National Diet and Nutrition Survey

Rolling programme Years 9 to 11 (2016/2017 to 2018/2019)

A survey carried out on behalf of Public Health England and the Food Standards Agency

Contents

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Executive summary

The National Diet and Nutrition Survey Rolling Programme (NDNS RP) is a continuous cross-sectional survey, designed to assess the diet, nutrient intake and nutritional status of the general population aged 1.5 years and over living in private households in the UK. A representative sample of around 1,000 people (500 adults and 500 children) take part in the NDNS RP each year.

Fieldwork for Years 9 to 11 of the NDNS RP was carried out between April 2016 and June 2019. The survey comprised an interview, a 4-day estimated diet diary, physical measurements and a blood and urine sample. Results are used by government to monitor progress toward diet and nutrition objectives of UK Health Departments and to develop policy interventions.

The foods, nutrients and blood and urine measures presented in this report were selected for their nutritional and public health relevance to current dietary concerns in the UK. Results are analysed for 7 age groups: 1.5 to 3 years; 4 to 10 years; 11 to 18 years; 19 to 64 years; 65 years and over; 65 to 74 years and 75 years and over, split by sex in all except the youngest age group.

This report includes:

- descriptive statistics of food consumption, nutrient intake and nutritional status including proportion of the population meeting government recommendations for NDNS RP Years 9 to 11 (2016/17 to 2018/19) and comparison with results from years 7&8 (2014/15 to 2015/16).
- trends over time in relation to food consumption, nutrient intakes and nutritional status in the UK for the first 11 years of the NDNS RP (2008/09 to 2018/19)

Main findings

Findings from Years 9 to 11 (2016 to 2019) for a number of priority foods, nutrients and blood analytes are put into the context of results from the most recent previous paired years (2014 to 2016) and in relation to the more robust long-term trend (since 2008). These foods/nutrients/analytes were selected on the basis of their importance to public health and government priorities for policy and monitoring. Statistical significance was defined at the 5% level ($p<0.05$).

Sugar-sweetened soft drinks

For the period 2016 to 2019, the highest mean consumption of sugar-sweetened soft drinks for children was seen in those aged 11 to 18 years (142g/day) with the lowest seen in those aged 1.5 to 3 years (19g/day). Consumption was lower in 2016-2019 compared with 2014 to 2016 and this was statistically significant for all child age/sex groups except boys aged 11 to 18 years. Over the 11 years (since 2008), the proportion of children consuming sugar-sweetened soft drinks dropped significantly by 32, 44 and 25 percentage points for those aged 1.5 to 3 years, 4 to 10 years and 11 to 18 years, respectively. When restricting analysis to consumers only, for children the quantities consumed also fell significantly over time.

In adults, mean consumption of sugar-sweetened soft drinks was 106g/day for those aged 19 to 64 years and 34g/day for those aged 65 years and over for the period 2016 to 2019. For adults aged 19 to 64 years consumption was significantly lower in 2016 to 2019 compared with 2014 to 2016. Over the 11 years (since 2008), the proportion of adults aged 19 to 64 years consuming sugar-sweetened soft drinks dropped significantly by 20 percentage points. When restricting analysis to consumers only, a significant downward trend in mean consumption was observed in adults aged 65 years and over but not in adults aged 19 to 64 years.

Free sugars

In 2016 to 2019, free sugars[i,ii] intake exceeded the government recommendation of providing no more than 5% of total energy intake (which applies to those aged 2 years and over). Across the age groups, mean intake ranged from 9.4% of total energy for adults aged 65 years and over to 12.3% of total energy for children aged 11 to 18 years. For all child age/sex groups average intake of free sugars as a percentage of total energy was significantly lower than in 2014-2016 and intake dropped by 3.8, 3.9 and 4.9 percentage points over the 11 years (since 2008) for children aged 1.5 to 3 years, 4 to 10 years and 11 to 18 years respectively. For adults aged 19 to 64 years and men aged 65 years and over, average intake of free sugars as a percentage of total energy was significantly lower than in 2014 to 2016. Over the 11 years (since 2008), adults showed a significant reduction in free sugars intake as a percentage of total energy although this was smaller than for children.

Saturated fatty acids

In 2016-2019, saturated fatty acids (saturated fat) intake exceeded the government recommendation of no more than 10% of total energy in all age groups to whom the recommendation applied. Mean intake was 13.1% of total energy for children aged 4 to 10 years, 12.6% for children aged 11 to 18 years, 12.3% for adults aged 19 to 64 years and 13.3% for adults aged 65 years and over. For men aged 19 to 64 years average saturated fatty acids intake as a percentage of total energy increased significantly by 0.5 percentage points and the proportion meeting the recommendation decreased significantly by 7 percentage points between 2014 to 2016 and 2016 to 2019. There was no trend seen in saturated fatty acid intakes over the longer term (since 2008) in any of the age/sex groups.

Fibre

In 2016 to 2019, fibre[iii] intake was below the government recommendations for all age groups.[iv] For boys aged 4 to 10 years there was a significant increase of 7 percentage points in the proportion meeting the recommendation since 2014 to 2016 but there were no significant changes for other age/sex groups. Analysis of the trend over 11 years (since 2008) showed that changes over time were small and inconsistent in direction. Men aged 75 years and over showed the largest change in fibre intake with a significant increase of 2.6g/day over the 11 years.

Red blood cell folate

In 2016 to 2019, red blood cell (RBC) folate concentration was less than 305nmol/L (the threshold indicating folate deficiency and risk of anaemia) in 17% of children aged 11 to 18 years, 13% of adults aged 19 to 64 years and 11% of adults aged 65 years and over. Since 2008, there has been a significant increase of between 1 and 2 percentage points per year in the proportion of the population with a RBC folate less than 305nmol/L in all age/sex groups reflecting a 2 to 3% per year decrease in geometric mean RBC folate concentration.

In 2016 to 2019, 18% of women of childbearing age (aged 16 to 49 years) had an RBC folate concentration less than 305nmol/L. In the same period, 89% of women of childbearing age had a RBC folate concentration less than 748nmol/L (the level below which there is an increased risk of neural tube defects); this was similar to the 91% observed in 2014 to 2016. However, over the longer term (since 2008) the proportion of women of childbearing age with RBC folate less than 748nmol/L increased significantly by 20 percentage points.

Serum folate

In 2016-2019, serum folate concentration less than 13nmol/L (indicative of possible deficiency) was present in half of children aged 11 to 18 years (53%) and adults aged 19 to 64 years (52%) and in one-third of adults aged 65 years and over (34%). In women of childbearing age (aged 16 to 49 years), serum folate concentration less than 13nmol/L was present in 52%. Serum folate deficiency less than 7nmol/L (indicative of clinical deficiency) was present in 9%, 11% and 7% of children aged 11 to 18 years, adults aged 19 to 64 years and adults aged 65 years and over, respectively. In women of childbearing age, serum folate concentration less than 7 nmol/L was present in 13%. Over the 11 years (since 2008), the proportion of the population with serum folate less than 13nmol/L significantly increased by 16, 21 and 29 percentage points in children aged 4 to 10 years, children aged 11 to 18 years and adults aged 19 to 64 years respectively. For women of childbearing age, the proportion with serum folate less than 13nmol/L significantly increased by 28 percentage points over the 11 years (since 2008).

Serum 25-hydroxyvitamin D

In 2016 to 2019, 19%, 16% and 13% of children aged 11 to 18 years, adults aged 19 to 64 years and adults aged 65 years and over, respectively, had a 25-hydroxyvitamin D (25-OHD) concentration less than 25 nmol/L (the level below which there is increased risk of poor musculoskeletal health at a population level). Differences in 25-OHD concentration between 2014-2016 and 2016-2019 were small and not significant except for children aged 4 to 10 years where the mean increase was 6.2 nmol/L. Over the 11 years (since 2008), there was a significant 9 percentage point decrease in the proportion of boys aged 4 to 10 years with 25-OHD concentration less than 25 nmol/L.

Chapter 1 Background and purpose

Background

The National Diet and Nutrition Survey Rolling Programme (NDNS RP) is a cross-sectional survey with a continuous programme of fieldwork, designed to assess the diet, nutrient intake and nutritional status of the general population aged 1.5 years and over living in private households in the UK. The core NDNS RP is jointly funded by Public Health England (PHE)[v] and the UK Food Standards Agency (FSA). The NDNS RP is currently carried out by a consortium comprising NatCen Social Research (NatCen) and the National Institute of Health Research Cambridge Biomedical Research Centre (NIHR BRC, Cambridge).[vi] The latter consists of the NIHR BRC Diet, Anthropometry and Physical Activity Group and the NIHR BRC Nutritional Biomarker Laboratory hosted at the Medical Research Council Epidemiology Unit at the University of Cambridge.[vii,viii] Interviewer fieldwork in Northern Ireland is carried out by the Northern Ireland Statistics and Research Agency (NISRA).

The NDNS provides the only source of nationally representative UK data on the types and quantities of foods consumed by individuals, from which estimates of nutrient intake for the population are derived and on their nutritional status from analysis of blood and urinary biomarkers. Results are used by government to monitor progress toward diet and nutrition objectives of UK Health Departments and develop policy interventions, for example to monitor progress towards a healthy, balanced diet as visually depicted in the Eatwell Guide.[ix] The NDNS is an important source of evidence underpinning work of the Scientific Advisory Committee on Nutrition (SACN) and their advice to UK governments on nutrition related matters. The food consumption data is also used by the FSA to assess exposure to chemicals in food, as part of the risk assessment and communication process in response to a food emergency or to inform negotiations on setting regulatory limits for contaminants.

The NDNS programme began in 1992 as a series of cross-sectional surveys designed to be representative of the UK population, each covering a different age group: pre-school children (aged 1.5 to 4.5 years);[x] young people (aged 4 to 18 years);[xi] adults (aged 19 to 64 years)[xii] and older adults (aged 65 years and over)[xiii] Since 2008, the NDNS has run continuously as a rolling programme (RP) covering adults and children aged 1.5 years and over. Methods used in the NDNS are kept under review to ensure they remain the best practical methods available.

Content of this report

This report presents an overview of food consumption, nutrient intake and nutritional status for the UK in NDNS RP Years 9 to 11 combined (2016/2017 to 2018/2019). The NDNS RP sample is drawn from all 4 UK countries, and is designed to be nationally representative.[xiv, xv, xvi] Background information on the survey, including the sample and methodology can be found in the appendices.

Excel tables provide data for those foods, nutrients, and blood and urinary analytes listed in table A. They show data for Years 9 to 11 combined (2016/2017 to 2018/2019) and data for the previous paired years: Years 1 and 2 combined (2008/2009 to 2009/2010); Years 3 and 4 combined (2010/2011 to 2011/2012); Years 5 and 6 combined (2012/2013 to 2013/2014): Years 7 and 8 combined (2014/2015 to 2015/2016). From Year 12 (2019/2020) the dietary assessment method has changed from a paper 4-day estimated diet diary to an online 24-hour recall (Intake24, https://intake24.org/). Year 11 (2018/2019) was the final year of the diet diary method and so the decision was taken to combine Year 11 data with Years 9 and 10 (2016/2017 to 2017/2018) for reporting.

Results are presented for age groups 1.5 to 3 years (sex combined), 4 to 10 years, 11 to 18 years, 19 to 64 years and 65 years and over. In addition, for food and nutrient intakes, the 65 years and over age group is split into those aged 65 to 74 years and those aged 75 years and over. Due to small cell sizes, results for blood and urinary analytes have not been split into these additional age groups for 65 years and over.

Statistical comparisons to analyse differences between the latest data (Years 9 to 11 (combined)) and the last report (Years 7 and 8 combined (2014/2015 to 2015/2016)) and time trend analyses (Years 1 to 11 (2008/2009 to 2018/2019) have been performed for a number of key foods, nutrients, and blood and urinary analytes (see table A) selected for their nutritional and public health relevance to current dietary concerns in the UK. Statistical significance was defined at the 5% level ($p<0.05$).

Table A: Variables presented in report tables

Foods	Fruit juice Total fruit and vegetables (not including fruit juice) Total fruit (not including fruit juice) Total vegetables 5 A Day fruit and vegetable portions and % achieving 5 A DAY* Total meat Red and processed meat* Total fish Oily fish Sugar-sweetened soft drinks* Sugar confectionery* Chocolate confectionery*
Macronutrients	Energy* Protein Total fat Saturated fatty acids* Trans fatty acids Cis monounsaturated fatty acids* Cis n-3 polyunsaturated fatty acids*

	Cis n-6 polyunsaturated fatty acids* Carbohydrate* Free sugars* Fibre*,[iv] Alcohol
Micronutrients	Vitamin A* Riboflavin Folate* Vitamin D Iron* Calcium Magnesium Potassium Iodine Selenium Zinc
Blood and urinary analytes	Haemoglobin and ferritin Vitamin B12 Holotranscobalamin (HoloTC) Erythrocyte glutathione reductase activation coefficient (EGRAC) Pyridoxal-5-phosphate (PLP) Red blood cell folate* Serum folate* Unmetabolised (free) folic acid 25-hydroxyvitamin D*(25-OHD) Total cholesterol Total cholesterol to high density lipoprotein (HDL) cholesterol ratio Low density lipoprotein (LDL) cholesterol Urinary iodine*

* Variables included in statistical comparisons and time trend analyses.

Commentary is provided in chapter 2 for dietary intake of sugar–sweetened soft drinks, saturated fatty acids, free sugars, fibre, and for blood biomarkers of folate and vitamin D status.

Appendix U provides more information on the statistical analysis methods used for the year group comparisons and time trend analysis along with rationale for the different descriptive statistics used. Chapter 1 provides guidance on interpreting the time trend analysis.

Interpreting the Years 1 to 11 time trend analysis

In this report the time trend analysis has been presented as plots in Excel and the following guidance is provided to aid interpretation of these plots. Appendix U provides a full explanation of the analytical approach.

In each case the analysis has been summarised using the slope of the regression line along with the 95% confidence interval. Where there is a statistically significant trend ($p<0.05$) the quantification of the slope has been assigned an asterisk. The slope of the regression line represents the average change per year.

Where data distribution was highly skewed it was analysed on a log scale. In these cases the geometric mean is the most appropriate average and changes are represented as ratios of geometric means (rather than differences of arithmetic means as they were for non-logged analyses). The average per year ratio of geometric means has been converted into a per cent (%) change per year.

Information has been provided in appendix U to explain how the average increase/reduction over the 11 years of the survey was calculated for the time trend analysis. It should be noted that the calculation method for variables that are analysed on the log scale is different from that for variables analysed on the linear scale. Eleven-year change values are presented in Excel tables U.1-U.4.

Due to differences in the variation of the datapoints or sample size within each of the age/sex groups, there are instances for some foods/nutrients/blood analytes where larger slopes were not statistically significant whereas smaller slopes were statistically significant.

For foods where there were a large number of non-consumers, percentage of consumers and intakes for consumers only are presented instead of population intakes. This is because the regression analysis of population intakes is highly influenced by zero values which can be misleading.

Methodological changes during Years 1 to 11 of the NDNS RP

The data collection and analysis methods used in the NDNS RP are kept as consistent as possible over time. For Years 1 to 11 dietary data was collected through a 4-day food and drink diary throughout. Blood sampling, processing and analysis methods were generally unchanged, but, where changes were needed, crossover studies were carried out to ensure comparability of results over time was maintained. Details of the dietary data and blood and urine sample collection, processing and analysis for Years 10 and 11 are provided in appendices A, M, P and

Q of this report. Details for Year 9 can be found in the equivalent appendices of the Years 1 to 9 report.[xvii]

Measurement of energy expenditure during Years 1 to 11

The misreporting of energy intake (EI) is known to be an issue for all dietary surveys and studies.[xviii,xix] Previous NDNS and the current NDNS RP are unique amongst large-scale population surveys in their inclusion of doubly labelled water (DLW)[xx] as an objective biomarker to validate EI estimated from reported food consumption. In the NDNS RP, estimates of EI from the 4-day diary were compared with measurements of total energy expenditure (TEE) using the DLW technique in 2 separate sub-samples of survey participants. The first sub-sample was taken from Year 1 (2008 to 2009) and Year 3 (2010 to 2011) and the second sub-sample from Year 6 (2013 to 2014) and Year 7 (2014 to 2015). Appendix X of the Years 1 to 9 report[xvii] provides a summary of the DLW method, the results of the analysis and an illustration of a number of considerations relevant to the interpretation of the survey findings.[xxi]

As previously reported[xvii] the results of the most recent analysis (DLW sub-study 2013 to 2015), indicated that reported EI in children aged 4 to 10 years was on average 13% lower than TEE measured by the DLW technique, 31% lower in children aged 11 to 15 years, 33% lower in adults aged 16 to 64 years and 28% lower in adults aged 65 years and over. These results are consistent with findings from the DLW sub-sample taken from 2008 to 2009 and 2010 to 2011.[xxii]

The energy and nutrient intakes presented in this report have not been adjusted to take account of misreporting.

Changes to UK dietary recommendations

Government advice on energy and nutrient intakes is based on recommendations from the Scientific Advisory Committee on Nutrition (SACN) and its predecessor, the Committee on Medical Aspects of Food and Nutrition Policy (COMA).[xxiii] Since the start of the NDNS RP in 2008 government has revised its advice on energy intakes, red and processed meat consumption, and intakes of free sugars, fibre and vitamin D, as a result of changes to recommendations from SACN. Revised advice has also been issued on consumption of fruit juice and smoothies in the context of government 5-a-day recommendations. Further details on these changes can be found in the Years 1 to 9 report.[xvii]

In 2019 SACN published its report on saturated fats and health.[xxiv] COMA had recommended in 1994 that the population average contribution of saturated fatty acids to total dietary energy be reduced to no more than about 10%.[xxv,xxvi] SACN (2019) concluded that new evidence published since 1994 supports and strengthens the existing saturated fat recommendations.

Response rates

Household level response

Overall, of the 13,244 addresses issued to interviewers for Years 9 to 11 (combined), 45% were eligible for household selection. Ineligible addresses included vacant or derelict properties and institutions. Addresses that were selected for the child boost sample and were screened out because they did not contain any children in the eligible age range (1.5 to 18 years) were also included in the ineligible category. These addresses accounted for 76% of the total ineligible addresses.

Household selection was carried out at 96% of eligible addresses. The individuals in the remaining 4% of addresses refused to participate before the household selection could be carried out (Table 1.1).

Individual level response

The overall response rate for fully productive individuals (that is those completing 3 or 4 diary recording days was 50% in Year 9 (2016 to 2017), 45% in Year 10 (2017 to 2018) and 47% in Year 11 (2018 to 2019), giving a sample size of 3,558 fully productive individuals. Of the 3,558 fully productive individuals, 3,466 (97%) completed the diet diary for 4 days and 92 (3%) completed 3 days. Analyses in this report (including response rates for subsequent stages/components of the survey) are based on these 3,558 individuals.

In Years 9 to 11 (2016/2017 to 2018/2019), participants aged 4 years and over were asked to provide a spot urine sample. Seventy-two per cent of these fully productive participants provided a spot urine sample (82% of adults, 61% of children).

In total, 65% of all fully productive participants (Years 9 to 11) were visited by a nurse.[xxvii] Fifty-three per cent of fully productive adults and 25% of fully productive children provided a blood sample. Younger children were less likely to give a blood sample than older children or adults: 10% of those aged 1.5 to 3 years and 22% of those aged 4 to 10 years provided a blood sample compared with 35% of those aged 11 to 18 years and 53% of those aged 19 years and over (Table 1.2).

Previous NDNS RP reports and data archiving

This report builds on a series of previous NDNS RP reports that have been published since Year 1 (2008 to 2009). These include:

UK reports

- paired years report series commencing from Year 5, that is Years 5 and 6 (2012/13 to 2013/14)[xxviii] and Years 7 and 8 (2014/15 to 2015/16)[xxix]

- the Years 1 to 9 time trend and income analyses report[xvii]
- the Years 1 to 4 (2008/09 to 2011/12) report[xxii]
- a supplementary folate report for Years 1 to 4 (2008/09 to 2011/12)[xxx]

Country reports

- for Northern Ireland: the Years 5 to 9 (2012/13 to 2016/17) and Years 1 to 9 (2008/2009 to 2016/2017) time trend and income analyses report[xxxi] and the Years 1 to 4 (2008/2009 to 2011/2012) report[xxxii]
- for Wales: the Years 5 to 9 (2012/2013 to 2016/2017) and Years 1 to 9 (2008/2009 to 2016/2017) time trend and income analyses report[xxxiii] and the Years 2 to 5 (2009/2010 to 2012/2013) report[xxxiv]
- for Scotland: the Years 1 to 4 (2008/2009 to 2011/2012) report[xxxv]

The NDNS also includes a series of urinary sodium surveys for the assessment of population salt intake, with fieldwork in England in 2018 to 2019,[xxxvi] 2014[xxxvii] and 2011,[xxxviii] and Northern Ireland in 2015,[xxxix] Scotland, most recently in 2014,[xl] and Wales in 2006.[xli]

NDNS RP data are routinely deposited at the UK Data Service after each NDNS RP report publication.[xlii]

Chapter 2 Priority foods, nutrients and analytes

Introduction

This chapter presents key findings on the following: sugar-sweetened soft drinks, saturated fatty acids, free sugars, fibre, red cell and serum folate and 25-hydroxyvitamin D. These foods/nutrients/analytes have been selected on the basis of their importance to public health and government priorities for policy and monitoring.

Years 9 to 11 (2016/2017 to 2018/2019) and comparison with Years 7 and 8 (2014/2015 to 2015/2016)

This section presents key findings for Years 9 to 11 (combined) for the standard NDNS RP age groups and includes sex-combined and sex-split results. The following commentary is supported by Excel tables 1.1-9.2 providing data for Years 9 to 11 combined and data for the previous paired years: Years 1 and 2 combined (2008/2009 to 2009/2010); Years 3 and 4 combined (2010/2011 to 2011/2012); Years 5 and 6 combined (2012/2013 to 2013/2014): Years 7 and 8 combined (2014/2015 to 2015/2016). Statistical comparisons have been performed to analyse differences between the latest data (Years 9 to 11 (combined)) and the previous set of estimates (Years 7 and 8 (combined)). Statistical significance was defined at the 5% level ($p<0.05$). The commentary below describes the overall size of any observed changes in intakes or nutritional status.[xliii]

Consumption of sugar-sweetened soft drinks

Sugar sweetened soft drinks are a major contributor to free sugars intakes, especially in children. In 2015 SACN recommended that the consumption of sugar-sweetened beverages (that is soft drinks) should be minimised by both children and adults.[xliv]

In children, the highest mean consumption of sugar-sweetened soft drinks (including non-consumers) was seen in those aged 11 to 18 years (142g/day) with the lowest seen in those aged 1.5 to 3 years (19g/day). Consumption was lower in Years 9 to 11 (combined) compared with Years 7 and 8 (combined) and this was statistically significant for all child age/sex groups except boys aged 11 to 18 years.[xlv]

In adults, mean consumption of sugar-sweetened soft drinks (including non-consumers) was 106g/day for those aged 19 to 64 years and 34g/day for those aged 65 years and over. For adults aged 19 to 64 years, consumption was significantly lower in Years 9 to 11 (combined) compared with Years 7 and 8 (combined).[i] For adults aged 65 years and over differences were smaller and not in a consistent direction (Table 7.10).

Free sugars intake

The government has adopted free sugars[i,xlvi] as the basis for sugar intake recommendations, following the recommendation of SACN in its 2015 report on carbohydrates and health.[xliv] SACN found evidence that high levels of sugar consumption are associated with greater risk of tooth decay and that the higher the proportion of sugar in the diet, the greater the risk of high energy intake, which can lead to weight gain. The recommendation is that free sugars should provide a population average of no more than 5% of total energy for those aged 2 years and over.

In all age groups, mean intake of free sugars exceeded the government recommendation. In children, girls aged 11 to 18 years and boys aged 4 to 10 years had the highest mean free sugars intakes as a percentage of total energy (12.5% and 12.4% of total energy respectively); whilst children aged 1.5 to 3 years had the lowest mean intake (9.7%).[xlvii] In adults mean intake of free sugars as a percentage of total energy intake was 9.9% for those aged 19 to 64 years and 9.4% for those aged 65 years and over. Men aged 75 years and over had the highest mean intake among adults (10.9% of total energy). Mean intake of free sugars as a percentage of total energy was lower in Years 9 to 11 (combined) compared with Years 7 and 8 (combined) and this was statistically significant for all child age/sex groups, adults aged 19 to 64 years and men aged 65 years and over.

The percentage meeting the recommendation of no more than 5% of daily total energy intake from free sugars was 15% for children aged 1.5 to 3 years, 2% of children aged 4 to 10 years and 7% of children aged 11 to 18 years. Seventeen per cent of adults aged 19 to 64 years and 16% of adults aged 65 years and over met the recommendation. There was a statistically significant 4 percentage point (CI 1, 8) increase in the proportion of adults aged 19 to 64 years meeting the recommendation in Years 9 to 11 (combined) compared with Years 7 and 8 (combined). In men aged 65 years and over, there was a 5 percentage point (CI -2, 12) increase in the proportion meeting the recommendation although this was not statistically significant. Significant changes between Years 7 and 8 (combined) and Years 9 to 11 (combined) were not seen in the other age/sex groups (Table 3.10).

Saturated fatty acids intake

The government recommendation for saturated fat is that the population average contribution of saturated fat should be reduced to no more than 10% of total dietary energy. This recommendation applies to adults and children aged 5 years and older. This recommendation was confirmed by SACN in 2019 on the basis of evidence that higher saturated fat consumption is linked to raised blood cholesterol and with increased risk of heart disease.[xxiv]

Mean saturated fatty acids intake exceeded the government recommendation in all age groups to which the recommendation applied. For children, mean intakes were 13.1% and 12.6% of total energy for children aged 4 to 10 years and 11 to 18 years respectively. For adults mean intakes were 12.3% and 13.3% of total energy for the 19 to 64 years and 65 years and over groups respectively. Women aged 75 years and over had the highest intake (14.3% of total energy). In men aged 19 to 64 years and men aged 65 to 74 years, mean saturated fatty acids intake as a percentage of total energy increased by 0.5 percentage points between Years 7 and 8 (combined) and Years 9 to 11 (combined) although this was only statistically significant for men aged 19 to 64 years (CI 0.0, 1.0). Significant changes were not seen in the other age/sex groups.

The percentage meeting the recommendation of no more than 10% of daily total energy intake from saturated fatty acids was 11% for children aged 4 to 10 years, 18% for children 11 to 18 years, 25% for adults aged 19 to 64 years and 17% for adults aged 65 years and over. In men aged 19 to 64 years the proportion meeting the recommendation fell by 7 percentage points (CI 0, 13) between Years 7 and 8 (combined) and Years 9 to 11 (combined). No significant changes were seen in the other age/sex groups (Table 3.4).

Fibre intake

The government recommendation, based on SACN's 2015 report on carbohydrates and health,[xliv] is that the population average intake of fibre[iii] (measured by the AOAC method) for adults should be 30g per day, with proportionally lower recommendations for children from the age of 2 years.[iv] There is strong evidence to indicate that diets high in fibre are associated with a lower risk of cardiovascular diseases, type 2 diabetes and bowel cancer.

In all age groups, mean intake of fibre was below the government recommendations. For children aged 1.5 to 3 years, 4 to 10 years and 11 to 18 years, mean intakes were 10.4g, 14.3g and 16.0g respectively. For adults aged 19 to 64 years and 65 years and over, mean intakes were 19.7g and 18.7g respectively. In girls aged 11 to 18 years mean fibre intake increased by 1.3g (CI 0.3, 2.3) between Years 7 and 8 (combined) and Years 9 to 11 (combined). Significant changes were not seen in the other age/sex groups.

The percentage of children meeting the fibre recommendation was 12% for those aged 1.5 to 3 years, 14% for those aged 4 to 10 years and 4% for those aged 11 to 18 years. Nine per cent of adults aged 19 to 64 years met the recommendation as did 6% of adults aged 65 years and over (9% of those aged 65 to 74 years and 3% of those aged 75 years and over). In boys aged 4 to 10 years, the proportion meeting the recommendation increased by 7 percentage points between Years 7 and 8 (combined) and Years 9 to 11 (combined) and this was statistically significant (CI 0, 14). No significant changes were seen in the other age/sex groups (Table 3.11).

Folate status – red blood cell (RBC) and serum folate

Folate is a general term for a number of related compounds crucial to metabolic systems and the maintenance of optimal health. Folate is necessary for DNA synthesis and replication required for normal cell development and growth. Folate deficiency may lead to megaloblastic anemia in adults and children and inadequate folate is a risk factor for neural tube defects and other poor health outcomes during foetal development.[xlviii]

Folate status can be assessed with a number of different biomarkers. Serum folate concentration responds rapidly to changes in folate intake and provides information on recent folate status. In this report, serum folate represents the sum of individual folate vitamers measured by LC-MS/MS (see appendix Q), and can provide information on folate vitamers, including folic acid.

Red blood cell (RBC) folate provides a sensitive marker of longer-term folate status and represents folate status during the previous 3 to 4 months, mirroring tissue folate stores. As such RBC folate is less sensitive to short-term fluctuations in folate intake or metabolism and provides a better marker of population folate status.

Folate status is assessed with reference to thresholds indicating deficiency or insufficiency. Based on haematological indicators, the threshold for folate deficiency assessed with RBC folate is 305nmol/L.[xlix] For serum folate a threshold of 13nmol/L indicates possible deficiency and 7nmol/L indicates clinical deficiency.[l] The threshold of 748nmol/L for RBC folate in women of childbearing age (aged 16 to 49 years) is the level at which there is increased risk of neural tube defects.[li,lii]

RBC folate

Four per cent of children aged 4 to 10 years, 17% of children aged 11 to 18 years, 13% of adults aged 19 to 64 years and 11% of adults aged 65 years and over had an RBC folate concentration below the threshold indicating risk of anaemia (305nmol/L). Proportions were slightly higher in women than men in the adult age groups.

There was a statistically significant 16% (CI 0, 29) decrease in geometric mean RBC folate concentration in women aged 65 years and over between Years 7 and 8 (combined) and Years 9 to 11 (combined). Changes in geometric mean RBC folate concentration in other age/sex groups between Years 7 and 8 (combined) and Years 9 to 11 (combined) had wide confidence intervals and were not significant.

In women of childbearing age (aged 16 to 49 years), 89% had a RBC folate concentration less than the 748nmol/L threshold indicating increased risk of neural tube defects in Years 9 to 11 (combined), consistent with the proportion (91%) observed in women of childbearing age in Years 7 and 8 (combined) (Table 8.6).

Serum folate

More than half of children aged 11 to 18 years (53%), adults aged 19 to 64 years (52%) and women of childbearing age (16 to 49 years) (52%), and a third of adults aged 65 years and over

(34%) had a serum folate concentration below the 13nmol/L threshold indicative of possible deficiency. Assessed against the 7nmol/L threshold for clinical deficiency, 9% of children aged 11 to 18 years, 11% of adults aged 19 to 64 years and 7% of adults aged 65 years and over had folate deficiency; proportions were similar between men and women. In women of childbearing age (aged 16 to 49 years), 13% had folate deficiency.

Compared with Years 7 and 8 (combined), the geometric mean serum folate concentration was 13% (CI 2, 24) higher in children aged 11 to 18 years in Years 9 to 11 (combined), although this was only significant in girls (19%, CI 3, 37). In women of childbearing age (aged 16 to 49 years), the geometric mean serum folate concentration was 11% higher in Years 9 to 11 (combined) but this difference was not significant (CI -2, 25). Whilst in adults aged 65 years and over (sex combined) there was a non-significant 4% reduction (CI -18, 13) in the geometric mean serum folate concentration, there was a disparity between men and women; in men aged 65 years and over there was a non-significant 19% increase (CI -3, 46) and in women of the same age a non-significant 19% decrease (CI -1, 35) (Table 8.7).

Vitamin D status (25-hydroxyvitamin D concentration)

Vitamin D is synthesised in the skin from the action of ultraviolet B (UVB) irradiation from the sun and is also available from foods and supplements. 25-hydroxyvitamin D (25-OHD) is derived from vitamin D precursors and primary circulating form of vitamin D. 25-OHD concentration as a measure of vitamin D status reflects the availability of vitamin D in the body from both cutaneous (skin) synthesis and from the diet.

Due to the limited availability of UVB radiation of the correct wavelength, cutaneous synthesis of biologically relevant quantities of vitamin D cannot occur during the winter months in the UK and consequently 25-OHD concentration shows a strong seasonal pattern. However, changes with seasonality do not affect the comparisons between NDNS RP reports or calculation of the time trends reported because individual data are used rather than annual average and the NDNS RP covers the entire calendar year equally.

In the UK, risk of poor musculoskeletal health is increased at serum 25-OHD concentrations below 25 nmol/L.[liii]

In 2016, SACN published an evidence review of vitamin D and health and set a Reference Nutrient Intake (RNI) of 10µg/day for adults and children of all ages.[liv] Government advice recommends that in the summer months the majority of adults and children aged 5 years and older will probably obtain sufficient vitamin D from sunshine when they are outdoors, and by following a healthy, balanced diet. However, because it is difficult to get enough vitamin D from food alone, everyone over the age of 5 years should consider taking a daily supplement containing 10µg vitamin D during the autumn and winter months.

People who have no or very little sunshine exposure such as those living in an institution (for example, a care home) or who are not often outdoors or who cover their skin when outdoors, should take a daily supplement containing 10µg vitamin D throughout the year. People from minority ethnic groups with dark skin, such as those of African, African Caribbean or South Asian origin, might not get enough vitamin D from sunlight, so should consider taking a vitamin D supplement throughout the year. Children aged 1 to 4 years should be given a daily supplement containing 10µg vitamin D throughout the year. Infants from birth up to 1 year of age should also be given a daily supplement containing 8.5-10µg vitamin D unless they are receiving at least 500ml of infant formula per day.

In Years 9 to 11 (combined), 19%, 16% and 13% of children aged 11 to 18 years, adults aged 19 to 64 years and adults aged 65 years and over, respectively, had a serum 25-OHD concentration less than 25 nmol/L; in children aged 4 to 10 years, the proportion was 2%. Prevalence of deficiency was 4 percentage points higher in boys than girls (aged 11 to 18 years) and 3 percentage points higher in men than women (aged 19 to 64 years), although these differences were not tested for statistical significance.

Compared with Years 7 and 8 (combined), the mean 25-OHD concentration was 6.2 nmol/L (CI 0.4, 11.9) higher in children aged 4 to 10 years in Years 9 to 11 (combined). Consistent with this, the prevalence of deficiency in children aged 4 to 10 years was lower in Years 9 to 11 (combined) (2%) compared with Years 7 and 8 (combined) (10%), although this difference was not tested for statistical significance. There were no significant changes in mean 25-OHD in the other age groups (Table 8.9).

Time trend analysis for Years 1 to 11 (2008/09 to 2018/19)

This section presents time trend analyses for selected key foods and nutrients over the 11-year period (2008/09 to 2018/19) of the NDNS RP. The following commentary is supported by Excel tables 10.1-11.14.

The time trend analysis uses a linear regression model, which splits each survey year into quarters to characterise more fully the trends over time and to provide an estimate of the average per year change over the 11-year period. The slope of the regression line represents the average year-by-year change. The analysis is shown as a plot in Excel. Refer to chapter 1 for a guide to interpretation of the time trend analysis plots. To calculate the 11-year change refer to appendix U, which provides instructions and explains that the calculations for variables that are analysed on the log scale are different from those for variables analysed on the linear scale. Eleven-year change values are presented in Excel tables U.1-U.4.

Many of the trends identified by the analysis were small in magnitude and some were not statistically significant. The commentary in this section describes trends in selected key foods, nutrients and analytes taking account of statistical significance (as indicated by the confidence intervals set out in brackets in the text) and whether the change is nutritionally meaningful. The text describes upward or downward trends and the overall size of any observed changes in intakes.[xliii] The plots provide an indication of mean food and/or nutrient intakes across the 11-year period. Mean values for each combined year can be found in Excel tables 1.1-9.2.

Trends in arithmetic mean (referred to as mean for simplicity) are reported as 'change per year' where the data were normally distributed and could be analysed without transformation. Where the data were skewed and were log-transformed before analysis, the trends in geometric mean are reported as 'percentage change per year' (see chapter 1 for more detail).

Sugar-sweetened soft drinks

For sugar-sweetened soft drinks, trends are presented for percentage of consumers and intakes for consumers only because the proportion of non-consumers over the 4 days was high, or was high in some age/sex groups; the inclusion of non-consumers can cause the regression analysis of population intakes to be misleading.

Sugar-sweetened soft drinks – children

There was a significant downward trend over time in the percentage of children consuming sugar-sweetened soft drinks. In children aged 1.5 to 3 years, 4 to 10 years and 11 to 18 years there was an average reduction in the percentage consuming sugar-sweetened soft drinks per year of 3 (CI 2, 4), 4 (CI 3, 5) and 2 (CI 2, 3) percentage points respectively. This is equivalent to a reduction of 32, 44 and 25 percentage points over the 11 years (Table U.1). Consumption of sugar-sweetened soft drinks among children (consumers only) showed an average yearly reduction of 7% (CI 3, 10), 4% (CI 2, 6) and 5% (CI 3, 6) for each age group respectively.

Sugar-sweetened soft drinks – adults

In adults aged 19 to 64 years an average reduction of 2 percentage points per year (CI 1, 2) was observed in the proportion consuming sugar-sweetened soft drinks equivalent to a reduction of 20 percentage points over the 11 years (Table U.1). A significant reduction of 2 percentage points per year (CI 1, 4) was also observed in women aged 75 years and over; there were no significant differences in those aged 65 to 74 years or in men. A significant downward trend in the quantity consumed of sugar-sweetened soft drinks (consumers only) was observed in adults aged 65 years and over but not in those aged 19 to 64 years. Women aged 65 to 74 years who drank sugar-sweetened soft drinks showed an average reduction in consumption of 7% per year (CI 2, 11) (Tables U.1,10.5,10.6).

Free sugars intake

There was a downward trend over time in free sugars intake[i] as a percentage of total energy and this was statistically significant in all age/sex groups except men aged 65 years and over. Children aged 1.5 to 3 years, 4 to 10 years and 11 to 18 years had an average yearly reduction of 0.3 (CI 0.2, 0.4), 0.4 (CI 0.3, 0.4) and 0.4 (CI 0.4, 0.5) percentage points respectively. This is equivalent to a reduction of 3.8, 3.9 and 4.9 percentage points respectively over the 11 years (table U.2). In adults, the largest reductions over time were seen in men aged 19 to 64 years

(0.3 percentage points per year, CI 0.2, 0.4) and women aged 75 years and over (0.3 percentage points per year, CI 0.1, 0.4) (Table 10.17).

Saturated fatty acids intake

Over the 11-year period, changes in saturated fatty acids intake as a percentage of total energy were close to zero in all age/sex groups (Table 10.12).

Fibre intake

There was no consistent pattern in direction of change in fibre intake[iii] across the age/sex groups over the 11-year period, and all changes were very small or close to zero. Girls aged 4 to 10 years showed a small significant decrease in intakes over the 11-year period (0.1g/day per year, CI 0.0, 0.2). In contrast, there was a significant average increase in fibre intake of 0.2g/day per year for adults aged 19 to 64 years (CI 0.1, 0.2) and men aged 75 years and over (CI 0.0, 0.5) (Table 10.18).

Folate status – red blood cell (RBC) and serum folate

RBC folate

Geometric mean RBC folate concentration significantly decreased by 2 to 3% per year in all age/sex groups over the 11-year period. This is equivalent to between a 22 to 31% decrease in RBC folate concentration since 2008 (Table U.4).

In children aged 11 to 18 years, adults aged 19 to 64 years, adults aged 65 years and over and in women of child bearing age (aged 16 to 49 years) there was a significant 1 to 2 percentage point per year increase in the proportion of individuals with a RBC folate concentration less than 305nmol/l (clinical threshold for deficiency). In children aged 1.5 to 3 years and 4 to 10 years there was an insufficient number of participants to estimate the regression line. These annual percentage point increases are equivalent to increases in deficiency of 17, 10, 12 and 16 percentage points over the 11-year period for children aged 11 to 18 years, adults aged 19 to 64 years, adults aged 65 years and over and for women of child bearing age, respectively (Table U.4).

The proportion of women of childbearing age with RBC folate less than 748nmol/L (indicating increased risk of NTDs) increased by 2 percentage points per year (CI 1, 3), equivalent to a 20 percentage point increase over the 11-year period (Tables U.4, 11.1-11.5).

Serum folate

Geometric mean serum folate concentration significantly decreased by 2 to 4% per year in all age/sex groups except for children aged 1.5 to 3 years and men and women (separately) aged 65 years and over.

Consistent with the general decrease in mean serum folate concentration, the proportion of the population below the serum folate concentration indicative of possible deficiency (less than

13nmol/L) significantly increased in children aged 4 to 10 years, children aged 11 to 18 years and adults aged 19 to 64 years by 1 (CI 1, 2), 2 (CI 1, 3) and 3 (CI 2, 3) percentage points per year, respectively. This is equivalent to between a 16 and 34 percentage point increase over the 11-year period (Table U.4).

Since cell sizes were smaller it was not possible to estimate time trends for the youngest age groups when considering folate deficiency based on serum folate (less than 7nmol/L). However, in children aged 11 to 18 years and adults aged 19 to 64 years and aged 65 years and over, the proportion with folate deficiency significantly increased by 1 (CI 0, 1) percentage point per year.

The proportion of women of childbearing age (aged 16 to 49 years) with serum folate less than 13nmol/L significantly increased by 3 (CI 2, 4) percentage points per year equivalent to a 28 percentage point increase over the 11-year period (Tables U.4, 11.6-11.11).

Vitamin D status (25-hydroxyvitamin D concentration)

In general there was little change in mean 25-OHD concentration over the 11-year period of the NDNS RP. In children aged 4 to 10 years there was a small but significant average increase of 1 nmol/L per year (CI 0, 2) and a similar significant increase in adults aged 65 years and over (1 nmol/L per year, CI 1, 2) which was significant in women (2 nmol/L per year, CI 1, 2) but not in men (1 nmol/L per year, CI 0, 1).

Consistent with the observations in mean 25-OHD concentration, there was a 1 percentage point decrease per year in the proportion of children aged 4 to 10 years with 25-OHD concentration less than 25 nmol/L but this was only significant in boys (CI 0, 2) equal to a 9 percentage point decrease in the risk of vitamin D deficiency over the 11-year period (table U.4). Conversely there were small, non-significant increases (1 percentage point per year, CI -0.1, 2) in the same parameter in children aged 11 to 18 years, equal to a 9 percentage point increase in the risk of vitamin D deficiency over the 11-year period (Tables U.4, 11.2, 11.3).

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i The definition of free sugars includes: all added sugars in any form including honey and syrups; all sugars naturally present in fruit and vegetable juices, spreads, purees and pastes, and similar products in which the structure has been broken down; all naturally occurring sugars in drinks (except for dairy-based drinks) and lactose and galactose added as ingredients. The sugars naturally present in milk and dairy products, fresh and most types of processed fruit and vegetables and in cereal grains, nuts and seeds are excluded from the definition. Further details of the methodology for determining free sugars in the NDNS RP are provided in appendix AA of the Years 1 to 9 report. National Diet and Nutrition Survey: Results for Years 5 to 9 of the Rolling Programme (2012/2013 – 2016/2017) and time trend and income analyses (Years 1-9; 2008/2009 – 2016/2017). [Internet]. Available from
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iv Fibre recommendations: 30g/day for adults; 25g/day for older children aged 11 to 16 years, 20g/day for children aged 5 to 11 years and 15g/day for children aged 2 to 5 years.

v From 1 April 2013, responsibility for the NDNS contract transferred from the Department of Health in England to the Department of Health's Executive Agency, Public Health England (PHE).

vi NatCen has led the consortium since the beginning of the RP. The Cambridge NDNS team is supported by the NIHR Cambridge Biomedical Research Centre (IS-BRC-1215-20014) and joined the consortium in November 2017.

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