National Diet and Nutrition Survey: Results from Years 1-4 (combined) of the Rolling Programme (2008/2009 – 2011/12)

Executive summary

About Public Health England

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Introduction

The National Diet and Nutrition Survey (NDNS) is designed to assess the diet, nutrient intake and nutritional status of the general population aged 1.5 years and over living in private households in the UK. The NDNS is jointly funded by Public Health England (PHE), an executive agency of the Department of Health, and the UK Food Standards Agency (FSA)[i,ii] and carried out by a consortium of three organisations: NatCen Social Research (NatCen), MRC Human Nutrition Research (HNR) and the University College London Medical School (UCL).[iii]

The NDNS provides the only source of high quality nationally representative data on the types and quantities of foods consumed by individuals, from which estimates of nutrient intake for the population are derived.[iv] Results are used by Government to develop policy and monitor progress on diet and nutrition objectives of UK health departments, for example those set out in the *Healthy Lives, Healthy People* white paper in England.[v] The food consumption data are also used by 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, each covering a different age group: pre-school children (aged 1.5 to 4.5 years);[vi] young people (aged 4 to 18 years);[vii] adults (aged 19 to 64 years)[viii] and older adults (aged 65 years and over).[ix] Methods used in the NDNS are continually reviewed to ensure they remain the best practical methods available. Since 2008, the NDNS has been a rolling programme (RP) covering adults and children aged 1.5 years and over.

This report presents combined results from Years 1, 2, 3 and 4 of the RP (2008/09 – 2011/12) for a sample of the UK population designed to be nationally representative.[x] This report supersedes and replaces previous reports for the NDNS RP,[xi] providing a larger sample size. For the first time, comparisons within the RP are made (ie Years 3 & 4 (Y3&4) combined is compared with Years 1 & 2 (Y1&2) combined). This report also includes findings from blood indices of nutritional status and salt intakes from 24-hour urinary sodium in young children and older adults for the first time in the RP. Analysis is also presented by household income and with a more detailed age breakdown for adults.

Overview of key findings from NDNS Years 1 to 4 (2008/09-2011/12)

- in the population as a whole, mean saturated fat, non-milk extrinsic sugars (NMES) and salt intakes were above dietary recommendations, and the mean intakes of fruit and vegetables, non-starch polysaccharides (NSP) and oily fish were below recommendations. Overall mean total fat and trans-fatty acids intakes were in line with recommendations

- on average, intakes of the majority of vitamins were adequate (excluding vitamin D, see below), as indicated by dietary intakes and biochemical indices of nutritional status. Intakes below the Lower Reference Nutrient Intake (LRNI)[xii] were found in a proportion of the 11 to 18 years age group for vitamin A, riboflavin and folate (girls only). Women aged 19 to 64 years also had intakes below the LRNI for riboflavin. For vitamin A, there was no indication from the biochemical status data that this age group was at risk of vitamin A deficiency. This discrepancy is likely to be due to the infrequent consumption of vitamin A-rich foods meaning that a longer recording period is needed to assess the customary vitamin A intake of an individual.[xiii] For riboflavin, blood results indicate a high proportion of the population with low biochemical status but the health implications of this are unclear. Results for blood measures of folate status have been delayed due to problems with the laboratory analysis and publication is expected in 2015

- vitamin D is obtained both from skin synthesis and from the diet; the status indicator plasma 25-hydroxyvitamin D is used to assess adequacy. There was evidence of an increased risk of vitamin D deficiency in all age/sex groups. Year-round, the proportion of children with a serum 25-OHD concentration below 25nmol/L at the time of venepuncture ranged from 7.5% for children aged 1.5 to 3 years to 24.4% for girls aged 11 to 18 years and for adults this ranged from 16.9% for men aged 65 years and over to 24.1% for women aged 65 years and over. The proportion of participants with a serum 25-OHD concentration below 25nmol/L was higher in the winter months

- for iron, both the dietary intake and biochemical status data indicated an increased risk of iron deficiency in girls aged 11 to 18 years and women aged 19 to 64 years

- there was evidence of intakes below the LRNI in a substantial proportion of older children and adults for some minerals, particularly magnesium, potassium and selenium. However the health implications of this are unclear

- analysis by equivalised income quintile showed some evidence of income differences in diet and nutrient intake with those in lower income quintiles tending to have poorer diets, particularly with respect to fruit and vegetable consumption. With the exception of those aged 65 years and over, mean fruit and vegetable consumption was significantly lower in all age/sex groups in the lowest income quintile compared with the highest quintile. There was evidence of a similar pattern for NSP, and for some vitamins and minerals. However, there was no consistent pattern in energy or macronutrient intakes across income groups. Where intakes failed to meet recommendations this was the case for all income quintiles

- mean intakes of energy, total fat and saturated fat tended to be lower in Y3&4 than in Y1&2 and the differences reached statistical significance for some age groups. Intakes expressed as a percentage of energy tended to be higher for carbohydrate and lower for total fat in Y3&4 than in Y1&2 with the differences reaching statistical significance for some age/sex groups. There was some evidence that intakes of some micronutrients were slightly lower in Y3&4 compared with Y1&2 but differences were small and not consistent across age groups. Total and red meat consumption tended to be lower in Y3&4 compared with Y1&2 but there were no differences in fruit and vegetable consumption

- comparisons between the RP and previous NDNS carried out in between 1992 and 2000/01 should be interpreted with caution due to methodological differences between the current RP and the older surveys. While some differences were seen in energy and nutrient intakes, these were generally small and the direction of the difference varied by age group. In general, total fat tended to make a smaller contribution to total energy, and protein a greater contribution in the RP than in previous NDNS surveys. Mean intakes of saturated fat, *trans* fatty acids and NMES were lower and NSP intake was higher than in previous surveys. The proportion of the population at risk of vitamin or mineral deficiencies was similar in the RP to previous surveys

Sample and response rates

A random sample of 21,573 addresses from 799 postcode sectors, drawn from the UK Postcode Address File, was issued between April 2008 and March 2011. Where there were multiple households at an address, a single household was selected at random. For each household, either one adult (aged 19 years and over) and one child (aged 1.5 to 18 years), or one child only were randomly selected to take part.[xiv] Selected individuals were asked to complete a diary of food and drink consumption over four consecutive days (with the start date randomly allocated) and an interview was conducted to collect background information on dietary habits, socio-demographic status, lifestyle and physical activity (stage one). Participants who agreed to a nurse visit (stage two) were asked to provide a blood sample to assess biochemical indices of nutritional status and those who were aged four years and older were asked to provide a 24-hour urine collection to assess salt intake. Physical measurement data were also collected.

The response rate for completion of the diary was 56% for Years 1 to 4 combined.[xv] A total of 6,828 individuals aged 1.5 years and older completed at least three days[xvi] of the food and drink diary (3,450 adults aged 19 years and over and 3,378 children aged 1.5 to 18 years). Fewer participants agreed to be visited by a nurse and a further percentage declined to give a blood or a 24-hour urine sample.[xvii] Overall in Years 1 to 4 combined, 51% of adults (1,769) and 27% of children (902) who had completed a diary went on to give a blood sample. Sixty per cent of adults (2,074) and 58% of children aged 4 to 18 years (1,602) who completed a diary agreed to provide a 24-hour urine sample.[xviii]

The data are weighted to minimise any bias in the observed results which may be due to differences in the probability of households and individuals being selected to take part; and to attempt to reduce non-response bias.[xix] See Appendix B for more information on sampling and weighting.

Contents of the report

The results in the report update information published in previous reports on food consumption, nutrient intakes and blood analytes.[xi] Blood analyte results from the RP for older adults (aged 65 years and over) and younger children (aged 1.5 to 10 years) are published for the first time. The report also contains results for salt intake estimated from urinary sodium excretion for children and adults aged 65 years and over.[xx] Contextual information on the physical measurements, blood pressure, physical activity and socio-demographic characteristics of the participants is also included.

The results in the report cover the following areas:

- types and quantities of foods consumed based on food and composite dishes as eaten (Chapter 5)
- consumption of meat, fish, fruit and vegetables, including the contribution from composite dishes (based on disaggregated data)[xxi] (Chapter 5)
- the number of portions of fruit and vegetables consumed, including the contribution from composite dishes, and the proportion of participants meeting the “5-a-day” recommendation[xxii] (Chapter 5)

- intakes of energy, macronutrients (protein, fat and fatty acids, carbohydrates) and alcohol; comparison of energy and nutrient intakes with UK Dietary Reference Values (DRVs)[xxiii,xxiv] (Chapter 5)
- intakes of vitamins and minerals, including and excluding the contribution from dietary supplements; comparison of intakes with UK DRVs (Chapter 5)
- percentage contributions of major food groups to energy, macronutrient and micronutrient intakes (Chapter 5)
- use of dietary supplements and intakes of vitamins and minerals from the diet for supplement users compared with non-users (Chapter 5)
- status indices measured in blood for micronutrients and blood lipids (Chapter 6).[xxv] Additional blood indices assayed are reported in Appendix Q
- salt intake estimated from urinary sodium excretion (Chapter 7). Additional urinary indices assayed are reported in Appendix S

This report included additional analyses on food consumption and nutrient intakes for a number of key foods and nutrients selected on the basis of public health interest (Chapters 8-10):

- intakes of selected foods and nutrients for young people and adults presented by narrower age bands (Chapter 8)
- statistical comparison of intakes of selected foods and nutrients by equivalised household income[xxvi] (Chapter 9)
- statistical comparisons between Y1&2 and Y3&4 of the NDNS RP for selected foods and nutrients (Chapter 10)
- informal comparison between Years 1 to 4 of the NDNS RP and previous NDNS for selected nutrients (Chapter 10)

Current UK diet and nutrition recommendations

The NDNS RP findings are compared to the UK recommendations for food and nutrient intakes. Current UK recommendations for consumption of fruit and vegetables, red and processed meat and oily fish are shown below.

Food	**Recommendation**
Fruit and vegetables	At least 5 portions per day for those aged 11 years and over[xxii]
Red and processed meat[a]	Should not exceed 70g per day for adults[xxvii]
Oily fish[b]	At least 1 portion per week for all ages (140g)[xxviii]

[a] Red meat includes beef, lamb, pork, sausages, burgers and kebabs, offal, processed red meat and other red meat.

[b] Oily fish includes anchovies, carp, trout, mackerel, herring, jack fish, pilchards, salmon (including canned), sardines, sprats, swordfish, tuna (fresh only) and whitebait

The DRVs for key macronutrients are shown below. These indicate the average or the maximum contribution that these nutrients should make to the population average intakes of these nutrients. In addition, biochemical measures of blood lipids are compared with clinical thresholds to provide an indication of the proportion of the population at increased risk of vascular disease.

Macronutrient	**Dietary Reference Value[xxix]**
Total fat	Population average no more than 35% of food energy for those aged 5 years and over
Saturated fatty acids	Population average no more than 11% food energy for those aged 5 years and over
Trans fatty acids	Population average no more than 2% food energy
Non-milk extrinsic sugars (NMES)	Population average no more than 11% food energy for all ages
Non-starch polysaccharides (NSP)	Adult population average at least 18g per day

Population adequacy of micronutrient intake is assessed by comparing intake with the age and sex specific DRV for each vitamin and mineral. Mean intake is compared with the Reference Nutrient Intake (RNI)[xxx] and an estimate is made of the proportion with intake below the Lower Reference Nutrient Intake (LRNI).[xii] The RNI and LRNI for each vitamin and mineral are given in tables 5.14 and 5.32 of the report. In addition, biochemical indices of micronutrient status are compared with threshold values, where they have been set, to give an estimate of the proportion of the population at greater risk of deficiency due to depleted body stores or tissue concentrations.

The RNIs[xxiii] for sodium, set in 1991 by the Committee on Medical Aspects of Food and Nutrition Policy's (COMA) Panel on Dietary Reference Values,[xxix] are presented in the table below for the different NDNS age groups covered in the report. The table also shows the corresponding recommended maximum salt intake per day for adults, which was set by COMA[xxxi] and endorsed by the Scientific Advisory Committee on Nutrition in its report on Salt and Health (2003) and the recommended maximum intakes set by SACN (2003) for children.[xxxii]

NDNS age group	RNI[xxiii,xxix] mmol sodium per day*	Recommended maximum salt intakeError! Bookmark not defined.,Error! Bookmark not defined. g per day**
4 to 6 years	30	3
7 to 10 years	50	5
11 to 18 years	70	6
19 to 64 years***	70	6
65 years and over	70	6

*1g salt contains 17.1mmol sodium

****** These are the maximum daily dietary targets.

******* results for this age group have been previously published elsewhere

Key findings

Food consumption and nutrient intakes (Chapter 5)

- adults aged 19 to 64 years on average consumed 4.1 portions of fruit and vegetables per day, while adults aged 65 years and over consumed 4.6 portions per day.[xxii] Thirty per cent of adults and 41% of older adults met the "5-a-day" recommendation[xxxiii]

- mean consumption of fruit and vegetables for children aged 11 to 18 years was 3.0 portions per day for boys and 2.7 portions per day for girls. Ten per cent of boys and 7% of girls in this age group met the “5-a-day” recommendation
- mean consumption of oily fish in all age groups was well below the recommended one portion (140g) per week. For example, mean consumption in adults aged 19 to 64 years was 54g per week (52g for men and 54g for women) and for adults aged 65 years and over mean consumption was 90g per week (103g for men and 81g for women)[xxxiv]
- mean consumption of red meat for adults aged 19 to 64 years was 71g per day (86g for men and 56g for women) and for adults aged 65 years or over was 63g per day (75g for men and 54g for women)
- mean reported total energy intake was 4.75 MJ/day (1126 kcal/day) for children aged 1.5 to 3 years and 6.46 MJ/day (1532 kcal/day) for children aged 4 to 10 years. For children aged 11 to 18 years, mean total energy intake was 8.30 MJ/day (1972 kcal/day) for boys and 6.60 MJ/day (1569 kcal/day) for girls. For adults aged 19 to 64 years, mean total energy intake was 8.88 MJ/day (2111 kcal/day) for men and 6.78 MJ/day (1613 kcal/day) for women. For older adults, mean total energy intake was 8.14 MJ/day (1935 kcal/day) for men and 6.35 MJ/day (1510 kcal/day) for women. Mean energy intakes were below the Estimated Average Requirement (EAR) for adults and children aged 11 years and over. However it should be borne in mind that the doubly labelled water (DLW) sub-study showed evidence of under-reporting of energy intakes in these age groups. ‘Cereals and cereal products’ was the main contributor to energy intake in all age groups. ‘Meat and meat products’ and ‘milk and milk products’ were the other major contributors with ‘milk and milk products’ making a larger contribution in younger children
- mean intake of total fat met the DRV (no more than 35% food energy) in all age/sex groups except for men aged 65 years and over, for whom, on average, total fat provided 36.0% food energy. ‘Cereals and cereal products’ and ‘meat and meat products’ were the main contributors to total fat intake, except in children under four years, for whom ‘milk and milk products’ was the largest contributor
- mean intake of saturated fat exceeded the DRV (no more than 11% food energy) in all age/sex groups. For example, mean saturated fat intake for adults aged 19 to 64 years was 12.6% food energy. ‘Milk and milk products’, ‘cereals and cereal products’, and ‘meat and meat products’ made similar contributions to saturated fat intake in adults and older children while in younger children ‘milk and milk products’ was the largest contributor
- mean intake of *trans* fatty acids provided 0.6-0.7% of food energy for all age/sex groups, and thus met the DRV (no more than 2% food energy). ‘Milk and milk products’, ‘meat and meat products’ and ‘cereals and cereal products’ were the main contributors to intake, partly from naturally occurring trans fats in dairy products and the meat of ruminant animals
- mean NMES intake exceeded the DRV (no more than 11% food energy) for all age/sex groups most notably for children aged 4 to 10 years and 11 to 18 years

where mean intake provided 14.7% and 15.6% of food energy respectively. For children, the main source of NMES was 'non-alcoholic beverages' (soft drinks and 'fruit juice' – soft drinks alone provided 30% of NMES intake in the 11 to 18 years age group). 'Cereals and cereal products' was the other major contributor in children mainly from cakes, biscuits and breakfast cereals. For adults, 'table sugar and confectionery', 'non-alcoholic beverages' (soft drinks and 'fruit juice') and 'cereals and cereal products' (mainly cakes and 'biscuits') made similar contributions to intake

- fifty-eight per cent of adults aged 19 to 64 years and 51% of adults aged 65 years and over reported consuming alcohol during the four-day recording period. On average, adults aged 19 to 64 years who consumed alcohol during the four-day recording period obtained 8.4% of energy intake from alcohol and older adult consumers obtained 6.4%
- mean intake of non-starch polysaccharide (NSP) for adults aged 19 to 64 years and 65 years and over was 13.7-13.9g per day, below the DRV set for adults of at least 18g per day. 'Cereals and cereal products' and 'vegetables and potatoes' were the main sources of NSP
- mean intakes of vitamins (except vitamin D) from food sources were close to or above the RNI for all age/sex groups. Mean intake of vitamin D was below the RNI for children aged 1.5 to 3 years and for adults aged 65 years and over, both with and without the contribution of supplements.[xxxv] For children aged 11 to 18 years, 13% and 15% had vitamin A and riboflavin intake below the LRNI respectively; 8% of girls aged 11 to 18 years had folate intake below the LRNI
- mean intakes of minerals from food sources were below the RNI for some age/sex groups, in particular children aged 11 to 18 years. A substantial proportion of this age group, especially girls, had intakes of some minerals below the LRNI. For example, mean iron intakes were below the RNI for both women aged 19 to 64 years and girls aged 11 to 18 years and 23% of women and 46% of girls had iron intake below the LRNI. Mean intakes of calcium, zinc (and iodine for girls only) were also below the RNI in the 11 to 18 years age group and about a fifth of girls aged 11 to 18 years fell below the LRNI
- mean intakes of potassium, magnesium and selenium were below the RNI in all age groups except children aged under 11 years and substantial proportions fell below the LRNI. It should be noted that the DRVs for these minerals are based on limited data so caution should be used when assessing adequacy of intake using the LRNI
- mean intakes of all minerals were close to or above the RNI for children aged under 11 years and few children in this age group had intakes below the LRNI
- seventeen per cent of men and 27% of women aged 19 to 64 years, and 35% of men and 47% of women aged 65 years and over reported taking at least one dietary supplement during the four-day recording period
- in general, supplement takers had higher intakes of vitamins and minerals from food sources than those who did not take supplements. The contribution from supplements had little effect on the proportion of participants below the LRNI,

indicating that supplement takers generally had adequate intakes of vitamins and minerals from the diet

Biochemical indices of nutritional status (Chapter 6)

- approximately a third of adults had a serum total cholesterol concentration between 5.2 and 6.4mmol/litre, indicating a marginally increased risk of cardiovascular disease. In slightly more than 10% of adults, total serum cholesterol concentration was between 6.4 and 7.8mmol/litre indicating moderately elevated cardiovascular risk, and in approximately 2% of adults it was above 7.8mmol/l indicating high risk.[xxxvi] The association of elevated serum cholesterol concentration with an increased risk of cardiovascular disease is well established[xxxvii]
- over two-thirds of those aged 4 to 64 years and almost half of those in other age groups had riboflavin status values above the generally accepted upper threshold of normal status indicating biochemical depletion.[xxxviii] However, there is uncertainty about whether these are associated with functional consequences. To aid future population monitoring, additional information on the distribution of riboflavin status values has been included in the report to provide a baseline against which any future change in the dietary adequacy of this vitamin can be assessed[xxxix]
- there was evidence of low vitamin D status at the time the blood sample was taken in a proportion of participants in all reported age/sex groups. The proportion of children who, at the time of venepuncture, had a 25-hydroxyvitamin D (25-OHD) concentration below the lower threshold for vitamin D adequacy ranged from 7.5% for children aged 1.5 to 3 years to 24.4% for girls aged 11 to 18 years. For adults this ranged from 16.9% for men aged 65 years and over to 24.1% for women aged 65 years and over. People obtain vitamin D from two sources: endogenous synthesis when their skin is exposed to ultra violet B (UVB) radiation and their diet. There was marked seasonal variation in the proportion of participants with a 25-OHD below the threshold of adequacy at the time of venepuncture, in line with the known seasonal variation in the UVB content of sunshine in the UK. When subdivided by season, the proportion below the lower threshold for vitamin D adequacy in the winter months (January to March) when UK sunshine lacks UVB ranged from 29.3% for adults aged 65 years and over to 40.0% for children aged 11 to 18 years. This contrasted with the summer months (July to September) when the proportion below the lower threshold was much smaller, ranging from 1.7% for children aged 4 to 10 years to 13.4% for children aged 11 to 18 years. Low vitamin D status has implications for bone health, (increasing the risk of rickets and osteomalacia)
- there was evidence of anaemia (as indicated by low haemoglobin levels) plus low iron stores (plasma ferritin) in a proportion of older girls aged 11 to 18 years (4.9%) and women aged 19 to 64 years (4.7%), indicative of iron deficiency
- there was little evidence of low status for other micronutrients where normal ranges or thresholds of adequacy have been set. Mean values for vitamin C, B_{12}, thiamin, retinol (vitamin A)[xl] and vitamin E fell within the normal range and the proportion

falling outside established thresholds indicating low status, where these have been set, was low

Estimated salt intake (Chapter 7)

- estimated salt intake for children, based on urinary sodium excretion, exceeded the SACN recommendations for each age group[xli] except for girls aged 7 to 10 years. Mean estimated salt intake for children aged 4 to 6 years was 3.7g/day. In children aged 7 to 10 years mean intake was 5.5g/day for boys and 4.6g/day for girls and for the 11 to 18 years age group mean intake was 7.1g/day for boys and 6.2g/day for girls

- estimated mean salt intake for people aged 65 years and over was 7.2g/day (8.3g/day for men and 6.4g/day for women) which is above the SACN recommended maximum of 6g/day

Analysis for Chapters 8, 9 and 10 was done for energy and macronutrients plus four micronutrients, selected on the basis of public health interest: iron, calcium, folate, vitamin C.

Detailed age breakdown for young people and adults (Chapter 8)
Results for key foods and nutrients are presented for four age groups, subdivided by sex: 11 to 15 years, 16 to 24 years, 25 to 49 years and 50 to 64 years. These age sub-groups differ from the age/sex groups used elsewhere in the report and are referred to as "age sub-groups".

- mean daily intake for all age sub-groups was close to the DRV for total fat but exceeded the DRV for saturated fat. Mean intake of NMES exceeded the DRV in all age sub-groups, except females aged 50 to 64 years. Mean NMES intake was higher in the 11 to 15 years and 16 to 24 years sub-groups than in the older sub-groups
- mean intake of NSP increased by age across the age sub-groups but was below the DRV in all age sub-groups
- for men and women aged 25 to 49 years and 50 to 64 years, mean intakes from food sources of vitamin C, folate, iron and calcium were close to or above the RNI, except iron for women aged 25 to 49 years. The mean iron intake in this group was 65% of the RNI; 29% of these women had iron intakes below the LRNI
- for the 11 to 15 years and 16 to 24 years sub-groups, males had mean intake from food sources of vitamin C, folate, iron and calcium close to or above the RNI, while females had mean intake close to or above the RNI for vitamin C and folate but below the RNI for calcium and iron. Iron intake was below the LRNI for 44% of females aged 11 to 15 years and 40% of females aged 16 to 24 years. Calcium

intake was below the LRNI for 18% of females aged 11 to 15 years and 16% of females aged 16 to 24 years

- the number of portions of fruit and vegetables consumed per day increased with age from 2.9 for children aged 11 to 15 years to 4.7 for adults aged 50 to 64 years. The proportion of participants meeting the “5-a-day” recommendation also increased with age: 9% of those aged 11 to 15 years, 14% of those aged 16 to 24 years (18% of males and 10% of females), 29% of those aged 25 to 49 years and 38% of those aged 50 to 64 years (36% of males and 40% of females)

Intake by equivalised income (Chapter 9)

Households were ranked by equivalised income, and grouped into five quintiles.[xxvi] Statistical comparisons were undertaken for intakes of key foods and nutrients by quintiles of equivalised income within each age/sex group. Quintile 5 (the highest income) was used as the reference category.

- there were some differences observed in food consumption and energy and nutrient intakes by equivalised income quintile, particularly for fruit and vegetable consumption. Differences were clearest between the lowest and highest income quintile but were not seen in all age/sex groups. Where differences were seen they were generally in the direction of poorer diets in the lower income quintiles
- income differences in mean intake of energy and macronutrients were observed in women aged 19 to 64 years and to some extent in men aged 19 to 64 years. Total energy and protein intake in women aged 19 to 64 years was significantly lower in quintiles 1, 2 and 3 than in quintile 5. The lowest quintile in this age group also had a higher intake of carbohydrate and a lower intake of protein as a percentage of energy than did the highest quintile. However, protein intakes were above the RNI in all income quintiles. To some extent alcohol intake in men aged 19 to 64 years and women aged 19 to 64 years also increased through the quintiles
- men and women aged 19 to 64 years had a lower percentage of energy from saturated fat and a higher percentage energy from NMES in the lowest quintile compared with the highest although intakes exceeded recommended levels in almost all quintiles. NSP intakes were significantly lower in the lowest quintile groups compared with the highest in all age/sex groups but intakes for adults were below the recommendation in all quintiles
- mean iron intake for girls aged 11 to 18 years and women aged 19 to 64 years was below 90% of the RNI in all income quintiles. In women, but not in girls, the lowest income quintile had a significantly lower mean intake than the highest quintile and a significantly higher proportion below the LRNI. For both men and women aged 19 to 64 years, mean intake of calcium increased from the lowest to highest quintile and a substantial proportion of girls aged 11 to 18 years in all income quintiles had calcium intakes below the LRNI. There were clear differences in intakes of both vitamin C and folate by income quintile with lower intakes in the lowest quintile. For vitamin C

mean intake was above the RNI in all quintiles while for folate girls aged 11 to 18 years had a mean intake below the RNI in the lowest income quintile

- mean fruit and vegetable consumption expressed in grams and as “5-a-day” portions was significantly lower in all age/sex groups in income quintile 1 (lowest income) compared with quintile 5 (highest income). In most age/sex groups consumption in quintile 2 and 3 was also significantly lower than in quintile 5. No clear pattern in total meat or red meat consumption was observed, with the exception of children aged 1.5 to 3 years where mean consumption of total meat was higher in income quintiles 1 and 2 than in quintile 5. Oily fish consumption, increased from the lowest to highest quintile for men and women aged 19 to 64 years

Years 3 and 4 combined (Y3&4) compared with Years 1 and 2 combined (Y1&2) (Chapter 10)

Statistical comparisons between Y3&4 and Y1&2 were carried out for key foods and nutrients. When interpreting the results it should be borne in mind that changes in nutrient intakes can reflect changes in food composition over time as well as changes in consumption. In some cases apparently marked differences between Y1&2 and Y3&4 are a result of step changes in the available data on nutrient composition.

- mean reported total daily energy intake tended to be lower in all age/sex groups in Y3&4 compared with those in Y1&2 except for children aged 1.5-3 years. The differences were statistically significant in adults aged 19 to 64 years and children 11 to 18 years. Mean total fat intake was lower in Y3&4 in most age groups compared with Y1&2 whereas the differences for protein and total carbohydrate were smaller and less consistent
- mean intake of total fat as a percentage of energy was generally lower in Y3&4 compared with Y1&2 while intake of carbohydrate as a percentage of food energy tended to be higher in Y3&4 and there was no consistent difference for protein. Intakes of saturated and trans fatty acids as a percentage of food energy were also lower in Y3&4 but there was no consistent difference in intakes of NMES as a percentage of food energy, nor in NSP intake
- in all age/sex groups, mean daily iron intake was similar in Y3&4 and Y1&2. No clear pattern of differences was observed in mean calcium or vitamin C intake between Y3&4 and Y1&2 although a significantly higher proportion of girls aged 11 to 18 years and women aged 19 to 64 years had calcium intake below the LRNI in Y3&4 compared with Y1&2. Mean daily folate intake tended to be lower in Y3&4 compared with Y1&2 for most age groups, significantly so for children aged 1.5 to 3 years, boys aged 4 to 10 years and adults aged 19 to 64 years
- no consistent differences between Y3&4 and Y1&2 were observed for total mean fruit and vegetable consumption (excluding fruit juice) in any age/sex group, except for boys aged 4 to 10 years in Y3&4 where mean consumption was significantly higher than in Y1&2. The number of portions of fruit and vegetables consumed

tended to be lower in boys aged 11 to 18 years and men aged 19 to 64 years in Y3&4 than in Y1&2, but this was not statistically significant

- mean intakes of total fish and oily fish were similar in all age/sex groups in Y3&4 compared with Y1&2

Years 1, 2, 3 and 4 combined of the RP compared with previous surveys (Chapter 10)

Comparisons between results from the RP and those from previous NDNS carried out between 1992 and 2000/01 should be interpreted with caution due to methodological differences between the RP and previous surveys (ie differences in duration of assessment period and methods of assessing portion size). Statistical comparisons have not been carried out for this reason.

- mean reported total energy intake for children aged 4 to 18 years and adults aged 19 to 64 years was lower in the RP compared with previous surveys. For adults aged 65 years and over total energy intake was higher in the RP, while for children aged 1.5 to 3 years intake was similar between surveys
- for all age/sex groups, mean daily intake of total fat both in grams and as a percentage of food energy was lower or similar in the RP compared with previous surveys. Mean intake of saturated fatty acids and *trans* fatty acids tended to be lower in the RP than in previous surveys, both in absolute terms and as a percentage of food energy for all age/sex groups. For example in adults aged 19 to 64 years intake of saturated fat as a percentage of food energy was 12.6% in the RP compared with 13.2% in the previous survey of this age group in 2000/01
- mean intake of NMES was lower in the RP than in previous surveys, both in absolute terms and as a percentage of food energy for all age/sex groups (except for women aged 65 years and over), particularly for younger children aged 1.5 to 3 years and 4 to 10 years where the proportion of food energy from NMES decreased from 18.7% to 11.9% and 17.1% to 14.7% respectively
- mean intake of NSP in children aged 1.5 to 3 years, 4 to 10 years and adults aged 65 years and over was higher in the RP than in previous surveys
- for children aged 1.5 to 3 years and adults aged 65 years and over, mean intakes of iron, calcium, vitamin C and folate were higher in the RP than in previous surveys. For children aged 4 to 10 years, mean intake was similar for iron and folate and higher for calcium and vitamin C. In the 11 to 18 years age group, however, iron and folate intakes were lower in the RP than in the previous survey. For girls in the RP, mean iron intake remained below the RNI (57% compared with 60% in the previous survey) and mean folate intake was lower (93% of the RNI compared to 105% in the previous survey)
- for adults aged 19 to 64 years, mean intake was lower for iron, folate and calcium and similar for vitamin C in the RP compared with the previous survey

Generally, there was little difference between surveys in terms of the proportion of individuals with intake below the LRNI for each micronutrient. There was a smaller proportion of individuals with iron intake below the LRNI for children aged 1.5 to 3 years in the RP (6% compared with 16% in the previous survey).

Methodological issues

Misreporting of food consumption

Dietary surveys are reliant on self-reported measures of food intake. Previous NDNS and the current RP are unique among large-scale population surveys in their inclusion of DLW as an objective biomarker to validate EI estimated from reported food consumption. There is evidence of mis-reporting of food consumption in this survey as in all dietary surveys. A sub-study comparing EI estimates from the four-day diary with total energy expenditure (TEE) measurements using the DLW technique found that reported EI in those aged 16 years and over was about 32% lower than TEE on average (see Chapter 5 and Appendix X for more detail). This should be borne in mind when interpreting the findings (see Chapter 5).

Diet and nutritional status

Results based on assessment of food and drink consumption over the four-day diary period provides information about dietary intake over a relatively short period. Analysis of blood samples generally provides an indication of the nutritional status of the population over a longer period. Nutritional status indices provide an assessment of availability of nutrients to the body (after absorption) for use in metabolic processes.

It is not possible to make direct comparisons between the dietary data and biochemical results presented in the report due to the elapsed time between the diary recording period and the collection of blood and urine (a gap of at least eight weeks in Year 2 onwards) and also because many of the biochemical indicators generally reflect longer term body stores of a nutrient rather than recent intake.

Days of the week

Weekend days were oversampled in Year 1 and, while weekend days were under-sampled in Year 2 to redress this, there still remains a slightly higher proportion of weekend days in the Years 1 to 4 combined data.[xlii] As eating habits vary on different days of the week for some age groups, this could lead to a bias in the reporting of some foods and drinks.

Differences between the previous surveys and the RP

There are a number of methodological differences between the previous cross-sectional surveys and the RP. The previous surveys of children aged 4 to 18 years[vii] and adults aged 19 to 64 years[viii] used a seven-day diary whereas the RP uses a four-day diary. The survey of children aged 1.5 to 4.5 years[vi] used a four-day diary which over-sampled weekend days. Differences in number of days have little effect on comparisons of mean consumption of food groups or mean nutrient intakes between surveys but do affect comparisons for percentages consuming food groups and meeting dietary recommendations. Another key methodological difference is that all the previous surveys used a weighed diary method whereas the RP uses estimated portion sizes such as household measures and weights from labels.

For blood analytes, the RP collects blood samples following an overnight fast for all age groups (except those aged 1.5 to 3 years and diabetics not willing to fast who are asked to provide a non-fasting blood sample). Status data from fasting blood samples are considered to be more informative because some analytes are affected by recent food consumption. This is a change in methodology from the previous NDNS of adults aged 19 to 64 years carried out in 2000/01,[viii] which collected non-fasting samples and means that comparisons with that survey cannot be made for nutrients affected by recent consumption. In addition, some of the analytical methods have changed since previous NDNS in 1997 and 2000/01 and the new analytical methods are not always comparable with those used in the previous surveys. Because of these methodological changes comparisons have not been made between the blood results in the report and those in previous NDNS surveys.

For urine analytes, some of the analytical methods have changed since previous NDNS surveys in 1997 and 2000/01 and the new analytical methods are not always comparable with those used in the previous surveys. In addition para-aminobenzoic acid (PABA)[xliii] was used to determine completeness of 24-hour urine collections in the RP but was not used in previous NDNS.

Future reports

Reports of findings for Scotland, Northern Ireland and Wales will be published during 2014/15. These reports will include a comparison with findings for the UK as a whole.

Results for blood indices of folate status have been delayed due to analytical problems in the laboratory. Publication of these results is expected in 2015.

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[i] Responsibility for nutrition policy in England and Wales transferred from FSA to Health Departments in 2010. Management of NDNS also transferred to the Department of Health in England at that time. From 1 April 2013, responsibility for the survey transferred to the Department of Health's Executive Agency, Public Health England (PHE).

[ii] Additional recruitment in the devolved countries is funded by Government bodies in Scotland, Wales and Northern Ireland.

[iii] For Years 6 onwards, the consortium comprises NatCen and MRC HNR.

[iv] Ashwell M, Barlow S, Gibson S, Harris C (2006) National Diet and Nutrition Surveys: the British experience. Public Health Nutrition 9(4) 523-530.

[v] Department of Health Healthy Lives, Healthy People: Our Strategy for public health in England White Paper http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_121941 (accessed 22/04/2014).

[vi] Gregory JR, Collins DL, Davies PSW, Hughes JM, Clarke PC. National Diet and Nutrition Survey: children aged 1 ½ to 4 ½ years. Volume 1: Report of the diet and nutrition survey London: HMSO, 1995.
Hinds K, Gregory JR. National Diet and Nutrition Survey: children aged 1½ to 4½ years. Volume 2: Report of dental survey. London: HMSO, 1995.

[vii] Gregory JR, Lowe S, Bates CJ, Prentice A, Jackson LV, Smithers G, Wenlock R, Farron M. National Diet and Nutrition Survey: young people aged 4 to 18 years. Volume 1: Report of the diet and nutrition survey. London: TSO, 2000.
Walker A, Gregory J, Bradnock G, Nunn J, & White D. National Diet and Nutrition Survey: young people aged 4 to 18 years. Volume 2: Report of the oral health survey. London: TSO, 2000.

[viii] Henderson L, Gregory J, Swan G. National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 1: Types and quantities of food consumed. London: TSO, 2002.
Henderson L, Gregory J, Irving K, Swan G. National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 2: Energy, protein, carbohydrate, fat and alcohol intake. London: TSO, 2002.
Henderson L, Irving K, Gregory J, Bates CJ, Prentice A, Perks J, Swan G, Farron M. National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 3: Vitamin and mineral intake and urinary analytes. London: TSO, 2003.
Rustin D, Hoare J, Henderson L, Gregory J, Bates CJ, Prentice A, Birch M. National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 4: Nutritional status (anthropometry and blood analytes), blood pressure and physical activity. London: TSO, 2004.
Hoare J, Henderson L, Bates CJ, Prentice A, Birch M, Swan G, Farron M. National Diet and Nutrition Survey: adults aged 19 to 64 years. Volume 5: Summary report. London: TSO, 2004.

[ix] Finch S, Doyle W, Lowe C, Bates CJ, Prentice A, Smithers G, Clarke PC. National Diet and Nutrition Survey: people aged 65 years and over. Volume 1: Report of the diet and nutrition survey. London: TSO, 1998.
Steele JG, Sheiham A, Marcenes W, Walls AWG. National Diet and Nutrition Survey: people aged 65 years and over. Volume 2: Report of the oral health survey. London: TSO, 1998.

[x] As well as the individuals from the core UK sample, this report also includes individuals from the additional recruitment carried out in Scotland, Wales and Northern Ireland. All cases have been appropriately weighted to put them in their correct proportions to represent the UK population (See Appendix B in the main report for more detail of the weighting scheme).

[xi] Bates B, Lennox A, Swan G (2010) National Diet and Nutrition Survey; Headline results from year 1 of the rolling programme (2008/09): http://www.food.gov.uk/science/dietarysurveys/ndnsdocuments/ndns0809year1(accessed 22/04/14).
Bates B, Lennox A, Bates C, Swan G (2011) National Diet and Nutrition Survey; Headline results from years 1 and 2 (combined) of the rolling programme (2008/09- 2009/10):
http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsStatistics/DH_128166 (accessed 22/04/14).
Bates B, Lennox A, Prentice A, Bates C, Swan G (2012) National Diet and Nutrition Survey; Headline results from years 1,2 and 3 (combined) of the rolling programme (2008/09- 2010/11):
https://www.gov.uk/government/publications/national-diet-and-nutrition-survey-headline-results-from-years-1-2-and-3-combined-of-the-rolling-programme-200809-201011 (accessed 22/04/14).

[xii] The adequacy of vitamin or mineral intake can be expressed as the proportion of individuals with intakes below the LRNI. The LRNI for a vitamin or mineral is set at the level of intake considered likely to be sufficient to meet the needs of only 2.5% of the population.

[xiii] Basiotis PP, Welsh SO, Cronin FJ, Kelsay JL, Mertz W, (1987). Number of days of food intake records required to estimate individual and group nutrient intakes with defined confidence. Journal of Nutrition; 117(9):1638-41.

[xiv] In some core sample households (where up to one adult and one child could be selected), it was possible to end up with an adult participant only, either because the selected child was not able/did not wish to take part or because there was no resident child eligible for selection.

[xv] Response rates for individual fieldwork years were as follows: 56% in Year 1, 57% in Year 2, 53% in Year 3 and 55% in Year 4. These response rates are different to those included in previous reports as they include cases from the country boost samples in Scotland, Wales and Northern Ireland whereas previous reports were based on core sample cases only.

[xvi] The majority of participants completed four days of the food and drink diary. Only 2% completed three days.

[xvii] All individuals visited by a nurse were asked if they were willing to provide a blood sample and, if aged four years and older (and fully out of nappies), a 24-hour urine sample.

[xviii] The report includes estimated salt intakes based on 24-hour urinary sodium excretion data from the analyses of 24-hour urine collections from participants aged 4-18 years and 65 years and over. Estimates for those aged 19 to 64 years have already been published. (Also see note 16 below).

[xix] Non-response bias occurs if those who respond to the survey (or elements of the survey) differ from those who do not respond. Data were weighted to reduce such bias.

[xx] Chapter 7 presents estimated salt intakes based on 24-hour urinary sodium excretion data from the sodium analyses of 24-hour urine collections from participants aged 4 to 18 years and 65 years and over in the NDNS RP. Estimated salt intakes based on 24-hour urinary sodium excretion for adults aged 19 to 64 years in England and, separately, in Scotland were published in 2012. These estimates were based on analysis of 24-hour urines collected over a shorter period in 2011 than the NDNS RP in order to provide a more precise estimate of salt intake in the population at a point in time. The estimate for England includes some urines collected as part of the NDNS RP, while the estimate for Scotland is based on 24-hour urines collected outside the RP. As these estimates (for adults aged 19 to 64 years) have already been published, the estimates based on four years of the RP are not included in this report.

[xxi] All composite dishes in the NDNS Nutrient Databank have been disaggregated into their constituent ingredients. This enables the fruit, vegetables, meat and fish in mixed dishes such as stews and pies to be included in consumption figures. The methodology for the disaggregation of composite dishes is provided in Appendix A.

[xxii] Department of Health 5 A DAY programme [online]
http://www.nhs.uk/Livewell/5ADAY/Pages/5ADAYhome.aspx (accessed 22/04/14).
[xxiii] Report on Health and Social Subjects, 41, *Dietary Reference Values (DRVs) for Food Energy and Nutrients for the UK*, Report of the Panel on DRVs of the Committee on Medical Aspects of Food Policy (COMA) 1991. The Stationery Office. London

[xxiv] Scientific Advisory Committee on Nutrition. Dietary Recommendations for Energy:[Online]
Available http://www.sacn.gov.uk/pdfs/sacn_dietary_reference_values_for_energy.pdf (2011) (accessed 22/04/14).

[xxv] For some micronutrients, status can be assessed by directly measuring the level of the nutrient in blood, while for others it is assessed by a functional measure such as the activity of vitamin-dependent enzymes. For example, riboflavin status can be assessed by measuring the activity of the red cell enzyme glutathione reductase which is

dependent on a co-factor derived from riboflavin. Threshold values, below or above which low status is indicated, have been set for some, though not all, micronutrients. A value indicating that the individual has low status for that micronutrient usually means that body stores or tissue levels are depleted and the individual is at greater risk of deficiency. This may reflect dietary inadequacy or health issues such as blood loss. However, a value indicating low status does not necessarily mean that the individual is clinically deficient, rather that they are at risk of becoming deficient.

[xxvi] Equivalised household income is a measure of income that takes account of the differences in a household's size and composition and thus is made equivalent for all household sizes and compositions.

[xxvii] Scientific Advisory Committee on Nutrition. Iron and Health. London: TSO, 2010. This recommendation applies to adults only. The recommendation is that adults with relatively high intakes of red and processed meat (of 90g or more per day) should consider reducing their intakes.

[xxviii] Scientific Advisory Committee on Nutrition. Advice on fish consumption: benefits and risks. London: TSO, 2004.

[xxix] Report on Health and Social Subjects 41 *Dietary Reference Values (DRVs) for Food Energy and Nutrients for the UK*, Report of the Panel on DRVs of the Committee on Medical Aspects of Food Policy (COMA) 1991. The Stationery Office. London.

[xxx] The RNI for a vitamin or mineral is the amount of the nutrient that is sufficient for about 97% of people in the group. If the average intake of the group is at the RNI, then the risk of deficiency in the group is judged to be very small. However, if the average intake is lower than the RNI then it is possible that some of the group will have an intake below their requirement.

[xxxi] Department of Health. Report on Health and Social Subjects: 46. Nutritional Aspects of Cardiovascular Disease. HMSO (London, 1994).

[xxxii] Scientific Advisory Committee on Nutrition (2003). Salt and Health. The Stationery Office. http://www.sacn.gov.uk/pdfs/sacn_salt_final.pdf (accessed 22/04/14)

[xxxiii] The Health Survey for England (HSE) is used to monitor "5-a-day". HSE estimates of fruit and vegetable consumption are based on a recall of consumption over the previous 24 hours and are therefore different from NDNS RP estimates which are based on a four-day diary. NDNS RP estimates are higher than HSE estimates, at least in part because the NDNS RP is better able to capture the contribution from composite dishes containing fruit and vegetables.

[xxxiv] Weekly equivalent oily fish consumption has been calculated using unrounded data rather than the rounded figures in Table 5.3 and sex combined averages have been calculated using unrounded sex combined data in Table 5.3.

[xxxv] For vitamin D, RNIs are only set for those aged up to four years and those aged 65 years and over.

[xxxvi] The British Cardiac Society, British Hyperlipidaemia Association, British Hypertension Society, endorsed by the British Diabetic Association, have issued guidance published in the article 'Joint British recommendations on prevention of coronary heart disease in clinical practice'. Heart, 1998; 80: 1–29.

[xxxvii] Prospective Studies Collaboration (2007). Blood cholesterol and vascular mortality by age, sex, and blood pressure: a meta-analysis of individual data from 61 prospective studies with 55 000 vascular deaths. Lancet; 370: 1829–39.

[xxxviii] Riboflavin status was determined by measuring Erythrocyte Glutathione Reductase Activation Coefficient (EGRAC). EGRAC is a measure of red cell enzyme saturation with its cofactor flavin adenine dinucleotide (FAD) derived from riboflavin (vitamin B2).

[xxxix] Scientific Advisory Committee on Nutrition: SACN/13/07. Setting an upper monitoring threshold for Erythrocyte Glutathione Reductase Activation Co-efficient (EGRAC) in reporting NDNS, Available:
http://www.sacn.gov.uk/pdfs/sacn1307_egrac_paper_june_2013.pdf
Minutes of 39th meeting 12th June 2013. Available:
http://www.sacn.gov.uk/pdfs/sacn13min02_final_minutes_12_june_13.pdf

[xl] Vitamin A can be obtained in two forms: as preformed vitamin A (retinol) and from some carotenoids that can be cleaved in the body to provide retinol.

[xli] The SACN recommendation for maximum daily salt is no more than 3g/day for children aged 4 to 6 years, no more than 5g/day for children 7 to 10 years and no more than 6g/day for those aged 11 years and over.

[xlii] This may be explained by the survey design allowing some flexibility in the diary start day to help maintain response rates.

[xliii] To be representative of daily salt intake the 24-hour collection has to be complete; this can be assessed by orally administering para-aminobenzoic acid (PABA) and measuring its excretion in the 24-hour urine collection.