Health Survey for England 2019 Methods

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This report provides details of the methodology of the Health Survey for England 2019. It covers sample design, topic coverage, fieldwork procedures, quality control, ethical approval, survey response, weighting and data analysis.

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This report may be of interest to members of the public, policy officials, people working in public health and to commissioners of health and care services who wish to see the details of the methodology of the Health Survey for England 2019.

1 Introduction

1.1 The Health Survey for England series

The Health Survey for England (HSE) comprises a series of annual surveys, of which the 2019 survey is the twenty ninth. Each annual survey has covered the adult population aged 16 and over living in private households in England. From 1995, the surveys also covered children aged 2 to 15; from 2001, infants aged under 2 were included as well.

The HSE is part of a programme of surveys commissioned since 2005 by the Health and Social Care Information Centre (NHS Digital from August 2016). Before April 2005, the survey series was commissioned by the Department of Health.[1] The surveys provide regular information that cannot be obtained from other sources about the public's health and associated factors. The series of Health Surveys for England was designed to:

- provide annual data from nationally representative samples to monitor trends in the nation's health;
- estimate the proportion of people in England who have specified health conditions;
- estimate the prevalence of certain risk factors associated with these conditions;
- examine differences between subgroups of the population (e.g. by age, sex or income) in their likelihood of having specified conditions or risk factors;
- assess the frequency with which particular combinations of risk factors are found, and in which groups these combinations most commonly occur;
- monitor progress towards health targets;
- (since 1995) measure the height of children at different ages, replacing the National Study of Health and Growth; and
- (since 1995) monitor the prevalence of overweight and obesity in children.

Each survey in the series includes core questions, and measurements such as blood pressure, height and weight measurements and analysis of blood and saliva samples. In addition there are modules of questions on specific issues that vary from year to year. In some years, the core sample has also been augmented by an additional boosted sample from a specific population subgroup, such as minority ethnic groups, older people or children. There was no such boost in 2019.

The HSE has been designed and carried out since 1994 by the Joint Health Surveys Unit of NatCen Social Research and the Research Department of Epidemiology and Public Health at University College London (UCL).

[1] From January 2018, the Department of Health and Social Care.

1.2 The 2019 survey

1.2.1 Subject coverage

The survey series covers core topics every year, including general health and key lifestyle behaviours that influence health, and social care. In 2019, there were additional questions on these topics:

- providing unpaid social care,
- dental health,
- eating disorders,
- use of GP and counselling services, and
- awareness of two mental health resources, Good Thinking and Every Mind Matters.

1.2.2 Summary of survey design

As in previous years, the HSE 2019 used a stratified random probability sample of households. The sample comprised 9,612 addresses selected at random in 534 postcode sectors. Adults and children were interviewed in households identified at the selected addresses. To limit the burden of responding for parents, no more than four children in each household were selected at random: up to two children aged between 0 and 12, and up to two aged between 13 and 15. For further details on the sample design, see Section 2 of this report.

Data collection comprised an interview, followed by a visit from a specially trained nurse for a proportion of participating households. The nurse visit included additional questions, measurements, collection of blood samples from adults and saliva samples from adults and children aged 4 and over.

Addresses were issued from January to December 2019. Fieldwork was completed in March 2020. A household response rate of 60% was achieved. In total, 8,205 adults and 2,095 children were interviewed, including 4,947 adults and 1,169 children who had a nurse visit.

1.2.3 Ethical approval

Overall ethical approval for the HSE between 2016 and 2019 was obtained from the East Midlands Nottingham 2 Research Ethics Committee in 2015 (Reference no. 15/EM/0254). The specific features of the 2019 survey were reviewed and approved in October 2018.

1.3 Reports on the Health Survey for England 2019

Findings from the HSE 2019 are published online and can be accessed via https://digital.nhs.uk/pubs/hse2019. Excel tables accompanying each report, including this one, can be found at https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2019/data-tables

Four topic reports are available.

- Overweight and obesity in adults and children
- Use of health care services
- Providing care for family and friends
- Eating disorders.

There are two reports focusing on broader measures of adult health, including trend data.

The report on Adults' health covers:

- general health;
- diabetes (diagnosed and undiagnosed);
- raised total cholesterol;
- hypertension (raised blood pressure).

The report on Adults' health-related behaviours covers:

- cigarette smoking, including the use of e-cigarettes and other nicotine delivery products;
- alcohol consumption.[2]

Children's health is covered in another report, including trend data. The report covers the following topics:

- cigarette smoking;
- drinking alcohol;
- general health, longstanding illness and acute sickness.

Population estimates are included in relevant reports for some estimates for adults and children covering 2019 and past years. For adults, these comprise body mass index categories; cigarette smoking; and average weekly alcohol consumption. For children, population estimates are shown for the prevalence of overweight and obesity.

[2] In other years this report has included data, including trend data, on fruit and vegetable consumption, physical activity and gambling, but these questions were not included in the 2019 survey.

1.4 Availability of data sets

The HSE is a long survey and only some of the results are included in the reports and data tables. Copies of the anonymised and disclosure-controlled datasets can be made available for specific research projects and teaching requirements. For the latest information about dissemination of the 2019 data please see the HSE website https://digital.nhs.uk/data-and-information/areas-of-interest/public-health/health-survey-for-england-health-social-care-and-lifestyles.

Past HSE datasets are available via the UK Data Service at http://discover.ukdataservice.ac.uk/series/?sn=2000021.

2 Sample design

2.1 Overview of the sample design

The sample for HSE 2019 was designed to be representative of the population living in private households in England. There was no boost sample. Those living in institutions were outside the scope of the survey.[3]

Like previous surveys in the HSE series, the 2019 survey adopted a multi-stage stratified probability sampling design. At the first stage, a random sample of primary sampling units (PSUs), based on postcode sectors, was selected. Within each selected PSU, a random sample of postal addresses (known as delivery points) was then drawn.

A reserve sample was built into the design, with options to withhold cases in the final two quarters of the 2019 survey year. This helped to ensure the target number of interviews was achieved, in the event of a lower than expected household response rate. Reserve sample was issued in the third but not the fourth quarter of fieldwork.

2.2 Selection of primary sampling units

2.2.1 Definition of primary sampling units

The sampling frame was the small user Postcode Address File (PAF). The very small proportion of households living at addresses not on PAF (estimated to be less than 1%) was not covered.

Postcode sectors with fewer than 500 PAF addresses were combined with neighbouring sectors to form the PSUs. This was done to prevent addresses being too clustered within a PSU. To maximise the precision of the sample, it was selected using a method called stratified sampling. The list of PSUs in England was sorted by former Government Office Regions (described throughout the report as regions) and, within each region, by local authority ordered by the percentage of adults in the 2011 Census from NS-SEC groups 1 and 2.[4] PSUs in smallest regions (the North East and East Midlands) were over-sampled to provide a minimum sample size (of approximately 700 adults).

534 PSUs were selected with probability proportional to the total number of addresses within them. Selecting PSUs with probability proportional to number of addresses and sampling a fixed number of addresses in each ensures that an efficient (equal probability) sample of addresses is obtained.

[3] This should be borne in mind when considering survey findings since the institutional population is likely to be older and, on average, less healthy than those living in private households.

[4] NS-SEC is a social classification system that attempts to classify groups on the basis of employment relations, based on characteristics such as career prospects, autonomy, mode of payment and period of notice. Participants are assigned to an NS-SEC category based on the current or former occupation of the household reference person. For a full explanation of NS-SEC and its derivation see the Glossary in this volume, and *The National Statistics Socio-economic Classification User Manual 2002,* ONS, 2002. Groups 1 and 2 in NS-SEC are higher managerial and higher professional occupations.

Once selected, the PSUs in each group were randomly allocated to the 12 months of the year so that each quarter provided a nationally representative sample. The first three quarters' samples included 136 PSUs, with 135 in the last quarter. The PSUs were evenly distributed by month in each fieldwork area.

The sample design included a reserve sample for the third and fourth quarters of the year. If the response rate reached 60%, (and the target number of 8,000 achieved interviews with adults was likely to be exceeded) nine points from the third quarter and nine points from the fourth quarter could be removed. In the end, all quarter three reserve points were issued but none of the quarter four reserve points. Therefore a total of 534 PSUs were issued.[5]

2.3 Sampling addresses, dwelling units and households

Within each of the PSUs, a fixed number of addresses was selected. Table 2.1 summarises the number of PSUs and addresses issued, in total, 9,612 addresses.

Table 2.1: Number of PSUs and addresses issued for HSE 2019

Number of PSUs	Number of addresses per PSU	Number of addresses issued
534	18	9,612

When visited by interviewers, 10% of the selected addresses were found not to contain private households. These included businesses and institutions, vacant properties, demolished properties and those still being built. These addresses were thus ineligible and were excluded from the survey sample.

Tables 1, 2

Most addresses selected from the PAF contained a single dwelling unit and/or household.[6] However, a small proportion of addresses (about 1%) were multi-occupied. At addresses with more than one dwelling unit (with a separate entrance), one was selected at random by the interviewer to be included in the survey. For dwelling units with more than one household, again, one was selected at random.[7]

Household-level survey response is discussed in detail in Section 6 of this report.

2.4 Sampling individuals within households

In the HSE sample, all adults aged 16 years and over at each household were selected for the interview (up to a maximum of ten adults per household). However, a

[5] The 534 comprised the original 543 sample points, less nine reserve points not issued in quarter four of fieldwork.
[6] A household is defined as 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 dining area.
[7] In the HSE 2009, the survey design was changed to select a single household at dwelling units with more than one household; previously interviewers carried out interviews at up to three households per dwelling unit. The change was made because the impact on the sample efficiency was negligible, and the procedures for interviewing at more than one household per dwelling unit were cumbersome and error prone for interviewers. The procedures used to select households were unchanged in 2009 and subsequent years.

limit of four was placed on the number of interviews carried out with children: up to two aged between 0 and 12 years and up to two aged between 13 and 15. For households at which there were three or more children in the relevant age range, interviewers selected two children at random.[8]

To compensate for the omission of children in households with more than two children in relevant age bands, selection weights were applied to the data (see Section 7). Otherwise children from large households would be under-represented in the survey estimates.

2.5 Eligibility for the nurse visit

In 2019 not all households were eligible for the nurse visit. In each PSU, 16 addresses were selected at random in advance; in these households all adults and children who were interviewed were eligible for the nurse visit. In the remaining two households in each PSU, nurse visits were not offered.

[8] This reflects a change in the selection procedures since HSE 2014 when up to two children aged between 0 and 15 were selected. The adjustment was necessary to make the sample more efficient by yielding more child interviews per household, while having a minimal impact on the clustering effect and the burden on parents or guardians.

3 Topic coverage

3.1 Documentation

Copies of the survey data collection documents are available and can be accessed at https://digital.nhs.uk/pubs/hse2019.

3.2 The Stage 1 interview

Information was collected at household level and at individual level. The household interview included questions on household size, composition and relationships; type of dwelling, tenure, and the number of bedrooms; car ownership; smoking within the home; the economic status and occupation of the household reference person; and household income.

Adults were asked core modules of questions, including general health, social care, alcohol consumption and smoking. In 2019, adults were also asked detailed questions about:

- providing unpaid social care,
- number of natural teeth,
- (for parents) time off work because of a child's dental or oral health problems,
- eating disorders,
- use of GP and counselling services, and
- awareness of two mental health resources, Good Thinking and Every Mind Matters.[9]

The interview concluded with additional questions about personal circumstances, and participants were asked for consent to link their survey data to other records held by the NHS.

Young adults, aged between 16 and 17 completed a set of questions about cigarette smoking, e-cigarettes and other nicotine replacement products, and alcohol consumption directly into the computer.[10] This method was also offered to young adults aged between 18 and 24 at the interviewer's discretion.

Interviews for children aged 0 to 12 were carried out with a parent; children aged 13 to 15 were interviewed directly. The interview for children included questions on general health, exposure to second-hand smoke and ethnicity. In 2019, there were also questions about time taken off school or nursery because of dental or oral health problems.

[9] Good Thinking is focused on London, and was asked about only in that region. https://www.good-thinking.uk/ Every Mind Matters is aimed at the whole of the United Kingdom. https://www.nhs.uk/oneyou/every-mind-matters/

[10] This method is known as computer-assisted self-interviewing (CASI) and was introduced to the HSE in 2019 to ensure greater confidentiality for young people in this age group who might be answering in the presence of their parents or other family members.

The content of the interview for different age groups is shown in Figure 3.1.

Figure 3.1: Content of interview by age group

Age in years	0-1	2-15	16-24	25-64	65+
General health, longstanding illness, limiting longstanding illness	●	●	●	●	●
Use of GP and counselling services			●	●	●
Doctor-diagnosed hypertension and diabetes			●	●	●
Number of natural teeth			●	●	●
Time off work because of child's dental or oral health problems			●	●	●
Time off nursery or school because of dental or oral health problems[a]	●	●			
Receipt of social care					●
Provision of unpaid social care			●	●	●
Awareness of Good Thinking (in London) and Every Mind Matters			●	●	●
Smoking, e-cigarettes and other nicotine delivery products			●[a]	●	●
Exposure to second-hand smoke	●	●	●	●	●
Drinking alcohol			●[a]	●	●
Economic status, occupation			●	●	●
Educational attainment			●	●	●
National identity			●	●	●
Ethnic origin	●	●	●	●	●
Height and weight measurements		●	●	●	●
Consent to link data to health records			●	●	●

[a] Questions about smoking, e-cigarette use and drinking alcohol were part of the interview for young adults aged between 18 and 24, but could be completed in CASI if the interviewer thought this appropriate for reasons of privacy.

Computer-assisted self-completion interviewing (CASI) was used to collect data from young adults aged between 16 and 17 about smoking, use of e-cigarettes and other nicotine delivery products, and drinking alcohol. This was to ensure confidentiality in the presence of other household members. If the interviewer considered this to be an issue for participants aged 18 to 24, they were offered the CASI instead of the interview.

During the interview, participants aged 8 and over were asked to answer questions about alcohol, smoking, well-being and other topics within a self-completion booklet. There were three booklets for different age groups. The content of the self-completion booklets for different age groups is shown in Figure 3.2.

Interviewers measured the weight of all participants and the height of everyone aged 2 and over.

Figure 3.2: Content of self-completion booklets by age group

Age in years	8-12	13-15	16+
Smoking	•	•	
E-cigarettes	•	•	
Other nicotine delivery products		•	
Exposure to second-hand smoke	•	•	
Drinking alcohol	•	•	
Warwick-Edinburgh Mental Well-Being Scale (WEMWBS)			•
ONS Life Satisfaction question			•
Attitudes to food and eating			•
Sexual orientation			•
National identity	•	•	
Religion	•	•	•

3.3 The Stage 2 nurse visit

In 2019, as in 2018, only a proportion (89%) of addresses were eligible for nurse visits. In these households, nurse visits were offered to all participants who were interviewed.

At the nurse visit, questions were asked about prescribed medicines, and adults were asked about folic acid. Nurses took waist and hip measurements for those aged 11 and over and measured the blood pressure of those aged 5 and over.

Adults were also asked to provide non-fasting blood samples[11] for the analysis of total cholesterol and HDL cholesterol and glycated haemoglobin (a marker of untreated diabetes). Samples of saliva were taken from adults and children aged 4 and over for the analysis of cotinine (a derivative of nicotine that shows recent exposure to tobacco or tobacco smoke). Written consent was obtained for these samples. Details of the analysis of these samples are provided in Section 9 of this report.

[11] For some blood analyses, participants must fast for a period before the sample is taken as the composition of the blood sample is affected by recent intake of food or drink. For the analytes in the HSE, non-fasting blood samples can be used and participants do not have to fast before the nurse visit.

4 Fieldwork procedures

4.1 Advance letters

Each sampled address was sent an advance letter which introduced the survey and stated that an interviewer would be calling to seek permission to interview. A leaflet was also enclosed providing general information about the survey and some of the findings from previous surveys.

4.2 Incentives

As in previous years, a small token of appreciation, in the form of a £10 voucher, was enclosed with the advance letter to encourage participation.

4.3 Making contact

At initial contact, the interviewer established the number of dwelling units and households at an address, and made any selection necessary (see Section 2.3).

The interviewer then made contact with each selected household and attempted to interview all adults (up to a maximum of ten) and up to four children aged 0 to 15 (see Section 2.4). The interviewer sought parents' consent and children's assent to interview the selected children aged up to 15.

At the end of the interview, participants in eligible households were asked for their agreement to the second stage of the survey, the follow-up visit by a nurse. In the case of children aged under 16, the parent's permission was sought (see Section 4.6 for details). The nurse visited within a few days of the interview, to carry out the measurements described in Section 3.3 and to obtain blood and saliva samples from those eligible and willing to provide these samples.

In addition to the advance letter and leaflet, participants were given two further leaflets describing the purpose of the survey and the associated measurements. Interviewers initially handed out a leaflet describing the purpose of the interview. At the end of the interview, they handed out a leaflet explaining the nurse visit to those who had agreed to this next stage. Copies of the leaflets are available as part of the survey documentation.

4.4 Collecting data

4.4.1 Interview data

Both interviewers and nurses used computer assisted personal interviewing (CAPI).

At each co-operating eligible household, the interviewer first completed a household questionnaire. Information was obtained from the household reference person (HRP)[12] or their partner wherever possible. This questionnaire obtained information about all

[12] The household reference person (HRP) is defined as the householder (the person in whose name the property is owned or rented); if there is more than one, the person with the highest income. If there are two householders with equal income, then the household reference person is the older of the two.

members of the household, regardless of age. If there were one or two children aged under 16, they were automatically included in the sample for an interview. If there were three or more children aged under 16, up to four were selected, up to two aged between 0 and 12, and up to two aged 13 to 15.

An individual interview was carried out with all selected adults and children. In order to reduce the amount of time spent in a household, interviews could be carried out concurrently, the program allowing for up to four participants to be interviewed in a session.

In 2019, a computer-assisted self-completion (CASI) module was introduced for young adults aged 16 to 24. Participants in this age group completed a set of questions about cigarette smoking, e-cigarettes and other nicotine replacement products, and alcohol consumption directly onto the computer.

During the interview, participants aged 8 and over were asked to answer questions within a printed self-completion booklet.

4.4.2 Height and weight measurements

Height and weight measurements were obtained towards the end of the interview.

Height was measured using a portable stadiometer with a sliding head plate, a base plate and connecting rods marked with a measuring scale. One measurement was taken with the head positioned in the Frankfort plane.[13] Adult participants stretched to their maximum height and for child participants interviewers administered a child stretch. The reading was recorded to the nearest even millimetre. Participants who were unable to stand or were unsteady on their feet were not measured.

For the weight measurement, participants were asked to remove their shoes and any bulky clothing or heavy items in pockets etc. A single measurement was recorded to the nearest 100g.[14] Adult participants who were pregnant, unable to stand, or unsteady on their feet were not weighed. Very young children who found it difficult to or could not stand were weighed while being held by a parent; the parent's weight was measured separately and then subtracted from the joint weight measurement.

In the analysis of height and weight, data were excluded for those who were considered by the interviewer to have unreliable measurements, for example those who were too stooped or wearing excessive clothing. Participants who weighed more than 200 kg were asked for their estimated weight because the scales are inaccurate above this level. These estimates have been included in the analyses.

The protocols for interviewers taking height and weight measurements are included in Appendix B of this report.

[13] The Frankfort Plane is an imaginary line passing through the external ear canal and across the top of the lower bone of the eye socket, immediately under the eye. A participant's head is positioned so that the Frankfort Plane is horizontal. In this position the head plate of the stadiometer will rest on the crown of the head.

[14] Class III Seca scales were introduced for HSE 2011 and have been used since then. These measure up to a maximum of 200 kg.

4.4.3 Blood pressure

Nurses measured the blood pressure of adults and children aged 5 and over.

Three blood pressure readings were taken from consenting participants at one-minute intervals using an appropriately sized cuff on the right arm.[15] Each participant was in a seated position and the readings were taken after five minutes' rest. Systolic and diastolic pressures and pulse measurements were displayed on the Omron from each measurement.

The size of the cuff used when taking blood pressure readings is an important factor in ensuring that accurate measurements are obtained. Too small a cuff can lead to an overestimation of blood pressure, while too large a cuff can lead to an underestimation.[16] Accordingly, three different sizes of cuff were available at HSE nurse visits.

The blood pressure variables used in the report are the means of the second and third measurements obtained from the participants for whom three readings were successfully obtained. The analyses exclude results from participants who had eaten, consumed alcohol, exercised, or smoked in the 30 minutes before the measurement was taken, and from participants who were pregnant.

Full protocols for nurses measuring blood pressure are included in Appendix B of this report.

4.4.4 Waist and hip measurements

Nurses measured the waist and hip circumference of adults and children aged 11 and over.[17]

The waist was defined as the midpoint between the lower rib and the upper margin of the iliac crest (hip bone). The measurement was taken twice, using the same tape (waist and hip measurements were alternated), and was recorded to the nearest even millimetre. Where the two waist measurements differed by more than 3 cm, a third measurement was taken. The mean of the two valid measurements (the two out of the three measurements that were the closest to each other, if there were three measurements) was used in the analysis.

Participants were excluded from waist measurements if they reported that they were pregnant, had a colostomy or ileostomy, or were unable to stand. All those with measurements considered unreliable by the nurse, for example due to excessive clothing or movement, were also excluded from the analysis.

The protocols for nurses taking waist measurements are included in Appendix B of this report.

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[15] Nurses used the Omron HEM207, an oscillometric automated device. This device has been used from HSE 2003 onwards, replacing the Dinamap device previously used.

[16] Parati G, Stergiou GS, Asmar R et al. *European Society of Hypertension guidelines for blood pressure monitoring at home: a summary report of the Second International Consensus Conference on Home Blood Pressure Monitoring.* J Hypertens. 2007;**28**:1505-26.

[17] Hip measurements were not reported in 2019, and are not discussed in detail here; see the protocol in Appendix B for more detail.

4.4.5 Blood samples

Non-fasting blood samples were collected by nurses from adults aged 16 and over. These were put into two tubes, a 6ml plain tube (with no anticoagulant) and 4ml EDTA (ethylene diamine tetra-acetic acid) tube. The order of priority for collecting samples was first the 6ml plain tube, followed by the 4ml EDTA tube. After collection, the tubes were posted to the Blood Sciences Department at the RVI, which acted as the co-ordinating department for transport of samples to the individual departments undertaking the analyses.

Full protocols for blood sample collection are included in Appendix B of this report.

4.4.6 Saliva samples

Saliva samples were collected by nurses from adults and children aged 4 and over. Full protocols are included in Appendix B of this report.

4.5 Obtaining informed consent from adults

It is important to ensure that participants aged 16 and over give informed consent for all stages of the interview and nurse visit process. For some elements of the survey, verbal consent was sought: for taking part in the survey at all, for answering modules of questions (and any individual question), for completing the self-completion booklet, and for measurements such as height, weight, blood pressure and waist and hip circumference. Verbal consent was not recorded; it is assumed that those who took part in the survey and answered individual questions or provided physical measurements had consented to do so. A proportion of participants did decline to take part in some of these survey elements, although they had consented to take part in the study and complete other elements. Section 6 provides details of response at different stages of the interview and nurse visit.

Written consent was required for:

- taking biological measurements (blood and saliva samples)
- passing on information to others, for instance sending blood pressure and biological sample results to the participant's GP
- storing blood samples for future use
- using personal details for matching to administrative data.

Written consent was obtained in a booklet, included in the survey documentation, which was signed by the participant and countersigned by the interviewer or nurse. These consents were recorded in the CAPI interview. The consent booklets were supplemented by information leaflets, and by information provided by the interviewer or nurse.

4.6 Interviewing and measuring children

Children aged 13 to 15 were interviewed directly, after permission was obtained from the child's parent or guardian. Interviewers were instructed to ensure that the child's parent or guardian was present in the home throughout the interview. Information about younger children was collected from a parent. Whenever possible, younger children were present while their parent answered questions about their health. This was partly because the interviewer had to measure their height and weight and, in the case of those aged 8 and over, to ask the child to complete a short self-completion booklet during the interview. It also ensured that the child could contribute information where appropriate.

Permission for a nurse to carry out any measurements on a child aged under 16 had to be obtained from the child's parent or someone else with legal parental responsibility for that child. This person had to be present during the nurse visit. The child's assent was also required.

Written consent to collect a saliva sample from a child, and to send their blood pressure results to their GP, was obtained from the parent. Children indicated their assent to these procedures by initialling a box on their consent form, if they were able to do so; if not, parents initialled to indicate that the child had given their assent.[18]

4.7 Interview length

Interviews could be conducted with between one and four persons per session; the most common session types were with one or two individuals. The median (average) interview length for a single adult was 35 minutes, and for two people (including at least one adult) median interview length was 52 minutes. Nurse visits were conducted with a single individual at a time, and the nurse visit for adults who took part in all the measurements averaged 32 minutes.[19]

Interviews with children were shorter than with adults, and the interview length varied with age as some modules were only asked of older children. When children were interviewed without adults, for a single child aged 8 to 15 the median interview length was 11 minutes and the median length of the nurse interview was 16 minutes.

4.8 Feedback to participants

Each participant was given a Measurement Record Card in which the interviewer entered the participant's height and weight, and the nurse entered waist, hip and blood pressure measurements. Participants who saw a nurse were asked if they would like

[18] Adults and parents were required to give fully informed consent. Assent from children indicated that they had been given an age-appropriate explanation that they could understand (even if not as comprehensive as for an adult), and that the child was happy for the procedure to go ahead.

[19] The median is the value of a distribution which divides it into two equal parts such that half the cases have values below the median and half the cases have values above the median. It may be a better indicator of interview length than the mean, which can be disproportionately influenced by a relatively small number of cases with very high values (i.e. very long interviews). This can happen because of interruptions, because the respondent has a great deal of information to impart or because the pace of the interviewer is slower than usual, for example because the respondent has difficulties in comprehending questions or instructions.

their blood pressure and blood sample results sent to their GP. If they did want results to go to their GP, written consent was obtained.

Nurses were issued with a set of guidelines to follow when commenting on participants' blood pressure readings. (For the text, see the protocols in Appendix B of this report.) If an adult's blood pressure reading was severely raised, nurses were instructed to contact the survey doctor at the earliest opportunity after leaving the participant's home. For children, they were instructed not to comment on a high reading but to contact the survey doctor to assess whether any action was required. Where permission had been given for results to be sent to a participant's GP, the survey doctor contacted the GP if any blood pressure results were markedly abnormal. Where permission was not obtained, the survey doctor wrote to the participant where this was deemed clinically appropriate.

5 Fieldwork quality control

5.1 Training interviewers and nurses

Interviewers were fully briefed on the administration of the survey. They were given training, including a practice session, on measuring height and weight, and were required to pass an accreditation test for these measures before working on the study.

All nurses were professionally qualified and proficient in taking blood samples before joining the NatCen team. They attended a two day training session at which they received equipment training and were briefed on the specific requirements of the survey with respect to taking blood pressure, taking waist and hip measurements and taking blood and saliva samples.

Full sets of written instructions, covering both survey procedures and measurement protocols, were provided for both interviewers and nurses. These are included in the Appendix B of this report.

Interviewers and nurses who had worked on the previous year's Health Survey attended full day refresher training sessions, where the emphasis was on updating them on new topic coverage, improving measurement skills and gaining respondent participation.

All interviewers and nurses new to the Health Survey were accompanied by a supervisor during the early stages of their work to ensure that interviews and protocols were being correctly followed. Routine supervision of 10% of the work of both interviewers and nurses was carried out subsequently.

5.2 Checking interviewer and measurement quality

A large number of quality control measures were built into the survey at both data collection and subsequent stages to check on the quality of interviewer and nurse performance.

Recalls to check on the work of both interviewers and nurses were carried out at 10% of households where interviews were taken.

The computer program used by interviewers had in-built soft checks (which can be suppressed) and hard checks (which cannot be suppressed); these included messages querying uncommon or unlikely answers as well as answers out of an acceptable range. For example, if someone aged 16 or over had a height entered in excess of 1.93 metres, a message asked the interviewer to confirm that this was a correct entry (a soft check), and if someone said they had drunk alcohol on more than seven days in the last week the interviewer would not be able to enter this (a hard check). For children, the checks were age specific.

The measurements made by each interviewer and nurse were regularly inspected during fieldwork. Any problems (such as higher than average proportions of measurements not obtained, insufficient samples and so on) were discussed with the relevant nurse or interviewer and their supervisor.

6 Survey response

6.1 Introduction to response analysis

This section looks at the response of households in the sample (Section 6.2), and at the response of eligible individuals within those households, first for adults (Section 6.3) and then for children (Section 6.4). Individual response for adults and children is examined in two ways: overall response for all eligible individuals in the 'set' sample, and response for individuals within co-operating households.

Participants were asked to co-operate in a sequence of survey stages. Adults and children were asked to take part in a face-to-face interview, as well as measurement of height and weight. In eligible addresses,[20] those who were interviewed were offered a nurse visit, including various measurements and a request for blood samples from adults and a saliva sample from children. Individual non-response is therefore accumulated through the survey stages.

Not every measurement obtained by an interviewer or a nurse was subsequently considered valid for analysis purposes. Individual topic reports give further details of the numbers of measurements used for analysis, the numbers of exclusions and the reasons for them.

Detailed analysis of survey response is shown in the Excel tables accompanying this report, at https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2019/data-tables.

6.2 General population sample: household response

Table 1 shows household response by calendar quarter. The row labelled 'Total eligible households' shows the number of private residential households found at the selected addresses (after selection of a single dwelling unit, and a single household when necessary). 90% of selected addresses were eligible.

60% of eligible households (5,226) were described as 'co-operating'; households in this category are those where at least one eligible person was interviewed at the interviewer stage.

47% of eligible households were described as 'all interviewed' where all eligible persons were interviewed.

37% of eligible households were 'fully productive' where all eligible persons were interviewed, had height and weight measured and agreed to the nurse visit. (Households that were ineligible for the nurse visit or where a participant was ineligible for a height or weight measurement because of a functional impairment or pregnancy were considered as fully productive if all other survey elements were successfully completed.)

Non-respondents to the survey fell into two groups, those living in households where no-one co-operated with the survey, and those living in households where at least one person was interviewed.

[20] 16 out of 18 addresses were eligible for the nurse visit.

Table 2 gives detailed outcomes for ineligible and non-responding households.

Tables 1, 2

6.3 General population sample: individual response for adults

6.3.1 Overall response

There were 8,205 individual interviews with adults, and 4,947 adults had a nurse visit.

To calculate the response rate for individuals, this number of interviews should be expressed as a proportion of the total number of adults in the sampled households. However, the total number of adults in the sampled households is not known, and must be estimated. There are three groups of households to consider:

- co-operating households (9,745 adults in 5,226 households, average 1.86 per household);
- non co-operating households where information on the number of adults is known (3,320 adults in 2,435 households, average 1.36);
- non co-operating households about which nothing is known (1009 households).

In the absence of other evidence it was assumed that the last group had the same average number of adults (1.71) as for all households where the number of adults was known (the sum of the first two groups); this gives an estimate of 1,721 adults in these households. In combination with the first two groups, this gives an estimated total of 14,786 eligible adults, known as the ‘set sample’.

A further assumption was needed to provide separate set samples for men and women. In non co-operating households where the number of adults was known, the numbers of men and women were not usually obtained. It was assumed that the proportion of men and women in the estimated total sample was the same as for the adults in the 5,226 co-operating households. The proportions were 48% men and 52% women. Applying these proportions to the estimated total of adults gives set samples of 7,023 men and 7,762 women.[21]

Minimum response rates for adults were estimated using the estimated total number of adults in sampled households (the adult set sample) as a denominator. The response to the interview was 55%, being 52% among men and 58% among women. Response rates to different stages of the survey are shown in Table 5, and summarised in Table 6.1.

Table 5

[21] Note that all these totals are rounded, which is why the individual totals for men and women do not sum to the total number of adults.

Table 6.1: Response among all adults

	Men	Women	All adults
	%	%	%
Interviewed	52	58	55
Height measured	44	50	47
Weight measured	44	48	46
Saw a nurse	31	36	33
Waist and hip measured	30	34	32
Blood pressure measured	30	35	33
Gave blood sample	23	26	25
Gave saliva sample	29	34	32

6.3.2 Adult response in co-operating households

As adults' ages and other personal characteristics are not known in non co-operating households, indications of differences in response by these characteristics are confined to co-operating households. Tables 7 to 9 show the proportion of men, women and all adults in co-operating households who participated in the key survey stages, by age. These are summarised in Table 6.2 below.

In co-operating households, 84% of adults were interviewed. Women were more likely than men to agree to an interview (89% and 79% respectively). Response was highest among the oldest age groups (94% of men and 95% of women aged 75 and over were interviewed), and lowest among those aged 16 to 24 (56% of men and 67% of women).

Although a lower proportion of men than women had height or weight measured, saw a nurse or had any of the nurse measures, this difference is because a lower proportion of men than women was interviewed. As a proportion of those interviewed, co-operation rates were very similar among men and women for each measure.

Tables 7 to 9

Table 6.2: Response among adults in co-operating households

	Men	Women	All adults
	%	%	%
Interviewed	79	89	84
Height measured	67	76	72
Weight measured	66	73	70
Saw a nurse	46	55	51
Waist and hip measured	45	52	49
Blood pressure measured	46	53	49
Gave blood sample	35	40	38
Gave saliva sample	45	52	48

6.4 Individual response for children aged 0 to 15

6.4.1 Overall response among children

Interviews were carried out with 2,095 children (1,071 boys and 1,024 girls) aged between 0 and 15. 1,169 children were seen by a nurse.

The response rate for children was calculated in a similar way to that for adults, using the number of eligible children in sampled households (the 'set sample') as the denominator. The number of eligible children was estimated by assuming that the proportion of households and the number of children was the same for all households, whether or not this information was available.[22] This resulted in a set sample of 3,593 children. This is likely to be an over-estimate, since households in which one or more individuals were interviewed had fewer children on average than those who were contacted but not interviewed. Response rates computed for children are therefore conservative.

[22] In 2019, information was available for 7,661 households. 1,729 (23%) of these households contained children; 767 with one child, 721 with two children, 203 with three children and 89 with four or more children, a total of 3,174 eligible children (an average of 1.78 in households with children and 0.41 across all households for which information was available).

In the 1011 households with no information about the number of resident children, it has been assumed that the proportion of households with children, and the number of children per household, was as for households where this was known, giving an estimate of 419 eligible children.

The set sample of eligible children is therefore 3,593. The sex of children was only known in co-operating households; 49% of these children were boys and 51% were girls. These proportions have been applied to the total set sample of children, giving 1,839 boys and 1,754 girls.

Response to the interview was 58% among both boys and girls. Height measurements were limited to those aged 2 and over. On the assumption that the age distribution of children in the set sample is the same as that of children living in interviewed households, response rates were as shown in Table 6 and summarised in Table 6.3 below.

Table 6

Table 6.3: Response among all children

	Boys	Girls	All children
	%	%	%
Interviewed	58	58	58
Height measured	40	40	40
Weight measured	44	44	44
Saw a nurse	32	33	33

6.4.2 Response in co-operating households

Child response rates, like adult response rates, have also been calculated based on co-operating households to allow analysis by age. Among selected children aged 0 to 15 in co-operating households, the proportion who were interviewed was high, 88% of eligible boys and 89% of eligible girls. The proportion interviewed was lower among children aged 11 to 15 (79% of boys and 83% of girls) than among those aged under 11 (92% among both boys and girls).

Tables 10 to 12 show the proportion of boys, girls and all children in co-operating households who participated in the key survey stages, by age. These are summarised in Table 6.4 below.

The majority of children who were eligible co-operated with the height and weight measurements.[23] 49% of children co-operated with the nurse visit and most of them took part in the measurements for which they were eligible.

Tables 10 to 12

[23] Boys and girls who were interviewed were eligible for the measures of height and weight; those who saw a nurse were eligible for other measures, depending also on their age.

Table 6.4: Response among all children in co-operating households

	Boys	Girls	All children
	%	%	%
Interviewed	88	89	88
Height measured (aged 2 and over)	68	69	68
Weight measured	67	67	67
Saw a nurse	49	50	49
Gave saliva sample (aged 4 and over)	37	36	36
Blood pressure measured (aged 5 and over)	44	43	44
Waist and hip measured (aged 11 and over)	41	44	42

6.5 Variations in survey response

6.5.1 Regional variations in response

As in previous years, response varied by region. Household response was highest in the North West (64%) and was lowest in London (54%).

Table 3

6.5.2 Response by type of dwelling

Table 4 shows household response by the type of building in which the address was found, as classified by interviewers. Response was highest among households living in detached houses (68%), and lowest among households living in purpose-built flats (53%).

Table 4

6.6 Age and sex profile of the sample

Tables 13 and 14 compare the age and sex profiles of responding adults and children in the general population sample at the two survey stages (interview and nurse visit) with the mid-2019 population estimates.

Overall the 2019 HSE sample over-represented women relative to men (55% and 45% respectively, compared with 50% of men and 50% of women in the mid-year population estimates). This is a response pattern found on a number of surveys. Men aged under 35 were under-represented at both interview and nurse visit relative to their proportions in the population, while men aged 65 and over were over-

represented. Women under 35 were under-represented at both stages, and women aged between 65 and 74 were over-represented at both stages.

Table 13

As Table 14 shows, among children aged 0 to 15, the representation of boys and girls matched that in the population, and the age profiles of the achieved HSE sample were similar to the population estimates.

Table 14

7 Weighting the data

7.1 Background

Before 2003, the weighting strategy for the HSE sample was to apply selection weights only and no attempt was made to reduce non-response bias through weighting. Following a review of the weighting for the HSE 2003, non-response weighting was incorporated into the weighting strategy (as well as selection weights).

In 2018, another review of the weighting strategy recommended changes to the age groups used in calibration weighting for children and regional level adjustments to population of residents over 65 living in communal establishments. These changes have been implemented in the 2019 weighting and are highlighted in the appropriate sections below.

7.2 Calculation of the general population sample weights

7.2.1 Address selection weights

The least populated regions (the North East and East Midlands) were over-sampled to ensure a minimum sample size of approximately 700 adults. Address selection weights (w_{add}) were calculated that corrected for this over-sampling so that the weighted number of addresses in each region was in the correct proportion.

7.2.2 Dwelling unit selection weights

Most addresses selected from the PAF contain a single dwelling unit, i.e. with a separate entrance. At addresses with more than one dwelling unit, only one is selected; interviewers carry out a selection procedure to identify which dwelling unit to include in the sample using a Kish grid.[24]

The dwelling unit selection weights (w_{du}) adjust for this selection at addresses with more than one dwelling unit. The weights were calculated as the number of dwelling units identified at the address.

The dwelling unit selection weights ensure that in addresses containing more than one dwelling unit, these are not under-represented in the issued sample.

7.2.3 Household selection weights

Most dwelling units selected via the PAF contain a single household. At dwelling units with more than one household, only one is selected; interviewers carry out a selection procedure to identify which household to include in the sample using a Kish grid.

[24] A Kish grid is a framework to ensure that the dwelling unit is selected without interviewer bias. The number of dwelling units is listed across the top of the grid, with a random number below to indicate which dwelling unit should be selected.

The household selection weights (w_{hh}) adjust for this selection of households and ensure that households in multi-occupied dwelling units are not under-represented in the issued sample. The weights were calculated as the number of households identified at the dwelling unit.

Composite selection weights were calculated as the product of the dwelling unit selection weights (w_{du}) and household selection weights (w_{hh}). The composite selection weights were trimmed at 4 to avoid any large values. These were combined with the address selection weights (w_{add}) to give the initial weights for the calibration weighting (w_1).

7.2.4 Calibration weighting

Calibration weighting was used to ensure that the weighted distribution of household members in participating households matched Office for National Statistics (ONS) 2019 mid-year population estimates for sex/age groups and region as shown in Tables 7.1 and 7.2 below.[25]

Following a review of the HSE weighting scheme in 2018, more granular age groups were used to better reflect the age groups typically used for HSE analysis.[26] Population estimates were also adjusted to remove people aged 65 and over living in institutions (communal establishments), who are not eligible for the HSE; this was estimated using data from the 2011 Census. Based on the 2018 weighting strategy review, these adjustments were made at the regional level to better reflect regional differences in the proportion of the population over 65 who live in institutions. The composite selection weights (w_1), described in Section 7.2.3, were used as initial values when generating the calibration weights (w_2).

The aim of the calibration weighting is to reduce non-response bias resulting from differential non-response at the household level. The calibration weights generated (w_2) were re-scaled so that the sum of the weights equalled the number of participating households to give the household weights for the sample (wt_hhld). Thus, the final household weight adjusts for dwelling unit and household selection, and for the age/sex and region profiles of participating households.

25 https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2019estimates
Population estimates for the years 2003 to 2019 are shown in Tables 14 and 15.
https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2019/data-tables

26 Prior to the 2018 weighting review the age groups used for calibration have historically been set to: 0-4, 5-10, 11-15, 16-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75+. The current age groups used in calibration are described in Table 7.1.

Table 7.1: 2019 ONS mid-year population estimates by age and sex (adjusted)

Age (grouped)	Men		Women	
	N	%	N	%
0-1	648,530	1.2	614,384	1.1
2-4	1,044,683	1.9	992,040	1.8
5-7	1,089,031	1.9	1,036,771	1.9
8-10	1,076,734	1.9	1,025,403	1.8
11-12	702,959	1.3	666,583	1.2
13-15	983,338	1.8	936,223	1.7
16-24	3,060,302	5.5	2,893,203	5.2
25-34	3,833,674	6.9	3,775,689	6.8
35-44	3,549,307	6.3	3,598,632	6.4
45-54	3,766,221	6.7	3,857,052	6.9
55-64	3,336,851	6.0	3,445,635	6.2
65-74	2,658,949	4.8	2,870,153	5.1
75+	1,969,819	3.5	2,488,840	4.5
Total	27,720,398	49.6	28,200,608	50.4

Table 7.2: 2019 ONS mid-year population estimates by region (adjusted)

Region	N	%
North East	2,649,549	4.7
North West	7,289,245	13.0
Yorkshire and the Humber	5,467,130	9.8
East Midlands	4,802,524	8.6
West Midlands	5,897,354	10.5
East of England	6,195,502	11.1
London	8,929,638	16.0
South East	9,110,857	16.3
South West	5,579,209	10.0
Total	55,921,008	100.0

7.2.5 Child selection and adjustment weights

In each participating household up to two children aged 0 to 12 and up to two children aged 13 to 15 were selected for the core sample. In order for children in larger households not to be under-represented in the sample, selection weights (w_3) were calculated as the number of children within the household divided by the number selected, for each age group. It was ensured the weights were not higher than 3 to avoid any large weights.

The selection of children within the participating households and differential non-response mean that the age/sex distribution of the achieved sample of children does not match that of all children in participating households. Unless corrected, this would result in bias for estimates. Child adjustment weights (w_4) were therefore calculated by dividing the number of children in the issued households (weighted by wt_hhld) by the number of children in the achieved sample (weighted by wt_hhld x w_3), within each age year for girls and boys separately.

Thus these weights both adjust for the probability of selection for children in larger households, and ensure that the profile of children selected for the survey matches the profile of all children. As the level of response for obtaining a child interview in participating households in the sample was relatively high (91%), no additional non-response weighting was undertaken for the sample of children.

7.2.6 Non-response weights for adults

There were no selection weights for adult participants in the sample since all adults in responding households were selected. However, non-response weights were calculated to reduce bias from adult non-response within households with more than one adult (80% of adults responded in these households). Participants in single adult households were not included in the model and were given a non-response weight of 1.

To obtain the non-response weights, a logistic regression model (weighted by wt_hhld) was fitted for all adults in participating households, excluding single-adult households. The outcome variable was whether or not the interview was completed. The following variables were entered as covariates: age group by sex,[27] household type,[28] region, and social class of household reference person (HRP).[29] The adult non-response weights (w_5) were calculated as the inverse of the predicted probabilities of response estimated from the regression model. The non-response weights for adults were trimmed at the upper 1% tail to remove extreme values.

[27] The age/sex groups used for the weighting were:

Male 16-24	Female 16-24
Male 25-34	Female 25-34
Male 35-44	Female 35-44
Male 45-54	Female 45-54
Male 55-64	Female 55-64
Male 65-74	Female 65-74
Male 75+	Female 75+

[28] The household types used for the weighting were:

Two adults, both 16-59, no children
Small family
Large family
Large adult household
Two adults, one or both aged 60+, no children

[29] The social classes of household reference person used for the weighting were:

Higher managerial and professional occupations
Lower managerial and professional occupations
Intermediate occupations
Small employers and own account workers
Lower supervisory and technical occupations
Semi-routine occupations
Routine occupations
Never worked and long term unemployed
Other

7.2.7 Combining the weights

The interview weights for the general population sample of adults and children were then calculated as:

wt_int = wt_hhld x w_5 for adults; and wt_int = wt_hhld x w_3 x w_4 for children.

The interview weights for all responding adults and children were re-scaled so that the weighted sample size is the same as the achieved sample size. Therefore, the final interview weights adjust for selection, non-response and population profile for all those interviewed.

7.2.8 Nurse visit weights

In 2019, only 89% of the issued addresses were randomly selected to be eligible for a nurse visit. In 'nurse eligible' addresses, all adults and all children who participated in the interviewer stage were eligible for the nurse visit. In 'nurse ineligible' addresses, no one was eligible for the nurse visit. Furthermore, not all those interviewed went on to have a nurse visit and further non-response bias may be introduced. For data relating to nurse visits, two logistic regression models were fitted, weighted by interview weight (wt_int); one for adults and one for children. The outcome variable was whether or not a nurse visit was undertaken, with the following as covariates: age group by sex, household type, region, social class of HRP, smoking status (for adults) and general health.

The weights for non-response to the nurse visit (w_6) were calculated as the reciprocal of the predicted probability of a nurse visit being undertaken, estimated from the regression models.

The weights were trimmed at the 0.5% tails to remove extreme values; this was done separately for adults and children. The weights for the nurse visit sample were calculated as wt_nurse = wt_int x w_6. These weights were re-scaled so that the weighted sample size for the nurse visit is the same as the achieved sample size. They adjust for selection, non-response and population profile for the sample that receives the nurse visit.

7.2.9 Blood weights

Almost all adults who had a nurse visit were eligible to have a blood sample taken, but not all those eligible agreed or were able to do so. A logistic regression model was fitted, weighted by wt_nurse. The outcome variable was whether or not a usable blood sample was obtained, and the following were included as covariates: age group by sex, household type, region, social class of HRP, smoking status and general health.

The weights for non-participation for the blood sample (w_7) were calculated as the reciprocal of the predicted probability of blood being obtained, estimated from the regression models.

The weights were trimmed at the 0.5% tails to remove extreme values. The weights for the blood sample were calculated as wt_blood = wt_nurse x w_7. Two large outliers

caused by high wt_nurse was trimmed at 5.8. These weights were re-scaled so that the weighted blood sample size was the same as the achieved sample size.

7.2.10 Cotinine weights

In 2019, both adults and children aged 4 to 15 that had a nurse visit were eligible to have a sample of saliva taken, but not all gave a valid sample. Regression models weighted by wt_nurse were run separately for adults and children aged 4 to 15. In both models the outcome variable was whether or not a usable saliva sample was obtained. The covariates in the models were age group, sex, household type, region, social class of HRP, smoking status (adults only) and general health.

The weights for non-participation for the saliva sample (w_9) were calculated as the reciprocal of the predicted probability of a saliva sample being obtained, estimated from the regression model.

The weights were trimmed at the 1% tails to remove extreme values. The weights for the saliva sample were calculated as wt_cotinine = wt_nurse x w_9. These weights were re-scaled so that the weighted cotinine sample size is the same as the achieved sample size.

7.3 Effect of the weights on the precision of the estimates

A design factor (DEFT) for each weight has been calculated to provide an approximate guide to the effect of the weighting on the precision of estimates. The DEFT is calculated as the average squared weight divided by the square of the average weight.

For instance, the DEFT of 1.18 for the interview weight indicates that the standard error of estimates is assumed to increase by 18%, with a corresponding loss of precision. Consequently, these weighted estimates have the same level of precision as an estimate based on a simple random sample, unweighted, of around 82% of the size of the actual sample. This is known as the effective sample size.

Table 7.3 summarises the effect of each weight on the precision of the estimates.

Table 7.3: Effect of HSE weights on the precision of survey estimates

	N	Effective sample size	DEFT
Interview weight (wt_int)	10300	8763	1.18
Nurse weight (wt_nurse)	6116	4877	1.25
Blood weight (wt_blood)	3659	2675	1.37
Cotinine sample (wt_cotinine)	5306	4208	1.26

Design effects and true standard errors have also been calculated for selected survey estimates presented in the topic reports; see Section 8.2 and the relevant reports and tables.

7.4 Selecting the appropriate weight

Five different weights have been provided, for data from different stages of the survey:

- Interview stage (*wt_int*): for adults and children from the core sample
- Nurse visit (*wt_nurse*): for adults and children from the core sample, for questions from the nurse visit
- Blood sample (*wt_blood*): for adults who have given a blood sample
- Cotinine sample *(wt_cotinine*): for adults and children aged 4-15 who have given a saliva sample.

If questions from different stages of the survey are combined in analysis, the weights for the latest stage of the survey should be used (that is, the latest in the list above). For instance, if blood sample results are being cross-tabulated with questions from the interview stage, the blood sample weight should be used; or if waist circumference results (from the nurse visit) are cross-tabulated with BMI data from the interview, the nurse visit weight should be used.

8 Data analysis and reporting

8.1 Accuracy and reliability of survey estimates

The HSE in common with other surveys, collects information from a sample of the population. The sample is designed to represent the whole population as accurately as possible within practical constraints, such as time and cost. Consequently, statistics based on the survey are estimates, rather than precise figures, and are subject to a margin of error, also known as a 95% confidence interval. For example the survey estimate might be 24% with a 95% confidence interval of 22% to 26%. A different sample might have given a different estimate, but we expect that the true value of the statistic in the population would be within the range given by the 95% confidence interval in 95 cases out of 100.

Confidence intervals are affected by the size of the sample on which the estimate is based. Generally, the larger the sample, the smaller the confidence interval, and hence the more precise the estimate.

Where differences are commented on in this report, these reflect the same degree of certainty that these differences are real, and not just within the margins of sampling error. These differences can be described as statistically significant.[30]

Confidence intervals are quoted for key statistics within this publication.

8.2 Design effects and true standard errors

The HSE 2019 used a clustered, stratified multi-stage sample design. In addition, weights were applied when obtaining survey estimates. One of the effects of using the complex design and weighting is that standard errors and confidence intervals for survey estimates are generally larger than those that would be derived from an unweighted simple random sample of the same size. The calculations of standard errors shown in tables, and comments on statistical significance throughout the report, have taken the clustering, stratification and weighting into account.

The ratio of the standard error of the complex sample to that of a simple random sample of the same size is known as the design factor. Put another way, the design factor (or 'DEFT') is the factor by which the standard error of an estimate from a simple random sample has to be multiplied to give the true standard error of the complex design.

The true standard errors and DEFTs for the HSE 2019 have been calculated using a Taylor Series expansion method.[31] The deft values and true standard errors (which are themselves estimates subject to random sampling error) have been calculated for

[30] Statistical significance does not imply substantive importance; differences that are statistically significant are not necessarily meaningful or relevant.

[31] The Taylor Series expansion method is a mathematical technique to simplify the computation of infinite series. For further information, see Wolter KM. *Introduction to Variance Estimation*. 2nd ed. 2007.New York, Springer.

selected survey estimates, and these are presented in the relevant reports and tables.

8.3 Survey limitations

The HSE is a cross-sectional survey of the population. It examines associations between health states, personal characteristics and behaviour. However, such associations do not necessarily imply causality. In particular, associations between current health states and current behaviour need careful interpretation, as current health may reflect past, rather than present, behaviour (for instance, current liver disease may reflect previous heavy drinking, although no alcohol is currently consumed). Similarly, current behaviour may be influenced by advice or treatment for particular health conditions (for instance, not smoking currently because of advice relating to lung disease caused by previous smoking).

8.4 Weighted and unweighted data and bases in report tables

Non-response weighting was introduced to the HSE in 2003, and has been used in all subsequent years. All 2019 data in this report are weighted (apart from response tables). Both weighted and unweighted bases are given in each table in the report.[32] The unweighted bases show the number of participants involved, in other words the size of the sample on which the estimate is based. The size of the unweighted base influences the precision of the estimates derived from it; in general, the larger the unweighted base, the more precise is the estimate and the narrower the confidence interval around it.

The weighted bases show the relative sizes of the various sample elements after weighting, reflecting their proportions in the population in England, so that data from different columns can be combined in their correct proportions. The absolute size of the weighted bases has no particular significance, since they have been scaled to the achieved sample size.

Children's data each year have been weighted to adjust for the probability of selection, since a maximum of four children are selected in each household (see Section 7.2.5). This ensures that children from larger households are not under-represented. Since 2003, as for adults, non-response weighting has also been applied. A full discussion of the effects of non-response weighting can be found in the 2003 HSE report.[33]

[32] In the adult trend tables, unweighted bases are provided for years up to 2002, and weighted bases for 2003 onwards (the year from which non-response weighting was introduced). In the children's trend tables, for years up to 2002 weighted bases are shown, adjusted for probability of selection (since a maximum of two children per household is selected); from 2003 weighted bases are shown corrected for selection and non-response.

[33] Sproston K, Primatesta P (eds). Health Survey for England 2003. Volume 3: Methodology and documentation. The Stationery Office, London, 2004.

8.5 Reporting age variables

8.5.1 Defining age for data collection

Some sections of the data collected in the HSE 2019 are age specific, with different questions directed to different age groups. This was based on the participant's date of birth which was ascertained early in the interview. For data collection purposes, a participant's age was defined as their age on their last birthday before the interview. The nurse, who visited later, treated the participant as being of the same age as at the interview, even if he or she had an intervening birthday.

In the present report all references to age are age at last birthday.

8.6 Age standardisation

Adult data have been age-standardised throughout the 2019 report to allow comparisons between groups after adjusting for the effects of any differences in their age distributions. When different sub-groups are compared in respect of a variable on which age has an important influence, any differences in age distributions between these sub-groups are likely to affect the observed differences in the proportions of interest.

All age-standardised analyses in the report are presented separately for men and women, and age standardisation was undertaken within each sex, expressing male data to the overall male population and female data to the overall female population. When comparing data for the two sexes, it should be remembered that no standardisation has been introduced to remove the effects of the sexes' different age distributions.

Age standardisation was carried out using the direct standardisation method. The standard population to which the age distribution of sub-groups was adjusted was the mid-year 2019 population estimates for England. The age-standardised proportion p' was calculated as follows, where p_i is the age- specific proportion in age group *i* and N_i is the standard population size in age group *i*:

$$p' = \frac{\sum_i N_i p_i}{\sum_i N_i}$$

Therefore p' can be viewed as a weighted mean of p_i using the weights N_i. Age standardisation was carried out using the age groups 16 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, 65 to 74 and 75 and over; in some cases, for example in the Unpaid Carers report, other groupings have been used. The variance of the standardised proportion can be estimated by:

$$var(p') = \frac{\sum_i (N_i^2 p_i q_i / n_i)}{(\sum_i N_i)^2}$$

where $q_i = 1 - p_i$, and n_i is the sample number in age-sex group *i*.

8.7 Standard analysis breakdowns

8.7.1 Introduction

This report includes tables analysed by age and, depending on the topic, region, equivalised household income and Index of Multiple Deprivation (IMD).

8.7.2 Region

Analysis by region is based on the nine former Government Office Regions.

Both observed and age-standardised data are provided by region in the tables. Observed data can be used to examine actual prevalence or mean values within a region, needed, for example, for planning services. Age-standardised data are required for comparisons between regions to exclude age-related effects, and are discussed in the report text.

Base sizes for regions can be relatively small, and caution should be exercised in examining regional differences. In 2019, the smallest region (the North East) was over-sampled to provide a minimum unweighted sample size of approximately 700 adults; the weighting process adjusted for this.

8.7.4 Equivalised household income

Household income was established by means of a show card.[34] This can be used directly as an analysis variable, but it can also be adjusted to take account of the number of persons in the household; this is called equivalised household income. To derive this, each household member is given a score. For adults, this is based on the number of adults apart from the household reference person, and for dependent children, it is based on their age. The total household income is divided by the sum of the scores to provide the measure of equivalised household income. All individuals in each household were allocated to the equivalised household income quintile to which their household had been allocated.

It should be noted that around 20% of adults live in households where no information was provided on income, and are therefore excluded from the breakdown by equivalised household income.

Further details about equivalised household income are given in the Glossary (Appendix A).

[34] The show card containing the banded income categories is included in the survey documentation, available on the HSE 2019 report web page, https://digital.nhs.uk/pubs/hse19

8.7.3 Index of Multiple Deprivation

The Index of Multiple Deprivation (IMD) was revised in 2019.[35] It combines a number of indicators, chosen to cover a range of economic, social and housing issues, into a single deprivation score for each small area in England. This allows each area to be ranked relative to others according to their level of deprivation.[36] Seven distinct domains have been identified in the English Indices of Deprivation:

- income deprivation
- employment deprivation
- health deprivation and disability
- education skills and training deprivation
- barriers to housing and services
- living environment deprivation
- crime.

Individual domains can be used in isolation as measures of each specific form of deprivation, as well as using the single overall Index of Multiple Deprivation (IMD).

The IMD is used widely to analyse patterns of deprivation, identify areas that would benefit from special initiatives or programmes and as a tool to determine eligibility for specific funding streams. In this report quintiles of IMD are used to give an area-level measure of socio-economic status, as opposed to the household-level measure of equivalised household income.

Further details about the IMD are given in the Glossary (Appendix A).

8.8 Testing for statistical significance

Significance testing is carried out on the results in the 2019 report. The term 'significant' refers to statistical significance at the 95% level and is not intended to imply substantive importance.

The significance tests are carried out in order to test the relationship between variables in a cross tabulation, usually an outcome variable nested within sex, cross-tabulated with an explanatory variable such as age (in categories), income groups or region. The test is for the main effects only (using a Wald test[37]). For example the test

35 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/835115/IoD2019_Statistical_Release.pdf

36 https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015

37 The Wald test is statistical test used to calculate the significance of parameters in a statistical model. The Wald test is used in analysis of HSE data in this report to establish whether the association among particular variables is statistically significant. For example the test might help to establish whether there is a statistically significant relationship between smoking prevalence and age (after controlling for sex) and between smoking prevalence and sex (after controlling for age). The test calculates the statistical

might examine whether there is a statistically significant relationship between smoking prevalence and age (after controlling for sex) and between smoking prevalence and sex (after controlling for age).

It is worth noting that the test does not establish whether there is a statistically significant difference between any particular pair of subgroups (e.g. the highest and lowest subgroups). Rather it seeks to establish whether the variation in the outcome between groups that is observed could have happened by chance or whether it is likely to reflect some 'real' differences in the population.

A p-value is the probability of the observed result occurring due to chance alone. A p-value of less than 5% is conventionally taken to indicate a statistically significant result ($p<0.05$). It should be noted that the p-value is dependent on the sample size, so that with large samples differences or associations which are very small may still be statistically significant.

Using this method of statistical testing, differences which are significant at the 5% level indicate that there is sufficient evidence in the data to suggest that the differences in the sample reflect a true difference in the population.

A second test of significance looks at the interaction between sex and the variable under consideration. If the interaction is statistically significant ($p<0.05$) this indicates that there is likely to be an underlying difference in the pattern of results for men and women, and this will normally be commented on in the report text.

8.9 Population estimates

The number estimates presented in three HSE 2019 reports convert the prevalence in the key trend tables into estimates of the numbers of people in the population in England that they represent. The tables in this series relate to characteristics and behaviours influencing health:

Overweight and obesity

Smoking

Drinking alcohol.[38]

As an illustration, the obesity prevalence estimate of 28.0% for all adults aged 16 and over in 2019 has been converted into a number estimate of around 12.6 million (between 12,014,000 and 13,264,000).

significance of parameters in a logistic regression model of smoking prevalence in order to establish whether age and sex are significantly associated with smoking prevalence.

[38] These tables can be found in the relevant HSE 2019 reports: Overweight and obesity in adults and children, Adults' health-related behaviours and Children's health.

The number estimates cover 2003 to 2019.[39] Weekly alcohol consumption is shown from 2011 onwards.[40]

The trend tables present the results from the representative general population sample, and in some years boost sample data are also included to increase the precision of sub-group estimates (e.g. young adults in 2002, people aged 65 and over in 2005, and children in 2015).

[39] In previous years, population estimates for adults' and children's fruit and vegetable consumption and physical activity were presented. As there are no new estimates available for 2019, these are not shown.

[40] In 2018, the population estimates for maximum alcohol consumption for any day in the last week were replaced by estimates of usual weekly alcohol consumption to reflect a change in emphasis in the official alcohol guidelines.

For the number estimates, the prevalence estimates for each year (expressed as a proportion) were multiplied by a scaling factor equal to the total mid-year population estimate,[41] then multiplied by the estimated proportion of people in the relevant age-sex group in the HSE. The mid-year population estimate was adjusted to represent the population living in private households excluding those aged 65 years and over living in institutions (45.1 million adults aged 16 and over in 2019).

Details of the method used to compute the number estimates and accompanying margin of error (i.e. the width of the 95% confidence interval divided by two) are provided in Appendix C of this report.

How to use the tables of population estimates

The tables show estimates of how many people in England, living in private households, have particular characteristics or behaviour. For instance, the tables show the number of men and women who are estimated to be obese or who currently smoke cigarettes. The tables also show breakdowns by age groups, for instance the number of children aged 13 to 15 who have ever drunk alcohol, or the number of 16 to 24 year olds who drink at levels of increasing risk.

Each table for adults shows results separately for men and women, usually within age categories, followed by results for all adults (men and women combined). Similarly, tables for children show results for boys and girls within age groups, and then results for all children.

Numbers in all tables are presented in thousands, so, for example, 10,301 in the tables represents an estimate of 10,301,000 people in the population in England.

The Health Survey for England, in common with other surveys, collects information from a sample of the population. The sample is designed to represent the whole population as accurately as possible within practical constraints, such as time and cost. Consequently, statistics based on the survey are estimates, rather than precise figures, and are subject to a margin of error, which defines what is known as the 95% confidence interval.

The margin of error is shown for each estimate in the tables, again in thousands. For instance, '+/- 389' in the tables represents +/-389,000. The lower and upper limits of the 95% confidence interval can be obtained from the margin of error as follows:

Upper limit = estimate + margin of error

Lower limit = estimate – margin of error

A different sample might have given a different estimate, but we expect that the true value of the statistic in the population would be within the range given by the 95% confidence interval in 95 cases out of 100. Thus, for the estimate of 10,301,000 people and a margin of error of +/-389,000, the true number in the population is expected to lie between 9,912,000 and 10,690,000 in 95 cases out of 100.

[41] Mid-year population estimates are published by the Office for National Statistics (ONS), and can be found at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2019estimates

Confidence intervals are affected by the size of the sample on which the estimate is based. Generally, the larger the sample, the smaller the confidence interval, and hence the more precise the estimate. Estimates for adults aged 16 and over based on a general population sample of 15,000 to 16,000 adults (2003, 2006 and 2008) have a narrower confidence interval than in years with smaller samples (2004, 2005, 2007 and 2009 onwards). Similarly, in years when the sample has been boosted to include additional numbers of a specific population group, for example children aged under 16 in 2015, confidence intervals for those groups will be narrower than in years when no such boost has been applied.

The same principle applies to estimates based on subgroups. For a large sample such as all men or all women, the confidence interval is narrower than for an estimate based on a smaller sample, for instance when looking at a particular age group, reflecting the larger uncertainty in the estimation.

The ONS mid-year population estimate bases for 2003 to 2019 are shown in Tables 15 and 16 for adults and children respectively, within the Excel tables accompanying this report, at https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2019/data-tables

These have been adjusted to represent the population living in private households, excluding those aged 65 years and over living in institutions.[42] It should be noted that there may be slight differences between the sum of estimates in the tables and the bases in the final two tables. (For instance, the numbers in each BMI category may not sum to the exact population size). The reason for this is the rounding of estimates to the nearest thousand.

Tables 15 and 16

Before 2003, no weighting was applied to the adult sample, whereas from 2003 survey estimates have been weighted for non-response.[43] The sample of children each year was weighted to adjust for the probabilities of selection,[44] and from 2003 non-response weighting was also introduced for children. While the trend tables show estimates from 1993 onwards, the number estimates series are published from 2003 onwards. Number estimates before 2003 are not shown because the change in weighting means a different calculation must be used for the confidence intervals, as described in the technical annex.

Non-response weighting brings the profile of the survey sample very close to the profile of the total population. Estimates for the 2019 prevalence trends have been computed on a non-response weight based on 2019 mid-year population estimates.[45]

[42] The ONS mid-year population estimates for those aged 65+ were adjusted to remove the proportion in that age group who were living in institutions according to the 2011 Census. See Section 7 for a full description of how the HSE data are weighted.

[43] Sproston K, Primatesta P (eds). *Health Survey for England 2003: Volume 3 Methodology and documentation*: The Stationery Office, London, 2004.

[44] Until 2014, up to two children per household were interviewed, and in households with three or more children, two were selected at random. From 2015, up to four children per household can be interviewed. Therefore weighting is required to ensure that children in larger households are not under-represented in the sample. The non-response weighted estimates from 2003 onwards include the necessary adjustment for child selection.

[45] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates

Similarly, the number estimates have been computed using a grossing-up factor calculated from the ONS mid-year population estimates; for the 2012 number estimates, the grossing-up factor was calculated from the 2011 census.

The adult population of England living in private households has increased from around 39.7 million in 2003 to 45.1 million in 2019. For any given category in the tables, changes in the projected population numbers from one year to the next will be affected by changes in the population size as well as changes in prevalence (i.e. the percentage of the population) for that category. These population figures should be read in conjunction with the key trend tables in the same reports since 1993, to see whether changes in numbers are due to changes in estimated proportions for that category or merely reflect the change in the overall population over time.

9 Quality control of blood and saliva analytes

9.1 Introduction

9.1.1 Key conclusions

This section describes the assay of analytes for the HSE 2019 biological samples and the quality control and quality assessment procedures that were carried out during the survey period. Details of procedures used in the collection, processing and transportation of the specimens are described in Appendix B of this report.

The overall conclusion for the data provided in this report is that the methods and equipment used for the measurement of blood and saliva analytes produced internal quality control (IQC) and external quality assessment (EQA) results within expected limits. The results of the analyses for each of the main blood analytes and saliva cotinine levels were acceptable for the HSE 2019.

Details of the different quality assessments are found in the tables accompanying this report, at https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2019/data-tables

9.2 Analysing laboratories

As in previous years, the Royal Victoria Infirmary (RVI), Newcastle upon Tyne Hospitals NHS Foundation Trust, was the analysing laboratory used in the HSE 2019 for the blood sample analyses. Salivary cotinine analyses for the HSE 2019 were conducted by ABS Laboratories. In August 2019, ABS Laboratories moved from Welwyn Garden City, Hertfordshire, to York. All samples analysed from 12 August 2019 onwards were assayed at the new laboratory in York.

9.3 Non-fasting blood samples

Following written consent from eligible participants, non-fasting blood samples were collected by the survey nurses from adults aged 16 and over into two tubes, a 6ml plain tube (no anticoagulant) and a 4ml EDTA (ethylene diamine tetra-acetic acid) tube. The order of priority for collecting samples was first the 6ml plain tube, followed by the 4ml EDTA tube. After collection, the tubes were posted to the Blood Sciences Department at the RVI, which acted as the co-ordinating department for transport of samples to the individual departments undertaking the analyses.

Samples collected in the 6ml plain tube for serum
Samples in the plain tube were used for analysis of total cholesterol and high density lipoprotein (HDL) cholesterol. If written consent was given by the participant, a minimum of 0.5ml of the remaining serum was stored in a freezer at -40°C (± 5°C) for possible future analysis.

Samples collected in the 4ml EDTA tube
Samples in the EDTA tube were used for the glycated haemoglobin analyses.

9.4 Saliva samples

A saliva sample was obtained by the survey nurses from consenting participants aged 4 and over. Saliva samples were collected for analysis of cotinine (a metabolite of nicotine that shows recent exposure to tobacco or tobacco smoke). A saliva collection tube was used for this purpose.

9.5 Methods

9.5.1 Laboratory procedures

All analyses were carried out according to Standard Operating Procedures by State Registered Biomedical Scientists (BMS) under the supervision of a Senior BMS. All results were routinely checked by the duty biochemist and highly abnormal results were notified to the survey doctor. In such cases, the survey doctor notified and advised the participant and/or, where prior consent had been obtained, their general practitioner as appropriate.

A schedule of Planned Preventative Maintenance was used for each item of analytical equipment. These plans were carried out jointly by the manufacturers and the laboratories. Records were kept of when maintenance was due and carried out.

Table 17 shows reference ranges used for each of the blood analytes measured in the HSE 2019. Values within these reference ranges were considered to be clinically 'normal' while those outside were treated as clinically 'abnormal' (either too high or too low). For total and HDL cholesterol, where a large proportion of the population have values which are statistically within the normal distribution but are not ideal for good health, the term 'desirable' rather than 'normal' was used when results were sent to participants and/or their GPs.

Ranges are also given for salivary cotinine.

Table 17

9.5.2 Blood sample analytical methods and equipment

Total cholesterol

Measurement of total cholesterol was carried out in the Blood Sciences Department at the RVI using a Cholesterol Oxidase assay method on a Roche Cobas 702 analyser. This is the same equipment that was used from June 16th 2015 onwards in HSE 2015. The effect of that change of equipment was that measured concentrations of total cholesterol were on average 0.1mmol/L lower.[46] A previous change had occurred on 12th April 2010, resulting in an average increase of 0.1mmol/L

[46] 40 random patient samples were tested with both the Roche Cobas 702, and the Roche Modular P analyser. An average 0.1mmol/L in difference (decrease) in total and HDL cholesterol was shown. There was no significant bias: an adjustment of 0.1mmol/L is appropriate for high and low cholesterol results.

cholesterol. Unadjusted total cholesterol values are therefore comparable before 12th April 2010 and after 16th June 2015, including HSE 2019 results. (Values were very slightly higher in the period between these dates).[47]

HDL cholesterol

HDL cholesterol analysis was carried out in the Blood Sciences Department at the RVI using the Roche HDLC4 (4th generation) assay on a Roche Cobas 702 analyser. Prior to 4th September 2017, the HDLC3 (3rd generation) assay was used.[48] Standardisation to CDC reference method remained the same.[49] Following this change the mean difference in results over the concentration range of the assay was -0.03mmol/L. This is the same equipment that was used from 16th June 2015 onwards in HSE 2015, which resulted in the recorded concentrations of HDL cholesterol being on average 0.1mmol/L lower than those previously measured.[50] A previous change had occurred on 12th April 2010, resulting in an average decrease of 0.1mmol/L cholesterol from the previous measures. Consequently, measured HDL cholesterol was on average 0.2mmol/L lower after 16th June 2015 (including throughout the HSE 2019) than before 12th April 2010.[47] The very small change from September 2017 onwards, and thus throughout the HSE 2018 and 2019 does not make a noticeable difference to the correction needed.

Glycated haemoglobin

Glycated haemoglobin (HbA_{1c}) analysis was carried out in the Blood Sciences Department at the RVI using the Tosoh G8 analyser throughout the HSE 2019. The Tosoh G8 analyser has been used in the HSE since 26th August 2010.[51] Since 3rd October 2011, the International Federation of Clinical Chemistry (IFCC) standardisation was introduced, and the unit changed to mmol/mol. Since the introduction of IFCC standardisation, TOSOH calibrator values have been assigned using various IFCC calibrators, dependent on the availability of specific IFCC calibrator lot numbers. On September 19th 2013, there was a change to using a TOSOH calibrator assigned using IFCC calibrator (Lot California 2012.102). Comparisons made by the manufacturer TOSOH indicated that the change caused variations of 1.4-2.2 mmol/mol, which is deemed acceptable.[52,53] The calibrator used

[47] In the HSE 2015 dataset, a variable CHOLFLAG3 showed whether the cholesterol was collected pre- or post- 16th June 2015. From this date onwards, the variables CHOLVAL3 and CHOLVAL13 have been used instead of CHOLVAL and CHOLVAL1, to indicate this revised measurement.

[48] Version 4 has reduced sensitivity towards denatured lipoprotein.

[49] Literature provided by Roche indicated that results would be likely to shift downwards by 3-5% for HDL-cholesterol at a level of 1.3mmol/L. However, the difference in results observed at the RVI were smaller than that.

[50] As noted above, 40 random patient samples were tested with both the Roche Cobas 702, and the Roche Modular P analyser. An average 0.1mmol/L in difference (decrease) in total and HDL cholesterol was shown. There was no significant bias: an adjustment of 0.1mmol/L is appropriate for high and low cholesterol results.

[51] Before this, a Tosoh G7 analyser was used, but the change made no impact on measured concentrations. Both were calibrated using Diabetes Control and Complications Trial (DCCT) standards until 3rd October 2011. Measurements were provided as %.

[52] Sacks DB, Arnold M, Bakris GL, et al. Guidelines and Recommendations for Laboratory Analysis in the Diagnosis and Management of Diabetes Mellitus. Diabetes Care 2011;34:e61-e99.

[53] Little RR, Rohlfing CL, Sacks DB; National Glycohemoglobin Standardization Program (NGSP) Steering Committee. *Status of HbA1c measurement and goals for improvement: from chaos to order for improving diabetes care.* Clin Chem 2011;57:205–14.

after 19th September 2013 (including throughout the HSE 2019) produced lower glycated haemoglobin results compared with the previous one.[54]

9.5.3 Saliva sample (cotinine) analytical methods and equipment

Saliva samples received at the RVI were checked for correct identification, assigned a laboratory accession number, and stored at 4°C. Samples were checked for details and despatched fortnightly in polythene bags (20 samples per bag) by courier for overnight delivery to ABS Laboratories, where cotinine analysis was carried out. This laboratory specialises in accurate measurement of low levels of cotinine and therefore takes special precautions to ensure no contamination by environmental tobacco smoke occurs.

The method of analysis used was a high performance liquid chromatography coupled to tandem mass spectrometry with multiple reaction monitoring (LC-MS/MS).[55] All methods were validated before use.

As mentioned above, ABS Laboratories moved site in August 2019. The same laboratory equipment was used by the same personnel in both the Welwyn Garden City laboratory and the York laboratory. The same stringent controls were in place on the smoke-free environment and laboratory.

The five high performance liquid chromatography tandem mass spectrometry (LC-MS/MS) systems were decommissioned, relocated and recommissioned in the new laboratory in York by the instrument manufacturer AB Sciex. In addition, a new system LC-MS/MS system was purchased and installed by AB Sciex. Prior to assaying any saliva samples in the new laboratory, the performance of the LC-MS/MS system that was to be used for the salivary cotinine assays was assessed by preparing new calibration standards and quality control samples to cover both the high calibration range and the low calibration range assays and measuring them against a batch of quality control samples that had been prepared and assayed with saliva samples at the Welwyn Garden City Laboratory. The assay batches run at York contained calibration standards in duplicate and at least five quality control samples at low, medium and high concentrations. The performance of the two methods are summarised in the table below.

[54] In the HSE 2013 archived dataset, a variable glyflag shows whether the sample was analysed before or after 19th September 2013. Samples analysed were labelled glyhbval and glyhbval2 (and iffcval and iffcval2) respectively. Adjusted variables glyhbvala and iffcvala can be used to compare trends over time: these adjust the later results to reflect those before the 19th September 2013.

[55] Bernert JT, Jacob III P, Holiday DB et al. *Interlaboratory comparability of serum cotinine measurements at smoker and nonsmoker concentration levels: A round robin study.* Nicotine Tob Res. 2009;11:1458-66.

Table A: Quality control pre- and post- laboratory move

Test	*Low range Results*	*High range Results*	*Comment*
Retention time	As expected	As expected	Acceptable
Peak shape	As expected	As expected	Acceptable
Sensitivity	>5 times s/n	>5 times s/n	Acceptable
Selectivity	No peak found	No peak found	Acceptable
Carry-over	No peak found	No peak found	Acceptable
Calibration data	All standards <±15% from nominal concentration	All standards <±15% from nominal concentration	Acceptable
QC Precision (CV%)	≤4.9%	≤4.3%	Acceptable
QC mean accuracy	94.6% to 96.5%	111.1% to 113.8%	Acceptable

Both assays showed acceptable performance, precision and accuracy so the system was then accepted for use to analyse samples.

An advantage of the LC-MS/MS assay is that it is less prone than other methods to non-specific interference when assaying low levels of cotinine as seen due to passive smoking. This assay is therefore preferable for samples from non-smokers. [56]

A disadvantage of LC-MS/MS is that it does not have the dynamic range of the GC-NPD assay used in earlier HSE years.[56] Therefore, since 2011 the laboratory has been informed whether the samples were from self-reported smokers or not. All the samples from self-reported smokers were first assayed using the high calibration range assay of 1 to 750ng/ml, and any that were below 1ng/ml were then re-assayed with the low range assay. All the remaining samples were first assayed using the low range assay of 0.1-50ng/ml. Any of these that were over-range were then re-assayed using the high calibration range assay of 1 to 750ng/ml, provided there was sufficient saliva available from that participant.

9.6 Internal quality control (IQC)

9.6.1 Introduction

The purpose of IQC is to ensure reliability of an analytical run. IQC helps to identify and prevent the release of any errors in an analytical run. IQC is also used to monitor trends over time.

For each analyte or group of analytes, the laboratory obtains a supply of commercial quality control materials, usually at more than one concentration of analyte. Target values and target standard deviations (SD) are assigned for each analyte. Target assignment includes evaluation of values obtained by the laboratory from replicate measurements (over several runs) in conjunction with target values provided by manufacturers of IQC materials, if available. The standard deviation and the coefficient of variation (CV) are measures of imprecision and are presented in the

[56] Bernert JT, Jacob III P, Holiday DB et al. *Interlaboratory comparability of serum cotinine measurements at smoker and nonsmoker concentration levels: A round robin study.* Nicotine Tob Res. 2009;11:1458-66.

tables. IQC values are assessed against an acceptable range and samples are re-analysed if any of the Westgard rules have been violated.[57,58,59]

The tables providing IQC results show the assayed value compared with the target value, and the acceptable range is also provided so that, where the assayed and target values differ, it is possible to check that they are still within expected limits. The final columns of the tables show the SD and CV. Results are provided for IQC only for 'runs' in which HSE samples were tested.

9.6.2 Non-fasting blood samples

Total and HDL cholesterol
Two levels of IQC were assayed throughout the day. Tables 18 and 19 show the monthly IQC results for total and HDL cholesterol.

Tables 18 and 19

Glycated haemoglobin (HbA1c)
Before October 2011, the analytical methods used for glycated haemoglobin measurement in the United Kingdom were required to be traceable to the work carried out on the DCCT part of the National Glycohemoglobin Standardisation Program (NGSP) in the USA. The Secondary Reference Laboratory (SRL) in the University of Minnesota was the main analytical laboratory for the DCCT work. The IQC results for glycated haemoglobin were DCCT standardised until October 2011, when the standard changed to IFCC values.

Two levels of internal quality control were run at the beginning and end of each run and at regular intervals throughout. Table 20 shows the monthly IQC results for glycated haemoglobin.

Table 20

9.6.3 Saliva samples (cotinine)

ABS laboratories ran 16 non-zero calibration standards for each batch of the low range assay (0.1-50ng/ml), and 16 for the high range assay (1-750ng/ml). Six QC

[57] Westgard rules are a statistical approach to evaluation of day-to-day analytical performance. The Westgard multi-rule quality control procedure uses five different control rules to judge the acceptability of an analytical run. This differs from the single criterion or single set of control limits used by single-rule quality control systems, such as a Levey-Jennings chart with control limits set as either the mean plus or minus 2 standard deviations or the mean plus or minus 3 standard deviations. Westgard rules are generally used with two or four control measurements per run. This means they are appropriate when two different control materials are measured once or twice per material, which is the case in many chemistry applications. Some alternative control rules are more suitable when three control materials are analysed, which is common for applications in haematology. More detail is available at www.westgard.com/mltirule.htm#westgard

[58] Westgard JO, Barry PL, Hunt MR, Groth T. *A multi-rule Shewhart chart for quality control in clinical chemistry.* Clin Chem. 1981;**27**:493-501.

[59] Westgard JO, Klee GG. *Quality Management.* Chapter 16 in Burtis C (ed.). *Fundamentals of Clinical Chemistry.*4th edition. Philadelphia: WB Saunders Company, 1996, pp.211-23.

samples, two each at a set concentration to represent Low, Medium and High levels for the calibration level used, were also analysed with each analytical batch.

For the results from any analytical batch to be acceptable, four out of the six QCs must have a bias of no greater than ±15%, with at least one from each QC level being within these acceptance criteria, and 75% of the calibration standards must have a bias of no greater than ±15% except at the lower limit of quantification (0.1ng/ml) where the bias must be no greater than ±20%. A summary of the quality control samples results is collated and presented in Tables 21 and 22.

Tables 21 and 22

9.7 External quality assessment (EQA)

9.7.1 Introduction

EQA permits comparison of results between laboratories measuring the same analyte. An EQA scheme for an analyte or group of analytes distributes aliquots of the same samples to participating laboratories, which are blind to the concentration of the analytes. The usual practice is to participate in a scheme for a full year during which samples are distributed at regular frequency (monthly or bimonthly for example); the number of samples in each distribution and the frequency differ between schemes. The samples contain varying concentrations of analytes. The same samples may or may not be distributed more than once.

Samples are assayed shortly after they arrive at the laboratory. Depending on the frequency of distribution, there may be weeks or months in which no EQA samples are analysed. Results are returned to the scheme organisers, who issue a laboratory specific report giving at least the following data:

- Mean values, usually both for all methods and for method groups;
- A measure of the between-laboratory precision;
- The bias of the results obtained by that laboratory.

EQA is a retrospective process of assessment of performance, particularly of inaccuracy or bias with respect to mean values; unlike IQC, it does not provide control of release of results at the time of analysis.

The RVI laboratory participates in the Welsh External Quality Assessment Schemes (WEQAS) on a routine basis. The WEQAS schemes do not include cotinine (tested by ABS laboratory); there is no EQA scheme for cotinine results.

For blood analytes the standard deviation index (SDI) is reported here in addition to the target and achieved values, to conform with best practice across Europe.[60] The SDI is an index of total error, including components of inaccuracy and imprecision. It is calculated as:

[60] Alfthan G, Sundvall J. '*Blood samples and laboratory analyses'.* Chapter 10 in Tolonen H (ed). *EHES Manual.* National Institute for Health and Welfare (THL), Helsinki, 2011.

$$SDI = \frac{\text{(laboratory result – target value)}}{\text{(WEQAS standard deviation * method-specific comparability factor)}}$$

This adjustment ensures that each laboratory can compare their results with others using their own method, the peer reference method, and the overall mean of all groups. The target values reported in Tables 23 to 25 are the reference values, or (if reference values are absent from the report) the mean for the specific method used by the RVI.

A score between -1 and 1 SDI is good; between 1 and 2 or between -2 and -1 SDI is acceptable. A score greater than 2 or below -2 is unacceptable and would trigger an investigation by the laboratory.[61]

Each of the figures presented in Tables 23 to 25 corresponds to an individual EQA sample.

9.7.2 Non-fasting blood samples

The Blood Sciences laboratory participates in the WEQAS scheme for total and HDL cholesterol and glycated haemoglobin. Table 23 shows the monthly EQA results for total cholesterol, Table 24 for HDL cholesterol, and Table 25 for glycated haemoglobin. The target and achieved values are shown, along with SDI in Tables 23 to 25.

Tables 23 to 25

9.7.3 Saliva samples (cotinine)

There was no external quality control scheme available in 2019 for cotinine analysis but ABS Laboratories participates in inter-laboratory split analyses to ensure comparable results. The latest International inter-laboratory study was published in 2009.[62]

[61] Welsh External Quality Assurance Scheme. *Participants' Manual.* WEQAS, Cardiff, 2016.
[62] Bernert JT, Jacob III P, Holiday DB et al. *Interlaboratory comparability of serum cotinine measurements at smoker and nonsmoker concentration levels: A round robin study.* Nicotine Tob Res. 2009;11:1458-66.

Appendix A: Glossary

This glossary explains terms used in the HSE 2019 reports.

Abdominal obesity

Body Mass Index (BMI) does not distinguish between mass due to body fat and mass due to muscular physique, nor the distribution of fat. It has therefore been suggested that waist circumference, waist to hip ratio or waist to height ratio may be useful supplements to BMI to identify central (abdominal) obesity, which increases the health risk from being overweight. More recently, waist circumference has been identified as the most useful of these three measures of central obesity in determining health risk.

To measure abdominal obesity, waist circumference is measured, and categorised into desirable, high and very high, by sex-specific thresholds.

According to NICE guidelines, for men, waist circumference of less than 94cm is defined as 'low' waist measurement, between 94cm and 102cm is 'high' and more than 102cm is 'very high'. For women, waist circumference of less than 80cm is defined as 'low' waist measurement, between 80cm and 88cm is 'high' and more than 88cm is 'very high'. These waist circumference categories, in combination with BMI, have been used to identify categories of health risk.

In 2014, NICE published guidance on the identification, assessment and management of overweight and obesity in children, young people and adults, which partially updated its 2006 guidance. The recommendation is to base the assessment of health risks associated with being overweight or obese on BMI and waist circumference, as in the table below. This is because some people, despite having a BMI of less than 35 kg/m^2, may have a higher risk of disease due to having a more 'central' fat distribution as identified by a high or very high waist circumference.

For those with a BMI of 35 kg/m^2 or more, waist circumference has little added predictive power of disease risk, and these individuals are also unlikely to have a low waist circumference.

Health risk from BMI and waist circumference

BMI classification	**Waist circumference**		
	Low	High	Very high
Normal weight (18.5 to less than 25)	No increased risk	No increased risk	Increased risk
Overweight (25 to less than 30)	No increased risk	Increased risk	High risk
Obesity I (30 to less than 35)	Increase risk	High risk	Very high risk
Obesity II (35 to less than 40)	Very high risk	Very high risk	Very high risk
Obesity III (40 or more)	Very high risk	Very high risk	Very high risk

References: Molarius A, Seidell JC. *Selection of anthropometric indicators for classification of abdominal fatness - a critical review.* Int J Obes 1998; 22:719-727

National Institute of Health and Clinical Excellence. *Obesity: the prevention, identification, assessment and management of overweight and obesity in adults and children.* www.nice.org.uk/nicemedia/pdf/cg43niceguideline.pdf

See **Body mass index (BMI)**

Acute sickness
Any illness or injury (including any longstanding condition) that has caused the participant to cut down in the last two weeks on things they usually do.

Age standardisation
Age standardisation has been used in order to enable different groups to be compared after adjusting for the effects of any differences in their age distributions.

When different sub-groups are compared in respect of a variable on which age has an important influence, any differences in age distributions between these sub-groups are likely to affect the observed differences in the proportions of interest.

Age standardisation was carried out for adults aged 16 and over, using the direct standardisation method. The standard population to which the age distribution of sub-groups was adjusted was the mid-year 2019 population estimates for England. All age standardisation has been undertaken separately within each sex.

Age standardisation was carried out using the age groups 16 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, 65 to 74 and 75 and over.

Most tables present age-standardised data. For region analysis, both observed and standardised data are provided, so that those who need results for a single region can look at the observed estimates. However, for any comparisons across regions, the age-standardised estimates are recommended, and these are the results commented on in the report.

Alcohol consumption
Measures of usual weekly consumption are presented in line with the current guidelines for sensible drinking:

- Lower risk: up to 14 units for men and women
- Increasing risk: above 14 and up to 50 units for men, above 14 and up to 35 units for women
- Higher risk: above 50 units a week for men, above 35 units for women.

The weekly categories are approximate only and do not take into account varying patterns of consumption, for example on different days of the week or at different times of year. By definition they cover a ‘typical’ day, and therefore do not reflect occasions when consumption might be higher than usual (for instance holidays, or celebrations such as parties, weddings, Christmas).

See **Units of alcohol**.

Biomarkers
Biophysical measurements such as blood pressure, cholesterol, and glycated haemoglobin). Elevated levels of some biomarkers can be risk factors for non-communicable diseases.

See **Blood pressure, Cholesterol, Glycated haemoglobin, Risk factors**

Blood analytes
Analysis of non-fasting blood samples.

See **Cholesterol (total and HDL)** and **Glycated haemoglobin (HbA1c)**.

Blood pressure
Systolic (SBP) and diastolic (DBP) blood pressure was measured in participants aged 5 and over using a standard method (see the Appendix B for the measurement protocol). In adults, hypertension (high blood pressure) is defined in this survey as SBP at least 140mmHg or DBP at least 90mmHg, or on medication prescribed to control hypertension. Participants are classified into one of four groups as follows:

- Normotensive untreated: SBP below 140mmHg and DBP below 90mmHg, not currently taking medication for blood pressure.
- Hypertensive controlled: SBP below 140mmHg and DBP below 90mmHg, currently taking medication for blood pressure.
- Hypertensive uncontrolled: SBP at or greater than 140mmHg and/or DBP at or greater than 90mmHg, currently taking medication for blood pressure.
- Hypertensive untreated: SBP at or greater than 140mmHg and/or DBP at or greater than 90mmHg, not currently taking medication for blood pressure.

See also **Diastolic blood pressure, Systolic blood pressure**.

Body mass index (BMI)
Weight in kilograms divided by the square of height in metres.

Adults (aged 16 and over) can be classified into the following BMI groups:

BMI (kg/m^2)	*Description*
Less than 18.5	Underweight
18.5 to less than 25	Normal
25 to less than 30	Overweight
30 or more	Obese
40 or more	Morbidly obese

In children, although the BMI calculation method is the same, there are no fixed BMI cut-off points defining overweight and obesity. Instead, overweight and obesity may be defined using several other methods, including age and sex specific BMI cut-off points or BMI centile cut-offs based on reference populations. In this report, overweight and obesity prevalence for children have been estimated using the 85th and 95th BMI centiles of the 1990 UK reference curves as cut-offs respectively for overweight and obesity.

For information about the combined risks associated with BMI and high waist circumference, see **Abdominal obesity**

Carers
Carers were defined as adults aged 16 and over who personally provided help or support to anyone in the last month because they had long-term physical or mental ill-health problems, a disability or problems relating to old age. Help provided in a professional capacity, as part of a job, or on behalf of a voluntary organisation was excluded, but not help or support provided to family or friends for which some payment was received.

Cholesterol (total and HDL)
Measured in non-fasting blood samples. Cholesterol is a fat-like substance (lipid) that is present in cell membranes and is a precursor of bile acids and steroid hormones. Cholesterol is essential for the body in small amounts. It is made in the liver and some is obtained from the diet. Serum total cholesterol concentration is positively associated with the risk of coronary heart disease (CHD). In the HSE 2017 report Multiple Risk Factors, the definition of raised total cholesterol used the NICE guidance ‘audit level’ of 5.0 mmol/L or above.

In a normal individual, high density lipoprotein (HDL) constitutes approximately 20-30% of serum total cholesterol. HDL cholesterol carries cholesterol away from the arteries back to the liver and is considered to be beneficial or ‘good’ cholesterol. Studies have demonstrated a strong direct relationship between coronary heart disease and low HDL cholesterol. In the 2011 HSE report HDL cholesterol was defined as low at a level of less than 1.0 mmol/L.

Confidence interval
All such survey estimates are subject to some degree of error. The confidence interval (CI) is calculated from the sampling error, which is a measure of how such a survey estimate would vary if it were calculated for many different samples. If the survey was repeated many times, such a 95% CI would contain the true value 95% of the time. A CI includes information about the uncertainty associated with an estimate.

For example the survey estimate might be 24% with a 95% confidence interval of (22% to 26%). A different sample might have given a different estimate, but we expect

that the true value of the statistic in the population would be within the range given by the 95% confidence interval in 95 cases out of 100.

Confidence intervals are quoted for key statistics within individual reports and are also shown in more detail in the Excel tables accompanying each report. Confidence intervals are affected by the size of the sample on which the estimate is based. Generally, the larger the sample, the smaller the confidence interval, and hence the more precise the estimate.

See also **P-value, Statistical significance.**

Cotinine

Cotinine is a metabolite of nicotine. It is one of several biological markers that are indicators of smoking. In this survey, it was measured in saliva. It has a half-life in the body of between 16 and 20 hours, which means that it will detect regular smoking (or other tobacco use such as chewing) but may not detect occasional use if the last occasion was several days ago. (Half-life is the time taken for the concentration or amount of a substance in the body to reduce by half.) Anyone with a salivary cotinine level of 15 nanograms per millilitre or more is highly likely to be a tobacco user; more recently a threshold of 12 nanograms per millilitre has been taken as indicative of personal tobacco use; survey participants who report that they do not smoke are described as cotinine-validated non-smokers if their salivary cotinine levels are below this threshold.

Diabetes

Diabetes is characterised by high blood glucose levels (hyperglycaemia). Untreated, hyperglycaemia is associated with damage and possible failure of many organs, especially the eyes, kidneys, nerves, heart, and blood vessels. Diabetes substantially increases the risk of cardiovascular disease (CVD),[63] and tends to worsen the effect of other risk factors for CVD.

HSE measures diabetes in two ways. The prevalence of self-reported doctor-diagnosed diabetes is included in the main computer-assisted interview: ‘Do you now have, or have you ever had diabetes?’ and ‘Were you told by a doctor that you had diabetes?’. Additionally, glycated haemoglobin (HbA1c) levels are measured in blood samples collected at the nurse visit. HbA1c reflects average blood sugar levels over the previous two to three months and can therefore be used both to monitor diabetic control in people with diagnosed diabetes, and to detect undiagnosed diabetes.

In the HSE, prevalence of total diabetes, using glycated haemoglobin levels is limited to participants with a nurse visit and a valid HbA1c measurement. Total diabetes in the population includes all participants with an HbA1c level of 48mmol/mol or above, diagnostic of diabetes, as well as those who reported having diabetes diagnosed by a doctor. Among those with total diabetes, participants with a raised HbA1c who did not

[63] Garcia MJ, McNamara PM, Gordon T, Kannel WB. *Morbidity and mortality in the Framingham population. Sixteen year follow-up.* Diabetes 1974;**23**:105-111.

report having doctor-diagnosed diabetes are defined as having undiagnosed diabetes. The HSE interview makes no distinction between Type 1 and Type 2 diabetes.

See also **Glycated haemoglobin**.

Diastolic blood pressure
When measuring blood pressure, the diastolic arterial pressure is the lowest pressure at the resting phase of the cardiac cycle.

See also **Blood pressure, Systolic blood pressure**

Eating disorders
The SCOFF questionnaire[64] was used in the HSE 2019 survey to estimate the prevalence of possible eating disorders in the English adult population. SCOFF is a five-item measure designed and validated in the UK to strengthen suspicion that an eating disorder might exist, rather than to make a diagnosis. The letters in SCOFF represent the first letter of the words; Sick, Control, One stone, Fat, and Food, which are key words in the questions that are used to screen for a possible eating disorder. Each of the five questions can be answered 'yes' or 'no', and responding positively to two or more of the questions indicates a case of a possible eating disorder, which would warrant further clinical assessment.

The SCOFF screening items used in HSE 2019	
During the last year…	
…have you lost more than **one stone** in a 3 month period?	Yes/No
…have you made yourself be **sick** because you felt uncomfortably full?	Yes/No
…did you worry you had lost **control** over how much you eat?	Yes/No
…did you believe yourself to be **fat** when others said you were too thin?	Yes/No
…would you say **food** dominated your life?	Yes/No
…did your feelings about food interfere with your ability to work, meet personal responsibilities and/or enjoy a social life?	Yes/No

A SCOFF score of two or more was taken as a positive screening for a possible eating disorder. Using the SCOFF screening tool does not allow for different types of eating disorders to be specifically identified.

[64] Morgan, J., Reid, F. and Lacey, J. *The SCOFF questionnaire: assessment of a new screening tool for eating disorders*. BMJ 1999, 319(7223), pp.1467-1468. Doi:10.1136/bmj.319.7223.1467.

The proportion of participants who had a score of two or more and reported that food interfered with their lives were described in terms of food having 'a significant negative impact' or a 'significant impact'.

The SCOFF questionnaire was administered to all HSE 2019 participants aged 16 and over as part of the self-completion questionnaire. The HSE 2019 survey adopted the same approach that the 2007 Adult Psychiatric Morbidity Survey (APMS) used for SCOFF.[65] Amendments to the order of questions and the reference period mean that the HSE 2019 data is directly comparable to the APMS 2007 data, but not to other studies that have used the scale.

Further information about the SCOFF screening tool can be found in the HSE 2019 Eating disorders report.

E-cigarettes

The HSE asks about e-cigarettes and other vaping devices, defined as 'any product that you can use to inhale vapour rather like you would a cigarette. It includes ones that have a battery as well as ones that do not such as voke'. In 2019 the HSE asked about disposable electronic cigarettes (non-rechargeable), electronic cigarette kits refillable with pre-filled cartridges, electronic cigarette kits refillable with liquids, as well as modular systems, which by which the user combines separate devices, including batteries and atomizers. Since 2015, e-cigarette use has been asked in two different ways; as a set of questions specifically focused on current and any use of e-cigarettes, and then within a set of questions about the use of nicotine replacement products.

See also **Nicotine delivery products, Vaping devices**

Equivalised household income

Income has been included in the Health Survey for England (HSE) series since 1997. Making precise estimates of household income, as is done for example in the Family Resources Survey, requires far more interview time than was available in the HSE. Household income was thus established by means of a card (see the Survey documentation) on which banded incomes were presented. Information was obtained from the household reference person (HRP) or their partner. Initially they were asked to state their own (HRP and partner) aggregate gross income, and were then asked to estimate the total household income including that of any other persons in the household. Household income can be used as an analysis variable, but there is interest in using measures of equivalised income that adjust income to take account of the number of persons in the household. Methods of doing this vary in detail: the starting point is usually an exact estimate of net income, rather than the banded estimate of gross income obtained in the HSE. The method used in the present report

[65] Thompson J, Brugha T, Palmer B. *Eating disorders.* Chapter 8 in McManus S, Meltzer H, Brugha T, Bebbington P, Jenkins R (eds). *Adult psychiatric morbidity in England, 2007. Results of a household survey* [Internet]. 2009. Available from: https://digital.nhs.uk/data-and-information/publications/statistical/adult-psychiatric-morbidity-survey/adult-psychiatric-morbidity-in-england-2007-results-of-a-household-survey

was as follows. It utilises the widely used McClemens scoring system, described below.

A score was allocated to each household member, and these were added together to produce an overall household McClemens score. Household members were given scores as follows.

First adult (HRP)	0.61
Spouse/partner of HRP	0.39
Other second adult	0.46
Third adult	0.42
Subsequent adults	0.36
Dependant aged 0 to 1	0.09
Dependant aged 2 to 4	0.18
Dependant aged 5 to 7	0.21
Dependant aged 8 to 10	0.23
Dependant aged 11 to 12	0.25
Dependant aged 13 to 15	0.27
Dependant aged 16+	0.36

The equivalised income was derived as the annual household income divided by the McClemens score. This equivalised annual household income was attributed to all members of the household, including children.

Households were ranked by equivalised income, and quintiles q1 to q5 were identified. Because income was obtained in banded form, there were clumps of households with the same income spanning the quintiles. It was decided not to split clumps but to define the quintiles as ‘households with equivalised income up to q1’, ‘over q1 up to q2’ etc.

All individuals in each household were allocated to the equivalised household income quintile to which their household had been allocated. Insofar as the mean number of persons per household may vary between quintiles, the numbers in the quintiles will be unequal. Inequalities in numbers are also introduced by the clumping referred to above, and by the fact that in any sub-group analysed the proportionate distribution across quintiles will differ from that of the total sample.

In 2019 the limits of each quintile were as follows.

Equivalised household income quintiles, 2019 (based on annual gross household income)

Highest quintile	2nd quintile	3rd quintile	4th quintile	Lowest quintile
More than £56,000	Over £35,540, up to £56,000	Over £23,443, up to £35,540	Over £14,956, up to £23,443	£14,956 or less

Reference: McClemens D. *Equivalence scales for children*. Journal of Public Economics 1977;8:191-210

Glycated haemoglobin (HbA1c)
Measured from non-fasting blood samples. The percentage of glycated haemoglobin is the percentage of haemoglobin in the circulation to which glucose is bound. Glycated haemoglobin (HbA1c) concentration is an indicator of average blood glucose concentration over the previous three months and is therefore used to assess glycaemic control in people with diabetes. It is used as a diagnostic or screening tool for diabetes. Diabetic patients with elevated glycated haemoglobin are at increased risk of microvascular events (complications from diseased small blood vessels, such as eye and kidney problems) and macrovascular events (complications from diseased arteries, such as coronary heart disease including angina, heart attacks and heart failure). In the 2019 HSE report raised glycated haemoglobin was taken as 48mmol/mol (6.5%) or above.

See also **Diabetes**.

Household
A household is defined as one person 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.

Household Reference Person
The household reference person (HRP) is defined as the householder (a person in whose name the property is owned or rented); if there is more than one such person in a household, it is defined as the person with the highest income. If there is more than one householder with equal income, then the household reference person is the oldest.

Hypertension
See **Blood pressure**.

Income
See **Equivalised household income**.

Index of Multiple Deprivation
The Index of Multiple Deprivation 2019 combines a number of indicators, chosen to cover a range of economic, social and housing issues, into a single deprivation score for each small area in England. This allows each area to be ranked relative to others according to their level of deprivation. Seven distinct domains have been identified in the English Indices of Deprivation:

- Income Deprivation
- Employment Deprivation
- Health Deprivation and Disability
- Education, Skills and Training Deprivation
- Barriers to Housing and Services
- Living Environment Deprivation
- Crime.

Individual domains can be used in isolation as measures of each specific form of deprivation, as well as using the single overall Index of Multiple Deprivation (IMD).

The IMD is used widely to analyse patterns of deprivation, identify areas that would benefit from special initiatives or programmes and as a tool to determine eligibility for specific funding streams. In HSE reports, quintiles of IMD are used to give an area-level measure of socio-economic status, as opposed to household-level measures such as equivalised household income.

Reference: Ministry of Housing, Communities and Local Government. *The English Indices of Deprivation 2019.* https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019

Limiting longstanding illness
See **Longstanding illness**.

Longstanding illness
Longstanding illness is defined as ‘any physical or mental health condition or illness lasting or expected to last 12 months or more’. This definition changed in 2012; in previous years the question referred to ‘an illness, disability or infirmity… that has troubled you over a period of time or that is likely to affect you over a period of time’. This change was to bring the HSE questions in line with harmonised disability questions for social surveys. The harmonised standards are designed to be consistent with a conceptual framework of disability, taking account of the needs of national and European administrations for data continuity and the definitions and guidelines contained in UK and EU legislation, including the Equality Act and the EU-SILC (EU-Statistics on Income and Living Conditions) regulation.

A longstanding illness is defined as limiting if the participant reports that it reduces their ability to carry out day-to-day activities.

Mean
Means in this report are arithmetic means (the sum of the values for cases divided by the number of cases) unless stated otherwise.

See also **Standard error of the mean.**

Median
The value of a distribution which divides it into two equal parts such that half the cases have values below the median and half the cases have values above the median.

See also **Percentile**.

Morbid obesity
See **Body mass index**.

Nicotine delivery products (NDPs)

Nicotine delivery products are usually used to help smokers cut down or stop smoking. They include chewing gum, lozenges, patches, inhalers, mouth or nasal sprays. The HSE also asks about e-cigarettes in the context of NDPs, as well as separately as a product in their own right.

See also **E-cigarettes, Vaping devices**

NS-SEC
The National Statistics Socio-economic Classification (NS-SEC) was introduced from April 2001, and replaced Social Class based on occupation and Socio-economic Groups (SEG). NS-SEC is a social classification system that attempts to classify groups on the basis of employment relations, based on characteristics such as career prospects, autonomy, mode of payment and period of notice. Full details can be found in 'The National Statistics Socio-economic Classification User Manual 2002', ONS 2002.

There are fourteen operational categories representing different groups of occupations and a further three 'residual' categories that are excluded when the classification is collapsed into its analytical classes: full-time students, those whose occupation is not stated or inadequately described, and those who are not classifiable for some other reason. The classification excludes those who have never worked and the long term unemployed, in addition to the groups mentioned above.

In 2019, NS-SEC has been used to calculate non-response weights for individuals (see Section 7 of this report).

Obesity
See **Abdominal obesity, Body mass index**.

Overweight
-See **Body mass index**.

Percentile
Percentiles are values of a distribution that divide it into 100 equal parts. For example, the 20th percentile is the value of a distribution where 20% of the cases have values at or below the 20th centile and 80% have values above it. The 50th percentile is the median.

See also **Median**, **Quintile.**

P-value
A p -value is the probability of the observed result occurring due to chance alone. A p-value of less than 5% is conventionally taken to indicate a statistically significant result ($p<0.05$). It should be noted that the p-value is dependent on the sample size, so that with large samples differences or associations which are very small may still be statistically significant. Results should therefore be assessed for their importance on the magnitude of the differences or associations as well as on the p-value itself.

See also **Confidence interval**, **Statistical significance**.

Quintile
A quintile represents one fifth of a given population distribution. Quintiles are used to create cut-off points to divide a distribution into five equal parts, reflecting the ranked values within the distribution (for example the lowest quintile of an income distribution includes the fifth of the population with the lowest incomes).

See also **Percentile.**

Region
The regions used by the HSE since 2013 are based on the nine former Government Office Regions: North East, North West, Yorkshire and the Humber, East Midlands, West Midlands, East of England, London, South East and South West. This definition was also used as the regional base for sampling and weighting in HSE 2009. Between 2010 and 2013, the HSE used Strategic Health Authorities for sampling, weighting and reporting. These were co-terminus with the Government Office Regions, except that the South East was split into South Central and South East Coast. Following the abolition of SHAs from April 2012, the sampling from 2013 onwards is based on the former GORs, now referred to as ‘regions’.

SCOFF questionnaire
See **Eating disorders**.

Significance
See **Statistical significance**.

Smoking, smoker
Unless explicitly stated otherwise, references to smoking and smokers refer to the smoking of tobacco cigarettes. Smokers are categorised within the HSE 2019 reports as current smokers (who said they smoked cigarettes at all nowadays), ex-regular smokers (who don't currently smoke, but have smoked at least one cigarette a day in the past) and never regular smokers (who don't currently smoke, may have smoked in the past, but never smoked regularly).

Standard error of the mean
The standard error (SE) is a measure of the degree of sampling error associated with a mean. It quantifies the degree to which a mean is likely to vary over repeated samples of the same size: the larger the sample, the smaller the standard error for a given measure.

See also **Mean**.

Statistical significance
The statistical significance of an estimate is based on the probability of its occurring due to chance alone. Within this report, estimates are assumed to be statistically significant if they have a p-value of less than 0.05 or less, that is a probability of occurring by chance below 5%. Statistical significance does not imply substantive importance; differences that are statistically significant are not necessarily meaningful or relevant.

See also **Confidence interval**, **P-value**.

Systolic blood pressure
When measuring blood pressure, the systolic arterial pressure is defined as the peak pressure in the arteries, which occurs near the beginning of the cardiac cycle.

See also **Blood pressure**, **Diastolic blood pressure**.

Unit of alcohol
Alcohol consumption is reported in terms of units of alcohol; one unit of alcohol is 10ml by volume of pure alcohol. Participants are asked about the alcoholic drinks they have had, and these are converted to units. This conversion was revised in 2006 and 2007; see the 2007 report, Volume 1 Chapter 7, for full details of the revised method and the conversion of drinks to units. (www.hscic.gov.uk/pubs/hse07healthylifestyles).

See also **Alcohol consumption**.

Vaping devices
These include, but are not limited to, e-cigarettes. The HSE defines a vaping device as 'any product that you can use to inhale vapour rather like you would a cigarette. It includes ones that have a battery as well as ones that do not such as voke'. Types of vaping devices asked about in the 2019 questionnaire include disposable electronic cigarettes (non-rechargeable), electronic cigarette kits refillable with pre-filled cartridges, electronic cigarette kits refillable with liquids, and modular systems, which by which the user combines separate devices, including batteries and atomizers.

See also **Nicotine delivery products**

Waist circumference
See **Abdominal obesity**

Wellbeing
Wellbeing was measured using the Warwick Edinburgh Mental Well-being Scale (WEMWBS). The scale was developed by researchers at the Universities of Warwick and Edinburgh, with funding provided by NHS Health Scotland, to enable the measurement of mental well-being of adults in the UK. WEMWBS is a 14 item scale of mental well-being covering subjective well- being and psychological functioning, in which all items are worded positively and address aspects of positive mental health. The scale is scored by summing responses to each item answered on a 1 to 5 Likert scale. The minimum scale score is 14 and the maximum is 70. WEMWBS has been validated for use in the UK with those aged 16 and over. Validation involved both student and general population samples, and focus groups.

Appendix B: Measurement methods and protocols

Introduction

This section includes the protocols followed by interviewers and nurses in 2019 in taking measurements and biological samples during the HSE interview. They are presented as in the manuals used by interviewers and nurses. Note that the nurse manual covers all NatCen nurse projects and some instructions given may not be specifically relevant to HSE 2019.

The protocols include height and weight measurements (interviewer-administered) and the following nurse protocols:

- Recording ambient air temperature
- Blood pressure
- Waist and hip measurements
- Blood samples
- Saliva samples.

Height measurement

The equipment

A portable stadiometer: a collapsible device with a sliding head plate, a base plate and four connecting rods marked with a measuring scale, divided into centimetres and then further subdivided into millimetres.

The protocol – adults (16+)

Ask the respondent to remove their shoes in order to obtain a measurement that is as accurate as possible.

Assemble the stadiometer and raise the head plate to allow sufficient room for the respondent to stand underneath it. Double check that you have assembled the stadiometer correctly.

The respondent should stand with their feet flat on the centre of the base plate, feet together and heels against the rod. The respondent's back should be as straight as possible, preferably against the rod but NOT leaning on it. They should have their arms hanging loosely by their sides. They should be facing forwards.

Move the respondent's head so that the Frankfort Plane is in a horizontal position (i.e. parallel to the floor). The Frankfort Plane is an imaginary line passing through the external ear canal and across the top of the lower bone of the eye socket, immediately under the eye (see diagram). This position is important if an accurate reading is to be obtained. An additional check is to ensure that the measuring arm rests on the crown of the head, i.e. the top back half. To make sure that the Frankfort

Plane is horizontal, you can use the Frankfort Plane Card to line up the bottom of the eye socket with the flap of skin on the ear. The Frankfort Plane is horizontal when the card is parallel to the stadiometer arm.

Instruct the respondent to keep their eyes focused on a point straight ahead, to breathe in deeply and to stretch to their fullest height. If after stretching up the respondent's head is no longer horizontal, repeat the procedure. It can be difficult to determine whether the stadiometer head plate is resting on the respondent's head. If so, ask the respondent to tell you when s/he feels it touching their head.

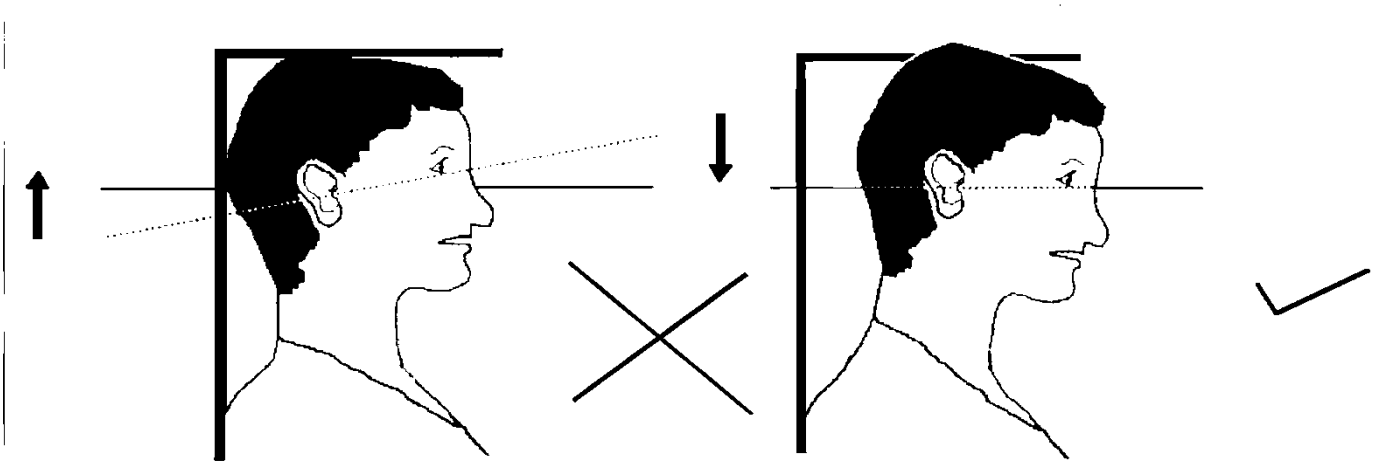
Ask the respondent to step forwards. If the measurement has been done correctly the respondent will be able to step off the stadiometer without ducking their head. Make sure that the head plate does not move when the respondent does this.

Look at the bottom edge of the head plate cuff. There is a red arrowhead pointing to the measuring scale. Take the reading from this point and record the respondent's height in centimetres and millimetres, that is in the form '123.4', at the question *Height*. You may at this time record the respondent's height onto their Measurement Record Card and at the question *MbookHt* you will be asked to check that you have done so. At that point the computer will display the recorded height in both centimetres and in feet and inches. At *RelHiteB* you will be asked to code whether the measurement you obtained was reliable or unreliable.

Height must be recorded in centimetres and millimetres, e.g. 176.5 cms. If a measurement falls between two **millimetres,** it should be recorded to the **nearest even millimetre.** E.g., if respondent's height is between 176.4 and 176.5 cms, you should round it down to 176.4. Likewise, if a respondent's height is between 176.5 and 176.6 cms, you should round it up to 176.6 cms.

Push the head plate high enough to avoid any member of the household hitting their head against it when getting ready to be measured.

Frankfort plane - adults



The protocol - children (2-15)

The protocol for measuring children differs slightly from that for adults. You must get the co-operation of an adult household member. You will need their assistance in order to carry out the protocol, and children are much more likely to be co-operative themselves if another household member is involved in the measurement. If possible measure children last so that they can see what is going on before they are measured themselves.

Children's bodies are much more elastic than those of adults. Unlike adults they will need your help in order to stretch to their fullest height. This is done by stretching them. This is essential in order to get an accurate measurement. It causes no pain and simply helps support the child while they stretch to their tallest height.

It is important that you practise these measurement techniques on any young children among your family or friends. The more practice you get before going into the field the better your technique will be.

Explain to the parent and child what you are going to do before you start the measurement. This includes describing the child lift, and the fact that you will ask the parent to lower the head plate.

In addition to removing their shoes, children should remove their socks as well. This is not because the socks affect the measurement. It is so that you can make sure that children don't lift their heels off of the base plate (see below).

Assemble the stadiometer and raise the head plate to allow sufficient room for the child to stand underneath it.

The child should stand with their feet flat on the centre of the base plate, feet together and heels against the rod. The child's back should be as straight as possible, preferably against the rod, and their arms hanging loosely by their sides. They should be facing forwards.

Place the measuring arm just above the child's head.

Move the child's head so that the Frankfort Plane is in a horizontal position (see diagram). This position is as important when measuring children as it is when measuring adults if the measurements are to be accurate. To make sure that the Frankfort Plane is horizontal, you can use the Frankfort Plane Card to line up the bottom of the eye socket with the flap of skin on the ear. The Frankfort Plane is horizontal when the card is parallel to the stadiometer arm.

Cup the child's head in your hands, placing the heels of your palms either side of the chin, with your thumbs just in front of the ears, and your fingers going round towards the back of the neck. (See diagram).

Firmly but gently, apply upward pressure, lifting the child's head upwards towards the stadiometer head plate and thus stretching the child to their maximum height. Avoid jerky movements, perform the procedure smoothly and take care not to tilt the head at

an angle: you must keep it in the Frankfort plane. Explain what you are doing and tell the child that you want them to stand up straight and tall but not to move their head or stand on their tip-toes.

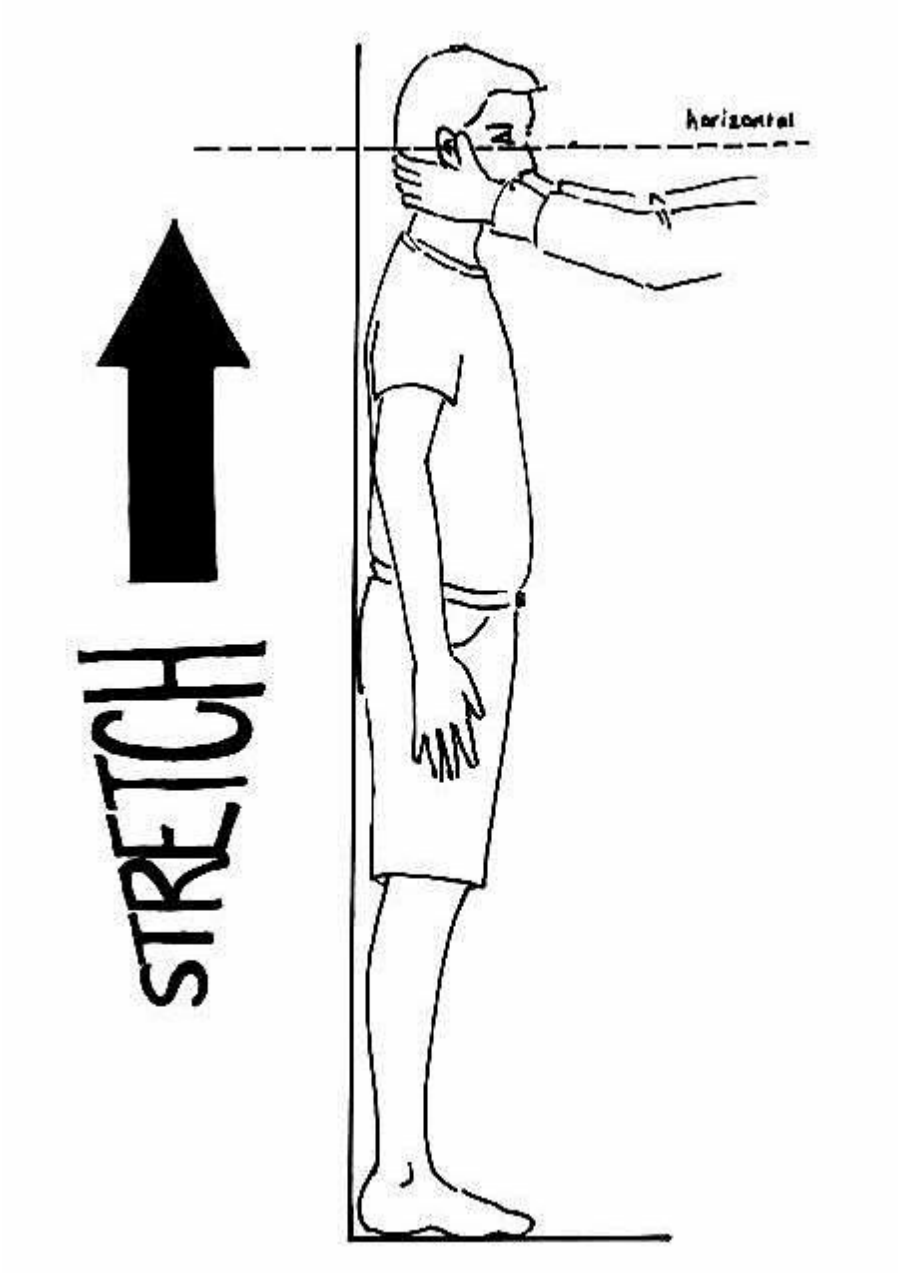
Ask the household member who is helping you to lower the head plate down gently onto the child's head. Make sure that the plate touches the skull and that it is not pressing down too hard.

Still holding the child's head, relieve traction and allow the child to stand relaxed. If the measurement has been done properly the child should be able to step off the stadiometer without ducking their head. Make sure that the child does not knock the head plate as they step off.

Read the height value in metric units to the nearest millimetre and enter the reading into the computer at the question “Height.” At the question “MbookHt” you will be asked to check that you have entered the child's height onto their Measurement Record Card. At that point the computer will display the recorded height in both centimetres and in feet and inches.

Push the head plate high enough to avoid any member of the household hitting their head against it when getting ready to be measured.

The child stretch



Height refused, not attempted or attempted but not obtained

At *HtResp* you are asked to code whether the measurement was taken, refused, attempted but not obtained or not attempted. If for any reason you cannot get a height measurement, enter the appropriate code at this question and you will automatically be routed to the relevant follow up questions (*ResNHi* and *NoHitM*) which will allow you to say why no measurement was obtained.

Additional points - all respondents

If the respondent cannot stand upright with their back against the stadiometer and have their heels against the rod (e.g. those with protruding bottoms) then give priority to standing upright.

If the respondent has a hair style which stands well above the top of their head, or is wearing a turban, bring the head plate down until it touches the hair or turban. With some hairstyles you can compress the hair to touch the head. If you cannot lower the head plate to touch the head, and think that this will lead to an unreliable measure, record this at question *RelHite.* If it is a hairstyle that can be altered, e.g. a bun, if possible ask the respondent to change or undo it.

If the respondent is tall, it can be difficult to line up the Frankfort Plane in the way described. When you think that the plane is horizontal, take one step back to check from a short distance that it is correct.

Weight measurement

The equipment

Seca 877 Scales

The protocol

Turn the display on by using the appropriate method for the scales. The readout should display 888.8 momentarily. If this is not displayed check the batteries, if this is not the cause you will need to report the problem to NatCen at Brentwood. While the scales read 888.8 do not attempt to weigh anyone.

Ask the respondent to remove shoes, heavy outer garments such as jackets and cardigans, heavy jewellery, loose change and keys.

If necessary, turn the scales on again. Wait for a display of 0.0 before the respondent stands on the scales.

Ask the respondent to stand with their feet together in the centre and their heels against the back edge of the scales. Arms should be hanging loosely at their sides and head facing forward. Ensure that they keep looking ahead - it may be tempting for the respondent to look down at their weight reading. Ask them not to do this and assure them that you will tell them their weight afterwards if they want to know.

The posture of the respondent is important. If they stand to one side, look down, or do not otherwise have their weight evenly spread, it can affect the reading.

The scales will take a short while to stabilise. If the respondent moves excessively while the scales are stabilising you may get a false reading. If you think this is the case reweigh, but first ensure that you have erased the memory by weighing a lighter item.

The scales have been calibrated in kilograms and 100 gram units (0.1 kg). Record the reading into the computer at the question *Weight* before the respondent steps off the scales. At question *MBookWt* you will be asked to check that you have entered the respondent's weight into their Measurement Record Card. At that point the computer will display the measured weight in both kilos and in stones and pounds.

WARNING: The maximum weight registering accurately on the scales is 200kg (31½ stone).

If you think the respondent exceeds the limit of the scales code them as “Weight not attempted” at *RespWts*. The computer will display a question asking them for an estimate. Do not attempt to weigh them.

Additional points

Uneven floor surfaces

Weight measurements should be done using the most even floor surface available e.g. a kitchen lino floor. If only a carpet is available then record this at *FloorC.* If the only available floor in a house is uneven e.g. uneven kitchen tiles or an older house with a slanted floor then the scales can be adjusted so that the surface of the scales is flat. This can be done by screwing and unscrewing the feet of the scales to bring them in line with the surface of the floor. You will know when the surface of the scales is flat as the small bubble in the spirit level on the surface of the scales is in the centre of the black circle. See picture.

Please make sure you check the round spirit level on the surface of the scales every time you use the scales. The small bubble should be in the centre of the black circle.

Pregnant women

Pregnant women do not have their weight measured. For female respondents aged 16-49, the computer displays a question asking them whether they are pregnant and then applies the appropriate routing. If you have a respondent aged under 16 who is obviously pregnant, code as “Weight not attempted” at *RespWts* and “Other - specify” at *NoWaitM*.

Small children

Children of all ages should be weighed. If a child under 2 cannot or does not want to stand on the scales alone, you can weigh a parent, and then weigh the child in the parent’s arms. When you enter the two weights into CAPI the child’s weight will be calculated.

Weight refused, not attempted or attempted but not obtained
At *RespWts* you are asked to code whether the measurement was taken, refused, attempted but not obtained or not attempted. If for any reason you cannot get a weight measurement, enter the appropriate code at this question and you will automatically be routed to the relevant follow up questions (*ResNWt* and *NoWaitM*) which will allow you to say why no measurement was obtained.

Recording ambient air temperature

Many of the physical measures taken fluctuate considerably due to air temperature. To be able to standardise the results that are obtained air temperature must be recorded. CAPI will tell you when to record the air temperature.

Equipment

A digital thermometer and probe.

Procedure

Set up the thermometer, usually on a surface near the Omron (blood pressure equipment), by plugging the probe into the socket at the top of the instrument. Do not let the probe touch anything and ensure that it is not near a radiator or in the sun. It is recommended that the probe hang over the edge of a table.

When prompted by CAPI to take a reading, turn on the thermometer by pressing the completely white circle.

Wait for the reading to stabilise and take a reading.

Record the air temperature in CAPI to one decimal place e.g. 21.4. Do not round this to a whole number.

To preserve battery life please ensure that after taking the reading the thermometer is switched off by pressing the white ring.

Blood pressure

Exclusion criteria

Participants are excluded from the blood pressure measure if they are:

- Aged 4 years and below
- Pregnant

If a pregnant woman wishes to have her blood pressure measured, you may do so, but do not record the readings in CAPI.

Consent

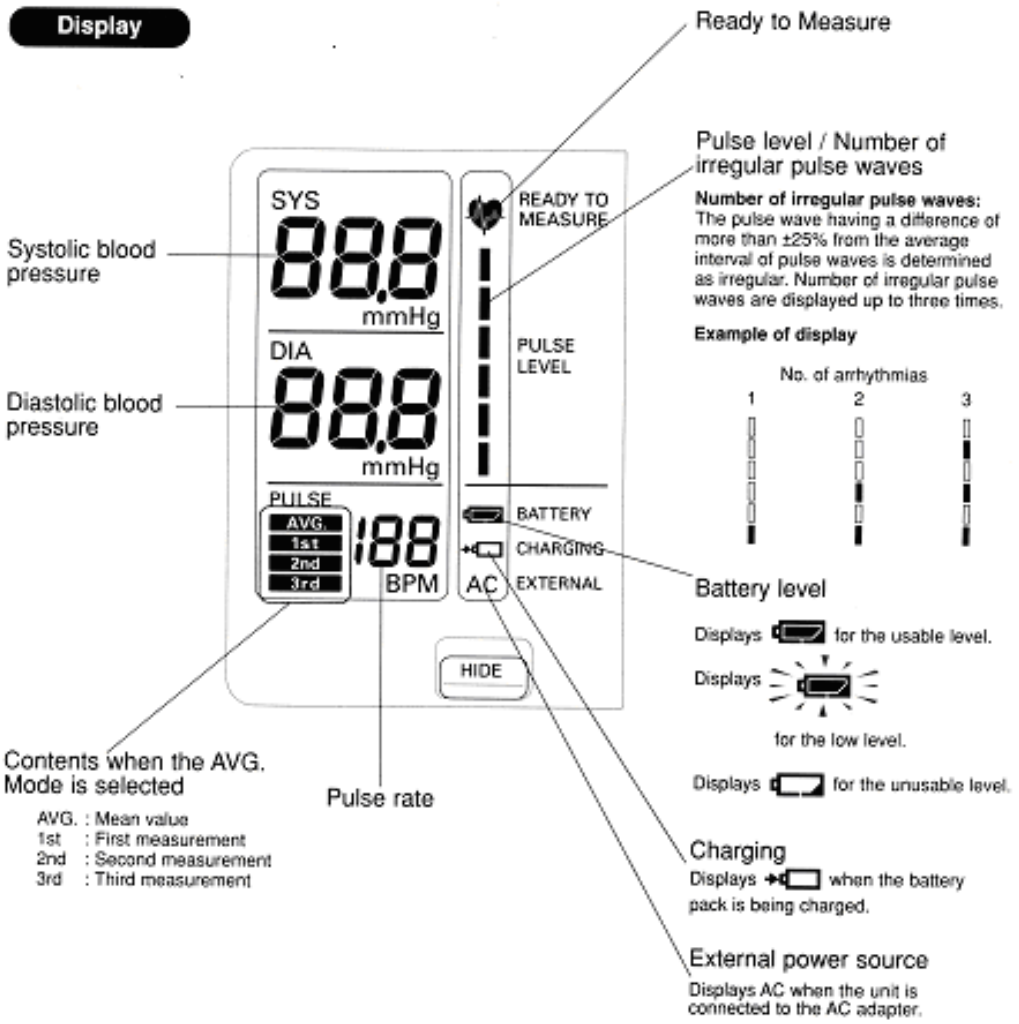
In addition to the verbal consent required to conduct all NatCen procedures, written consent is required for the results to be sent to the participant's GP. The appropriate form must be signed and dated by the participant.

Equipment

- An Omron HEM 907 blood pressure monitor
- Child/ small adult cuff (17-22 cm)
- Standard adult cuff (22-32 cm)
- Large adult cuff (32-42 cm)
- An AC adapter (for putting Monitor on charge at home).

Using the Omron HEM 907

The diagram below shows the Omron HEM 907 monitor.



Switch the monitor on by pressing the ON/OFF button. Wait for the READY TO MEASURE symbol to light, indicating the monitor is ready to start the measurement (approximately 2 seconds).

Check that the MODE selector is set to AVG (average) and P-SET Volume (pressure setting) is set to auto.

Press the start button to begin the measurement. The cuff will start to inflate and take the first measurement. When the first measurement is complete, the LCD screen will show the systolic pressure, diastolic pressure and pulse rate. It will continue to do this at one minute intervals.

Press the ON/OFF button to turn it off.

If at any stage while you are taking the measurement you need to stop the monitor, press STOP and start the procedure again, as described in section 3.6.

Preparing the participant

During the initial interview, the participant would have been informed not to eat, smoke, drink alcohol or participate in vigorous exercise 30 minutes before the nurse visit as this can cause blood pressure to be higher than normal. Before the procedure ask to see if they have carried out any of these activities and note their response in CAPI.

Select the right arm unless this is impossible. Ask the participant to remove outer garment (e.g. jumper, cardigan, jacket) and expose their upper right arm by rolling up their sleeve. If the sleeve constricts the arm, restricting the circulation of blood, ask the participant if they would mind taking their arm out of the sleeve for the measurement.

Selecting the correct cuff

Adults

Do **not** measure the upper arm circumference to determine which cuff size to use. Instead, choose the correct cuff size based on the acceptable range which is marked on the inside of the cuff. You will note that there is some overlap between the cuffs. If the participant falls within this overlap range then use the **standard** cuff where possible.

Children

It is important to select the correct cuff size to obtain an accurate reading and avoid injuring the child. The appropriate cuff is the largest cuff which fits between the axilla (underarm) and the antecubital fossa (front of elbow) without obscuring the brachial pulse and so that the index line is within the range marked on the inside of the cuff. You will be provided with a child's cuff as well as the other adult cuffs. Many children will not need the children's cuff and instead will require an adult cuff. You should choose the cuff that is appropriate to the circumference of the arm.

Procedure

Check that the monitor is working.

Use the right arm, unless this is impossible. If the left arm is used, record this in CAPI.

Get the participant to sit in a comfortable chair with a suitable support so that the **right arm** is resting at a level to bring the antecubital fossa (elbow) to approximately heart level. They should be seated in a comfortable position with legs uncrossed and feet flat on the floor.

Wrap the correct sized cuff round the upper **right arm** and check that the index line falls within the range lines. Do not put the cuff on too tightly as bruising may occur on inflation. Ideally it should be possible to insert two fingers between the cuff and the arm.

Locate the brachial pulse just medial to the biceps tendon and position the arrow on the cuff over the brachial artery. The lower edge should be about 1-2 cm above the cubital fossa (elbow crease).

Explain to the participant that you need them to sit quietly for five minutes and that during that time they cannot eat, drink or smoke.

During this ‘quiet time’ follow the procedure for taking ambient air temperature (Manual Section 14) and just before taking the blood pressure reading, make a note of the air temperature (this is not applicable for all surveys, refer to the project specific instructions).

After five minutes explain that you are starting the measurement, also explain that the cuff will inflate three times and each time they will feel some pressure on their arm. Ask them to relax, be seated in the position detailed in step 3 and not to speak until the measurement has been completed, as it may affect their reading.

Press start on the Omron HEM 907 to start the measurement. When the first measurement is complete it will be displayed on the LCD screen. Record this.

The unit will produce readings at one minute intervals thereafter; record the next two so you have three sets of readings in total. To check the readings press the ‘Deflation’ button. It is important that the three readings are recorded as the first reading is usually higher, and thus less accurate, than the other two readings as the participant may be feeling nervous.

Press ON/OFF on the Omron to switch the unit off and remove the cuff from the participant’s arm.

If the participant wishes, you should record details of their readings on the measurement record card.

Participant feedback

When answering queries about a participant's blood pressure it is very important to remember that it is NOT the purpose of the survey to provide participants with medical advice, nor are you in a position to do so as you do not have the participant's full medical history.

What you may say in each situation has been agreed with the Survey Doctor and CAPI will instruct you to read out the appropriate interpretations of the participant's results. It is very important that the agreed script in the CAPI is read word for word and that personal interpretation is never offered.

The participant feedback protocol should be strictly followed. It is very important that as little anxiety as possible is caused, but at the same time we have a duty to advise people to see their GP if the measurements indicate that blood pressure is raised.

Child participants

Do not comment on a child's blood pressure readings to the child or parents. If they seek comment, state that you are not able to interpret a single blood pressure measurement without checking to see whether it is normal for the child's age and height. Reassure them that if it is found to be markedly abnormal, the Survey Doctor will get in touch with them or their GP and advise them to get it checked. This rule applies for all readings you obtain.

Adult participants

As stated previously we have a duty to inform people that they need to see their GP if their blood pressure is high. It is important that the instructions below are carefully read and guidelines always followed precisely.

The computer tells you which readings your advice should be based on. This will be based on the **lowest** systolic and **lowest** diastolic reading from the last two readings. This will usually, but not always, be from the same reading. For example, occasionally it may be the systolic from the second reading and the diastolic from the third reading. Furthermore if the lowest systolic reading falls in one category and the lowest diastolic reading falls in another category, the higher of the two categories will be used to trigger the advice to participants. For example the lowest systolic reading is 138 (normal) and the lowest diastolic is 96 (mildly raised) then the advice given will be based on a mildly raised reading. If the first reading is higher than the other two it should be explained that the first reading can be high because people are nervous of having their pressure taken.

Definitions of raised blood pressure differ slightly. The Survey Doctor has recommended the blood pressure ratings given below based on the most recent guidelines from the British Hypertension Society. It is important that you adhere to these definitions, so that all participants are treated in an identical manner. These are shown in the table below.

For men and women aged 16+

Rating	Systolic		Diastolic
Normal	<140	and	<90
Mildly raised	140 - 159	or	90 – 99
Raised	160 - 179	or	100 – 114
Considerably raised	180 or more	or	115 or more

Points to make to a participant about their blood pressure (given on screen)

Normal: 'Your blood pressure is normal.'

Mildly raised: 'Your blood pressure is a bit high today.'

'Blood pressure can vary from day to day and throughout the day so that one high reading does not necessarily mean that you suffer from high blood pressure.'

'You are advised to visit your GP within 2 months to have a further blood pressure reading to see whether this is a one-off finding or not.'

Raised: 'Your blood pressure is a bit high today.'

'Blood pressure can vary from day to day and throughout the day so that one high reading does not necessarily mean that you suffer from high blood pressure.'

'You are advised to visit your GP within 2 weeks to have a further blood pressure reading to see whether this is a one-off finding or not.'

Considerably raised:

'Your blood pressure is high today.'

'Blood pressure can vary from day to day and throughout the day so that one high reading does not necessarily mean that you suffer from high blood pressure.'

'You are strongly advised to visit your GP within 5 days to have a further blood pressure reading to see whether this is a one-off finding or not.'

(For all of the above points, you can also advise the participant to see their practice nurse, if this is who they would typically see in relation to their blood pressure.)

If the participant is elderly and has considerably raised blood pressure, amend your advice so that they are advised to contact their GP within the next week or so about this reading. This is because in many cases the GP will be well aware of their high blood pressure and we do not want to worry the participant unduly. It is however important that they do contact their GP about the reading within 7 to 10 days. In the meantime, contact the Survey Doctor who will inform the participant's GP of their result, providing the participant has given their permission.

Action to be taken by the nurse after the visit

If you need to contact the Survey Doctor, unless there is a hypertensive crisis, do not do this from the participant's home - you may cause unnecessary distress.

Children

No further action is required after taking blood pressure readings on children. All high readings are viewed routinely by the Survey Doctor. However, in the rare event that you encounter a child with a very high blood pressure, i.e. systolic 160 or above or diastolic 100 or above please call the Survey Doctor.

Adults

The table below summarises what action to take based on the readings you have obtained for a participant. For this purpose you should only take into account the last two of the three readings you take, as the first reading is prone to error.

BLOOD PRESSURE	ACTION
Normal/mildly raised/raised BP Systolic less than 180 mmHg and Diastolic less than 115 mmHg	No further action necessary. If you feel that the circumstances demand further action, inform the Survey Doctor who will then inform the participant's GP immediately if she deems it necessary.*
Considerably raised BP Systolic at or greater than 180 mmHg or Diastolic at or greater than 115 mmHg	Contact the Survey Doctor at the earliest opportunity and she will inform the participant's GP if written consent has been given, or the participant if not.* If the participant has any symptoms of a hypertensive crisis** contact the survey doctor immediately or call an ambulance. The Survey Doctor must be informed as soon as possible.

* You must still contact the Survey Doctor even if participants tell you that their GP knows about their raised BP.

** A hypertensive crisis is an extremely rare complication of high blood pressure. Its signs and symptoms include diastolic bp > 135 mmHg, headache, confusion, sleepiness, stupor, visual loss, seizures, coma, cardiac failure, oliguria, nausea & vomiting.

The Survey Doctor will look at all high or unusual readings when they reach the office. If the reading is high, then the Survey Doctor will contact the participant directly. The Survey Doctor will also routinely check fast and slow pulse rates so no further action is necessary regarding these.

Waist and hip circumference

Exclusion criteria

Participants are excluded from the waist and hip circumference measurement if they:

- Are pregnant
- Are chairbound
- Have a colostomy / ileostomy

Equipment

An ‘Easy-Check Circumference Measurement’ tape calibrated in millimetres

Using the circumference measurement tape

The tape is passed around the waist or hip circumference. Click the press button in place at the back of the plastic slider. To check the tape is horizontal you have to position the tape on the right flank and look round the participant's back from his/her left flank to check that it is level. This will be easier if you are kneeling or sitting on a chair to the side of the participant. When taking the reading, be sure not to lift the tape, hold it flat against the body otherwise you will get an inaccurate measurement.

Preparing the participant

The participant needs to be wearing light clothing. Explain to the participant the importance of this measurement and that clothing can substantially affect the reading. If possible the participant needs to remove:

- All outer layers of clothing, such as jackets, heavy or baggy jumpers, cardigans and waistcoats
- Shoes with heels
- Tight garments intended to alter the shape of the body, such as corsets, lycra body suits and support tights/underwear
- Belts.

Pockets should be emptied and if possible ask the participant to empty their bladder before taking the measurement.

Explain to the participant that the waist and hip measurements taken on NatCen surveys are taken at different points to where the Participant might think their waist and hips are. Therefore measurements may differ to those taken for clothing purposes.

Some participants may be wearing religious or other symbols which they cannot remove and which may affect the measurement. Do not embarrass or offend the participant by asking them to remove such items. Record in CAPI if the measurement is likely to be affected by this.

Procedure

Steps 1-3 apply to both waist measurement and hip measurement.

1. Ensure that the participant is standing erect in a relaxed manner and breathing normally. Weight should be evenly balanced on both feet and the feet should be about 25-30cm (1 foot) apart. The arms should be hanging loosely at their sides. This position will provide the most accurate measurement of both the waist and the hip, and will allow for them to be measured easily.
2. If possible, kneel or sit on a chair to the side of the participant.

3. With assistance from the participant pass the tape around the participant's body, or if they are able to, get them to pass the tape around themselves and check that it is not twisted. Click the press button in place at the back of the plastic slider.

Measuring waist circumference

4. The participant's waist is located midway between the iliac crest and the costal margin (lower rib). To locate the levels of the costal margin and the iliac crest, ask the participant if you can touch them, and use the fingers of your right hand held straight and pointing in front of the participant to slide upward over the iliac crest.
5. Position the tape at the participant's waist, ensuring that it is horizontal.
6. Ask the participant to breathe out gently and to look straight ahead. This is to prevent the participant from contracting their muscles or holding their breath.
7. Take the measurement at the end of a normal expiration by holding the slider flat against the body and read the measurement from the red line.
8. Record the measurement in CAPI in centimetres and millimetres. Always record to a one decimal place. If the result falls between two millimetres, record to the **nearest even millimetre**.
9. Repeat steps 1-8 to record a second measurement. If the second reading differs significantly from the first, CAPI will report an error message. At this point check that you have entered the results into CAPI correctly. Otherwise take a third measurement, following the procedure above. Enter this result into CAPI, the computer will know which two results to use.

Measuring hip circumference

10. The participant's hip circumference is the widest circumference over the buttocks and below the iliac crest.

11. Position the tape in this area ensuring that the participant is looking straight ahead and not contracting their gluteal muscles. Ensure the tape is horizontal.

12. Measure the circumference at several positions over the participant's buttocks, by holding the slider flat against the body and read the measurement from the red line.

13. Record the widest circumference in CAPI. Always record to one decimal place.

14. Report in centimetres and millimetres. If the result falls between two millimetres, record to the **nearest even millimetre**.

15. Repeat steps 1-3 and 9-12 to record a second measurement. If the second reading differs substantially from the first, CAPI will report an error message. At this point check that you have entered the results into CAPI correctly. Otherwise take a third measurement, following the procedure above. Enter this result into CAPI, the computer will know which two results to use.

If the participant wishes, record the waist and hip measurement on their measurement record card.

Additional points

If you have problems palpating the rib, ask the participant to breathe in very deeply. Locate the rib and as the participant breathes out, follow the rib as it moves down with your finger.

The tape should be tight enough so that it doesn't slip but not tight enough to indent clothing.

If the participant is large, ask him/her to pass the tape around rather than 'hug' them. Remember to check that the tape is correctly placed to take the measurement and horizontal all the way around.

Some participants will be wearing clothing where the waistband of the trousers/skirt sits on the waist. Do not attempt to move the clothing or take the measurement at a different position. Measure the waist circumference over the waistband and make a note of this in CAPI. If the waistband is not horizontal all the way around the body i.e. it may be lower at the front, always ensure that the tape is horizontal which may mean that it passes over the waist band in some places and not in others. If there are belt loops, thread the tape through the loops so that they don't add to the measurement.

We only want to record problems that will affect the measurement by more than would be expected when measuring over light clothing. As a rough guide only record a problem if you feel it affected the measurements by more than 0.5cm. We particularly want to know if waist and hip are affected differently.

Before packing the tape away, ensure the length of tape is wiped with an antibacterial wiped and allowed to dry (min 30 secs) to reduce potential cross infection between households.

Blood sample

The protocol for taking blood samples set out below is written in accordance with the Clinical Procedure Guidelines: Venepuncture. All nurses are to read this document before carrying out any venepuncture procedure.

Exclusion criteria

All participants with the following exceptions are eligible to give blood:

- Pregnant women
- Participants who are HIV positive or who have Hepatitis B or C
- People with clotting or bleeding disorder.

By clotting or bleeding disorders we mean conditions such as haemophilia and low platelets, i.e. thrombocytopenia. There are many different types of bleeding/clotting disorders but they are all quite rare. The reason these participants are excluded from blood sampling is that:

a) the integrity of their veins is extremely precious

b) we do not wish to cause prolonged blood loss

For the purposes of blood sampling, those who have had, for example, a past history of thrombophlebitis, a deep venous thrombosis, a stroke caused by a clot, a myocardial infarction or an embolus are NOT considered to have clotting disorders.

- Adults and children (aged over 5yrs) who have had a fit (e.g. epileptic fit or convulsion) in the **previous 5 years** should not be asked to provide a blood sample. Children, aged 5 and under, who have also **ever** had a fit or convulsion should not be asked to provide a blood sample, even if the fit / convulsion was related to febrile illness rather than any other reason.
- People who are **currently** on anticoagulant drugs, e.g. Warfarin therapy.

Check if the participant has a clotting or bleeding disorder or is on anticoagulant drugs, such as Warfarin, and record this in CAPI. These are very uncommon. If you find someone with these problems, do not attempt to take blood, even if the disorder is controlled.

Aspirin or antiplatelet therapy is **not** a contraindication to blood sampling. If you are uncertain whether a condition constitutes a contraindication to blood sampling, the Survey Doctor will be happy to answer your queries.

- Adults who are not willing or able to give their consent in writing or children whose parent/guardian is unwilling or unable to give consent in writing.

Consent

As blood sampling is an invasive procedure we need to ensure that fully informed written consent is obtained from each participant. Information on what they are consenting to is mainly given in the Nurse visit related participant information leaflet, and the participant confirms that they have been provided with this information on the consent form.

The cross project leaflet ‘Giving a Blood Sample’ also provides useful information about the risks around giving a sample and after-care. This is information that you should be giving verbally in any case, and you therefore do not need to ensure that the participant has read this leaflet in advance as long as you make sure you have covered all the points yourself.

On **no** account should you ever take blood before you have obtained written consent to do so from the participant.

There are two further written consents we wish to obtain in most surveys in respect to blood sampling:

Consent to send the results to the GP (verbal consent only is required for results to be sent back to the participant

Consent to store a small amount of the blood, anonymously, for future research purposes

You should seek to obtain all of the required consents before you take any blood.

Small quantities of blood are being stored in special freezers for further analysis in the future. Stored blood will only be analysed in future studies if permission for that particular study is obtained from NHS Digital and from a Research Ethics Committee. Any future analysis will be unlinked which means that the researcher doing the analysis will not be able to link it back to the participant. Participants will therefore not receive the results of any tests done on their blood in the future.

The questions on the CAPI questionnaire will take you step by step through all the procedures for obtaining consents. Make sure you follow these carefully - recording consent codes as instructed and giving reasons for refusals, if applicable.

In summary:

Ask the participant if they would be willing to have a blood sample taken. Try to reassure participants about the process, and be prepared to answer their concerns. You will need to explain the importance of written consent to the participant

Obtain written consents on the appropriate consent form (including initials or ticks where required **and full signature**).

Remember to enter their name or serial number on each page of the form before asking the participant to sign.

Remember to enter your name in the qualified nurse space provided on each form.

Check that you have circled the correct consent codes on the front of the consent booklet, and that this corresponds with the CAPI instructions on screen.

Equipment

The equipment required is listed in the Clinical Practice Guideline for Venepuncture (CPG). Any additional equipment, specific to a project, will be listed in the project instructions.

Preparing the participant

Protocol on preparing the participant can be found in the Venepuncture CPG.

Further points to note include:

- Ask the participant to remove any jackets, thick garments and/or roll their sleeves up.
- Instruct the participant to remain as still as possible

Procedure

The procedure for taking the blood sample can be found in the Venepuncture CPG. This procedure is to be followed. It is to be used in conjunction with CAPI which will guide you through the blood sampling process.

Additional points to note include:

Ametop Gel®, a local anaesthetic, can only be used in some projects (refer to the specific project instructions). There is an HRP / CPG on use of Ametop which must be followed.

Cryogesic Spray® , a vaso-coolant short acting pain relieving spray, can only be used in some projects (refer to the specific project instructions). There is an HRP / CPG on use of Cryogesic Spray which must be followed.

The vacutainers and monovette blood tubes should be filled to the specified capacity in turn (according to the order of draw specified in the project instructions) and inverted gently 5 times on removal to ensure complete mixing of blood and preservatives (in some surveys not all tubes will need to be inverted, refer to project specific instructions).

IMPORTANT WARNING – PREVENTING NEEDLESTICK INJURY

Always use the safety sharps supplied for the project you are working on and engage the safety mechanism on venepuncture needles either 'in vein' (for BD push button needles) or immediately after use, where appropriate.

Dispose of the used needle immediately into the sharps disposal box.

Do not allow the sharps disposal box to fill above the 'fill line' as this can present the potential for a subsequent needlestick injury.

Label the tubes according to your CAPI instructions, immediately after completing the venepuncture procedure. Refer to the project specific instructions for further guidance about labelling and packaging the blood samples.

It cannot be stressed enough the importance of correctly labelling each tube with the correct serial number for the person from whom the blood was obtained. Apart from the risk of matching up the blood analyses to the wrong person's data, we will be sending the GP the wrong results. Imagine the implications of an abnormal result being reported to the wrong participant.

Some projects provide participant specific barcode labels. You must therefore take great care to ensure the right labels are used on the right blood samples prior to packing and dispatching the samples!

Other important points

‘Giving a blood sample’ leaflet

We need to be sure that each participant is left with information about giving a blood sample, including information about who to contact should they experience any side effects as a result of the blood sample.

To provide them with this information, leave the participant with the leaflet ‘Giving a blood sample’. The leaflet includes information on any possible side effects they may experience such as pain and bruising, and how to care for the puncture site. It is also a useful leaflet to leave behind to reassure the friends and family of the participant of the procedure used should they have any concerns after your visit.

Venepuncture check questions

Always complete the Venepuncture checklist on CAPI for every participant from whom you attempt to take blood. This shows that you have followed the correct procedure, and noted, where applicable, any abnormalities, and the action you took. The checklist is usually towards the end of the CAPI.

Please remember to check the participant’s venepuncture site just before you leave and note any changes in their physical appearance in CAPI.

Fainting participants

If a participant looks or feels faint during the venepuncture procedure, it should be discontinued. The participant should be asked to lie down with feet elevated.

If they agree for the test to be continued after a suitable length of time, the procedure should be performed with the participant lying down and the circumstances should be recorded in CAPI.

If a participant fully faints, then you should apply the principles of first aid by:

- Calling for help / assistance, if there is another adult relative within the house
- Ensure the participant is supported safely and eased into a position lying down on their side, where they can recover. Loosen tight clothing and elevate the legs.
- Remain with the participant until they come round and feel able to slowly move to a sitting position.
- Discontinue the interview unless, in your professional opinion you and the participant feels it is safe to continue.
- Ensure you submit a Special Report Form to the Field Quality Unit detailing what happened, what course of action you took and how the participant appeared when leaving them.
- NB: - Should a participant not recover as quickly as expected from a fainting episode then the course of action is to phone the Emergency Services and hand over the situation to them.

Fitting participants

It is rare for a participant to experience a fit or experience a convulsion during the venepuncture procedure, especially as those with a declared history of fitting or convulsion within the previous five years will have been excluded. However, there is always a possibility of this happening.

If a participant appears to have an episode of fitting or convulsion during or immediately after venepuncture procedure, then you should apply the principles of first aid by:

- Calling for help / assistance, if there is another adult relative within the house. If there isn't any other person in the household to support / assist you, then you should call the emergency services.
- Ensure the participant is supported safely and eased into a position lying down on their side, with their airway supported open and where they can recover safely
- Remain with the participant until they come round, monitor their level of response, pulse and breathing.
- Ensure you submit a Special Report Form to the Field Quality Unit detailing what happened, what course of action you took and how the participant appeared when leaving them.

Handling & disposal of needles and other materials

Safe disposal of needles is required to control the risk of injury from the disposed sharps. Without the safe disposal of needles there is an increased risk of needle stick injuries and/or psychological trauma due to fear of potential infection. NatCen's policy is that only safety sharps are provided for use on all projects requiring blood sampling.

Precautions

- Wear gloves at all times when performing the venepuncture procedure to reduce blood 'transmission load' if a needlestick injury occurs
- Sharps should be disposed of at the point of use
- Do not carry sharps unnecessarily
- Sharps handling must be kept to a minimum
- Needles must not be passed directly from hand to hand
- Needles must not be bent or broken prior to use
- Safety Sharps mechanisms should always be engaged at point of use.
- Never hand sharps to anyone else unless they are an authorised Sharps and Hazardous Waste Disposal registered service.

Disposal

Do:

Continue to wear gloves when disposing of sharps and related contaminated waste

Sharps must always be disposed of in the NatCen provided 1L 'sharps bins' immediately after use

A Sharps bin should be available beside you before opening and using the sharp

Fully seal the sharps bin when the manufacturer's marked line has been reached or when it is three quarters full (see Sharps Disposal Policy)

Check to ensure that the sharps bin lid is securely closed and sealed as per Sharps Disposal Policy

Don't:

Fill sharps containers above the manufacturer's marked line

Dispose of sharps with other clinical waste

Put your hands into sharps bins

Never return any used sharps bins by post or courier to the Equipment Unit or other member of the freelance nurse or interviewer panel by a postal / courier service.

Allow non NatCen personnel (e.g. friends / family / colleagues / neighbours) to handle any sharps bins on your behalf.

Any non sharps venepuncture waste (e.g. gauze swab, gloves, plaster covering etc) can be disposed of in the participant's household waste.

Needle stick injury
In the event of a Needlestick injury (by participant or nurse) – follow NatCen's specific needlestick injury protocol.

Participants who are HIV or Hepatitis B / C positive

If a participant volunteers that they are HIV, Hepatitis B or Hepatitis C positive, **do not** take a blood sample. Record this as the reason for not taking a blood sample in the CAPI. You should never, of course, seek this information outright unless it is specified in the Project CAPI questionnaire.

Participants who declare they are HIV or Hepatitis B positive during or after venepuncture procedure

If a participant volunteers this information whilst a blood sample is actively being taken – then inform the participant politely that you must stop the procedure, at that point, as any blood taken for research purposes cannot be sent to the laboratory for processing. Dispose of the tubes already filled into the sharps bin and once all sharps

are within the bin, the bin should be fully sealed and disposed of according to the current NatCen contaminated waste and sharp disposal procedure.

Record the relevant information into the CAPI – including completion of the venepuncture check questions.

Ensure you submit a Special Report Form to the Field Quality Unit detailing the situation, what course of action you took and how the participant appeared when leaving.

Participant feedback

Results from some blood tests (though not necessarily all) are usually sent to the participant as part of the Project requirements. If the participant gives written consent for the results of their blood sample to be sent to their GP then they are also able to get feedback on the results.

Saliva sample

Saliva samples are taken from participants for analysis to detect various chemical compounds (depending on the aims of the individual surveys) to provide information on people's health and lifestyle. For HSE, saliva is taken to measure cotinine, a derivative of nicotine showing levels of exposure to tobacco smoke.

Exclusion criteria

Participants are excluded from giving a saliva sample if they:

- Are pregnant
- Are HIV positive
- Have Hepatitis B or C

Do not ask for information regarding HIV and Hepatitis B or C, however if they volunteer it, record them as unable to give a sample and make a note.

Consent

There is a separate consent form for the saliva sample. This must be signed and dated by the participant or by the parent or legal guardian in the case of children aged 15 years and below. Please make it clear to participants that they will not receive results regarding their saliva sample.

Preparing the participant

Explain to the participant what you will require them to do and the reasons behind why saliva samples are taken.

Equipment

You will need:

- A plain 5ml tube
- A short wide bore straw
- Kitchen paper
- Gloves

Procedure

Remove the cap from the plain tube. Give the straw to the participant. Explain that you want him/her to collect their saliva in their mouth and then let it dribble down the straw into the tube. The saliva does not need to go through the straw, the straw is intended to direct the saliva into the tube. Ensure that you are not getting sputum i.e. they are not clearing their chest to collect their saliva.

Allow the participant three minutes to do this, collecting as much as you can in this time. The saliva will be frothy and will look greater in volume than it actually is, so do not give up too soon. You need at least 0.5cm on depth in the tube, not including froth.

If participants find it difficult to use the straw they may dribble into the tube directly. This is acceptable, but encourage them to use the straw where possible.

If a participant's mouth is excessively dry and they cannot produce saliva allow them to have a drink of plain water. Wait for five minutes before collecting the sample to ensure that water is not retained when the sample is given.

Replace the cap on the tube and report any problems in CAPI. You should wear gloves at all times when you come in contact with a saliva sample.

Label and package as directed in the project specific instructions.

Appendix C: About the population estimates

Introduction

This section provides a technical description of the methods used to calculate the number estimates and accompanying margins of error, including a worked example. The method used is valid only from the introduction of non-response weighting into the HSE series and so number estimates are presented from 2003 onwards.

Number estimates

For each indicator, the prevalence data presented in the trend tables were multiplied by a scaling factor to estimate the number of people with particular characteristics or behaviour (for example, the number of obese adults, or the number of children who ate five or more portions of fruit and vegetables in the preceding day).

The scaling factor was based on two figures. The first was the ONS mid-year population estimate for the relevant year, adjusted to represent the population living in private households.

The second was an estimate of the proportion of people in the relevant age-sex group, for example, the percentage of the adult population who were men aged 16 to 24. The proportions in each age-sex group were calculated from the weighted HSE data. Different estimates of the proportions in each age-sex group were calculated for each table, based on the respondents to the relevant questions. This means that the age-sex distribution shown in the tables and estimated from HSE data does not correspond exactly to the age-sex distribution estimated by the ONS.[66]

[66] For example, the estimates of usual weekly alcohol consumption were based on respondents who answered questions about whether they drank alcohol, how often they did so and what they drank in a typical week. There was some non-response to each of these questions among survey participants, which was not corrected for by the weighting applied to interview data (which corrected for overall survey non-response). The age profile for the achieved sample with a valid estimate of weekly alcohol consumption in 2019, shown in the table below, differed from the ONS population estimates for 2019 (adjusted for institutional populations), shown in the shaded column.

Age profiles for ONS household population and bases for HSE estimates of weekly alcohol consumption

Age group	ONS	HSE
	2019	2019
	%	%
16-24	13.2	11.9
25-34	16.9	16.7
35-44	15.8	16.3
45-54	16.9	17.3
55-64	15.0	15.4
65-74	12.3	12.5
75+	9.9	10.0

This method allows the prevalence estimates to be re-created from the number estimate tables.

The weighting variable can be denoted as w_{ij} where i denotes the age-sex group of the HSE respondent (e.g. men aged 16 to 24) and j denotes the respondents to the question within each age-sex group.

Then the weighted number of respondents to the question can be expressed as:

$$w = \sum_{i,j} w_{ij} \qquad [1]$$

and the weighted number of respondents of a particular age-sex group as:

$$w_i = \sum_{j} w_{ij} \qquad [2]$$

Dividing [2] by [1] gives the estimate of the proportion of the population belonging to a particular age-sex group.

If the overall ONS mid-year population estimate (men and women combined) is labelled as P, then the HSE estimate of the number of persons belonging to age-sex group i (labelled M_i) can be expressed as:

$$M_i = P\left(\frac{w_i}{w}\right) \qquad [3]$$

This is the scaling factor described above: the ONS mid-year population total (P) multiplied by the estimate of the proportion of people in the relevant age-sex group. Note that due to item non-response (refusals and don't knows) the proportion will be slightly different for each table.

Finally, if the number estimate for age-sex group i and health indicator k is labelled N_{ik}, and the corresponding prevalence estimate is labelled ϕ_{ik}, then the number estimate can be derived as follows:

$$N_{ik} = P\frac{w_i}{w}\phi_{ik} \qquad [4]$$

In other words, the estimated number of, for example, men aged 16 to 24 who did not drink alcohol can be expressed as the overall ONS population estimate P, multiplied by the proportion of respondents with a valid estimate of alcohol consumption who were male aged 16 to 24, multiplied by the estimated prevalence of non-drinking for men aged 16 to 24.

Using this calculation method allows the estimates in the prevalence trend tables to be reproduced from the number estimates, ensuring consistency between the two sets of tables. Consequently, the only ONS mid-year population estimate that can be reproduced from these figures is the overall population figure, P (i.e. total population aged 16 and over in the relevant year). The proportion of people in the relevant age-sex group is taken from the HSE data, and is not based on the ONS estimates; the prevalence estimates cannot (and should not) be derived by dividing the number estimate for each age-sex group by the corresponding ONS age-sex population estimate.[67] For prevalence estimates users are advised to consult the prevalence trend tables.

Margin of error

The margin of error (MoE) of the number estimates is calculated by multiplying the MoE of the prevalence by M_i, the scaling factor used to create the number estimates. If E_{ik} is the MoE for a number estimate and ε_{ik} is the MoE of the associated prevalence, then:

$$\mathrm{E}_{ik} = \frac{Pw_i\varepsilon_{ik}}{w} \qquad [5]$$

The standard error of the prevalence is calculated using SPSS and taking into account the complex sample design. The MoE is then calculated by multiplying the standard error by 1.96.

In order to use equation 5, it must be assumed that no further uncertainty is added to the number estimate when the prevalence is multiplied by the scaling factor, in other words that the scaling factor $P\frac{w_i}{w}$ is constant. It is assumed that the ONS estimates *P* have small enough variance to discount.

The same assumption can be made for the factor $\frac{w_i}{w}$. This assumption is justified by considering that $\frac{w_i}{w}$ is the weighted proportion of respondents for a particular age-sex group. The purpose of the weighting is to correct the figures for non-response. The weighting scheme uses several variables including age and sex. The weighting is chosen to make $\frac{w_i}{w}$ approximately equal to a fixed value, taken from the ONS population estimates. That is, although the age-sex distribution of the sample is prone

[67] See footnote 66 for details.

to sampling error, the weighting 'fixes' the values of $\frac{w_i}{w}$ to be approximately equal to the ONS population estimates.

It should be noted that the variance of $\frac{w_i}{w}$ is not exactly zero. Due to the impact of other variables included in the weighting and differential item non-response the value of $\frac{w_i}{w}$ is not exactly the same for all possible samples. This means the assumption causes a slight underestimate in the value of the MoE. However, the variation is small and the assumption allows considerable computational efficiency gains.

Worked example

This worked example illustrates the method used to convert the prevalence estimates in some of the standard trend tables into estimates of the numbers of people in the population in England that they represent. The example used is the proportions of non-drinkers among men using HSE 2019. Table A shows the calculation of the number estimates; Table B the calculation of the margin of error. After each table the detailed calculations behind the numbers are explained.

Table A: 2019 number estimates (men who do not drink alcohol)

Age group	ONS population estimate P	Prevalence of not drinking alcohol ϕ_{ik}	Weighted number of respondents w	Weighted number of respondents of age-sex group w_i	HSE number estimate age-sex group M_i	Estimated number of non-drinkers N_{ik}
	Column					
	1	**2**	**3**	**4**	**5**	**6**
16-24	45,104,526	0.265	8,009	482	2,727,092	721,921
25-34	45,104,526	0.150	8,009	655	3,705,903	554,166
35-44	45,104,526	0.181	8,009	642	3,632,351	775,911
45-54	45,104,526	0.167	8,009	680	3,847,350	643,703
55-64	45,104,526	0.126	8,009	603	3,411,695	431,034
65-74	45,104,526	0.133	8,009	475	2,687,487	356,452
75+	45,104,526	0.194	8,009	355	2,008,543	390,595

Data in columns 2, 3 and 4 have been rounded, and the numbers shown are not exact.

Column 1 shows the overall ONS population estimate for adults, showing 45.1 million adults aged 16 and over living in private households in England on 30 June 2019.

Column 2 shows the estimated proportions of non-drinkers for each of the seven age groups. 26.5% of men aged 16 to 24 reported that they didn't drink alcohol, compared with 19.4% of men aged 75+.

Column 3 shows the weighted number of HSE respondents who answered the questions about alcohol consumption.[68] Note that not all adults who took part in the interview answered these questions (8,009 did so, compared with 8,205 adults who were interviewed).

Column 4 shows the weighted number of HSE respondents in each age-sex group. For example, 482 HSE 2019 respondents aged 16 and over with valid information about alcohol consumption were men aged 16 to 24.

Column 5 shows the proportion of HSE respondents in each age-sex group applied to the ONS population estimate (P) to give an HSE estimate of the number of persons in the population in each age-sex group: equation [3] above. In 2019, applying the proportion of HSE respondents who were male aged 16 to 24 (482/8,009 = 0.060) to the ONS population estimate gives an estimated number of 2,727,092 men aged 16 to 24.[69]

$$HSE\ estimate_{men,16\text{-}24} = 45{,}104{,}525\left(\frac{482}{8{,}009}\right) = 2{,}727{,}092$$

Column 6 shows the number estimate of men in England who did not drink alcohol in 2019, which can be calculated using equation [4].

As an illustration, for men aged 16 to 24, the estimate of the number who did not drink alcohol can be calculated as follows:

$$nondrink_{men,16\text{-}24} = 45{,}104{,}525\left(\frac{482}{8{,}009}\right)0.265 = 721{,}921\ \ (rounded\ to\ 722{,}000)$$

The number in the population estimated to be non-drinkers can be expressed as the prevalence (0.265 for men aged 16 to 24) multiplied by a scaling factor equal

[68] Using the non-response main interview weight, scaled to the achieved sample size, which results in the weight being standardised around an average of one. Weighted totals may not sum to a whole number.

[69] Numbers shown in column 5 are based on unrounded figures and consequently differ slightly from those produced by using the rounded figures shown here. Using the latter, 45,104,526*(482/8,009) totals to 2,714,494. There are similar discrepancies between rounded and unrounded calculations for other age groups.

to the ONS mid-year population estimate (45.1 million) multiplied by the HSE estimate of the proportion of men aged 16 to 24 (482/8,009 = 0.060).[70]

Note, therefore, that the HSE estimate of the proportion of the population in England in each age-sex group does not match exactly the equivalent ONS mid-year estimate (see footnote 66). The only ONS mid-year population estimate that can be reproduced is the *overall* population figure.

Table B: Estimated margin of error

Age group	Prevalence of not drinking alcohol ϕ_{ik}	Estimated standard error *SE*	HSE number estimate (age-sex group) M_i	Standard error of estimated number of non-drinkers	Margin of error (unrounded)
	Column				
	1	**2**	**3**	**4**	**5**
16-24	0.265	0.031	2,727,092	84,868	166,341
25-34	0.150	0.019	3,705,903	71,778	140,686
35-44	0.181	0.018	3,632,351	67,089	131,494
45-54	0.167	0.017	3,847,350	66,227	129,804
55-64	0.126	0.014	3,411,695	46,585	91,306
65-74	0.133	0.015	2,687,487	39,588	77,592
75+	0.194	0.020	2,008,543	39,391	77,207

Columns 1 and 2 show the estimated prevalence of not drinking alcohol and accompanying standard error (SE) respectively (both expressed as a proportion).

Column 3 shows the HSE estimate of the number of residents in England in each age-sex group (described above).

Column 4 shows the SE of the estimated number that did not drink alcohol. It is calculated by multiplying the SE of the prevalence by the estimated number of people in the relevant age-sex group (column 2 $\times$ column 3). For men aged 16 to 24, the estimated SE of the number who were non-drinkers can be calculated as follows:

[70] Numbers shown in column 6 are based on unrounded figures and consequently differ slightly from those produced by using the rounded figures shown here. Using the latter, 45,104,526*(482/8,009)*0.265 totals to 719,341. There are similar discrepancies between rounded and unrounded calculations for other age groups.

$$SE\ number\ nondrink_{men,16\text{-}24} = 0.031 \times 2{,}727{,}092 = 84{,}868$$

Column 5 gives the margin of error (MoE): the estimated SE of the number estimate multiplied by 1.96. For men aged 16 to 24 the MoE is as follows:

$$MoEnumbernondrink_{men,16\text{-}24} = 84{,}868 \times 1.96$$
$$= 166{,}341\ (rounded\ to\ \pm 166{,}000)$$

Note that in these two worked examples, all figures based on survey estimates or weighted survey data have been rounded and so the estimated population projections and margins of error cannot be exactly calculated step-by-step as presented here.

Appendix D: Acknowledgements

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