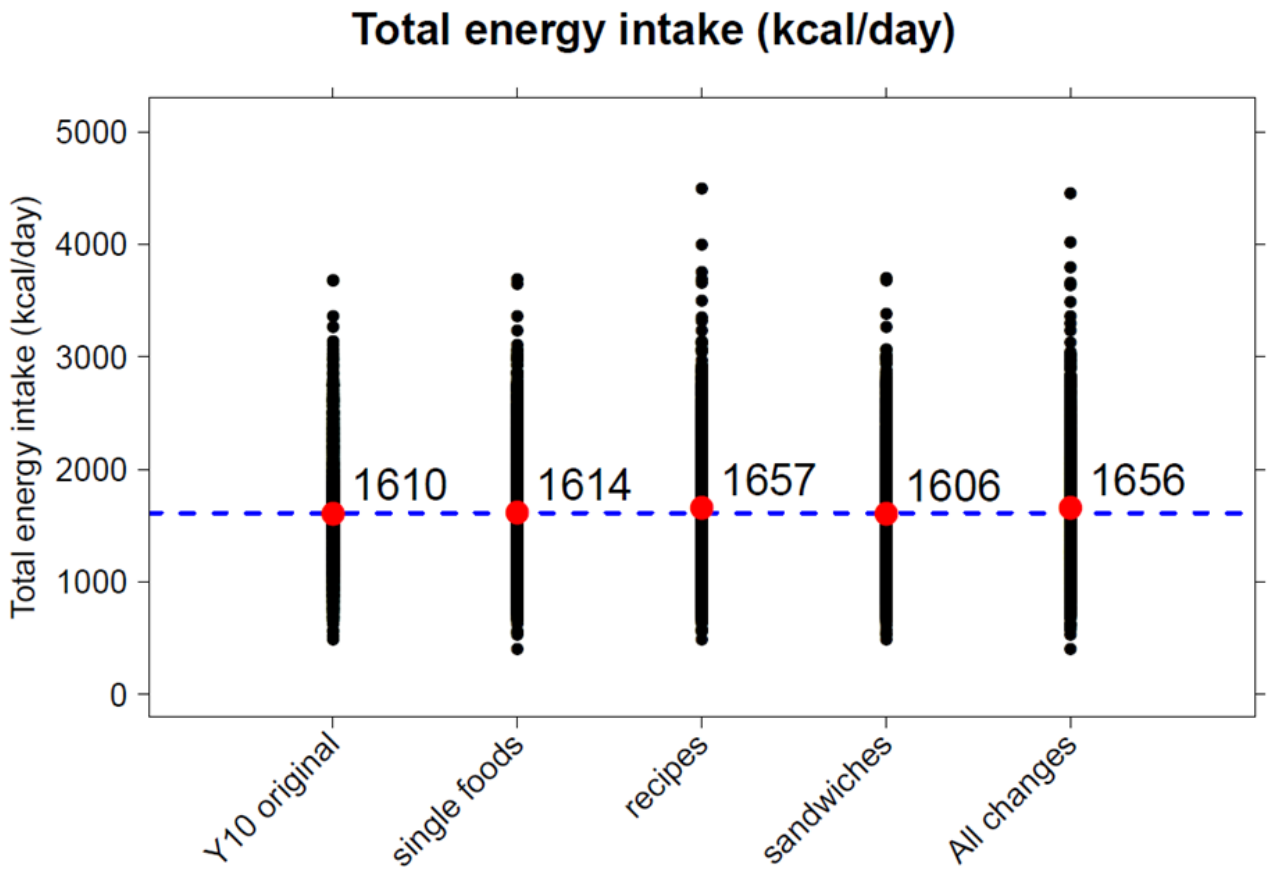


Figure 6b. Mean daily total fat intake (across all age groups) using the original Year 10 data and the matched daily intake for the rationalised NDB Year 10 data

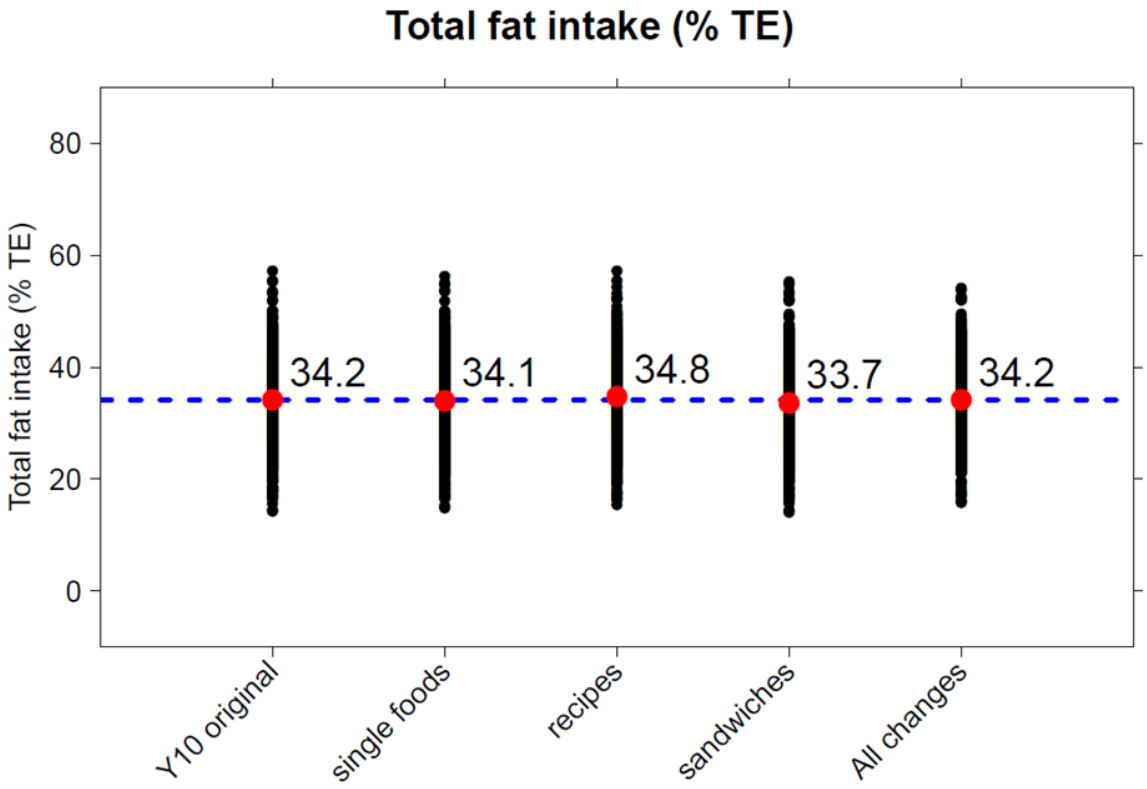
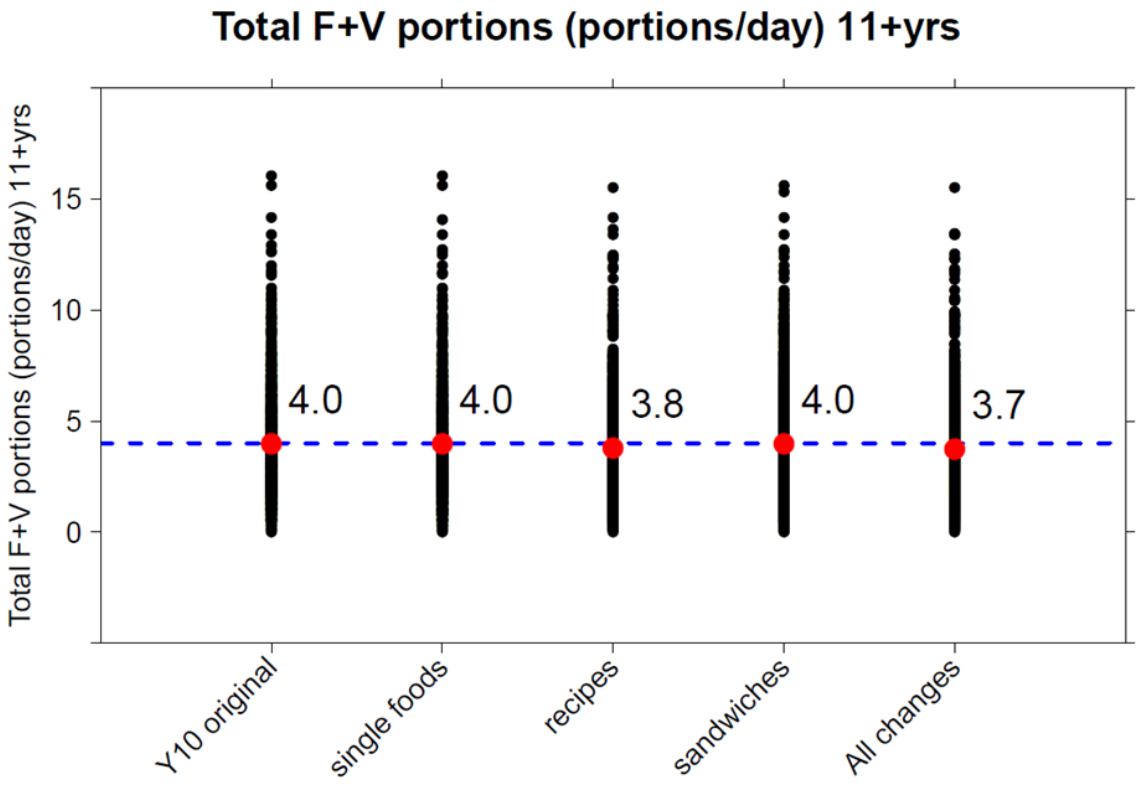


Figure 6c. Mean daily fruit and vegetable intake (across all age groups) using the original Year 10 data and the matched daily intake for the rationalised NDB Year 10 data



5.2 Impact of dietary assessment method change on monitoring trends over time

For this part of the evaluation, a number of key foods and nutrients were selected for inspection on the basis of the following considerations: importance for policy and monitoring over time; as indicators which have been relatively constant over time and where change would not necessarily be expected; items commonly omitted and items which may be misclassified by participants when using Intake24. These are listed in Appendix B.

For selected foods and nutrients, for each NDNS age group (1.5 to 3yrs, 4 to 10yrs, 11 to 18yrs, 19 to 64yrs and 65+yrs), individual level average daily intake was plotted per quarter of a year for Years 1 to 11 and a weighted linear regression line was presented along with combined year weighted means (34). Individual level average daily intake for Year 12 (October 2019 to March 2020) was added to the plots but the regression line was not extended to include Year 12 as data were not weighted. These plots are presented in Appendix B. While it is not possible to judge any shift in the centre of the distribution from the plots, they show the range of intakes so that any major increases or decreases in variation between Year 12 and previous years can be visually identified. No statistical testing has been performed between Year 12 and previous years because survey design information (such as weightings and stratification) was not available for Year 12.

For foods, percentage of consumers was plotted alongside intakes. For percentage of consumers, the unweighted proportion of consumers per quarter of a year was plotted for Years 1 to 11 for comparison with Year 12 to identify any step-changes. For foods where there were a large number of non-consumers, percentage of consumers and intakes for consumers only are presented instead of population intakes.

To examine the potential impact on the NDNS RP dietary data of including all participants who completed at least one recall as opposed to only including those with 3 or 4 recalls (which would be comparable with the food diary method in Years 1 to 11), the time trend plots in Appendix B distinguish between those participants in Year 12 who only completed 1 or 2 recalls (n= 93) from those who completed 3 or 4 (n=481). Differences in average daily intake or the percentage of consumers can be considered for those with only 1 or 2 recalls compared to those with 3 or 4 recalls.

When interpreting the plots, please note:

- there is only 6 months of data for Year 12 (October 2019 to March 2020) and data was predominantly collected in autumn and winter
- data for Years 1 to 11 is weighted prior to calculating the regression line and combined year means, whereas data for Year 12 is unweighted (as it only contains 6 months of data) and therefore may not be representative of the UK population

- numbers for each age group are shown in the table ‘Numbers of participants’ in the time trend plots
- numbers of consumers for some foods in some age or sex groups are very small
- with additional data, differences may be confirmed or may no longer be observed

5.2.1 Observations

Energy and nutrients

Generally, the plots show that the spread of the Year 12 energy and nutrient intake data appeared similar to data from Years 1 to 11.

For vitamin D and folate, intakes are presented including the contribution from supplements, and these are also within a range comparable with Years 1 to 11. However, in Year 12 there appeared to be a drop in the percentage of participants reporting taking supplements containing vitamin D or folic acid compared to Years 1 to 11. While data in Year 12 was predominantly collected in autumn and winter, there is no indication from previous NDNS data that use of these types of supplements is seasonal and it is possible that this shift in the data is related to the change in dietary assessment tool.

Prior to its introduction into NDNS RP, Intake24 had to be modified in order to ask participants to report supplement use in the dietary recall. Due to the technical complexity of Intake24, a short-term solution was implemented using the ‘Add a Meal’ function pending the wider programming upgrade of the Intake24 tool due to be implemented early 2022. Given concerns on the reporting of supplements, further changes to the way Intake24 asks participants to record supplements have been identified to try to improve estimates.

Foods

While caution is needed where there are small numbers of consumers, possible step changes were observed in Year 12 for some foods, both in amounts consumed and percentage of consumers. Notable observations for these foods are summarised below.

Foods with dietary recommendations

There was an observed decrease in the proportion of adults aged 19 to 64 years achieving 5 A Day fruit and vegetable portions in Year 12 compared to Years 1 to 11. While there was no evidence of a change in the amount of fruit consumed in this age group, reported vegetable intakes (including the contribution from composite dishes) were lower with noticeably fewer high intakes of vegetables reported. Recoding of Year 10 data suggests that the generic recipe codes used in Intake24 may not be capturing the range of vegetable content in recipes in the same way as the food diary method (section 5.1) and it is possible that participants are not reporting discrete vegetable items to the same degree as with the diary. This will be further examined when more data is available.

There appeared to be no evidence of changes in total meat and red and processed meat in any age group. The percentage of consumers of total fish and oily fish appeared to fall in the Year 12 data but there was no evidence of change in amounts consumed.

Commonly omitted foods

Snacks, condiments and beverages are commonly underreported foods (35). Data on the online recall dietary assessment tool ASA24, showed that foods eaten as additions such as salad vegetables, cheese and condiments were commonly omitted when comparing self-reported ASA24 recalls to interviewer-led recalls and observed eating studies (36). A previous study comparing Intake24 with interviewer-led recalls found that drinks and vegetables were the most commonly omitted items (14). In Intake24, as part of the multiple pass method (see section 2.1), there is a last chance review which includes a list of example foods to prompt consideration of commonly omitted items. For these types of foods, attention was particularly given to whether there was a step change in the percentage of consumers to indicate that these foods were reported to a greater or lesser extent in Intake24 compared to the paper diary.

A drop was seen in the percentage of consumers in children aged 4 to 10 years for both sugar and chocolate confectionery. In the same age group there was also a drop in percentage of consumers of buns, cakes and pastries. No change was seen in the other age groups. As numbers are very small, data is insufficient to draw conclusions; hence this has been identified for further monitoring. No changes were seen in the percentage of consumers of biscuits or crisps and snacks in any age group.

A drop was seen in the percentage of consumers of salad vegetables across all age groups but not in the amount consumed by consumers. The data from Years 1 to 11 suggests that salad intake is not seasonal. This drop in percentage of consumers may be in part due to a coding difference which has impacted on the ability to identify salad consumers. In the food diary, if a participant recorded salad as part of a composite dish, for example, sandwiches or burgers, this would have been coded separately and the participant would be identified and counted as a consumer of salad vegetables. In Intake24, salad in sandwiches and burgers is included in the new single generic food codes (for example cheese and tomato sandwich code) and whilst the salad component will be disaggregated for contribution to vegetable intake, participants are not identified and counted as salad consumers in the same way as with the diary. For cooked vegetables, there was a drop in percentage of consumers aged 11 to 18 years but not in amounts consumed by consumers.

For sauces and condiments, there was a decrease in the percentage of consumers of mayonnaise across all age groups. This may be because, like salad above, mayonnaise is included as a constituent ingredient in single food codes in Intake24 (for example, tuna mayonnaise sandwich) whereas it would have been coded separately in the diary data. This could explain why a similar change was not seen for tomato ketchup, because it is less likely to

be part of a composite food code. There was a drop in the amount of gravy consumed by consumers but not in the percentage of consumers.

Misclassifications

Fat spreads, soft drinks and fruit juice were reviewed to see if reporting was similar between the paper diary and Intake24. Based on the research team`s previous experience, these categories were considered at higher risk of misclassification due to the range of products on the market and the common use of colloquial descriptors which may not reflect the product specification. For example the term 'juice' is sometimes used to describe drinks that are not 100% fruit juice or 'butter' is used to describe any fat spread.

There appeared to be an increase in the percentage of consumers of butter but a decrease in the percentage of consumers of reduced fat spread compared with previous years' data. There was no change in the percentage of consumers of low fat spreads. This could be because reduced fat spread was used as the default in diary coding if the type of spread was not specified and so may have been over-represented in the Years 1 to 11 data. Also, reduced fat spread would have been coded separately for sandwiches whereas the fat spread in sandwiches in Intake24 is now part of the generic sandwich food codes. Further exploration identified inconsistencies in the way fat spreads are described in the food list in Intake24 which may be misleading to participants when they are selecting their food match. The order of foods coming up in the associated food prompt question may also impact (for example if they say yes to having butter on toast, the prompt list has butter first on the list). It may also be that participants more often used butter as a generic search term for any fat. The presentation of fats and spreads within Intake24 has been identified for further work.

There appeared to be an increase in the percentage of consumers of sugar-sweetened soft drinks in children. This is against the long term downward trend seen in the NDNS RP (8). This difference was due to an increase in the percentage of consumers of "ready to drink" (RTD) still drinks as there was no change for carbonated or concentrated sugar-sweetened soft drinks There was also an increase in the amount of "ready to drink" (RTD) still drinks consumed by children. These differences may be due to issues with the description of this type of food in the food list in Intake24 and inconsistency in naming sugar-sweetened and low calorie or "no added sugar" (NAS) versions of some drinks. A review of sugar-sweetened soft drinks within Intake24 has been identified for further work.

Overall there was a drop in the percentage of consumers of low calorie or NAS soft drinks (not just in children). There was no change for carbonated drinks but a decrease in concentrated and an increase in RTD still drinks. The amount consumed by consumers followed the same pattern: a decrease in concentrated and an increase in RTD still drinks. The main reason behind this is likely to be that concentrate codes in Intake24 include the water component and so are linked to RTD still codes. Presentation of low calorie or NAS soft drinks within Intake24 has been identified for further review.

There was no change for fruit juice which indicated that this was being reported and recorded consistently with previous years.

Portion sizes – consistency over time

Breakfast cereals, rice and pizzas were reviewed as these foods were often poorly quantified in the food diary by participants. There appeared to be no step changes for amounts consumed of these foods (pizza data was analysed after winsorization – see section 4.2).

Comparing intakes from 1 or 2 recalls vs 3 or 4 recalls

For average daily intake of nutrients and foods consumed in Year 12, some relatively extreme high and low individual values were observed for those with 1 or 2 recalls compared to those with 3 or 4 recalls. However, not all participants with 1 or 2 recalls had extreme values (there are some values in the middle of the distribution) so the overall impact of this on a group mean level will be small. The extreme low values (zero consumption) for some foods, for instance, total fish, will have an impact on the percentage of consumers (because a participant with 1 or 2 recalls is less likely to be a consumer than someone with 3 or 4 recalls). However, the plots in Appendix B showed that including those with only 1 or 2 recalls did not have a large effect on the proportion of consumers. While the intention is to continue including participants with only 1 or 2 recalls, this will be monitored and, where required, methods will be adopted to mitigate the influence of extreme values in the analysis of future NDNS RP datasets.

6. Conclusions and next steps

This Stage 1 evaluation report provides the first review of data from the NDNS RP following the introduction of a new dietary assessment method, the online 24-hour recall tool, Intake24.

The first aim was to describe how the new method is performing in the NDNS RP. The data suggest that response to the survey is broadly similar to previous survey years and that the majority of participants who complete their first recall go on to complete all 4 recalls using Intake24. The average recall completion time is comparable with other online dietary recall tools and shorter completion times do not necessarily equate to fewer foods reported. The range of numbers of food items reported per recall appears to be similar to numbers of foods reported using the paper diary.

The second aim was to identify any aspects of data discontinuity and to assess the feasibility of continuation of the time series dataset for monitoring ongoing trends over time. The Year 12 data indicates some possible step changes in trends for some foods, but these changes are not carrying through to nutrient intakes. Some of the observed differences appear to be the result of functionality or usability issues within Intake24. These are being addressed in the short-term or are on the list to optimise further when the programming upgrade for the tool is complete by early 2022. Some differences appear to be the result of the rationalisation of the NDB and use of generic food codes, particularly for recipes, and work is underway to investigate these aspects and to make improvements where possible.

A limitation of this first stage of the evaluation is the limited amount of data available. For some foods where there appears to be a step change between Year 1 to 11 and Year 12 data, observed differences may be confirmed or may no longer be evident when a larger dataset is available. All observations will be subject to further analyses in later stages of the evaluation. It was expected that some differences may be observed with the change in methodology and these could impact at different levels. For example, for some of the commonly omitted foods where there appears to be a drop in percentage consumers, this may be the result of the identification and counting method and changes to the way these foods are coded in Intake24 compared with the diary, rather than because they have been genuinely omitted in Intake24 (for example salad vegetables and mayonnaise). Consideration will be given as to how these will be dealt with when presenting time trend data in future NDNS RP reports.

Table 5 summarises specific issues arising from this first evaluation stage and the actions that are being taken forward to address these.

Table 5. Key areas identified for further work and proposed actions

Area identified for further work	Proposed action
Dietary supplements	Improve functionality within Intake24 for recording supplements so that it is more straightforward for participants
Fruit and vegetables	Review the generic recipe codes to consider better representation of homemade dishes
Fat spreads	Changes to food names and improve how foods appear in the Intake24 food lists
Soft drinks	Review which food codes are linked to soft drinks, food names and how foods appear in the Intake24 food lists

Overall, this first stage of the evaluation indicates that the introduction of Intake24 as a new dietary assessment tool and the related methodological changes implemented from Year 12, is compatible with meeting NDNS RP requirements. While overall comparability with the previous method appears to be good, a number of issues have been identified that require action to ensure and maintain the robustness of the data collection.

The next evaluation report will reproduce all the analyses presented here incorporating additional data from Year 13 fieldwork, and will address and report on issues identified in the Stage 1 analysis. The next stage of the evaluation will also include the DLW analysis to assess the degree of misreporting of energy intake and compare differences in EI:TEE between Intake24 and the paper diary method.

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2. NatCen has led the consortium since the beginning of the RP. The Cambridge NDNS team is supported by the NIHR Cambridge Biomedical Research Centre (IS-BRC-1215-20014) and joined the consortium in November 2017. The latter consists of the NIHR BRC Diet, Anthropometry and Physical Activity Group and the NIHR BRC Nutritional Biomarker Laboratory hosted at the Medical Research Council Epidemiology Unit at the University of Cambridge
3. The MRC Epidemiology Unit joined the consortium in November 2017
4. From 1 April 2013, responsibility for the NDNS contract transferred from the Department of Health in England to the Department of Health's Executive Agency, Public Health England
5 NatCen has led the consortium since the beginning of the RP. The Cambridge NDNS team is supported by the NIHR Cambridge Biomedical Research Centre (IS-BRC-1215-20014) and joined the consortium in November 2017. The latter consists of the NIHR BRC Diet, Anthropometry and Physical Activity Group and the NIHR BRC Nutritional Biomarker Laboratory hosted at the Medical Research Council Epidemiology Unit at the University of Cambridge
6. Until December 2018, the consortium included the MRC Elsie Widdowson Laboratory, Cambridge
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22. 'National Diet and Nutrition Survey'
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