Health Survey for England 2015
Methods

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This report provides details of the methodology of the Health Survey for England 2015, covering sample design, topic coverage, fieldwork procedures and 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 to see the details of the methodology of the Health Survey for England 2015.

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 2015 survey is the twenty fifth. All surveys have covered the adult population aged 16 and over living in private households in England. Since 1995, the surveys have also covered children aged 2 to 15 living in households selected for the survey. Since 2001, infants aged under 2 have been included as well as older children.

The HSE is part of a programme of surveys commissioned between 2005 and 2016 by the Health and Social Care Information Centre (NHS Digital since August 2016). Before April 2005, the survey series was commissioned by the Department of Health. The surveys provide regular information that cannot be obtained from other sources on a range of aspects concerning the public's health, and many of the factors that affect health. 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 selected 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; in 2015, there was a boosted sample of children aged 2 to 15.

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).

1.2 The 2015 survey

1.2.1 Topics

Core topics include general health and longstanding illness, key lifestyle behaviours that influence health, and social care. In 2015, the focus of the survey was on children's health, and an additional module of questions on children's physical activity was included.

Other additional modules of questions included were:

- gambling
- learning difficulties (as in 2014)
- shingles
- stroke.

Details of the core topics included in 2015 can be found in Section 3.

1.2.2 Summary of survey design

Core survey
As with all previous years, the 2015 HSE involved a stratified random probability sample of households. The core sample comprised 9,372 addresses selected at random in 579 postcode sectors. Adults and children were interviewed at households identified at the selected addresses. To limit the respondent burden for parents, up to four children in each household were selected at random: up to two aged 2 to 12, and up to two aged 13 to 15. Data collection involved an interview, followed by a visit from a specially trained nurse for all those who agreed. The nurse visit included measurements and collection of blood and saliva samples, as well as additional questions.

Addresses were issued over 12 months from January to December 2015, with an additional issue in January 2016. Fieldwork was completed in April 2016. For further details on sampling see Section 2. A household response rate of 60% was achieved. A total of 8,034 adults and 2,123 children were interviewed, including 5,378 adults and 1,297 children who had a nurse visit.

Child boost
The child boost sample comprised 17,252 addresses. For reasons of efficiency, these were drawn from the same PSUs as the core fieldwork for most of the fieldwork period. Households were screened for the presence of children aged 2 to 15. Only children were interviewed; as with the core sample this included up to four children in selected households: up to two aged 2 to 12, and up to two aged 13 to 15. Children in the boost sample were not eligible for a nurse visit.

Addresses were issued over ten months from March to December 2015, with additional issues in January and February 2016. Fieldwork for the child boost was completed in April 2016. 3,631 households were identified as containing at least one eligible child; a household response rate of 63% was achieved in these. A total of 3,591 children were interviewed as part of the boost sample.

1.3 Reports on the Health Survey for England 2015

In 2015, findings from the HSE 2015 have been published online as nine separate topic reports, each accompanied by tables in Excel format.

- Adults' cigarette smoking
- Adults' alcohol consumption
- Adults' overweight and obesity
- Adults' social care
- Children's physical activity

- Children's overweight and obesity
- Children's smoking and exposure to other people's smoke
- Children's alcohol consumption
- Children's well-being

These reports can be accessed via http://digital.nhs.uk/pubs/hse2015.

Trend tables for key statistics for adults and children from 2015 and earlier years, including health measures and lifestyle behaviours, are published with a commentary at http://digital.nhs.uk/pubs/hse2015trend. Estimates of population numbers for selected indicators are also provided.

For adults, the trend tables include the following topics:

- Blood pressure
- Mean height and weight
- Body mass index, prevalence of overweight and obesity*
- Mean waist circumference
- Weekly alcohol consumption
- Maximum alcohol consumption on any day in the last week*
- Cigarette smoking*
- Fruit and vegetable consumption*
- General health, longstanding illness and acute sickness
- Prevalence of ischaemic heart disease (IHD) or stroke
- Prevalence of diabetes
- Levels of physical activity*
- Well-being.

For children, the trend tables include the following topics:

- Mean height and weight
- Body mass index, prevalence of overweight and obesity*
- Cigarette smoking
- Experience of alcohol
- Fruit and vegetable consumption*
- General health, longstanding illness and acute sickness
- Levels of physical activity*.

*Population estimates are also available for these topics.

1.4 Availability of datasets

Copies of the anonymised datasets for each survey since 1993 are available through the UK Data Service. These include all questions asked, not just those covered in the reports. A copy of the anonymised HSE 2015 dataset will be deposited with the UK Data Service in early 2017. Full documentation is available in the archive, including a list of all the variables and definitions for derived variables. For further information go to https://discover.ukdataservice.ac.uk/series/?sn=2000021 .

2 Sample design

2.1 Overview of the sample design

The sample for HSE 2015 comprised two main components: the core (general population) sample and a boost sample of children aged 2 to 15.

The core sample was designed to be representative of the population living in private households in England. Those living in institutions were outside the scope of the survey. 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.

The child boost sample was drawn in order to increase the size of the sample of children aged 2 to 15, to enable more robust analysis of subgroups within this age range.

Like previous surveys in the HSE series, the 2015 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.

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 the 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 2001 Census from NS-SEC groups 1 and 2.[1] PSUs in smallest regions (the North East and East Midlands) were over-sampled to provide a minimum sample size (of approximately 700 adults).

2.2.2 Core sample

For the core sample, initially 552 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.

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. Each month the PSUs were evenly distributed by month in each fieldwork area.

The initial sample design included a ‘reserve’ for the final quarter of the year (8 PSUs). The intention was that, if the response rate achieved in the early months of the year was high and the target number of achieved interviews (8,000 adults) was likely to be exceeded, some points could be withdrawn in the final quarter of the year without

affecting the representative coverage of the sample. In the event, not only were the reserve points issued, but an additional sample of 27 PSUs was released in January 2016 due to lower than expected response rate. Therefore a total of 579 PSUs were issued for the core sample.

2.2.3 Child boost

In order to increase fieldwork efficiency, the child boost was designed to be sampled within the PSUs drawn for the core sample. 35 PSUs per month (from March to December) were drawn at random from the core sample PSUs, resulting in 350 PSUs for the child boost sample.

As for the core sample, it was necessary to draw additional sample of points for the child boost. Again, in order to make the work of the field more efficient, 104 points were selected at the same time as selecting the 2016 core sample. These were issued in January and February 2016.

2.3 Sampling addresses, dwelling units and households

Within each of the PSUs, a fixed number of addresses was selected. Table 1 summarizes the number of PSUs and addresses issued for core and child boost samples, including additional samples. In total, 9,372 addresses were issued for the core sample and 17,252 for the child boost.

Table 1: Number of PSUs and addresses issued for HSE 2015

	Number of PSUs	Number of addresses per PSU	Number of addresses issued
Core sample			
Mainstage	552	16	8,832
Additional sample (January 2016)	27	20	540
Total core sample	579		9,372
Child boost			
Mainstage	350	38	13,300
Additional sample (January & February 2016)	104	38	3,952
Total child boost	454		17,252
Total	1,033		26,624

When visited by interviewers, 10% of the selected addresses in the core sample and 6% of the boost sample 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 A1, A2

Most addresses selected from the PAF contained a single dwelling unit and/or household.[2] 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.[3]

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 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. 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.

For the child boost sample, children under 2 were not eligible for the study. The selection procedures were similar to the core sample: up to two children aged 2 to 12 and up to two children aged 13 to 15 could be selected to take part.

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.

3 Topic coverage

3.1 Documentation

Copies of the survey data collection documents are available, as well as protocols for measurements and for the collection of blood and saliva samples can be accessed via http://digital.nhs.uk/pubs/hse2015 .

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. Any household members with learning difficulties were also identified at this stage.[4]

Adults were asked core modules of questions, including general health, social care, alcohol consumption and smoking. Self-reported height and weight was established early in the interview, to provide a comparison with the height and weight measurements which were taken later. Participants were asked additional questions about their personal circumstances, and were also asked for consent to link their survey data to other records held by the NHS.

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, fruit and vegetable consumption, exposure to second-hand smoke, physical activity and ethnicity.

The content of the interview for different age groups is shown in Figure 1.

Participants aged 8 and over were asked to fill in a self-completion booklet during the interview. There were four booklets for different age groups. The booklets for young adults aged 16 to 17 asked about smoking and drinking behaviour as well as other questions. Interviewers also had the option of using this booklet for those aged 18 to 24 if they felt that it would be difficult for anyone in this age group to give honest answers to the questions face-to-face with other household members present. The content of the self-completion booklets for different age groups is shown in Figure 2.

Figure 1: Content of interview by age group

Age in years	0-1	2-4	5-15	16-65	65+
General health, longstanding illness, limiting longstanding illness	•	•	•	•	•
Self-reported height and weight				•	•
Personal care plans				•	•
Doctor diagnosed hypertension and diabetes				•	•
Use of health services				•	•
Shingles and stroke				•	•
Receipt of social care					•
Provision of social care				•	•
Smoking[a]				•[a]	•
Exposure to second-hand smoke	•	•	•		
Drinking[a]				•[a]	•
Fruit and vegetable consumption			•	•	•
Physical activity		•	•		
Height and weight measurements		•	•	•	•
Reported birth weight	•	•	•		
Economic status, occupation				•	•
Educational attainment				•	•
Ethnic origin, national identity	•	•	•	•	•
Consent to link data to health records				•	•

[a] Questions about smoking and drinking were included in the self-completion questionnaires for young adults aged 16 to 17. Interviewers also had the option of using this booklet for those aged 18 to 24 if they felt that they would be inhibited from giving honest answers to the questions face-to-face with other household members present.

Figure 2: Content of self-completion booklets by age group

Age in years	8-12	13-15	16-17	18+
Smoking[a]	•	•	•	
Drinking[a]	•	•	•	
Well-being (Warwick Edinburgh Mental Well-being Scale)[b]		•	•	•
Well-being (ONS measures)[b]		•		
Gambling			•	•
Learning difficulties			•	•
Physical activity[b]		•	•	•
Perception of own weight	•	•	•	•
Perception of child's weight			•	•
Learning difficulties[c]			•	•
Sexual orientation			•	•
Religion			•	•

[a] Interviewers had the option of using the booklet for 16 and 17 year olds for those aged 18 to 24 if they felt that they would be inhibited from giving honest answers to the questions about smoking and drinking face-to-face with other household members present.

[b] In January and February 2015, there was no child boost sample and the booklets for children aged 8 to 15 omitted questions about well-being and physical activity.

[c] Adults were asked about their own experience of learning difficulties; parents answered on behalf of children aged 11 to 15. In addition, a responsible adult completed a similar questionnaire on behalf of anyone in the household who had already been identified as having learning difficulties.

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

3.3 The Stage 2 nurse visit

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 the use of nicotine replacement products. 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[5] for the analysis of total and HDL cholesterol and glycated haemoglobin. 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.

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.

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

4.2 Making contact

At initial contact, the interviewer established the number of dwelling units and/or 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.

4.3 Collecting data

4.3.1 Core interview

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)[6] or their partner wherever possible. This questionnaire obtained information about all 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, two were selected.

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.

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

At the end of the interview, participants 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 4.4 for details). Wherever possible, an appointment was made for the nurse to visit within a few days of the interview. At this visit the nurse carried out the measurements described in Section 3.3 and obtained 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 via http://digital.nhs.uk/pubs/hse2015.

4.3.2 Child boost interview

For the child boost sample, households were screened for the presence of any children aged between 2 and 15. In households containing at least one child in this age range, the interview followed the same procedure as for the core sample, except that adults were not interviewed and no nurse visit was carried out.

4.4 Obtaining informed consent

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, urine and saliva samples)
- passing on information to others, for instance sending 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 (available via http://digital.nhs.uk/pubs/hse2015), 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.

Parents gave consent on behalf of their children aged up to 15 years; children also had to give their assent for an element to go ahead. This is described in more detail in the next section.

4.5 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.[7]

4.6 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 interview length for a single adult was 38 minutes, and for two people (including at least one adult) median interview length was 59 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 33 minutes.[8]

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, the median interview length was 26 minutes for a single child aged 8 to 15, and 40 minutes for two children of this age. The median length of the nurse interview for a child was 11 minutes.

4.7 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 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 via http://digital.nhs.uk/pubs/hse2015.) 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 and ethical approval

5.1 Quality control measures

5.1.1 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; see http://digital.nhs.uk/pubs/hse2015.

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.

5.1.2 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 carried out an activity on more than 28 days in the last four weeks the interviewer would not be able to enter this (a hard check). For children, the checks were age specific.

At the end of each survey month, the measurements made by each interviewer and nurse were inspected. 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.

5.2 Ethical approval

Ethical approval for the 2015 survey was obtained from the West London Research Ethics Committee (reference number 14/LO/0862).

6 Survey response

6.1 Introduction to response analysis

This section looks at the response of households in the general population (core) 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. Section 6.5 looks at the response among the total sample of children, combining the general population and the boost samples.

Participants were asked to co-operate in a sequence of survey stages. All respondents were asked to take part in a face-to-face interview, as well as measurement of height and weight. Adults and children in the general population sample were offered a nurse visit, including various measurements and a request for a saliva sample from adults and children and blood samples from adults. 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 tables can be found in the Appendix to this report.

6.2 General population sample: household response

Table A1 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 (5,111) 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.

42% of eligible households were 'fully co-operating' where all eligible persons were interviewed, had height and weight measured and agreed to the nurse visit. (Households where a participant was ineligible for a height or weight measurement because of a functional impairment or pregnancy are not counted as fully co-operating for this response analysis.)

Non-respondents to the survey fall 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.

10% of selected addresses were ineligible. Table A3 gives detailed outcomes for these and other non-responding households.

Tables A1, A3

6.3 General population sample: individual response for adults

6.3.1 Overall response

There were 8,034 individual interviews with adults, and 5,378 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 (9,475 adults in 5,111 households, average 1.85 per household)
- non co-operating households where information on the number of adults is known (3,681 adults in 2,394 households, average 1.54)
- non co-operating households about which nothing is known (476 households).

The most reasonable assumption is to attribute to the last group the same average number of adults (1.75) as for all households where the number of adults is known (the sum of the first two groups); this gives an estimate of 834 adults in these households. Summing this with the first two groups, this gives an estimated total of 13,990 eligible adults, known as the ‘set’ sample.

A further assumption is 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. However, it can be assumed that the proportion of men and women in the estimated total sample is the same as for the adults in the 5,111 co-operating households. The proportions are 48% men and 52% women. Applying these proportions to the estimated total of adults gives ‘set’ samples of 6,681 men and 7,309 women.

Using the estimated total number of adults in sampled households, the adult ‘set’ sample, as a denominator, minimum response rates for adults in the sample were as shown in Table A6, and summarised below. The response to the interview was 57% overall, being 54% among men and 61% among women.

Table A6

Table 2: Response among all adults

	Men	Women	All adults
	%	%	%
Interviewed	54	61	57
Height measured	47	54	51
Weight measured	47	52	50
Saw a nurse	36	41	38
Waist and hip measured	35	39	37
Blood pressure measured	35	40	38
Gave blood sample	27	30	28
Gave saliva sample	34	39	37

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 A8 to A10 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 3 below.

Table 3: Response among adults in co-operating households

	Men	Women	All adults
	%	%	%
Interviewed	79	90	85
Height measured	70	80	75
Weight measured	69	77	73
Saw a nurse	53	61	57
Waist and hip measured	51	58	55
Blood pressure measured	52	59	56
Gave blood sample	40	44	42
Gave saliva sample	51	57	54

In co-operating households, response was highest among the oldest age groups (93% of men and 96% of women aged 75 and over were interviewed), and lowest among those aged 16 to 24 (56% of men and 72% of women were interviewed).

It should be noted that, 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 A8 to A10

6.4 General population sample: individual response for children aged 0 to 15

6.4.1 Overall response among children

Within the general population sample, interviews were carried out with 2,123 children (1,064 boys and 1,059 girls) aged between 0 and 15. 1,297 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.. This resulted in a 'set sample' of 3,438 children.[9] This is likely to be an over-estimate, since non-contacted households have fewer children, on average, than those contacted. Response rates computed for children are therefore conservative.

Response to the interview was 61% among boys and 63% among 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 A7 and summarised in Table 4 below.

Table A7

Table 4: Response among all children in general population (core) sample

	Boys	Girls	All children
	%	%	%
Interviewed	61	63	62
Height measured	42	45	43
Weight measured	47	51	49
Saw a nurse	37	38	38

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, at 90% of eligible boys and 93% of eligible girls. The proportion interviewed was lower among children aged 11 to 15 (81% of boys and 87% of girls) than among those aged under 11 (93% of boys and 96% of girls).

Tables A11 to A13 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 5 below.

Table 5: Response among all children in co-operating households (core only)

	Boys	Girls	All children
	%	%	%
Interviewed	90	93	91
Height measured (aged 2 and over)	71	76	73
Weight measured	69	75	72
Saw a nurse	55	57	56
Gave saliva sample (aged 4 and over)	44	47	46
Blood pressure measured (aged 5 and over)	48	52	50
Waist and hip measured (aged 11 and over)	42	51	47

The majority of children who were eligible (i.e. those interviewed for height and weight, and those of the appropriate age having a nurse visit for the other measurements) co-operated with the measurements. 56% of children co-operated with the nurse visit.

Tables A11 to A13

6.6 General population and boost sample of children: individual response

A total of 3,591 children aged between 2 and 15 (1,782 boys and 1,809 girls) were interviewed in the boost sample, giving a total sample of 5,714 children (2,846 boys, 2,868 girls). In the boost sample, 63% of eligible households took part, and at 62% all eligible children took part. There were some differences in eligibility for different survey elements; the core sample but not the boost sample included infants aged under 2, and children in the boost sample did not have a nurse visit.

Tables A14 to A16 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 below.

Tables A14 to A16

Table 6: Response among all children in co-operating households (core and boost)

	Boys	Girls	All children
	%	%	%
Interviewed	96	97	96
Height measured	81	82	81
Weight measured	80	81	80

6.6 Variations in survey response

6.6.1 Regional variations in response

As in previous years, response varied by region. Household response was highest in the North West (66%) and was lowest in London (54%).

Table A4

6.6.2 Response by type of dwelling

Table A4 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 (64%), and lowest among households living in purpose-built flats (55%).

Table A5

6.7 Age and sex profile of the general population sample

Tables A17 and A18 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-2015 population estimates.[10]

Overall the 2015 HSE sample over-represented women relative to men (55% and 45% respectively, compared with 51% of men and 49% 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 55 and over were over-represented. The pattern was similar among women, with those aged under 25 under-represented at both stages. The proportions of women in other age groups at interview and nurse visit were within 2% to 3% of the population estimates.

Table A17

As Table A17 shows, among children aged 0 to 15, both the sex and age profiles of the achieved HSE sample were generally close to the population estimates.

Table A18

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. However, following a review of the weighting for the HSE 2003,[11] non-response weighting has been incorporated into the weighting strategy (as well as selection weights). This same strategy has been followed for weighting the HSE 2015 data.

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.[12]

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.

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) 2015 mid-year population estimates for sex/age groups and region as shown in Tables 7 and 8 below. Note that the population estimates were 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. 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.

Table 7: 2015 ONS mid-year population estimates by age and sex (adjusted)

Age (grouped)	Men		Women	
	N	%	N	%
0-4	1,760,388	6.5	1,674,292	6.1
5-10	2,036,215	7.6	1,941,321	7.1
11-15	1,532,217	5.7	1,460,681	5.3
16-24	3,168,692	11.8	3,024,178	11.0
25-34	3,745,263	13.9	3,740,733	13.6
35-44	3,535,782	13.1	3,571,590	13.0
45-54	3,805,185	14.1	3,895,175	14.2
55-64	3,044,343	11.3	3,138,700	11.4
65-74	2,523,235	9.4	2,717,980	9.9
75+	1,779,803	6.6	2,348,381	8.5
Total	26,931,123		27,513,031	

Table 8: 2015 ONS mid-year population estimates by region (adjusted)

Region	N	%
North East	2,608,229	4.8
North West	7,129,030	13.1
Yorkshire and the Humber	5,356,909	9.8
East Midlands	4,647,827	8.5
West Midlands	5,715,082	10.5
East of England	6,038,500	11.1
London	8,619,541	15.8
South East	8,892,028	16.3
South West	5,437,009	10.0
Total	54,444,155	

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 that children in larger households were not 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. The weights were trimmed at 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,[13] household type,[14] region, and social class of household reference person (HRP)[15]. 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.

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

Not all those interviewed went on to have a nurse visit (66% of those interviewed had 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 that had a nurse visit were eligible to have a blood sample taken, but not all those eligible agreed or were able to do so (74% of eligible participants had a blood sample taken). 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. 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

All 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 (92% did so). A regression model was fitted separately for adults and children, weighted by wt_nurse; the outcome variable was whether or not a usable saliva sample was obtained, and the following were used as covariates: age group, sex, household type, region, social class of HRP and general health.

The weights for non-participation for the saliva sample (w_8) 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_8. These weights were re-scaled so that the weighted cotinine sample size is the same as the achieved sample size.

7.2.11 Gambling module weight

The questions about gambling were included in the self-completion booklet for adults (aged 16 and over). Weighting was applied to adjust for non-response to the self-completion booklet, and also for whether the problem gambling screen in the self-completion booklet was completed.

A logistic regression model was fitted for those participants that were eligible to fill in the self-completion booklet (we have received a completed booklet from 96% of them). The outcome variable was whether or not the booklet was filled in. The covariates in the model were age group by sex, household type, social class of HRP, smoking status and general health.

The weights for not filling in the self-completion booklet (w_9) were calculated as the reciprocal of the predicted probability of the self-completion booklet being filled in, estimated from the regression models.

The weights were trimmed at the 0.5% tails to remove extreme values. The weights for the self-completion booklet sample were then calculated as wt_sc = wt_int x w_9. The weights were re-scaled so that the size of the weighted self-completion booklet sample was the same as the achieved sample size.

The same approach was used to generate the non-response weights for the problem gambling screen sampling. The weights for that component of non-response, i.e. not completing the problem gambling screen (w_{10}), were generated from a logistic regression model with the same covariates.

The weights were trimmed at the 0.5% tails to remove extreme values. The weights for the problem gambling screen sample were then calculated as wt_gambling = wt_sc

x w_{10}. The weights were re-scaled so that the size of the weighted problem gambling screen sample was the same as the achieved sample size.

7.3 Child sample weights combining general population and boost sample

7.3.1 Background

The child sample is defined as all children aged 0 to 15 from the core sample and all children aged 2 to 15 from the boost sample addresses. The weighting approach for this child sample is different from that used for children in the core sample (described in Section 7.2.5). This different approach is needed because no household information is obtained for the many households in the boost sample that are screened out once it is established that no children live there. This means there is no population data to weight to. Moreover, children from different age groups in the combined core and child boost sample did not have equal chances of selection, e.g. children aged 0 or 1 could have been selected only through the core sample.

There are several stages in generating the weights for the child sample: selection weights for the dwelling unit/household, selection weights for the children in the household, and calibration weighting to adjust the profile of the achieved sample.

7.3.2 Dwelling unit and household selection weights

The combined weights for the selection of dwelling units and households (w_1) were generated in the same way for the child boost sample as for the core sample (see Section 7.2.2 and 7.2.3).

7.3.3 Address and child selection weights

The children selection procedure differed slightly for the core and child boost sample:

- In each participating core sample household up to two children aged 0 to 12 and up to two children aged 13 to 15 were selected,
- In each participating child boost household up to two children aged 2 to 12 and up to two children aged 13 to 15 were selected.

Therefore, the person selection weight depended on the age of the respondent, as the probability of selection varied for the three groups: children aged 0 to 1 (who were included in the core sample only), children aged 2 to 12 (who were selected with infants in the core sample, but without infants in the boost sample), and those aged 13 to 15 (selected through both core and child boost).

In order that children in larger households were not under-represented in the sample, and the imbalances created by the use of different selection procedures were removed, selection probabilities were calculated separately for the three age groups. The selection probabilities depended on the regional selection probability for households and the number of children in the household in the relevant age group:

A = number of 0 to 1 year olds in a household

B = number of 2 to 12 year olds in a household

C = number of 13 to 15 year olds in a household

nc_i = number addresses selected in region i for the core

nb_i = number addresses selected in region i for the boost

N_i = total addresses in region 1

0-1 year olds

$nc_i / N_i * 2/(A+B)$

2-12 year olds

$nc_i / N_i * 2/(A+B) + nb_i / N_i * 2/B$

13-15 year olds

$nc_i / N_i * 2/C + nb_i / N_i * 2/C = (nc_i + nb_i)/ N_i * 2/C$

The weights were calculated as an inverse of selection probabilities, and multiplied by dwelling unit and household selection weight (w_1) to give the initial weights for the calibration (w_3).

Unlike the core children sample weights, the age/sex profile of the achieved sample was not adjusted to the profile all children in participating households (see Section 7.2.5); instead, calibration weighting was used to correct the age, sex and regional distribution of children (see Section 7.3.4).

7.3.4 Calibration weights for children

The achieved sample of children was calibrated to generate weights so that the (weighted) distributions for age/sex groups and GOR matched ONS 2015 mid-year population estimates (Tables 9 and 10 below). The aim of the calibration weighting was to reduce non-response bias resulting from differential non-response at the individual interview stage. The selection weights (w_3) were used as initial values when generating the calibration weights (w_4). These were re-scaled so that the weighted sample size is the same as the achieved sample size. This gave the final weight for the child sample: wt_child.

Table 9: 2015 ONS mid-year population estimates for children aged 0 to 15 by age and sex

Age (grouped)	N	%
Boy 0-1	684,097	6.6
Boy 2-3	718,228	6.9
Boy 4-5	709,843	6.8
Boy 6-7	696,761	6.7
Boy 8-9	670,364	6.4
Boy 10-11	629,320	6.0
Boy 12-13	601,180	5.8
Boy 14-15	619,027	5.9
Girl 0-1	649,873	6.2
Girl 2-3	683,291	6.6
Girl 4-5	676,959	6.5
Girl 6-7	664,360	6.4
Girl 8-9	638,367	6.1
Girl 10-11	600,543	5.8
Girl 12-13	572,559	5.5
Girl 14-15	590,342	5.7

Table 10: 2015 ONS mid-year population estimates for children aged 0 to 15 by region

Region	N	%
North East	465,017	4.5
North West	1,353,211	13.0
Yorkshire and the Humber	1,018,999	9.8
East Midlands	861,689	8.3
West Midlands	1,122,376	10.8
East of England	1,157,277	11.1
London	1,764,585	17.0
South East	1,704,480	16.4
South West	957,480	9.2
Total	10,405,114	

There were nurse visits and saliva samples for children at core addresses but not at boost addresses. Therefore, additional weights were not required for nurse visits and saliva samples for children; for the questions related to nurse visits weights derived for the core sample should be used (see sections 7.2.8).

7.4 Selecting the appropriate weight

Six 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
- Interview stage (*wt_child*): for children from the core and child boost sample
- Nurse visit (*wt_nurse*): for adults 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
- Gambling module sample (*wt_gambling*): for adults who completed problem gambling screen in the self-completion booklet

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.

7.5 Effect of the weights on the precision of the estimates

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

For instance, the DEFF of 1.17 for the interview weight indicates that the standard error of estimates is assumed to increase by 17%, with a corresponding loss of precision. Consequently these weighted estimates have same level of precision as an estimate based on a simple random sample, unweighted, of around 83% of the size of the actual sample. This is known as the effective sample size.

Table 11 summarises the effect of each weight on the precision of the estimates.

Table 11: Effect of HSE weights on the precision of survey estimates

	N	Effective sample size	DEFF
Interview weight (*wt_int*)	10,157	8,662	1.17
Interview weight (*wt_child*)	5,714	4,044	1.41
Nurse weight (*wt_nurse*)	6,675	5,290	1.26
Blood weight (*wt_blood*)	3,983	2,876	1.38
Cotinine sample (*wt_cotinine*)	5,795	4,545	1.27
Gambling module sample (*wt_gambling*)	6,755	5,626	1.20

Note that design effects and true standard errors have also been calculated for selected survey estimates presented in the topic chapters; see Section 8.8 and http://digital.nhs.uk/pubs/hse2015.

8 Data analysis and reporting

8.1 Introduction

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).

8.2 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 2015 data in this report are weighted (apart from response tables). Both weighted and unweighted bases are given in each table in the report.[16] The unweighted bases show the number of participants involved. 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, Volume 3, Methodology and Documentation.[17]

In this report, chapters focus mainly on 2015 results. Trend data on key measures can be found in *Health Survey for England 2015 Trend Tables* on the NHS Digital website, at http://digital.nhs.uk/pubs/hse2015trend.

8.3 Reporting age variables

8.3.1 Defining age for data collection

Some sections of the data collected in the HSE 2015 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.

8.4 Age standardisation

Adult data have been age-standardised throughout the 2015 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.

It should be noted that all analyses in the report are presented separately for men and women, as well as all adults. All age standardisation has been undertaken separately 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 2014 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 16-24, 25-34, 35-44, 45-54, 55-64, 65-74 and 75 and over; and in some cases the final age group was split into two further groups, 75-84 and 85+. 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*.

8.5 Standard analysis breakdowns

8.5.1 Introduction

For most tables in this report, two standard analysis breakdowns have been used as well as age. These are region and equivalised household income.

8.5.2 Region

Analysis by region is provided throughout the report. The former Government Office Regions have been used.

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.

It should be noted that base sizes for regions are often relatively small, and caution should be exercised in examining regional differences. In 2015, 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.

8.5.3 Equivalised household income

Household income was established by means of a show card (see field documents http://digital.nhs.uk/pubs/hse2015) on which banded incomes were presented. This can be used as an analysis variable, but there has been increasing interest recently in using measures of equivalised income that adjust income to take account of the number of persons in the household. 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 17% 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 B).

8.6 Significance testing

Significance testing is carried out on the results in the 2015 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[18]). For example the test 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.

8.7 Design effects and true standard errors

The HSE 2015 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 for survey estimates are generally higher than the standard errors 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 2015 have been calculated using a Taylor Series expansion method.[19] The deft values and true standard errors (which are themselves estimates subject to random sampling error) have been calculated for selected survey estimates; see http://digital.nhs.uk/pubs/hse2015.

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 2015 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.

The overall conclusion for the data provided in this chapter is that 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 2015.

9.1.2 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 2015 for the blood sample analyses. Salivary cotinine analyses for the HSE 2015 were conducted by ABS Laboratories in Welwyn Garden City, Hertfordshire.

9.1.3 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 4ml EDTA (ethylene diamine tetra-acetic acid) tube. The order of priority for collecting samples was first the 6ml plain tube (no anticoagulant), 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.

9.1.4 Saliva samples

A saliva sample was obtained by the survey nurses from participants aged four 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.

9.2 Methods

9.2.1 Laboratory procedures

All analyses were carried out according to Standard Operating Procedures by State Registered Biomedical Scientists (BMS) under the supervision of the 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, 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 A19 shows reference ranges used for each of the blood analytes measured in the HSE 2015. 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 A19

9.2.2 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. Initially this was on a Roche Modular P analyser, changed on June 16th 2015 to a Roche Cobas 702 analyser. Reference ranges were not changed, as the chemistries remained the same.

However, the effect of this change of equipment was that measured concentrations of total cholesterol were on average 0.1mmol/L lower.[20] A previous change had occurred on 12th April 2010, resulting in an average increase of 0.1mmol/L cholesterol. Unadjusted total cholesterol values are therefore comparable before 12th April 2010 and after 16th June 2015 (and very slightly higher in between).[21]

HDL cholesterol
HDL-cholesterol analysis was carried out in the Blood Sciences Department at the RVI using a direct method (no precipitation). Initially this was on a Roche Modular P analyser, changed on June 16th 2015 to a Roche Cobas 702 analyser. The effect of this change of equipment was that measured concentrations of HDL cholesterol were on average 0.1mmol/L lower.[20] A previous change had occurred on 12th April 2010, resulting in an average decrease of 0.1mmol/L cholesterol, i.e. reported HDL cholesterol is on average 0.2mmol/L lower after June 16th 2015 than before April 12th 2010.[21]

Glycated haemoglobin
Glycated haemoglobin (HbA1c) analysis was carried out in the Blood Sciences Department at the RVI using the Tosoh G8 analyser throughout HSE 2015. The Tosoh G8 analyser has been used in HSE since 26th August 2010; 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, when International Federation of Clinical Chemistry (IFCC) standardisation was introduced. 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.[22,23] The calibrator used after 19th September 2013 produced lower glycated haemoglobin results compared with the previous one.[24]

9.2.3 Saliva sample analytical methods and equipment

Cotinine

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).[25] A Tomtec Quadra was used to allow for the automation of some of the sample preparation. All methods were validated before use.

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.[25]

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.25 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 1-750ng/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 1-750ng/ml, provided there was sufficient saliva available from that participant.

9.3 Internal quality control (IQC)

9.3.1 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 tables. IQC values are assessed against an acceptable range and samples are re-analysed if any of the Westgard rules have been violated.[26,27,28]

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.

9.3.2 Non-fasting blood samples

Total and HDL cholesterol
Two levels of IQC were assayed throughout the day. Tables A20 and A21 show the monthly IQC results for total and HDL cholesterol.

Tables A20, A21

Glycated haemoglobin (HbA_{1c})
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 A22 shows the monthly IQC results for glycated haemoglobin.

Table A22

9.3.3 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 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 individual 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 monthly summary of the quality control samples results is collated and presented in Tables A23-A24.

Tables A23, A24

9.4 External quality assessment (EQA)

9.4.1 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 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 scheme does not include cotinine (tested by ABS laboratory); there is no EQA scheme for cotinine results.

For the blood samples, the standard deviation index (SDI) is reported here in addition to the target and achieved values, to conform with best practice across Europe.[29] The SDI is an index of total error, including components of inaccuracy and imprecision. It is calculated as:

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

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 A25-A27 are the reference values, or (if reference values are absent from the report) the mean for the specific method used by 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.[30] In two cases, the SDI indicated that the variation was outside acceptable limits; the laboratory investigations suggested that despite the SDI value there was no particular cause for concern. Footnotes have been included in the tables relating to the specific instances.

Each of the figures presented in Tables A25-A27 corresponds to an individual EQA sample.

9.4.2 Non-fasting blood samples

The Blood Sciences laboratory participates in the WEQAS scheme. Table A25 shows the monthly EQA results for total cholesterol, Table A26 for HDL cholesterol, and Table A27 for glycated haemoglobin. The target and achieved values are shown, along with SDI.

Tables A25 to A27

9.4.3 Saliva samples

Cotinine

There was no external quality control scheme available in 2015 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 2009.25

9.5 European comparison study

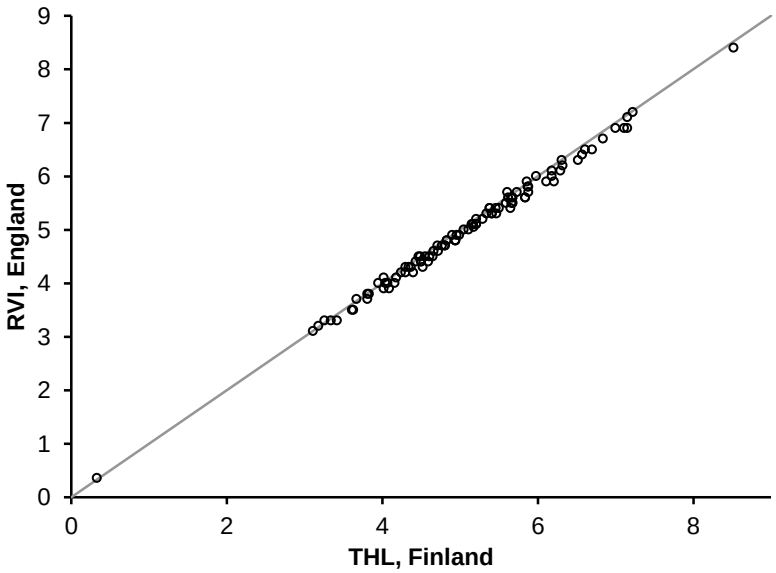
The HSE is part of the European Health Examination Survey (EHES) consortium, which aims to standardise national health examination surveys so that the data can be compared internationally. As part of this, 99 blood samples from HSE 2015, collected between 1st July 2015 and 20th March 2016, were re-analysed for total cholesterol and HDL cholesterol at the EHES laboratory in Helsinki.

The methods and equipment for total and HDL-cholesterol assays in the EHES laboratory, as in the RVI (see Section 9.2.2), have been calibrated to Center for Disease Control (CDC) guidelines. This is regarded as the 'gold standard'.

The total cholesterol results from the UK and Helsinki laboratories showed a very high correlation (0.997), as shown in Figure 1, and low mean bias (-0.09mmol/L). This equates to a systematic error of <2%, which is within the acceptable limits of 3% for total cholesterol. Bias was small, and did not depend on concentration or date of analysis.

Figure 1

Figure 1. Scatter plot RVI vs. THL measurment of total cholesterol mmol/L



The HDL cholesterol results also had a high correlation (0.975), as shown by Figure 2; and a low mean bias (-0.01mmol/L) equating to <1% systematic error (well within acceptable limits of 5%). Although bias was not dependent on date of analysis, there were noteworthy greater biases at extreme values low and high values (negative at the low, and positive at the high end), due to methodological differences between the

laboratories (Figure 3). The implication of this is that the UK values are suitable for comparison within the UK, however adjustments of very high or very low values could be considered for international comparison.

Figures 2 and 3

Figure 2. Scatter plot RVI vs. THL measurment of HDL cholesterol mmol/L

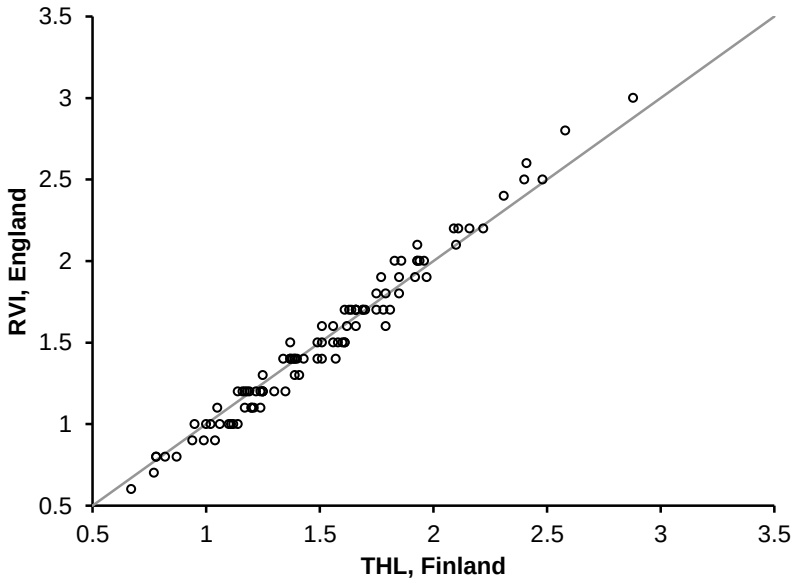
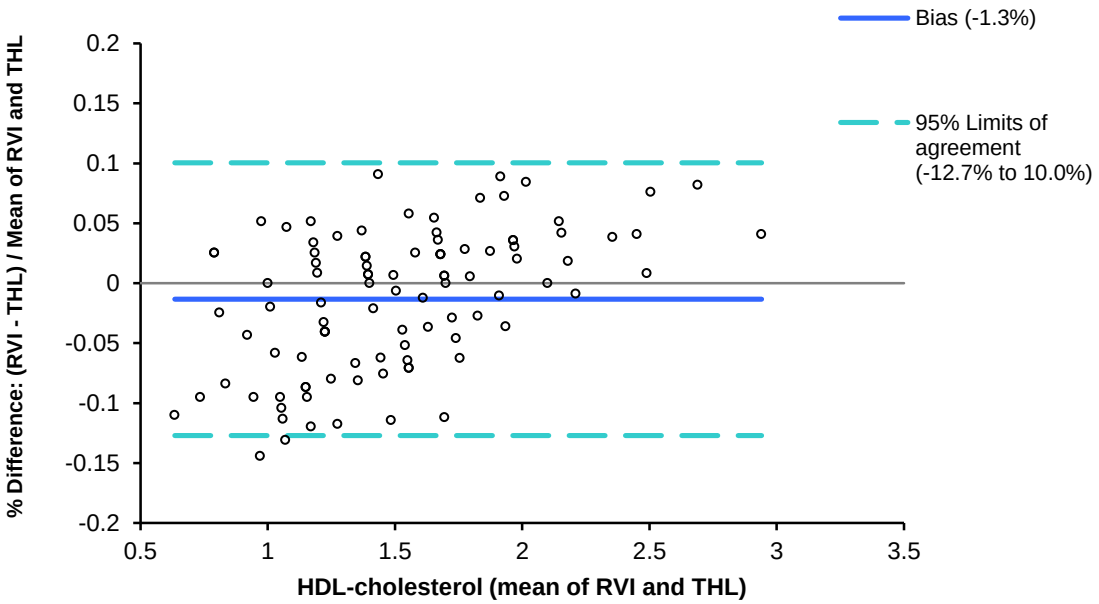


Figure 3. HDL-cholesterol bias difference (Altman-Bland) RVI vs. THL



Notes and references

1 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.

2 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.

3 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.

4 Adults with learning difficulties who were not considered capable of giving informed consent were not interviewed. A short questionnaire focusing on their learning difficulties was completed by a responsible adult in the household; otherwise no information was collected by proxy.

5 For some blood sample analyses it is necessary for participants to 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. However, for the analytes in the HSE, 'non-fasting' blood samples can be used and participants do not have to fast before the nurse visit.

6 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 oldest.

7 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.

8 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.

9 The 'set' sample of children is calculated as follows:

- In the 5,111 co-operating households, 1,436 households had children (627 with one child, 566 with two, 185 with three, and 58 with four or more), giving 2,546 eligible children in total in these households. Note that up to four children were eligible in any household, although their eligibility was age-dependent (see Section 2.4), so this is an over-estimate of eligible children.
- In the 2,365 non co-operating households where some information about residents was established, there were 139 households with one child, 176 with two, 36 with three and 22 with four or more children; this gave a total of 687 eligible children.
- In the 476 households where no information was known, 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 205 eligible children.
- The 'set' sample is therefore 3,438 children.
- Sex of children was only known in co-operating households; 51% of the children were boys and 49% were girls. These proportions have been applied to the total set sample of children, giving 1,751 boys and 1,687 girls.

10 Mid-2015 population estimates were obtained from ONS. See: http://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2015

[11] Korovessis C, Tipping S and Purdon S. *Health Survey for England 2002. Volume1: Weighting.* The Stationery Office, London, 2003.

[12] 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.

[13] 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+

[14] 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

[15] 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

[16] 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.

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

[18] 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 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.

[19] The Taylor Series expansion method is a mathematical technique to simplify the computation of infinite series. It is the default method of calculating standard errors used by the STATA analysis software. http://www.stata.com/manuals13/svy.pdf . For further information, see Wolter KM. *Introduction to Variance Estimation. 2nd ed*. 2007.New York, Springer.

[20] 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.

[21] 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.

[22] Sacks DB, et al. *Guidelines and Recommendations for Laboratory Analysis in the Diagnosis and Management of Diabetes Mellitus*. Diabetes Care, 34:e61-e99, 2011

[23] Little et al. *Status of HbA1c measurement and goals for improvement: from chaos to order for improving diabetes care*. Clin Chem 2011;57:205–14

[24] 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.

[25] 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.

[26] 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 analyzed, which is common for applications in haematology. More detail is available at www.westgard.com/mltirule.htm#westgard

[27] 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.

[28] 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.

[29] 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.

[30] Welsh External Quality Assurance Scheme. *Participants Manual.* WEQAS, Cardiff, 2016.

Appendix A: Tables

List of tables

Table A1: HSE 2015, general population sample: household response by calendar quarter

	Survey quarter										Total	
Address and household outcome	**Jan-Mar**		**Apr-Jun**		**Jul-Sep**		**Oct-Dec**		**Jan 2016**			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Issued sample												
Selected addresses	2208		2208		2208		2208		540		9372	
Ineligible addresses – type a[a]	215	10	219	10	214	10	203	9	45	8	896	10
Total eligible households	1993	90	1989	90	1994	90	2005	91	495	92	8476	90
Household response												
Co-operating households[b]	1238	62	1250	63	1197	60	1165	58	261	53	5111	60
All interviewed	974	49	933	47	960	48	920	46	195	39	3982	47
Fully co-operating[c]	852	43	845	42	856	43	812	40	181	37	3546	42
Non-responding households	755	38	739	37	797	40	840	42	234	47	3365	40
No contact	68	3	54	3	57	3	53	3	21	4	253	3
Unknown eligibility	14	1	17	1	18	1	8	0	11	2	68	1
Refusal	604	30	592	30	642	32	672	34	170	34	2680	32
Other non-response	69	3	76	4	80	4	107	5	32	6	364	4
Bases: all eligible households	*1993*		*1989*		*1994*		*2005*		*495*		*8476*	

[a] Addresses where no private households were found.
[b] Households where at least one person was interviewed.
[c] All eligible household members were interviewed, had height and weight measured and had a nurse visit.

Table A2: HSE 2015, boost sample: household response by calendar quarter

Address and household outcome	Survey quarter Jan-Mar[a] 2015		Apr-Jun		Jul-Sep		Oct-Dec		Jan-Mar 2016		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Issued sample												
Selected addresses	1330		3990		3990		3990		3952		17252	
Ineligible addresses – type a[b]	70	5	298	7	254	6	232	6	219	6	1073	6
Ineligible addresses – type b[c]	988	74	2866	72	2885	72	2920	73	2889	73	12548	73
Total eligible households	272	20	826	21	851	21	838	21	844	21	3631	21
Household response												
Co-operating households[d]	171	63	521	63	525	62	573	68	499	59	2289	63
All interviewed	171	63	511	62	518	61	571	68	497	59	2268	62
Fully co-operating[e]	164	60	486	59	493	58	545	65	472	56	2160	59
Non-responding households	100	37	300	36	322	38	254	30	336	40	1312	36
No contact	6	2	18	2	29	3	14	2	38	5	105	3
Unknown eligibility	1	0	6	1	11	1	11	1	33	4	62	2
Refusal	89	33	254	31	11	1	204	24	490	58	1048	29
Other non-response	4	1	22	3	23	3	25	3	23	3	97	3
Bases: all eligible households	*272*		*826*		*851*		*838*		*844*		*3631*	

[a] Fieldwork for the child boost began in March 2015.
[b] Addresses where no private households were found.
[c] Addresses where no eligible children were found.
[d] Households where at least one child was interviewed.
[e] All eligible children were interviewed and had height and weight measured.

Table A3: HSE 2015, general population sample: detailed outcomes for non-responding households

	N	%
Ineligible		
Vacant/empty	568	6.1
Address occupied, but no resident household	138	1.5
Non-residential address	144	1.5
Demolished/derelict	34	0.4
Not yet built/under construction	12	0.1
Total ineligible	*896*	*9.6*
No contact		
No contact with anyone at address after 6+ calls	228	2.7
Unable to locate address	8	0.1
Inaccessible/ not attempted	17	0.2
Total no contact	*253*	*3.0*
Unknown eligibility		
Contact made, but not with responsible resident	51	0.6
Unknown whether address is eligible or residential due to non-contact	12	0.1
Unable to confirm eligibility due to language barrier	2	0.0
Other unknown eligibility	3	0.0
Total unknown eligibility	*68*	*0.8*
Refusal		
Office refusal (household contacted office before interviewer made contact)	466	5.5
Information refused about number of dwelling units at address	16	0.2
Information refused about people in household	164	1.9
Refusal before household interview	1805	21.3
Refusal after completion of household questionnaire	17	0.2
Broken appointment - no recontact	212	2.5
Total refusals	*2680*	*31.6*
Others with no interview		
Physically unable/incompetent	38	0.4
Mentally unable/incompetent	67	0.8
Language difficulties	75	0.9
Away/in hospital throughout field work period	39	0.5
Ill at home during survey period	32	0.4
Full or partial interview but respondent requested data be deleted	4	0.0
Other reasons why unproductive	109	1.3
Total other	*364*	*4.3*

Table A4: HSE 2015, general population sample: household response, by region

Address and household outcome	Region[a] North East		North West		Yorkshire & the Humber		East Midlands		West Midlands		East of England		London		South East		South West		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Issued sample																				
Selected addresses	823		1212		925		828		931		1000		1246		1462		945		9372	
Ineligible addresses – type a[b]	68	8	137	11	73	8	50	6	111	12	89	9	130	10	125	9	113	12	896	10
Total eligible households	755	92	1075	89	852	92	778	94	820	88	911	91	1116	90	1337	91	832	88	8476	90
Household response																				
Co-operating households[c]	422	56	708	66	497	58	484	62	467	57	578	63	600	54	847	63	508	61	5111	60
All interviewed	311	41	557	52	383	45	396	51	352	43	477	52	447	40	656	49	403	48	3982	47
Fully co-operating[d]	273	36	511	48	324	38	344	44	318	39	440	48	392	35	578	43	366	44	3546	42
Non-responding households	333	44	367	34	355	42	294	38	353	43	333	37	516	46	490	37	324	39	3365	40
No contact	30	4	26	2	30	4	22	3	39	5	13	1	49	4	22	2	22	3	253	3
Unknown eligibility	16	2	9	1	7	1	1	0	4	0	7	1	9	1	11	1	4	0	68	1
Refusal	260	34	309	29	263	31	249	32	267	33	283	31	394	35	404	30	251	30	2680	32
Other non-response	27	4	23	2	55	6	22	3	43	5	30	3	64	6	53	4	47	6	364	4
Bases: all eligible households	*755*		*1075*		*852*		*778*		*820*		*911*		*1116*		*1337*		*832*		*8476*	

[a] Regions are former Government Office Regions.
[b] Addresses where no private households were found.
[c] Households where at least one person was interviewed.
[d] All eligible household members were interviewed, had height and weight measured and had a nurse visit.

Table A5: HSE 2015, general population sample: household response, by dwelling type

	Dwelling type						Total
Household response	**Detached house**	**Semi-detached house**	**Terraced house (including end of terrace)**	**Flat or maisonette: purpose built**	**Flat or maisonette: conversion**	**Other type**	
	%	**%**	**%**	**%**	**%**	**%**	**%**
Co-operating households [a]	64	62	61	55	58	26	60
All interviewed	47	48	47	49	50	21	47
Fully co-operating [b]	41	42	42	45	44	19	42
Non-responding households	36	38	39	45	42	74	40
No contact	1	2	3	7	6	13	3
Unknown eligibility	1	0	1	1	3	1	1
Refusal	31	32	30	30	29	58	32
Other non-response	2	2	4	5	3	1	4
Bases: all eligible households	*1953*	*2598*	*2230*	*1239*	*277*	*172*	*8476*

[a] Households where at least one person was interviewed.

[b] All eligible household members were interviewed, had height and weight measured and had a nurse visit.

Table A6: HSE 2015, general population sample: summary of adults' individual response to the survey, by sex

Individual response	Sex Men		Women		All adults	
	N	%	N	%	N	%
Interviewed	3578	54	4456	61	8034	57
Non responders:						
In co-operating households	947	14	494	7	1441	10
In non-responding households	2156	32	2359	32	4515	32
Responded to:						
Self-completion	3323	50	4202	57	7525	54
Height	3166	47	3964	54	7130	51
Weight	3142	47	3816	52	6958	50
Nurse visit	2381	36	2997	41	5378	38
Waist/hip	2322	35	2872	39	5194	37
Blood pressure	2353	35	2916	40	5269	38
Blood sample	1806	27	2177	30	3983	28
Saliva sample	2295	34	2846	39	5141	37
Bases: set sample[a]	*6681*		*7309*		*13990*	

[a] For the method of estimating the adult 'set' sample, see Section 6.3. Estimated bases have been rounded to whole numbers.

Table A7: HSE 2015, general population sample: summary of children's individual response to the survey, by sex

Individual response	Sex Boys		Girls		All children	
	N	%	N	%	N	%
Interviewed	1064	61	1059	63	2123	62
Non responders:						
In co-operating households	139	8	95	6	234	7
In non-responding households	548	31	533	32	1081	31
Responded to:						
Height[a]	731	42	761	45	1492	43
Weight	821	47	852	51	1673	49
Nurse visit	649	37	648	38	1297	38
Bases: set sample[b]	*1751*		*1687*		*3438*	

[a] Based on children aged 2 to 15.

[b] For the method of estimating the child 'set' sample, see Section 6.4. Estimated bases have been rounded.

Table A8: HSE 2015, general population sample: men in co-operating households: response to the stages of the survey, by age

	Age group							Total
Individual response	**16-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65-74**	**75 +**	
	%	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Interviewed								
Interviewed	56	75	78	77	83	91	93	79
Not contacted/refused	44	25	22	23	17	9	7	21
Height								
Measured	50	68	68	69	73	84	78	70
Refused	4	5	6	6	6	5	4	5
Measurement not attempted	3	3	5	2	5	3	9	4
Not contacted/not obtained[a]	44	25	22	23	17	9	8	21
Weight								
Measured	49	67	68	68	72	83	79	69
Refused	4	5	6	6	6	5	4	5
Measurement not attempted	3	3	5	3	5	3	9	4
Not contacted/not obtained[a]	44	25	22	23	17	9	8	21
Nurse visit								
Co-operated with nurse visit	33	42	49	52	57	70	66	53
Refused/no contact at nurse visit	14	18	16	14	11	7	7	13
Not interviewed	53	40	35	34	33	23	27	35
Waist/hip								
Measured	33	42	48	51	55	68	63	51
Refused/not obtained	0	0	1	1	1	2	3	1
No nurse visit[b]	67	58	51	48	43	30	34	47
Blood pressure								
Measured	33	42	48	51	56	69	65	52
Refused/not obtained	0	0	1	0	1	1	1	1
No nurse visit[b]	67	58	51	48	43	30	34	47
Blood sample								
Sample taken	21	31	39	44	45	53	45	40
Ineligible – medical grounds	1	2	1	1	3	4	3	2
Unsuccessful attempt at sample	0	1	1	2	2	8	10	3
Refused	10	8	7	4	6	5	6	7
No nurse visit[b]	67	58	52	49	44	31	37	48
Saliva sample								
Measured	32	41	46	51	55	68	62	51
Refused/not obtained	1	2	2	1	2	2	4	2
No nurse visit[b]	67	58	51	48	43	30	34	47
Bases: men aged 16 and over in co-operating households	*535*	*659*	*727*	*810*	*678*	*657*	*459*	*4525*

[a] Includes non-responders to interview as well as those where measurements not obtained.

[b] Includes non-responders to interview.

Table A9: HSE 2015, general population sample: women in co-operating households: response to the stages of the survey, by age

	Age group							Total
Individual response	**16-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65-74**	**75 +**	
	%	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Interviewed								
Interviewed	72	88	93	92	93	94	96	90
Not contacted/refused	28	12	7	8	7	6	4	10
Height								
Measured	64	81	85	81	83	83	78	80
Refused	4	5	7	8	7	6	5	6
Measurement not attempted	3	2	1	3	2	4	11	4
Not contacted/not obtained[a]	29	12	7	8	7	7	6	10
Weight								
Measured	60	74	81	79	82	81	78	77
Refused	5	6	8	10	9	8	5	7
Measurement not attempted	6	5	3	3	2	4	12	5
Not contacted/not obtained[a]	29	16	8	8	7	7	5	11
Nurse visit								
Co-operated with nurse visit	39	57	60	61	67	69	69	61
Refused/no contact at nurse visit	19	17	18	13	12	7	7	14
Not interviewed	41	26	22	26	21	24	23	26
Waist/hip								
Measured	38	52	57	60	65	67	67	58
Refused/not obtained	1	2	2	1	2	2	3	2
No nurse visit[b]	62	47	42	39	33	31	31	40
Blood pressure								
Measured	38	53	58	60	66	67	68	59
Refused/not obtained	1	0	1	1	0	2	1	1
No nurse visit[b]	62	47	42	39	33	31	31	40
Blood sample								
Sample taken	21	35	44	48	54	53	49	44
Ineligible – medical grounds	5	5	5	4	4	5	4	4
Unsuccessful attempt at sample	2	5	2	2	1	3	7	3
Refused	11	10	8	6	6	7	7	7
No nurse visit[b]	62	45	42	40	36	32	33	41
Saliva sample								
Measured	37	51	57	59	65	66	66	57
Refused/not obtained	2	2	2	2	2	3	4	2
No nurse visit[b]	62	47	42	39	33	31	31	40
Bases: women aged 16 and over in co-operating households	*570*	*726*	*830*	*854*	*753*	*670*	*547*	*4950*

[a] Includes non-responders to interview as well as those where measurements not obtained.

[b] Includes non-responders to interview.

Table A10: HSE 2015, general population sample: all adults in co-operating households: response to the stages of the survey, by age

	Age group							Total
Individual response	**16-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65-74**	**75 +**	
	%	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Interviewed								
Interviewed	64	82	86	85	88	92	95	85
Not contacted/refused	36	18	14	15	12	8	5	15
Height								
Measured	57	75	77	75	78	84	78	75
Refused	4	5	6	7	7	5	5	6
Measurement not attempted	3	2	3	3	3	3	10	4
Not contacted/not obtained[a]	36	18	14	15	12	8	7	15
Weight								
Measured	55	70	75	74	77	82	78	73
Refused	4	5	7	8	7	6	5	6
Measurement not attempted	4	4	4	3	4	4	10	4
Not contacted/not obtained[a]	36	20	15	16	12	8	7	16
Nurse visit								
Co-operated with nurse visit	36	50	55	57	62	70	68	57
Refused/no contact at nurse visit	17	17	17	14	12	7	7	13
Not interviewed	47	33	28	30	27	23	25	30
Waist/hip								
Measured	35	47	52	56	60	68	65	55
Refused/not obtained	1	1	1	1	2	2	3	2
No nurse visit[b]	64	52	46	43	38	30	32	44
Blood pressure								
Measured	35	48	53	56	61	68	67	56
Refused/not obtained	0	0	1	1	1	1	1	1
No nurse visit[b]	64	52	46	43	38	30	32	44
Blood sample								
Sample taken	21	33	41	46	49	53	47	42
Ineligible – medical grounds	3	4	3	3	3	4	4	3
Unsuccessful attempt at sample	1	3	2	2	2	6	8	3
Refused	10	9	7	5	6	6	6	7
No nurse visit[b]	64	51	47	44	40	31	34	45
Saliva sample								
Measured	35	46	52	55	60	67	64	54
Refused/not obtained	1	2	2	2	2	3	4	2
No nurse visit[b]	64	52	46	43	38	30	32	44
Bases: all adults aged 16 and over in co-operating households	*1105*	*1385*	*1557*	*1664*	*1431*	*1327*	*1006*	*9475*

[a] Includes non-responders to interview as well as those where measurements not obtained.

[b] Includes non-responders to interview.

Table A11: HSE 2015, general population sample: boys in co-operating households: response to the stages of the survey, by age

	Age group					Total
Individual response	**0-1**	**2-4**	**5-6**	**7-10**	**11-15**	
	%	**%**	**%**	**%**	**%**	**%**
Interviewed[1]						
Interviewed	97	96	93	90	81	90
Not contacted/refused	3	4	7	10	19	10
Height[2]						
Measured		68	74	76	66	71
Refused		6	4	5	6	5
Measurement not attempted		19	13	9	9	12
Not contacted/not obtained[a]		7	9	10	20	12
Weight[1]						
Measured	61	68	74	76	65	69
Refused	7	6	3	5	7	6
Measurement not attempted	27	19	14	9	9	14
Not contacted/not obtained[a]	5	7	8	10	19	11
Nurse visit[1]						
Co-operated with nurse visit	65	63	57	55	44	55
Refused/no contact at nurse visit	13	18	20	21	18	18
Not interviewed	22	20	23	24	38	27
Saliva sample[3]						
Measured		37	43	51	41	44
Refused/not obtained		24	14	4	2	7
No nurse visit[b]		38	43	45	56	49
Blood pressure[4]						
Measured			47	53	43	48
Refused/not obtained			9	2	0	3
No nurse visit[b]			43	45	56	50
Waist/hip[5]						
Measured					42	42
Refused/not obtained					1	1
No nurse visit[b]					56	56
Bases in co-operating households						
[1]*All eligible boys aged 0-15*	*153*	*228*	*175*	*284*	*347*	*1187*
[2] *All eligible boys aged 2-15*		*228*	*175*	*284*	*347*	*1034*
[3] *All eligible boys aged 4-15*		*78*	*175*	*284*	*347*	*884*
[4] *All eligible boys aged 5-15*			*175*	*284*	*347*	*806*
[5] *All eligible boys aged 11-15*				*284*	*347*	*631*

[a] Includes non-responders to interview as well as those where measurements not obtained.

[b] Includes non-responders to interview.

Table A12: HSE 2015, general population sample: girls in co-operating households: response to the stages of the survey, by age

	Age group					Total
Individual response	**0-1**	**2-4**	**5-6**	**7-10**	**11-15**	
	%	**%**	**%**	**%**	**%**	**%**
Interviewed[1]						
Interviewed	98	95	96	95	87	93
Not contacted/refused	2	5	4	5	13	7
Height[2]						
Measured		71	79	78	75	76
Refused		3	2	4	4	3
Measurement not attempted		18	14	13	7	12
Not contacted/not obtained[a]		8	4	5	13	9
Weight[1]						
Measured	66	76	79	77	74	75
Refused	5	2	2	4	5	4
Measurement not attempted	26	17	14	14	8	14
Not contacted/not obtained[a]	2	5	4	6	13	7
Nurse visit[1]						
Co-operated with nurse visit	58	59	58	59	53	57
Refused/no contact at nurse visit	19	18	20	19	21	19
Not interviewed	23	23	23	22	26	24
Saliva sample[3]						
Measured		30	42	51	51	47
Refused/not obtained		33	15	8	3	9
No nurse visit[b]		37	42	41	47	43
Blood pressure[4]						
Measured			49	53	52	52
Refused/not obtained			8	5	1	4
No nurse visit[b]			42	41	47	44
Waist/hip[5]						
Measured					51	51
Refused/not obtained					2	2
No nurse visit[b]					47	47
Bases in co-operating households	*133*	*247*	*146*	*263*	*351*	*1140*
[1] *All eligible girls aged 0-15*		*247*	*146*	*263*	*351*	*1007*
[2] *All eligible girls aged 2-15*		*89*	*146*	*263*	*351*	*849*
[3] *All eligible girls aged 4-15*			*146*	*263*	*351*	*760*
[4] *All eligible girls aged 5-15*				*263*	*351*	*614*
[5] *All eligible girls aged 11-15*					*351*	*351*

[a] Includes non-responders to interview as well as those where measurements not obtained.

[b] Includes non-responders to interview.

Table A13: HSE 2015, general population sample: all children in co-operating households: response to the stages of the survey, by age

	Age group					Total
Individual response	**0-1**	**2-4**	**5-6**	**7-10**	**11-15**	
	%	**%**	**%**	**%**	**%**	**%**
Interviewed[1]						
Interviewed	97	95	94	92	84	91
Not contacted/refused	3	5	6	8	16	9
Height[2]						
Measured		70	77	77	71	73
Refused		4	3	4	5	4
Measurement not attempted		18	14	11	8	12
Not contacted/not obtained[a]		7	7	8	16	10
Weight[1]						
Measured	63	72	77	76	69	72
Refused	6	4	3	4	6	5
Measurement not attempted	27	18	14	11	9	14
Not contacted/not obtained[a]	3	6	6	8	16	9
Nurse visit[1]						
Co-operated with nurse visit	62	61	57	57	48	56
Refused/no contact at nurse visit	16	18	20	20	20	19
Not interviewed	23	21	23	23	32	25
Saliva sample[3]						
Measured		34	43	51	46	46
Refused/not obtained		29	14	6	2	8
No nurse visit[b]		38	43	43	52	46
Blood pressure[4]						
Measured			48	53	48	50
Refused/not obtained			9	4	1	3
No nurse visit[b]			43	43	52	47
Waist/hip[5]						
Measured					47	47
Refused/not obtained					2	2
No nurse visit[b]					52	52
Bases in co-operating households	*286*	*475*	*321*	*547*	*698*	*2327*
[1] *All eligible children aged 0-15*		*475*	*321*	*547*	*698*	*2041*
[2] *All eligible children aged 2-15*		*167*	*321*	*547*	*698*	*1733*
[3] *All eligible children aged 4-15*			*321*	*547*	*698*	*1566*
[4] *All eligible children aged 5-15*				*547*	*698*	*1245*
[5] *All eligible children aged 11-15*					*698*	*698*

[a] Includes non-responders to interview as well as those where measurements not obtained.
[b] Includes non-responders to interview.

Table A14: HSE 2015, general population and boost sample: boys in co-operating households: response to the stages of the survey, by age

	Age group					Total
Individual response	**0-1**	**2-4**	**5-6**	**7-10**	**11-15**	
	%	**%**	**%**	**%**	**%**	**%**
Interviewed[1]						
Interviewed	96	98	97	97	92	96
Not contacted/refused	4	2	3	3	8	4
Height[2]						
Measured		75	81	86	80	81
Refused		5	4	3	4	4
Measurement not attempted		16	12	8	7	10
Not contacted/not obtained[a]		4	4	4	9	5
Weight[1]						
Measured	60	77	81	85	80	80
Refused	7	5	3	3	4	4
Measurement not attempted	27	15	12	8	7	11
Not contacted/not obtained[a]	5	3	4	4	9	5
Bases in co-operating households						
[1] *All eligible boys aged 0-15*	*154*	*638*	*464*	*830*	*892*	*2978*
[2] *All eligible boys aged 2-15*		*638*	*464*	*830*	*892*	*2824*

[a] Includes non-responders to interview as well as those where measurements not obtained.
[b] Includes non-responders to interview.

Table A15: HSE 2015, general population and boost sample: girls in co-operating households: response to the stages of the survey, by age

	Age group					Total
Individual response	**0-1**	**2-4**	**5-6**	**7-10**	**11-15**	
	%	**%**	**%**	**%**	**%**	**%**
Interviewed[1]						
Interviewed	98	98	98	98	94	97
Not contacted/refused	2	2	2	2	6	3
Height[2]						
Measured		78	83	84	83	82
Refused		3	3	3	4	3
Measurement not attempted		14	12	11	7	11
Not contacted/not obtained[a]		5	2	2	6	4
Weight[1]						
Measured	66	80	83	83	81	81
Refused	5	3	3	3	5	4
Measurement not attempted	26	13	12	12	8	11
Not contacted/not obtained[a]	2	3	2	2	6	4
Bases in co-operating households						
[1] *All eligible girls aged 0-15*	*133*	*665*	*427*	*781*	*957*	*2963*
[2] *All eligible girls aged 2-15*		*665*	*427*	*781*	*957*	*2830*

[a] Includes non-responders to interview as well as those where measurements not obtained.
[b] Includes non-responders to interview.

Table A16: HSE 2015, general population and boost sample: all children in co-operating households: response to the stages of the survey, by age

	Age group					Total
Individual response	**0-1**	**2-4**	**5-6**	**7-10**	**11-15**	
	%	**%**	**%**	**%**	**%**	**%**
Interviewed[1]						
Interviewed	97	98	98	97	93	96
Not contacted/refused	3	2	2	3	7	4
Height[2]						
Measured		77	82	85	82	81
Refused		4	3	3	4	4
Measurement not attempted		15	12	9	7	10
Not contacted/not obtained[a]		4	3	3	7	5
Weight[1]						
Measured	63	79	82	84	80	80
Refused	6	4	3	3	5	4
Measurement not attempted	27	14	12	10	7	11
Not contacted/not obtained[a]	4	3	3	3	7	4
Bases in co-operating households						
[1] *All eligible children aged 0-15*	*287*	*1303*	*891*	*1611*	*1849*	*5941*
[2] *All eligible children aged 2-15*		*1303*	*891*	*1611*	*1849*	*5654*

[a] Includes non-responders to interview as well as those where measurements not obtained.

Table A17: HSE 2015, general population sample: age distribution of responding adult sample compared with mid-2015 population estimates for England, by sex

	Health survey responding adult sample		2015 mid-year population estimates[a]
Age group	**At interview**	**At nurse visit**	
	%	%	%
Men			
16-24	8	7	15
25-34	14	12	17
35-44	16	15	16
45-54	17	18	18
55-64	16	16	14
65-74	17	19	12
75 and over	12	13	8
All men[b]	45	44	49
Women			
16-24	9	7	13
25-34	14	14	17
35-44	17	16	16
45-54	18	17	17
55-64	16	17	14
65-74	14	15	12
75 and over	12	13	10
All women[b]	55	56	51
Bases			
Men	*3578*	*2381*	*21,602*
Women	*4456*	*2997*	*22,437*

[a] Mid population estimates for England excluding those in institutions (Source: ONS). Base shown in thousands.

[b] Note that the percentages for age groups within sex are based on all participants of that sex (they may not sum to 100% because of rounding). The 'All men' and 'All women' percentages are based on all participants.

Table A18: HSE 2015, general population sample: age distribution of responding child sample compared with mid-2015 population estimates for England, by sex

	Health survey responding child sample		2015 mid-year population estimates[a]
Age group	At interview	At nurse visit	
	%	%	%
Boys			
0-1	14	15	13
2-3	14	15	13
4-5	15	14	13
6-7	14	15	13
8-9	12	12	13
10-11	12	11	12
12-13	10	9	11
14-15	10	8	12
All boys[b]	50	50	51
Girls			
0-1	12	12	13
2-3	14	14	13
4-5	14	14	13
6-7	12	13	13
8-9	12	13	13
10-11	13	12	12
12-13	10	11	11
14-15	11	11	12
All girls[b]	50	50	49
Bases			
Boys	*1064*	*649*	*5329*
Girls	*1059*	*648*	*5076*

[a] Mid population estimates for England excluding those in institutions (Source: ONS). Base shown in thousands.

[b] Note that the percentages for age groups within sex are based on all participants of that sex (they may not sum to 100% because of rounding). The 'All boys' and 'All girls' percentages are based on all participants.

Table A19: HSE 2015: Reference intervals for blood[a] and saliva[b] analytes[c]

Analyte	Reference interval	Units
Serum[a]		
Total cholesterol		
Males	3.5-5.1	mmol/L
Females	3.5-5.1	mmol/L
HDL cholesterol		
Males	0.9-1.4	mmol/L
Females	1.1-1.7	mmol/L
Blood[a]		
Total glycated haemoglobin (HbA_{1c})		
Males	Non diabetic: <48	mmol/mol
Females	Non diabetic: <48	mmol/mol
Saliva[b]		
Cotinine[d]		
No exposure to tobacco	Undetectable (<0.1)	ng/ml
Passive smoking	0.1 to less than <12	ng/ml
Personal tobacco use	≥ 12	ng/ml

[a] Analyses by Clinical Biochemistry and Haematology Laboratories, Royal Victoria Infirmary, Newcastle upon Tyne Hospitals NHS Foundation Trust.

[b] Analyses by ABS Laboratories, Welwyn Garden City.

[c] No reference ranges are available for spot urines for sodium, potassium, creatinine.

[d] Jarvis MJ, Fidler J, Mindell J, Feyerabend M, West R. *Assessing smoking status in children, adolescents and adults: cotinine cutpoints revisited*. Addiction 2008;**103**:1553-61.

Table A20: HSE 2015: internal quality control results for total cholesterol

Date	Target value (mmol/L)	Assayed value (mmol/L)	Acceptable range (mmol/L)	SD[a] (mmol/L) achieved	CV[b] (%) achieved
January 2015	3.6	3.59	(3.4-3.7)	0.06	1.72
	7.2	7.23	(6.9-7.4)	0.14	1.88
February	3.6	3.58	(3.4-3.7)	0.05	1.50
	7.2	7.17	(6.9-7.4)	0.10	1.36
March [c]	3.7	3.67	(3.6-3.9)	0.06	1.56
	7.3	7.15	(7.0-7.6)	0.11	1.58
April	3.7	3.67	(3.6-3.9)	0.10	2.69
	7.3	7.14	(7.0-7.6)	0.13	1.75
May	3.7	3.67	(3.6-3.9)	0.07	1.79
	7.3	7.16	(7.0-7.6)	0.14	1.99
June 1st-15th [c]	3.7	3.77	(3.6-3.9)	0.05	1.43
	7.3	7.38	(7.0-7.6)	0.12	1.63
June 15th-30th [c]	3.7	3.61	(3.5-3.8)	0.04	1.08
	7.2	7.17	(7.0-7.4)	0.06	0.77
July	3.7	3.62	(3.5-3.8)	0.04	1.00
	7.2	7.15	(7.0-7.4)	0.07	1.00
August	3.7	3.62	(3.5-3.8)	0.03	0.74
	7.2	7.18	(7.0-7.4)	0.05	0.66
September	3.7	3.62	(3.5-3.8)	0.04	1.08
	7.2	7.17	(7.0-7.4)	0.07	0.92
October	3.7	3.64	(3.5-3.8)	0.04	1.06
	7.2	7.19	(7.0-7.4)	0.13	1.75
November	3.7	3.63	(3.5-3.8)	0.04	1.02
	7.2	7.18	(7.0-7.4)	0.21	2.99
December [c]	3.2	3.13	(3.1-3.3)	0.03	0.99
	6.8	6.72	(6.6-6.9)	0.06	0.84
January 2016	3.2	3.14	(3.1-3.3)	0.04	1.18
	6.8	6.73	(6.6-6.9)	0.07	1.06
February [c]	3.1	3.18	(3.0-3.2)	0.05	1.48
	6.7	6.79	(6.5-6.9)	0.06	0.85
March	3.1	3.14	(3.0-3.2)	0.05	1.65
	6.7	6.72	(6.5-6.9)	0.09	1.28

[a] Standard deviation.
[b] Coefficient of variation.
[c] The target values changed in March, mid-June, December 2015 and February 2016

Table A21: HSE 2015: internal quality control results for HDL cholesterol

Date	Target value (mmol/L)	Assayed value (mmol/L)	Acceptable range (mmol/L)	SD[a] (mmol/L) achieved	CV[b] (%) achieved
January 2015	1.8	1.87	(1.7-2.0)	0.05	2.52
	4.4	4.49	(4.1-4.7)	0.12	0.70
February	1.8	1.81	(1.7-2.0)	0.03	1.58
	4.4	4.38	(4.1-4.7)	0.07	1.56
March [c]	1.8	1.76	(1.7-1.9)	0.03	1.40
	3.4	3.27	(3.1-3.6)	0.07	2.25
April	1.8	1.76	(1.7-1.9)	0.03	1.48
	3.4	3.30	(3.1-3.6)	0.08	2.41
May	1.8	1.76	(1.7-1.9)	0.02	1.36
	3.4	3.26	(3.1-3.6)	0.07	2.27
June 1st-15th [c]	1.8	1.78	(1.7-1.9)	0.02	1.37
	3.4	3.32	(3.1-3.6)	0.10	2.96
June 15th-30th [c]	1.7	1.70	(1.6-1.8)	0.02	1.22
	3.2	3.23	(3.0-3.3)	0.06	1.89
July	1.7	1.70	(1.6-1.8)	0.04	2.25
	3.2	3.20	(3.0-3.3)	0.09	2.74
August	1.7	1.71	(1.6-1.8)	0.03	1.79
	3.2	3.19	(3.0-3.3)	0.09	2.89
September	1.7	1.72	(1.6-1.8)	0.04	2.48
	3.2	3.21	(3.0-3.3)	0.08	2.34
October	1.7	1.73	(1.6-1.8)	0.03	1.70
	3.2	3.17	(3.0-3.3)	0.08	2.53
November	1.7	1.68	(1.6-1.8)	0.04	2.35
	3.2	3.10	(3.0-3.3)	0.08	2.65
December [c]	1.5	1.44	(1.4-1.6)	0.02	1.62
	2.8	2.72	(2.7-3.0)	0.06	2.15
January 2016	1.5	1.44	(1.4-1.6)	0.02	1.24
	2.8	2.73	(2.7-3.0)	0.05	1.78
February	1.5	1.44	(1.4-1.6)	0.03	2.17
	2.8	2.73	(2.7-3.0)	0.05	1.72
March	1.5	1.50	(1.4-1.6)	0.02	1.40
	2.8	2.84	(2.7-3.0)	0.05	1.61

[a] Standard deviation.

[b] Coefficient of variation.

[c] The target values changed in March, mid-June and December 2015.

Table A22: HSE 2015: internal quality control results for glycated haemoglobin (HbA_{1c})

Date	Target value (mmol/mol)	Assayed value (mmol/mol)	Acceptable range (mmol/mol)	SD[a] (mmol/mol) achieved	CV[b] (%) achieved
January 2015	33	32.0	(30-35)	0.9	3.0
	84	83.5	(80-89)	0.9	1.0
February	33	31.6	(30-35)	1.1	3.5
	84	83.6	(80-89)	1.3	1.6
March	33	31.9	(30-35)	1.2	3.7
	84	83.8	(80-89)	1.0	1.2
April[c]	35	33.8	(34-36)	0.9	2.8
	84	82.9	(81-87)	1.3	1.6
May	35	34.8	(34-36)	0.8	2.4
	84	84.1	(81-87)	1.6	1.8
June	35	34.2	(34-36)	0.6	1.6
	84	82.6	(81-87)	1.0	1.2
July	35	34.2	(34-36)	0.6	1.8
	84	81.8	(81-87)	0.8	1.0
August	35	33.9	(34-36)	0.8	2.4
	84	82.0	(81-87)	0.9	1.1
September	35	34.6	(34-36)	0.9	2.6
	84	82.4	(81-87)	1.2	1.4
October	35	34.7	(34-36)	0.8	2.2
	84	82.5	(81-87)	1.2	1.5
November	35	34.6	(34-36)	0.7	2.0
	84	81.9	(81-87)	1.0	1.2
December	35	35.1	(34-36)	0.6	1.6
	84	81.2	(81-87)	0.4	0.5
January 2016	35	35.0	(34-36)	0.7	1.9
	84	80.9	(81-87)	1.0	1.2
February	35	34.9	(34-36)	0.5	1.5
	84	80.9	(81-87)	0.8	1.0
March	35	34.7	(34-36)	0.8	2.2
	84	81.2	(81-87)	1.2	1.4

[a] Standard deviation.

[b] Coefficient of variation.

[c] The target value of the lower sample changed in April.

Table A23: HSE 2015: internal quality control results for saliva cotinine - LC-MS/MS: low calibration range

Date	Target value (ng/ml)	Assayed value (ng/ml)	SD[a] achieved	CV[b] (%) achieved
February 2015	40	42	1.7	4.05
	8	8	0.3	3.70
	0.3	0.3	0.03	9.31
March	40	39	2.0	5.16
	8	8	0.6	7.53
	0.3	0.3	0.02	8.13
April	40	39	1.2	3.07
	8	8	0.2	3.03
	0.3	0.3	0.01	3.60
May	40	40	1.1	2.85
	8	8	0.2	2.48
	0.3	0.3	0.02	4.85
June	40	42	1.4	3.41
	8	8	0.4	4.28
	0.3	0.3	0.01	3.50
July	40	43	1.7	3.93
	8	8	0.3	4.02
	0.3	0.3	0.01	4.40
August	40	43	1.0	2.40
	8	9	0.2	2.11
	0.3	0.3	0.01	3.56
September	40	40	2.5	6.23
	8	8	0.3	3.60
	0.3	0.3	0.01	1.91
October	40	41	1.3	3.25
	8	8	0.3	3.38
	0.3	0.3	0.02	5.70
November	40	41	1.3	3.17
	8	8	0.2	2.44
	0.3	0.3	0.01	3.64
December	40	40	0.6	1.42
	8	8	0.2	2.19
	0.3	0.3	0.01	2.47
January 2016	40	40	1.2	2.91
	8	8	0.2	2.38
	0.3	0.3	0.02	4.91
February	40	39	1.1	2.83
	8	8	0.1	1.04
	0.3	0.3	0.01	3.32
March	40	38	1.3	3.37
	8	8	0.3	3.34
	0.3	0.3	0.01	4.41
April	40	39	1.0	2.59
	8	8	0.2	3.25
	0.3	0.3	0.00	1.48

[a] Standard deviation.

[b] Coefficient of variation.

Table A24: HSE 2015: internal quality control results for saliva cotinine - LC-MS/MS: high calibration range

Date	Target value (ng/ml)	Assayed value (ng/ml)	SD[a] achieved	CV[b] (%) achieved
February 2015	500	503	9.9	1.97
	200	207	2.0	0.96
	3	3.4	0.05	1.60
March	500	509	9.5	1.86
	200	197	5.0	2.51
	3	3.1	0.09	2.78
April	500	517	1.9	0.36
	200	195	2.9	1.51
	3	3.2	0.17	5.14
May	500	508	13.2	2.60
	200	188	8.7	4.61
	3	3.1	0.06	1.91
June	500	519	13.3	2.57
	200	204	2.7	1.33
	3	3.1	0.09	2.77
July	500	519	18.0	3.48
	200	202	13.0	6.42
	3	3.2	0.14	4.36
August	500	531	11.2	2.11
	200	209	2.5	1.21
	3	3.2	0.09	2.76
September	500	505	18.0	3.56
	200	198	8.4	4.24
	3	3.1	0.11	3.53
October	500	515	11.7	2.28
	200	205	3.5	1.68
	3	3.1	0.14	4.48
November	500	498	8.0	1.60
	200	214	5.0	2.34
	3	3.1	0.21	6.76
December	500	492	12.0	2.44
	200	191	2.9	1.50
	3	2.9	0.21	7.48
January 2016	500	490	10.2	2.09
	200	193	2.2	1.17
	3	2.9	0.11	3.69
February	500	486	34.6	7.12
	200	189	2.4	1.30
	3	2.9	0.10	3.51
March	500	489	16.2	3.32
	200	194	11.1	5.72
	3	3.0	0.08	2.59
April	500	473	3.6	0.76
	200	192	2.1	1.08
	3	2.7	0.12	4.51

[a] Standard deviation.
[b] Coefficient of variation.

Table A25: HSE 2015: external quality assessment results for total cholesterol

Date	Target value (mmol/L)[a]	Assayed value (mmol/L)	WEQAS SDI[b]
January 2015	4.5	4.5	0.10
	4.9	4.9	0.05
	3.6	3.7	0.52
	6.4	6.6	0.55
February	3.6	3.8	1.16
	6.6	6.6	0.08
	4.9	4.9	0.05
	5.9	5.9	0.10
March	3.6	3.7	0.52
	4.9	4.9	0.05
	4.5	4.5	0.10
	6.4	6.7	0.91
April	4.9	4.9	0.05
	4.5	4.5	0.10
	6.4	6.4	-0.17
	3.6	3.7	0.52
May	5.1	5.2	0.56
	4.3	4.3	0.13
	6.6	6.8	0.78
	4.5	4.7	0.86
June	3.9	3.9	-0.20
	5.2	5.1	-0.33
	4.8	4.8	-0.12
	6.2	6.2	-0.12
July	4.3	4.3	0.13
	6.5	6.6	0.28
	5.3	5.4	0.52
	4.8	4.9	0.25
August	7.1	7.1	0.11
	4.5	4.6	0.34
	5.0	5.1	0.34
	3.7	3.7	-0.01
September	5.2	5.2	-0.20
	4.8	4.8	-0.23
	3.7	3.7	-0.01
	6.6	6.5	-0.28
October	3.7	3.7	-0.01
	5.2	5.3	0.24
	4.5	4.5	-0.17
	4.3	4.3	0.13

[a] Reference values.

[b] Standard Deviation Index (SDI) of the Welsh External Quality Assessment Schemes (WEQAS). The SDI is an index of total error, including components of inaccuracy and imprecision. A score between -1 and 1 SDI is good, between 1 and 2 or between -1 and -2 SDI is acceptable.

Continued…

Table A25 continued

Date	Target value (mmol/L)[a]	Assayed value (mmol/L)	WEQAS SDI[b]
November	5.0	5.0	-0.12
	3.7	3.7	-0.01
	5.2	5.2	-0.20
	4.8	4.9	0.25
December	4.6	4.6	0.11
	5.1	5.0	-0.27
	2.8	2.8	-0.30
	5.9	5.7	-0.88
January 2016	5.1	5.1	0.18
	2.8	2.8	-0.30
	6.0	5.9	-0.22
	5.5	5.4	-0.35
February	5.9	5.9	-0.08
	4.6	4.7	0.61
	4.2	4.2	0.13
	3.1	3.1	0.01
March	4.6	4.5	-0.40
	3.4	3.4	-0.14
	3.7	3.6	-0.35
	5.9	5.8	-0.48

[a] Reference values.

[b] Standard Deviation Index (SDI) of the Welsh External Quality Assessment Schemes (WEQAS). The SDI is an index of total error, including components of inaccuracy and imprecision. A score between -1 and 1 SDI is good, between 1 and 2 or between -1 and -2 SDI is acceptable.

[c] The investigation showed that that although the HDL result was outside 2 SDI, it was within 1SD of the Roche method mean. For this particular sample, all users of this method appeared to get a lower result than the target. This suggests that the problem related to this particular EQA sample and did not truly reflect assay performance.

Table A26: HSE 2015: external quality assessment results for HDL cholesterol

Date	Target value (mmol/L)[a]	Assayed value (mmol/L)	WEQAS SDI[b]
January 2015	1.6	1.7	0.78
	2.1	2.2	0.36
	0.8	0.8	-0.02
	1.7	1.8	0.96
February	0.8	0.8	-0.02
	1.8	1.8	0.02
	2.1	2.2	0.36
	1.4	1.5	0.82
March	0.8	0.8	-0.02
	2.1	2.2	0.36
	1.6	1.7	0.78
	1.7	1.7	0.22
April	2.1	2.3	0.93
	1.6	1.7	0.78
	1.7	1.7	0.22
	0.8	0.8	-0.02
May	0.9	0.8	-0.87
	1.6	1.7	0.88
	1.4	1.3	-0.85
	1.3	1.4	0.47
June	1.0	1.0	0.03
	0.6	0.6	-0.34
	2.5	2.6	0.66
	1.2	1.3	0.52
July	1.6	1.7	0.88
	1.8	1.8	0.30
	1.3	1.3	0.05
	1.9	2.0	0.48
August	1.7	1.8	0.67
	1.3	1.4	0.47
	1.5	1.5	0.33
	1.0	1.0	-0.04
September	1.5	1.5	0.36
	1.9	2.0	0.48
	1.0	1.0	-0.04
	1.4	1.3	-0.84
October	1.0	1.0	-0.04
	1.5	1.5	0.36
	1.3	1.4	0.47
	1.6	1.7	0.89
November	1.5	1.5	0.33
	1.0	1.0	-0.04
	1.5	1.5	0.36
	1.9	2.0	0.48

[a] Reference values.

[b] Standard Deviation Index (SDI) of the Welsh External Quality Assessment Schemes (WEQAS). The SDI is an index of total error, including components of inaccuracy and imprecision. A score between -1 and 1 SDI is good, between 1 and 2 or between -1 and -2 SDI is acceptable.

Continued…

Table A26 continued

Date	Target value (mmol/L)[a]	Assayed value (mmol/L)	WEQAS SDI[b]
December	1.2	1.1	-0.71
	2.2	2.2	-0.19
	1.1	1.1	0.03
	1.0	0.9	-1.44
January 2016	2.2	2.2	-0.19
	1.1	1.1	0.03
	0.9	0.7	-3.72[c]
	1.0	0.9	-0.93
February	1.0	1.0	-0.21
	1.2	1.1	-0.72
	1.1	1.1	0.07
	1.1	1.1	0.43
March	1.2	1.1	-0.72
	1.1	1.1	0.44
	1.7	1.7	-0.31
	1.0	1.0	-0.21

[a] Reference values.

[b] Standard Deviation Index (SDI) of the Welsh External Quality Assessment Schemes (WEQAS). The SDI is an index of total error, including components of inaccuracy and imprecision. A score between -1 and 1 SDI is good, between 1 and 2 or between -1 and -2 SDI is acceptable.

[c] The investigation showed that that although the HDL result was outside 2 SDI, it was within 1SD of the Roche method mean. For this particular sample, all users of this method appeared to get a lower result than the target. This suggests that the problem related to this particular EQA sample and did not truly reflect assay performance.

Table A27: HSE 2015: external quality assessment results for glycated haemoglobin (HbA_{1c})

Date	Target value[a] (mmol/mol)	Assayed value (mmol/mol)	WEQAS SDI[b]
January 2015	31.7	32	0.16
	52.3	54	0.65
February	56.2[c]	55	-0.41
	41.3[c]	42	0.29
	93.1[c]	94	0.21
March	44.2	49	2.01[d]
	50.2	53	1.08
April	66.2[c]	67	0.24
	48.4[c]	49	0.24
	80.4[c]	81	0.17
May	55.2	57	0.66
	63.5	65	0.50
June	38.7[c]	37	-0.73
	56.1[c]	57	0.33
	72.6[c]	73	0.12
July	63.6[c]	64	0.15
	49.6[c]	50	0.14
August	65.8[c]	66	0.07
	48.0[c]	49	0.38
	56.1[c]	57	0.32
September	61.6[c]	63	0.49
	52.5[c]	53	0.20
October	57.9[c]	59	0.38
	41.3[c]	42	0.30
	83.4[c]	85	0.42
November	32.3[c]	33	0.51
	32.4[c]	34	0.93
December	70.7[c]	69	-0.49
	49.3[c]	49	-0.11
	40.1[c]	39	-0.47
January 2016	51.5[c]	51	-0.18
	52.8[c]	52	-0.31
February	32.0	33	0.51
	35.0	36	0.49
	45.9	47	0.45
March	52.8	55	0.82
	33.8	35	0.59

[a] Reference values.

[b] Standard Deviation Index (SDI) of the Welsh External Quality Assessment Schemes (WEQAS). The SDI is an index of total error, including components of inaccuracy and imprecision. A score between -1 and 1 SDI is good, between 1 and 2 or between -1 and -2 SDI is acceptable.

[c] Method-specific mean used, as no reference value was given for this sample.

[d] One HbA_{1c} result was 2.01 SDI from target, however the result was within 2SD of the method mean and as the analyte SDI was 1.55, the results were deemed to be acceptable.

Appendix B: Glossary

This glossary explains terms used in the report; some definitions are also given in relevant chapters.

Acute sickness
A condition or illness that reduces a participant's ability to carry out day-to-day activities.

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 2015 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.

Anthropometric measurements

See **Body mass index (BMI), Waist circumference**.

Arithmetic mean
See **Mean**.

Blood analytes
Analysis of non fasting blood samples. See **Cholesterol (total and HDL)**, **Glycated haemoglobin (HbA_{1C})**.

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

Centile
Centiles are values of a distribution that divide it into 100 equal parts. For example, the 20th centile 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 centile is the median. See also **Quintile**, **Tertile**.

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 2011 HSE report, the most recent to examine blood analytes, the definition of raised total cholesterol used the NICE guidance ‘audit level’ of 5.0 mmol/L or above. For those at high risk of cardiovascular disease (CVD), or those with established CVD, the target of less than 4.0mmol/L was also examined.

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. 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. 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. See also **Half-life**.

Deferred payment agreement
Under the provisions of the Care Act 2014, from April 2015, local authorities must offer deferred payment agreements to people who in receipt of care and support, whether this is arranged by the local authority or by the individual. A deferred payment agreement enables people to use the value of their homes to help pay care home costs. For eligible individuals with capital below a certain threshold, the council will help to pay care home bills on their behalf; repayments are deferred until their home is sold or the individual dies.

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

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 Documents at http://digital.nhs.uk/pubs/hse2015) 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 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.

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

Geometric mean

The geometric mean is a measure of the central tendency of a distribution, which minimises the effects of extreme values. It is therefore useful in a skewed distribution (with most values at one end of the distribution), or a distribution that has a number of very high or very low values which can distort the arithmetic mean. For example, a geometric mean is useful in the distribution of cotinine values where most values (for non-smokers, the majority of the population) are below 12, but where the values for smokers are often in the hundreds.

The geometric mean is the mean of n numbers expressed as the n-th root of their product.

Glycated haemoglobin (HbA_{1C})

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 (HbA_{1c}) 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 2011 HSE report, the most recent where blood analytes were examined, raised glycated haemoglobin was taken as 48mmol/mol (6.5%) or above.

Half-life
Half-life is the time taken for the concentration or amount of a substance in the body to reduce by half. See **Cotinine**.

High blood pressure
See **Blood pressure**.

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 2015 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 Index 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: Department for Communities and Local Government. *The English Indices of Deprivation 2015.* London, 2015. https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015

Limiting longstanding illness
See **Longstanding illness**.

Lipids
Fats in blood, such as cholesterol.

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.

Longstanding illnesses were coded into categories defined in the International Classification of Diseases (ICD 10), but it should be noted that the ICD is used mostly to classify conditions according to the cause, whereas HSE classifies according to the reported symptoms.

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 Geometric **mean, 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 **Centile**.

Morbid obesity
See **Body mass index**.

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 2015, NS-SEC has been used to calculate non-response weights for individuals (see Chapter 7 of this volume).

Obesity
See **Body mass index**.

ONS well-being measures
As part of its programme to measure national well-being, the Office for National Statistics (ONS) developed four questions, which have been used on surveys since 2011.

> Overall, how satisfied are you with your life nowadays?
> Overall, to what extent do you feel that the things you do in your life are worthwhile?
> Overall, how happy did you feel yesterday?
> How anxious did you feel yesterday?

Each of these was scored on a scale where 0 indicated 'not at all' and 10 indicated 'completely'. As a result, higher scores for the first three measures indicated more positive responses, whereas for the measure of anxiety, a higher score indicated greater anxiety.

These questions have been validated for use with adults and children and in a variety of modes.

Reference: ONS. *Personal well-being.* Harmonised concepts and questions for social data sources: interim harmonised principle. ONS, 2015.
https://www.ons.gov.uk/methodology/programmesandservices/harmonisationprogramme/secondarysetofharmonisedconceptsandquestions

Overweight
See **Body mass index**.

Percentile
An alternative term for **Centile**.

Physical activity
In 2015, information on children's physical activity was collected by self-report, and classified into three categories: meets recommendations, some activity, and low activity.

For children under 5 who are able to walk unaided these categories are defined as follows:

Meets recommendations	At least 180 minutes (3 hours) of physical activity on all seven days in the last week.
Some activity	60 to 179 minutes of physical activity on all seven days in the last week.
Low activity	Fewer than 60 minutes of activity on each day, or activity of 180 minutes or more on fewer than seven days in the last week.

For children aged 5 to 18 these categories are defined as follows:

Meets recommendations	At least 60 minutes (1 hour) of moderate to vigorous intensity physical activity (MVPA) on all seven days in the last week.
Some activity	30 to 59 minutes of moderate to vigorous intensity physical activity on all seven days in the last week or at least 60 minutes of moderate to vigorous intensity physical activity on three to six days in the last week.
Low activity	Lower levels of physical activity.

Moderate intensity activities are described as those that make the participant warmer, breathe harder, or their heart beat faster, while still being able to converse, such as cycling or playground activities. Vigorous activities would have similar but greater effects, while making conversation much harder, such as running fast, swimming, or football.

In the report on Children's Physical Activity in HSE 2015, walking and cycling to school are excluded from these measures of activity. Summary levels of activity are calculated including and excluding activities carried out as part of school lessons.

p-value
A p -alue 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 is a statistical value of a data set that represents one fifth of a given population. Quintiles are used to create cut-off points to divide a distribution into five equal parts, i.e. the first quintile represents the lowest fifth of the data (0 to 20%), the next quintile represents 21% to 40% etc. See also **Centile, Tertile**.

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'.

Significance
See **Statistical significance**.

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 **Mean**.

Standardisation
In this report, standardisation refers to standardisation (or 'adjustment') by age. See **Age standardisation**.

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 significance. 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**.

Tertile
A tertile is a statistical value of a data set that represents one third of a given population. Tertiles are used to create cut-off points to divide a distribution into three equal parts, i.e. the first tertile represents the lowest third of the data (0 to 33%), the middle tertile represents 34% to 67% etc. See also **Centile**, **Quintile**.

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).

Waist circumference
Waist circumference is a measure of deposition of abdominal fat i.e. central obesity. A raised waist circumference has been taken to be greater than 102cm in men and greater than 88cm in women. 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.

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*

Warwick-Edinburgh Mental Well-being Scale (WEMWBS)

The Warwick-Edinburgh Mental Well-being Scale (WEMWBS) 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.

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