National Centre for Social Research

Natsal

Natsal-4 Technical Report (NatCen)

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Glossary

This glossary explains terms used in the Natsal-4 Technical Report.

The following terms are used throughout the glossary and the rest of the technical report to refer to Natsal-4's NatCen data collection arms:

- **Address-based probability sample ('PAF')** data collection using address-based probability sample from the postcode address file (PAF), which aims to represent people living in private households in Great Britain. Most interviews were conducted in person **('Face-to-face'**), but some were conducted by field interviewers over the telephone using the same questionnaire program (**CATI at home**)
- **Probability panel** data collection with members of NatCen's probability panel, panel of British adults who were originally recruited through the British Social Attitudes Survey (BSA) from 2015-2022. BSA participants were selected at random from the general population using the Post Adress File (PAF) as a sampling frame. Natsal-4 probability panel interviews were carried out using two data collection modes:
    - **Telephone interviews** (**CATI)**
    - **Online survey** with members of the NatCen probability panel who did not take part in the telephone mode (Web Follow Up, or **'WFU'**)

Advance mailing
For Natsal-4 NatCen data collection arms at the beginning of each wave, an advance mailing was sent to selected addresses. The advance mailing included a letter and a leaflet. Copies of these documents can be found in Appendices B (address-based probability sample), C (probability panel telephone), and D (probability panel online).

Computer assisted personal interviewing (CAPI)
An in-person interview mode where an interviewer reads out questions from and enters answers to a computer program on their laptop. This mode was used to collect some of the PAF data.

Computer assisted self-interviewing (CASI)
An in-person interview mode where the participant types in their answers to survey questions into the computer program using interviewer's laptop. This mode was used to collect more sensitive data in the PAF arm of Natsal.

Computer assisted telephone interviewing (CATI)
A remote interview mode where an interviewer reads out questions from and enters answers to a computer program over the telephone. In this technical report, this term is used to data collection which involved telephone interviews with the participants of the NatCen probability Panel.

CATI non-responder
Probability panel members who had not completed the interview by phone. Non-responders were invited to complete a shorter online only version of the Natsal-4 questionnaire.

Computer assisted web interviewing (CAWI)
A remote interview mode where the participant completes an online questionnaire on their own device. It was used to collect self-completion data from:

- PAF participants who completed the CATI interview (self-completion section)
- All panel telephone (CATI) participants (self-completion section)
- All panel online (WFU) participants (entire survey)

Core sample
Adults aged 16 to 59 for the address-based probability sample (PAF) and 18 to 59 for the probability panel telephone and online sample.

DataHub
A bespoke data management tool used by NatCen to prepare and check the Natsal-4 data.

Data linkage
Linking information collected in the Natsal-4 survey ('survey data') to information held about the participant by other data sources. In Natsal-4, participants were asked for the consent to link survey data to health, education and administrative datasets. More information on these datasets can be found in section 5.1.4.

Fully productive interview
Interviews were considered fully productive when all questionnaire sections had been completed. Participants did not have to consent to Data Linkage and/or to providing a biological sample for their interview to be considered fully productive.

Index of Multiple Deprivation (IMD)
The Index of Multiple Deprivation (IMD) is a measure of relative deprivation of small areas (neighbourhoods). IMD referred to in this report is an adjusted IMD measure for Great Britain.[a]

Interview pack
An interview pack was provided to address-based probability (PAF) telephone participants on the doorstep ahead of the interview. This contained physical copies of all the documents required for the interview to take place over the phone, including showcards. Aside from the advance letter and survey leaflet, probability panel telephone (CATI) participants were not provided with a physical copy of interview documents. Instead, they were referred to view online copies by a telephone interviewer during the interview.

NatCen probability panel
The NatCen probability panel is a probability sample panel (recruited from the British Social Attitudes Survey participants) who usually take part in brief online/telephone surveys.

Partial productive interview
Interviews were considered partially productive if the participant had reached at least to the end of the sexual attraction and experience sections but not to the end of the questionnaire.

Postcode Address File (PAF)
A list held by Royal Mail of all small-user residential addresses (delivery points) in the UK. Used as the sampling frame for the address-based probability PAF sample.

Primary sampling units (PSUs)
Postcode sectors which were selected systematically to be included in the PAF sample.

[a] We used an adjusted measure of IMD to allow IMD for England, Scotland and Wales to be analysed together; available open source at https://github.com/mysociety/composite_uk_imd, based on a method developed by Abel, Barclay and Payne, 2016 https://bmjopen.bmj.com/content/6/11/e012750

Productive interview
Includes both partially and fully productive interviews; i.e. all participants who reached at least to the end of the sexual attraction and experience sections.

Region
The regions reported on and used in the response section of this report are based on the nine former Government Office Regions (GOR): North East, North West, Yorkshire and the Humber, East Midlands, East of England, London, South East, South West, in addition to Scotland and Wales.

Showcards
Used by address-based probability (PAF) and probability panel telephone (CATI) interviewers for more sensitive interview questions. Each showcard displayed a list of response options to a question and participants were asked by the interviewer to read out the letter or number that matched their answer.

Young person boost sample
A boost sample of adults aged 16 to 29 for the address-based probability (PAF) sample.

1. Introduction

The fourth National Survey of Sexual Attitudes and Lifestyles (Natsal-4) was carried out between 2022 and 2024 by a collaborative team from University College London (UCL), the London School of Hygiene & Tropical Medicine (LSHTM), the University of Glasgow, Örebro University Hospital and the National Centre for Social Research (NatCen). The Natsal Resource (including Natsal-4) is supported by a grant from the Wellcome Trust with contributions from the Economic and Social Research Council and the National Institute of Health Research.

This technical report details the methods used for Natsal-4 NatCen fieldwork and covers the sample design, questionnaire development, piloting, fieldwork, biological sampling, survey response, data processing and weighting. Fieldwork documents and data collection instruments are provided in the appendices. This report does not provide any survey results. A technical report detailing the methods used for the non-probability Ipsos study arm are described separately.

This report describes, where relevant, the differences between the Natsal-4 NatCen fieldwork arms: address-based probability sample (PAF), probability panel telephone (CATI), and probability panel online (WFU).

Natsal-4 was given ethical approval by the East Midlands - Leicester South Research Ethics Committee (Reference no. 20/EM/0025).

1.1 The Natsal series

Natsal-4 was closely modelled on the three previous Natsal surveys on sexual behaviour in Great Britain (Natsal-1 in 1990-1991, Natsal-2 in 1999-2001, and Natsal-3 in 2010-2012) and was carried out by the same core team of investigators as Natsal-3.

Natsal-1 involved 18,876 adults aged 16-59; data was collected using a combination of face-to-face interviews (conducted by interviewers using paper questionnaire) and ‘paper-and-pencil' self-completion questionnaire. Natsal-2 involved interviews with 11,161 adults aged 16-44, along with a further 949 adults from boosted ethnic minority groups; data collection was carried out using computer assisted personal interview (CAPI) techniques along with computer assisted self-interviewing (CASI) for the more sensitive questions. Natsal-3 included interviews with 15,162 adults aged 16-74 and like Natsal-2, data collection was carried out using CAPI and CASI methods in a face-to-face interview.

Details of the methodologies used for Natsal-1, Natsal-2 and Natsal-3 have been reported in several books, reports and academic papers.[1] [2] [3] [4] [5] [6] [7] [8] A full list of publications can be found on the Natsal website (www.natsal.ac.uk).

Data from Natsal-1, Natsal-2 and Natsal-3 has provided evidence underpinning public health policy, practice and research for over 25 years. Natsal provides the evidence-base for major sexual and reproductive health interventions and monitoring their impact, including:

- The National Chlamydia Screening Programme
- National Sexual Health & HIV strategies
- Enhanced HIV testing

- HPV vaccination programme
- The Teenage Pregnancy Strategy (2000-2010)
- Sex and relationship education in schools (PSHE education)
- Delivery of sexual and reproductive health services.

1.2 Natsal-4

The aim of Natsal-4 was to provide up-to-date information on sexual lifestyles, behaviours, sexual and reproductive health outcomes and risk factors for adverse outcomes. An additional aim was to look at trends over time by including comparable measures to those used in the previous three Natsal surveys, and to include new questions to take account of current information needs in the field of sexual and reproductive health.

The main objectives of Natsal-4 were to provide:

- A detailed understanding of patterns and variability of sexual behaviour in Great Britain (for example, partners, practices, frequency)
- Self-reported estimates of a range of sexual and reproductive health outcomes (for example, STI diagnosis, reproductive health, sexual violence, sexual function and wellbeing)
- Evidence regarding sexual and reproductive health service use and uptake of interventions
- Population prevalences of key STIs, measured in biological samples
- Trend data to examine changes in sexual behaviour, relationships, reproductive history and patterns of fertility.

Planned methods and innovations for Natsal-4 (see section 1.3 for changes to this following the COVID-19 pandemic)

To enable comparisons over time, Natsal-4 was largely based on methods developed for previous Natsal surveys. However, several innovations and methodological changes were planned for Natsal-4 from the outset, including:

- A range of new topic areas including gender identity, sexual wellbeing, use of digital technology and use of online sexual and reproductive health services
- Vaginal swab samples collected from women; and a urine sample collected from men and trans/gender diverse participants and women who did not provide vaginal swab samples.
- Participant consent to link survey data to routinely collected administrative data.
- An achieved sample of circa 10,000 participants resident in Great Britain, comprising:
  - a general population sample of people aged 15-59. Target sample size 7,000.
  - a young person boost sample of people aged 15-29 years. Target sample size 2,000.
  - an ethnic minority boost sample. Target sample size circa 790.
- The planned inclusion of 15 year olds, which was to be the youngest age in any of the Natsal surveys to date.

The age range eligible for Natsal has varied with each survey depending on the focus, for example a key focus of Natsal-3 was sexual and reproductive health across the life course, for which the age range was extended up to 74 (having previously had an upper age limit of 59 for Natsal-1 and 44 for Natsal-2). The upper age limit for Natsal-4 was reduced back to 59 in order to focus resources on younger people, who experience the greatest social and sexual changes and are more likely to experience adverse sexual and reproductive health outcomes than other age groups. Although there may have been some change in sexual behaviour among the older age groups over time, we expect that key findings around the association between health, ageing and sexual lifestyles[9] would remain valid.

Similar to previous Natsals, the intention for Natsal-4 was to carry out hour-long (on average), face-to-face interviews with an address-based probability sample of participants drawn from the Postcode Adress File (PAF). Considerable development work was carried out for Natsal-4, including:

- A scoping review[10], to inform the survey design
- A stakeholder consultation to inform content of the questionnaire[11]
- Qualitative interviews to inform the development of new questionnaire topics[12] [13] [14]
- A validation study for a new measure of sexual wellbeing[15]
- Development of new or modified questions
- Cognitive testing of some new or modified questions[16]
- Further in-depth stakeholder engagement on particular question topics (e.g. sexual violence, measuring gender and sex) and an overall questionnaire review by individuals belonging to/working with populations of key relevance to sexual and reproductive health, or which are underrepresented on the research team.
- Piloting data collection methods, including vaginal swab samples and consent to data linkage
- In-depth interviews with 20 pilot participants to obtain views on survey documents, their experience of and feedback on the questionnaire content and to gain insight into data linkage and biosampling consent.

Following the emergence of the COVID-19 pandemic in early 2020 and the ongoing disruption to in-person data collection, many aspects of the survey were changed. These modifications are described in the next section.

1.3 Impact of the COVID-19 pandemic on Natsal-4

The development work on Natsal-4 was well underway when the COVID-19 pandemic began. Pilot fieldwork was due to commence in May 2020 and was paused while alternative data collection options were considered.

The COVID-19 pandemic had both immediate and long-term consequences for social research data collection methods. Lockdown restrictions and social distancing measures prevented the delivery of the original Natsal-4 study design. To overcome these problems, **remote data collection** approaches were developed and implemented, enabling participation among individuals who were unable or unwilling to allow an interviewer into their home.

Despite implementing remote data collection options, the delivery of Natsal-4 fieldwork was challenging in the post-pandemic period. Natsal-4 was one of the first interviewer-administered probability sample surveys to resume fieldwork (in September 2022) following the pause during the early months of the pandemic. It was immediately clear that response rates to face-to-face surveys were substantially lower than pre-pandemic averages across the UK. This was driven both by damage to the research industry's field force infrastructure and changes in the general public's willingness to participate in face-to-face research studies, representing a sharp acceleration of long-term declines in survey response rates over the previous decades. Despite concerted efforts across the survey industry to recruit new interviewers to the fieldforce, progress was slow and fieldwork was challenging. To compensate for the low response rates among the original Natsal-4 sample (the PAF sample) and slow fieldwork coverage, **data collection with the NatCen probability panel** was implemented.

1.3.1. Remote data collection with the address-based probability (PAF) sample

An evaluation of potential remote data collection models was undertaken, considering the ability of each model to deliver Natsal's key survey design features. In-person interviewing with telephone mode as an alternative mode emerged as most suitable for Natsal. Following the identification of a preferred model, the implementation of remote fieldwork procedures was undertaken. The following adaptations were made:

- Telephone and video interviewing options were enabled as alternatives to face-to-face interviewing
  - Take-up of video interviews was very low during the first pilot and was subsequently dropped
- Initial contact with selected addresses and individual participant selection was made in-person on the doorstep
- Remote participants were provided with study documents before the interview
- CAPI questions were administered over the telephone (or video) call

- An online self-completion questionnaire was created, mirroring the CASI self-completion, and nested in the telephone interview
- New biological sampling protocols were developed for remote participants
- An eConsent (electronic consent) process was developed to replace paper consent forms.

The PAF pilots (in June-July 2021 and Feb-March 2022) demonstrated the feasibility and acceptability of the remote methods. However, response to biological sampling and data linkage consent were lower in remote interviews compared to face-to-face. Natsal-4 mainstage fieldwork retained a remote option but emphasised in-home interviewing as the preferred mode.

1.3.2. Data collection with the NatCen probability panel

Several initiatives were put in place to try to alleviate the shortfall in interviews among the PAF sample. However, by early 2023 it was apparent that initiatives to try to improve PAF fieldwork were having limited impact and additional sampling strategies were required. The decision was made to invite participants from the NatCen probability panel to take part in Natsal-4. It was acknowledged that the panel does not include 16 and 17 year olds and has lower cumulative response rates than a 'fresh' probability sample survey, but it was a pragmatic solution to increase the sample size for analytic purposes, while retaining a probability sample design.

The NatCen probability panel is a probability sample panel (recruited from the British Social Attitudes Survey participants) who usually take part in brief online/telephone surveys. In this case we invited them to take part in an hour-long Natsal remote interview (by telephone with a nested online self-completion), including self-collected biological samples and consent to data linkage. This arm of the study has been labelled Natsal **Probability panel telephone (CATI)** and it took place from July to December 2023.

The Natsal-4 interview was different (in terms of length, primary mode of data collection being telephone rather than online, and sensitivity) to the short surveys that the panel are used to completing, so uptake was assumed to be lower than usual NatCen Panel studies. Therefore, a shorter (~20 minute) online version of the survey was also offered to panel members who had not taken part in the full hour-long telephone interview (CATI), which could provide valuable information about harder-to-recruit participants. This arm of the study took place from September 2023 to January 2024 and has been labelled **Probability panel online (sometimes referred to as web follow up, or WFU)**.

1.3.3. Changes to the Natsal-4 design following the COVID-19 pandemic

Adaptations to the Natsal-4 design following the COVID-19 pandemic resulted in the following additional changes:

- The ambition to collect data from 15 year olds was dropped, in part due to ethical concerns given the introduction of remote data collection
- The fieldwork design and target sample composition were incrementally adapted in response to difficulties obtaining PAF interviews. After a series of changes, the final targets became:
  - PAF sample: 1,000 general population sample of people aged 16-59 ('core' sample)
  - PAF sample: 1,000 general population sample of people aged 16-29 ('young person' sample)
  - Probability panel sample: 2,400 CATI and 2,300 WFU panel sample aged 18-59
- Only four (of eight) waves of the PAF sample were issued (see section 2.2.1)
- Plans for a probability sample ethnic minority boost sample were not implemented. This decision was taken due to the dramatic reduction in feasibility of doorstep screening for eligible participants resulting from the impact of the pandemic on PAF fieldwork generally.

1.3.4. Additional data collection via non-probability sample methods

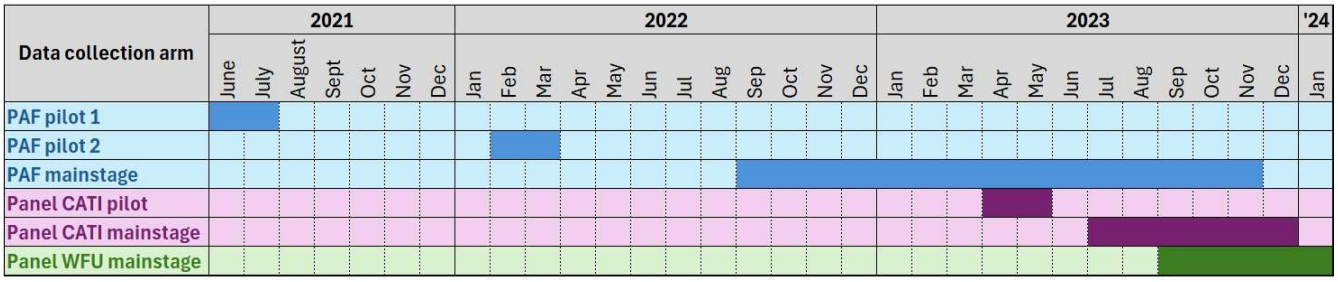
In addition to the Natsal-4 probability sample data collection, the Natsal team commissioned Ipsos to conduct a quota (non-probability) online panel survey of ~12,400 participants using a similar questionnaire as the Natsal

WFU study described above. This follows successful implementation of two similar non-probability online panel surveys during the COVID-19 pandemic to assess the impact of the pandemic on sexual and reproductive health (the 'Natsal-COVID' studies[17,18]). This was not intended to replace the main Natsal-4 probability survey, but to complement it. Details of that study can be found in the complementary Natsal-4 technical report (Ipsos).

1.4 Natsal-4 data collection timeline

A summary of the data collection timelines for the different arms of the Natsal probability study is shown below in figure 1.

Figure 1: Natsal-4 probability data collection timeline



Specifically, PAF questionnaire data collection ran from 20th September 2022 to 5th November 2023; probability panel telephone (CATI) from 12th July to 3rd December 2023; and probability panel online (WFU) from 1st September 2023 to 7th January 2024.

2. Sample design

2.1 Design overview

2.2 Address-based probability sample (PAF)

2.2.1. Sample size and structure

Natsal-4 aimed to interview a representative sample of men and women aged 16-59 living in private households in Great Britain. This comprised a 'core' sample of adults aged 16-59, and a further 'boost' sample of young people aged 16-29. The reason for boosting the 16-29 age group was to have sufficient statistical power to permit detailed exploration of behaviours among the age-group at highest risk of a range of sexual and reproductive health outcomes, including teenage pregnancy and STIs.

The initial sample used a multi-stage, clustered and stratified probability design, with grouped postcode sectors selected as the primary sampling units (PSUs), addresses within them selected at the second stage, and finally one eligible adult was randomly selected at the final stage. The sampling frame was the 'small-user' Postcode Address File (PAF), a list of all addresses (delivery points) in the United Kingdom, of which for Natsal those in England, Wales and Scotland were included. The original sample design involved selecting 108,460 addresses from the PAF, 28,050 for the core sample and 80,410 for the boost sample. (For practical reasons, addresses north of the Caledonian Canal, the Scottish islands, and the Isles of Scilly were excluded from the sample frame. This excludes 0.5% of eligible addresses in Great Britain.)

Fieldwork proceeded more slowly than planned, due to difficulties recruiting interviewers, and a decline in response rates across all surveys, following the emergency phase of the COVID-19 pandemic. After four survey waves had been launched (out of eight) by the end of March 2023, only ~1,050 interviews of the ~2,500 target (42%) by that point had been achieved. It was therefore decided to use the remaining fieldwork period to fully complete these first four waves, and not to proceed with the last four waves. It was also decided around this time to increase the biosampling consent token of appreciation from £5 to £10. A further sample of adults aged 18-59 was drawn from the NatCen probability panel instead.

The PAF sample design is described more fully below.

2.2.2. Selection of primary sampling units (PSUs)

A list of all postcode sectors (south of the Caledonian Canal) in Great Britain was generated. Postcode sectors with fewer than 1000 PAF 'delivery points' (addresses) were combined with neighbouring sectors to avoid any tight clustering of sampled addresses. A total of 1,870 postcode sectors were selected as PSUs; 1,593 from England, 104 from Wales, and 173 from Scotland.

Before selection, postcode sectors were stratified to maximise precision of the sample and to ensure that different strata in the population were correctly represented. These were first sorted by country, then by Government Office Regions within England, with a further distinction between inner and outer London. Within each country and region, these were then sorted by tertiles of population density, then by tertiles of the proportion of the population aged 16-29, and finally (within region and tertiles of population density and proportion aged 16-29) postcode sectors were listed in increasing order of the proportion of households with a

head of household in a non-manual occupation (Socio-Economic Groups 1-6, 13). The data used to create these strata were taken from the 2011 Census. The sectors were selected systematically, with each postcode sector being given a probability of selection proportional to its total number of delivery points.

Fieldwork was split into eight 'waves', and also divided into a primary sample, a secondary sample, and two reserve samples. The reserve samples were ultimately not used, nor were the last four waves.

Table 2.1: Number of PSUs assigned to each wave, and each subsample

	Number of PSUs			
Wave	**Primary sample**	**Secondary sample**	***Reserve sample A***	***Reserve sample B***
1	76	30	-	-
2	76	30	-	-
3	177	30	*23*	*46*
4	177	30	*23*	*46*
5	*177*	*30*	*23*	*46*
6	*177*	*30*	*23*	*47*
7	*177*	*30*	*23*	*46*
8	*178*	*30*	*23*	*46*
Total	**1,215**	**240**	***138***	***277***

2.2.3. Sampling delivery points (addresses)

Within each selected PSU, a systematic random sample of 58 delivery points (addresses) was selected. Within each PSU, 15 of the selected addresses were assigned to the core sample, and the remaining 43 were young person boost addresses (to be screened for ages 16-29).

2.2.4. Sampling dwelling units, households, and people

At each selected address, the interviewer enumerated the dwelling units[b], and one would be selected using a pre-supplied random number (sometimes known as a 'Kish grid'). Within the selected dwelling unit, the interviewer would enumerate the households[c], and one would again be selected using a pre-supplied random number. The interview would then list the people residing in that household aged 16-59 (or 16-29 at young person boost addresses) and select one using a pre-supplied random number.

2.2.5. Enhanced address-based probability (PAF) sampling

Screening addresses to establish which had a resident in the eligible age range was costly and time-consuming, especially in the young person boost sample where the age range was narrow (16-29) We explored the use of an 'enhanced PAF' sample, where a demographic data about residents at sampled addresses was sought from the National Health Service (NHS), to help establish which addresses do not have any residents in the eligible age range, and remove these addresses from the sample ('screen out'). This approach had the potential to avoid unnecessarily contacting addresses with no eligible residents, and greatly reduce the amount of wasted resource spent visiting those addresses. For the remaining sampled addresses, where patient records indicated one or more eligible individuals were resident, or where there was no patient data available, procedures would be exactly the same as the standard PAF procedures, whereby an interviewer would visit the address to establish whether any eligible individuals were resident.

[b] A dwelling unit is a living space with its own locked front door. This can be either a street door or a door within a house or block of flats. Usually there is only one dwelling unit at an address.
c One person living alone or a group of people (not necessarily related) living at the same address who share cooking facilities AND share a living room or sitting room or dining area.

Permissions to use patient data for this purpose were granted by Public Health Scotland and Digital Health and Care Wales. A validation analysis, comparing the patient data from Scotland and Wales with data from interviewer visits, suggested this approach had the potential to greatly improve fieldwork efficiency. However, the approvals and patient data were received too late to implement this enhanced PAF sample approach for Natsal-4, and approval for access to patient data was not granted by NHS England.

2.3 Probability panel

2.3.1. Sampling frame

The Probability Panel sample was drawn from members of the NatCen Opinion Panel, a panel of UK adults recruited for social research.[d] The NatCen Opinion Panel is recruited through studies for which participants are selected at random from the general population using the Postcode Address File (PAF) as a sampling frame. For this study, we used NatCen Opinion Panel sample recruited from the British Social Attitudes survey (BSA) from 2015 to 2022, where participants were asked if they would like to join the panel after completing the survey. Prior to 2020, BSA was conducted face-to-face, with interviewers sent to a stratified random sample of addresses in Great Britain, with some clustering of addresses within postcode sectors. In response to the COVID-19 pandemic, BSA transitioned in 2020 to a 'push-to-web' approach, with invitation and reminder letters sent to an un-clustered stratified random sample of addresses in Great Britain asking up to two people per household to take part online. More information about the sampling and fieldwork design for BSA can be found in technical reports published online.[e]

2.3.2. Sampling individuals – probability panel telephone (CATI) sample

For this study, a sub-sample of all NatCen Opinion Panel members were invited to take part in the CATI survey. As is standard for practice for all NatCen panel surveys, panel members were only eligible for sampling if they had not a) requested to leave or b) become 'inactive'.[f] In addition, only panel members who were part of the target population (adults aged 18 to 59) were eligible for sampling.

The total panel sample was split into 12 'batches' (plus the pilot sample), with the sample allocated to batches at random.

As age is not a static characteristic, panel members' eligibility changed over time. For the purposes of sampling, panel members' age was assumed to be what it would be at the fieldwork start date for their batch. This was calculated based on their reported date of birth. Where date of birth information was not available, it was calculated based on their reported age at their recruitment interview, adjusted by the number of years since their recruitment interview.[g]

As noted in Section 2.3.1, it is possible for up to two members of the same household to be members of the panel. Given the sensitivity of the survey, and to minimise clustering effects on sample efficiency, where two members of the panel were recruited from the same household and eligible for the Natsal study only one was sampled at random.

For batches 1 to 6, all eligible panel members (up to one per household) were sampled. However, due to the panel age distribution and differential recruitment/attrition and response rates, the resulting sample over-represented people aged 45-59 relative to people aged 18-44. For batches 7 to 12 therefore, all eligible panel members aged 18-44, and a random 3 in 10 eligible panel members aged 45-59 were sampled. To maximise the representativeness of this sub-sample, the extent to which they had characteristics that were over- or under-

[d] https://natcen.ac.uk/centres/natcen-panel
[e] https://natcen.ac.uk/british-social-attitudes
[f] A panel member that had not participated in the last six surveys they had been invited to is classified as 'inactive'. All panel members who have not been invited to take part in six surveys are classified as 'active'.
[g] In a small number of instances, sampled panel members were identified as ineligible during fieldwork as either the initial estimates were inaccurate, or they turned 60/left Great Britain during the fieldwork period. These cases were removed from the data post-fieldwork.

represented in the panel were modelled using information on their age, sex, region, household structure, income, education, economic activity, ethnicity, tenure, National Statistics Socio-economic Classification (NS-SEC), interest in politics and party support, and their odds of selection adjusted accordingly.

2.3.3. Probability panel online (WFU) sample

No sampling was performed for the WFU survey. Rather, all panel members who were not classified as fully or partially productive during CATI fieldwork and had not subsequently left the panel or been identified as ineligible (for example, being deceased) were invited to take part in the web follow-up survey.

3. Questionnaire development, topics and modes

3.1 Questionnaire development

The Natsal-4 PAF and CATI questionnaire involved a combination of interviewer-administered questions and a self-completion component, while the WFU questionnaire was self-completion only. The questionnaire was broadly based on the previous three Natsal questionnaires; the development of these instruments has been described elsewhere.[19] A major review of the questionnaire content was undertaken, and significant changes were implemented made to the questionnaire prior to the start of Natsal-4 fieldwork.

Questionnaire development activities included:

- an open online consultation to gather the views of stakeholders and members of the public on which content should be included (see section 3.1.1)
- qualitative research to inform new questions on sexual wellbeing[15] and use of digital technology[13 14]
- thematic Working Groups were established to assess changes needed and develop new content for individual questionnaire modules.
- a range of engagement with experts and those with lived experience about specific questionnaire topics such as sexual violence, gender.
- a full questionnaire review by individuals belonging to or representing particular groups who were either of key relevance to the survey topic, and/or who are traditionally under-represented on academic research teams
- cognitive interviews to test new and revised questions, such as those on gender identity, reproductive health and pornography (see section 3.1.2).

3.1.1. Stakeholder consultation

The Natsal team held an open consultation between June and July 2019 to capture the views of stakeholders and interested members of the public on the content of the Natsal-4 questionnaire. They received 294 responses (online and via email); 30 from organisations and 264 from individuals including members of the public, researchers, clinicians, policy makers, educators, and those representing voluntary or community groups.

Consultees were asked to rank the importance of topics which had been included in the previous Natsal surveys and new topics planned for Natsal-4. The highest- ranking topics were: ‘Experience of sex against your will’, ‘Gender identity’ (a new topic for Natsal-4), ‘Sexual attraction, experience and identity’, and ‘Use of sexual and reproductive health services and testing’.

Consultees proposed many new topics and specific questions they thought to be relevant for Natsal-4, and there were relatively few suggestions for topics to be removed from the existing questionnaire. The consultation responses fed into a series of prioritisation exercises to determine which questions would be taken forward as part of the questionnaire for the Natsal-4 pilot study. This was necessary due to restrictions on the overall feasible questionnaire length, the large number of potential new topics and questions for Natsal-4, and the need to retain many questions from previous Natsal surveys.

Consultees also proposed improvements to existing questions, which fed into a wider questionnaire design review. Decisions about which changes to make were balanced against the need to make improvements to the existing questionnaire (some sections of which were initially developed in the late 1980s) with the need to keep core question wording the same to enable examination of change over time.

Further details about the stakeholder consultation can be found in the Natsal-4 Stakeholder Consultation Report.[11]

3.1.2. Cognitive testing

Cognitive testing was carried out on a selection of new or revised questions planned for inclusion in Natsal-4. This involved individual cognitive interviews with 30 individuals who were purposively sampled to include a range of people with different characteristics (age, gender identity, ethnicity, sexual orientation, recent new relationship and recent internet dating). The cognitive interviews tested questions on the following topics:

- Gender identity
- Sexual identity
- Transgender history and sexual partners
- Agreement to sexual activity
- Exclusivity in sexual relationships
- Use of digital technology and pornography
- Paid sex
- Reproductive health

Testing focussed on comprehension, information recall and response time, whether answer options were used appropriately by participants and if the list was exhaustive, cognitive burden and whether participants felt able to provide an honest answer.

Cognitive testing provided recommendations for improvements to specific survey questions as well as broader information about the acceptability of the proposed questions and topics. These recommendations for improvement were incorporated and tested during the PAF pilots.

Further details about the cognitive testing can be found in the Natsal-4 Cognitive Testing Report.[16]

3.1.3. Adaptations following the COVID-19 pandemic

Changes were made throughout the questionnaire to facilitate the use of remote data collection methods (see section 1.3). The main changes related to the implementation of the online self-completion questionnaire, the remote biological sampling protocol, and the use of eConsent for data linkage. Some changes were also made to the questionnaire content in light of the pandemic. These included:

- Additional questions to capture use of GP services, COVID-19 testing and vaccinations, loneliness, non-suicidal self-harm and, Intimate Partner Violence (IPV)
- Revisions to the STIs and sexual and reproductive health services module to reflect the increasingly online nature of these services.

3.1.4. Adaptations following piloting

The first Natsal-4 pilot ('pilot 1') was conducted in June to July 2021. Pilot 1 showed that the content of the questionnaire was generally well-received by interviewers and participants. While it was recognised that much of the content was extremely sensitive, interviewers and participants accepted that the topics covered were important and necessary. However, the questionnaire (including eConsents) was too long at an overall median of 63 minutes, with face-to-face interviews taking a median of 67 minutes and remote interviews 62 minutes, and therefore required some cuts before the second pilot.

The following questions were dropped after pilot 1:

- Detailed employment questions required for coding Standard Industrial Classifications (SIC) and Standard Occupational Classifications (SOC)
- Detailed educational attainment
- Religious service attendance
- Covid testing and vaccination
- How and where met most recent sexual partners
- Whether total number of sexual partners includes paid sex
- Three attitudinal questions (respect for stay at home dads, men expressing emotions or fears and women expressing emotions or fears)

The following questions were added after pilot 1:

- Brief education questions (GSS harmonised set)
- Household income
- Physical and/or mental health condition(s) (whether long-term limiting illness is physical, mental or both)
- Fertility tracking (use of fertility tracking devices/methods)
- Condom access (experience of any difficulty accessing condoms)
- One attitudinal question (whether it's more acceptable for a man to have a lot of sexual partners than a woman)

The second pilot ('pilot 2') was conducted in February - March 2022. As in pilot 1, interviewers gave positive feedback regarding the overall content, length, order, and flow of the Natsal-4 questionnaire. Many interviewers stated that they enjoyed conducting this survey, that it was straightforward and there were no major problems experienced. The median length of interviews (including eConsents) was 61 minutes, and therefore there was no need to reduce the number of questions included in the survey.

Relatively minor questionnaire updates were made following pilot 2. These included changes to question wording, answer categories, formatting, help instructions, interviewer instructions and question routing.

3.1.5. Development of the probability panel online (WFU) questionnaire

In Spring 2023, a shorter (~20 minute) online only version of the Natsal-4 questionnaire was developed by the Natsal team, for use in the Web Follow Up (WFU) survey (offered to non-responders to the probability panel telephone survey), on the expectation that an online only questionnaire would need to be much shorter than the full ~60 minute Natsal-4 questionnaire. This shorter online questionnaire was based on the full-length questionnaire, but with adaptations to reflect the entirely online mode of data collection, some topics were removed, and others reduced in length or simplified. A prioritisation exercise was taken by the team to determine which questions would be included in the shorter questionnaire.

3.2 Questionnaire topics

The final Natsal-4 questionnaire covered a wide range of topics. Participants from the address-based probability sample (PAF) and probability panel telephone sample answered the full questionnaire (see Appendix B). Participants from the probability panel online (WFU) answered a shortened version of the questionnaire (see

Appendix C). Table 3.1 outlines the topics covered in each version of the questionnaire – in general the same topics were included in each, but the shorter online (WFU) questionnaire contained a reduced set of questions on each topic:

Table 3.1: Natsal-4 questionnaire topics

	Full questionnaire	Shortened questionnaire
Introduction	●	●
Health (part 1)	●	●(reduced)
Family and learning about sex	●	●(reduced)
Contraception and STI prevention	●	●(reduced)
Sexual attraction and experience	●	●(attraction only)
Gender identity*	●	●(reduced)
First sexual experiences*	●	●[h] (reduced and simplified)
Sexual practices*	●	●(reduced)
Number of partners*	●	●(reduced)
Most recent partners*	●	
Paid sex*	●	●(reduced)
Digital technology*	●	●(reduced)
Sexual harassment, sexual violence and childhood sexual abuse*	●	●(sexual harassment and sexual violence only)
Reproductive health*	●	●(reduced)
Sexually Transmitted Infections*	●	●(reduced)
Sexual function*	●	●(reduced)
Sexual wellbeing*	●	●(reduced)
Health (part 2)	●	●(reduced)
Attitudinal questions	●	●(reduced)
Demographics	●	●(reduced)

*(*asked in self-completion section of full questionnaire)*

3.3 Questionnaire modes

The full Natsal-4 questionnaire was used in the address-based sample (PAF) and probability panel telephone (CATI) samples, and involved a combination of interviewer-administered questions and a self-completion component. Question modes were kept consistent between face-to-face and telephone interviews (e.g. either interviewer administered or self-completion) in order to minimise measurement differences across modes. A shortened version of the Natsal-4 questionnaire was administered to probability panel online (WFU) participants and was self-completion (online) only.

Table 3.2 summarises the modes of data collection for each module across NatCen's different data collection arms for Natsal-4. Abbreviations used in the table are:

- Computer Assisted Personal Interviewing (CAPI): questions are administered face-to-face by interviewers
- Computer Assisted Telephone Interviewing (CATI): questions are administered over the phone by interviewers
- Computer Assisted Self Interviewing (CASI): participant answers self-completion questions using the interviewer's laptop.
- Computer Assisted Web Interviewing (CAWI): participant answers self-completion questions online using their own device.

[h] Simplified routing/skip patterns, and removal of questions about age at first experience of different sexual practices.

Table 3.2: Natsal-4 questionnaire modes of administration

<table>
<tr><th></th><th colspan="2">Address-based probability (PAF) sample</th><th colspan="2">Probability panel sample</th></tr>
<tr><th></th><th>Face-to-face</th><th>Telephone</th><th>Telephone</th><th>WFU</th></tr>
<tr><td>Introduction</td><td rowspan="5">Interviewer - administered (CAPI)</td><td rowspan="5">Interviewer-administered (CATI)</td><td rowspan="5">Interviewer-administered (CATI)</td><td rowspan="5">Self-completion (CAWI)</td></tr>
<tr><td>Health (part 1)</td></tr>
<tr><td>Family and learning about sex</td></tr>
<tr><td>Contraception and STI prevention</td></tr>
<tr><td>Sexual attraction and experience</td></tr>
<tr><td>Gender identity</td><td rowspan="14">Self-completion (CASI)</td><td rowspan="14">Self-completion (CAWI)</td><td rowspan="14">Self-completion (CAWI)</td><td rowspan="4">Self-completion (CAWI)</td></tr>
<tr><td>First sexual experiences</td></tr>
<tr><td>Sexual practices</td></tr>
<tr><td>Number of partners</td></tr>
<tr><td>Most recent partners</td><td>NOT ASKED</td></tr>
<tr><td>Paid sex</td><td rowspan="13">Self-completion (CAWI)</td></tr>
<tr><td>Digital technology</td></tr>
<tr><td>Sexual harassment, sexual violence and child sexual abuse</td></tr>
<tr><td>Reproductive health</td></tr>
<tr><td>Sexually Transmitted Infections</td></tr>
<tr><td>Sexual function</td></tr>
<tr><td>Sexual wellbeing</td></tr>
<tr><td>Health (part 2)</td></tr>
<tr><td>Sexual well-being</td></tr>
<tr><td>Attitudinal questions</td><td rowspan="2">Interviewer - administered (CAPI)</td><td rowspan="2">Interviewer - administered (CATI)</td><td rowspan="2">Interviewer-administered (CATI)</td><td rowspan="2">Self-completion (CAWI)</td></tr>
<tr><td>Demographics</td></tr>
</table>

3.4 Small scale biosample pilot

A small urine sample collection pilot was carried out in Dec 2021 - Jan 2022 with N=29 (women n=23; men n=6) postgraduate students at UCL to test the Colli-Pee urine collection devices worked as expected and did not compromise the HPV assay, and to trial laboratory processes. This 'mini' pilot was approved by UCL research ethics committee (ref: 2179/001). The study found that, (1) the Colli-Pee devices worked well, (2) urine samples degraded rapidly if left at room temperature but storage at +4°C or -80°C, or addition of Aptima buffer reduced the rate of degradation, and (3) cellular content of material collected was relatively low. These findings were used to inform the design of urine collection and processing protocols.

4. Piloting the survey

4.1 Address-based probability (PAF) pilots

4.1.1. Pilot 1

Pilot 1 took place in June and July 2021. Survey interviews were carried out with 130 people aged 16-59 in England, and qualitative follow-up interviews were conducted with 20 of the survey participants. Pilot 1 aimed to test the feasibility of the survey procedures, test new modes of interview in response to the COVID-19 pandemic, assess the acceptability of the biological sample and data linkage consent, and to assess the interview length.

The eligibility rate and the response rate for the pilot 1 survey were both significantly lower than anticipated. To reduce the shortfall in the number of target productive interviews, fieldwork was extended. The initial pilot sample was drawn by randomly selecting addresses within postcode sectors whereas the pilot extension used a quota sampling approach in the same postcode sectors.

Response rate analysis was based on the first stage of the pilot (reflecting the sampling methods of the two stages). The response rate to the pilot survey was 32%; the refusal rate was 29%; the non-contact rate was 8% and the remaining 32% of cases were unproductive for other reasons. 73% of first stage participants agreed to provide a biological sample, and samples were received by the laboratory for 51% of participants. 78% of those participating in the first stage of the pilot consented to data linkage.

A series of recommendations were made based on the pilot 1 findings, and the following adaptations to the survey were subsequently implemented:

Documents

- The documents were reviewed to improve the use of colour to aid interviewers to quickly identify documents during the interview and on the doorstep.
- Improvements were made to the advance letter to add information about Natsal's achievements and highlight the token of appreciation to participants.
- The data linkage leaflet and consent information were revised to give broad details of the approach without naming specific datasets or data controllers.

Interview mode

- The alternative mode option of a video interview was removed as take up was low during the pilot (5%); the telephone mode was retained.

Questionnaire

- The questionnaire was reviewed to reduce length, iron out any issues identified by the pilot, and to make other minor adaptations.

- The biological sample module was streamlined to ensure we capture participants agreement to the biological sample correctly to improve consent rate reporting given the multiple points participants can disagree to provide a sample.

Biological sampling

- A cover letter was introduced for telephone participants to explain the biological sample and provide them with a freephone number to call if they had any issues.
- The process for follow up phone calls for telephone participants was formalised by creating a prompt sheet for interviewers to ensure participants received the phone call after the interview.
- Automation of the sample tracking process with the lab was improved.
- For participants who wished to provide a sample after the face-to-face interview, a text message reminder was introduced to remind participants to send their sample.

4.1.2. Pilot 2

Pilot 2 took place in February and March 2022. Survey interviews were carried out with 131 people aged 16 to 59 in England, Scotland, and Wales. Pilot 2 aimed to test response rates to the survey, biosamples and data linkage; revised fieldwork procedures; the refined questionnaire; biological sampling procedures; data linkage consent procedures.

The sample for pilot 2 was based on a multi-stage stratified cluster probability sample design, including the selection of one eligible person per household, to reflect the proposed design for the main survey. Each interviewer assignment comprised both core (16 to 59 years) and young person boost (16 to 29 years) addresses.

The response rate was 25%; the refusal rate was 36%; the non-contact rate was 5% and the remaining 12% of cases were unproductive for other reasons. The response rates did not vary substantially by sample type (25% in the core sample; 27% in the young person boost sample). Overall, 61% of pilot 2 participants consented to give a biological sample, with a sample received by the laboratory for 53%. 69% of participants consented to linkage to one or more of the three record types.

A series of recommendations were made based on the pilot 2 findings, including:

Fieldwork and response

A detailed Action Plan was developed with NatCen field department, which included:

- the development of a communication strategy with interviewers and Field Performance Managers to help generate enthusiasm for and interest in Natsal-4 ahead of work allocations;
- not launching new interviewers on Natsal (i.e., they would have worked on a different survey before being offered Natsal);
- additional doorstep technique coaching and training for less experienced interviewers;
- provision of ongoing support to all interviewers throughout fieldwork, including the role of a dedicated Field Delivery Manager;
- at the organisational level, NatCen was working hard to re-build the interviewer field force (i.e. recruit and train new interviewers), which had been markedly depleted following the COVID-19 pandemic.

Interview mode

- Retain the current model of emphasising face-to-face interviews as the preferred mode, with a telephone option where needed.

Documents

- Rationale for the stepped doorstep approach to be explicitly described and explained in the interviewer briefings and project instructions i.e., that there is little mention of the subject matter (sex) in the advance

mailing to the household. Greater detail about the subject matter and the study is provided in the survey leaflet which is given only to the selected household member.

Interview length
At 61 minutes overall (including biological sampling and data linkage consent), no further questionnaire cuts were needed to reduce the interview length from a fieldwork budget perspective. However, as some interviews were very long, a final review to ensure all questions were necessary, and the questionnaire was as easy to complete as possible, was recommended.

Questionnaire
- Retain the initial CAPI section as is, for comparability with previous Natsal surveys and to account for the self-completion element already being very long. Include enhanced messaging at the mainstage briefings about the rationale behind the ordering of the topics and what is and is not included in the self-completion.
- Retain the 'emergency exit' for particularly sensitive modules (sexual violence, child sexual abuse and history of pregnancy). The 'emergency exit' routing meant that if a participant selected 'prefer not to answer' at any of these questions, a question appeared which asked if the participant wanted to skip to the end of the section of questions or just that question.
- Add confirmation checks to the section of questions about gender and sex where the pattern of responses suggests participants may have been misclassified as trans/gender diverse.

4.2 Probability panel telephone (CATI) pilot

The panel pilot study took place in April and May 2023. Survey interviews were carried out by NatCen's Telephone Unit with 31 people aged 18 to 59 in England and Scotland. The panel pilot aimed to assess the feasibility of NatCen's telephone interviewers conducting, on average, one-hour interviews with randomly selected panel members; estimate the survey response, the biosampling consent rate, the sample return rate and the data linkage consent rate; test study protocols, including documents, biosampling and data linkage; trial the participant communication strategy.

As per the main sample, the pilot sample was issued from the NatCen probability panel sample (see section 1.3.2). The pilot sample was drawn to be representative of the overall panel sample.

Of the 111 panel members issued, 28% (31) completed an interview. Of those with a telephone number, 56% (29/52) took part in the study, compared to only 3% (2/59) of those with no telephone number. 97% of survey participants consented to providing a biological sample, with a sample received by the laboratory for 73%. 87% of participants consented to at least one type of data linkage. Interviews took a median of 60 minutes.

As PAF fieldwork had already been running since September 2022, and with the pressure to start mainstage CATI fieldwork as soon as possible (given that all Natsal fieldwork was due to be finished by the end of 2023), adaptations which drew on learnings from the CATI pilot, were kept to a minimum:

- Add a short instruction in the CATI to read the contraception questions carefully.
- Add an instruction into the interviewer CATI script on the importance of sending the sample ASAP (rather than just doing the sample ASAP).
- Update the closing page so the message that the helplines leaflet will be sent in the post is given only once.
- Run some high-level data checks on the newly programmed CATI modules to limit programming errors.
- For any errors being identified in the ongoing CAPI (PAF) data checks, ensure updates are applied accordingly to the panel CATI.

Given the time constraints to complete panel data collection by end 2023, no pilot study of the shorter web follow-up survey was conducted. Productive pilot CATI cases are included in the final data, but unproductive CATI cases were not invited to take part in a web follow-up study.

5. Fieldwork procedures

Fieldwork Dates

Data collection arm	Start Date (advance letters sent)	End Date (interviewing stopped)
Address-based probability (PAF)	20th September 2022	5th November 2023
Probability Panel CATI	12th July 2023	3rd December 2023
Probability Panel Online (WFU)	1st September 2023	7th January 2024

5.1. Address-based probability (PAF) fieldwork

5.1.1. Fieldwork organisation

PAF fieldwork was carried out by NatCen's face-to-face interviewers, supplemented by a small number of Ipsos face-to-face interviewers. In addition to their standard interviewer training and development, all interviewers working on the study received a day-long briefing covering the background to Natsal, questionnaire, doorstep technique, biosampling, documents, data linkage and future research consents, and safeguarding and disclosure. Most interviewers were briefed in person and a small number remotely via a Teams session.
The four waves of mainstage PAF fieldwork ran from September 2022 to November 2023. Some cases which had not been sufficiently worked by the original interviewer were re-issued during the last three months of the fieldwork.

All participants who took part in a PAF interview were given a £20 gift card as a token of appreciation.

5.1.2. Advance mailing and participant selection

Advance mailing
At the beginning of each wave the advance mailing was sent to selected addresses. The advance mailing included an advance letter and an advance leaflet.

Copies of the advance letter and advance leaflet can be found in Appendix A.

Doorstep contact with selected household
Interviewers were instructed to contact addresses a few days after the advance mailing had been sent. This was not possible for all cases, as not all addresses could be allocated to interviewers at the start of each wave. Where an interviewer was allocated later, they were instructed to start work as soon as possible.
Interviewers were briefed, and encouraged by their Field Performance Manager, to visit addresses at different times of day and on different days of the week (i.e. mornings, afternoons, evenings, weekdays and weekends) and a minimum of six times to maximise their opportunity of making contact with a householder.

In most cases addresses consisted of one dwelling, however in cases where there was more than one dwelling unit interviewers conducted a random selection of a dwelling using a Kish grid.

Once contact was made with a householder, interviewers checked whether the household had received the advance mailing and provided a short general introduction to the study. Interviewers were briefed to take a 'stepped approach' to introducing the study to householders keeping their introduction brief and suitably high level in terms of describing the subject matter, to maintain privacy for the selected participant, and to minimise proxy refusals (other householders refusing on behalf of a selected participant, without the opportunity for the interviewer to speak to that participant). Full information about the subject matter and the study were then provided to the selected participant. A laminated copy of the advance letter was available for interviewers to use with householders where the advance mailing has been misplaced. Copies of advance letters were provided to interviewers to leave with householders if required.

Screening for eligibility
Once introductions had been made, the interviewer asked the householder whether anyone residing in the household of the eligible age to take part in Natsal. Households were eligible to take part if at least one member of the household was aged 16 to 29 for the young person boost sample or aged 16 to 59 for the core sample. If no one in the household was eligible to take part, the address was screened out as ineligible. Young person addresses were not allowed to be swapped to a core address even if a member of the household was aged 16 to 59.

Individual householder selection (if necessary)
If more than one householder was eligible to take part, interviewers conducted a random selection of an individual using a Kish grid. No substitutions were allowed.
If the selected householder was aged 16 or 17 and living in the parental home as a courtesy measure interviewers gained informal verbal agreement from a parent, carer or guardian of the participant before conducting the interview. No formal or signed parental consent was required.

Doorstep contact with selected householder
Once the interviewer had contacted the selected householder they gave a fuller introduction, expanding on the aims of the survey and the subject matter. An interviewer factsheet provided interviewers with a list of 'selling points' they could use to tailor their conversations with selected householder on the doorstep (see Appendix A). Selected householders were also provided with a survey information leaflet which provided more detail on the content of the interview, what the interview would entail and details of the token of appreciation for completing an interview (see Appendix A). Providing eligible individuals with a full introduction to the study and with a copy of the survey information leaflet was important for informed consent, ensuring eligible individuals had understood what taking part entailed and ensuring they had not been misled about the content. All participants were required to have read and understood the survey information leaflet before taking part in Natsal, and interviewers confirmed this and if necessary reiterated key points at the start of the interview.

The interviewer then arranged to interview the selected householder. Interviewers were free to carry out the interview at the time or alternatively arrange to call-back and carry out the interview at a time suitable for the participant, with interviewers encouraged to be flexible in the interview times they offered.

The majority of PAF interviews took place face-to-face with participants, which was the preferred interview mode, however participants could opt for a telephone interview. For telephone interviews the interviewer provided the participant with an interview pack containing physical copies of all the documents required for the interview to take place over the telephone, including showcards (see Appendix A). All the interview documents were also available to telephone participants online through the Natsal taking part pages on the NatCen website.

5.1.3. Questionnaire data collection

To conduct the interview, interviewers used the questionnaire program on their laptops (Computer Assisted Personal Interviewing – CAPI). They used the same program regardless of whether the interview was carried out in person or over the telephone. The self-completion questionnaire was incorporated into the overall questionnaire program for interviews that were carried out in person and was completed by participants on the interviewer's laptop (Computer Assisted Self-Interviewing - CASI). This was not possible for telephone interviews, where an online self-completion questionnaire was used instead (Computer Assisted Web Interviewing - CAWI). Interviewers sent participants an email with a link to the CAWI questionnaire for the participant to complete at the relevant point in the telephone interview.

CAPI and CASI used Blaise survey software and CAWI used Unicom Intelligence (UI) survey software.

In both modes, interviewers gave participants showcards that they were directed to refer to when answering questions with a longer list of answer categories or where response options were considered sensitive.

A copy of the questionnaire can be found on the Natsal website (www.natsal.ac.uk).

5.1.4. Data linkage consent

Towards the end of the questionnaire, participants were asked for consent to data linkage and their response was recorded electronically. Participants were referred to the data linkage leaflet, an important part of informed consent, which explained what permissions were being asked and how linkage would work (see Appendix A). Interviewers were able to refer participants to the data linkage flowchart which provided further detail of the data linkage process to participants wanting further information or reassurance (see Appendix A).

Consent was recorded electronically by participants in CASI (face-to-face interviews) and in CAWI (telephone interviews).

Participants were asked for permission to link their survey data to three different types of records:

- Health information: including records held by GP's, hospital records, community care details, prescription records, vaccination records and cancer records
- Education information: including records about attendance, test and exam results, information about special educational needs and disabilities, eligibility for free school meals, university and college and admissions and educational outcomes
- Administrative and survey datasets held by the Office for National Statistics for research and statistical purposes

Participants could agree to one, two, three or none of the data linkage consent statements. If participants agreed to one or more of the data linkage consent statements, they were asked to provide their full name which in combination with their address, sex and date of birth would be used to match survey data to their records.

5.1.5. Quality control

The following steps were taken to quality assure the fieldwork:

- 10% of each interviewer's cases received a callback (or letter if no phone number was available) from NatCen's field quality control team to verify that interviewer had carried out fieldwork and followed the procedures. As part of this process 1 interviewer was identified who had falsified 4 cases. These were removed from the data.
- Interviewers relatively new to NatCen were supervised at one of their first interviews to ensure they were conducting the survey as intended.

5.2 Probability panel fieldwork

5.2.1. Fieldwork organisation

Probability panel members selected to the Natsal sample, were first invited to take part in a telephone survey. Those who did not respond by telephone, were subsequently invited to take part in a shorter online survey (the WFU). Telephone fieldwork was carried out by trained telephone interviewers from NatCen's Telephone Unit. All interviewers attended a remote briefing session that covered: background, the questionnaire, biosampling, data linkage, participant communication and encouraging participation.

Probability panel fieldwork ran for six months from July 2023 January 2024; CATI fieldwork ran from July 2023 to December 2023, and WFU fieldwork ran from September 2023 to January 2024.

Probability panel fieldwork was split across twelve batches. Each batch began 3-4 weeks of CATI fieldwork, followed by a short gap in fieldwork of one to two weeks to prepare for the next stage of fieldwork, and ending with 3-4 weeks of WFU fieldwork with CATI non-responders.

Batches 1 to 7 were staggered at two-week intervals. Batches 8 and 9 were grouped together and batches 10, 11 and 12 were also grouped together.

All participants who completed a CATI interview were sent a £20 gift card as a token of appreciation. All participants who completed a WFU questionnaire were sent a £10 gift card as a token of appreciation.

5.2.2. Advance mailing and participant contact

Advance mailing and email

Telephone (CATI)

At the start of each CATI wave, panel members who had been selected for that wave were sent an advance mailing which included an advance letter and a survey leaflet. The survey leaflet replaced the advance leaflet and survey leaflet used for PAF fieldwork, combining information from both these leaflets into one. Panel members were also sent an advance email.

Copies of the advance letter, survey leaflet and advance email text can be found in Appendix B.

Online (WFU)

Panel members who did not take part in a CATI interview, and did not contact the office to refuse, were invited to take part in a shorter Natsal web-only questionnaire. They were sent a separate invitation letter and leaflet, as well as an email inviting them to take part.

Copies of the invitation letter, leaflet and email can be found in Appendix C.

Telephone fieldwork

Telephone (CATI)

Panel members with a telephone number were called within a week of fieldwork starting, by a telephone interviewer who introduced the study and encouraged the panel member to take part in a telephone interview. Interviewers were provided with a script for these initial calls which included a list of 'selling points' with the aim of encouraging participation. Panel members were called at different times of day and on weekdays and weekends to maximise the chances of contacting them. A maximum of 6 call attempts were made to each selected panel member. A scripted message was left on answerphones where no contact had been made after a second attempt of calling with the aim of reducing the number of cases where the call always went through to the answerphone.

Telephone numbers were known for about half of panel members. Therefore, panel members with no known telephone number had to opt-in to taking part in Natsal. Instructions about how to opt-in to taking part in Natsal-4

were included in the advance email and letter for panel members without a phone number. Panel members without telephone number could opt-in to taking part in Natsal by contacting NatCen by phone or by updating their contact information and providing a telephone number through a secure online web form. Panel members who provided their phone numbers were then contacted by a telephone interviewer.

All panel participants consent to be part of the panel and be contacted about research studies by NatCen. Before participation, all invited panel members were sent a copy of the survey leaflet, which similar to the PAF arm was considered important for informed consent. Before beginning the telephone interview, interviewers confirmed that the participant had read the leaflet and, if necessary, reiterated the key points.

Once the participant agreed to take part, the interview could go ahead, or an appointment could be scheduled for a time convenient to the participant. Most participants opted to arrange an appointment given the interview length. Interviews could be conducted at different times of day and days of the week to be flexible to participant availability.

Online (WFU)
Approximately a week after WFU participants received their invitation letter and leaflet, telephone interviewers contacted participants (where there was a telephone number on file for them) who had not yet completed the questionnaire to encourage them to complete online (termed 'telephone nudges'). The script was similar to the script used for the telephone interviews.

Before beginning the online survey, WFU participants were shown a summary reiterating key information about the survey, including a link to the full survey leaflet.

The two phases of fieldwork (CATI and WFU) were consecutive and it was not possible for participants to opt to take part in the other mode.

Reminders
Telephone (CATI)
Generally, reminders started being sent out about one week after the advance email and letter. A reminder email was sent to participants, followed by a reminder letter, around five days later, and a reminder text and second reminder email, around three days after that.

Copies of the reminder letter and reminder email text can be found in Appendix B.

Online (WFU)
Generally, reminders started being sent out about one week after the advance email and letter. A reminder email and text were sent to participants on the same day, followed by a reminder letter, around two days later, and a second reminder email, around two days after that. For later batches, participants were also sent a second reminder text, about two weeks after the second reminder email.

Copies of the reminder letter and reminder email text can be found in Appendix C.

5.2.3. Encouraging response among younger panel members (aged 18-29)

Telephone (CATI) and online (WFU)
From batch eight onwards one telephone interviewer was assigned to call only younger panel members for both CATI and WFU fieldwork. This was in response to the low response rate amongst panel members aged 18 to 29, an age group of particular interest for Natsal-4. This appeared to have a small positive impact on the number of young people taking part in interviews, particularly for batches 10 to 12 where calls from the dedicated interviewer started earlier.

From batch eight onwards an additional reminder text was sent to all participants with content aimed at encouraging young people to participate.

5.2.4. Questionnaire data collection

Telephone interviews included a component administered by an interviewer (CATI) and a self-completion component (CAWI) that participants completed online. Interviewers sent participants a link to the CAWI questionnaire during the interview and stayed on the phone with them until participant had finished the self-completion. Participants were also sent a link to an online version of showcards to use during the interview (see Appendix A).

WFU participants completed a shorter CAWI questionnaire.

Both CATI and CAWI questionnaires used UI survey software.

Copies of the CATI and the WFU questionnaires can be found on the Natsal website (www.natsal.ac.uk).

5.2.5. Data linkage consent

Telephone (CATI)
Data linkage consent was included in the CAWI component of the CATI interview. Participants were directed to the online data linkage leaflet (see Appendix B), which explained what permissions were being asked and how linkage would work. If the participant had any questions they could ask the telephone interviewer, and they were also shown a link to the data linkage flowchart (see Appendix A). Similar to PAF (and WFU, see below), participants were asked for permission to link their survey data to up to three different record types. If consent was given, they were asked to provide their full name, which in combination with their address, sex and date of birth would be used to match survey data to their records.

Online (WFU)
Data linkage consent was included in the WFU. A link to the online data linkage leaflet (see Appendix C) was provided, as was a link to the data linkage flowchart (see Appendix A). If any WFU participant had any questions about data linkage they could call NatCen's freephone team, and if consent was given participants were asked to provide their full name, which in combination with their address, sex and date of birth would be used to match survey data to their records.

5.2.6. Quality control

Telephone Unit supervisors listened in to 10% of each telephone interviewer's work to check that they were carrying out the survey as intended. Any issues identified were promptly raised with interviewers and additional training provided if required.

5.3 Interview length, by data collection arm

The table below shows the mean, median, min and max length of the interview (in minutes) for each data collection arm, and for PAF and Panel CATI the length of biosampling consent and data linkage consent. The average interview length (as measured by the median) was: 62 minutes for PAF face-to-face interviews and 70 for PAF telephone, 62 for Panel CATI interviews and 20 minutes to complete the WFU questionnaire.

Table 5.1: Time (minutes) to complete the survey, by data collection arm

Data collection arm		Mean	Median	Min	Max
PAF F2F	**Interview**	**65**	**62**	**19**	**213**
	Of which biosampling	*9*	*8*	*1*	*30*
	Of which data linkage	*3*	*2*	*1*	*10*
PAF Telephone	**Interview**	**68**	**70**	**24**	**117**
	Of which biosampling	*5*	*4*	*1*	*14*
	Of which data linkage	*3*	*2*	*1*	*9*
Panel CATI	**Interview**	**64**	**62**	**20**	**210**
	Of which biosampling	*5*	*4*	*1*	*20*
	Of which data linkage	*3*	*2*	*1*	*10*
Panel WFU*	**Questionnaire**	**24**	**20**	**6**	**81**

**timings data for the WFU biosampling and data linkage modules not available*

6. The biological samples

6.1 Eligibility and consent

Towards the end of the Natsal-4 questionnaire, all participants were invited to provide a self-collected biological sample for testing for sexually transmitted infections (STI) and the microbiome without return of results. Cisgender women were invited to provide three self-collected vaginal swab samples. Women who did not wish to provide vaginal swab samples were asked to provide a urine sample. Cisgender men and trans/gender diverse participants were invited to provide a urine sample. All participants who consented to provide a sample were sent a biosample collection kit.

6.2 Consent and introducing the biological samples

6.2.1. Address-based probability (PAF) and probability panel telephone

The interviewer introduced the biological sample element of the study after the participant had completed the main survey questionnaire (see table 3.2). The interviewer asked the participant to read the relevant biological sample information leaflet (see Appendix A for the PAF leaflets and Appendix B for the CATI leaflets).[i] Participants were able to ask questions if anything was unclear or they had any concerns. Once participants had read the information leaflet they were asked to read and agree to a series of consent questions.

Consent was recorded electronically. PAF face-to-face participants were handed the interviewer's laptop and asked to complete the electronic consent questions. PAF telephone and CATI participants were first asked by the interviewer if they would be willing to provide a biological sample, with the interviewer recording this response in CAPI or CATI. If participants agreed to provide a biological sample, they were then asked by the interviewer to go back to the online questionnaire and complete the electronic consent.[j] Once the electronic consent section had been completed, interviewers asked participants to share whether they had given consent and logged this response in CAPI or CATI.

PAF participants who took part between September 2022 and March 2023 and who consented to provide a biosample were sent a £5 gift card as a token of appreciation. From April onwards, this increased to £10 reflecting what was to be subsequently implemented for the CATI and WFU surveys.

Consent to provide a biological sample had to be given and recorded before the interviewer was able to provide the participant with a biological sample collection kit.

[i] PAF telephone participants were instructed to locate their copy of this leaflet, found in their remote document pack. Probability panel CATI participants were directed by their interviewer to a web version of the relevant biological sample information leaflet.
[j] A four-digit code, allowing participants to return to the self-completion questionnaire to complete their biological sample e-consents, was provided by the interviewer once the participant had agreed to provide a biological sample. This aimed to avoid participants completing e-consents before the biological sample element of the study had been properly introduced to them by the interviewer.

6.2.2. Probability panel online (WFU)

WFU participants were invited to provide a biological sample towards the end of the online questionnaire. Participants were directed towards an online version of the relevant biological sample information leaflet (see Appendix C) via a web link. Help screens, which drew on information from the relevant sample information leaflet, provided participants with further information about the biological sample process and with a phone number to contact NatCen if they had any questions.

Before consenting to provide a biological sample WFU participants were presented with a screen listing key points, including what providing a biological sample would entail, what the sample would be tested for, their right to request to withdraw their consent to processing the sample and that they would receive a £10 gift card as thank you for agreeing to provide a sample. Participants were asked to confirm whether they consented to provide a biological sample to the Natsal research team and whether they consented to their sample being stored for future use. Participants consenting to provide a biological sample were then advised that a sample kit would be posted to them within the next week.

6.3 Biosample kit, collection and dispatch protocols

6.3.1. Introduction

Participants self-collected a biological sample following the relevant biological sample collection instructions. There were two set of instructions for each sample type, one set for participants providing the sample during the interview and another for participants collecting the sample after the interview. Instructions for collecting the sample after the interview provided participants with details on how to send back their completed biological sample to the lab using a Royal Mail post box.

Participants collecting vaginal swab samples were instructed to collect three vaginal swab samples using the cotton tip swabs and collection tubes included in the sample kit. Participants collecting a urine sample were instructed to collect a sample into the collection tube using a Colli-Pee device provided in the sample kit.

A copy of the biological sample collection instructions can be found in Appendix A.

6.3.2. Collection from address-based probability (PAF) participants

PAF face-to-face participants could either provide a biological sample at the end of the interview, with the interviewer still present in the home, or in their own time after the interviewer had left. PAF telephone participants provided a sample after the interview.

Providing a sample during the interview

This protocol was followed during interviews with PAF face-to-face participants who had opted to provide a biological sample during the interview. CAPI guided the interviewer through the full labelling, collection and dispatch process. The interviewer assigned a sheet of barcode labels to the participant in CAPI. Interviewers assigned a dispatch label to the dispatch form and a tracker label to the tracker form. The interviewer provided the participant with:

- sample collection instructions
- sample collection labels
- sample collection kit

Copies of the biological sample collection instructions for samples collected *during* the interview can be found in Appendix A sections 12.1 and 13.1.

Interviewers were instructed to post completed biological samples as soon as possible after the interview, using the nearest Priority Royal Mail post box.

Providing a sample after the interview
This protocol was followed by interviewers of PAF face-to-face participants who wished to make their biological sample collection after the interview and all PAF telephone interviewers.

Interviewers were instructed by the CAPI to ensure that the participant fully understood the labelling, collection and dispatch protocols for collecting and returning a sample after the interview. This included ensuring the participant had a physical or electronic copy of the sample collection instructions and verbally reminding the participant of some of the more important instructions.

Copies of the biological sample collection instructions for samples collected *after* the interview can be found in Appendix A sections 12.2 and 13.2.

It was possible for the interviewer to prepare the biological sample kit for dispatch either during or after the telephone interview. Dispatch included:

- assigning a strip of barcode labels to the participant
- completing the relevant parts of the dispatch form
- placing collection labels in the relevant biological sample kit
- for PAF telephone participants, a sample kit covering letter was included (see Appendix A)
- preparing the postage bag with the recorded delivery label

Once the participant received a sample kit, they collected their biological sample and then returned the completed biological sample in the post to the laboratory following the collection instructions. Interviewers could offer to return to collect completed kits from participants at home.

For face-to-face participants, a reminder text was sent from the office reminding them to send their biological sample in the post. For telephone participants, interviewers phoned the participant a couple of days after dispatching the kit to check they had received it and had collected and returned their biological sample.

6.3.3. Collection from probability panel participants

Telephone (CATI) and online (WFU) participants who consented to provide a biological sample did so after the survey.

Telephone (CATI) participants
CATI interviewers were instructed by the questionnaire program to ensure that the participant fully understood the labelling, collecting and dispatch protocols for collecting and returning a sample after the interview. This included ensuring the participant had a physical or electronic copy of the sample collection instructions and verbally reminding the participant of some of the more important instructions. Participants were informed that they should receive their sample kit within a week after the interview.

Online (WFU) participants
WFU participants were informed that they should receive their sample kit within a week of completing the questionnaire. They were reminded of what the sample kit would include and the information needed to complete on the dispatch form, which was to be included when posting their biological sample to the lab.

Biological sample kit dispatch
Interviewers did not assign barcode numbers during the CATI interview. A unique barcode number was generated and assigned to all probability panel participants at the start of CATI fieldwork. Probability panel participants kept the same barcode number for the duration of probability panel fieldwork, regardless of whether they participated in a CATI interview or online.

Biological sample kits, instructions and a covering letter (see Appendix B) for probability panel participants were dispatched from the NatCen office on a regular basis during fieldwork.

Return of collected samples
Once CATI and WFU participants received the kit, they collected a biological sample and returned it to the laboratory following the collection instructions. A reminder text was sent from the office a few days after kit dispatch, reminding the participant to send their biological sample in the post..

6.4 Testing biological samples

Pseudonymised interview data pertaining to biological samples was transferred securely by NatCen to The Doctors Laboratory (TDL) via a File Transfer Protocol (FTP) every 24 hours during fieldwork. PAF interviewers were briefed to transmit their work back to the NatCen office on the same day, to avoid delays in the onward transfer of data to the lab for use in processing biological samples. CATI and WFU data were automatically transmitted to the lab on a daily basis.

Biological samples were reconciled by the lab on arrival using interview data. In circumstances where samples did not appear to have data or sample errors were noted on arrival to the lab, samples were still aliquoted (i.e. divided into the necessary parts, see sections 6.41 and 6.4.2 below) and stored by the lab until the errors were resolved. Errors were logged and reconciled between the lab and NatCen using an Error Log following a Reconciliation Specification for guidance. Once errors were resolved, the sample was processed for STI testing.

The STI testing was done on a rolling basis without freezing, and within 60 days. The HPV testing was done after freezing and in batches.

6.4.1. Urine samples

Participants collected one urine sample of approximately 10ml which was split into four aliquots by TDL:

- Aliquot one: sent to UK Health Security Agency (UKHSA) for type-specific HPV testing - female and trans/gender diverse participants only
- Aliquot two: tested for non-viral STIs including *Chlamydia trachomatis, Neisseria gonorrhoeae, Trichomonas vaginalis* and *Mycoplasma genitalium*
- Aliquot three: aliquot transferred into Aptima buffer tube and stored at -80c for future research
- Aliquot four: aliquot stored as raw urine without buffer at -80c for future research

6.4.2. Vaginal swab samples

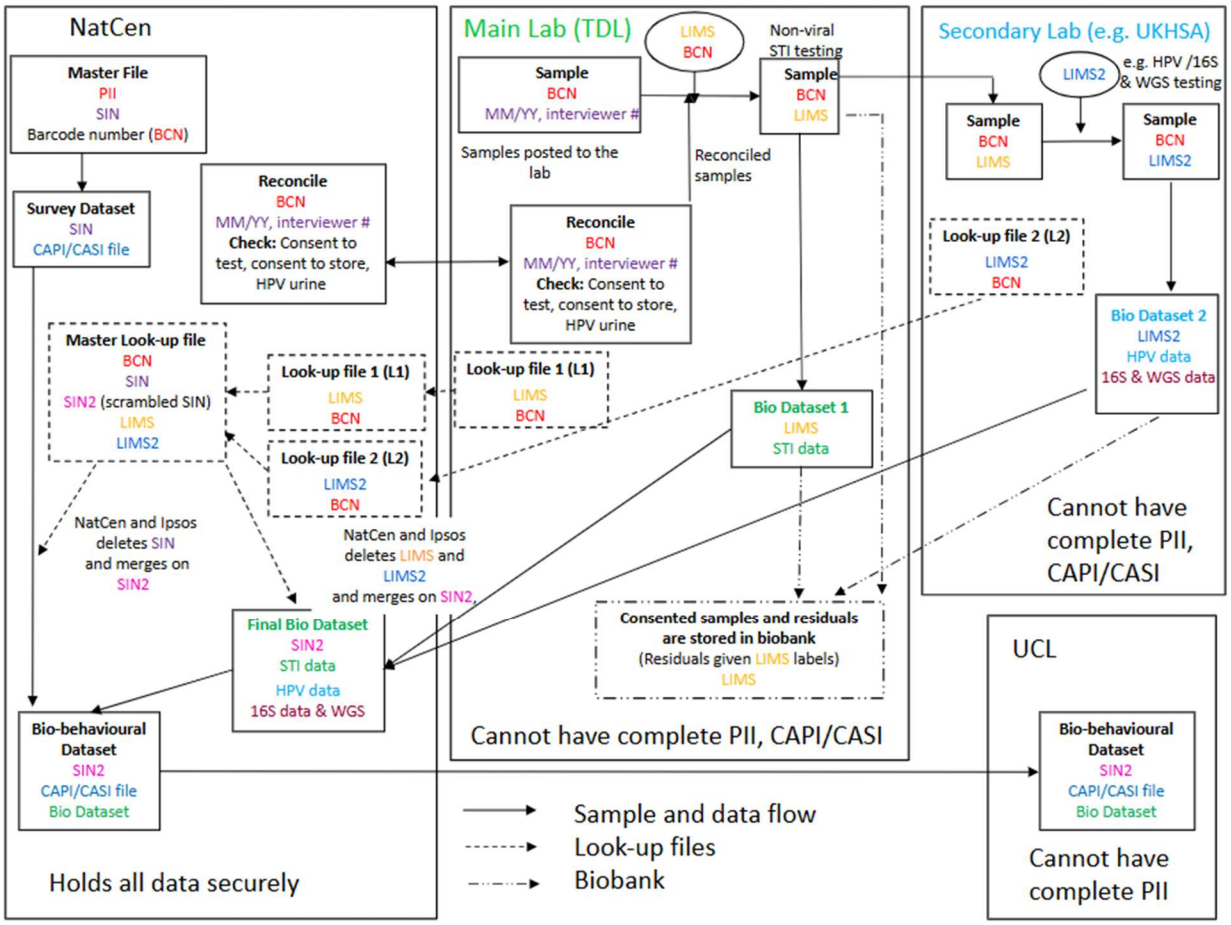
Participants collected three vaginal swab samples:

- Swab A was sent for testing for non-viral STIs including *Chlamydia trachomatis, Neisseria gonorrhoeae, Trichomonas vaginalis* and *Mycoplasma genitalium*
- Swab B was aliquoted. Aliquot one was sent to UKHSA for type-specific HPV testing. Aliquot two was stored at -80c for future research
- Swab C was held while waiting to see if *Neisseria gonorrhoeae* confirmation was required. In the event that it was needed, an aliquot was removed, and the remainder returned to -80C storage for future research. If not, it was sent direct to storage without opening.

6.5 Sample and data management

A data sharing plan ensured that samples and data were pseudonymised. Labs received month and date of birth only for reconciliation purposes. The lab fed back data to the fieldwork agency where STI data were combined with survey data before sharing with the Natsal research team (see Figure 6.1).

Figure 6.1: Biological Sampling Data Flow



6.5.1. Biological sample disposal

Throughout fieldwork if sample consent from or reconciliation with the participant was not able to be confirmed, UCL authorised the destruction of the received sample. At the end of fieldwork and on instruction from UCL, any samples where consent for storage was *not* given were destroyed.

6.5.2. Biological sample errors and reconciliation

Biological samples received in the laboratory were reconciled with the consents provided by participants and recorded in their questionnaire. In case of errors, the following steps were taken:

Error	Action
The lab received a sample but no consent to provide a sample is recorded.	Samples destroyed immediately.
Consent given to a vaginal sample, but urine sample received	Samples destroyed immediately. Consent info kept in data and a flag indicating an error added.
Consent given to a urine sample, but vaginal sample received	Samples destroyed immediately. Consent info kept in data and a flag indicating an error added.
Swab tubes received without physical swab inside	Tubes discarded by the lab.
Unlabelled sample with no form received in the lab	Where possible traced using Royal Mail tracking information. Samples were destroyed if tracing was unsuccessful.

7. Response

7.1 Address-based probability (PAF) survey response rate

Table 7.1 presents the response for PAF data collection. Of 36,380 addresses issued, 68% (22,231) were found to be ineligible; 18% (6,533) were found to be eligible and eligibility for the remaining 14% (5,213) was unknown, of which 10% (3,727) were assumed to be ineligible.

Of the 8,424 addresses assumed to be eligible, 42% (3,500) were coded as refusals (either by a household member on behalf of the whole household or by a selected individual) and 34% (2,905) were unproductive for other reasons e.g., no contact with selected individual, no contact at the address, or all information refused.

2,019 productive interviews were achieved (including 85 partial interviews) with a final response rate of 24%. This response rate was calculated using the third of six standard definitions set by the American Association for Public Opinion Research (AAPOR) (RR3). The RR3 definition excludes cases estimated to be ineligible from the denominator and is in line with the main response rate reported for Natsal-3.

The achieved cooperation rate, when using AAPOR's formula for cooperation rate 2 (COOP2, the proportion of full and partial productive cases of all eligible units contacted) was 58.7%.

Table 7.1: PAF response rate, by core and young person boost sample types

	Core (16-59 year olds)			Young person (16-29 year olds)			All		
	n	**% of issued**	**% of eligible**	**n**	**% of issued**	**% of eligible**	**n**	**% of issued**	**% of eligible**
Issued (Waves 1-4)	**9,402**			**26,906**			**36,308**		
Out of scope addresses:									
Vacant/ derelict	410	4%		928	3%		1,338	4%	
Non-residential	180	2%		430	2%		610	2%	
Not traced built/other	110	1%		273	1%		383	1%	
Not eligible age range	3,004	32%		19,227	71%		22,231	61%	
Total known ineligibles	**3,704**	39%		**20,858**	78%		**24,562**	**68%**	
Unknown eligibility:									
No contact	981	10%		1,844	7%		2,825	8%	
All information refused	1,174	12%		977	4%		2,151	6%	
Other[1]	103	1%		134	0%		237	1%	

Total unknown eligibility	**2,258**	24%		**2,955**	11%		**5,213**	14%	
Estimated ineligible[2]	*949*	10%		*2,372*	9%		*3,727*	10%	
Known eligible	**3,440**	37%		**3,093**	11%		**6,533**	18%	
Assumed eligible households[3]	**4,749**	**51%**	**100%**	**3,676**	**14%**	**100%**	**8,424**	**23%**	**100%**
No interview:									
No contact with selected person	108		2%	172		5%	280		3%
Refused (including proxy refusal)	1,825		38%	1,675		46%	3,500		42%
Other reason	407		9%	327		9%	734		9%
No information about address	1,309		28%	583		16%	1,891		22%
Total unproductive	**3,649**		**77%**	**2,757**		**75%**	**6,405**		**76%**
Productive interviews	**1,100**		**23%**	**919**		**25%**	**2,019**		**24%**

[1] *Other reasons include language difficulties at address, no-one at address knows if any residents are eligible.*
[2] *Estimated ineligible = total unknown eligible *(ineligible due to age range/known eligibility status). Totals may not match due to rounding.*
[3] *Total assumed eligible = core + young person assumed eligible.*

Of all productive PAF interviews, 434 (23% response rate) were conducted in the most deprived areas[k] and 429 (33% response rate) were conducted in the least deprived. See table 7.2.

Table 7.2: PAF response rate, by area deprivation

Index of Multiple Deprivation (IMD) quintile[l]	**Number of productives & response rate**	
	n	**Response rate (%)**
Most deprived	434	23%
2nd	406	22%
3rd	372	23%
4th	378	27%
Least deprived	429	33%

Of the 1,877 participants who were interviewed face-to-face and reached the self-completion consent, 99% (1,854) went on to fully complete the self-completion questionnaire. The majority, 92% (1,699) did so with no help or advice from the interviewer. See table 7.3 for variation by age.

[k] As measured using Index of Multiple Deprivation scores presented by quintiles.
[l] We used an adjusted measure of IMD to allow IMD for England, Scotland and Wales to be analysed together; available open source at https://github.com/mysociety/composite_uk_imd, based on a method developed by Abel, Barclay and Payne, 2016 https://bmjopen.bmj.com/content/6/11/e012750

Table 7.3: PAF* response rate to self-completion questionnaire, by age

**face-to-face interviews only*

	16-29 year olds		30-39 year olds		40-49 year olds		50-59 year olds		All	
	n	%	n	%	n	%	n	%	n	%
Eligible for self-completion questionnaire	**1,058**	**-**	**292**	**-**	**262**	**-**	**265**	**-**	**1,877**	**-**
Completed CASI										
- without help/advice	978	92%	263	90%	234	89%	224	85%	1,699	91%
- with help/advice	68	6%	18	6%	15	6%	25	9%	126	7%
- don't know	2	0%	1	0%	1	0%	2	1%	6	0%
- partially completed CASI	0	0%	1	0%	1	0%	1	0%	3	0%
Questions read out by interviewer	6	1%	6	2%	4	2%	7	3%	23	1%
Refused to complete	4	0%	3	1%	7	3%	6	2%	20	1%

7.2 Panel survey completion rate and estimated cumulative response rate

7,764 cases were issued to NatCen telephone interviewers for CATI data collection. Telephone numbers were known for 4,596 (59%) panel members and 3,168 (41%) did not have a telephone number held by NatCen (data not shown).

The final CATI response rate was 31%, with 2,426 interviews achieved (including 38 partial interviews). This differed by telephone status; of those with a telephone number the response rate was 46%, compared to 10% among those without a telephone number.

Of the 5,218 eligible for issue to the WFU, 44% (2,274) completed the online questionnaire.

The combined CATI and WFU panel completion rate was 61% (4,700 / 7,764 invited panel members, table 7.4).

The response rates given are the proportion of eligible members of the NatCen Panel invited to take part in the Natsal-4 survey that did so. There are other stages of non-response that are not represented in these response rates (non-response to the initial survey; further subsequent attrition from the panel before the Natsal sample was drawn). A cumulative response rate, taking the original British Social Attitudes Survey sample as the starting point, can be estimated as approximately 6% (data not shown).

Table 7.4: Probability panel response rate, by data collection arm

	CATI		WFU		Total	
	n	%	n	%	n	%
Eligible issued[1]	**7,764**		**5,218**		**7,764**	
Final outcome:						
Productive	**2,426**	**31%**	**2,274**	**44%**	**4,700**	**61%**
Unproductive, of which:						
-Refusal/opt-out	*353*	*5%*	*n/a*	*n/a*	*n/a*	*n/a*
-No contact at numbers available	*2,111*	*27%*	*n/a*	*n/a*	*n/a*	*n/a*
-No phone number given	*2,619*	*34%*	*n/a*	*n/a*	*n/a*	*n/a*
-Other unproductive	*255*	*3%*	*n/a*	*n/a*	*n/a*	*n/a*
Total unproductive	**5,338**	**69%**	**2,944**	**56%**	**2,944**	**38%**

[1] *120 unproductive CATI cases were not eligible for the WFU (80 CATI pilot unproductive cases and 40 panel members who asked to leave the survey).*

Both the CATI and WFU panel response rate varied by area deprivation (see table 7.5). For CATI, it ranged from 28% in the most deprived area to 34% in the least deprived, and in WFU from 43% in the most deprived area to 47% in the least deprived.

Table 7.5: Probability panel response rate, by area deprivation and data collection arm

Index of Multiple Deprivation (IMD) quintile[m]	CATI[1]		WFU[2]		Total	
	N	Response rate (%)	N	Response rate (%)	N	Response rate (%)
Most deprived	401	28%	423	43%	824	34%
2nd	450	30%	462	45%	912	36%
3rd	488	32%	436	43%	924	37%
4th	532	34%	453	46%	985	39%
Least deprived	553	34%	497	47%	1,050	39%

[1] *of the 7,764 CATI cases issued, 142 have missing IMD status*

[2] *of the 5,218 WFU cases issued, 137 have missing IMD status*

Similar to the PAF survey, 99% (2,400) of the CATI participants who reached the self-completion consent went on to fully complete the self-completion questionnaire. See table 7.6.

Table 7.6: Panel CATI response rate to self-completion, by age

	18-29 year olds		30-39 year olds		40-49 year olds		50-59 year olds		All	
	n	%	n	%	n	%	n	%	n	%
Eligible for self-completion questionnaire	**257**		**721**		**735**		**713**		**2,426**	
Completed CASI										
- fully completed	254	99%	716	99%	723	98%	707	99%	2,400	99%
- partially completed	0	0%	0	0%	4	1%	4	1%	8	0%
Refused to complete	3	1%	5	1%	8	1%	2	0%	18	1%

7.3 Interviews achieved

Across all arms of NatCen data collection, 6,719 interviews were achieved. Of these, 4,445 (66%) took part in the long questionnaire (either PAF or panel CATI) and 2,274 (34%) took part in the shorter WFU questionnaire. Table 7.7 shows the gender, age and region for participants in each data collection arm (unweighted).

The achieved unweighted sample included more women (4,092, 61%) than men (2,580, 38%); 47 (1%) of the sample identified their gender in another way. The overall age-distribution,16 to 17 year olds aside, was relatively even varying from 1,506 (22%) 50 to 59 year olds to 1,773 (26%) 30 to 39 year olds. However, the age distribution varies greatly between the different data collection arms, reflecting that the PAF included a young person boost sample, and that the probability panel was skewed towards older people (both in terms of the available sample (see section 2.3.1) and differential non-response by age). Due to the inclusion of 16 to 17 year olds in PAF only, they comprised a smaller proportion of the total achieved sample (3%, 195).

[m] We used an adjusted measure of IMD to allow IMD for England, Scotland and Wales to be analysed together; available open source at https://github.com/mysociety/composite_uk_imd, based on a method developed by Abel, Barclay and Payne, 2016 https://bmjopen.bmj.com/content/6/11/e012750).

Of the 6,714 participants with known country of residence, 5,836 (87%) lived in England, 390 (6%) in Wales and 488 (7%) in Scotland.

Table 7.7: Demographic profile of all participants, by gender, age and region (unweighted)

	PAF		Panel telephone (CATI)		Panel online (WFU)		All	
	N	% of participants	N	% of participants	N	% of participants	N	% of participants
Gender								
Men	819	41%	939	39%	822	36%	2,580	38%
Women	1,180	58%	1472	61%	1,440	63%	4,092	61%
Another gender identity	20	1%	15	1%	12	1%	47	1%
Age-group (years)								
16-17[1]	195	10%	n/a	*n/a*	*n/a*	*n/a*	195	3%
18-29	950	47%	257	11%	346	15%	1,553	23%
30-39	313	16%	721	30%	739	32%	1,773	26%
40-49	278	14%	735	30%	679	30%	1,692	25%
50-59	283	14%	713	29%	510	22%	1,506	22%
Region								
North East	74	4%	103	4%	110	5%	287	4%
North West	181	9%	247	10%	279	12%	707	11%
Yorkshire and The Humber	207	10%	231	10%	226	10%	664	10%
East Midlands	151	7%	213	9%	205	9%	569	8%
West Midlands	141	7%	210	9%	210	9%	561	8%
East of England	215	11%	247	10%	204	9%	666	10%
London	221	11%	270	11%	256	11%	747	11%
South East	326	16%	383	16%	298	13%	1,007	15%
South West	213	11%	224	9%	191	8%	628	9%
Wales	184	9%	104	4%	102	4%	390	6%
Scotland	106	5%	192	8%	190	8%	488	7%
Total productive	**2,019**	-	**2,426**	-	**2,274**	-	**6,719**	-

[1] *16 to 17 year olds were included in PAF only*

7.4 Address-based probability (PAF) biosampling response[n]

Of the 1,146 eligible women, 636 (55%) consented to provide a biological sample. Of these, 464 (73%) consented to provide a vaginal swabs sample and 172 (37%) a urine sample.
365 vaginal swab samples (79% of consented) and 145 urine samples (84% of consented) were received at the laboratory. See table 7.8.

Overall, 45% (510/1,146) of eligible women provided a biological sample. This proportion did not vary by age. A biological sample was received from 44% (272) eligible 16 to 29[o] year olds, 44% (83) eligible 30 to 39 year olds, 43% (78) 40 to 49 year olds and 48% (77) eligible 50 to 59 year olds.

Of all samples received from eligible women, 94% (481) consented to sample storage for future research.

Table 7.8: PAF biological sample consent and receipt for cisgender women, by sample type and age

	16-29 year olds		30-39 year olds		40-59 year olds		50-59 year olds		All	
	n	%	n	%	n	%	n	%	n	%
Eligible for providing a vaginal swab sample^	**616**	-	**190**	-	**180**	-	**160**	-	**1,146**	
Vaginal swab consent provided, of which:	253	41%	80	42%	66	37%	65	41%	464	40%
*- sample received**	*198*	*78%*	*60*	*75%*	*53*	*80%*	*54*	*83%*	*365*	*79%*
- no sample received	*55*	*22%*	*20*	*25%*	*13*	*20%*	*11*	*17%*	*99*	*21%*
Refusal/consent withdrawn/unable for other reason	363	59%	110	58%	114	63%	95	59%	682	60%
Vaginal swab sample received from those eligible	-	**32%**	-	**32%**	-	**29%**	-	**34%**	-	**32%**
Eligible for providing a urine sample^	**363**	**-**	**110**	**-**	**114**	**-**	**95**	**-**	**682**	**-**
Urine consent provided, of which:	87	24%	28	25%	31	27%	26	27%	172	25%
- sample received#	*74*	*85%*	*23*	*82%*	*25*	*81%*	*23*	*88%*	*145*	*84%*
- no sample received	*13*	*15%*	*5*	*18%*	*6*	*19%*	*3*	*12%*	*27*	*16%*
Refusal/consent withdrawn/unable for other reason	276	76%	82	75%	83	73%	69	73%	510	75%
Urine sample received from those eligible	-	**20%**	-	**21%**	-	**22%**	-	**24%**	-	**21%**
Eligible for providing a biological sample	**616**	-	**190**	-	**180**	-	**160**	-	**1,146**	-
Total sample consent provided, of which:	340	55%	108	57%	97	54%	91	57%	636	55%
- sample received	*272*	*80%*	*83*	*77%*	*78*	*80%*	*77*	*85%*	*510*	*80%*
- no sample received	*68*	*20%*	*25*	*23%*	*19*	*20%*	*14*	*15%*	*126*	*20%*

[n] Gender in the biosampling response tables uses the gender variable 'd_groute', a variable based on a combination of gender identity, sex described at birth, and trans identity/history. This variable is used throughout the questionnaire module to determine routing and eligibility to different sample types. Therefore, numbers of women, men and trans/gender diverse in all biosampling response tables are different to those in survey response, demographic and data linkage tables (which uses only gender identity)
[o] 16 to 17 year olds were included in PAF only

Total refused/consent withdrawn/unable for other reason	276	45%	82	43%	83	46%	69	43%	510	45%
Sample received from those eligible	-	**44%**	-	**44%**	-	**43%**	-	**48%**	-	**45%**
Consented to storage for future research (% from samples received)	253	**93%**	78	**94%**	75	**96%**	75	**97%**	481	**94%**

3 trans/gender diverse participants consented to and provided vaginal swab samples. Their data is not shown in this table.

^women were eligible to provide a urine sample if they did not consent to provide a vaginal swab sample
#1 sample received by the lab was unusable (all non-viral STI results were equivocal or invalid)

Of the 873 eligible men and trans/gender diverse participants, 468 (54%) consented to provide a urine sample. 406 urine samples (87% of consented) were received at the laboratory. See table 7.9.

Overall, 47% (406/873) of eligible men and trans/gender diverse participants provided a urine sample. A urine sample was received from 46% (241) eligible 16 to 29 year olds, 46% (56) eligible 30 to 39 year olds, 45% (44) eligible 40-49 year olds and 53% (65) eligible 50 to 59 year olds.

Of all samples received from eligible men and trans/gender diverse participants, 96% (389) consented to sample storage for future research.

Table 7.9: PAF biological sample consent and receipt for cisgender men and trans/gender diverse participants, by age

	16-29 year olds		**30-39 year olds**		**40-49 year olds**		**50-59 year olds**		**All**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Eligible for providing a urine sample*	**529**	-	**123**	-	**98**	-	**123**	-	**873**	-
Urine consent provided, of which:	285	54%	63	51%	51	52%	69	56%	468	54%
- sample received~	*241*	*85%*	*56*	*89%*	*44*	*86%*	*65*	*94%*	*406*	*87%*
- no sample received	*44*	*15%*	*7*	*11%*	*7*	*14%*	*4*	*6%*	*62*	*13%*
Refusal/consent withdrawn/unable for other reason	244	46%	60	49%	47	48%	54	44%	405	46%
Urine sample received from those eligible^	-	**46%**	-	**46%**	-	**45%**	-	**53%**	-	**47%**
Consented to storage for future research (% from samples received)	231	**96%**	52	**93%**	44	**100%**	62	**95%**	389	**96%**

** of which 86 were trans/gender diverse participants according to the gender routing variable 'd_groute', which is based on a combination of gender identity, sex described at birth, and trans identity/history.*

^ of which 31 were trans/gender diverse participants.

7.5 Probability panel telephone biosampling response

Of the 1,449 eligible women, 1,153 (80%) consented to provide a biological sample. Of these, 1,052 (91%) consented to provide a vaginal swabs sample and 101 (9%) a urine sample. See table 7.10.

742 vaginal swab samples (71% of consented) and 71 urine samples (70% of consented) were received at the laboratory.

Overall, 56% (813/1,449) of eligible women provided a biological sample. This rate increased with age: a biological sample was received from 42% (67), 53% (244), 58% (254) and 63% (248) of eligible 16 to 29 year olds, 30 to 39 year olds, 40 to 49 year olds and 50 to 59 year olds respectively.

Of all samples received from eligible women, 95% (774) consented to sample storage for future research.

Table 7.10: Panel CATI biological sample consent and receipt for cisgender women, by sample type and age

	18-29 year olds		30-39 year olds		40-49 year olds		50-59 year olds		All	
	n	%	n	%	n	%	n	%	n	%
Eligible for providing a vaginal swab sample^	**160**	-	**459**	-	**437**	-	**393**	-	**1,449**	-
Vaginal swab consent provided, of which:	112	70%	338	74%	326	75%	276	70%	1,052	73%
- sample received#	*62*	*55%*	*223*	*66%*	*236*	*72%*	*221*	*80%*	*742*	*71%*
- no sample received	*50*	*45%*	*115*	*34%*	*90*	*28%*	*55*	*20%*	*310*	*29%*
Refusal/consent withdrawn/unable for other reason	48	30%	121	26%	111	25%	117	30%	397	27%
Vaginal swab sample received from those eligible	-	**39%**	-	**49%**	-	**54%**	-	**56%**	-	**51%**
Eligible for providing a urine sample^	**48**	**-**	**121**	**-**	**111**	**-**	**117**	**-**	**397**	**-**
Urine consent provided, of which:	9	19%	33	27%	24	22%	35	30%	101	25%
- sample received	5	*56%*	21	*64%*	18	*75%*	27	*77%*	71	*70%*
- no sample received	*4*	*44%*	*12*	*36%*	*6*	*25%*	*8*	*23%*	*30*	*30%*
Refusal/consent withdrawn/unable for other reason	39	81%	88	73%	87	78%	82	70%	296	75%
Urine sample received from those eligible	-	**10%**	-	**17%**	-	**16%**	-	**23%**	-	**18%**
Eligible for providing a biological sample	**160**	-	**459**	-	**437**	-	**393**	-	**1,449**	-
Total sample consent provided, of which:	121	76%	371	81%	350	80%	311	79%	1,153	80%
- sample received	*67*	*55%*	*244*	*66%*	*254*	*73%*	*248*	*80%*	*813*	*71%*
- no sample received	*54*	*45%*	*127*	*34%*	*96*	*27%*	*63*	*20%*	*340*	*29%*
Total refused/consent withdrawn/unable for other reason	39	24%	88	19%	87	20%	82	21%	296	20%
Sample received from those eligible	-	**42%**	-	**53%**	-	**58%**	-	**63%**	-	**56%**
Consented to storage for future research	60	**90%**	231	**95%**	239	**94%**	244	**98%**	774	**95%**

^women were eligible to provide a urine sample if they did not consent to provide a vaginal swab sample

 # 2 samples received by the lab were unusable (all non-viral STI results were equivocal or invalid)

Of the 977 eligible men and trans/gender diverse participants, 793 (81%) consented to provide a urine sample.

576 urine samples (73% of consented) were received at the laboratory.

Overall, 59% (576/977) of eligible men and trans/gender diverse participants provided a urine sample. This rate increased with age: a biological sample was received from 56% (54), 53% (139), 58% (172) and 66% (211) of eligible 16 to 29 year olds, 30 to 39 year olds, 40 to 49 year olds and 50 to 59 year olds respectively. See table 7.11.

Of all samples received from eligible men and trans/gender diverse participants, 96% (554) consented to sample storage for future research.

Table 7.11: Panel CATI biological sample consent and receipt for cisgender men and trans/gender diverse participants, by age

	18-29 year olds		30-39 year olds		40-49 year olds		50-59 year olds		All	
	n	%	n	%	n	%	n	%	n	%
Eligible for providing a urine sample*	**97**	-	**262**	-	**298**	-	**320**	-	**977**	-
Urine consent provided, of which:	82	85%	217	83%	233	78%	261	82%	793	81%
- sample received	*54*	*66%*	*139*	*64%*	*172*	*74%*	*211*	*81%*	*576*	*73%*
- no sample received	*28*	*34%*	*78*	*36%*	*61*	*26%*	*50*	*19%*	*217*	*27%*
Refusal/consent withdrawn/unable for other reason	15	15%	45	17%	65	22%	59	18%	0	0%
Urine sample received from those eligible^	-	**56%**	-	**53%**	-	**58%**	-	**66%**	-	**59%**
Consented to storage for future research	50	**93%**	132	**95%**	168	**98%**	204	**97%**	554	**96%**

**of which 52 were trans/gender diverse participants*

^of which 18 were trans/gender diverse participants.

7.6 Probability panel online (WFU) biosampling response

Of the 1,428 eligible women, 768 (54%) consented to provide a biological sample. Of these, 688 (90%) consented to provide a vaginal swabs sample and 80 (10%) a urine sample. See table 7.12.

308 vaginal swab samples (45% of consented) and 28 urine samples (35% of consented) were received at the laboratory.

Overall, 24% (336/1,428) of eligible women provided a biological sample. This rate increased with age: a biological sample was received from 18% (40), 20% (99), 21% (88) and 36% (109) of eligible 16 to 29 year olds, 30 to 39 year olds, 40 to 49 year olds and 50 to 59 year olds respectively.

Of all samples received from eligible women, 82% (276) consented to sample storage for future research.

Table 7.12: Panel WFU biological sample consent and receipt for cisgender women, by sample type and age

	18-29 year olds		30-39 year olds		40-49 year olds		50-59 year olds		All	
	n	%	n	%	n	%	n	%	n	%
Eligible for providing a vaginal swab sample^	**224**	-	**483**	-	**417**	-	**304**	-	**1,428**	-
Vaginal swab consent provided, of which:	94	42%	250	52%	196	47%	148	49%	688	48%
- sample received	*38*	*40%*	*95*	*38%*	*76*	*39%*	*99*	*67%*	*308*	*45%*
- no sample received	*56*	*60%*	*155*	*62%*	*120*	*61%*	*49*	*33%*	*380*	*55%*
Refusal/consent withdrawn/unable for other reason	130	58%	233	48%	221	53%	156	51%	740	52%
Vaginal swab sample received from those eligible	-	**17%**	-	**20%**	-	**18%**	-	**33%**	-	**22%**
Eligible for providing a urine sample^	**130**	-	**233**	-	**221**	-	**156**	-	**740**	-
Urine consent provided, of which:	9	7%	20	9%	24	11%	27	17%	80	11%
- sample received	2	*22%*	4	*20%*	12	*50%*	10	*37%*	28	*35%*
- no sample received	*7*	*78%*	*16*	*80%*	*12*	*50%*	*17*	*63%*	*52*	*65%*
Refusal/consent withdrawn/unable for other reason	121	93%	213	91%	197	89%	129	83%	660	89%
Urine sample received from those eligible	-	**2%**	-	**2%**	-	**5%**	-	**6%**	-	**4%**
Eligible for providing a biological sample	**224**	-	**483**	-	**417**	-	**304**	-	**1,428**	-
Total sample consent provided, of which:	103	46%	270	56%	220	53%	175	58%	768	54%
- sample received	*40*	*39%*	*99*	*37%*	*88*	*40%*	*109*	*62%*	*336*	*44%*
- no sample received	*63*	*61%*	*171*	*63%*	*132*	*60%*	*66*	*38%*	*432*	*56%*
Total refused/consent withdrawn/unable for other reason	121	54%	213	44%	197	47%	129	42%	660	46%
Sample received from those eligible	-	**18%**	-	**20%**	-	**21%**	-	**36%**	-	**24%**
Consented to storage for future research	31	**78%**	78	**79%**	71	**81%**	96	**88%**	276	**82%**

^women were eligible to provide a urine sample if they did not consent to provide a vaginal swab sample

Of the 846 eligible men and trans/gender diverse participants, 505 (60%) consented to provide a urine sample. See table 7.13.

310 urine samples (61% of consented) were received at the laboratory.

Overall, 37% (341/846) of eligible men and trans/gender diverse participants provided a urine sample. This rate increased with age: a biological sample was received from 26% (32), 32% (81), 40% (106) and 44% (91) of eligible 16 to 29 year olds, 30 to 39 year olds, 40 to 49 year olds and 50 to 59 year olds respectively.

Of all samples received from eligible men and trans/gender diverse participants, 85% (265) consented to sample storage for future research.

Table 7.13: Panel WFU biological sample consent and receipt for cisgender men and trans/gender diverse participants, by age

	18-29 year olds		30-39 year olds		40-49 year olds		50-59 year olds		All	
	n	%	n	%	n	%	n	%	n	%
Eligible for providing a urine sample*	**122**	-	**256**	-	**262**	-	**206**	-	**846**	-
Urine consent provided, of which:	68	56%	145	57%	171	65%	121	59%	505	60%
- sample received	*32*	*47%*	*81*	*56%*	*106*	*62%*	*91*	*75%*	*310*	*61%*
- no sample received	*36*	*53%*	*64*	*44%*	*65*	*38%*	*30*	*25%*	*195*	*39%*
Refusal/consent withdrawn/unable for other reason	54	44%	111	43%	91	35%	85	41%	341	40%
Urine sample received from those eligible^	-	**26%**	-	**32%**	-	**40%**	-	**44%**	-	**37%**
Consented to storage for future research	27	**84%**	65	**80%**	94	**89%**	79	**87%**	265	**85%**

**of which 34 were trans/gender diverse participants*
^of which 13 were trans/gender diverse participants.

7.7 Total biosampling consent,receipt and timings

Across the three data collection arms, of the 6,719 eligible participants 4,323 (64%) consented to provide a biological sample. Of these, 2,951 (68%) provided a biological sample, representing 44% of the eligible sample. See table 7.14.

Among eligible women, 1,659 (41%) provided a biological sample, of which 85% (1,415) provided a vaginal swab sample and 15% (244) provide a urine sample.

Among eligible men, 1,229 (49%) provided a urine sample and among eligible trans/gender diverse participants, 63 (37%) provided a urine sample.

The proportion of eligible participants providing a biological sample broadly increased with age: a sample was received from 40% (706) of 16 to 29 year olds, 40% (702) of 30 to 39 year olds, 44% (742) of 40 to 49 year olds and 53% (801) of 50 to 59 year olds.

Of all samples received from eligible participants, 93% (2,739) consented to sample storage for future research.

Table 7.14: Total biological sample consent and receipt, by sample type, gender and age

	16-29 year olds*		30-39 year olds		40-59 year olds		50-59 year olds		All	
	n	%	n	%	n	%	n	%	n	%
Eligible women for providing a vaginal swab sample^	**1,000**	-	**1,132**	-	**1,034**	-	**857**	-	**4,023**	-
Vaginal swab consent provided, of which:	459	46%	668	59%	588	57%	489	57%	2,204	55%
- sample received	*298*	*65%*	*378*	*57%*	*365*	*62%*	*374*	*76%*	*1,415*	*64%*
- no sample received	*161*	*35%*	*290*	*43%*	*223*	*38%*	*115*	*24%*	*789*	*36%*
Refusal/consent withdrawn/unable for other reason	541	54%	464	41%	446	43%	368	43%	1,819	45%
Vaginal swab sample received from eligible women	-	**30%**	-	**33%**	-	**35%**	-	**44%**	-	**35%**
Eligible women for providing a urine sample^	**541**	-	**464**	-	**446**	-	**368**	-	**1,819**	-
Urine consent provided by women, of which:	105	19%	81	17%	79	18%	88	24%	353	19%
- sample received+	*81*	*77%*	*48*	*59%*	*55*	*70%*	*60*	*68%*	*244*	*69%*
- no sample received	*24*	*23%*	*33*	*41%*	*24*	*30%*	*28*	*32%*	*109*	*31%*
Refusal/consent withdrawn/unable for other reason	436	81%	383	83%	367	82%	280	76%	1,466	81%
Urine sample received from eligible women	-	**15%**	-	**10%**	-	**12%**	-	**16%**	-	**13%**
Eligible men for providing a urine sample	**677**	-	**601**	-	**630**	-	**619**	-	**2,527**	-
Urine consent provided by men, of which:	402	59%	406	68%	440	70%	438	71%	1,686	67%
*- sample received***	*300*	*75%*	*263*	*65%*	*311*	*71%*	*355*	*81%*	*1,229*	*73%*
- no sample received	*102*	*25%*	*143*	*35%*	*129*	*29%*	*83*	*19%*	*457*	*27%*
Refusal/consent withdrawn/unable for other reason	104	15%	151	25%	153	24%	136	22%	544	22%
Urine sample received from eligible men	-	**44%**	-	**44%**	-	**49%**	-	**57%**	-	**49%**
Eligible trans/gender diverse for providing a urine sample	**71**	-	**40**	-	**28**	-	**30**	-	**169**	-
Urine consent provided by trans/gender diverse, of which:	33	46%	19	48%	15	54%	13	43%	80	47%
- sample received	*27*	*82%*	*13*	*68%*	*11*	*73%*	*12*	*92%*	63	*79%*
- no sample received	*6*	*18%*	*6*	*32%*	*4*	*27%*	*1*	*8%*	17	*21%*
Refusal/consent withdrawn/unable for other reason	38	54%	21	53%	13	46%	17	57%	89	53%

Urine sample received from eligible trans/gender diverse	-	**38%**	-	**33%**	-	**39%**	-	**40%**	-	**37%**
Total eligible for providing a biological sample	**1,748**	**-**	**1,773**	**-**	**1,692**	**-**	**1,506**	**-**	**6,719**	**-**
Total sample consent provided, of which:	999	57%	1,174	66%	1,122	66%	1,028	68%	4,323	64%
- sample received	*706*	*71%*	*702*	*60%*	*742*	*66%*	*801*	*78%*	*2,951*	*68%*
- no sample received	*293*	*29%*	*472*	*40%*	*380*	*34%*	*227*	*22%*	*1,372*	*32%*
Total refused/consent withdrawn/unable for other reason	578	33%	555	31%	533	32%	433	29%	2,099	31%
Total samples received from those eligible	-	**40%**	-	**40%**	-	**44%**	-	**53%**	-	**44%**
Consented to storage for future research	652	**92%**	636	**91%**	691	**93%**	760	**95%**	2,739	**93%**

**16-17yr olds in PAF only*
^women were eligible to provide a urine sample if they did not consent to provide a vaginal swab sample
~ 2 samples received by the lab were unusable (all non-viral STI results were equivocal or invalid)
+ 1 sample received by the lab was unusable (all non-viral STI results were equivocal or invalid)
++ 2 samples received by the lab were unusable (all non-viral STI results were equivocal or invalid)

On average (taking the median), across all arms it took 2 days from when the sample was collected by the participant to when the sample arrived at the lab. See table 7.15.

Table 7.15 Sample transit time (days)

	Transit time (days) between kit posted and sample collected[1,3]				**Transit time (days) between sample collected and sample arrived at TDL[3]**				**Transit time (days) between sample posted and sample arrived at TDL[2, 3]**			
	Mean	SD	Median	IQR	Mean	SD	Median	IQR	Mean	SD	Median	IQR
PAF												
During f2f interview	n/a	n/a	n/a	n/a	2.6	1.7	2	1	2.5	1.7	2	1
After f2f interview	n/a	n/a	n/a	n/a	2.6	2.0	2	2	n/a	n/a	n/a	n/a
Telephone interview	7.1	5.3	6	7	3.0	2.6	2	3	n/a	n/a	n/a	n/a
Total PAF	n/a	n/a	n/a	n/a	2.6	1.8	2	1	n/a	n/a	n/a	n/a
Panel CATI	13.8	10	11	10	2.6	2.2	2	1	n/a	n/a	n/a	n/a
Panel WFU	13.8	11	11	10	2.7	1.6	2	1	n/a	n/a	n/a	n/a

[1] During f2f interviews, the sample kits were not posted to participants (they were given to them during the interview)
[2] Data on when the sample was posted only available for samples collected during the f2f interview
[3] Outliers have been removed from analysis.

The STI testing was done on rolling basis without freezing. Testing for all samples was done within 60 days. The HPV testing was done after freezing and in batches.

7.8 Address-based probability (PAF) data linkage consent

On average, 68% of PAF participants (1,378) consented to link to health records, 68% (1,373) consented to link to education records and 68% (1,368) consented to link to ONS records. Around two thirds of PAF participants consented to link to at least one type of records (69%, 1,402).

Consent did not vary significantly by gender, age, country and deprivation. See table 7.16.

Table 7.16: PAF data linkage consent, by gender, age, country and area deprivation

	Consented to Health records		Consented to Education records		Consented to ONS records		Consented to at least 1 type of records		Number of participants
	n	%	n	%	n	%	n	%	n
Gender									
Men	554	68%	549	67%	547	67%	559	68%	819
Women	809	69%	810	69%	806	68%	828	70%	1,180
Another gender identity	15	75%	14	70%	15	75%	15	75%	20
Age-group (years)									
16-29	825	72%	818	71%	820	72%	839	73%	1,145
30-39	203	65%	203	65%	203	65%	208	66%	313
40-49	171	62%	172	62%	168	60%	174	63%	278
50-59	179	63%	180	64%	177	63%	181	64%	283
Country									
England	1,179	68%	1,178	68%	1,172	68%	1,200	69%	1,729
Wales	80	75%	80	75%	79	75%	81	76%	106
Scotland	119	65%	115	63%	117	64%	121	66%	184
IMD quintile									
Most deprived	285	66%	283	65%	284	65%	289	67%	434
2nd	273	67%	271	67%	269	66%	281	69%	406
3rd	259	70%	260	70%	257	69%	262	70%	372
4th	264	70%	263	70%	262	69%	266	70%	378
Least deprived	297	69%	296	69%	296	69%	304	71%	429
Total	**1,378**	**68%**	**1,373**	**68%**	**1,368**	**68%**	**1,402**	**69%**	**2,019**

7.9 Probability panel telephone data linkage consent

On average, 72% of CATI participants (1,742) consented to link to health records, 72% (1,743) consented to link to education records and 72% (1,742) consented to link to ONS records. Nearly three quarters of CATI participants consented to link to at least one type of records (74%, 1,805)

Consent did not vary significantly by gender, age, country and deprivation. See table 7.17.

Table 7.17: Panel CATI data linkage consent, by gender, age, country and area deprivation

	Consented to Health records		Consented to Education records		Consented to ONS records		Consented to at least 1 type of records		Number of participants
	n	%	n	%	n	%	n	%	n
Gender									
Men	695	74%	695	74%	695	74%	718	76%	939
Women	1,036	70%	1,037	70%	1,035	70%	1,075	73%	1,472
Another gender identity	11	73%	11	73%	12	80%	12	80%	15
Age-group (years)									
18-29	193	75%	191	74%	191	74%	198	77%	257
30-39	505	70%	514	71%	500	69%	523	73%	721
40-49	520	71%	522	71%	525	71%	541	74%	735
50-59	524	73%	516	72%	526	74%	543	76%	713
Country									
England	1,514	71%	1,519	71%	1,515	71%	1,574	74%	2,128
Wales	80	77%	77	74%	79	76%	81	78%	104
Scotland	148	77%	147	77%	148	77%	150	78%	192
IMD quintile									
Most deprived	280	70%	276	69%	278	69%	289	72%	401
2nd	325	72%	323	72%	327	73%	337	75%	450
3rd	345	71%	343	70%	348	71%	357	73%	488
4th	394	74%	396	74%	386	73%	405	76%	532
Least deprived	398	72%	405	73%	403	73%	417	75%	553
Total	**1,742**	**72%**	**1,743**	**72%**	**1,742**	**72%**	**1,805**	**74%**	**2,426**

7.10 Probability panel online (WFU) data linkage consent

On average, 34% of WFU participants (764) consented to link to health records, 34% (764) consented to link to education records and 35% (860) consented to link to ONS records. 38% (860) of WFU participants consented to link to at least one type of records. Consent did not vary significantly by gender, age, country and deprivation. See table 7.18.

Table 7.18: Panel WFU data linkage consent, by gender, age, country and area deprivation

	Consented to Health records		Consented to Education records		Consented to ONS records		Consented to at least 1 type of records		Number of participants
	n	%	n	%	n	%	n	%	n
Gender									
Men	299	36%	298	36%	310	38%	333	41%	822
Women	456	32%	458	32%	483	34%	518	36%	1,440
Another gender identity	9	75%	8	67%	8	67%	9	75%	12
Age-group (years)									
18-29	110	32%	114	33%	120	35%	126	36%	346
30-39	235	32%	230	31%	247	33%	269	36%	739

40-49	229	34%	230	34%	241	35%	256	38%	679
50-59	190	37%	190	37%	193	38%	209	41%	510
Country									
England	654	33%	654	33%	686	35%	735	37%	1,979
Wales	39	38%	40	39%	40	39%	43	42%	102
Scotland	71	37%	70	37%	75	39%	82	43%	190
IMD quintile									
Most deprived	151	36%	147	35%	158	37%	167	39%	423
2nd	173	37%	171	37%	181	39%	189	41%	462
3rd	136	31%	137	31%	147	34%	159	36%	436
4th	139	31%	139	31%	146	32%	157	35%	453
Least deprived	165	33%	170	34%	169	34%	188	38%	497
Total	**764**	**34%**	**764**	**34%**	**801**	**35%**	**860**	**38%**	**2,274**

7.11 Total probability data linkage consents achieved

Across the probability data collection arms, 61% (4,067) of participants consented to link to at least one type of records. Consent to health, education or ONS records were each the same at 58%.

Consent did not vary significantly by gender, age, country and deprivation. See table 7.19.

Table 7.19: Total data linkage consent, by gender, age, country and area deprivation

	Consented to Health records		Consented to Education records		Consented to ONS records		Consented to at least 1 type of record		Number of participants
	n	%	n	%	n	%	n	%	n
Gender									
Men	1,548	60%	1,542	60%	1,552	60%	1,610	62%	2,580
Women	2,301	56%	2,305	56%	2,324	57%	2,421	59%	4,092
Another gender identity	35	74%	33	70%	35	74%	36	77%	47
Age-group (years)									
16-29	1,128	65%	1,123	64%	1,131	65%	1,163	67%	1,748
30-39	943	53%	947	53%	950	54%	1,000	56%	1,773
40-49	920	54%	924	55%	934	55%	971	57%	1,692
50-59	893	59%	886	59%	896	59%	933	62%	1,506
Country									
England	3,347	57%	3,351	57%	3,373	58%	3,509	60%	5,836
Wales	199	64%	197	63%	198	63%	205	66%	312
Scotland	338	60%	332	59%	340	60%	353	62%	566
IMD quintile									
Most deprived	716	57%	706	56%	720	57%	745	59%	1,258
2nd	771	58%	765	58%	777	59%	807	61%	1,318
3rd	740	57%	740	57%	752	58%	778	60%	1,296

4th	797	58%	798	59%	794	58%	828	61%	1,363
Least deprived	860	58%	871	59%	868	59%	909	61%	1,479
Total	**3,884**	**58%**	**3,880**	**58%**	**3,911**	**58%**	**4,067**	**61%**	**6,719**

8. Data preparation

8.1 Data overview

We used a bespoke data management tool (DataHub) to prepare and check the data. The DataHub streamlines the production of data, reduces the risk of human error in processing, and ensures the data will be produced in the same way every time. It is a metadata-driven approach to data management which centralises all project metadata into a single and transparent source of information. It uses reusable SPSS syntax templates and advanced techniques in metadata manipulation to produce survey-specific syntax for the processing and checking of outputs.

Due to Natsal-4's multi-pronged approach involving different surveys and different modes within surveys, and structural complexity of its questionnaires, it required extensive data management. Data had to be merged from three separate surveys: PAF survey, Panel telephone survey (CATI) and Panel online survey (WFU). The PAF survey in turn included four separate modes: in-person interviewer administered, in-person self-completion and in the alternative PAF remote mode an interviewer administered telephone interview and online self-completion. The Panel CATI survey included an interviewer administered telephone interview and an online self-completion.

PAF data collected through online self-completion (i.e. for the self-completion section of the remote PAF interviews) and all the data collected through the NatCen Panel used questionnaires programmed in Unicom Intelligence (UI) software and the rest of the data were collected by questionnaires programmed in Blaise 4 software. The two software programs produce data in different formats, which means that work was needed to render them to the same structure.

Further, the questionnaires were not identical in different modes, with the WFU survey being both shorter and different in structure. This meant that data from all surveys and modes had to be mapped together to create a combined dataset of three surveys.

8.2 Coding

Some questions allowed participants to provide a free form answer, usually if they thought none of the existing answer categories were suitable. These verbatim responses were reviewed and if possible coded back to the existing code frame by a team of experienced coders.

8.3 Data management and quality control

For all data sources, data management involved the following steps:

- **Basic checks** to ensure that the data files contained the productive cases based on the final outcome code.

- **Checking for satisficing:** WFU cases were checked for signs that suggested that a participant had not engaged with the survey when responding (e.g. giving the same answer for a number of subsequent questions). Questionnaires that failed this test were removed.
- **Routing checks**, which involved checking that all questions were asked of the right participants. Errors could happen due to the questionnaire specification being incorrectly implemented in the questionnaire program. A small number of instances where the routing had been incorrect were uncovered, but this did not affect any key variables. This process also uncovered some cases where the participant had changed answers to some questions, which then meant that they had been asked questions that were not intended for them (i.e. that they should not have been routed to). The answers for these questions were removed and set to an appropriate missing value code.
- **Variable checks** involved checking that all variables included had the same answer categories that had been specified in the questionnaire. This stage also included checking that all variables had consistent missing value codes.
- **Consistency checks** involved checking that answers to two or more questions were consistent. If it was clear that one of the answers was incorrect, it was either changed or set to missing. However, in many instances, it was not possible to prioritise one answer over another, in which case the inconsistencies were left in the data (see Appendix D).
- Reviewing all **variable and value labels** to ensure these were clear, consistent and matched the questionnaires.
- Deriving additional variables that summarise or combine the raw variables from the questionnaire (**derived variables**).
- **Curating** the final dataset to ensure that they contained all the required variables in the expected order.

All these steps were quality assured by a different data manager or researcher.

9. Weighting

9.1 Survey weighting

9.1.1. Address-based probability (PAF) survey weighting

Selection weights

The first step in weighting the PAF data was to adjust for the different probabilities of selection introduced by the sample design. A selection weight was calculated as the inverse of each participant's probability of selection. This depended on several factors, including their location and age.

Address selection probabilities

For each issued address, the probability of selection for the core sample was calculated (separately for each country, England, Scotland and Wales) as the total number of addresses issued[p], divided by the total number of residential delivery points in the country (omitting exclusions such as addresses north of the Caledonian canal). Similarly, the probability of selection for the young person boost sample was calculated as the total number of addresses issued[q] divided by the total number of residential delivery points in that country (again omitting exclusions).[r]

Dwelling units and households

One dwelling unit (DU) was selected at each address, and one household was selected from the chosen dwelling unit, hence the selection probabilities were inversely proportional to the numbers of each. A value of 1 was imputed where these were unknown. The corresponding selection weights were therefore equal to the number of DUs and households. These were each trimmed at 2 to reduce the variability of the selection weights and maintain efficiency. The (capped) number of dwelling units and households for each address were then multiplied together.[s]

Selection probabilities for participants

Individual participants could be selected via either the core sample or, for people aged 16 to 29, the young person boost sample. The probability of selection via each route was inversely proportional to the number of people in the relevant eligible age group (16 to 59 for the core sample, vs 16 to 29 for the young person boost sample) in the selected household. It was calculated as the probability that the address was selected for that sample, *divided by* the number of people in the relevant age group in the selected household *and* by the product of the number of dwelling units and households. A maximum value of 3 people was imposed for both eligible age ranges, to improve efficiency.

The combined probability of selection for people aged 16 to 29 via either route was calculated as the sum of the probabilities for each selection route.

[p] Equal to the number of selected residential delivery points multiplied by 15, the number of core addresses per point.
[q] Equal to the number of selected residential delivery points multiplied by 43, the number of young person boost addresses per point.
[r] Twelve interviews with people aged 30 or more were mistakenly conducted at young person boost addresses, all in England. The data from these interviews has been retained, and 12 addresses were, accordingly, added to the numbers of core addresses selected in England and subtracted from the number of young person boost addresses for the purposes of these calculations.
[s] A small but still implausible number of addresses had the same number of dwelling units and households recorded. For these cases, one of the pair of identical values was recoded to 1. Hence, the product of the two was also capped at 2.

A participant's selection weight (*selwt_paf*) was then derived as the inverse of this combined selection probability (for people aged 16 to 29) or the inverse of their selection probability for the core sample (for people aged 30 to 59). The distribution of selection weights was examined, and the top 5 weights were trimmed. Finally, the selection weights were scaled to have mean 1.

Calibration

In Natsal-3, calibration weighting used age, sex and region population estimates only. For Natsal-4, given the much lower response rate, the calibration targets were extended to include more demographic variables. After careful deliberation, four additional measures were chosen (a-priori): tenure, ethnicity, cohabiting status and household composition.

In the final calibration, the selection weights were adjusted to match the following population estimates (for 2022):

- Age (in 5-year age bands) *within* sex
- Region *within* sex
- Tenure (Owned, Mortgage, Rented, Missing) *within sex*
- Ethnicity (White, Ethnic minority group, Missing) *within sex*
- Cohabiting status (Cohabiting, Not, Missing) *within sex*
- Household composition (Single person, 2+ adults, Adults & children, Missing) *within sex*

The population estimates, shown in table 9.1, were taken from the following sources:

- Age, sex and region: ONS mid-year population estimates for 2022
- Tenure, ethnicity and cohabiting status: Annual Population Survey 2022
- Household composition: two quarters (January-March & July-Sept) of the Labour Force Survey 2022 (the two quarters for which the relevant variables were available)

Missing values

There were no missing values for age, sex or region but the four other variables used in calibration included some missing codes (e.g. Don't know, Not answered). In each case, they were grouped into a single missing category, which was included in the calibration targets (see above). The missing proportions were fixed to match the proportions produced from initial weighting by the selection weights; the raw population estimates were adjusted accordingly.

Trimming

Following the calibration, the weights were scaled to have a mean of 1. Two outlying weights were then trimmed back to the next highest weight. This weight was then re-scaled and re-calibrated to match population proportions for age within sex, hence that the final profile of age/sex matches population estimates precisely (whilst there are small differences for other variables). The final weights (total_wt_paf) have an effective sample size of 1,100 and a mean of 1.

Weighted profiles

The weighted profiles of respondents prior to calibration (weighted by the selection weights) and following calibration are shown in table 9.2, alongside the population profile. Prior to calibration, the largest differences compared to the population were for sex, with males making up just 39% of respondents, compared to 49% of the population. Younger people were also under-represented, with 18-29 year olds making up 23% of respondents (with selection weights applied) compared to 30% of the population. The unweighted sample over-represents this age group, due to the young person boost, but application of selection weights removes the effect of this over-sampling, illustrating that response was lower, on average, for this age group. Households with

two or more adults and no children were also under-represented prior to calibration. Following calibration, the weighted profile matches the population very closely; trimming of large weights is the sole reason for any small discrepancies.

Table 9.1: Population estimates for Great Britain (16-59 year olds)

	All	Males	Females
Age group (years)			
16-19	3,009,051	1,549,110	1,459,941
20-24	3,962,260	2,005,071	1,957,189
25-29	4,245,059	2,094,941	2,150,118
30-34	4,548,717	2,204,700	2,344,017
35-39	4,400,561	2,128,511	2,272,050
40-44	4,204,441	2,050,699	2,153,742
45-49	3,982,364	1,959,286	2,023,078
50-54	4,468,345	2,192,138	2,276,207
55-59	4,486,351	2,199,513	2,286,838
Region			
North East	1,476,709	728,466	748,243
North West	4,234,944	2,094,620	2,140,324
Yorkshire and the Humber	3,112,773	1,540,841	1,571,932
East Midlands	2,764,749	1,372,082	1,392,667
West Midlands	3,368,054	1,672,861	1,695,193
East	3,541,007	1,750,358	1,790,649
London	5,681,866	2,755,617	2,926,249
South East	5,224,318	2,576,933	2,647,385
South West	3,115,715	1,542,848	1,572,867
Wales	1,702,275	840,520	861,755
Scotland	3,084,739	1,508,823	1,575,916
Tenure			
Owned	6,756,332	3,383,568	3,372,763
Mortgage	17,007,332	8,550,990	8,456,342
Rented	13,543,485	6,449,411	7,094,074
Ethnicity			
White	30,845,133	15,345,861	15,499,272
Ethnic minority	6,462,016	3,038,108	3,423,908
Cohabiting status			
Cohabiting	21,930,052	10,900,798	11,029,254
Not cohabiting	15,377,097	7,483,171	7,893,926
Household composition			
Single person	3,314,369	2,001,553	1,312,816
2+ adults	18,916,971	9,590,240	9,326,731
Adults & children	15,075,809	6,792,176	8,283,633
Total	37,307,149	18,383,969	18,923,180

Table 9.2: Comparison of weighted PAF sample with population estimates

	PAF sample weighted by selection weights			PAF sample weighted by final weights			Population estimates		
	Males	Females	All	Males	Females	All	Males	Females	All
	%	%	%	%	%	%	%	%	%
Total	39.3	60.7	100.0	49.3	50.7	100.0	49.3	50.7	100.0
Age group (years)									
16-19	3.2	3.6	6.8	4.2	3.9	8.1	4.2	3.9	8.1
20-24	3.4	3.8	7.2	5.4	5.2	10.6	5.4	5.2	10.6
25-29	3.6	5.6	9.2	5.6	5.8	11.4	5.6	5.8	11.4
30-34	5.2	8.1	13.3	5.9	6.3	12.2	5.9	6.3	12.2
35-39	5.1	8.5	13.6	5.7	6.1	11.8	5.7	6.1	11.8
40-44	4.8	9.3	14.1	5.5	5.8	11.3	5.5	5.8	11.3
45-49	3.2	7.6	10.8	5.3	5.4	10.7	5.3	5.4	10.7
50-54	4.9	7.1	12.0	5.9	6.1	12.0	5.9	6.1	12.0
55-59	5.9	7.2	13.1	5.9	6.1	12.0	5.9	6.1	12.0
Region									
North East	1.2	2.4	3.6	2.0	2.0	4.0	2.0	2.0	4.0
North West	4.5	5.4	9.9	5.5	5.7	11.3	5.6	5.7	11.4
Yorkshire & the Humber	4.4	6.4	10.8	4.1	4.2	8.4	4.1	4.2	8.3
East Midlands	3.1	4.9	8.1	3.7	3.7	7.4	3.7	3.7	7.4
West Midlands	2.1	4.0	6.1	4.5	4.5	9.0	4.5	4.5	9.0
East	4.3	7.4	11.8	4.7	4.8	9.5	4.7	4.8	9.5
London	5.2	6.0	11.2	7.3	7.8	15.2	7.4	7.8	15.2
South East	6.2	9.5	15.7	6.9	7.1	14.0	6.9	7.1	14.0
South West	3.5	6.5	9.9	4.1	4.2	8.4	4.1	4.2	8.4
Wales	3.3	5.0	8.3	4.1	4.2	8.3	2.3	2.3	4.6
Scotland	1.3	3.4	4.7	2.3	2.3	4.6	4.0	4.2	8.3
Tenure									
Owned	7.7	10.6	18.3	9.1	9.0	18.1	9.1	9.0	18.1
Mortgage	15.3	26.5	41.8	22.9	22.7	45.6	22.9	22.7	45.6
Renting	16.4	23.5	39.9	17.2	19.0	36.3	17.3	19.0	36.3
Ethnicity									
White	31.6	51.7	83.3	41.1	41.5	82.6	41.1	41.5	82.7
Ethnic minority	7.6	9.1	16.7	8.2	9.2	17.4	8.1	9.2	17.3
Cohabiting status									
Cohabiting	24.2	37.1	61.3	29.3	29.6	58.8	29.2	29.6	58.8
Not cohabiting	15.1	23.6	38.7	20.0	21.2	41.2	20.1	21.2	41.2
Household composition									
Single person	5.7	6.4	12.1	5.4	3.5	8.9	5.4	3.5	8.9
2+ adults	20.6	25.3	45.9	25.8	25.0	50.8	25.7	25.0	50.7
Adults & children	13.0	29.0	42.0	18.1	22.2	40.3	18.2	22.2	40.4

Nb. Bases for percentages exclude missing values for tenure, ethnicity, cohabiting status and household composition.

Strata variables

There are three PAF strata variables for use in complex survey analysis. In addition, there are equivalent variables for analysis of the combined data (PAF+CATI or PAF+CATI+WFU). For brevity, the description below refers to the PAF strata variables only. The combined strata variables are: strata1_combined, strata2_combined, strata_rgn_combined.

- **strata1_paf** is based on pairs/triplets of PSUs and is for analysis of the whole PAF sample, e.g. a crosstab of sexual identity by country (Eng/Scot/Wales).
- **strata2_paf** is for analysis that is filtered by sex or gender, e.g. a crosstab of sexual identity by country for males only.
- **strata_rgn** is equivalent to Region and is for analysing smaller subgroups, e.g. a crosstab of sexual identity by country for males aged 16 to 29 only.

Strata1 and strata2 are to be used by default. However, there will be scenarios where they will produce an error (in STATA) or warning (in SPSS) due to single PSUs in some strata[t]. In this situation, strata with single PSUs can be recoded to be combined with adjacent strata. Strata_rgn is available as a backup, i.e. it's for use when strata2 proves impractical due to there being many strata with single PSUs; e.g. if (say) 20 strata require a recode, this might be considered overly time-consuming or impractical, hence strata_rgn can be used instead.

9.1.2. Probability panel survey weighting

The NatCen panel has a standard approach to non-response weighting: weights are generated at the sampling stage, reflecting the weights applied to the original survey, from which the panelist was recruited, *and* the probability of selection from the pool of eligible panelists. This composite weight, when applied to the issued sample, produces a representative sample of adults in the relevant age range. Non-response to the panel survey is then modelled using logistic regression. In this case the following characteristics (from the original survey) were used as predictors: age by sex, region, household income, work status and NS-SEC[u]. The predicted probabilities from the model are used to create non-response weights, which are multiplied by the sampling weights to create a pre-calibration weight.

The above process was repeated twice over, once for CATI and a second time including the web respondents in addition to the CATI respondents. In each case, the base for the model was all cases issued to the panel survey, i.e., the web respondents were treated as non-respondents for the purpose of creating the CATI weights.

At the calibration stage, the pre-calibration weights were adjusted to match the following population estimates (for 2022) for adults 18+:

- Age (in 5-year age bands) *within* sex
- Region *within* sex
- Tenure (Owned, Mortgage, Rented, Missing) *within sex*
- Ethnicity (White, Ethnic, Missing) *within sex*
- Cohabiting status (Cohabiting, Not, Missing) *within sex*
- Household composition (Single person, 2+ adults, Adults & children, Missing) *within sex*

[t] Where analysis is filtered, one or more PSUs with a handful of respondents may include no one from that subgroup, leaving only cases in a single other PSU within the strata.

[u] To minimize the variance of the weights, a small number of additional variables used as standard were not included: tenure, ethnicity and household type were missed out as they were included in calibration, whilst interest in politics and political party identification were judged to be of limited value in the context of this survey.

Apart from the age range (18-59 years), these were equivalent to the population estimates used for PAF calibration and were taken from the same sources, as follows:

- Age, sex and region: ONS mid-year population estimates for 2022.
- Tenure, ethnicity and cohabiting status: Annual Population Survey 2022.
- Household composition: two quarters (January-March & July-Sept) of the Labour Force Survey 2022 (the two quarters for which the relevant variables were available).

The population totals used in calibration are shown in table 9.3.

Missing values

There were no missing values for CATI respondents on age, sex[v] or region but the four other variables in the calibration had some missing codes (e.g. Don't know, Not answered). For tenure, ethnicity and household composition, missing values were imputed using data from the panel[w]. For cohabiting status, the missing values could not be imputed, hence the missing codes were grouped into a single category, which this was included in the calibration targets. The missing proportion was fixed to match the proportion produced by the pre-calibration weights; the raw population estimates were adjusted accordingly.

There were no missing values for web respondents on age or sex, and only one for region (this was imputed using data from the panel). However, out of the four other variables, only ethnicity was included in the web questionnaire, hence all web respondents were missing values for the three other measures to start with. Whilst missing values for tenure and household composition were largely imputed with data from the panel, partner status could not be imputed accurately, hence this ended up being missing for all web respondents. To deal with this, a dummy variable for CATI+WFU respondents was added to the calibration so that the proportion of web cases would remain unchanged[x].

Trimming

Following the calibration, the weights were scaled to have a mean of 1. As with the PAF weights, a small number of outlying weights were trimmed back to the next highest weight[y]. Each set of weights was then re-scaled and re-calibrated to match population proportions for age within sex, hence the final profile of age/sex matches population estimates precisely (whilst there are small differences for other variables). The final CATI weights (*total_wt_cati*) have an effective sample size of 956 and a mean of 1. The final CATI+WFU weights (*total_wt_catiweb*) have an effective sample size of 2,087 and a mean of 1.

Weighted profiles

The weighted profiles of respondents prior to calibration and following calibration are shown in table 8.4 and 8.5, alongside the population profile. Prior to calibration, when weighted by the pre-calibration weights, 18-24 year olds made up only 7% of both CATI and CATI/web respondents, compared to 15% of the population. This is expected as the NatCen panel sample disproportionately represents older people due to natural panel ageing and cumulative non-response (to the original survey, the invitation to join the panel, and subsequent attrition) being greater among younger people. People who were not cohabiting were the next most under-represented group, making up 33% of CATI respondents and 32% of CATI/web respondents (when weighted by the pre-calibration weights) compared to 39% of the population. As with the PAF, the final weighted profiles (following calibration) match the population very closely; trimming of large weights is, again, the sole reason for any small discrepancies.

[v] For 20 cases, sex was replaced with gender ID: man/boy was imputed as male and girl/female was imputed as female.
[w] The data was taken from the last panel survey in which the panelist participated.
[x] The targets were set such that the proportion of web respondents was fixed at the level produced by calibration to age/sex and region only.
[y] The top 4 CATI weights and the top 9 CATI+web weights were trimmed back.

Table 9.3: Population estimates for Great Britain (18-59 year olds)

	Persons	Males	Females
Age-group (years)			
18-24	5,475,063	2,784,416	2,690,647
25-29	4,245,059	2,094,941	2,150,118
30-34	4,548,717	2,204,700	2,344,017
35-39	4,400,561	2,128,511	2,272,050
40-44	4,204,441	2,050,699	2,153,742
45-49	3,982,364	1,959,286	2,023,078
55-54	4,468,345	2,192,138	2,276,207
55-59	4,486,351	2,199,513	2,286,838
Region			
North East	1,417,464	698,144	719,320
North West	4,058,902	2,003,602	2,055,300
Yorkshire and the Humber	2,983,482	1,474,135	1,509,347
East Midlands	2,653,371	1,314,818	1,338,553
West Midlands	3,222,686	1,597,975	1,624,711
East	3,395,327	1,675,320	1,720,007
London	5,477,640	2,651,010	2,826,630
South East	5,006,813	2,464,999	2,541,814
South West	2,992,864	1,479,966	1,512,898
Wales	1,631,933	804,117	827,816
Scotland	2,970,419	1,450,118	1,520,301
Tenure			
Owned	6,485,771	3,240,967	3,244,804
Mortgage	16,279,996	8,190,615	8,089,381
Rented	13,045,135	6,182,622	6,862,512
Ethnicity			
White	29,658,801	14,732,485	14,926,316
Ethnic	6,152,100	2,881,719	3,270,381
Cohabiting status			
Cohabiting	21,907,939	10,883,574	11,024,365
Not	13,902,962	6,730,630	7,172,332
Household composition			
Single person	3,309,773	1,997,337	1,312,436
2+ adults	18,206,168	9,226,315	8,979,853
Adults & children	14,294,960	6,390,552	7,904,408
Total	35,810,901	17,614,204	18,196,697

Table 9.4: Comparison of weighted NatCen panel (CATI only) sample with population estimates

	CATI sample weighted by pre-calibration weights			CATI sample weighted by final weights			Population estimates		
	Males	Females	All	Males	Females	All	Males	Females	All
	%	%	%	%	%	%	%	%	%
Total	48.2	51.8	100.0	49.2	50.8	100.0	49.2	50.8	100.0
Age group (years)									
18-24	3.1	4.1	7.1	7.6	7.5	15.1	7.8	7.5	15.3
25-29	5.3	6.1	11.4	6.0	6.0	12.0	5.9	6.0	11.9
30-34	5.8	6.2	11.9	6.2	6.5	12.7	6.2	6.5	12.7
35-39	6.4	8.4	14.8	5.9	6.3	12.3	5.9	6.3	12.3
40-44	7.5	8.4	15.8	5.7	6.0	11.7	5.7	6.0	11.7
45-49	5.9	4.6	10.5	5.5	5.6	11.1	5.5	5.6	11.1
50-54	6.3	7.0	13.3	6.1	6.4	12.5	6.1	6.4	12.5
54-59	7.9	7.1	15.0	6.1	6.4	12.5	6.1	6.4	12.5
Region									
North East	2.1	1.8	4.0	2.6	1.7	4.3	1.9	2.0	4.0
North West	4.7	6.2	10.9	3.7	6.2	9.9	5.6	5.7	11.3
Yorkshire and the Humber	3.5	5.2	8.7	3.4	4.5	7.9	4.1	4.2	8.3
East Midlands	2.9	5.0	7.9	3.4	4.4	7.9	3.7	3.7	7.4
West Midlands	5.0	4.2	9.2	6.2	4.1	10.3	4.5	4.5	9.0
East	3.9	5.3	9.2	4.9	4.1	9.1	4.7	4.8	9.5
London	8.1	6.9	15.0	7.5	7.9	15.3	7.4	7.9	15.3
South East	7.3	6.7	14.0	6.9	7.1	14.0	6.9	7.1	14.0
South West	3.8	4.4	8.2	4.2	4.2	8.4	4.1	4.2	8.4
Wales	2.6	1.8	4.3	2.3	2.3	4.6	2.2	2.3	4.6
Scotland	4.3	4.3	8.6	4.1	4.3	8.3	4.0	4.2	8.3
Tenure									
Owned	10.1	10.4	20.5	9.0	9.1	18.0	9.1	9.1	18.1
Mortgage	21.8	23.2	44.9	22.8	22.6	45.4	22.9	22.6	45.5
Renting	16.4	18.2	34.6	17.4	19.2	36.6	17.3	19.2	36.4
Ethnicity									
White	40.1	44.6	84.8	41.1	41.7	82.8	41.1	41.7	82.8
Ethnic minority	8.1	7.1	15.2	8.0	9.1	17.2	8.0	9.1	17.2
Cohabiting status									
Cohabiting	33.2	33.4	66.6	30.6	30.9	61.4	30.4	30.8	61.2
Not cohabiting	15.3	18.1	33.4	18.6	20.0	38.6	18.8	20.0	38.8
Household composition									
Single person	7.4	6.2	13.6	5.6	3.7	9.3	5.6	3.7	9.2
2+ adults	24.3	24.3	48.6	25.7	25.3	51.0	25.8	25.1	50.8
Adults & children	16.5	21.3	37.8	17.8	21.8	39.7	17.8	22.1	39.9

Nb. Panel data used to impute missing values as per calibration; bases exclude missing values for cohabiting status.

Table 9.5: Comparison of weighted NatCen panel (CATI+WFU) sample with population estimates

	CATI+WFU sample weighted by pre-calibration weights			CATI+WFU sample weighted by final weights			Population estimates		
	Males	Females	All	Males	Females	All	Males	Females	All
	%	%	%	%	%	%	%	%	%
Total	48.9	51.1	100.0	49.2	50.8	100.0	49.2	50.8	100.0
Age group (years)									
18-24	3.6	3.6	7.2	7.8	7.5	15.3	7.8	7.5	15.3
25-29	5.7	6.6	12.3	5.9	6.0	11.9	5.9	6.0	11.9
30-34	5.6	6.7	12.3	6.2	6.5	12.7	6.2	6.5	12.7
35-39	6.6	7.5	14.2	5.9	6.3	12.3	5.9	6.3	12.3
40-44	7.4	8.3	15.8	5.7	6.0	11.7	5.7	6.0	11.7
45-49	5.7	4.6	10.3	5.5	5.6	11.1	5.5	5.6	11.1
50-54	6.5	6.5	12.9	6.1	6.4	12.5	6.1	6.4	12.5
54-59	7.7	7.3	15.0	6.1	6.4	12.5	6.1	6.4	12.5
Region									
North East	2.0	2.0	3.9	1.9	2.0	3.9	1.9	2.0	4.0
North West	5.6	5.9	11.5	5.6	5.7	11.3	5.6	5.7	11.3
Yorkshire and the Humber	3.8	4.9	8.6	4.1	4.2	8.3	4.1	4.2	8.3
East Midlands	3.4	4.3	7.6	3.7	3.7	7.4	3.7	3.7	7.4
West Midlands	4.8	4.4	9.2	4.5	4.5	9.0	4.5	4.5	9.0
East	4.2	5.2	9.4	4.7	4.8	9.5	4.7	4.8	9.5
London	7.7	7.4	15.2	7.3	7.9	15.2	7.4	7.9	15.3
South East	7.1	6.7	13.8	6.9	7.1	14.0	6.9	7.1	14.0
South West	3.5	4.5	8.0	4.2	4.2	8.4	4.1	4.2	8.4
Wales	2.3	2.1	4.4	2.2	2.3	4.6	2.2	2.3	4.6
Scotland	4.5	4.0	8.4	4.1	4.2	8.3	4.0	4.2	8.3
Tenure									
Owned	8.8	8.8	17.6	8.9	9.1	18.0	9.1	9.1	18.1
Mortgage	23.8	23.0	46.8	22.9	22.6	45.5	22.9	22.6	45.5
Renting	16.4	19.2	35.6	17.3	19.2	36.5	17.3	19.2	36.4
Ethnicity									
White	41.5	44.1	85.5	41.2	41.7	82.9	41.1	41.7	82.8
Ethnic minority	7.4	7.1	14.5	8.0	9.1	17.1	8.0	9.1	17.2
Cohabiting status (CATI only)									
Cohabiting	35.1	32.4	67.6	30.5	30.8	61.3	30.4	30.8	61.2
Not cohabiting	15.6	16.8	32.4	18.7	20.0	38.7	18.8	20.0	38.8
Household composition									
Single person	6.6	5.4	12.0	5.6	3.7	9.3	5.6	3.7	9.2
2+ adults	22.8	22.9	45.7	25.7	25.1	50.8	25.8	25.1	50.8
Adults & children	19.4	22.9	42.3	17.9	22.1	39.9	17.8	22.1	39.9

Nb. Panel data used to impute missing values as per calibration; bases exclude missing values for tenure and cohabiting status.

Panel Strata variables
There are two strata variables for use in complex survey analysis, one for CATI (strata_rgn_CATI) and one for CATI+WFU (strata_rgn_CATIweb). These are both equivalent to Region. This reflects the standard approach to producing strata for the NatCen panel.

9.1.3. Combined probability survey weighting

Initial weights
A set of combined weights for analysis of all Natsal-4 respondents was created by putting the PAF and panel weights together into one variable (*total_wt_combined)*. Had the two weights been stacked on top of one another with no further adjustments, 16-17 year olds would have been under-represented, due to the different age ranges (16-59 for PAF respondents and 18-59 for the panel). An adjustment to the weights was therefore necessary to deal with this discrepancy.

The panel weights were left unchanged, while the PAF weights for 16-17 year olds were scaled up, so that the sum of their weights was in the correct proportion within the full set of respondents (2,019 PAF respondents + 4,700 panelists). Because the 16-19 year olds from PAF were grouped together within sex for calibration weighting, this slightly altered the balance of males and female PAF respondents within the 16-19 age group. Therefore, a small adjustment was made to the PAF weights for 18-19 year olds: these were re-scaled, so that males and females were in the correct (population) proportion.

Following these adjustments, the two sets of weights were stacked into a single variable, and checks were carried out to ensure that the combined weights closely matched population totals.

There is also a combined weight for PAF and CATI only (*total_wt_PAFCATI)*, to be used for analysing the long questionnaire. This weight was produced using the same methodology as the one described above. The weight combines the 2,019 PAF respondents with the 2,426 CATI respondents.

The initial combined PAF+CATI+WFU weights (*total_wt_combined*) have an effective sample size of 3,238 and a mean of 1. The initial combined PAF+CATI weights (*total_wt_PAFCATI*) have an effective sample size of 2,049 and a mean of 1.

Final weights
For the initial combined weights, the PAF and panel weights were stacked on top of one another (with an adjustment for the 16-17 year olds, as mentioned above) without accounting for the relative size of the PAF and panel samples. In this initial set of combined weights, the mean weight for 18-29 year old panel respondents is 3.8 times higher compared to the mean weight for 18-29 year old PAF respondents[z]. This is down to 18-29s being weighted down in the PAF sample (due to the young person boost) and weighted up in the panel sample (due to under-representation in the issued sample coupled with lower response). It means the initial combined weights are not as efficient as they could be, especially when producing estimates for young people.

To address this imbalance, and improve the efficiency of the combined weights, another (final) set of combined weights for analysis of all Natsal-4 respondents was created by re-scaling the initial weights within each age group (18-29 and 30-59), so that the PAF and panel respondents are in proportion to their unweighted sample sizes[aa] (*total_wt_combined_final).* The initial weights for PAF respondents aged 16-17 year olds were left

[z] For 18-29 year olds, the mean initial combined weight is 1.13 varying between 0.54 for the PAF and 2.06 for the panel respondents; for 30-59 year olds, the mean initial combined weight is 0.94 varying between 1.57 for the PAF and 0.81 for the panel respondents.
[aa] Of the 1,553 respondents 18-29 year old, 950 (61%) are from the PAF and 603 (39%) from the panel; of the 4,971 respondents 30-59 year old, 874 (18%) are from the PAF and 4,097 (82%) from the panel. After weighting by the initial combined weight, 71% of respondents in each age group come from the panel.

unchanged as they were correctly scaled. After final weighting, the two sample sources have the same mean combined weight within each age group[bb].

There is also a final combined weight for PAF and CATI only (*total_wt_PAFCATI_final)* to be used for analysing the long questionnaire which was produced using the same methodology as the one described above.

The final combined PAF+CATI+WFU weights (*total_wt_combined_final*) have an effective sample size of 4,088 (which is larger than the initial combined weights) and a mean of 1. The final combined PAF+CATI weights (*total_wt_PAFCATI_final*) have an effective sample size of 2,742 (again, larger than the initial combined weights) and a mean of 1.

9.2 Biosample weighting

9.2.1. Address-based probability (PAF) biosample weighting

Separate biosample weights were required for analysis of tests conducted on biological samples provided by Natsal participants. Most tests were conducted on all people returning useable biological samples.

Table 9.6: tests conducted on sample and for which population (gender)

Test #	Test	Sample type (swab and/or urine)	Population
1	**Chlamydia**	Swab and urine	All: cis women, cis men and trans/non-binary.
2	**Gonorrhoea**	Swab and urine	All: cis women, cis men and trans/non-binary.
3	**Mycoplasma genitalium**	Swab and urine	All: cis women, cis men and trans/non-binary.
4	**Trichomonas vaginalis**	Swab and urine	All: cis women, cis men and trans/non-binary.
5	**HPV**	Swab and urine	cis-women and trans/non-binary.
6	**Microbiome**	Swab and urine	All: cis women, cis men and trans/non-binary.

Biosample weights were created by modelling response to the biosample (defined as providing a useable sample) and multiplying the resulting non-response weight by the main survey weight to create a composite biosample weight. This was done separately for the Natsal PAF and Panel samples. This section covers the PAF biosample weight (*bio_wt_paf*).

A wide range of candidate predictor variables were chosen to model response, including demographics variables and survey questions relating to sexual behaviour and health. Some of these were simplified by recoding to a smaller set of categories. Stepwise variable selection, both forward and backward, was used to guide the development of logistic regression models to predict response to the biosample. The models were weighted by the main survey weight and (10 year) age band and region were “forced” into the models i.e. the stepwise procedure began with these variables already included and they were not removed at any point. Separate models were created for the two gender groups: (i) cis men, and (ii) cis women + trans/non-binary people. The final model for each group included variables that were statistically significant in either or both the original

[bb] For 18-29 year olds, the mean final combined weight for PAF and panel respondents is 1.13; for 30-59 year olds, the mean final combined weight for PAF and panel respondents is 0.94.

stepwise models. The coefficients for the final PAF model are shown in Table 9.7 in Appendix E. The final set of variables included in all three models is listed below.

Non-response weights were calculated as the inverse of the predicted probabilities of response from each model. They were trimmed at 99%, and the two sets were combined (stacked) to create a single variable. This weight was multiplied by the main survey weight to create a composite biosample weight. The top three weights were trimmed back to the next highest weight, and the weights were re-scaled to have mean 1.

Variables included in the final model were as follows:
Ageband (16-19, 20-29, 30-39, 40-49, 50-59)
Region
Method(s) respondent or any partner has ever used: Male condom (long questionnaire)
DV: When (last) attended sexual health services (any appointment type)
DV: Respondent lives with child aged 12 to 17 (incl. adopted/step/fostered) (long questionnaire)
DV: Respondent lives with child aged under 12 (incl. adopted/step/fostered) (long questionnaire)
DV: Employment status at interview
DV: Ever tested for HIV (incl. pregnancy, excluding blood donation) (long questionnaire)
DV: Marital/cohabiting status (incl. info about spouses and cohabiting partners in the household) (long questionnaire)
DV: Ever had sex with same sex partner, age 13+
DV: No. of sex partners lifetime amongst all respondents
DV: No. of new sex partners in the past year amongst all respondents, 0 if not had sex with any gender
Household income (long questionnaire)
Whether any partners in the last 5 years that had sex with have overlapped in time (long questionnaire)

9.2.2. Probability panel biosample weighting

Biosample weights were created by modelling response to the biosample (defined as providing a useable sample) and multiplying the resulting non-response weight by the main survey weight to create a composite biosample weight. This was done separately for the Natsal PAF and Panel samples. This section covers the two biosample weights produced for panel respondents - CATI (*bio_wt_cati)* and CATI+WFU (*bio_wt_catiweb*).

As far as possible the same predictor variables used in modelling response to PAF biosample were used for the panel biosample modelling. However, some measures were missing altogether for online respondents, hence they could not be included. The exception to this rule was the three measures used in calibration that were not in the online questionnaire, i.e. tenure, partner status and household composition. These variables *were* included in the biosample modelling, as their missing values had been imputed using data from the panel[cc].

The same procedure as used for PAF biosample modelling was used to produce both the CATI and CATI+WFU biosample weights. Stepwise variable selection, both forward and backward, was used to produce an initial set of predictors, with ageband and region “forced” into the models. Separate models were created for the two gender groups: (i) cis men, and (ii) cis women + trans/non-binary people, and in both cases (CATI and CATI+WFU) the final model included variables that were statistically significant in either or both the original stepwise models. The coefficients for the final CATI and CATI+WFU models are shown in Tables 9.8 and 9.9 in Appendix E. The final set of variables included in all three models is listed below.

Non-response weights were calculated as the inverse of the predicted probabilities of response from each model. They were trimmed at 99%, and in both cases the two sets were combined (stacked) to create a single

[cc] A different version of partner status was used here compared to calibration. Missing values were imputed where possible using panel data on household composition; the measure used for this did correspond perfectly with the Natsal variable but was deemed “good enough” for this purpose (if not for use in calibration).

variable. This weight was multiplied by the main survey weight to create a composite biosample weight, and in each case a small set of large outlying weights were trimmed back to the next highest weight[dd]. Finally, the weights were re-scaled to have mean 1.

Variables included in the final CATI biosample model were as follows:
Ageband (16-19, 20-29, 30-39, 40-49, 50-59)
Region
Tenure (Owned, Mortgage, Rented)
Ethnicity (White, Ethnic)
Cohabiting status (Cohabiting, Not)
DV: Educational attainment (GSS harmonised variable)
DV: Marital/cohabiting status (incl. info about spouses and cohabiting partners in the household) (long questionnaire)
Household income (long questionnaire)
DV: Employment status at interview
DV: No. of sex partners without a condom amongst all respondents in the last year, grouped (long questionnaire)
DV: When (last) attended sexual health services (any appointment type)
Whether had sex with anyone who normally lives outside the UK, in the last 5 years (long questionnaire)
Whether any partners in the last 5 years that had sex with have overlapped in time (long questionnaire)
DV: No. of sex partners lifetime amongst all respondents

Variables included in the final CATI+WFU biosample model were as follows:
Ageband (16-19, 20-29, 30-39, 40-49, 50-59)
Region
Tenure (Owned, Mortgage, Rented)
Ethnicity (White, Ethnic)
Cohabiting status (Cohabiting, Not, Missing)
Household composition (Single person, 2+ adults, Adults & children)
DV: Educational attainment (GSS harmonised variable)
DV: Employment status at interview
DV: No. of sex partners without a condom amongst all respondents in the last year, grouped (long questionnaire)
DV: Ever had opp. sex anal sex (penis in anus) (given or received) (long questionnaire)
DV: Ever had sex with same sex partner, age 13+
DV: When (last) attended sexual health services (any appointment type)
DV: Ever been diagnosed with an STI (Natsal-4 definition)
Whether any partners in the last 5 years that had sex with have overlapped in time (long questionnaire)
DV: No. of sex partners in past year amongst all respondents, 0 if not had sex with any gender
DV: No. of sex partners in past year amongst all respondents, grouped
DV: No. of sex partners lifetime amongst all respondents
DV: No. of new sex partners in the past year amongst all respondents, 0 if not had sex with any gender

9.2.3. Combined probability biosample weighting

Initial weights

Combined biosample weights (bio_wt_combined) were created in two simple steps. First an adjustment factor was calculated for all respondents equal to the ratio of the (original) main survey weights and the (original) biosample weights. This adjustment factor was then multiplied by the (initial) combined weight (described above) to create the combined biosample weight. The ratio between the main and bio weights was therefore maintained for the combined weights.

[dd] The top 3 CATI bio weights and the top 8 CATI+web bio weights were trimmed back.

The profile of this combined biosample weight was checked to ensure that it closely matched the profiles produced by the separate biosample weights.

In addition, there are biosample weights (*bio_wt_PAFCATI*) for PAF and CATI only, to be used for analysing the long questionnaire. These were produced in the same manner as described above.

The initial combined PAF+CATI+WFU biosample weights (*bio_wt_combined*) have an effective sample size of 1,312 and a mean of 1. The initial combined PAF+CATI biosample weights (*bio_wt_PAFCATI*) have an effective sample size of 1,046 and a mean of 1.

Final weights

As with the main survey initial combined weights, the two sample sources (PAF and panel) do not contribute to the combined weighted biosample according to their sample size within each age group (18-29 and 30-59). For example, the mean initial combined biosample weight for 18-29 year old panel respondents is 4.2 times higher compared to the initial combined biosample weight for 18-29 year old PAF respondents[ee].

To address this imbalance, a final set of combined biosample weights was created by re-scaling the initial biosample weights within each age group (18-29 and 30-59) so that the PAF and panel cases are in proportion to their unweighted sample sizes[ff] (*bio_wt_combined_final).* The initial biosample weights for PAF respondents aged 16-17 year olds were left unchanged as they were correctly scaled. After final weighting, the two sample sources have the same mean combined biosample weight within each age group[gg].

There is also a final combined biosample weight for PAF and CATI only (*bio_wt_PAFCATI_final)* to be used for analysing the long questionnaire which was produced using the same methodology as the one described above.

The final combined PAF+CATI+WFU biosample weights (*bio_wt_combined_final*) have an effective sample size of 1,590 (which is larger than the initial weights) and a mean of 1. The final combined PAF+CATI biosample weights (*bio_wt_PAFCATI_final*) have an effective sample size of 1,297 (again, larger than the initial weights) and a mean of 1.

[ee] For 18-29 year olds, the mean initial combined biosample weight is 1.16 varying between 0.59 for the PAF and 2.46 for the panel respondents; for 30-59 year olds, the mean initial combined biosample weight is 0.94 varying between 1.48 for the PAF and 0.82 for the panel respondents.

[ff] Of the 630 respondents 18-29 year old, 436 (69%) are from the PAF and 194 (31%) from the panel; of the 2,253 respondents 30-59 year old, 402 (18%) are from the PAF and 1,851 (82%) from the panel. After weighting by the initial combined biosample weight, 65% of respondents aged 18-29 and 72% of respondents aged 30-59 come from the panel respectively.

[gg] For 18-29 year olds, the mean final combined biosample weight for PAF and panel respondents is 1.16; for 30-59 year olds, the mean final combined biosample weight for PAF and panel respondents is 0.94.

10. Strengths and limitations

10.1 Study strengths

A key aim of the Natsal series is to provide prevalence estimates for the British general population and **probability-based sampling methods** are currently considered the best method to obtain generalisable population estimates.[10, 20] The Natsal-4 address-based probability sample (PAF) arm drew a sample of addresses from the postcode address file (PAF), enabling data collection designed to minimise bias and produce estimates that are generalisable to people living in private households in Great Britain. Field interviewers collected data from eligible participants either in-person or remotely, including all components of the Natsal-4 interview. The probability panel telephone (CATI) and probability panel online (WFU) arms drew a sample of individuals from the NatCen Opinion Panel, who were recruited through studies for which participants are selected at random from the general population using the Postcode Address File (PAF) as a sampling frame. The probability panel telephone (CATI) arm included all components of the Natsal-4 interview (including biological sampling and data linkage consent). The probability panel online (WFU) arm included a shortened version of the Natsal-4 questionnaire but still included biological sampling and data linkage consent.

Despite different modes of data collection, the address-based probability sample (PAF) and the probability panel telephone (CATI) sample both include interviewer-administered questions and a self-completion component. Consistency of question administration (e.g. either interviewer administered or self-completion) was maintained in to **minimise measurement differences** across modes. This was not possible in the probability panel online (WFU) arm where there was no interviewer involvement. While this represents a difference in terms of the loss of rapport and support that interviewer involvement brings, the online mode is similar in many ways to the self-completion modes used within the PAF and panel telephone surveys, including in terms of the sense of privacy and anonymity for participants which may facilitate accurate reporting of sensitive behaviours.

The use of **different sampling frames** and **data collection modes** provides an opportunity for **comprehensive methodological analysis**. Such research can be used to inform the optimum design of future Natsal studies and will be of value to the wider research methods community.

The probability panel online (WFU) arm sampled members of the NatCen Opinion Panel who had not participated in the probability panel telephone (CATI) arm and, as such, can be considered a **non-responder web follow-up (WFU) survey**. This provides the opportunity to gain valuable information about the demographic profile and survey estimates for participants who were harder-to-recruit using a CATI approach, for example those who were generally less willing or who preferred online interaction to speaking to an interviewer over the telephone.

The Natsal-4 **questionnaire content** was developed through consultation with a wide range of stakeholders, ensuring the most relevant topics were prioritised for inclusion. Questionnaire development drew on the expertise and experience of the multi-disciplinary team of researchers within the Natsal team who implemented a range of development activities.

The Natsal-4 questionnaire included questions and measures used in previous Natsal surveys, which have been carefully developed over decades of extensive methodological work.[21] [22] [23] [24] [25] [26] [27] Self-completion questionnaire instruments were used to administer questions on the most **sensitive topics**, including gender identity, sexual behaviours, paid sex, sexual violence, reproductive health, STIs, sexual function, and sexual wellbeing. Various measures were put in place to ensure participants' privacy, confidentiality and to provide appropriate safeguards.

The Natsal-4 survey also included a number of **validated measurement tools** such as the Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS), the London Measure of Unplanned Pregnancy (LMUP), the Patient Health Questionnaire-2 (PHQ-2), the Generalized Anxiety Disorder 2-item (GAD-2), the Natsal Sexual Function measure (Natsal-SF) and the Natsal Sexual Wellbeing Measure (Natsal-SW). These standardised measures, along with the use of many Office for National Statistics/Government Statistical Service harmonised questions facilitates benchmarking (e.g. of particular sub-groups of interest identified in the Natsal-4 dataset) against national averages. In the case of Natsal-SW, it will establish a national benchmark.

The collection and analysis of **biological samples** (vaginal swabs or urine) will provide up-to-date population prevalence estimates for a range of STIs in the British population. The results, in combination with behavioural information, service use and demographic data collected in the Natsal-4 questionnaire will enable a better understanding of the prevalence, transmission dynamics and control of STIs.

All Natsal-4 participants were invited to consent to link their survey and biological data to their health, education and other **administrative records** held by ONS. Linking these records creates opportunities to expand the range of data to answer complex research questions.

Participants in the Natsal-4 survey were also asked for their consent to be contacted by the Natsal team in the future about taking part in **related research studies**. This provides researchers with opportunities to sample specific sub-groups of the population (based on their Natsal-4 survey data) or to create longitudinal follow-up research studies.

10.2 Study limitations

As with any survey, some individuals sampled for the survey could not be contacted or refused to take part. The response rate for the address-based probability sample (PAF) arm of the study was 24%. This was a significantly lower **response rate** than anticipated when the study was originally planned (prior to the COVID-19 pandemic) but in line with other major surveys conducted at the time (e.g. the Family Resources Survey 22-23 achieved the response rate of 25%[28] and the English Housing Survey 22-23 achieved a response rate of 32%[29]). The combined completion rate for the probability panel telephone (CATI) and probability panel online (WFU) was 61%. A cumulative response rate, taking the original British Social Attitudes Survey sample as the starting point, can be estimated as approximately 6%

A challenge for all probability-sample surveys is how to take account of those who do not take part, either because contact could not be established with the selected household or individual, or because they refused to take part. This may include individuals whose sexual behaviour and attitudes differ from those who did take part. The weighting scheme includes a non-response adjustment based on available sociodemographic population characteristics (outlined in the weighting section) to help account for non-response bias. This scheme is unlikely to address all biases.

The probability panel telephone (CATI) and probability panel online (WFU) arms of the study drew a large sample of individuals from the NatCen Opinion Panel. While the panel is sampled using probability sampling methods, panel members tend to represent a group of individuals who are generally engaged in research. It is likely that these participants differ from the general population, albeit to a lesser extent than volunteer-based internet panel samples.

The Natsal-4 dataset will include multiple study arms, resulting in a **complex dataset**. Users will need to take care to consider which study arm is most appropriate for their analysis, data missingness (e.g. for cases where the shorter questionnaire was used) and the potential impact of mode effects on the survey estimates. Further work is underway to investigate the extent to which data from the different arms, including the non-probability survey, can be a combined for analysis in a way that allows full use of the data and harnesses the benefits of the probability sample methods, while mitigating the biases present in each method.

A sizable proportion (34%) of the achieved Natsal-4 sample participated in the probability panel online (WFU) arm of the study. They answered a shortened version of the Natsal-4 questionnaire and therefore will have missing data for particular modules (or sections of modules). Additionally, questions that were interviewer-administered in the address-based probability sample (PAF) and the probability panel telephone (CATI) arms were, by necessity, self-completion questions for the probability panel online (WFU). Questions administered by different modes across the survey arms will be at higher risk of measurement differences as a result of survey mode.

The Natsal-4 questionnaire asks participants about a number of topics that may be perceived as socially undesirable, stigmatised or sensitive; these behaviours and feelings may be **underreported.** While this is a risk for any study based on self-report data, Natsal-4 goes some way to minimising this through careful design including the use of self-completion questionnaires which will help reduce bias in survey estimates.

Although the questionnaire was largely based on that used in Natsal-1, -2, -3, there are several major changes to Natsal-4 which mean **trends over time** should be treated with caution and will require additional scrutiny. First, the questionnaire underwent substantial updates, including the redesign of several key sections (first sexual experiences and sexual practices) originally designed for the first survey in 1990-91, to update them such that they are fit-for purpose for a contemporary sexual and reproductive health survey seeking to capture greater diversity in sexual lifestyles. Second, introduction of new sampling and recruitment methods, combined with new modes of questionnaire administration will all impact on the comparability of estimates in ways that may not be possible to disentangle. Therefore, although assessment of change over time is possible (particularly with the address-based probability (PAF) survey, subject to sufficient statistical power), these limitations should be borne in mind when interpreting the results.

Consent for biological sampling and data linkage varied in the different arms of Natsal-4. It is likely that this variation is associated with several factors that differ across the study arms including data collection mode, research engagement levels and sample composition. Although weights have been created which should mitigate the resulting bias, these are unlikely to completely eliminate bias.

10.3 Conclusion

Natsal-4 faced unprecedented delivery challenges, which led to a lower than expected address-based probability (PAF) response rate and lower number of address-based probability (PAF) interviews than initially planned. However, this necessitated a number of unplanned and innovative adaptations, which will benefit not only Natsal, but the survey research community as a whole.

11. Appendices

Appendix A: Address-based probability (PAF) documents

Appendix B: Probability panel telephone documents

Appendix C: Probability panel online (WFU) documents

Appendix D: Post-fieldwork consistency checks

Appendix E: Biosample non-response tables

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