National Diet and Nutrition Survey Rolling Programme (NDNS RP)

Results from Years 2-5 (combined) for Wales (2009/10-2012/13)

A survey carried out on behalf of the Food Standards Agency in Wales, Welsh Government and Public Health England

Edited by: Beverley Bates, Alison Lennox, Ann Prentice, Chris Bates, Polly Page, Sonja Nicholson, and Gillian Swan

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Notes to text and tables

1 The data used in the report have been weighted. The weighting is described in appendix B of this report. Unweighted sample sizes are shown at the foot of each table.

2 The NDNS RP requires weights to adjust for differences in sample selection and response. The weights adjust for:
- differential selection probabilities of addresses, households and individuals
- non-response to the individual questionnaire
- non-response to the nurse visit
- non-response of participants aged 16 years and older to the physical activity self-completion questionnaire (the RPAQ)
- non-response to providing a blood sample
- non-response to providing a 24-hour urine sample
- non-response to wearing an ActiGraph

3 The data were analysed as follows:
- chapter 3: with the complex surveys module (SPSS version 18.0)
- chapter 4: with the complex surveys module (SPSS version 20.0)
- chapters 5, 6 and 8 and appendices Q, S and T: with SPSS version 22
- Chapters 7 and 9: with the complex survey package (R version 3.0.2)
- Chapter 10: with SPSS version 22 and the complex survey package (R version 3.0.2)

4 The following conventions have been used in tables:
- \- no observations (zero value)
- 0 non-zero values of less than 0.5% and thus rounded to zero
- [ ] unless stated otherwise data and bases for a variable with a cell size between 30-49 are presented in square brackets. For cell sizes below 30, bases have been presented in square brackets, but data has not been presented. The 2.5th and 97.5th percentiles have only been presented for a variable with a cell size of 50 or greater.

5 Because of rounding, row or column percentages may not add exactly to 100%.

6 A percentage may be quoted in the text for a single category that aggregates two or more of the percentages shown in a table. The percentage for the single category may, because of rounding, differ by one percentage point from the sum of the percentages in the table.

7 Values for means, medians, percentiles and standard deviations and standard errors are shown to an appropriate number of decimal places. For reasons of space, Standard Error may sometimes be abbreviated to SE and Standard Deviation to sd.

8 'Missing values' occur for several reasons, including refusal or inability to answer a particular question; refusal to co-operate in an entire section of the survey (such as the nurse visit or a self-completion questionnaire); and cases where the question is not applicable to the participant. In general, missing values have been omitted from all tables and analyses.

9 The group to whom each table refers is stated at the upper left corner of the table.

10 The term 'significant' refers to statistical significance (at the 95% level) and is not intended to imply substantive importance.

11 It should be noted that for some dietary variables the UK values in this Wales report will not exactly match the values in the UK report due to an update in the coding of diluent water for soft drinks after publication of the UK report. The updated dataset has been used to produce values for this report.

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Executive summary

Erratum note: Correction to the fruit and vegetable consumption and salt intake data

This Executive Summary has been updated in 2017 since first publication (in December 2015) to take account of corrections to fruit and vegetable consumption estimates due to an error in the calculation and to salt intake values due to bias detected in the original analytical data. Further details are provided in chapters 5 and 7.

Introduction

The National Diet and Nutrition Survey Rolling Programme (NDNS RP) is 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)[1] and the UK Food Standards Agency (FSA) and is 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).[2] Recruitment in Wales was boosted to 200 participants per year for four years (2009/10 to 2012/13), in order to achieve representative data specific for Wales. The boost was funded by the Food Standards Agency (FSA) in Wales which previously shared policy responsibility for the diet and nutrition of the population in Wales with the Welsh Government. This policy area is now solely the responsibility of the Welsh Government.

This publication of the Wales NDNS RP Years 2 to 5 report forms part of a series of publications from the NDNS RP, the first of which was the UK combined report covering Years 1 to 4 (2008/9 to 2011/12), released as an Official Statistic by PHE in May 2014.[3] This was followed by the Scotland and Northern Ireland reports for the equivalent time period, released as Official Statistics by FSA in Scotland in September 2014[4] and FSA in Northern Ireland in February 2015[5] respectively. The combined results from Years 2 to 5 is the first time that representative data for Wales from the NDNS RP has been available. The data will inform nutritional surveillance in Wales; assist in evaluating existing policies; and set future, evidence-based policy direction.

The NDNS RP provides high quality data on the types and quantities of foods consumed by individuals, from which estimates of average nutrient intakes for the population can be derived.[6] The main report presents combined results from Years 2 to 5 combined of the NDNS RP for the Wales sample, designed to be nationally representative. It follows the same general format as the UK Years 1 to 4 combined report[3] including types and quantities of foods consumed, and compares intakes of key foods and nutrients in Wales (Years 2 to 5 combined) with the UK as a whole (Years 1 to 4 combined) and by equivalised household income and deprivation indices. The report also includes findings from blood indices of nutritional status and information on

Body Mass Index (BMI), blood pressure, blood cholesterol levels and the socio-demographic characteristics of the participants. Salt intakes for adults and children in Wales are also presented (these results were excluded from the original report due to the identification of analytical bias in the sodium concentrations which has now been corrected).

This executive summary provides background information on the survey, including sampling and methodology, and presents some of the key findings from the Wales Years 2 to 5 combined report on food consumption, nutrient intake and nutritional status.

Headline findings

- Seventy-eight percent of adults aged 19 to 64 years, 77% of adults aged 65 years and over and 94% of children aged 11 to 18 years in Wales did not meet the “5-A-Day” recommendation for fruit and vegetables. Women aged 19 to 64 years and adults aged 65 years and over in Wales consumed significantly fewer portions of fruit and vegetables than the same age groups in the UK as a whole.
- Mean intakes of non-starch polysaccharide (NSP) were below the recommended level of 18g per day for adults in Wales and were similar to mean intakes in the UK as a whole.
- Mean consumption of oil-rich fish was well below the recommended one portion per week.
- Mean intakes of saturated fat exceeded recommendations in all age groups.
- Mean intakes of non-milk extrinsic sugars (NMES) exceeded recommendations in all age groups except those aged 65 years and over.
- Mean intakes of NMES for the 4 to 10 years and 65 years and over age groups were significantly lower than mean intakes in the UK as a whole.
- As for the UK as a whole, there was evidence of low intakes for some vitamins and minerals, particularly in the 11 to 18 years age group. Mean intakes of calcium, iron, vitamin C and folate were significantly lower in Wales than in the UK as a whole for some age/sex groups.
- The proportion of adults aged 19 to 64 years in Wales who had low blood vitamin D status was 17.7%, a lower proportion than in the UK as a whole (22.8%).
- Adults aged 19 to 64 years in the lowest income tertiles had significantly lower intakes of NSP, fruit and vegetables, and some of the micronutrients and higher intakes of NMES compared to those in the highest income tertiles. Analysis by multiple deprivation index showed a similar pattern but not all the differences reached statistical significance.

Sample and response rates

A random sample of 2,603 addresses from 97 postcode sectors, drawn from the Postcode Address File, was issued in Wales between April 2009 and March 2013. 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.[7] 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 measurements were also collected.

Table 1.1 Response rates achieved in Wales for Years 2 to 5 combined

Individual response	**N**	**%**
Completion of food and drink diary (3 or 4 days)[a]	852 (461 adults, 391 children)	60%
Of those completing a food and drink diary:		
Blood sample obtained[b]	339 (228 adults, 111 children)	49% of adults, 28% of children
24-hour urine collection obtained[b]	461 (276 adults, 185 children)	60% of adults, 57% of children

[a] The majority of participants completed four days of the food and drink diary. Only 3% completed three days.

[b] 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), they were asked if they were willing to provide a 24-hour urine collection.

The data were 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.[8] Details of the sampling and methods of analyses can be found in chapter 2 and appendix B of the main report.

Current UK diet and nutrition recommendations

The NDNS RP Wales findings are compared with 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 in table 1.2.

Table 1.2 UK recommendations for consumption of fruit and vegetables, red and processed meat and oily fish

Food	Recommendation
Fruit and vegetables	At least 5 portions per day for those aged 11 years and over[9]
Red and processed meat[a]	Should not exceed 70g per day for adults[10]
Oily fish[b]	At least 1 portion per week for all ages (140g)[11]

[a] Red and processed meat referred to in the main report as 'total 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 Dietary Reference Values (DRVs) for key macronutrients are shown in table 1.3. They indicate the average or the maximum contribution that these nutrients should make to the population average intakes. 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.

Table 1.3 UK Dietary Reference Values (DRVs) for key macronutrients

Macronutrient	Dietary Reference Value[12]
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 for all ages
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 UK DRV for each vitamin and mineral.[12] 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.

Key findings

Erratum note: correction to fruit and vegetable consumption data
Consumption figures in this section have been corrected for an error in the estimation of fruit, vegetables and fruit juice and the calculation of "5-a-day" portions. Fruit and vegetable components of some food groups (soft drinks, confectionery, biscuits, cakes, sugar, preserves and sweet spreads, savoury snacks and ice cream) were included in the estimates when they should have been excluded. This has now been corrected and the corrected values are slightly lower than the original published values. Further details are provided in chapter 5.

Food consumption[13] and nutrient intakes (Chapter 5)

Table 1.4 provides a summary of the consumption of selected foods for adults and children in Wales. Six per cent of boys and girls aged 11 to 18 years met the "5-A-Day" recommendation.[9] Twenty-two per cent of adults aged 19 to 64 years and 23% of adults aged 65 years and over met the recommendation. Mean consumption of oily fish in all age groups was well below the recommended one portion (140g) per week.[11] Mean consumption of red and processed meat for adults aged 19 to 64 years and 65 years and over met the recommendation that, for adults, average intakes should not exceed 70g per day.[10] However mean consumption of red and processed meat for men aged 19 to 64 years (82g per day) exceeded the recommendation that, for adults, average intakes should not exceed 70g per day.[10]

Table 1.4 Average daily intake of selected foods, for NDNS RP Wales Years 2-5 combined

	NDNS age group (years)				
Food	1.5-3	4-10	11-18	19-64	65+
"5-A-Day" portions (portions/day)[a]	-	-	2.7	3.7	3.6
Fruit g/day[b]	115	97	58	92	105
Vegetables g/day[c]	77	83	117	162	150
Oily fish g/day[d]	2	1	2	7	10
Red and processed meat g/day[e]	31	44	64	66	65
Bases (unweighted)	*67*	*149*	*175*	*328*	*133*

[a] To calculate "5-A-Day" portions of fruit and vegetables see chapter 5 and appendix A. Children under 11 years have not been included as the 80g portion is only appropriate for older children and adults.

[b] Average daily consumption (mean in grams) of fruit including contribution from composite dishes, also includes fruit from smoothies, but excludes fruit juice.

[c] Average daily consumption (mean in grams) of vegetables (not including potatoes) including contribution from composite dishes.

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

[e] Red and processed meat referred to in the main report as 'total red meat' includes beef, lamb, pork, sausages, burgers and kebabs, offal, processed red meat and other red meat.

Table 1.5 provides a summary of the reported total energy intake for adults and children in Wales. Mean energy intakes were below the Estimated Average Requirement (EAR)[14] for adults and children aged 11 years and over. However it should be borne in mind that the UK doubly labelled water (DLW) sub-study showed evidence of under-reporting of energy intakes in these age groups; see appendix X of the main UK report for more details. 'Cereals and cereal products' was the largest 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.

Table 1.5 Average daily total energy intake for NDNS RP Wales Years 2-5 combined

	NDNS age groups (years)						
Total energy	1.5-3	4-10	11-18	19-64		65+	
	sex-combined	sex-combined	sex-combined	Men	Women	Men	Women
MJ	4.84	6.30	7.28	8.47	6.52	7.59	6.12
kcal	1146	1494	1730	2015	1550	1807	1455
Bases (unweighted)	*67*	*149*	*175*	*130*	*198*	*54*	*79*

Table 1.6 provides a summary of the intakes of selected macronutrients for adults and children in Wales.

- 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 (36.8%). Mean intake of saturated fatty acids exceeded the DRV (no more than 11% food energy) in all age/sex groups, whilst mean intake of trans fatty acids met the DRV (no more than 2% food energy) in all age/sex groups. 'Milk and milk products', 'cereals and cereal products' and 'meat and meat products' were the main contributors to intake of total fat, saturated and trans fatty acids; 'milk and milk products' made a larger contribution for younger children.

- Mean NMES intake exceeded the DRV (no more than 11% food energy) for all age/sex groups except men and women aged 65 years and over. For children, the overall main source of NMES was 'non-alcoholic beverages' (soft drinks and fruit juice). Of these, 'soft' drinks contributed 29% to NMES intake for children aged 11 to 18 years and 13-14% for children aged 10 years and under, while 'fruit juice' contributed 10-13% in children across the age groups. 'Cereals and cereal products' (mainly 'buns, cakes, pastries and fruit pies', biscuits and breakfast cereals) and 'sugar, preserves and confectionery' were the other major contributors in children. For adults aged 19 to 64 years, 'sugar, preserves and confectionery' (including table sugar), 'non-alcoholic beverages' (soft drinks and 'fruit juice') and 'cereals and cereal products' (mainly 'buns, cakes, pastries and fruit pies' and biscuits) made similar contributions to intake (27%, 23% and 20% respectively). For adults aged 65 years and over, 'cereals and cereal products' was the largest contributor (34%), half of which was from 'buns, cakes, pastries and fruit pies'. 'Sugar, preserves and confectionery' was also a major contributor in this age group providing 26%, mainly from table sugar, preserves and spreads.

- Mean intake of non-starch polysaccharides (NSP) for adults aged 19 to 64 years and 65 years and over was 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.

Table 1.6 Average daily intake of selected macronutrients, for NDNS RP Wales Years 2-5 combined

Macronutrient	**NDNS age group (years)**				
	1.5-3	4-10	11-18	19-64	65+
Total fat % food energy	33.6	33.4	33.6	33.6	35.2
Saturated fatty acids % food energy	14.5	13.0	12.2	12.5	13.9
Trans fatty acids % food energy	0.6	0.5	0.5	0.6	0.7
NMES % food energy	11.7	13.3	15.1	11.8	10.3
NSP g	8.8	10.8	12.1	13.5	13.2
Bases (unweighted)	*67*	*149*	*175*	*328*	*133*

- For adults, 58% of men and 45% of women aged 19 to 64 years and 48% of those aged 65 years and over reported consuming alcohol over the four-day diary recording period. For adult consumers, alcohol provided on average 9.3% of energy intake for men aged 19 to 64 years and 9.7% of energy intake for women aged 19 to 64 years and 5.4% of energy intake for those aged 65 years and over.

Table 1.7 provides a summary of the intakes of selected micronutrients for adults and children in Wales. Mean intake is compared with the Reference Nutrient Intake (RNI)[15] and an estimate is made of the proportion with intake below the Lower Reference Nutrient Intake (LRNI).[16]

- Mean daily intakes of most vitamins from food sources were close to or above the RNI for all age/sex groups. For girls aged 11 to 18 years, 15% and 16% had intakes below the LRNI for vitamin A and riboflavin respectively. Twelve per cent of women aged 19 to 64 years had intakes of riboflavin from food sources below the LRNI.

- For vitamin D, RNIs are set only for those aged up to four years and those aged 65 years and over and there are no LRNIs. Mean intakes from food sources were well below the RNI in both these age groups: 27% of the RNI for children aged 1.5 to 3 years and 32% of the RNI for adults aged 65 years and over.[17]

- Mean intakes of most minerals from food sources were below the RNI for some age/sex groups, in particular children aged 11 to 18 years. 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. For children aged 11 to 18 years substantial proportions had intakes of minerals (from food sources only) below the LRNI, including 33% and 32% of boys for selenium and magnesium (respectively) and 45% and 54% of girls for selenium and magnesium (respectively). For adults aged 19 to 64 years substantial proportions also had intakes of minerals (from food sources only) below the LRNI, including 27% and 16% of men and 54% and 15% of women for selenium and magnesium (respectively). Iron intakes below the LRNI were found in 25% of women aged 19 to 64 years and 38% of girls aged 11 to 18 years. For adults aged 65 years and over, 37% of men and 49% of women had intakes of selenium from food sources below the LRNI and 29% of men and 18% of women had intakes of magnesium from food sources below the LRNI. It should be noted that the DRVs for some micronutrients such as magnesium, selenium and zinc are based on limited data so caution should be used when assessing adequacy of intake using the LRNI.

- Twenty per cent of adults aged 19 to 64 years (19% of men, 21% of women) and 39% of adults aged 65 years and over (29% of men, 47% of women) reported taking at least one dietary supplement during the four-day diary recording period. Adults aged 19 to 64 years who took supplements generally had higher intakes of vitamins and minerals from food than did non-supplement takers. This pattern was less clear in the 65 years and over age group.

Table 1.7 Mean daily intake as a percentage of the Reference Nutrient Intake (RNI) from food sources only and proportion of participants with average daily intakes below the Lower Reference Nutrient Intake (LRNI) for selected micronutrients, for NDNS RP Wales Years 2-5 combined

Micronutrients[a]	NDNS age groups (years)									
	Boys		Total	Men		Girls		Total	Women	
	4-10	11-18	boys	19-64	65+	4-10	11-18	girls	19-64	65+
Vitamin A										
Mean % RNI	153	91	118	129	133	108	115	112	150	145
% with intake below the LRNI	3	14	9	9	6	5	15	11	7	3
Riboflavin										
Mean % RNI	182	122	148	134	120	151	108	127	132	140
% with intake below the LRNI	1	5	3	7	5	2	16	10	12	9
Folate										
Mean % RNI	162	112	134	132	130	137	95	113	113	106
% with intake below the LRNI	0	1	1	1	2	0	4	2	5	2
Iron										
Mean % RNI	121	89	103	128	122	101	60	78	79	102
% with intake below the LRNI	0	5	3	7	1	4	38	23	25	6
Bases (unweighted)	*83*	*81*	*164*	*130*	*54*	*66*	*94*	*160*	*198*	*79*

[a] The % of RNI for vitamin D has not been included in this table as RNI's for vitamin D have only been set for those aged 1.5-3 years and 65 years and over.

Table 1.7 (continued) Mean daily intake as a percentage of the Reference Nutrient Intake (RNI) from food sources only and proportion of participants with average daily intakes below the Lower Reference Nutrient Intake (LRNI) for selected micronutrients, for NDNS RP Wales Years 2-5 combined

Micronutrients[a]	NDNS age groups (years)									
	Boys		Total	Men		Girls		Total	Women	
	4-10	11-18	boys	19-64	65+	4-10	11-18	girls	19-64	65+
Calcium										
Mean % RNI	174	83	123	125	116	152	78	110	105	114
% with intake below the LRNI	0	8	4	3	2	2	16	10	7	8
Magnesium										
Mean % RNI	126	74	97	90	81	112	64	85	82	80
% with intake below the LRNI	0	32	18	16	29	1	54	31	15	18
Potassium										
Mean % RNI	152	75	109	83	77	135	62	94	73	73
% with intake below the LRNI	0	17	10	13	19	0	39	22	24	32
Selenium										
Mean % RNI	131	71	97	70	60	122	71	93	68	67
% with intake below the LRNI	0	33	18	27	37	3	45	27	54	49
Zinc										
Mean % RNI	94	81	87	95	88	85	83	84	103	104
% with intake below the LRNI	2	18	11	11	13	10	21	16	8	5
Bases (unweighted)	*83*	*81*	*164*	*130*	*54*	*66*	*94*	*160*	*198*	*79*

[a] The % of RNI for vitamin D has not been included in this table as RNI's for vitamin D have only been set for those aged 1.5-3 years and 65 years and over.

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 groups differ from the age/sex groups used elsewhere in the report and are referred to as "age subgroups". Due to small numbers in some of the age/sex subgroups in the Wales sample (males aged 11 to 15 years, 16 to 24 years and 50 to 64 years and females aged 16 to 24 years), caution should be exercised when interpreting findings for these age/sex subgroups.

- Mean daily intake of saturated fatty acids as a percentage of food energy exceeded the DRV for all age subgroups.

- Mean intake of NMES as a percentage of food energy exceeded the DRV in all age subgroups, except females aged 25 to 49 years and adults aged 50 to 64 years.

- Females aged 11 to 15 years had mean intakes below the RNI[15] for iron and calcium, as did females aged 16 to 24 years. Females aged 25 to 49 years had mean intake below the RNI[15] for iron only.

- The number of portions of fruit and vegetables consumed per day and the proportion of participants in Wales meeting the "5-A-Day" recommendation[9] was higher in those aged 25 to 64 years than in those aged 11 to 24 years. The proportion achieving "5-A-Day" was similar or lower in Wales compared with the UK as a whole for all sex-combined age subgroups.

Intake by equivalised income or by Wales Index of Multiple Deprivation (Chapter 9)

Households were grouped into tertiles, ranked by equivalised income[18] and separately by the Wales Index of Multiple Deprivation (WIMD).[19] Statistical comparisons were undertaken for intakes of key foods and nutrients by tertiles of equivalised income or WIMD for adults aged 19 to 64 years. Tertile 3 (the highest income or lowest deprivation) was used as the reference category. Numbers in the 4 to 10 years and 11 to 18 years age groups were too small to allow statistical comparisons between tertiles and data has not been presented for the 65 years and over age group.

- There were some observed differences in food consumption, energy and nutrient intakes by equivalised household income tertiles and WIMD tertiles. Differences tended to be clearest between the lowest and highest tertiles and analysis by equivalised income and WIMD generally showed consistent results. However, differences between tertiles were not consistently seen for all age groups.

- Overall there were few clear differences in energy or macronutrient intake by equivalised household income or WIMD for adults aged 19 to 64 years. Mean protein intake (as a percentage of food energy) and mean NSP intake were significantly lower in the lowest income tertile compared with the highest while mean NMES intake (as a percentage of food energy) showed the opposite trend, significantly higher in the lowest income tertile compared with the highest tertile. Analysis by WIMD showed the same difference for NSP but the difference for NMES did not reach statistical significance and there was no pattern for protein.

- Mean intake of micronutrients tended to be lower in the equivalised income tertiles 1 and 2 compared with the highest income tertile (tertile 3) for adults aged 19 to 64 years. However the pattern was less clear when split by WIMD tertiles. Where mean intakes fell below recommendations this was generally the case for all tertiles.

Mean fruit and vegetable consumption expressed in grams and as "5-A-Day" portions showed clear differences between lowest and highest tertile when split by income and by WIMD. However, mean consumption in all tertiles was below the recommendation of "5-A-Day". No clear pattern for total meat or red meat[20] was observed. Mean oily fish consumption was below the recommended one portion per week[21] in all tertiles.

24-hour urine analyses: Sodium excretion and estimated Salt intake (Chapter 7)[22]

Erratum note: The results in this section were excluded from the original report published in December 2015. The results published here have been corrected to take account of analytical bias in sodium concentrations and are in line with data republished in the UK year 1-4 report in February 2017 and the urinary sodium surveys of adults in England and Scotland (2014) [23,24] and Northern Ireland (2015).[25]

Salt intake has been estimated from urinary sodium excretion. Table 1.8 presents the recommended maximum salt intake per day for adults, which was set by COMA[26] and endorsed by the Scientific Advisory Committee on Nutrition (SACN) in its report on Salt and Health (2003) and the recommended maximum intakes set by SACN (2003) for children.[27]

In Wales, mean estimated salt intake for those aged 11 years and over, was higher than the maximum recommended intake.

Mean estimated salt intake was 7.8g/day for children aged 11 to 18 years, this was 29% greater than the SACN recommendation of a population average of no more than 6g/day. Mean estimated salt intake was 8.4g/day for adults aged 19 to 64 years, this was 41% greater than the SACN recommendation of a population average of no more than 6g/day; 9.7g/day for men aged 19 to 64 years and 7.3g/day for women aged 19 to 64 years. Mean estimated salt intake was 7.1g/day for adults aged 65 years and over, this was 18% greater than the SACN recommendation of a population average of no more than 6g/day.

Table 1.8 Average estimated salt intake (g/day), for NDNS RP Wales Years 2-5 combined compared with NDNS RP UK Years 1-4 combined, by age[a]

NDNS age/sex group[b]	Recommended maximum salt intake (g/day)[26,27 ,c,d]	Wales Years 2-5 combined[e] (g/day)	UK Years 1-4 combined[e,f] and England 2011 survey[e,g] (g/day)
11 to 18 years	6	[7.8] (n=44)	7.0[f] (n=377)
19 to 64 years	6	8.4 (n=123)	8.5[g] (n=547)
19 to 64 years males	6	9.7 (n=56)	9.8[g] (n=250)
19 to 64 years females	6	7.3 (n=67)	7.2[g] (n=297)
65 years and over	6	[7.1] (n=41)	7.6[f] (n=270)

[a] complete by standard criteria only.
[b] Results are not presented for children aged 4 to 6 years as base numbers are below 30.
[c] 1g salt contains 17.1mmol sodium.
[d] These are the maximum daily dietary targets.
[e] Counts are provided in brackets.
[f] The UK report for years 1 to 4 of the NDNS RP[3] reported urinary sodium results from participants aged 4 to 18 years and 65 years and over only.
[g] The most recent published data for adults in England comes from a 24-hour urinary sodium survey carried out in 2011.[28]

Biochemical indices of nutritional status (Chapter 6)

This section reports on the results of blood samples taken from participants in Wales, which provide an assessment of the availability of nutrients to the body (after absorption) for use in metabolic processes.

- There is evidence of anaemia (as indicated by low haemoglobin levels) or low iron stores (plasma ferritin) in all age/sex groups in the population, with a higher proportion in females. The proportion of participants who had both haemoglobin and plasma ferritin concentrations below the thresholds which indicate iron deficiency was 3.0% of those aged 11 to 18 years, 3.9% of women aged 19 to 64 years and 4.3% of adults aged 65 years and over.

- There is evidence of low vitamin D status (vitamin D concentration below the threshold of 25nmol/L) at the time of venepuncture in all reported age/sex groups. For children aged 11 to 18 years 23.0% had a vitamin D concentration below the threshold of 25nmol/L. For adults, 19.8% of men and 15.8% of women aged 19 to 64 years and 16.5% of adults aged 65 years and over had a vitamin D concentration below the threshold of 25nmol/L; this has implications for bone health (increasing the risk of rickets and osteomalacia).

- A substantial proportion of participants in all reported age/sex groups had riboflavin status values based on raised erythrocyte glutathione reductase activation coefficient (EGRAC) indicating biochemical depletion. In Wales the proportion ranged from 51.2% for those aged 65 years and over and 59.9% for men aged 19 to 64 years up to 88.2% for children aged 11 to 18 years. However, there is uncertainty about the functional consequences of a raised EGRAC and it has been recommended that the EGRAC threshold should be raised to a level above 1.30 to better reflect riboflavin inadequacy; this requires further consideration.[29] Therefore, in addition to using this threshold, changes in the riboflavin status of the UK population (including those in Wales) will also be monitored by reviewing the EGRAC values at the 75th and 90th percentiles in successive years.

- There is little evidence of low status for other micronutrients where normal ranges or thresholds for low status have been set, e.g. vitamin C, thiamin as indicated by erythrocyte transketolase activation coefficient (ETKAC), retinol and vitamin E.

- The proportion of adults aged 19 to 64 years and aged 65 years and over who had a serum total cholesterol concentration between 5.2 and 6.4mmol/L, indicating a marginally increased risk of cardiovascular disease was 34.4% and 27.6% respectively. A further 12.1% and 17.2% of adults aged 19 to 64 years and 65 years and over respectively had serum cholesterol in the range 6.5 to 7.8mmol/L indicating a moderately elevated cardiovascular risk. Another 1.2% of adults aged 19 to 64 years had a serum total cholesterol concentration greater than 7.8mmol/L, indicating severe risk, whilst there were no such cases for those aged 65 years and over.

- The UK, Scotland, Northern Ireland and Wales results for blood folate status were originally published in March 2015, but the thresholds published by the WHO which were used in that report were set using blood folate data based on different laboratory assays from those used to analyse NDNS samples. Measurements of blood folate are specific to the assay method and the laboratory used; therefore thresholds need to be appropriate to the assay method or to have been adjusted for the assay method used. Consequently, the report on folate status in the UK, Scotland and Northern Ireland as determined in Years 1 to 4 and in Wales in Years 2 to 5 of the NDNS RP will be republished in 2017.

Differences between Wales Years 2 to 5 combined and the UK Years 1 to 4 combined for intakes of key foods and nutrients (Chapter 10)

Erratum note: correction to fruit and vegetable consumption data
Consumption figures in this section have been corrected for an error in the estimation of fruit, vegetables and fruit juice and the calculation of “5-A-Day” portions. Fruit and vegetable components of some food groups (soft drinks, confectionery, biscuits, cakes, sugar, preserves and sweet spreads, savoury snacks and ice cream) were included in the estimates when they should have been excluded. This has now been corrected and the corrected values are slightly lower than the original published values. Further details are provided in chapter 5.

Statistical comparisons were undertaken for intakes of key foods and nutrients between the Wales sample of the NDNS RP Years 2 to 5 combined and the whole of the UK sample of the NDNS RP Years 1 to 4 combined.[30] Results are presented by standard age groups; 1.5 to 3 years, 4 to 10 years, 11 to 18 years, 19 to 64 years and 65 years and over and are also subdivided by sex (except for children aged 1.5 to 3 years and adults aged 65 years and over, where numbers are insufficient to subdivide by sex).

- Overall there were few differences between Wales and the UK as a whole for mean intakes of energy and macronutrients.

- Mean daily total energy intake was significantly lower in girls aged 4 to 10 years in Wales compared with the UK as a whole (1404 kcal compared with 1489 kcal) and for adults aged 19 to 64 years (1780 kcal compared with 1861 kcal).

- In women aged 19 to 64 years mean intake of total fat as a percentage of food energy was significantly lower in Wales compared with the UK as a whole.

- For all age groups, with the exception of children aged 1.5 to 3 years, mean intakes of *trans* fatty acids were significantly lower in Wales compared with the UK as a whole. In both Wales and the UK as a whole mean intakes met the recommendation of remaining below 2% of food energy. This apparent difference in intake between Wales and the UK is mainly due to lower *trans* fatty acid composition values for many processed foods in the dataset from Year 3 onwards.[31]

- Mean intake of non-milk extrinsic sugars (NMES) tended to be slightly lower in most age/sex groups in Wales compared with the same groups in the UK as a whole although the differences were not significant in all age/sex groups. Mean NMES intake as a percentage of food energy was significantly lower in Wales than in the UK as a whole for children aged 4 to 10 years (13.3% and 14.7% respectively) and adults aged 65 years and over (10.3% and 11.5% respectively).

- Mean intakes of NSP were similar in Wales and the UK as a whole.

- Mean alcohol intake expressed as a percentage of total energy for female consumers aged 19 to 64 years was significantly higher in Wales (9.7%) compared with the UK as a whole (7.8%).

- Mean iron intake in Wales generally showed a similar pattern to the UK as a whole across the age groups (except for girls aged 4 to 10 years in Wales who had a lower mean intake than in the UK as a whole).

- Mean calcium intake was significantly lower in girls aged 11 to 18 years in Wales (622mg) compared with the UK as a whole (670mg) and fell below the RNI in both Wales and the UK as a whole. For girls aged 11 to 18 years, 16% in Wales and 19% in the UK as a whole had intakes below the LRNI, however this difference did not reach significance.

- Women aged 19 to 64 years in Wales had a significantly lower mean consumption of portions of fruit and vegetables compared with the same group in the UK as a whole (3.6 and 4.0 respectively). Adults aged 65 years and over in Wales also had a significantly lower mean consumption of portions of fruit and vegetables compared with the same age group in the UK as a whole (3.6 portions and 4.5 portions respectively). The percentage achieving “5-A-Day” was significantly lower in Wales compared with the UK as a whole for women aged 19 to 64 years (21%

compared with 28%) and adults aged 65 years and over (23% compared with 36%).

- No clear pattern was observed in either direction in any of the age/sex groups for mean consumption of red meat. Mean oily fish consumption was similar in Wales and the UK as a whole across all age/sex groups, with the exception of women aged 19 to 64 years where mean oily fish intake was significantly lower in Wales (35g per week) compared with the UK as a whole (54g per week).[21]

Differences between Wales (Years 2 to 5 combined) and the UK as a whole (Years 1 to 4 combined) for blood analytes[32,33]

No statistical comparisons were undertaken for blood analytes between the Wales sample of the NDNS RP Years 2 to 5 combined and the whole of the UK sample of the NDNS RP Years 1 to 4 combined. Therefore this section includes observed differences only.[30]

- For men aged 19 to 64 years, mean vitamin C concentration was lower in Wales (37.7μmol/L) than in the UK as a whole (48.9μmol/L).

- In Wales, there was a higher proportion of women aged 19 to 64 years (15.7%) and adults aged 65 years and over (17.2%) with a serum total cholesterol between 6.5 and 7.8mmol/L (a level associated with moderate risk) than in the UK as a whole (11.5% for women aged 19 to 64 years and 13.2% for adults aged 65 years and over in the UK as a whole).

- In all adult age/sex groups, a lower proportion of participants in Wales than in the UK as a whole had a 25-OHD concentration below 25nmol/L (the current threshold indicating vitamin D adequacy) at the time of venepuncture. Results are summarised in table 1.9.

Table 1.9 The percentage of NDNS RP Wales (Years 2 to 5 combined) and NDNS RP UK (Years 1 to 4 combined) participants with 25-OHD concentration below 25nmol/L at the time of venepuncture[a]

	% of respective dataset with 25-OHD concentration <25nmol/litre[a] *Cell size for each age group is shown in brackets*			
	11-18y (sex-combined)	19-64y men	19-64y women	65y (sex-combined)
Wales (Years 2-5 combined)	23.0% (53)	19.8% (62)	15.8% (105)	16.5% (50)
UK as a whole (Years 1-4 combined)	22.0% (523)	24.0% (551)	21.7% (770)	21.0% (338)

[a] It should be noted that no statistical analysis of the differences has been performed.

Methodological issues

An overview of the purpose, documents, methodologies, procedures for data collection and quality control are provided in the main report along with supporting technical appendices. These include a consideration of the methodological issues and limitations which include self-reported measures of food intake, time between diet and nutritional status assessment and days of the week in the food diary. This should be borne in mind while interpreting these findings (see chapter 5 and appendix X of the main report for more detail).

Future reports

A Years 5 and 6 report with key foods, nutrients and indices of nutritional status for the UK as a whole was published in September 2016.

The UK, Scotland, Northern Ireland and Wales results for blood folate status were originally published in March 2015, but the thresholds published by the WHO which were used in that report were set using blood folate data based on different laboratory assays from those used to analyse NDNS samples. Measurements of blood folate are specific to the assay method and the laboratory used; therefore thresholds need to be appropriate to the assay method or to have been adjusted for the assay method used. Consequently, the report on folate status in the UK, Scotland and Northern Ireland as determined in Years 1 to 4 and in Wales in Years 2 to 5 of the NDNS RP will be republished in 2017.

Additional recruitment has taken place in Wales since 2013/14 and is planned to be completed by 2016/17, allowing an analysis of changes over time in diet and nutrition in Wales.

[1] Responsibility for nutrition policy in England and Wales transferred from the Food Standards Agency (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).

[2] From Year 6 onwards, the consortium comprises NatCen and HNR.

[3] National Diet and Nutrition Survey: results from Years 1 to 4 (combined) of the rolling programme for 2008 and 2009 to 2011 and 2012 https://www.gov.uk/government/publications/national-diet-and-nutrition-survey-results-from-years-1-to-4-combined-of-the-rolling-programme-for-2008-and-2009-to-2011-and-2012 (accessed 21/05/15).

[4] National Diet and Nutrition Survey Rolling Programme (NDNS RP): results from Years 1- 4 (combined) for Scotland (2008/09-2011/12) http://www.food.gov.uk/sites/default/files/ndns-scotland-full-report.pdf (accessed 21/05/15).

[5] National Diet and Nutrition Survey Rolling Programme (NDNS RP): results from Years 1- 4 (combined) for Northern Ireland (2008/09-2011/12) http://www.food.gov.uk/sites/default/files/ndns-ni-full-report.pdf (accessed 21/05/15).

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

[7] 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.

[8] 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.

[9] Department of Health 5 A DAY programme [online]
http://www.nhs.uk/Livewell/5ADAY/Pages/5ADAYhome.aspx (accessed 21/05/15).

[10] 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.

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

[12] 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.

[13] Results for food consumption include vegetables, fruit, meat and fish after disaggregation (i.e. including the contribution from composite dishes, both homemade dishes and manufactured products, containing these ingredients but excluding other components of these dishes).

[14] Scientific Advisory Committee on Nutrition. Dietary Reference Values for Energy: [Online]. Available http://www.sacn.gov.uk/pdfs/sacn_dietary_reference_values_for_energy.pdf (2011) (accessed 21/06/15).

[15] 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.

[16] 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.

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

[18] Equivalisation is a standard methodology that adjusts household income to account for different demands on resources, by considering the household size and composition.

[19] The Welsh Index of Multiple Deprivation (WIMD) is the official measure of relative deprivation for small areas in Wales. It is designed to identify those small areas where there are the highest concentrations of several different types of deprivation. The WIMD comprises seven domains of deprivation, each developed to measure a distinct form or type of deprivation; income, employment, health, education, proximity to services, living environment and crime. Although the term deprivation is often synonymous with monetary poverty it is important to note that only the Income Deprivation Domain is intended to measure poverty in this sense. The remaining six domains focus on other types of deprivation, such as the lack of adequate education or poor health. The domains can be interpreted individually or combined to assess deprivation in more than one domain http://wales.gov.uk/statistics-and-research/welsh-index-multiple-deprivation/?lang=en.

[20] Total red meat (also referred to in this executive summary as 'Red and processed meat') includes beef, lamb, pork, sausages, burgers and kebabs, offal, processed red meat and other red meat.

[21] Weekly equivalent oily fish consumption has been calculated using unrounded data rather than the rounded figures in tables 9.6a-c, 9.12a-c and 10.6a-c.

[22] Dietary salt intake can only be accurately assessed by measuring sodium excretion in urine. The predominant source of sodium in the diet is "common salt" (sodium chloride). It is not possible to obtain accurate estimates of dietary intake of sodium from food intake information, mainly because of the difficulty with accurately assessing the amount of salt added to food in cooking or at the table. Estimates of sodium intake can be obtained by measuring urinary sodium excretion, assuming the body is in balance for sodium.

[23] National Diet and Nutrition Survey (NDNS): Assessment of dietary sodium for adults (19 to 64 years) in England, 2014 report;
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/509399/Sodium_study_2014_England_Text_final.pdf Published 2016 (accessed 27/06/16).

[24] National Diet and Nutrition Survey (NDNS): Assessment of dietary sodium for adults (19 to 64 years) in Scotland, 2014 report;
http://www.foodstandards.gov.scot/sites/default/files/Monitoring%20the%20Scottish%20Diet-%20Sodium%20Survey%202014%20SCOTLAND_FINAL%20PDF.pdf Published 2016 (accessed 27/06/16).

[25] National Diet and Nutrition Survey: Assessment of dietary sodium - Adults (19 to 64 years) in Northern Ireland 2015;
https://www.food.gov.uk/northern-ireland/nutritionni/national-diet-and-nutrition-survey-assessment-of-dietary-sodium. Published 2016 (accessed 06/10/16).

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

[27] Scientific Advisory Committee on Nutrition (2003). Salt and Health. The Stationery Office.
http://www.sacn.gov.uk/pdfs/sacn_salt_final.pdf (accessed 15/09/14).

[28] National Diet and Nutrition Survey - Assessment of dietary sodium in adults (aged 19 to 64 years) in England, 2011 report. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/127916/Sodium-Survey-England-2011_Text_to-DH_FINAL1.pdf.pdf (accessed 15/09/14).

[29] It should be noted that there is uncertainty about the functional consequences of a raised EGRAC. Therefore, in addition to using this threshold, changes in the riboflavin status of the UK population (including those in Wales) will also be monitored by reviewing the EGRAC values at the 75th and 90th percentiles in successive years.

[30] The Wales Years 2 to 5 sample includes core and boost participants. The UK Years 1 to 4 sample also includes the core and boost participants from Wales. In the UK Years 1 to 4 data, the Wales cases were weighted down to represent the proportion of participants that the Wales core participants represent in the UK Years 1 to 4 NDNS RP survey population.

[31] New, lower analytical values for *trans* fatty acids in a range of processed foods were added to the nutrient databank in Years 3 and 4 onwards. Therefore there is a higher proportion of the new, lower composition values in the Wales dataset, based on years 2-5 than in the UK dataset, based on Years 1-4. This is likely to be the main explanation for the apparently lower *trans* fatty acid intakes in Wales compared with the UK.

[32] In section 6.8.1 comparisons are made between blood analyte results for NDNS RP participants in the Wales (Years 2 to 5 combined) and the UK (Years 1 to 4 combined) samples. The following points should be taken into consideration when making any comparisons between these datasets:

- the number of blood samples obtained in Wales for those aged 11 years and over was 288. The sample size for blood samples obtained from those aged 11 years and over was 2,344 for the UK. It should be noted that this number for the UK also includes blood samples obtained from participants in Wales.
- the Wales blood samples were collected between April 2009 and July 2013; (Years 2 to 5 of the NDNS RP) whilst the UK blood samples were collected between February 2008 and July 2012 (Years 1 to 4 of the NDNS RP).
- plasma 25-hydroxyvitamin D (25-OHD) data are only presented as annual averages in Table 6.3, because if split by season the cell sizes would be too small.all of the noted differences are observed differences only and no statistical analysis of the differences has been undertaken as the cell sizes in some age/sex groups in Wales are small. Therefore caution should be taken when comparing findings between Wales Years 2-5 and UK Years 1 to 4 where cell sizes are small.

[33] It should be noted that this number for the UK also includes blood samples obtained from participants in Wales.

1 Background and purpose

Beverley Bates

The National Diet and Nutrition Survey Rolling Programme (NDNS RP) is a survey of the food consumption, nutrient intakes and nutritional status of people aged 1.5 years and older living in private households. The survey is carried out in all four countries of the United Kingdom (UK) and is designed to be representative of the UK population.

The NDNS RP was first commissioned by the UK Food Standards Agency (FSA) in 2006 and the core survey is now jointly funded by Public Health England and FSA, with additional recruitment boosts funded by Government bodies in Wales, Scotland and Northern Ireland. Details on the background to the NDNS RP can be found in the main UK report of the first four years of the NDNS RP (2008/09 to 2011/12).[1]

The NDNS RP is carried out by a consortium of three organisations: NatCen Social Research (NatCen), Medical Research Council Human Nutrition Research (MRC HNR), based in Cambridge and the Department of Epidemiology and Public Health at the Royal Free and University College London Medical School (UCL).[2] Haematological and biochemical analyses of blood samples are carried out at MRC HNR and Addenbrooke's Hospital NHS Trust, Cambridge.

Government bodies in Wales have funded additional recruitment in 2009/10 to 2012/13 (Years 2 to 5[3]) in order to achieve representative data for Wales and to enable comparisons to be made with UK results.[4] The four survey years (Years 2 to 5) have been combined to provide a large enough sample on which to base analyses.5

The report provides information about the diet and nutrient intakes of participants in Wales and includes results from analysis of blood and urine samples. The report also provides additional analyses of the intakes of key foods and nutrients and nutritional status measures in different income and deprivation groups and comparisons between Wales and the UK as a whole. The data in this report will support work by the Welsh Government to facilitate improvements to the diet and nutritional status of children and adults in Wales.

The specific aims of the NDNS RP in Wales were to:

- provide quantitative data on the food and nutrient intakes, sources of nutrients and nutritional status of the population aged 1.5 years and above
- provide height, weight and other physical measurements
- provide information on food consumption, nutrient intake and nutritional status in different age groups
- establish the extent to which the diet of the population meets Government recommendations
- provide information on intakes of key foods and nutrients and nutritional status measures in different income and deprivation groups
- compare the intakes of key foods and nutrients and nutritional status measures in Wales with the UK population.

The NDNS RP will benefit a wide range of Government activities in Wales and the rest of the UK. It is key to monitoring progress on diet and nutrition objectives and in identifying aspects of the diet requiring future action. Reducing unhealthy eating is a key priority for the Welsh Government, which is reflected in a broad range of policies across departments, including health, education, environment and tackling poverty.[6] It will also provide the detailed food consumption data essential to support risk assessments for food chemicals.

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[1] https://www.gov.uk/government/publications/national-diet-and-nutrition-survey-results-from-years-1-to-4-combined-of-the-rolling-programme-for-2008-and-2009-to-2011-and-2012 (accessed 15/07/15).

[2] From Year 6 onwards, the consortium comprises NatCen and HNR.

[3] Fieldwork for the four fieldwork years was carried out as follows: Year 2 - between April 2009 and August 2010), Year 3 - between April 2010 and August 2011, Year 4 - between April 2011 and August 2012) and Year 5 - between April 2012 and August 2013. Fieldwork periods overlap as each fieldwork year continues for more than 12 months. This is due to the staggering of interviewer and nurse fieldwork (see chapter 2 for further detail).

[4] There was no Wales boost in Year 1. Boosted samples in Scotland and Northern Ireland were included from Year 1.

[5] Government bodies in Wales are funding a further boost in Wales which started in Year 6.

[6] Welsh Government. Our Healthy Future. http://wales.gov.uk/topics/health/cmo/healthy/?lang=en (accessed 15/07/15).

2 Methodology and response

Original author: Sarah Pigott
Updated by: Beverley Bates

2.1 Introduction

This chapter provides an overview of the NDNS RP methodology used in Wales and the rest of the UK over Years 2 to 5. There were few changes to methodology between Years 2 and 5; the key changes are summarised in section 2.7.

A sample of people representative of the UK population aged 1.5 years and over was selected. In addition, a "boost" sample was selected in Wales to increase the numbers in this country, thereby allowing comparisons to be made between Wales and the UK as a whole.[1] The samples were drawn from the Postcode Address File (PAF),[2] a list of all the addresses in the UK. In order to improve cost effectiveness the addresses were clustered into Primary Sampling Units (PSUs), small geographical areas, based on postcode sectors, randomly selected from across the UK. A list of addresses was randomly selected from each PSU.

Information describing the purpose of the survey was posted to all selected addresses. This was followed by a face-to-face visit by an interviewer to each address to recruit participants in the eligible age range(s). In order to achieve (as far as possible) equal numbers of adults and children in the sample, at some addresses only children were selected to take part (see section 2.2.2).

If there was more than one household at an address, an interviewer randomly selected one to take part. From each selected household, up to one adult and one child was then randomly selected to take part in the survey. These are known as *participants*. The first stage of the survey comprised a face-to-face Computer Assisted Personal Interview (CAPI) with each participant (or in the case of a young child, their parent or guardian[3]), completion of a four-day food diary by the participant (outside the interviewer visits) and measurements of height and weight. The interviewer also collected information on shopping and food preparation practices and facilities in the household by additionally interviewing the *Main Food Provider* (MFP)[4] of the household where this was not a selected participant. The MFP was the person who was best placed to answer questions about food purchased and prepared for the participant(s). The interview also identified the *Household Reference Person* (HRP)[5] in each household and asked questions about housing tenure, as well as his or her employment, to determine the socio-economic classification of the household.[6]

Participants who took part in the CAPI interview and completed a food diary for at least three days were classified as '*fully productive'* and were invited to take part in the second stage of the survey. This involved a visit from a nurse to take further physical measurements including a blood sample and a 24-hour urine collection.

2.2 Sample design

2.2.1 Selecting addresses

The sample was drawn from the PAF. The aim was to achieve 200 fully productive individuals (100 adults, 100 children) in Wales in each survey year (so 400 adults and 400 children for Years 2 to 5 combined). In total 2,603 addresses in 97 PSUs were randomly selected.[7] Of these, 659 addresses in 25 PSUs were in the core UK sample and 1,944 addresses in 72 PSUs formed the Wales boost sample.

2.2.2 Selecting participants

To determine whether an adult (aged 19 years or over) and a child (aged 1.5 to 18 years), or a child only, were selected for interview the 27 addresses in each assignment were randomly allocated to one of two groups as follows.

Survey year	*No. addresses at which adult and child selected ('basic' addresses)*	*No. addresses at which child only selected ('child boost' addresses)*
2	9	18
3	9	18
4 (quarters 1,2)	11	16
4 (quarters 3,4)	10	17
5	10	17

The split was changed from Year 4 to ensure that the target number of child participants was met. In households containing more than one eligible person (adult and/or child), interviewers selected the participant(s) using a random selection procedure.

Further details on sampling can be found in appendix B.

2.3 Ethics approval

Ethics approval for the UK study as a whole was obtained from the Oxfordshire A Research Ethics Committee. The letters of approval for the original submission and subsequent substantial amendments, together with approved documents, were sent to all Local Research Ethics Committees (LRECs) covering areas where fieldwork was being conducted. Research governance[8] approval was sought for all participating NHS laboratories and obtained where required by the Research and Development (R&D) Committee for each laboratory.

2.4 Fieldwork

Years 2 to 5 of NDNS RP fieldwork was issued to fieldworkers as follows:

Survey year	*Fieldwork period*
Year 2	April 2009 - June 2010
Year 3	April 2010 - June 2011
Year 4	April 2011 - June 2012
Year 5	April 2012 - June 2013

In each survey year, fieldwork was issued monthly to interviewers and nurses in the following waves:

Wave	*Interviewers (Stage 1)*	*Nurses (Stage 2)*[9]
Quarter 1	April-June	July-September
Quarter 2	July-September	October-December
Quarter 3	October-December	January-March
Quarter 4	January-March	April-June

Stage 1 fieldwork commenced on the first weekday of the month, and interviewers were given six weeks in which to complete their assignment. Stage 2 fieldwork for a particular month started six weeks after the interviewer deadline (for example, interviewers completed April assignments by mid-May and nurse visits to these participants started in July).[9] Nurses had up to seven weeks to complete their work.

2.5 Overview of survey components and fieldwork procedures

There were two main stages to the survey:

Stage 1- Interviewer visit: Four-day food diary
Detailed background interview
Interview with MFP
Height and weight measurements
Smoking and drinking self-completion questionnaires
Physical activity self-completion questionnaire or ActiGraph

	Doubly labelled water sub study (Years 1 and 3, core UK sample, only)[10]
Stage 2 - Nurse visit:	Blood sample 24-hour urine collection Physical measurements Blood pressure Collection of information about prescribed medicines

2.5.1 Stage 1: the interviewer visits

A letter and leaflet describing the purpose of the survey was sent to all sampled addresses before the fieldwork start date. A few days later, interviewers visited the addresses to determine whether the address was private, residential and occupied. They then carried out the selection process and, for children aged under 16 years, sought both the child's and their parent's (or guardian's) consent to interview.

Interviewers carried out three main visits to households who agreed to participate:

- **Visit 1:** Four-day food diary explained to the participant and left with them to complete; interviewer-administered CAPI; height and weight measurements; and self-completion booklets in which children and young people were asked to record their smoking and drinking habits. Participants aged 16 years and above were asked to fill in a self-completion questionnaire designed to collect information about physical activity (the Recent Physical Activity Questionnaire (RPAQ)).[11] In Years 2 to 4,[12] children aged 4 to 15 years were asked whether they would be willing to wear a physical activity monitor (an ActiGraph) for seven consecutive days (the monitor was explained and left with those who agreed to wear it).
- **Visit 2:** The diary check visit, where the interviewer reviewed the completion of the four-day food diary so far and filled in any missing information with the participant.
- **Visit 3:** Review and collection of four-day food diary, RPAQ self-completion, ActiGraph collection and further CAPI questionnaire administration.

At the end of the third main interviewer visit, interviewers gave each participant completing at least three food diary recording days a token of appreciation (£30 in high street vouchers).[13] Interviewers then introduced the second stage of the survey, asking for permission for the nurse to visit.[10]

Further details about information collected during the interviewer stage (and the fieldwork documents used) can be found in appendices C to F.

Computer Assisted Personal Interview (CAPI) programme

CAPI interviewing involves the interviewer reading questions from a laptop screen and entering the participants' responses into designated fields. The CAPI questionnaire had three main elements: household composition/ structure interview, MFP interview and individual interview. The individual questionnaire, asked of each selected participant, had two parts: Part 1, which was asked at the first main interviewer visit; and Part 2, which was asked at the third main visit after the interviewer collected the food diary.

The content of the CAPI questionnaires is shown in appendix D.

Collection of dietary data: the four-day food diary

Based on the day of the first individual CAPI interview, the interviewer's laptop program selected four consecutive days as the food diary recording period. Participants were provided with a diary and asked to keep a record of everything they ate and drank over these four days, both in and outside the home. Interviewers carried out a food diary check visit with participants on the second or third day of recording either in person or over the telephone, with the aim of collecting missing detail for foods recorded, improving recording for the remaining days and also providing encouragement to participants to continue recording. Interviewers then returned to collect the diary and check the remaining days no later than three days after the final day of recording.
As participants were not expected to weigh their food and drink, portion sizes were estimated using household measures (e.g. two thick slices of bread, four tablespoons of peas) or using weights from labels (e.g. 420g tin of baked beans, 330ml can of lemonade). Those aged 16 years and over were also able to describe their portion size using photographs of 10 frequently consumed foods reproduced in the diary. To improve the accuracy of recording of children's food portion sizes, three age-appropriate versions of a 'Young persons food photograph atlas' were introduced from Year 4 for use during the diary review process. The atlases presented a range of served and leftover portion sizes for 44 commonly consumed foods for which portion size estimation is difficult. Interviewers asked participants to select the appropriate portion sizes for all diary entries represented in the atlas.

A parent was asked to keep the food diary on behalf of participants aged 11 years and younger, with the child contributing information where possible and with help from other carers.

Appendix A provides full details of the dietary data collection and processing protocols.

Selection of food diary start day

The study design for Years 2 to 5 aimed to give an even representation of diary days on all days of the week so the food diary could start on any day of the week and run for four consecutive days. The diary start day for each participant was assigned by the CAPI program but could be changed by the interviewer if the participant preferred a different day.[14]

Further information about the distribution of days of the week can be found in chapter 5, section 5.1.

2.5.1.1 Collection of physical activity data

In Years 2 to 4,[12] objective physical activity measurements for children aged 4 to 15 years were obtained through the use of a device called an accelerometer - the ActiGraph. This provides a measure of the frequency, intensity, and duration of physical activity and allows classification of activity levels as sedentary, light, moderate and vigorous.

Children were asked to wear the ActiGraph on a belt above the right hip, during waking hours for seven consecutive full days. At the end of the first CAPI interview, interviewers obtained agreement for participation in this element of the study, provided the ActiGraphs and explained procedures. The protocols used for the placement are provided in appendix G.

All children who wore an ActiGraph for seven consecutive days received a £10 high street voucher as a token of appreciation.[13]

2.5.2 Stage 2: the nurse visit

Stage 2 of the survey was carried out by a qualified nurse and took place within two to four months of the final interviewer visit. All individuals completing three or four food diary days were eligible for a nurse visit.

At the end of Stage 1, interviewers provided participants with information leaflets giving details of the nurse visit. Nurses could provide these again if necessary. The nurse asked questions about prescribed medications before taking, with agreement, a number of physical measurements.

2.5.2.1 Measurements taken by the nurse

A summary of the information collected during the nurse stage is provided below. Some of the information collected by nurses was limited to particular age groups.

Measurement or procedure	**Participant**
Details of prescribed medications	All ages
Blood pressure	Aged four years and over
Infant length measurement	Aged 18 to 23 months
Waist and hip circumferences	Aged 11 years and over
Demispan	Aged 65 years and over and those aged 16 to 64 years where height could not be measured
Mid Upper Arm Circumference (MUAC)	Aged 2 to 15 years
24-hour urine collection	Aged four years and over fully out of nappies
Non-fasting blood sample	Aged 1.5 to 3 years; people with diabetes not willing to fast
Fasting blood sample	Aged four years and over

The nurse fieldwork documents are provided in appendices H and I. Measurement protocols are provided in appendix L.

2.5.2.2 Blood sample

After providing the physical measurements, participants were asked whether they were willing to give a small blood sample by venepuncture after an overnight fast (those aged 1.5 to 3 years and people with diabetes who were not willing to fast were asked whether they were willing to provide a non-fasting blood sample). The nurse obtained written consent from the participants aged 16 years and over before the sample was taken. For children aged 1.5 to 15 years, written consent of a parent or guardian was required and nurses additionally obtained the assent of the child where possible. For those aged 10 years or younger, blood was taken by a paediatric phlebotomist who accompanied the nurse on the visit.[15] Nurses also sought written agreement to store part of the blood sample for additional analyses at a future date. Participants who provided a blood sample were given £15 in high street vouchers as a token of appreciation for agreeing to this part of the study.

2.5.2.3 24-hour urine sampling

Nurses also sought agreement from adult participants, and child participants aged four years and over who were fully out of nappies (and their parent or guardian), to provide a 24-hour urine collection. If participants agreed, they were asked to take three para-aminobenzoic acid (PABA) tablets evenly spaced throughout the waking hours of the day on which the 24-hour urine sample was collected, in order to assess the completeness of the urine collections.

Written consent was sought for the taking of PABA tablets, laboratory analysis of the 24-hour urine sample and storage of any remaining urine for future analyses. Participants who provided a 24-hour urine sample were given £10 in high street vouchers as a token of appreciation for taking part in this element of the study.

2.5.3 Feedback to participants and GPs

Participants who completed three or four food diary recording days were asked whether they would like to be sent feedback on the analysis of their diary and how this compared to nutrient intake recommendations. The feedback also included general information on sources of healthy eating advice. Further information about the dietary feedback can be found in appendix A and an example of the dietary feedback is provided in appendix M.

Each participant was also given a ‘Measurement Record Card’ on which the interviewer and nurse recorded the person’s height, weight, body mass index (BMI) (if aged 16 years and over), blood pressure (if aged four years and over) and other age-dependent anthropometric measurements: waist and hip circumferences (ages 11 years and over); mid upper arm circumference (MUAC) (aged two to 15 years); demispan measurement (aged 65 years and over) and infant length (aged 18 to 23 months). Participants who provided a blood sample were asked whether they wished to be sent results of the blood sample analyses most related to their health. Participants were asked if they wanted details of these analyses, their BMI and their blood pressure readings to be sent to their GP. If they did, written consent was obtained from the individual (or from the parent/guardian in the case of a child). See appendix M for an example of feedback to GPs.

2.6 Fieldwork quality control

2.6.1 Project specific training for interviewers and nurses

Fieldwork was carried out by NatCen's panel of interviewers and nurses. All interviewers and nurses working on the NDNS RP were briefed and trained before undertaking an assignment and were monitored during their assignment. Fieldworkers were also issued with comprehensive written instructions covering survey procedures and measurement protocols.

2.6.2 Training for interviewers

From Year 2 onwards, all new-to-NDNS RP interviewers and those who had worked on the NDNS RP previously but not in the preceding year, attended a two-day training course where they were fully briefed on the protocols and administration of the survey. Interviewers who had worked on the NDNS RP in the preceding year attended a one-day refresher briefing.

The full and refresher briefing sessions covered background and content, doorstep approach, questionnaire administration (including practice sessions), placement and collection of self-completions and ActiGraphs and the placement, checking and collection of the four-day food diaries. In Year 4, interviewers who had not been trained in measuring heights and weights were asked to attend an additional 'accreditation' day which focused on how to take accurate measurements. In Year 5, 'accreditation' sessions in heights and weights were introduced as a standard element of the full and refresher briefings.

After the briefing, "early work" checks were carried out on the first two or three food diaries returned by each interviewer with timely feedback provided on any areas of concern. Before working on a second or subsequent assignment, all interviewers received feedback on the diaries from their previous assignment. Further, any interviewer who had more than three months gap between assignments completed their own two-day diary which was reviewed and comments fed back.

2.6.3 Training for nurses

Nurse briefings lasted one and a half days and covered equipment training, blood sampling and 24-hour urine sample training and questionnaire administration (including practice sessions). Nurses were also briefed on the demispan, MUAC and infant length measurement protocols (i.e. the physical measurements less regularly taken on other surveys). All other physical measurements were either regularly taken by nurses on the

NDNS RP and other NatCen surveys or the newer nurses attended a general training session which covered these protocols.

Nurses who had a gap of three months or more between assignments and new-to-NDNS RP nurses completed three homework exercises which were marked and individual feedback given to each nurse.

2.7 Key methodological changes

The main methodological changes that were introduced over Years 2 to 5 of the NDNS RP were as follows:

- The UK DLW sub-study took place in Years 1 and 3 only. There was no DLW sub-study in Year 2, Year 4 or Year 5 of the NDNS RP[10]
- A question was introduced in the CAPI interview from Year 3 onwards to find out whether households were in receipt of Working Families' Tax Credits, Income Support or Income-Related Job Seekers Allowance
- The 'Young persons food photograph atlases' were introduced in Year 4 (following feasibility testing in Year 3, quarter 2) as a tool to improve the accuracy of portion sizes for participants aged under 16 years (see appendix A for further information)
- Information about childrens' physical activity was not collected in Year 5[12]
- In Year 5 questions on ethnicity and national identity were updated to harmonise with Census 2011 questions[16]

These methodological changes did not affect the way the rest of the data were collected, analysed or interpreted.

2.8 Response rates

Response rates presented in this section are for Years 2 to 5 combined in Wales. See appendix B for more information on sampling design.

2.8.1 Household level response

Overall for Years 2 to 5 combined, of the 2,603 addresses (core and country boost) issued to interviewers in Wales, 45% were eligible for household selection and 55% were ineligible. Ineligible addresses include vacant or derelict properties/institutions.

Addresses that were selected for the 'child boost' and were screened out because they did not contain any children in the eligible age range were also included in the ineligible category. This explains the higher than average proportion of ineligible addresses.

Household selection was carried out at 92% of eligible addresses. The remaining 8% of addresses refused before the household selection could be carried out. Of eligible households, 67% were productive – i.e. at least one selected participant completed three or four dietary recording days.

(Table 2.1)

2.8.2 Individual level response

The overall response rate for fully productive individuals (i.e. those completing three or four dietary recording days) in Wales was 60% (65% in Year 2, 53% in Year 3, 61% in Year 4 and 59% in Year 5), giving a sample size of 852 fully productive individuals.[17] Analyses in this report (including response rates for subsequent stages/components of the survey) are based on these 852 individuals.

Valid height and weight measurements were obtained for around 90% of fully productive participants (height 92%; weight 89%).

Seventy-three per cent of all fully productive participants were visited by a nurse.[18]

Seventy-one percent of participants completing at least three diary days had their waist:hip ratio measured by a nurse. A similar proportion (70% of males, 71% of females) had their blood pressure measured. Seventy percent of boys aged 2 to 15 years who had completed at least three diary days and 71% of girls of the same age had their MUAC measured.

Forty-nine per cent of adults completing at least three diary days and 28% of children completing at least three diary days provided a blood sample.[19]

Fifty-nine per cent of participants aged four years and over[20] who completed at least three diary days went on to provide a 24-hour urine sample (60% of adults, 57% of children). Samples were assessed for completeness; a proportion were found to be incomplete and therefore not usable for the analysis (see chapter 7).

Across Years 2 to 4[12] interviewers placed an ActiGraph with 42% of eligible children and usable ActiGraph data was collected from 28% of eligible children.

(Table 2.2)

2.9 Weighting the survey data

It is necessary to apply weighting factors to the data collected in the NDNS RP for two reasons: to remove 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.

The survey was designed so that no more than one adult and one child were selected to take part from any one household. This meant that adults living in households with one or more other adults, and children in households with one or more other child(ren) were less likely to be selected than were adults or children in single adult/child households.

In addition, the multi-stage design means there were a number of stages in the survey where it was possible for participants to drop out. If the people who refused to participate at a particular stage were systematically different from those who took part then the sample would be biased.

Weighting factors were used to correct for both these cases. There were two stages to the weighting scheme: the first was to generate a set of design weights to correct for the unequal selection probabilities; and the second was to create a set of weights to adjust for non-response. The final weights were a product of the selection weights and the non-response weights.

The weighted sample is representative of the Wales population living in private households.

Full detail of the NDNS RP weighting scheme is provided in appendix B.

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[1] Boost samples were also drawn in Scotland (Years 1-4) and Northern Ireland (Years 1-4).

[2] The sample was drawn from the ‘small users’ sub-file of the Postcode Address File (PAF).This is a computer list, prepared by the Post Office, of all the addresses (delivery points) which receive fewer than 25 articles of mail a day.

[3] A guardian is defined as a person with legal responsibility for the child.

[4] The Main Food Provider (MFP) is the person in the household with the main responsibility for shopping and preparing food. If these tasks were shared equally between two people, for example if one person did all the shopping and another person did all the cooking, then either resident could be classified as the MFP.

[5] The ‘Household Reference Person’ (HRP) was defined as the householder (a person in whose name the property is owned or rented) with the highest income. If there was more than one householder and they had equal income, then the eldest was selected as the HRP.

[6] Questions were asked to ascertain whether the HRP was in paid work at the time of the interview and, if not, whether they had ever had a paid job. If the HRP had ever worked, there were further questions about their current or most recent job in order to classify HRPs into the National Statistics Socio-economic Classification (NS-SEC) groupings.

[7] In each year 648 addresses were randomly selected from 24 PSUs (27 addresses per PSU). In addition, a further PSU in Year 2 yielded an additional 11 addresses. One of the PSUs selected in Year 2 straddled the England/Wales border; the 11 addresses in Wales were included in the Wales sample. The remaining 16 addresses were in the North West of England and were included in the UK sample.

[8] The Research Governance Framework is intended to define the broad principles of good research practice, and to ensure that health and social care research is conducted to high scientific and ethical standards.

[9] The nurse visit took place between two to four months after the interviewer visits to the household had been completed.

[10] A sub-sample of participants from the core UK sample were recruited for a Doubly Labelled Water (DLW) sub-study to measure energy expenditure. Participants from the Wales boost sample were not eligible for the sub-study. The DLW sub-study took place in Years 1 and 3 (there was no DLW sub-study in Years 2, 4 or 5).

[11] Based on the Recent Physical Activity Questionnaire developed by the MRC Epidemiology Unit, Cambridge.

[12] Collection of objective information about the physical activity of children was discontinued in Year 5 due to concerns about the usability of data.

[13] Children who had worn an ActiGraph were given a promissory note stating that their £10 token of appreciation would be sent from the office within four weeks of interview.

[14] In Year 1, the recording period always started on a Thursday, Friday or Saturday and included both weekend days (Saturday and Sunday). This meant that weekend days were over-represented and Wednesdays were never represented. To redress the over-representation of weekend days and non-representation of Wednesdays in Year 1, the food diary recording period was changed from Year 2 onwards so that all days of the week would (as far as possible) be equally represented.

[15] Nurses qualified and experienced in paediatric phlebotomy took blood samples from children. Protocols and procedures are in line with official Royal College of Nursing (RCN) guidelines. Ref: RCN (2013), An education and traning competence framework for capillary blood sampling and venepunture in children and young people, RCN London. ISBN 978-1-908782-56

[16] http://www.ons.gov.uk/ons/guide-method/census/2011/how-our-census-works/how-we-took-the-2011-census/how-we-collected-the-information/questionnaires--delivery--completion-and-return/2011-census-questions/index.html

[17] Of the 852 fully productive individuals, 823 (97%) completed four dietary days and 29 (3%) completed three days.

[18] The remainder of fully productive respondents either refused to progress to stage 2 or, in a small number of cases, could not be visited during the nurse fieldwork period.

[19] Blood sampling response rates for children varied by age group. Blood was obtained from 41% of fully productive children aged 11 to 18 years and 3% of those aged 4 to 10 years.

[20] Participants also had to be fully out of nappies to be eligible for the 24-hour urine collection element.

3 Socio-demographic and lifestyle characteristics of the NDNS RP Wales sample

Original authors: Sarah Pigott & Beverley Bates
Updated by: Laura Weston

3.1 Introduction

This chapter describes the socio-demographic and health-related lifestyle characteristics of the NDNS RP Wales sample for Years 2 to 5 combined, using data collected during the CAPI interviews and, in the case of smoking and drinking, analysis from self-completion questionnaires.

3.2 Sex

In the unweighted NDNS RP sample, 40% of adults (aged 19 years and over) were men and 60% were women, while for children (aged 1.5 to 18 years) 50% were boys and 50% were girls. The sample was weighted to reflect the distribution of males and females in the general population within Wales.[1]

(Table 3.1)

3.3 Age

The unweighted sample of adults included 71% aged 19 to 64 years and 29% aged 65 years and over. The unweighted sample of children included 17% aged 1.5 to 3 years, 38% aged 4 to 10 years and 45% aged 11 to 18 years. The sample was weighted to bring the proportions in line with the age profile of the general population in Wales.[1]

(Tables 3.2 and 3.3)

All text and tables in the remainder of this report use weighted data to present a representative sex and age profile of the Wales population.

3.4 National Statistics Socio-economic Classification (NS-SEC), housing tenure, education and qualifications

Participants were assigned a socio-economic classification based on the employment of the Household Reference Person (HRP) for their household (see chapter 2, section 2.1 for HRP definition).

In terms of the HRP's current or most recent job, the proportion of participants' households[2] classified to the main NS-SEC occupational groupings reflected those reported in the General Lifestyle Survey (GLF 2011).[3,4]

Participants were categorised according to the housing tenure of the HRP. Around two-thirds of participants (70% adults, 62% children) lived in owner-occupied accommodation and around one-fifth (17% of adults, 22% of children) lived in social housing. A further 13% of adults and 17% of children lived in privately rented accommodation. These proportions are in line with those found in the general Great Britain population.[4]

(Table 3.4)

Participants aged 16 years and over were asked the age at which they had left full-time education. More than half (52%) reported that they had left school by the age of 16 years but the proportion having done so was much higher amongst older adults (77% of those aged 65 years and over had left school by the age of 16 years).

If participants had finished full-time education, they were asked the highest qualification (if any) they had achieved. Older adults aged 65 years and over were less likely than other adults to have a degree (7% compared with 18% of those aged 50 to 64 years, 23% of those aged 35 to 49 years and 20% of those aged 19 to 34 years). Conversely, the proportion of those having no qualifications increased with age: 3% of those aged 16 to 18 years had no qualifications compared with 66% of those aged 65 years and over.

(Table 3.5)

3.5 Vegetarian and vegan diets

Three per cent of adults and 1% of children reported that they were vegetarian; and less than 1% of participants reported following a vegan diet.[5]

(Table 3.6)

3.6 Smoking

Of those aged 16 years and over, 27% of men and 22% of women reported that they were current smokers. As would be expected given that smoking rates have fallen in recent years, these proportions are slightly higher than reported in the more recent Welsh Health Survey 2013[6] where 23% of men and 20% of women were categorised as current smokers.

(Table 3.7)

Those who reported that they were current smokers were asked how many cigarettes they smoked on an average week and weekend day. Seven per cent of men and 9% of women were classed as heavy smokers (i.e. they smoked 20 or more cigarettes per day). These proportions are slightly higher than those for the Great Britain population reported in the GLF 2011 (where 4% of men and 3% of women were classed as heavy smokers) though numbers are small so differences should be treated with caution.[4]

(Table 3.8)

3.7 Alcohol consumption

3.7.1 Drinking behaviour amongst adults aged 16 years and older

The recommended sensible drinking guidelines for UK countries are that men should not regularly drink more than three to four units of alcohol per day, and women should not regularly drink more than two to three units of alcohol per day. Men who regularly drink more than eight units a day (or 50 units a week) and women who regularly drink more than six units a day (or 35 units a week) are considered to be at particular risk of harm.[7, 8]

Alcohol consumption is reported in terms of units of alcohol; one unit of alcohol is 10ml by volume of pure alcohol. Daily consumption is calculated by recording the amounts drunk on the day in the past week when the participant drank most.

Most adults (73% of men, 54% of women) had drunk alcohol in the last week, including 24% of men and 16% of women who had drunk more than twice the recommended levels on one of these days.

(Table 3.10)

On average among those who drank in the last week, men consumed 8.5 units on the day they drank most in the last week, and women consumed 6 units.

(Table 3.11)

Alcohol consumption levels amongst NDNS RP adults are similar to those reported in the GLF 2011.[4]

3.7.2 Drinking behaviour amongst children aged 8 to 15 years

In 2010 the Chief Medical Officer for Wales published guidance on the consumption of alcohol amongst children and young people.[9] It emphasises that an alcohol-free childhood is the healthiest option. The advice also recommends that parents should try to ensure that their children do not drink alcohol, at least up to the age of 15 years. Furthermore, it advises that young people aged 15 to 17 years should never exceed recommended adult daily limits and, on days when they drink, consumption should be below such levels. Guidance in Wales (and in Scotland) is that not drinking alcohol at all is the best option for young people.[9,10]

The proportion of children who reported ever having had a proper alcoholic drink (not just a taste) is broadly in line with Health Survey for England (HSE) 2009 results.[11,12,13]

(Table 3.12)

Data from the Health Behaviour in School-Aged Children (HBSC) key findings[14] shows that, between 1997/88 and 2013/14, there was a reduction from 57% to 14% in the number of 15 to 16 year old boys in Wales and a reduction from 45% to 12% in the number of 15 to 16 year old girls in Wales reporting to drink alcohol at least weekly.

As discussed in the ‘Smoking, drinking and drug use among young people in England in 2012’ report,[15] attempting to accurately measure alcohol consumption among children can be challenging. Recall of their drinking can be erroneous; a generally acknowledged problem for all surveys measuring alcohol consumption. Further, the majority of childrens’ drinking is in informal settings, and the quantities they drink are not necessarily standard measures. This, as well as the small numbers, should be borne in mind when interpreting the figures in tables 3.12 and 3.13.

[1] Office for National Statistics. *2011 Population Estimates*. http://www.ons.gov.uk/ons/guide-method/census/2011/census-data/2011-census-user-guide/quality-and-methods/index.html (accessed 15/07/15).

[2] Some households contained both an adult and a child participant. Such households and their HRP will be represented in both the adult and child figures.

[3] The General Lifestyle Survey (GLF) formerly known as the General Household Survey (GHS) is a multi-purpose continuous survey which collects information on a range of topics from people living in private households in Great Britain.

[4] Dunstan S General Lifestyle Survey 2011. Overview report, 2013 http://www.ons.gov.uk/ons/rel/ghs/general-lifestyle-survey/2011/index.html (accessed 15/07/15)

[5] Self-reported assessment via question in the CAPI interview.

[6] Welsh Health Survey 2013 http://wales.gov.uk/statistics-and-research/welsh-health-survey/?lang=en (accessed 15/07/15)

[7] https://www.gov.uk/government/policies/reducing-harmful-drinking (accessed 15/07/15).
Drinking at this level has been described in surveys, including the Health Survey for England, as 'binge drinking'. 'Binge drinking' is also used to define a pattern of drinking a large quantity of alcohol in a short period with the aim of getting drunk. In practice, this may involve considerably more than twice the recommended daily limits. To avoid confusion, the term 'binge drinking' is not used in this report.

[8] Adults (i.e. those aged 16 years or older) who drank bottled or canned beer, lager, stout or cider were asked in detail about what they drank, and this information was used to estimate the amount in pints (one pint is equivalent to 0.568 litres). Adults were also asked to quantity the amount of wine drunk in terms of large (250ml), standard (175ml) and small (125ml) glasses, and were also given the option of specifying the quantity of wine drunk in bottles or fractions of a bottle; a bottle was treated as the equivalent of six small (125ml) glasses. Adults who drank spirits were asked to quantify how much they drunk in single measures (25ml).

[9] Welsh Assembly Government. You, Your child and Alcohol. http://drinkwisewales.advantecinternet.co.uk/wp-content/uploads/2014/08/CMOParentsbooklet-1.pdf (accessed 15/07/15).

[10] http://www.drinksmarter.org/sensible-drinking-and-you/alcohol-and-young-people (accessed 15/07/15).

[11] Health Survey for England - 2012: Health and lifestyles. http://www.hscic.gov.uk/article/2021/Website-Search?q=health+survey+for+england&area=both (accessed 15/07/15).

[12] Note that results are not directly comparable with HSE (2009) as age groupings differ in the two surveys.

[13] Comparable data is not available for Scotland, Wales and Northern Ireland.

[14] Health behaviour in school-aged children – key findings. 2015. http://gov.wales/statistics-and-research/health-behaviour-school-aged-children/?lang=en. Publication expected Autumn 2015.

[15] Smoking, Drinking and Drug Use Among Young People in England - 2012.
http://www.hscic.gov.uk/catalogue/PUB11334 (accessed 15/07/15).

4 Physical measurements and physical activity

Original authors: Jenny Mindell & Vasant Hirani
Updated by: Shaun Scholes

4.1 Physical measurements

4.1.1 Introduction

Height and weight measurements, from which body mass index (BMI) was calculated, were taken during Stage 1 (the interviewer visit). Waist and hip circumference and blood pressure were measured during Stage 2 (the nurse visit). Comparisons were made, where possible, with data on physical measurements from both the NDNS RP UK sample[1] and the most recent health survey in Wales.[2,3] Data presented are for Years 2 to 5 combined (2009/10 to 2012/13).

Detailed descriptions of the measurement protocols used in the NDNS RP are available in appendix L but a brief description is provided within each section below.

Measurements of mid upper arm circumference (MUAC) are not reported in this chapter but will be included in the archived data (see appendix W for more details).

4.1.2 Anthropometry

4.1.2.1 Measurements

Height and weight were measured at the first interviewer visit, using a portable stadiometer, measuring to the nearest 0.1 cm (and if between two mm, rounded to the nearest even mm) and weighing scales, measuring to the nearest 0.1kg. BMI = weight (kg) / height squared (m^2) was calculated by the interviewer's CAPI programme. For adult participants whose height could not be measured, estimated height based on demispan[4] was used to calculate BMI.[5] For children aged under two years, the interviewer measured length instead of height and this measurement was used in place of height when calculating BMI for these youngest children.[6] The nurse measured waist and hip circumferences in those aged 11 years and over using an insertion tape measure.[7]

4.1.3 Obesity

4.1.3.1 Adults

Table 4.1a shows mean BMI and BMI status, in adults, by age group and sex (according to the World Health Organization (WHO)[8] and National Institute for Health and Care Excellence (NICE) classification).[9] This report has the same classification as used in the NDNS RP UK report[1] to facilitate comparisons across countries. Cell sizes in the 65 years and over age group are small, especially for men, so caution should be used when interpreting results for this age group.

Table 4A: BMI classification

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

An adult was classified as having abdominal obesity if their waist circumference was greater than 102cm for men and greater than 88cm for women, or if their waist: hip ratio (WHR) was greater than 0.95 for men and greater than 0.85 for women.[10]

There were no significant differences in mean BMI or in the prevalence of obesity by sex in younger adults (aged 19 to 64 years) nor older adults (aged 65 years and older). Mean waist circumference and mean WHR were both significantly higher[11] in men than in women in younger adults (19 to 64 years).

In men and women, mean waist circumference and mean WHR were both significantly higher in the older age group (those aged 65 years and over). Mean WHR was 0.84 for women aged 19 to 64 years and 0.87 for women aged 65 years and over. Equivalent figures for men were 0.92 and 0.99.

A significantly higher proportion of older men and women (those aged 65 years and over) than younger men and women (19 to 64 years) had a raised waist circumference (66% and 34% respectively for men; 74% and 51% respectively for women) or raised WHR (74% and 35% respectively for men; 59% and 41% respectively for women). Due to the small cell sizes, significance tests comparing older adults with younger adults should be treated with caution.

Among those aged 19 to 64 years, a higher percentage of women (51%) than men (34%) had a raised waist circumference. There was no significant difference between the sexes in this age group in the prevalence of raised WHR.

(Table 4.1a)

4.1.3.2 Children

In the UK, the current growth charts are a combination of the WHO growth standards for children from birth to four years and the UK 1990 reference values for older children. New UK (WHO) growth charts for children from birth to four years were introduced in May 2009 for all new births in Wales.[12,13] These are based on WHO growth standards from data in infants who were exclusively or predominantly breastfed.[14,15]

Growth standards for the youngest children are based on breastfed babies, who tend to have a different pattern of growth compared with formula-fed infants, whereas growth standards for older children are based on the growth of UK children regardless of feeding (UK 1990 reference values). Differences between the youngest and oldest children should be viewed with caution due to the use of different growth standards.

For clinical purposes, the charts define overweight as above the 91st but on or below the 98th centile for BMI and obesity as above the 98th centile. However, this report uses the 85th and 95th centiles to define overweight and obesity, as is standard government practice for population monitoring.[16]

Similar proportions of boys and girls were overweight (14% and 15% respectively); overweight, including obese (34% and 36% respectively); and obese (20% and 21% respectively). BMI in children can be useful as an indicator of over- or under-nutrition, but must be interpreted carefully and compared with suitable age- and sex-specific thresholds for defining normal / abnormal categories.[17]

(Table 4.1b)

4.1.4 Comparisons with other surveys

Physical measurements in the NDNS RP Wales sample are compared with the NDNS RP UK sample and, for children only, with the 2012 Welsh Health Survey (WHS 2012).[2,3]

Adults

Comparisons of results for adults (19 years and over) participating in the NDNS RP Wales sample with adults in the NDNS RP UK sample[1] showed that anthropometric measurements appeared to be higher in the NDNS RP Wales sample.

Mean BMI was higher in adults in the NDNS RP Wales sample (28.3kg/m^2) than in the NDNS RP UK sample (27.6kg/m^2 and 27.4kg/m^2 in men and women respectively). The proportion of obese adults was also higher (34% in the NDNS RP Wales sample compared with 26% in men and 29% in women in the NDNS RP UK sample).

The proportion of adults with raised waist circumference was higher in the NDNS RP Wales sample (50%) than in the NDNS RP UK sample (37% and 46% in men and women respectively).

Children
Analyses in the NDNS RP Wales sample were not entirely comparable with WHS 2012[2,3] due to the different age bands and reference thresholds for obesity being used for children aged 2 to 3 years in the two surveys. In order to compare the NDNS RP Wales sample with WHS 2012,[2] this section refers to children aged 2 to 15 years only; the estimates therefore differ from those shown for children aged 2 to 18 years in table 4.1b.

The proportion of boys aged 2 to 15 years who were obese were similar in the NDNS RP Wales sample and NDNS RP UK sample (17% and 18% respectively) but lower than in WHS 2012 (20%). The proportion of girls who were obese appeared slightly higher in the NDNS RP Wales sample (21%) compared with the NDNS RP UK sample (18%) and WHS 2012 (19%).

4.2 Blood pressure

4.2.1 Measurement of blood pressure

Blood pressure was measured in a sitting position using an automated, validated machine, the Omron HEM907, after a five minute rest. Results presented in this chapter are based on the mean of the second and third readings, taken at one minute intervals, in participants with valid readings (i.e. three readings in people who had not eaten, drunk alcohol, smoked or exercised for at least 30 minutes prior to measurement). Full details of protocols are available in appendix L.

Hypertension was defined as a systolic blood pressure of 140mmHg or above, and/or diastolic blood pressure of 90mmHg or above,[18] and/or taking medication specifically to reduce blood pressure.

4.2.2 Results

Table 4.2 shows mean systolic (SBP) and diastolic (DBP) blood pressure by age and sex, together with the proportion of participants whose blood pressure results indicated hypertension, and whether this was treated and/or controlled.

Mean SBP was significantly higher in men (131.9mmHg) than women (120.3mmHg) in younger adults (19 to 64 years). Mean SBP varied by age group (in women), being higher in women aged 65 years and over (138.5mmHg in those aged 65 years and over, 120.3mmHg in those aged 19 to 64 years). Mean DBP, however, varied neither by age group (in women) nor sex (in those aged 19 to 64 years).

The prevalence of hypertension was significantly greater in older women than in younger women. Among adults aged 19 to 64 years, 5% of women were on treatment for hypertension (i.e. controlled or uncontrolled hypertension),[19] compared with 38% of women aged 65 years and over. Untreated hypertension was more than twice as common in older adults (25% of women aged 65 years and over, compared with 9% of women aged 19 to 64 years).

(Table 4.2)

4.2.3 Comparisons with other surveys

Mean SBP and DBP levels in adults were similar in the NDNS RP Wales and the NDNS RP UK samples. Blood pressure is not measured in the WHS.

The proportion of participants in the NDNS RP Wales sample with survey-defined hypertension (raised blood pressure and/or on medication for hypertension) was slightly higher than the proportion in the NDNS RP UK sample (34% in the NDNS RP Wales sample compared with 32% of men and 28% of women in the NDNS RP UK sample).

4.3 Physical activity

4.3.1 Introduction

Physical activity was assessed in different ways for children (aged 4 to 15 years) and adults (aged 16 years and over).

A self-completion questionnaire - the Recent Physical Activity Questionnaire; RPAQ (developed by the MRC Epidemiology Unit Cambridge)[20] was used to estimate physical activity in participants aged 16 years and over (deemed “adults” in this section) from Year 2 onwards. The RPAQ was designed to assess usual physical activity in the last month in four domains:

- home (watching television, using a computer, climbing stairs)
- work (type and amount of physical activity)
- commuting to work (by car, public transport, cycling, and/or walking)
- leisure activities (frequency of participation in 35 different activities (none to every day) and average time per episode)

The RPAQ was given to participants aged 16 years and over at the food diary pick-up visit. Participants completed the RPAQ while the interviewer was present. Detailed descriptions of the assessment of adult and children’s physical activity in the NDNS RP and the processing of data from the ActiGraph and RPAQ are available in appendices G and V respectively. A brief description of the processing of data from the RPAQ is provided below. Comparisons are made with data on physical activity from the NDNS RP UK sample.[1]

Children's physical activity was measured using accelerometers (ActiGraphs) during Stage 1 (the interviewer visits). In Years 2 to 4, use of the ActiGraph was extended from children aged 4 to 10 years to also include children aged 11 to 15 years. ActiGraph data was not collected in Year 5.[21] Due to small numbers, children's physical activity data is not presented in this report.

4.3.2 Physical activity in adults

4.3.2.1 Estimation of physical activity

Using the Physical Activity Compendium,[22] all activities covered by the RPAQ, including the type and amount of physical activity at work, were grouped into one of four categories representing the metabolic cost of each activity, expressed in metabolic equivalents (METs):

- sedentary (< 2 METs)
- light (2-3.5 METs)
- moderate (3.6-6 METs)
- vigorous (>6 METs)

For each participant, the number of hours per day (h/d) spent in each of the four categories was computed (see appendix V). Time spent in each moderate or vigorous activity (≥ 3.6 METs) was summed to provide the mean daily time (in h/d) spent in moderate or vigorous activities, the variable used to summarise adult physical activity levels in this report. As the physical activity data were skewed, the median rather than mean number of h/d spent in moderate or vigorous activity is presented as the summary measure of overall activity. The 5th, 10th, 25th, 75th, 90th and 95th percentiles are also shown.

4.3.2.2 Results

Table 4.3 shows median number of h/d spent in moderate or vigorous physical activity. Median h/d spent in moderate or vigorous physical activities was higher in men aged 16 to 64 years (1.1h/d) than in women of that age (0.5h/d). For men and women, median time spent in moderate or vigorous activity was higher in those aged 16 to 64 years than in those aged 65 years and over. It should be noted that these comparisons were not formally tested.

(Table 4.3)

4.3.2.3 Comparisons with other surveys

There are methodological differences between the RPAQ and the physical activity questionnaire used in the WHS.[23] Comparisons, therefore, are only made with the NDNS RP UK sample. The median h/d spent in moderate or vigorous physical activities appeared to be similar in the NDNS RP Wales sample and NDNS RP UK sample. Among adults aged 16 to 64 years, the median h/d spent in moderate or vigorous activities was 1.1h/d (men) and 0.5h/d (women) in both surveys.

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[1] Bates B, Lennox A, Prentice A, Bates C, Page P, Nicholson S, Swan G. National Diet and Nutrition Survey. Results from Years 1, 2, 3 and 4 (combined) of the Rolling Programme (2008/2009 - 2011/12). Food Standards Agency, Public Health England; 2014.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/310995/NDNS_Y1_to_4_UK_report.pdf (accessed 21/07/15)

[2] Varney B, Roberts C (eds). *Welsh Health Survey 2012.* Welsh Assembly Government 2013.
http://wales.gov.uk/docs/statistics/2013/130911-welsh-health-survey-2012-en.pdf (accessed 21/07/15)

[3] Comparisons of the NDNS Welsh sample with health surveys in Wales for height and weight could only be made for children due to the data not being comparable or available for adults. The Welsh Health Survey (WHS) uses self-report, not measured weight and height for adults. The NDNS RP Wales sample was a subset of the NDNS RP UK sample. Comparisons between the two samples were not formally tested as they are not statistically independent.

[4] Demispan is defined as the distance between the mid-point of the sternal notch and the finger roots with the arm outstretched laterally. Using BMI based on demispan equivalent height is recommended where no measured height is available, and has been suggested as a preferred measure of BMI in older people. (Hirani V, Mindell J. *A comparison of measured height and demispan equivalent height in the assessment of body mass index among people aged 65 years and over in England*. Age Ageing. 2008;37:311-7.)

[5] The demispan equivalent height was calculated using regression equations derived by Bassey: (Bassey EJ. *Demispan as a measure of skeletal size*. Annals of Human Biology 1986; 13: 499-502.) Females: Height (cm) = (1.35x demispan in cm) + 60.1. Males: Height in (cm) = (1.40x demispan in cm) + 57.8.

[6] These data are not shown but are included in the archived data.

[7] All fieldworkers were trained to carefully observe the standard measurement protocols. Each measurement was taken twice. Where the discrepancy between the measurements was at or above a given value (height ≥ 0.5cm, weight ≥ 0.2kg, waist and hip circumferences ≥ 3cm), a third measurement was taken. The mean of the two closest measurements was used. If only one measurement was available, it was excluded from the analysis.

[8] *World Health Organization body mass index (BMI) classification*.
http://apps.who.int/bmi/index.jsp?introPage=intro_3.html (accessed 21/07/15)

[9] National Institute of Health and Care Excellence. *Obesity: the prevention, identification, assessment and management of overweight and obesity in adults and children.*
http://www.nice.org.uk/Guidance/CG43 page 221 (accessed 21/07/15).

[10] Molarius A, Seidell JC. *Selection of anthropometric indicators for classification of abdominal fatness – a critical review.* Int J Obes 1998; 22: 719-27.

[11] The term 'significant' refers to statistical significance (at the 5% level).

[12] SACN/RCPCH. *Application of WHO Growth standards in the UK*. London: TSO, 2007.
www.sacn.gov.uk/pdfs/sacn.rcpch_who_growth_standards_report_final.pdf (accessed 21/07/15)

[13] The new growth charts were introduced in England and Northern Ireland at the same time (May 2009) and in Scotland from January 2010.

[14] Royal College of Paediatrics and Child Health / World Health Organization. *The UK_WHO Growth Charts: Early Years.* London: RCPCH, 2009. www.rcpch.ac.uk/Research/UK-WHO-Growth-Charts (accessed 21/07/15).

[15] The new UK-WHO 0-4 years growth charts were introduced in the UK because they represent an international standard of growth for healthy infants and young children. Breastfed infants exhibit a healthier pattern of growth. The new charts were constructed using the WHO Growth Standards for infants aged two weeks to four years, which used data from healthy children from around the world with no known health or environmental constraints to growth. WHO found that infants worldwide have very similar patterns of linear growth, whatever their ethnic origin. The new charts provide a description of optimal growth, describing the ideal patterns of growth for all UK children, whatever their ethnic origin and however they are fed in infancy. The WHO data is combined with birth data for gestations 23 to 42 weeks from the UK1990 growth reference, as the WHO dataset did not include preterm infants. The UK1990 reference is still to be used for children aged four years and over.

[16] Cole T, Freeman JV, Preece MA. *Body mass index reference curves for the UK, 1990.* Arch Dis Child 1995; 73: 25-29.

[17] Scientific Advisory Committee on Nutrition and Royal College of Paediatrics and Child Health. *Consideration of issues around the use of BMI centile thresholds for defining underweight, overweight and obesity in children aged 2-18 years in the UK.* April 2012. Online at:
http://www.sacn.gov.uk/reports_position_statements/position_statements/sacnrcpch_joint_statement_on_defining_child_underweight_overweight_and_obesity_in_the_uk_-_april_2012.html (accessed 21/07/15)

[18] Hypertension was defined as at or over 140/90mmHg in the following paper:
Williams B, Poulter NR, Brown MJ et al. *Guidelines for management of hypertension: report of the fourth working party of the British Hypertension Society, 2004 –BHS IV.* J Hum Hypertens. 2004; 18:139-85.
These thresholds were reiterated in the latest NICE guidelines, which also recommend ambulatory blood pressure monitoring to confirm a diagnosis of hypertension if the clinic measurement indicates blood pressure at or over the 140/90mmHg threshold. http://publications.nice.org.uk/hypertension-cg127/key-priorities-for-implementation#diagnosing-hypertension (accessed 21/07/15). Within the constraints of the survey, blood pressure was measured three times, and the average of the second and third readings used for analysis.

[19] Participants who reported that they were taking medication prescribed for hypertension are classified as either controlled (if their blood pressure falls within the normal range) or uncontrolled (if it is raised).

[20] Besson H, Brage S, Jakes RW, Ekelund E, Wareham NJ. Estimating physical activity energy expenditure, sedentary time and physical activity intensity by self-report in adults. *Am J Clin Nutr.* 2010;91:106-114.

[21] Collection of objective information about the physical activity of children was discontinued in Year 5 due to concerns about the usability of the data.

[22] Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of Physical Activities: an update of activity codes and MET intensities. *Med Sci Sport Exer.* 2000;32(suppl):S498-S516.

[23] The WHS physical activity questionnaire asked participants on which days during the last seven they did light, moderate, and vigorous exercise for at least 30 minutes. Information on duration (average time per episode) was not assessed in the WHS.

5 Dietary intakes

Original authors: Alison Lennox, Celia Prynne and Gillian Swan
Updated by: Caireen Roberts, Toni Steer, Sonja Nicholson, Nida Ziauddeen and Polly Page

Erratum note: Correction to fruit and vegetable consumption estimates including from composite dishes (section 5.3)
In the first publication of this report (in December 2015), consumption estimates for fruit and vegetables, fruit juice and "5-A-Day" portions, including composite dishes, were incorrectly calculated. Fruit and vegetable components of food groups that should have been excluded (see Appendix A of this report) were mistakenly included. These were: soft drinks, confectionery, biscuits, cakes, sugar, preserves (including jam) and sweet spreads, savoury snacks and ice cream. The results presented in this chapter have been updated to correctly exclude all of the food groups that should be excluded as part of the "5-A-Day" calculations. The corrected values for Years 2-5 are therefore slightly lower than the values originally published but the overall conclusions on fruit and vegetable consumption are unchanged. Details of the methodology for estimating fruit and vegetable consumption and calculating "5-A-Day" portions can be found in Appendix A.

5.1 Introduction

The results presented in this chapter derive from the Wales sample for Years 2 to 5 combined of the NDNS RP. Analysis is based both on Wales core cases from the UK sample and Wales boost cases providing an overall Wales sample of 852 individuals aged 1.5 years and over (see chapter 2, section 2.8).

Results in this chapter are presented for both sexes combined for the age groups: 1.5 to 3 years, 4 to 10 years, 11 to 18 years, 19 to 64 years and 65 years and over. Results are also subdivided by sex for all age groups, except for children aged 1.5 to 3 years as intakes in this age group do not tend to vary by sex. The comparisons provided in this chapter are observed differences only and have not been tested for statistical significance as the main purpose of this chapter is to describe how the diets of different population age groups compare with recommendations. Caution should be taken when interpreting results where the cell sizes are small.

Comparisons of consumption of key foods and nutrients between the Wales sample and the UK sample by a more detailed age breakdown for young people and adults are presented in chapter 8. An overview of consumption of key foods and nutrients in the Wales sample by equivalised income and Welsh Index of Multiple Deprivation (WIMD) are presented in chapter 9. Comparisons between the Wales sample and the UK sample as a whole are reported in chapter 10.

Unless stated otherwise, all Dietary Reference Values (DRVs) are those presented in the 1991 Committee on Medical Aspects of Food Policy (COMA) report on Dietary Reference Values for Food Energy and Nutrients for the United Kingdom.[1]

Results in this chapter and in chapters 8, 9 and 10 are based on dietary assessment using a four-day estimated food diary and represent a daily average of the days assessed.[2] In Year 1 the study design was to have each participant record both weekend days as well as two weekdays, in an effort to capture both weekday and weekend consumption for each person. It was thought that the oversampling of weekend days in Year 1 could have led to a bias in reported food consumption and nutrient intake, since it has been shown that there is day-to-day variation in intake of some foods and nutrients for specific age and sex groups. For example, men often consumed alcoholic beverages and takeaway foods more frequently on Fridays and Saturdays, whilst Sunday is often associated with higher consumption of meat and vegetables in many groups (unpublished UK data). Hence the protocol was changed in Year 2 to one where all days of the week would (as far as possible) be equally represented. Year 2 was therefore designed to over-represent weekdays and under-represent weekend days to compensate for the over-representation of weekend days in Year 1 (see chapter 2, section 2.5.1.3). Years 3, 4 and 5 were designed so that all days of the week were evenly represented. Therefore, in the Years 2 to 5 combined data for the Wales sample, Saturdays and Sundays are slightly under-represented[3] (see table 5A).

Table 5A: Number of diary days by day of week for UK and Wales samples

	All UK (Years 1 to 4 combined)		Wales (Years 2 to 5 combined)	
Day of the week	**Number of diary days**	**% of total days**	**Number of diary days**	**% of total days**
Monday	3,677	13.5	491	14.5
Tuesday	3,477	12.8	506	15.0
Wednesday	3,382	12.4	513	15.2
Thursday	3,879	14.3	481	14.2
Friday	4,234	15.6	475	14.1
Saturday	4,302	15.8	464	13.7
Sunday	4,232	15.6	449	13.3

Dietary surveys are reliant on self-reported measures of food intake. Misreporting of food consumption, generally underreporting, in self-reported dietary methods is well-documented. The underreporting of energy intake (EI) is known to be an issue in past and current NDNS, as for all dietary surveys and studies.[4,5] This is an important consideration when interpreting the findings from this survey. Previous NDNS and the current RP are unique amongst large-scale population surveys in their inclusion of doubly labelled water (DLW)[6] as an objective biomarker to validate EI estimated from reported food consumption.

In the UK NDNS RP, estimates of EI from the four-day diary were compared with measurements of total energy expenditure (TEE) using the DLW technique in a sub-sample of survey participants. The results of this UK analysis indicated that reported EI in adults aged 16 to 64 years was on average 34% lower than TEE measured by the DLW technique, 12% lower in children aged 4 to 10 years, 26% lower in children aged 11 to 15 years, and 29% lower in adults aged 65 years and over. The extent of misreporting of EI has not been estimated separately for Wales due to the small number of Welsh participants in the DLW sub-sample.[7]

There are a number of factors that may contribute to this difference including: misreporting of actual consumption; the possibility that participants underreported or changed their usual intake during the diary period which was typically two to three weeks prior to the DLW measurement; and methodological considerations relating to dietary assessment method, food composition and portion assignment used in the NDNS RP. It is not possible to extrapolate this estimate of underreporting to individual foods and nutrients because they may be affected differentially.

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

Appendix X provides a summary of the DLW method, the results obtained and an illustration of a number of considerations relevant to the interpretation of the survey findings.

5.2 Foods consumed

Tables 5.1a-5.1c show mean consumption of standard NDNS food groups for the total Wales sample (i.e. including non-consumers, those who did not consume from a food group during the four-day diary recording period). Tables 5.2a-5.2c show mean consumption of standard NDNS food groups for consumers only and the percentage of consumers over four days. Mean consumption levels highlighted in the commentary below are for the total survey population including non-consumers of the food group. Details of the food groups can be found in appendix R.

(**Tables 5.1a-5.2c**)

5.2.1 Cereals and cereal products

‘White bread’ and ‘pasta, rice, pizza and other miscellaneous cereals’ were the most commonly consumed ‘cereals and cereal products’, both eaten by more than 70% of participants over the four-day diary period, except for those aged 65 years and over who were less likely to consume ‘pasta, rice, pizza and other miscellaneous cereals’. Children aged 1.5 to 3 years consumed similar quantities of bread (all types combined) and ‘pasta, rice, pizza and other miscellaneous cereals’, as did adults aged 19 to 64 years. Children aged 4 to 10 years and adults aged 65 years and over consumed more bread; children aged 11 to 18 years consumed more ‘pasta, rice, pizza and other miscellaneous cereals’. Mean consumption of white bread exceeded that for other types of bread combined, accounting for 60% of total bread consumption in adults, higher in children.

‘Biscuits’ were consumed by more than three-quarters of children aged 1.5 to 3 years and 4 to 10 years and by over half of the other age groups. ‘Buns, cakes, pastries and fruit pies’ were also consumed by 73% of adults aged 65 years and over.

5.2.2 Milk and milk products

For most age groups, ‘semi-skimmed milk’ had the highest mean consumption accounting for about two-thirds of total milk consumption in adults and older children and was the most commonly consumed type of milk. The exception was those aged 1.5 to 3 years for whom ‘whole milk’ was the most commonly consumed. For all age groups, ‘cheddar cheese’ had the highest mean consumption compared with other types of cheese, accounting for about two-thirds of total cheese consumption. Over half of participants in all age groups consumed ‘cheese’ over the four-day recording period.

5.2.3 Fat spreads

For all age groups, except those aged 65 years and over, ‘reduced fat spread (not polyunsaturated)’ was the most commonly consumed type of fat spread, followed by butter. For example in adults aged 19 to 64 years 52% consumed ‘reduced fat spread (not polyunsaturated)’ and 28% consumed butter. Conversely for adults aged 65 years and over, 40% consumed ‘butter’ and 37% consumed ‘reduced fat spread (not polyunsaturated)’ over the four-day recording period.

5.2.4 Meat and meat products and dishes

Consumption figures for ‘meat and meat products and dishes’ presented in tables 5.1a-5.2c include non-meat components of composite and recipe dishes. For children aged 10 years and under, ‘bacon and ham’, ‘chicken, turkey and dishes’ and ‘sausages’ were the most commonly consumed types of meat, each consumed by more than half the children in this age group during the four-day recording period. For children aged 11 to 18 years, the most commonly consumed type of meat was ‘chicken, turkey and dishes’, with 75% having eaten this type of meat over the four-day recording period. For adults aged 19 to 64 years, ‘bacon and ham’ and ‘chicken, turkey and dishes’ were the most commonly consumed types of meat (each eaten by 64-65% of adults) while for adults aged 65 years and over, the most commonly consumed type of meat was ‘bacon and ham’, with 64% having eaten this type of meat over the four-day recording period.

Results for disaggregated total meat consumption, excluding non-meat components of meat dishes and products, are presented in table 5.3 and discussed in section 5.3.

5.2.5 Fish and fish dishes

Consumption figures for fish and fish dishes presented in tables 5.1a-5.2c include non-meat components of composite and recipe dishes. The highest per cent consumers of oily fish over the four-day recording period were adults aged 65 years and over (28%), followed by adults aged 19 to 64 years (20%) and children aged 1.5 to 3 years (17%). For children aged 4 to 18 years, 8-11% consumed oily fish over the four-day recording period. ‘White fish coated or fried including fish fingers’ was the most commonly consumed type of fish for children aged 10 years and under (eaten by 44% of children aged 1.5 to 3 years and 34% of children aged 4 to 10 years) and adults aged 65 years and over (eaten by 37%). In the 11 to 18 years and 19 to 64 years age groups ‘other white fish, shellfish, fish dishes and canned tuna’ was the most commonly consumed type of fish, eaten by 22% and 35% respectively over the four-day recording period.

Results for disaggregated total fish consumption, excluding non-fish components of fish products and dishes are presented in table 5.3 and discussed in section 5.3.

5.2.6 Fruit and vegetables

This section refers to fruit and vegetables consumed as discrete items excluding those consumed as part of composite dishes such as in meat and in fish dishes. Fruit and vegetable consumption including the contribution from composite dishes and as “5-A-Day” portions are presented in table 5.3 and discussed in section 5.3.

Children aged 1.5 to 3 years were the highest per cent consumers of ‘fruit’ over the four-day recording period (97%), followed by children aged 4 to 10 years (87%). Adults aged 19 to 64 years were the lowest per cent consumers of ‘fruit’ (67%).

‘Vegetables (not raw) including vegetable dishes’ were consumed by more than 80% of participants in all age groups. ‘Salad and other raw vegetables’ were less commonly consumed; particularly by children aged 10 years and under, less than 50% of whom ate this type of food over the four-day recording period.

The highest percentage of consumers of ‘chips, fried and roast potatoes and potato products’ was in those aged 4 to 10 years (87%) and lowest in those aged 1.5 to 3 years (62%). ‘Other’ potatoes (including boiled, mashed, baked, potato salads and dishes) were eaten by 84% of those aged 65 years and over, 70% of adults aged 19 to 64 years and children aged under 10 years and 63% of children aged 11 to 18 years.

5.2.7 Sugar, confectionery and snacks

Mean consumption of ‘sugar confectionery’ and ‘chocolate confectionery’ combined was highest in those aged 4 to 10 years (14g per day) and 11 to 18 years (17g per day). ‘Chocolate confectionery’ was more commonly consumed than ‘sugar confectionery’ consumed by 53% compared with 23% of children aged 1.5 to 3 years, 50% compared with 36% of children aged 4 to 10 years and 55% compared with 30% of children aged 11 to 18 years over the four day recording period. Mean consumption of ‘sugar confectionery’ and ‘chocolate confectionery’ combined was lowest in those aged 65 years and over (5g per day). Mean consumption of ‘sugar, preserves and sweet spreads’ (including table sugar) was highest in adults aged 19 years and over (13g per day).

5.2.8 Beverages

Children aged 4 to 10 years were the highest per cent consumers of ‘fruit juice’ over the four day recording period (57%) while adults aged 19 years and over were the lowest (24%). Highest mean consumption of ‘soft drinks, not low calorie’ was seen in children aged 11 to 18 years (258g per day) while highest mean consumption of 'soft drinks, low calorie' was seen in children aged 1.5 to 3 years (249g per day). Children aged 10 years and under consumed more 'soft drinks, low calorie' than 'soft drinks, not low calorie'. Seventy-nine per cent of children aged 11 to 18 years consumed 'soft drinks, not low calorie' over the four-day recording period compared to 59% who consumed 'soft drinks, low calorie'.

For men, 'beer, lager, cider and perry' was the most commonly consumed alcoholic drink, consumed by 49% of men aged 19 to 64 years and by 33% of men aged 65 years and over. Men aged 19 to 64 years had the highest mean consumption of alcoholic drinks. For women, 'wine' was the most commonly consumed alcoholic drink, consumed by 30% of those aged 19 to 64 years and 24% of those aged 65 years and over.

As noted in section 5.1, there is a slight under-representation of weekend days compared to week days in the Years 2 to 5 combined data for Wales (see table 5A) and this may have some effect on the results for consumption of 'alcoholic beverages'.

5.3 Vegetable, fruit, meat and fish consumption, including from composite dishes

This section reports consumption of vegetables, fruit, meat and fish, including the contribution from composite dishes (both homemade dishes and manufactured products), but excluding the other components of those dishes. All composite dishes in the NDNS Nutrient Databank have been disaggregated into their constituent ingredients so they can be reported separately. Details on the NDNS Nutrient Databank and the methodology for the disaggregation of composite dishes is provided in appendix A. Mean consumption figures presented in table 5.3 are for the total population (i.e. including non-consumers, those who did not consume from a food group during the four-day recording period).

Erratum note: correction to fruit and vegetable consumption data
Consumption figures in this section have been corrected for an error in the estimation of fruit, vegetables and fruit juice and the calculation of "5-A-Day" portions. Fruit and vegetable components of some food groups (soft drinks, confectionery, biscuits, cakes, sugar, preserves and sweet spreads, savoury snacks and ice cream) were included in the estimates when they should have been excluded. This has now been corrected and the corrected values are slightly lower than the original published values.
Fruit and vegetable consumption figures in table 5.3 are based on disaggregated data, and therefore give higher estimates of consumption than tables 5.1a - 5.1c as they include fruit and vegetables in mixed dishes as well as fruit, salad and cooked vegetables consumed and reported as discrete items.

Mean total vegetable consumption based on disaggregated data was 77g per day for children aged 1.5 to 3 years, 83g per day for children aged 4 to 10 years and 117g per day for children aged 11 to 18 years. For adults, those aged 19 to 64 years consumed a mean of 162g per day and those aged 65 years and over, 150g per day. Mean total fruit consumption was 115g per day for children aged 1.5 to 3 years, 97g per day for those aged 4 to 10 years and 58g per day for children aged 11 to 18 years. Adults aged 19 to 64 years consumed a mean of 92g per day and adults aged 65 years and over, 105g per day. Mean consumption of fruit juice was highest in children aged 4 to 10 years (75g per day) and lowest in those aged 65 years and over (25g per day).

The number of portions of fruit and vegetables consumed per day has been calculated from the disaggregated data in line with the "5-A-Day" criteria, including up to one portion each of fruit juice and baked beans or pulses per day (see appendix A). For children aged 11 to 18 years, mean consumption was 2.7 portions per day.[8] Adults aged 19 to 64 years consumed 3.7 portions per day and those aged 65 years and over consumed 3.6 portions per day. The proportion of participants meeting the "5-A-Day" guideline was 6% of children aged 11 to 18 years, 22% of adults aged 19 to 64 years and 23% of adults aged 65 years and over.

Meat and fish consumption presented in table 5.3 is based on disaggregated data. These figures give lower estimates of consumption than the figures presented in tables 5.1a - 5.1c which include the non-meat and non-fish components of composite products and dishes. Total meat consumption based on disaggregated data was 101g per day for adults aged 19 to 64 years and 90g per day for adults aged 65 years and over. Mean consumption of red and processed meat was 66g per day for adults aged 19 to 64 years (men 82g per day; women 51g per day) and 65g per day for adults aged 65 years and over (men 77g per day; women 55g per day). The current recommendation is that, for adults, average intakes of red and processed meat should not exceed 70g per day.[9]

Mean consumption of oily fish was well below the recommendation of at least one portion (140g) per week[10] in all age groups: for adults aged 19 to 64 years, mean consumption was equivalent to 46g per week and equivalent to 70g per week for adults aged 65 years and over.[11]

(**Table 5.3, Appendix A)**

5.4 Energy and macronutrient intake and percentage contribution of food groups to intake

This section presents daily intakes of energy and macronutrients estimated from the food consumption data, and the percentage contribution of the major food types to intake of each nutrient.

Mean daily intakes of energy and macronutrients are compared with the UK DRVs.[1,12] For total fat, saturated and *trans* fatty acids and non-milk extrinsic sugars (NMES) the DRVs are the recommended maximum contribution these nutrients should make to the population average diet.[13] For total carbohydrate, *cis*-monounsaturated fatty acids and non-starch polysaccharide

(NSP) the DRVs are recommended population averages. For protein, the Reference Nutrient Intakes (RNIs) are set at levels of intake considered likely to be sufficient to meet the requirements of 97.5% of people in the group. For total energy, the DRVs are defined as the Estimated Average Requirements (EARs), that is, the average of energy requirements for any population group and have been taken from the 2011 Scientific Advisory Committee on Nutrition (SACN) report on Dietary Reference Values for Energy.[12] Analysis of the percentage contribution of the major food groups to energy and macronutrient intakes shown in tables 5.5-5.12 use the traditional NDNS food groups presented in section 5.2 and not the disaggregated food groups presented in section 5.3.

5.4.1 Energy

Mean daily intakes for total energy were 4.84 MJ (1146 kcal) for children aged 1.5 to 3 years, 6.30 MJ (1494 kcal) for children aged 4 to 10 years, 7.28 MJ (1730 kcal) for children aged 11 to 18 years, 8.47 MJ (2015 kcal) for men aged 19 to 64 years, 6.52 MJ (1550 kcal) for women aged 19 to 64 years, 7.59 MJ (1807 kcal) for men aged 65 years and over and 6.12 MJ (1455 kcal) for women aged 65 years and over. Mean daily intakes for total energy were close to or above the EAR in children aged 10 years and under but below the EAR in other age groups (74.9% and 77.9% of the EAR in adults aged 19 to 64 years and 65 years and over respectively and 70.3% in children aged 11 to 18 years) (see underreporting in section 5.1).

'Cereals and cereal products' was the main source of energy for all age groups, contributing 30% of energy intake for children aged 1.5 to 3 years, 35-36% for children aged 4 to 18 years and 30-33% for adults aged 19 years and over. 'Milk and milk products' was the second largest contributor to energy intake for children aged 1.5 to 3 years (23%) while 'meat and meat products' was the second largest contributor to energy intake for children aged 11 to 18 years (18%) and adults aged 19 years and over (16%). Children aged 4 to 10 years derived a similar

proportion of energy from 'milk and milk products' and 'meat and meat products' (13-14%).

(**Tables 5.4 and 5.5**)

5.4.2 Protein

Mean protein intakes were well above the RNIs in all age/sex groups (table not included) and provided 14.4-15.6% of food energy for children and 17.6% for adults.

For children aged 11 to 18 years and adults aged 19 years and over 'meat and meat products' was the largest contributor to protein intake (34-39%). For children aged 4 to 10 years 'meat and meat products' and 'cereal and cereal products' each contributed 28% to protein intake. 'Milk and milk products' was the major contributor to protein intake for children aged 1.5 to 3 years (31%). 'Cereals and cereal products' contributed around one quarter of protein intake for all age groups.

(**Tables 5.4 and 5.6**)

5.4.3 Carbohydrate

The DRV for total carbohydrate is 50% of food energy as a population average. Mean total carbohydrate intakes were 47.2-48.7% of food energy for adults and 50.8-52.2% of food energy for children.

The major contributor to carbohydrate intake was 'cereals and cereal products', providing 41-46% for children and 44-48% for adults. In addition, 'milk and milk products' contributed 16% of carbohydrate intake for children aged 1.5 to 3 years, 'non-alcoholic beverages' (soft drinks and fruit juice) contributed 13% for children aged 11 to 18 years and 'vegetables and potatoes' contributed 15-16% for adults aged 19 years and over and 11-13% for children.

(**Tables 5.4 and 5.7**)

5.4.4 Non-milk extrinsic sugars (NMES)

The DRV for NMES is that the population average intake should provide no more than 11% of food energy intake in children and adults. Mean intakes of NMES as a percentage of food energy exceeded the DRV in all age groups except those aged 65 years and over (10.3% food energy). Mean intakes were highest for children aged 4 to 10 years (14.1% food energy for boys, 12.5% for girls) and 11 to 18 years (14.8% food energy for boys, 15.5% for girls).

For children, the main sources of NMES were 'non-alcoholic beverages' (fruit juice and soft drinks), 'cereals and cereal products' (predominantly 'biscuits' and 'buns, cakes, pastries and fruit pies') and 'sugar, preserves and confectionery'. Within the non-alcoholic beverages group, soft drinks contributed 29% to NMES intake for children aged 11 to 18 years and 13-14% for children aged 10 years and under while 'fruit juice' contributed 10-13% in children across the age groups. 'Cereals and cereal products' contributed 24-29% and 'sugar, preserves and confectionery' contributed 20-23% to NMES intake in children.

For adults aged 19 to 64 years, the main sources of NMES were 'sugar, preserves and confectionery' (27%), 'non-alcoholic beverages' (23% mainly from soft drinks) and 'cereals and cereal products' (20%), predominantly 'biscuits' and 'buns, cakes, pastries, fruit pies'. 'Alcoholic beverages' provided a further 10% of intake. For adults aged 65 years and over, 'cereals and cereal products' provided 34% of NMES intake (predominantly 'buns, cakes, pastries and fruit pies') and 'sugar, preserves and confectionery' provided 26%, mainly from 'table sugar, preserves and spreads'.

(**Tables 5.4 and 5.8**)

5.4.5 Non-starch polysaccharides (NSP)

Mean intakes of NSP were 8.8g per day for children aged 1.5 to 3 years, 10.8g per day for children aged 4 to 10 years and 12.1g per day for children aged 11 to 18 years. For adults aged 19 years and over, the DRV is set at a population average intake of 18g per day; mean intakes were well below this at 13.5g per day for the 19 to 64 year age group and 13.2g per day for adults aged 65 years and over.

'Cereals and cereal products' was the main source of NSP for all age groups, contributing 38-42% of intake. 'Vegetables and potatoes' were the second major contributor to NSP. Vegetables contributed 19% to intakes for children aged 1.5 to 3 years, 14% for children aged 4 to 10 years, 17% for children aged 11 to 18 years and 20-21% for adults aged 19 years and over. Potatoes contributed 10% for children aged 1.5 to 3 years old and 13-15% for the other age groups.

(**Tables 5.4 and 5.9**)

5.4.6 Total fat

The DRV for total fat is that the population average intake should provide no more than 35% of food energy intake.[13] Mean percentage food energy from total fat met the recommendation in all age/sex groups, except for men aged 65 years and over where total fat provided 36.8% of food energy.

'Milk and milk products' was the major contributor to total fat intake for children aged 1.5 to 3 years, providing 31% (13% from 'whole milk'). For children aged 4 to 10 years, cereals and cereal products (23%), meat and meat products (19%) and milk and milk products (19%) made similar contributions to intake. For the other age groups the main sources were 'meat and meat products', contributing 22-27% of total fat intake, and 'cereals and cereal products', contributing 20-23%. Adults aged 65 years and over derived 16% of their total fat intake from 'fat spreads'.

(**Tables 5.4 and 5.10**)

5.4.7 Saturated fatty acids

The DRV for saturated fatty acids is that the population average intake should not exceed 11% of food energy intake.[13] Mean intakes of saturated fatty acids for all age groups exceeded the DRV at 13.0% for children aged 4 to 10 years, 12.2% for children aged 11 to 18 years, 12.5% for adults aged 19 to 64 years and 13.9% for adults aged 65 years and over.

‘Milk and milk products’ was the largest contributor to saturated fatty acids in children aged 1.5 to 3 years and children aged 4 to 10 years, providing 43% and 30% of intake respectively. This food group was also among the main sources of saturated fatty acids for the other age groups, providing 19-23%. Other key sources were ‘cereals and cereal products’ contributing 17-24% to intakes across all age groups and ‘meat and meat products’ contributing 14% for children aged 1.5 to 3 years, 18% for children aged 4 to 10 years, 26% for children aged 11 to 18 years and 22-23% for adults aged 19 years and over. ‘Fat spreads’ contributed 16% to saturated fatty acids intake for adults aged 65 years and over, mainly from ‘butter’ (10%).

(**Tables 5.4 and 5.11**)

5.4.8 *Trans* fatty acids

The DRV for *trans* fatty acids is that the population average intake should provide no more than 2% of food energy.[13] Mean *trans* fatty acid intakes were less than 2g per day for all age groups, representing 0.5-0.7% of food energy, thereby meeting the DRV. Intakes at the upper 2.5 percentile also met the DRV providing 0.9-1.4% of food energy.

Trans fatty acids are derived from two sources in the diet: those that occur naturally in meat and dairy products of ruminant animals, and those produced artificially through food processing. The levels of *trans* fatty acids from artificial sources have been reduced in recent years. This has resulted in a relative increase in the per cent contribution to intake of *trans* fatty acids derived from natural sources.

‘Milk and milk products’ was the largest contributor to *trans* fatty acid intake in children aged 1.5 to 3 years (48%) and 4 to 10 years (40%). ‘Milk and milk products’ was also a key source of *trans* fatty acids for older children and adults, providing 28-29%. The contribution of ‘meat and meat products’ to *trans* fatty acid intake was 15-19% in children aged 10 years and under, 27% in children aged 11 to 18 years and 25-26% in adults aged 19 years and over. ‘Cereals and cereal products’ contributed 13-20% to *trans* fatty acid intake across the age groups. This came from processed cereal products such as pizza, pasta products, garlic bread and buns, cakes and pastries.

(**Tables 5.4 and 5.12**)

5.4.9 Unsaturated fatty acids

The DRV for *cis* monounsaturated fatty acids is 13% of food energy as a population average. Mean intakes of *cis*-monounsaturated fatty acids provided 11-13% of food energy for both children and adults.

Mean intake of *cis* n-3 polyunsaturated fatty acids (PUFA), expressed as a percentage of food energy, increased with age from 0.7% for children aged 1.5 to 3 years to 1.0% for adults aged 19 years and over.

Mean intake of *cis* n-6 PUFA expressed as a percentage of food energy, was 3.9% for children aged 1.5 to 3 years, 4.3% for children aged 4 to 10 years, 4.8% for children aged 11 to 18 years and 4.7% for adults aged 19 years and over.

(**Table 5.4**)

5.5 Alcohol

This section reports on alcohol intake in grams per day and as a per cent of total energy, for both the total sample (including non-consumers) and consumers only (those who reported consumption of alcoholic beverages in the four-day food diary).[14] In the Years 2 to 5 combined data, weekend days are slightly under-represented compared to week days and this should be taken into account when interpreting findings on alcohol intake as there is evidence that alcohol consumption is higher on weekend days than week days (see section 5.1 table 5A).

For adult consumers, alcohol provided on average 9.5% and 5.4% of energy intake for those aged 19 to 64 years and 65 years and over respectively. Fifty-eight per cent of men and 45% of women aged 19 to 64 years consumed alcohol over the four-day recording period. For male consumers aged 19 to 64 years, alcohol intakes at the upper 2.5 percentile provided 28.9% of energy intake over the four-day recording period, while for female consumers, intakes at the upper 2.5 percentile provided 34.6% of energy. For consumers aged 65 years and over, intakes at the upper 2.5 percentile provided 22.7% of energy intake.

Questions about alcoholic beverage consumption were also asked in the Computer Assisted Personal Interview (CAPI) and via self-completion for children and young adults. This is reported in chapter 3, section 3.7 in terms of units of alcohol and related to recommended sensible drinking guidelines. The time period recalled in the CAPI/self-completions was the seven days before interview and so does not overlap with the diary recording period.

(**Table 5.13**)

5.6 Vitamins and minerals and percentage contribution of food groups to micronutrient intakes

Intakes of vitamins and minerals are reported in two ways: from foods only and from all sources, that is including dietary supplements, as recorded in the four-day food diary. This section also reports on vitamin and mineral intakes from foods only for the group of individuals who recorded taking at least one dietary supplement (regardless of the type) during the four-day recording period compared with intakes for the group who did not record taking any dietary supplements during this period. The percentage of individuals taking supplements and the different types of dietary supplements taken are reported in section 5.7.

For those vitamins and minerals for which UK RNIs and Lower Reference Nutrient Intakes (LRNIs) have been published,1 the proportions of participants with intakes below the LRNI is shown and mean daily intakes are compared with the RNI. The RNI for a vitamin or mineral is the amount of the nutrient that is sufficient for 97.5% of people in the group. If the average intake of the group is equal to 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 more likely that some of the group will have an intake below their requirement. 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. As diet is recorded for only four days in the NDNS RP, estimated intake values may not represent intakes over the longer term for micronutrients that are not widely distributed in foods such as vitamin A. It should also be noted that DRVs for some micronutrients such as magnesium, potassium, selenium and zinc are based on very limited data so caution should be used when assessing adequacy of intake using the LRNI. Published UK RNIs and LRNIs are shown in tables 5.14 and 5.32.

Analysis of the percentage contribution of the major food groups to micronutrient intake as shown in tables 5.21-5.31 and tables 5.39-5.47 uses the traditional NDNS food groups presented in section 5.2 and not the disaggregated food groups presented in section 5.3.

(**Tables 5.14 and 5.32**)

5.6.1 Vitamins

5.6.1.1 Vitamin A and retinol

Vitamin A is found in two forms: as retinol in foods from animal sources and as carotenoids (mainly beta-carotene) in foods from plant sources. Some carotenoids can be converted to retinol in the body; 6mg of dietary beta-carotene is considered equivalent to 1mg of retinol. The total vitamin A content of the diet (from both animal and plant sources) is normally expressed as retinol equivalents (RE). Intakes are presented in this report for total vitamin A and pre-formed retinol. Intakes of carotenoids are not presented but will be included in the dataset deposited at the UK Data Archive (details can be found in appendix W).[15] Plasma concentrations of carotenoids and retinol are presented in chapter 6.

Mean daily intakes of vitamin A from food sources were close to or above the RNI for all age/sex groups. Fourteen per cent of children aged 11 to 18 years had intakes from food sources only below the LRNI. The inclusion of dietary supplements had little effect on the per cent with intakes below the LRNI.

‘Milk and milk products’ was the largest contributor of vitamin A for children aged 1.5 to 3 years, providing 31%. ‘Vegetables and potatoes’ was the major contributor to vitamin A intake for all other age groups providing 27-35% of intake. ‘Fat spreads’ contributed 12-18% to vitamin A intakes across the age groups. Meat and meat products contributed 14-15% of intake for adults, less for children.

‘Milk and milk products’ was the largest contributor to retinol intake for children aged 1.5 to 3 years (56%), 4 to 10 years (39%) and 11 to 18 years (31%). ‘Fat spreads’ was the second largest contributor, providing 21-28%. For adults aged 19 years and over, the contribution from ‘milk and milk products’ and from ‘fat spreads’ was similar, each providing just under a third of retinol intake.

(**Tables 5.15-5.17a and 5.21-5.22**)

5.6.1.2 Thiamin

Mean daily intakes of thiamin from food sources were well above the RNI for all age/sex groups. Less than 0.5% of participants had intakes of thiamin from food sources below the LRNI.

The major source of thiamin for all age groups was ‘cereals and cereal products’, mainly bread (all types combined) and fortified breakfast cereals. The contribution from ‘cereals and cereal products’ decreased with age, providing 40-44% of intake for children aged 1.5 to 18 years and 35% for adults aged 19 years and over. For children aged 1.5 to 3 years, ‘milk and milk products’ was the second largest contributor to thiamin intake (17%) while ‘meat and meat products’ and ‘vegetables and potatoes’ were the second largest contributors for the other age groups, the contribution generally increasing with age.

(**Tables 5.15-5.17a and 5.23**)

5.6.1.3 Riboflavin

Mean daily intakes of riboflavin from food sources were above the RNI for all age/sex groups. However, 16% of girls aged 11 to 18 years and 12% of women aged 19 to 64 years had intakes of riboflavin from food sources below the LRNI. The inclusion of dietary supplements had little effect on the percentages with intakes below the LRNI.

‘Milk and milk products’ and ‘cereals and cereal products’ were the main sources of riboflavin for all age groups. Breakfast cereals, many of which are fortified with riboflavin, provided about half the contribution from cereals and cereal products. ‘Milk and milk products’ was the largest contributor to riboflavin intake for children aged 1.5 to 3 years (53%), children aged 4 to 10 years (44%) and adults aged 19 years and over (31-33%). For children aged 11 to 18 years, ‘cereals and cereal products’ provided 31% of intake and ‘milk and milk products’ 27%. In other age groups ‘cereals and cereal products’ contributed 21-29% of intake. ‘Meat and meat products’ contributed an additional 16-18% to riboflavin intake for adults and older children aged 11 to 18 years and less for children aged 10 years and under (7-10%).

(**Tables 5.15-5.17a and 5.24**)

5.6.1.4 Niacin equivalents

Mean daily intakes of niacin equivalents from food sources were well above the RNI for all age/sex groups. Less than 0.5% of participants had intakes of niacin equivalents from food sources below the LRNI.

The main sources of niacin equivalents were ‘cereals and cereal products’ and ‘meat and meat products’. ‘Cereals and cereal products’ was the largest contributor to intake of niacin equivalents for children aged 1.5 to 3 years and 4 to 10 years, providing 32-35%. ‘Meat and meat products’ was the largest contributor for older children aged 11 to 18 years and adults aged 19 years and over, providing 35-39% of niacin equivalents intake.

(**Tables 5.15-5.17a and 5.25**)

5.6.1.5 Vitamin B_6

Mean daily intakes of vitamin B_6 from food sources were well above the RNI for all age/sex groups. Less than 0.5% of participants had intakes of vitamin B_6 from food sources below the LRNI.

The major contributors to vitamin B_6 for children aged 1.5 to 3 years were ‘cereals and cereal products’ and ‘milk and milk products’, each providing 20-21% of intake. In other age groups ‘meat and meat products’, ‘cereals and cereal products’ and ‘vegetables and potatoes’ were the main sources, each providing between a sixth and a quarter of intake, a larger contribution coming from ‘cereals and cereal products’ in children and from ‘meat and meat products’, and ‘vegetables and potatoes’ in adults.

(**Tables 5.15-5.17a and 5.26**)

5.6.1.6 Vitamin B_{12}

Mean daily intakes of vitamin B_{12} from food sources were well above the RNI for all age/sex groups. The proportion of individuals with intakes below the LRNI was 4% for women aged 19 to 64 years and less in other groups.

'Milk and milk products' was the largest contributor to vitamin B_{12} intake for all age groups, except children aged 11 to 18 years. The contribution was highest for children aged 1.5 to 3 years (62%) and 4 to 10 years (51%) decreasing to 35% for adults aged 19 years and over. The second largest contributor was 'meat and meat products'. For children aged 11 to 18 years, the contribution from 'milk and milk products' and 'meat and meat products' was similar (33-34%).

(**Tables 5.15-5.17a and 5.27**)

5.6.1.7 Folate

Mean daily intakes of folate from food sources were close to or above the RNI for all age/sex groups. The proportion of individuals with intakes below the LRNI was 5% for women aged 19 to 64 years, 4% for girls aged 11 to 18 years and 2% or less in other age/sex groups.

'Cereals and cereal products' was the largest contributor to folate intake for children in all age groups (32-36%) with fortified breakfast cereals providing about half of this. For adults, 'cereals and cereal products' and 'vegetables and potatoes' made a similar contribution (27-29%). 'Vegetables and potatoes' also provided 20-26% of folate intake for children. 'Milk and milk products' provided 17% of folate intake for children aged 1.5 to 3 years. 'Beer, lager, cider and perry' contributed 11% to folate intakes for men aged 19 to 64 years.

(**Tables 5.15-5.17a and 5.28**)

5.6.1.8 Vitamin C

Mean daily intakes of vitamin C from food sources were well above the RNI for all age/sex groups. The proportion of individuals with intakes below the LRNI was 2% or less.

The main source of vitamin C for children aged 4 to 18 years was 'non-alcoholic beverages', providing 35-40%, of which 16% came from 'fruit juice' and 19-24% from soft drinks. 'Non-alcoholic beverages' contributed 29% to vitamin C intakes for children aged 1.5 to 3 years. For adults aged 19 years and over, the main source was 'vegetables and potatoes', providing 40-43% of vitamin C intake. 'Vegetables and potatoes' also contributed 19-26% to vitamin C intake for children aged 1.5 to 18 years. 'Fruit' provided 28% of vitamin C intake for children aged 1.5 to 3 years and 20% for children aged 4 to 10 years decreasing to 13% for children aged 11 to 18 years.

‘Fruit’ contributed 18% to vitamin C intake for adults aged 19 to 64 years and 25% for adults aged 65 years and over.

(**Tables 5.15-5.17a and 5.29**)

5.6.1.9 Vitamin D

For vitamin D, RNIs are set only for those aged up to four years and those aged 65 years and over. Mean intakes from food sources were well below the RNI in both these age groups: 27% of the RNI for children aged 1.5 to 3 years and 32% for adults aged 65 years and over. Inclusion of intakes from dietary supplements brought the mean intake up to 32% of the RNI for children aged 1.5 to 3 years and 55% for adults aged 65 years and over. There are no LRNIs set for vitamin D.

‘Meat and meat products’ was the major contributor to vitamin D intake for children aged 11 to 18 years (35%) and for adults aged 19 to 64 years (30%) and 65 years and over (26%) ‘Fat spreads’, most of which have added vitamin D, contributed 27% to intake for children aged 4 to 10 years, 17% for children aged 1.5 to 3 years and 21-22% across the other age groups. ‘Milk and milk products’ contributed 24% to intakes for children aged 1.5 to 3 years. ‘Cereals and cereal products’ provided 11-12% of intake for adults, 13% for children aged 1.5 to 3 years and 20% for children aged 4 to 18 years, from fortified breakfast cereals and from ‘buns, cakes, pastries and fruit pies’ and ‘puddings’ (via fats and eggs used as ingredients). The contribution from ‘fish and fish dishes’ was higher for adults aged 19 years and over (14-18%) compared to children aged 1.5 to 18 years (6-8%) and was mainly from ‘oily fish’, a rich source of vitamin D.

(**Tables 5.15-5.16a and 5.30**)

5.6.1.10 Vitamin E

There are no RNIs or LRNIs set for vitamin E. However, intakes above 4mg per day for men and above 3mg per day for women are considered safe and adequate.[1] Mean intakes of vitamin E were well above these levels for men and women aged 19 years and over.

‘Cereals and cereal products’ were the main source of vitamin E for all age groups, except for adults aged 19 to 64 years, providing 22-24% of intake. For those aged 19 to 64 years, ‘vegetables and potatoes’ and ‘cereal and cereal products’ made a similar contribution (19-20%). ‘Fat spreads’ contributed an additional 11-16% to vitamin E intakes across the age groups.

(**Tables 5.15-5.15a and 5.31**)

5.6.2 Vitamin intakes for supplement takers versus non-supplement takers[16]

Due to small numbers of supplement takers in the Wales sample, results are presented for sex-combined age groups only (see section 5.7). Comparisons of observed differences are only discussed for adults (aged 19 to 64 years and aged 65 years and over) as the cell sizes for supplement takers in the child age groups were below 30.

In general, adults aged 19 to 64 years who took supplements during the four-day recording period had similar or higher mean intakes of vitamins from food sources only compared to non-supplement takers. For example, those who took supplements had a mean vitamin C intake of 92.6mg from food compared to 64.6mg for those who did not take supplements (43% higher). The percentage of those aged 19 to 64 years with intakes below the LRNI from food sources only was similar or lower in the supplement takers compared to the non-supplement takers. For example, 11% of non-supplement takers had riboflavin intakes from food below the LRNI compared to 3% of supplement takers.

For adults aged 65 years and over the pattern of differences was less clear. Those who took supplements during the four-day recording period had lower mean intakes of vitamin A, retinol and folate from food sources only compared to non-supplement takers. For example, those who took supplements had a mean vitamin A intake of 799µg from food compared to 959µg for those who did not take supplements (20% lower).[17] For vitamin C and vitamin D, supplement takers had higher intakes from food sources only than non-supplement takers. For the other vitamins, those who took supplements during the four-day recording period had similar mean intakes from food sources only compared to non-supplement takers. For riboflavin, the percentage of those aged 65 years and over with intakes below the LRNI from food sources only was lower in the supplement takers compared to the non-supplement takers. Nine per cent of non-supplement takers in this age group had riboflavin intakes from food below the LRNI compared to 5% of supplement takers.

The percentage of individuals taking supplements and the different types of dietary supplements taken is reported in section 5.7.

(Tables 5.18-5.20)

5.6.3 Minerals

5.6.3.1 Iron

Mean daily intakes of iron from food sources were below the RNI for girls aged 11 to 18 years (60% of the RNI) and women aged 19 to 64 years where the mean intake was 79% of the RNI. Mean intake was also below the RNI for boys aged 11 to 18 years (89% of the RNI). Dietary supplements made little difference to mean intakes for boys and girls aged 11 to 18 years. For women aged 19 to 64 years, dietary supplements made a considerable difference to iron intakes bringing the mean intake of women in this group as a whole (including non-supplement takers) up from 79% to 98% of the RNI, although there was little change to the median intake, suggesting that those with higher intakes from food sources were taking these supplements.

Thirty-eight per cent of girls aged 11 to 18 years and 25% of women aged 19 to 64 years had iron intakes from food sources below the LRNI. Dietary supplements had no impact on these groups in terms of the proportions with intakes below the LRNI.

‘Cereals and cereal products’ was the largest contributor to iron intake for all age groups, with the contribution decreasing with age from 54-56% for children aged 10 years and under to 40-42% for adults aged 19 years and over. Within ‘cereals and cereal products’, bread and fortified breakfast cereals were the main source of iron intake. ‘Meat and meat products’ contributed 11-13% of iron intake for children aged 10 years and under and 18-19% for older children and adults; and ‘vegetables and potatoes’ contributed 14-17% to iron intake across the age groups.

(**Tables 5.33-5.35a and 5.39**)

5.6.3.2 Calcium

Mean daily intakes of calcium from food sources were above the RNI for all age groups except children aged 11 to 18 years (80% of the RNI). Inclusion of intakes from dietary supplements made little difference to mean intakes as a percentage of the RNI.

Sixteen per cent of girls and 8% of boys aged 11 to 18 years, and 7% of women aged 19 to 64 years had calcium intakes from food sources below the LRNI. The inclusion of supplements had no impact on these groups in terms of the proportions with intakes below the LRNI.

‘Milk and milk products’ was the largest contributor to calcium intake for children aged 1.5 to 3 years (58%), children aged 4 to 10 years (47%) and adults aged 19 years and over (39-41%). For children aged 11 to 18 years, ‘cereals and cereal products’ was the largest contributor, providing 38% of calcium intake, with 33% from ‘milk and milk products’. ‘Cereals and cereal products’ was also a major source of calcium for the other age groups, providing 23-35%.

(**Tables 5.33-5.35a and 5.40**)

5.6.3.3 Magnesium

Mean daily intakes of magnesium from food sources were below the RNI for children aged 11 to 18 years (69% of the RNI), adults aged 19 to 64 years (86% of the RNI) and adults aged 65 and over (81% of the RNI). Inclusion of intakes from dietary supplements made little difference to mean intakes as a percentage of the RNI.

Forty-three per cent of children aged 11 to 18 years (32% of boys, 54% of girls), 15% of adults aged 19 to 64 years (16% of men, 15% of women) and 23% of adults aged 65 and over (29% of men, 18% of women) had magnesium intakes from food sources below the LRNI. Dietary supplements had little impact on the proportion with intakes below the LRNI.

'Cereals and cereal products' was the largest contributor to magnesium intake for all age groups, providing 28-33%. 'Milk and milk products' contributed 25% to magnesium intake for children aged 1.5 to 3 years. Across the age groups, 'vegetables and potatoes' contributed 14-18% and 'meat and meat products' contributed 9-17% to magnesium intake.

(**Tables 5.33-5.35a and 5.41**)

5.6.3.4 Sodium

Mean daily sodium intakes presented in this chapter underestimate total sodium intake from the diet as they include only sodium in food and do not include discretionary salt added in cooking or at the table by survey participants. More complete and accurate estimates of total sodium intake from the diet are derived from urinary sodium excretion data and are presented in chapter 7.[18]

'Cereals and cereal products' was the largest contributor to sodium intake from food for all age groups, providing 31-37%, of which 15-19% came from bread (all types combined). 'Meat and meat products' was the second largest contributor for all age groups, providing 26-29% of sodium intake from food for adults and children aged 11 to 18 years and 21-23% for younger children. 'Milk and milk products' contributed 16% for children aged 1.5 to 3 years and 7-11% for the other age groups.

(**Table 5.42**)

5.6.3.5 Potassium

Mean daily intakes of potassium from food sources were below the RNI for children aged 11 to 18 years (69% of the RNI), adults aged 19 to 64 years (78% of the RNI) and adults aged 65 years and over (75% of the RNI). The inclusion of supplements had no impact on mean intake as a percentage of RNI.

Twenty-eight per cent of children aged 11 to 18 years (17% of boys, 39% of girls), 18% of adults aged 19 to 64 years (13% of men, 24% of women) and 26% of adults aged 65 years and over (19% of men, 32% of women) had potassium intakes from food sources below the LRNI. Dietary supplements had no impact on the proportions with intakes below the LRNI.

'Vegetables and potatoes' was the largest contributor to potassium intake for children aged 11 to 18 years and adults aged 19 years and over, providing 25-27%. 'Milk and milk products' was the major contributor to potassium intake for children aged 1.5 to 3 years, providing 29% of intake. 'Vegetables and potatoes' and 'milk and milk products' made a similar contribution (21-22%) for children aged 4 to 10 years. Across the age groups, 'cereals and cereal products' contributed 14-17% and 'meat and meat products' 10-19% of potassium intake. 'Fruit' provided 14% of potassium intake for children aged 1.5 to 3 years.

(**Tables 5.33-5.35a and 5.43**)

5.6.3.6 Zinc

Mean daily intakes of zinc from food sources were close to or above the RNI for all age/sex groups except children aged 4 to 10 years (89% of the RNI) and children aged 11 to 18 years (82% of the RNI). Inclusion of intakes from dietary supplements made little difference to mean intakes as a percentage of the RNI.

Ten per cent of girls aged 4 to 10 years, 20% of children aged 11 to 18 years and 9% of adults aged 19 to 64 years had zinc intakes from food sources below the LRNI. Dietary supplements had no impact on the proportion with intakes below the LRNI.

'Meat and meat products' was the largest contributor to zinc intake for children aged 11 to 18 years and adults aged 19 years and over, providing 33-36%. 'Milk and milk products' was the major contributor to zinc intake for children aged 1.5 to 3 years (34%) while 'cereal and cereal products' was the main source of zinc for those aged 4 to 10 years (31%).

(**Tables 5.33-5.35a and 5.44**)

5.6.3.7 Copper

Mean daily intakes of copper from food sources were below the RNI for women aged 19 to 64 years (88% of the RNI) and women aged 65 years and over (78% of the RNI). Inclusion of intakes from dietary supplements made little difference to mean intakes as a percentage of the RNI. There are no LRNIs set for copper.

'Cereals and cereal products' was the largest contributor to copper intake for all age groups, providing 33-34% of intake in adults and 38-43% in children. 'Vegetables and potatoes' contributed 12-16% and 'meat and meat products' contributed 12-18% of copper intake.

(**Tables 5.33-5.34a and 5.45**)

5.6.3.8 Selenium

Mean daily intakes of selenium from food sources were below the RNI for children aged 11 to 18 years (71% of the RNI), adults aged 19 to 64 years (69% of the RNI) and adults aged 65 years and over (63% of the RNI). Inclusion of intakes from dietary supplements made little difference to mean intakes as a percentage of the RNI.

Thirty-nine per cent of children aged 11 to 18 years (33% of boys, 45% of girls), 41% of adults aged 19 to 64 years (27% of men, 54% of women) and 44% of adults aged 65 years and over (37% of men, 49% of women) had selenium intakes from food sources below the LRNI. Dietary supplements had little impact on the proportions with intakes below the LRNI.

The main sources of selenium were ‘cereals and cereal products’ and ‘meat and meat products’. ‘Cereal and cereal products’ contributed 25-35% and ‘meat and meat products’ contributed 22-36% to intake across the age groups. ‘Fish and fish dishes’ contributed 20% to selenium intakes for adults aged 65 years and over, decreasing to 10% for children aged 11 to 18 years. Children aged 1.5 to 3 years derived 19% of their selenium intake from ‘milk and milk products’.

(**Tables 5.33-5.35a and 5.46**)

5.6.3.9 Iodine

Mean daily intakes of iodine from food sources were above the RNI for all age/sex groups except girls aged 11 to 18 years (75% of the RNI). The inclusion of intakes from dietary supplements had little impact on mean intakes as a percentage of the RNI.

Eighteen per cent of children aged 11 to 18 years (12% of boys, 23% of girls) had iodine intakes from food sources below the LRNI. Sixteen per cent of women aged 19 to 64 years also had intakes below the LRNI. Dietary supplements had no impact on the proportions with intakes below the LRNI for these groups.

‘Milk and milk products’ was the largest contributor to iodine intake for all age groups, with the contribution highest for children aged 1.5 to 3 years (62%), decreasing to 36% for adults aged 19 years and over. Across the age groups, ‘cereals and cereal products’ provided 8-16% of iodine intake. Adults aged 65 years and over derived 16% of their iodine intake from ‘fish and fish dishes’.

(**Tables 5.33-5.35a and 5.47**)

5.6.4 Mineral intakes for supplement takers versus non-supplement takers[16]

Due to small numbers of supplement takers in the Wales sample, results are presented for sex-combined age groups only (see section 5.7). Comparisons of observed differences are only discussed for adults (aged 19 to 64 years and aged 65 years and over) as the cell sizes for supplement takers in the child age groups were below 30.

Adults aged 19 to 64 years who took supplements during the four-day recording period had higher mean intakes of some minerals from food sources only compared to non-supplement takers. The percentage of those with mineral intakes from food sources below the LRNI was lower in the supplement takers. For example, 18% of non-supplement takers had magnesium intakes from food below the LRNI compared to 3% of supplement takers

For most minerals, adults aged 65 years and over who took supplements during the four-day recording period had similar mean intakes from food sources only to non-supplement takers. The percentage of those aged 65 years and over with intakes below the LRNI from food sources only was lower in the supplement takers compared to the non-supplement takers. For example, 8% of non-supplement takers in this age group had calcium intakes from food below the LRNI compared to 1% of supplement takers.

The percentage of individuals taking supplements and the different types of dietary supplements taken is reported in section 5.7.

(**Tables 5.36-5.38**)

5.7 Dietary supplements

Information on consumption of dietary supplements was collected both in the four-day food diary and in the CAPI interview, which asks about consumption in the year before interview. Dietary supplements were defined for participants as products intended to provide additional nutrients or give health benefits and taken in liquid, powder, tablet or capsule form. In the CAPI, participants were asked to list any dietary supplements taken over the past year. In the diary, participants were asked to write down the details of the supplements they took on each diary recording day.

Twenty per cent of adults aged 19 to 64 years (19% of men, 21% of women) and 39% of adults aged 65 years and over (29% of men, 47% of women) had taken at least one supplement during the four-day diary recording period. For children, 13% of those aged 10 years and under and 9% of those aged 11 to 18 years had taken at least one supplement during the four-day diary period.

A higher proportion of participants reported in the CAPI having taken at least one supplement during the previous year than reported taking a supplement during the four-day diary period. This may be because of infrequent, intermittent or seasonal use of supplements which may not have been captured in the diary period.

For most age groups, the two most common types of supplements were fish oils (including cod liver oil) and multivitamins with or without minerals. Twenty-two per cent of adults aged 65 years and over took cod liver oil and other fish oils during the four-day diary period.

(**Tables 5.48 and 5.49**)

5.8 Summary

The findings presented in this chapter show that fruit and vegetable consumption was below recommendations in all relevant age groups. Adults aged 65 years and over were most likely to meet the "5-A-Day" guideline. Mean red meat consumption for adult males and females combined met the recommendation of no more than 70g per day for adults but mean consumption for men exceeded the recommendation. Adults aged 65 years and over had the highest consumption of oily fish, although this still fell below the recommended one portion per week.

Recommendations for total fat were met or very close to being met for all age groups. Recommendations for *trans* fatty acids were met in all age groups. However, intakes of saturated fatty acids were in excess of the recommended level for all age groups. NMES intakes also exceeded the recommended level, except in adults aged 65 years and over.

There was evidence for some age groups of low intakes for vitamin A, riboflavin and most minerals, although it is important to take into account that the recording period was four days and this may have been an insufficient period to fully capture intakes of micronutrients that are found in a limited number of infrequently consumed foods. It should be noted that the DRVs for some micronutrients such as magnesium, selenium and zinc are based on limited data so caution should be used when assessing adequacy of intake using the LRNI.

The findings also indicate that some age groups are consistently not meeting dietary recommendations. Children aged 11 to 18 years in particular consumed the fewest portions of fruit and vegetables, had among the highest percentage of food energy from NMES and had substantial proportions falling below the LRNI for some vitamins and most minerals.

[1] 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.

[2] Participants with dietary data for at least three days were included in the analyses (only 29 of the 852 participants had three rather than four days of dietary data).

[3] For the Years 1 to 4 UK sample, Saturdays and Sundays are slightly over-represented.

[4] Black, AE, Prentice, AM, Goldberg, GR, Jebb, SA, Bingham, SA, Livingstone, MB, Coward, WA, (1993). Measurements of total energy expenditure provide insights into the validity of dietary measurements of energy intake. *J Am Diet Assoc,* 93**,** 572-9.

[5] Livingstone, M. B., Black, A. E. (2003). Markers of the validity of reported energy intake. *J Nutr,* 133 Suppl 3**,** 895S-920S.

[6] The doubly labelled water technique (DLW) is widely agreed to be the most accurate way of assessing energy expenditure over one to two weeks. Participants in DLW studies drink a weighed amount of water labelled with known amounts of the stable isotopes of hydrogen (^{2}H) and oxygen ($^{18}O_2$) based on their body weight. Loss of the two isotopes from body water is assessed by measurement of the rate of decline in concentration of the isotope in samples of the subject's urine, collected during the study period, and measured by isotope ratio mass spectrometry. The difference between the elimination rates of the two isotopes reflects the rate at which CO_2 is produced from metabolism. Energy expenditure can then be estimated from the CO_2 production.

[7] A sub-sample of participants from the core UK sample were recruited for a Doubly Labelled Water (DLW) sub-study to measure energy expenditure. Participants from the Wales boost sample were not eligible for the sub-study. The DLW sub-study took place in alternate fieldwork years (i.e. Years 1 and 3) so there was no DLW sub-study in Years 2, 4 and 5.

[8] "5-a-day" portions of fruit and vegetables were not calculated for children aged 10 years and younger as the 80g portion is only appropriate for older children and adults (see appendix A).

[9] Scientific Advisory Committee on Nutrition. Iron and Health. London: TSO, 2010.

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

[11] Weekly equivalent oily fish consumption has been calculated using unrounded data rather than the rounded figures in table 5.3.

[12] Scientific Advisory Committee on Nutrition. Dietary Reference Values for Energy: [Online]. Available http://www.sacn.gov.uk/pdfs/sacn_dietary_reference_values_for_energy.pdf (2011) (accessed 23/06/15).

[13] For total fat and saturated fatty acids, this recommendation applies to adults and children from the age of five years.

[14] Consumers also include those who consumed alcohol in recipes and other foods.

[15] http://www.data-archive.ac.uk (accessed 23/06/15).

[16] Separate descriptive statistics were carried out on two datasets – one containing all participants who had taken at least one dietary supplement (regardless of the type) during the four-day recording period (the supplement takers) and one containing all participants who had not taken any dietary supplement during the four-day recording period (the non-supplement takers).

[17] Vitamin A and retinol are not widely distributed in foods. However there are a few rich sources such as liver. In smaller subgroups, mean daily intake of these vitamins from foods might be influenced by individuals with consumption of these rich sources and this should be taken into account when interpreting the results. Median intake is also shown as an alternative measure not influenced by extreme values.

[18] Salt intakes from measurement of 24-hour urinary sodium excretion will be published separately later in 2015.

6 Blood analytes

Sonja Nicholson, Lorna Cox, Nida Ziauddeen, Polly Page, Chris Bates and Ann Prentice

6.1 Introduction

This chapter reports the results of the analysis of blood samples taken during the nurse visit from participants in Wales aged 11 years and over. Blood samples were also taken from participants aged 1.5 to 10 years but due to limited cell sizes results have not been included in this chapter. However, response rates are provided in this chapter for all age/sex groups. Data for all participants, including those aged 1.5 to 10 years, will be deposited at the UK Data Archive.[1]

Blood samples were collected between April 2009 and July 2013; Years 2 to 5 of the NDNS RP. The gap between the start of the interviewer and nurse stages was an average of eight weeks.

The analytes presented in this chapter have been divided into the following main groups:

- haemoglobin and ferritin
- water-soluble vitamins
- fat-soluble vitamins and carotenoids
- blood lipids
- zinc and selenium

It should be noted that blood samples were also analysed for serum total folate and red blood cell folate and these results have been published in a separate supplementary folate report[2] and are not repeated here.

The results in chapter 5 of this report are based on assessment of food consumption over four days and indicate reported dietary intake over a short period. Analysis of blood samples provides an indication of the nutritional status of the population usually over a longer period; that is, the level of nutrients available to the body (after absorption) for use in metabolic processes. For some micronutrients, status can be assessed by directly measuring the concentration of the nutrient in blood, while for others it is assessed by a functional measure such as the degree of activation of vitamin-dependent enzymes.

An overview of the purpose, methodologies and other procedures associated with obtaining blood samples from participants are provided in chapter 2 and appendices N to P. Examples of the letters sent to a participant and/or their general practitioner (GP) containing results for clinically reportable analytes measured in their blood sample are presented in appendix L. Analytes were given a priority order for analysis according to their clinical and public health importance (see appendix N). Appendix O details the procedures for obtaining written consent from adult participants and the parent/legal guardian of child participants, including written child assent where appropriate, prior to blood sampling. Appendix J contains examples of consent forms used in the NDNS RP. Appendix O provides information about obtaining and processing blood samples, the recruitment of field laboratories and the transport and storage of blood samples. Appendix P details the quality control data and methodology of blood analysis for each analyte described in this report. The nurse (stage two) participant information documents are provided in appendix H. Appendix W lists the analytes included in this report and details of other analytes which have been measured and will be deposited at the UK Data Archive.[1]

6.1.1 Obtaining the blood sample

Blood samples were requested from all fully productive participants[3] aged 1.5 years and over who were visited by a nurse where informed consent was obtained. Appropriate consents were obtained. For children under 16 years of age this included written parental consent, along with written assent from the child where the child was able to provide this. Blood samples were collected by venepuncture by a qualified nurse or paediatric phlebotomist using a Sarstedt fixed or butterfly needle, depending on the blood taker's preference. The monovette tube system was used as it is a closed system, and allows the safe collection of blood in a participant's home. Children aged 1.5 to 15 years, where parental consent was obtained, were offered application of anaesthetic gel prior to venepuncture. In accordance with external ethical approval (see chapter 2, section 2.3 for more information regarding ethical approval) and participant consent, a maximum of 10.9mL of blood was taken from participants aged 1.5 to 6 years, 21.1mL from participants aged 7 to 15 years and 35.1mL from participants aged 16 years and over.

Blood was collected into between four and eight tubes, depending on the age group of the participant. Each tube contained anticoagulant/stabilising agent as appropriate for the analysis required.

The following monovette tubes were filled according to age of the participant,

Age group	Tubes
1.5 to 6 years[4]	1 x EDTA, 1 x lithium heparin, 1 x serum gel and 1 x serum
7 to 15 years[4]	1 x EDTA, 1 x trace mineral controlled lithium heparin, 1 x lithium heparin, 1 x serum gel, 1 x serum and 1 x fluoride
16 years and over	2 x EDTA, 2 x trace mineral controlled lithium heparin, 1 x lithium heparin, 1 x serum gel, 1 x serum and 1 x fluoride

6.1.1.1 Blood Response

Blood samples were obtained from a total of 339 fully productive participants aged 1.5 years and over. Of those completing at least three diary days, 28% of children (13% of those aged 1.5 to 3 years, 28% of those aged 4 to 10 years and 34% of those aged 11 to 18 years) and 49% of adults aged 19 years and over provided a blood sample. This chapter presents analytical results for the 288 participants aged 11 years and older (60 children aged 11 to 18 years and 228 adults aged 19 years and over) who provided a blood sample.[5] The numbers in each age group can vary slightly for each analyte because, when the quantity of blood collected was not sufficient, lower priority analytes could not be assayed for some individuals. The primary reasons for not obtaining a sample, when consent had been given, were not being able to find a suitable vein or a vein collapsing during the procedure. Further details are provided in chapter 2 and appendix O of this report.

6.1.2 Fasting blood samples

Participants aged four years and over were asked to provide an overnight (minimum of eight hours) fasting blood sample and those aged 1.5 to 3 years were asked to provide a non-fasting blood sample. Participants with diabetes who were not willing or not able to fast were invited to provide a non-fasting blood sample. The requirement for blood processing to commence within two hours of collection (and also procedure-standardisation) dictated that all samples had to be collected as early in the day as possible, and always before midday.

6.1.3 Transport and storage of blood samples

Following venepuncture, an EDTA and a serum gel monovette tube from each participant's sample set were sent by post, to the Immunology and Biochemistry Laboratory at Addenbrooke's Hospital in Cambridge (Addenbrooke's) for prompt analysis. The remaining blood monovette tubes from a participant's sample set were taken to a local field laboratory for immediate processing and storage below -40^{o}C (or at a maximum of -20^{o}C where -40^{o}C facilities were not available). At the end of each fieldwork period, samples were transported on dry ice to HNR where they were stored at -80^{o}C before analysis. Appendix O provides further details on the transport, tracking and storage of blood samples.

6.1.4 Analysis of the blood samples

Blood analytes were assigned a priority order based on clinical and policy relevance. Where it was not possible to obtain the full volume of blood from a participant, analytes were assayed in the order of priority detailed in tables N.1, N.2 and N.3 (appendix N). Therefore the base numbers in the tables may be smaller for the lower priority analytes in each monovette tube than for the higher priority ones.

In addition to the blood analytes presented in tables 6.1 to 6.5, a selected number of additional analytes are presented in appendix Q. Data for analytes measured in NDNS RP including those reported in this chapter and appendix Q will be included in the dataset submitted to the UK Data Archive.[1]

Appendix P provides details on the quality control measures for all of the assays performed on blood samples in the NDNS RP. All the laboratories performing blood analyses for the NDNS RP participate in external quality assessment schemes, where available.

Data for the blood analytes in tables 6.1 to 6.5 have been weighted to account for differential non-response to providing a blood sample, in order to adjust for any bias arising from blood sampling refusals and/or failures. Details of the methodology used to weight the data are provided in chapter 2 and appendix B of this report. Notional values were assigned to results below the limit of detection.[6] These were calculated by dividing the analytical limit of detection by the square root of two. This method is consistent with that used in the National Health and Nutrition Examination Survey (NHANES) and has been described by Hornung and Reed (1990).[6] Results are presented as sex-combined for the age groups 11 to 18 years, 19 to 64 years and 65 years and over and are further split by sex for those aged 19 to 64 years.[7]

Cell sizes for the 11 to 18 years and 65 years and over age groups are small and this should be borne in mind when interpreting the results.

Where accepted thresholds exist to indicate low status for a nutrient or an increased risk of poor function or ill health, the percentage of participants in that category has been provided in tables 6.1 to 6.5.

6.2 Haemoglobin and ferritin

6.2.1 Haemoglobin concentration (grams/litre, g/L)

Haemoglobin is the iron-containing, oxygen-carrying molecule in red blood cells. Circulating levels of haemoglobin are indicative of the oxygen-carrying capacity of the blood and a low haemoglobin concentration (anaemia) when coupled with low serum ferritin can indicate iron deficiency. Table 6A shows the lower limits for haemoglobin below which anaemia is indicated for those aged 11 years and over. The lower limits were set by the World Health Organization (WHO)[8] and are endorsed by the UK Scientific Advisory Committee on Nutrition (SACN).[9]

Table 6A: Lower limits set by WHO and endorsed by SACN for haemoglobin thresholds below which anaemia is indicated

Age group	Lower limit for haemoglobin (g/L)
Children aged 1.5 to 4 years	110
Children aged 5 to 11 years	115
Children aged 12 to 14 years	120
Non-pregnant females aged 15 years and over	120
Males aged 15 years and over	130

The mean haemoglobin concentration for children aged 11 to 18 years was 137g/L.

The mean haemoglobin concentration for men aged 19 to 64 years was 147g/L, 132g/L for women aged 19 to 64 years and 136g/L for men and women combined aged 65 years and over.

The proportion of children with a haemoglobin concentration below the lower limit was 2.8% for children aged 11 to 18 years.

The proportion of adults with a haemoglobin concentration below the lower limit was 1.8% for men aged 19 to 64 years, 8.5% for women aged 19 to 64 years and 13.2% for men and women combined aged 65 years and over.

(**Table 6.1**)

6.2.2 Plasma ferritin (micrograms/litre, µg/L)

Ferritin is an intracellular iron storage protein. Plasma ferritin concentration gives an indication of the level of iron stores. However, ferritin is an acute phase reactant which is raised in response to infection or inflammation. Therefore a plasma ferritin concentration should be interpreted with care as it can be raised by recent infections or inflammatory conditions, liver disease and other chronic disorders.[9]

The lower limit for plasma ferritin concentration, below which iron stores are considered to be depleted and the risk of iron-deficiency anaemia increased, is 15µg/L for children aged 11 to 14 years, and males and non-pregnant women aged 15 years and over.[8,9]

The mean plasma ferritin concentration for children aged 11 to 18 years was 35µg/L.

The mean plasma ferritin concentration for men aged 19 to 64 years was 118µg/L, 74µg/L for women aged 19 to 64 years and 114µg/L for those aged 65 years and over.
The proportion of children aged 11 to 18 years with a ferritin concentration below the lower limit of the reference range was 17.6%.

The proportion of adults with a ferritin concentration below the lower limit of the reference range was 1.9% for men aged 19 to 64 years, 13.9% for women aged 19 to 64 years and 12.1% for those aged 65 years and over.

(**Table 6.1**)

6.2.3 Combined index: Haemoglobin concentration (grams/litre, g/L) and plasma ferritin (micrograms/litre, µg/L)

Assessment of an individual's iron status depends on the measurement, interpretation and synthesis of various markers of iron status. Determining adequate iron status is dependent on the measure of more than one marker.[9] The combination of haemoglobin and ferritin concentrations can be used as a measure of iron status and/or deficiency.

There is evidence of anaemia (as indicated by low haemoglobin levels) or low iron stores (plasma ferritin) in all age/sex groups in the population, with a higher proportion in females. The proportion of participants who had both haemoglobin and plasma ferritin concentrations below the thresholds which indicate iron deficiency was 3.0% of those aged 11 to 18 years, 3.9% of women aged 19 to 64 years and 4.3% of adults aged 65 years and over.

Table Q.1 (appendix Q) presents descriptive statistics for plasma soluble transferrin receptors.

(**Table 6.1**)

6.3 Water-soluble vitamins

6.3.1 Plasma vitamin C (micromoles/litre, μmol/L)

Vitamin C is needed for the maintenance of healthy connective tissue in the body and it can act as an antioxidant, protecting cells from the damage caused by oxidative free radicals. Clinical deficiency results in scurvy. Plasma vitamin C concentration reflects recent dietary intake of vitamin C; a value of less than 11μmol/L indicates biochemical depletion.[10]

The mean plasma vitamin C concentration for children aged 11 to 18 years was 55.6μmol/L.

The mean plasma vitamin C concentration for men aged 19 to 64 years was 37.7μmol/L, 50.7μmol/L for women aged 19 to 64 years and 42.4μmol/L for those aged 65 years and over.

There were no cases below the threshold for biochemical depletion for children aged 11 to 18 years.

The proportion of adults who had a vitamin C concentration below the threshold indicative of biochemical depletion was 3.2% for men aged 19 to 64 years, 1.8% for women aged 19 to 64 years and 1.9% for those aged 65 years and over.

(**Table 6.2**)

6.3.2 Serum vitamin B_{12} (picomoles/litre, pmol/L)

Vitamin B_{12} is a water-soluble vitamin with a key role in normal functioning of the brain and nervous system and in blood cell formation. Serum concentration of vitamin B_{12} is the commonly used measure of vitamin B_{12} status. Vitamin B_{12} is required, along with folate, for methyl group transfer during protein metabolism, DNA synthesis and the methylation of DNA and various other substrates. The most common cause of vitamin B_{12} deficiency is failure of the parietal cells of the stomach to secrete Intrinsic Factor (a protein cofactor), leading to impaired absorption and hence pernicious anaemia.[11] The lower threshold of the reference range for serum vitamin B_{12} concentration for all ages is usually accepted as 150pmol/L.[12]

The mean serum vitamin B_{12} concentration for children aged 11 to 18 years was 285pmol/L.

The mean serum vitamin B_{12} concentration for men aged 19 to 64 years was 254pmol/L, 255pmol/L for women aged 19 to 64 years and 250pmol/L for those aged 65 years and over.

There were no cases below the threshold for children aged 11 to 18 years.
The proportion of adults who had a vitamin B_{12} concentration below the lower threshold of the reference range of 150pmol/L was 8.2% for men aged 19 to 64 years, 7.2% for women aged 19 to 64 years and 7.0% for those aged 65 years and over.

(**Table 6.2**)

6.3.3 Erythrocyte Transketolase Activation Coefficient (ETKAC) for thiamin status (ratio)

Thiamin (vitamin B_1) status is measured by ETKAC. Thiamin is required mainly during the metabolism of carbohydrate, fat and alcohol. Diets high in carbohydrate require higher intake of thiamin than diets high in fat.[11] As with most water-soluble vitamins, there is no recognisable store of non-functional thiamin in the body and the only reserve is that which is functionally bound to enzymes within the tissues. ETKAC is a measure of the reactivation of the cofactor-depleted red cell enzyme transketolase *in vitro* by the cofactor, thiamin diphosphate. The higher the ETKAC, the lower the saturation *in vitro*, and hence the greater the degree of deficiency *in vivo.* This index is sensitive to the lower to moderate range of intakes of thiamin. For adults aged 19 to 64 years, values above 1.25 are indicative of biochemical thiamin deficiency.[13]

The mean ETKAC in children was 1.12 for those aged 11 to 18 years. In adults mean values were 1.11 for those aged 19 to 64 years (with little difference between men and women) and 1.10 for those aged 65 years and over.

No adults aged 19 to 64 years or 65 years and over, had ETKAC above the threshold of 1.25 indicating deficiency, which has been defined for adults aged 19 to 64 years. For children aged 11 to 18 years, 2% had ETKAC above this adult threshold.

(**Table 6.2**)

6.3.4 Erythrocyte Glutathione Reductase Activation Coefficient (EGRAC) for riboflavin status (ratio)

EGRAC is a measure of red cell enzyme saturation with its cofactor flavin adenine dinucleotide (FAD) derived from riboflavin (vitamin B_2). Riboflavin is needed for the utilisation of energy from food and is a cofactor in the metabolism of other B vitamins. It may also be important for the metabolism of iron. The coefficient is expressed as the ratio of two activity measures of the enzyme glutathione reductase, with and without added FAD in vitro. The higher the EGRAC, the lower the saturation *in vitro*, and hence the greater the degree of deficiency *in vivo*. A coefficient between 1.0 and 1.3 has generally been considered to be normal.[14] The test is most sensitive at low levels of riboflavin intake. The EGRAC index is highly sensitive to small degrees of cofactor desaturation and raised values are indicative of low vitamin B_2 status. Although moderately raised values are not consistently associated with known functional abnormality, high values indicative of riboflavin deficiency may be associated with compromised iron metabolism.[15]

However, recent research has indicated that the 1.30 threshold may be set too low, so giving an overestimate of the prevalence of functionally-significant low riboflavin status. It has been recommended that the EGRAC threshold should be raised to a level above 1.30 to better reflect riboflavin inadequacy; this requires further consideration.[14] The values at the 75th and 90th percentiles for EGRAC have been provided in table 6.2 as an additional means of monitoring changes in the population.

The mean EGRAC in children aged 11 to 18 years was 1.49.

The mean EGRAC was 1.36 for men aged 19 to 64 years, 1.43 for women aged 19 to 64 years and 1.35 for those aged 65 years and over.

The proportion of individuals with an EGRAC above the 1.30 threshold potentially indicating poorer vitamin B_2 status[14] was 51.2% of adults aged 65 years and over, 59.9% of men aged 19 to 64 years and 88.2% of those aged 11 to 18 years.

The values at the 75th percentile ranged from 1.45 for men aged 19 to 64 years to 1.59 for those aged 11 to 18 years. The values at the 90th percentile ranged from 1.53 for men aged 19 to 64 years to 1.70 for women aged 19 to 64 years.

(**Table 6.2**)

6.3.5 Plasma pyridoxal-5-phosphate (PLP) (nanomoles/litre, nmol/L)

Vitamin B_6 comprises pyridoxal, pyridoxine, pyridoxamine and their 5'-phosphates, which are metabolically interconvertible. Pyridoxal-5-phosphate (PLP) is the primary biologically active form of vitamin B_6, serving as a co-enzyme for a large number of enzymes which catalyse reactions of amino acids. These are important in the body's overall protein metabolism and B_6 requirements are therefore related to protein synthesis needs.[11] PLP may be decreased during acute phase reaction;[16] therefore the interpretation of PLP concentration is more complicated in the presence of inflammation or infection.

PLP was not measured in previous NDNS.[17,18,19,20] Instead, erythrocyte aspartate aminotransferase activation coefficient (EAATAC) was measured as an index of vitamin B_6 status.

There is currently no internationally recognised normal range for PLP concentration. Pyridoxic acid (PA), a less sensitive measure of vitamin B_6 status but less affected by acute phase, was also measured; results for PA are presented in appendix Q.
The mean PLP concentration for children aged 11 to 18 years was 64.8nmol/L.

The mean PLP concentration for men aged 19 to 64 years was 62.5nmol/L, 45.6nmol/L for women aged 19 to 64 years and 41.6nmol/L for those aged 65 years and over.

(**Table 6.2**)

6.4 Fat-soluble vitamins and carotenoids

6.4.1 Plasma retinol (vitamin A) (micromoles/litre, µmol/L)

Plasma retinol is related to long-term dietary intake of vitamin A. The plasma concentration is homeostatically controlled and there is little variation either within or between individuals.[21] For adults, concentrations below 0.35µmol/L are considered to reflect severe deficiency and concentrations between 0.35µmol/L and 0.70µmol/L to reflect mild deficiency.[13]

The mean plasma retinol concentration for children aged 11 to 18 years was 1.40µmol/L.

The mean plasma retinol concentration for men aged 19 to 64 years, women aged 19 to 64 years and those aged 65 years and over was 1.97µmol/L, 1.81µmol/L and 1.83µmol/L respectively.

No individual in any age group had a retinol concentration below the threshold associated with severe deficiency (0.35µmol/L) in an adult population.[13]

The proportion of children aged 11 to 18 years with a retinol concentration at a threshold associated with mild deficiency (0.35-0.70µmol/L) was 5.6%; the proportion for adults aged 65 years and over was 4.6%. There were no cases of adults aged 19 to 64 years with a retinol concentration in this range.

(**Table 6.3**)

6.4.2 Plasma α- and β-carotene and α- and β-cryptoxanthin (micromoles/litre, µmol/L)

α- and β-carotene and α– and β–cryptoxanthin are carotenoids with provitamin A activity and their plasma concentrations reflect short to medium term dietary intake. Plasma concentrations of these carotenoids may also be influenced by conversion to vitamin A, the conversion being dependent on vitamin A status and requirements. There are currently no established normal ranges for plasma α- and β-carotene or α- and β–cryptoxanthin concentrations.

Results for plasma concentrations of α- and β-carotene and α– and β–cryptoxanthin are shown in table 6.3.

(**Table 6.3**)

6.4.3 Plasma lycopene and plasma lutein and zeaxanthin (micromoles/litre, μmol/L)

Lycopene, lutein and zeaxanthin are also carotenoids but do not have provitamin A activity. Plasma lutein and zeaxanthin concentrations may be useful markers of green vegetable intake. There are currently no established normal ranges for the plasma concentrations of these carotenoids.

Results for plasma concentrations of lycopene, lutein and zeaxanthin are shown in table 6.3.

(**Table 6.3**)

6.4.4 Plasma 25-hydroxyvitamin D (nanomoles/litre, nmol/L)

Plasma 25-hydroxyvitamin D (25-OHD) concentration is a measure of vitamin D status and reflects the availability of vitamin D in the body from both dietary and endogenous sources. Plasma 25-OHD is derived from synthesis in the skin of vitamin D3 and its precursors during ultraviolet B irradiation from sunlight and from vitamin D2 and D3 and their precursors in the diet. Factors such as season of the year, time spent outdoors, habit of dress and consumption of foods and supplements containing vitamin D therefore influence 25-OHD. This metabolite has a long half-life in plasma and gives an indication of vitamin D availability over recent weeks. Vitamin D, after conversion to its active metabolite 1,25-dihydroxyvitamin D, facilitates calcium absorption from the intestine and is important for a range of other metabolic processes. In the UK, 25nmol/L of 25-OHD has been used as the lower threshold for vitamin D adequacy below which there is an increased risk of rickets and osteomalacia.[22,23] A higher threshold has been adopted by some countries to indicate population vitamin D sufficiency; SACN convened a working group in 2011 to review the thresholds and is expected to report in 2015.

Plasma 25-OHD concentration is not split by season in this report due to small sample sizes.[24] As the survey was spread evenly across the year, values in table 6.3 are year-round averages.

The mean 25-OHD concentration for children aged 11 to 18 years was 42.9nmol/L.

The mean 25-OHD concentration for men aged 19 to 64 years was 50.9nmol/L, 42.5nmol/L for women aged 19 to 64 years and 43.0nmol/L for those aged 65 years and over.

The proportion of children aged 11 to 18 years who had a 25-OHD concentration below 25nmol/L at the time of venepuncture was 23.0%.

The proportion of adults who had a 25-OHD concentration below 25nmol/L at the time of venepuncture was 19.8% of men aged 19 to 64 years, 15.8% of women aged 19 to 64 years and 16.5% of those aged 65 years and over.

(**Table 6.3**)

6.4.5 Plasma (alpha) α-tocopherol (micromoles/litre, μmol/L)

Vitamin E is a group of compounds called tocopherols. Alpha tocopherol is the predominant form of vitamin E in human tissue, and has the highest biological activity of the tocopherols. It acts as an antioxidant and is required to protect cells against oxidative damage by free radicals, for example oxidation of the lipids in cell membranes. Plasma α–tocopherol concentration can be used as a measure of vitamin E status.

Increased concentration of plasma lipids appear to cause tocopherols to partition out of cell membranes, thus increasing plasma concentrations of tocopherols and resulting in a correlation between tocopherols and total lipid in the blood, particularly with the cholesterol fraction. For this reason plasma α–tocopherol concentration can be usefully expressed as a ratio to plasma total cholesterol (μmol/mmol), enabling comparisons to be made between groups with different plasma lipid concentations.

For adults, a concentration of total plasma tocopherols below 11.6μmol/L, of which approximately 93% would be α–tocopherol, or a plasma tocopherol to cholesterol ratio of below 2.25μmol/mmol, tends to cause red blood cells to haemolyse after exposure to oxidising agents *in vitro*; this is a functional test for biochemical vitamin E deficiency, although it is not necessarily indicative of a clinical deficiency of vitamin E. There is currently no established normal range for plasma α-tocopherol concentration. The Committee on Medical Aspects of Food and Nutrition Policy (COMA) Panel on Dietary Reference Values considered a tocopherol to cholesterol ratio of 2.25μmol/mmol to be the lowest satisfactory value for adults.[11]

The mean plasma α-tocopherol concentration for children aged 11 to 18 years was 20.8μmol/L.

The mean plasma α-tocopherol concentration for men aged 19 to 64 years, women aged 19 to 64 years and those aged 65 years and over was 27.9μmol/L, 27.7μmol/L, and 26.9μmol/L respectively.

Alpha-tocopherol results expressed as μmol per mmol total cholesterol have also been provided in table 6.3 for each age/sex group. The mean ratio of α-tocopherol to total cholesterol was 5.08μmol/mmol for children aged 11 to 18 years, 5.66μmol/mmol and 5.22μmol/mmol for men aged 19 to 64 years and women aged 19 to 64 years and 5.49μmol/mmol for those aged 65 years and over. There were no cases for children or adults having a ratio of α-tocopherol to total cholesterol less than the lowest satisfactory value as defined for adults.[11]

(**Table 6.3**)

6.5 Blood lipids

6.5.1 Total cholesterol, high density lipoprotein (HDL) cholesterol and low density lipoprotein (LDL) cholesterol (millimoles/litre, mmol/L)

High circulating concentrations of serum total cholesterol and LDL cholesterol are among the predictors of coronary heart disease (CHD) and other vascular diseases in adults. They are affected by age, genetic and environmental influences, including dietary factors, notably the amount of saturated fatty acids in the diet.[25] High concentrations of total cholesterol occur in some diseases, for example kidney, liver and thyroid disorders or in diabetes.

Cholesterol circulates in the body carried by a variety of lipoproteins. Cholesterol transported in low density lipoproteins (LDL cholesterol) makes up the major proportion of total circulating cholesterol. In adults, the risk of CHD is positively correlated with the concentration of both serum total cholesterol and LDL cholesterol. Cholesterol transported in high density lipoproteins (HDL cholesterol) is a smaller proportion of the total circulating cholesterol and is inversely related to the development of CHD. It is generally accepted that a serum total cholesterol concentration below 5.2mmol/L represents a level associated with minimal CHD risk, 5.2mmol/L to 6.4mmol/L mildly elevated risk, 6.5mmol/L to 7.8mmol/L moderately elevated risk and above 7.8mmol/L a severely elevated level of risk.[26]

LDL cholesterol was not directly measured in the NDNS RP but it was calculated in samples taken after an overnight fast by subtraction of HDL cholesterol from serum total cholesterol and corrected for very low density lipoprotein (VLDL) cholesterol estimated from the serum triglyceride concentration using the Friedewald equation.[27] Serum triglyceride (triacylglycerol) concentrations are presented in appendix Q of this report.

Table 6.4 shows the mean serum total, HDL and LDL cholesterol concentration for children and adults. Approximately a third of adults aged 19 to 64 years and just over a quarter of adults aged 65 years and over had a serum total cholesterol between 5.2 and 6.4mmol/L, indicating a marginally increased risk of cardiovascular disease.

The proportion of adults aged 19 years and over with a serum total cholesterol between 6.5 and 7.8mmol/L indicating moderately elevated cardiovascular risk ranged from 7.7% for men aged 19 to 64 years to 15.7% for women aged 19 to 64 years and 17.2% for those aged 65 years and over. The proportion of adults aged 19 years and over with a serum total cholesterol above 7.8mmol/L indicating severe risk ranged from no cases for men aged 19 to 64 years and those aged 65 years and over to 2.2% for women aged 19 to 64 years.

(**Table 6.4**)

6.6 Selenium and zinc

6.6.1 Plasma selenium (micromoles/litre, µmol/L)

Selenium, an essential trace element, forms part of the structure of certain proteins, and plays a key role in a number of metabolic processes including antioxidant systems and thyroid hormone metabolism. There are well-confirmed pathological syndromes associated with selenium deficiency as well as selenium toxicity.[28] There is currently no established normal range for plasma selenium concentration.[29]

Mean plasma selenium concentration was 0.88µmol/L for children aged 11 to 18 years.

Mean plasma selenium concentration was similar across the three adult age/sex groups with a mean concentration of 0.95µmol/L for men aged 19 to 64 years, 1.00µmol/L for women aged 19 to 64 years and 0.96µmol/L for those aged 65 years and over.

(**Table 6.5**)

6.6.2 Plasma zinc (micromoles/litre, µmol/L)

Zinc, an essential trace element, has a regulatory and catalytic role in numerous enzymes and also has a structural role in a number of enzymes and non-enzymatic proteins. Zinc also plays a role in major metabolic pathways which contribute to protein, carbohydrate, lipids, nucleic acids and energy metabolism.[11] There is currently no established normal range for plasma zinc concentration.[29]

Mean plasma zinc concentration was 14.10µmol/L for children aged 11 to 18 years.

Mean plasma zinc concentration was 14.59µmol/L for men aged 19 to 64 years, 14.02µmol/L for women aged 19 to 64 years and 13.55µmol/L for those aged 65 years and over respectively.

(**Table 6.5**)

6.7 Summary of the nutritional status of the population

Analysis of blood samples can provide an indication of the level of nutrients available to the body (after absorption) for use in metabolic processes.

There is evidence of anaemia (as indicated by low haemoglobin concentrations) or low iron stores (plasma ferritin) in all age/sex groups in the population, with a higher proportion in females. Three percent of those aged 11 to 18 years, 3.9% of women aged 19 to 64 years and 4.3% of adults aged 65 years and over had concentrations for both haemoglobin and plasma ferritin below the threshold indicating iron deficiency.

There is evidence of low vitamin D status at the time of venepuncture in all reported age/sex groups ranging from 15.8% of women aged 19 to 64 years to 23.0% of children aged 11 to 18 years with a vitamin D concentration below the threshold of 25nmol/L; this has implications for bone health, (increasing the risk of rickets and osteomalacia).

A substantial proportion of participants in all reported age/sex groups had riboflavin status values based on raised EGRAC indicating biochemical depletion. However, there is uncertainty about the functional consequences of a raised EGRAC. Therefore, in addition to using this threshold, changes in the riboflavin status of the UK population (including those in Wales) will also be monitored by reviewing the EGRAC values at the 75th and 90th percentiles in successive years.

There is little evidence of low status for other micronutrients where normal ranges or thresholds for low status have been set, e.g. vitamin C, thiamin as indicated by ETKAC, retinol and vitamin E.

Approximately a third of adults aged 19 to 64 years and just over a quarter of those aged 65 years and over had a serum total cholesterol concentration between 5.2 and 6.4mmol/L, indicating a marginally increased risk of cardiovascular disease. A further 12.1% of adults aged 19 to 64 years and 17.2% of adults aged 65 and over (sex-combined) had serum cholesterol in the range 6.5 to 7.8mmol/L indicating a moderately elevated cardiovascular risk. Another 1.2% of adults aged 19 to 64 years had a serum total cholesterol concentration greater than 7.8mmol/L, indicating severe risk, whilst there were no cases for those aged 65 years and over.

6.8 Comparisons between the Wales sample of the NDNS RP (Years 2 to 5 combined) and the UK (Years 1 to 4 combined)

In section 6.8.1 comparisons are made between blood analyte results for NDNS RP participants in the Wales (Years 2 to 5 combined) and the UK (Years 1 to 4 combined) samples. The following points should be taken into consideration when making any comparisons between these datasets:

- The number of blood samples obtained in Wales for those aged 11 years and over was 288. The sample size for blood samples obtained from those aged 11 years and over for the UK as a whole was 2,344.[30]

- The Wales blood samples were collected between April 2009 and July 2013; (Years 2 to 5 of the NDNS RP) whilst the UK blood samples were collected between February 2008 and July 2012 (Years 1 to 4 of the NDNS RP). All of the noted differences are observed differences only and no statistical analysis of the differences has been undertaken as the cell sizes in some age/sex groups in Wales are small. Therefore caution should be taken when comparing findings between Wales Years 2 to 5 and UK Years 1 to 4 where cell sizes are small.

6.8.1 Key comparisons between Wales (Years 2 to 5 combined) and the UK as a whole (Years 1 to 4 combined)

- There is evidence of anaemia (as indicated by low haemoglobin levels) or low iron stores (plasma ferritin) in all age/sex groups in the population, with a higher proportion in females. The proportion of participants who had both haemoglobin and plasma ferritin concentrations below the thresholds which indicate iron deficiency was 3.0% of those aged 11 to 18 years, 3.9% of women aged 19 to 64 years and 4.3% of adults aged 65 years and over.

- For men aged 19 to 64 years, mean vitamin C concentration was lower in Wales (37.7µmol/L) than in the UK as a whole (48.9µmol/L).

- A substantial proportion of participants aged 11 years and over in both Wales and the UK as a whole had riboflavin status values based on raised EGRAC indicating biochemical depletion; 51.2% of adults aged 65 years and over, 59.9% of men aged 19 to 64 years and 88.2% of those aged 11 to 18 years. However it has been recommended that the EGRAC threshold should be raised to a level above 1.30 to better reflect riboflavin inadequacy; this requires further consideration.[14,31]

- In Wales, there was a higher proportion of women aged 19 to 64 years (15.7%) and adults aged 65 years and over (17.2%) with a serum total cholesterol between 6.5-7.8mmol/L (a level associated with moderate risk) than in the UK as a whole (11.5% for women aged 19 to 64 years and 13.2% for adults aged 65 years and over in the UK as a whole).

- There is evidence of low vitamin D status in all age/sex groups in Wales and the UK as a whole. Low vitamin D status has implications for bone health, increasing the risk of rickets and osteomalacia.

- In all adult age/sex groups, a lower proportion of participants in Wales than in the UK as a whole had a 25-OHD concentration below 25nmol/L (the current threshold indicating vitamin D adequacy) at the time of venepuncture. Results are summarised in table 6B.

Table 6B: The percentage of NDNS RP Wales (Years 2 to 5) and NDNS RP UK (Years 1 to 4) participants with 25-OHD concentration below 25nmol/L at the time of venepuncture[1]

	% of respective dataset with 25-OHD concentration <25nmol/L[1] ***Cell size for each age group is shown in brackets***			
	11-18y (sex combined)	**19-64y men**	**19-64y women**	**65+y (sex combined)**
Wales	23.0% (53)	19.8% (62)	15.8% (105)	16.5% (50)
UK	22.0% (523)	24.0% (551)	21.7% (770)	21.0% (338)

[1] It should be noted that no statistical analysis of the differences has been performed.

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[1] www.data_archive.ac.uk (accessed 21/05/15).

[2] National Diet and Nutrition Survey Rolling Programme (NDNS RP)
Supplementary report: blood folate results for the UK as a whole, Scotland, Northern Ireland (Years 1 to 4 combined) and Wales (Years 2 to 5 combined).
https://www.gov.uk/government/statistics/national-diet-and-nutrition-survey-supplementary-report-blood-folate
(Accessed 02/04/2015).

[3] Participants were classed as "fully productive" if they completed three or four days of the food and drink diary.

[4] Due to limited cell sizes results for children aged 1.5 to 10 years have not been included in this chapter. Data will, however, be deposited at the UK Data Archive.

[5] A further 51 samples were obtained from children aged 1.5 to 10 years. However due to small cell sizes no results are reported for young children.

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[24] Due to larger sample sizes in the UK NDNS RP (which includes the Years 2 to 4 core Welsh participants reported in this chapter) 25-OHD was split by season in the UK NDNS RP report for Year 1 to Year 4.

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[29] This analyte was not measured for children aged 1.5 to 6 years because of the small volumes of blood collected in this age group.

[30] It should be noted that this number for the UK also includes blood samples obtained from participants in Wales.

[31] It should be noted that there is uncertainty about the functional consequences of a raised EGRAC. Therefore, in addition to using this threshold, changes in the riboflavin status of the UK population (including those in Wales) will also be monitored by reviewing the EGRAC values at the 75th and 90th percentiles in successive years.

7 24-hour urine analyses: Sodium excretion and estimated salt intake

Sonja Nicholson, Lorna Cox, Nida Ziauddeen, Polly Page, Chris Bates and Ann Prentice

Note

This chapter was excluded from the original report published in December 2015 in order that the data could be corrected to take account of bias in the sodium concentrations. This correction has now been applied and the data published in this chapter are in line with the data republished in the UK Years 1 to 4 report in February 2017 and the urinary sodium surveys of adults in England and Scotland (2014) [1,2] and Northern Ireland (2015).[3] Data are available in the UK Data Archive[4] for urinary sodium concentration (mmol/L) and excretion (mmol/24-hour) with and without application of the correction factor. This chapter has not been updated to reflect the new results for salt intakes for adults in England (2014)[1] and Scotland (2014).[2]

Published figures for estimated salt intake from previous sodium surveys[5,6,7,8,9,10] have also recently been revised to take account of analytical bias in the instruments used at the time of measuring sodium concentration in the samples for the respective surveys. These revisions facilitate comparisons between surveys over time. Descriptive statistics and cumulative frequencies for adjusted sodium excretion and estimated salt intake data for the England 2006, UK 2008 and England 2011 sodium surveys are presented in tables E.1-E.12 of the England 2014 report.[1]

Further details of the correction can be found in appendix U of this report and in the reports for the England and Scotland 2014 sodium surveys.[1,2]

7.1 Introduction

This chapter presents the estimated salt intakes based on 24-hour urinary sodium excretion data from participants aged 11 years and over[11] in Wales in Years 2 to 5 combined of the National Diet and Nutrition Survey Rolling Programme (NDNS RP). Data were also collected for children aged 4 to 10 years but the number of samples collected was too small to report results.

The RP data presented here add to previous publications on estimated salt intake in adults aged 19 to 64 years in UK countries.[5,6,7,8,9,10] Key results are highlighted in section 7.5 of this chapter. Data presented in this chapter provide an estimate of the progress of the population aged four years and over towards meeting UK Health Departments' targets to reduce the average population salt intakes to no more than 3g/day for those aged 4 to 6 years, no more than 5g/day for those aged 7 to 10 years and no more than 6g/day for those aged 11 years and over.[12,13] The Reference Nutrient Intakes (RNI)[14] for sodium, set in 1991 by the Committee on Medical Aspects of Food and Nutrition Policy's (COMA) panel on Dietary Reference Values,[15] are presented in table 7A for each age group. The table also shows the corresponding recommended maximum salt intake per day for adults, which was set by COMA[12] and endorsed by the Scientific Advisory Committee on Nutrition (SACN) in its report on Salt and Health (2003) and the recommended maximum intakes for children set by SACN (2003).[13]

Table 7A The Reference Nutrient Intake (RNI)[14,15] for sodium and the corresponding maximum recommended salt intake per day[12,13]

NDNS age group	RNI[14,15] (mmol sodium per day*)	Maximum recommended salt intake[12,13**] (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

* 17.1mmol of sodium excreted = 1 g of salt consumed.

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

Dietary salt intake can only be accurately assessed by measuring sodium excretion in urine. Salt is the predominant source of sodium in the UK diet and an estimation of intake from excretion is more reliable than through dietary assessment as it is difficult to quantify discretionary salt used in cooking and at the table. Estimates of sodium intake can be obtained by measuring urinary sodium excretion, assuming the body is in balance for sodium. Sodium is readily and rapidly absorbed from the diet, its concentration in plasma is under tight homeostatic control and the excess is excreted rapidly in urine.

Sodium excretion in single (“spot”) urine samples is not a reliable indicator of salt intake because both the excretion of sodium and the excretion of water fluctuate greatly during the day according to what was eaten at the last meal and how much fluid an individual has drunk; hence the concentration of sodium in spot urine samples is very variable. A 24-hour urine collection is accepted as being the most reliable method for assessing population mean salt intake.[13] Therefore, as for the previous England and Scotland sodium surveys[9,10] and recently published sodium data for adults,[1,2] the 24-hour urine methodology was used for the NDNS RP, facilitated by the nurses during their visits to participants.

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.[16] Where participants were excluded from taking PABA[17] or were unwilling to do so, or where participants failed to take the required PABA dose, assessment of complete collections was reliant on information recorded by participants on the 24-hour urine record sheet (see appendix T).

Results for measurement of sodium excretion and estimated salt intake are provided in this chapter and in tables 7.1-7.4 using only those 24-hour urine collections that were classified as complete. Pre-determined criteria were used to determine completeness (see section 7.4 of this chapter and appendix T for more details). Supporting information about the 24-hour urine collection and the results for other urine analyses are provided in other sections of the report as follows:

- data on excretion of potassium, nitrogen, urea and creatinine are described in appendix S
- an overview of the purpose, methodologies and other procedures associated with collecting 24-hour urine samples, as well as the response rates achieved, are provided in chapters 1 to 3
- appendix T details the procedures for obtaining written consent from adult participants and the parent/legal guardian of child participants, including child assent where appropriate, prior to the 24-hour urine collection
- appendix T also provides information about obtaining the 24-hour urine collection (including the administration of PABA), the processing of the urine aliquots, categorisation of collections as "complete" or "incomplete/unreliable" and the representativeness of urine collections deemed to be complete and included in the data analysis
- appendix U details the quality control data and methodology of urine analysis for sodium along with details of the derivation of a method-specific factor to enhance accuracy of sodium results relative to a national consensus reference and to facilitate comparison with previous sodium surveys[5,6,7,8,9,10] and recently published data for adults.[1,2] Appendix U also includes quality control data and methodology for other urine analytes reported in appendix S
- appendix W details which analytes are reported for Years 1 to 4/Years 2 to 5 combined, as well as providing details about those analytes that are not reported here but will be included in the dataset deposited at the UK Data Archive[4]

All urine excretion data have been weighted to account for differential non-response in providing a 24-hour urine collection, in order to adjust for any bias arising from refusals to provide a 24-hour urine collection and also failure to provide a complete 24-hour urine collection; incomplete collections were excluded from the descriptive statistics.

7.2 Urine collection and processing

Eligible participants aged four years and over who agreed to the nurse visit were asked to provide a 24-hour urine collection for measurement of sodium excretion and other urinary analytes. Full details of the 24-hour urine collection protocol are given in appendix T.

The nurse visited the participant as soon as possible after the end of the collection period to process the urine. All urine from the 24-hour period was collected in a 5 litre bottle. The bottle containing the 24-hour urine collection was weighed twice by the nurse to determine urine volume and was thoroughly mixed prior to filling four monovette tubes with a representative aliquot of the urine. These were sent by post to HNR for storage at -20^{o}C and later analysis of sodium, potassium, urea, creatinine and nitrogen (see appendix U); urine remaining after analysis was retained at -20^{o}C, where consent had been given for storage and use in future research. Appendix T provides further details on urine processing and storage.

7.3 Results used in the data analysis

For the age groups reported in this chapter (participants aged 11 years and over),[11] 374 24-hour urines (from 158 males and 216 females) were received at HNR and a total of 373 sodium results were obtained (from 157 males and 216 females). Of these 24-hour urines with a sodium result, 55.8% of collections (208) were classified as ‘complete’ and are included in the descriptive statistics presented in tables 7.1 to 7.4; 44.2% (165) were classified as ‘incomplete or unreliable by standard criteria’ and have been omitted from the descriptive statistics (see section 7.4.1 below for details about the ‘standard criteria’).

Sodium concentrations were converted to mmol/24hr based on the weight of the full urine collection in kg and assuming a specific gravity of 1.0kg/litre. Urinary sodium excretion data were adjusted using a method-specific factor (i.e. multiplied by 1.052) in order to correct for analytical bias and to enable comparison with results from previous urinary sodium surveys of adults which have also been corrected. [5,6,7,8,9,10] Application of this factor has resulted in slightly higher estimates of salt intake compared with the original analytical values (for information on the derivation of this factor see appendix U).

In line with previous surveys, estimated salt intake was calculated from corrected 24-hour urinary sodium excretion using the equation:

17.1mmol of sodium excreted = 1 g of salt consumed.

This assumes that the dietary intake of sodium is equal to the urinary output, and that all sodium in the diet comes from salt.

7.4 Assessment of completeness of collection

Sodium excretion in the urine approximates to 24-hour intake of sodium in the diet only if the 24-hour urine collection is complete. Full details of the procedures used to establish completeness and the criteria applied to categorise the urine collections are given in appendix T.

Details regarding the number and representativeness of useable collections for the different age/sex groups are presented in appendix T and tables T.1-T.3.

7.4.1 Standard criteria for classifying complete collections

24-hour urine collections were classified as 'complete' or 'incomplete/unreliable' by either of two criteria: 'complete by PABA' (where the participant has reported taking three PABA tablets and the amount of PABA recovered in the urine collection is consistent with completeness) or 'complete by claim' (where the participant has reported taking less than three PABA tablets and reported (i.e. claimed) collection of all urine passed during 23 to 25 hours), jointly referred to as 'standard criteria'. For participants aged 11 years and over, only results of urine collections classified as complete by these criteria are included in the results data (tables 7.1 to 7.4).

7.5 Sodium excretion and estimated salt intake results

Table 7.1 provides mean urinary sodium excretion by age/sex group expressed as mmol per 24 hours (mmol/24hr), table 7.2 shows the cumulative percentage distribution of urinary sodium excretion per 24 hours. Table 7.3 provides mean estimated salt intake by age/sex group expressed as gram per 24 hours (g/24hr). Table 7.4 shows the cumulative percentage distribution of urinary estimated salt intake per 24 hours. Tables 7.1-7.4 provide data for children aged 11 to 18 years and adults aged 65 years and over (sex combined) and adults aged 19 to 64 years (split by sex and sex combined). As explained above, these data take into consideration the method specific factor (see appendix U).

Based on the standard criteria and alternative criteria for determining completeness of urine collections, the numbers were too low to calculate a population average estimated salt intake for children aged 4 to 10 years in Wales. Therefore descriptive statistics and cumulative percentage distributions have not been provided for this age group in Tables 7.1-7.4. It should also be noted that cell sizes in the 11 to 18 years and 65 years and over age/sex groups in Wales are small.

For all age/sex groups presented in this chapter, mean estimated salt intake was higher than the maximum recommended intake for each age group.[12,13,18]

Adult males aged 19 to 64 years had higher mean urinary sodium excretion per 24 hours (and estimated salt intake) than their female counterparts. As expected, mean urinary sodium excretion (and estimated salt intake) was higher in the 19 to 64 years age group than in the 11 to 18 years age group.

The mean urinary sodium excretion for children aged 11 to 18 years was 133mmol/24hr.

The mean estimated salt intake for children aged 11 to 18 years was 7.8g/day; 29% greater than the SACN recommendation of a population average of no more than 6g/day.[12,13] The population distribution was heavily skewed towards higher values; the median estimated salt intake for children aged 11 to 18 years was 7.2g/day.

Mean urinary sodium excretion was 166mmol/24hr for men aged 19 to 64 years and 124mmol/24hr for women aged 19 to 64 years.

The mean estimated salt intake for adults aged 19 to 64 years was 8.4g/day, this was 41% greater than the SACN recommendation of a population average of no more than 6g/day.[12,13] Men had a daily intake of 9.7g/day and women had a mean daily intake 7.3g/day. The population distribution for adults and men aged 19 to 64 years was heavily skewed towards higher values; the median estimated salt intake for the older adult population was 7.9g/day and 9.4g/day for men.

Mean urinary sodium excretion was 121mmol/24hr for adults aged 65 years and over.

The mean estimated salt intake for adults aged 65 years and over was 7.1g/day, this was 18% greater than the SACN recommendation of a population average of no more than 6g/day.[12,13] The population distribution was heavily skewed towards higher values; the median estimated salt intake for the adult population was 6.2g/day.

(Tables 7.1, 7.2, 7.3 and 7.4)

7.6 Differences from previous urinary sodium surveys conducted in Wales

Prior to this report, estimated salt intake data based on 24-hour urinary sodium excretion for adults aged 19 to 64 years in Wales were last reported from a survey carried out in 2006, published in 2007.[7]

Results from the two surveys (the 2006 survey and Years 2 to 5 of the NDNS RP) have not been compared in this report due to the following differences in methodology between the surveys:

- urinary sodium was measured using an ion-electrode selective method on Roche/Hitachi systems in the 2006 Wales survey and using the Siemens Dimension in the NDNS RP
- in the 2006 Wales survey the sodium content of marginally incomplete collections was included in the dataset after application of an adjustment equation;[19] in contrast, all collections deemed incomplete were excluded from the NDNS RP dataset and adjustment equations were not used.

Because of the methodological differences detailed above between the 2007 and the current reports it is not clear whether or not there has been any change in salt intake in Wales over this period.

7.7 Comparison with the previously published urinary sodium surveys in England and the UK NDNS RP

Since this report was originally published new data have been published for salt intakes for adults in England (2014).[1] This section has not been updated to reflect these new results. Prior to this report, estimated salt intake data based on 24-hour urinary sodium excretion for adults aged 19 to 64 years in England came from a 24-hour urinary sodium survey carried out in 2011,[9,20] which used the same methods for fieldwork and for analysis of sodium excretion and PABA recovery as those used concurrently in the NDNS RP. The UK report for Years 1 to 4 of the NDNS RP[21] reported urinary sodium results from participants aged 4 to 18 years and 65 years and over only, and not for those aged 19 to 64 years.

The Years 1 to 4 UK report[21] included core and boost participants from England, Wales, Scotland and Northern Ireland. Samples from all four countries were analysed concurrently hence all results obtained during this period of time are directly comparable. Further, Year 5 urine samples were collected and analysed in the same way as those collected in Years 1 to 4.

It should be noted that any differences presented in this section of chapter 7 are only observed differences and no statistical analysis of the differences has been undertaken as the cell sizes in some age/sex groups in Wales are small. Therefore care should be taken when comparing findings between Wales Years 2 to 5 and UK Years 1 to 4 for age/sex groups where cell sizes are small.

The mean estimated salt intake for children aged 11 to 18 years in the UK NDNS RP was 7.0g/day and 7.8g/day in the Wales sample. It should be noted that cell sizes in this age/sex group in Wales are small. Therefore caution should be taken when comparing findings between Wales Years 2 to 5 and UK Years 1 to 4 for this age/sex group. The mean estimated salt intake for children aged 11 to 18 years in Wales was 29% greater than the SACN recommendation of a population average of no more than 6g/day and in the UK was 16% greater than the SACN recommendation.

The mean estimated salt intake for adults aged 19 to 64 years in England in 2011[20] (8.5g per day) was similar to the NDNS RP in Wales 2009/10-2012/13 (8.4g per day). Results for men (9.8g per day versus 9.7g per day in Wales) and women (7.2g per day versus 7.3g per day in Wales) were also similar.

The mean estimated salt intake for adults aged 65 years and over was 7.6g/day in the UK NDNS RP and 7.1g/day in the NDNS RP Wales sample. It should be noted that cell sizes in this age/sex group in Wales are small. For adults aged 65 years and over the mean estimated salt intake in Wales was 18% greater than the SACN recommendation of a population average of no more than 6g/day and in the UK was 26% greater than the SACN recommendation.

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[1] National Diet and Nutrition Survey (NDNS): Assessment of dietary sodium for adults (19 to 64 years) in England, 2014 report; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/509399/Sodium_study_2014_England_Text_final.pdf Published 2016 (accessed 27/06/16).

[2] National Diet and Nutrition Survey (NDNS): Assessment of dietary sodium for adults (19 to 64 years) in Scotland, 2014 report; http://www.foodstandards.gov.scot/sites/default/files/Monitoring%20the%20Scottish%20Diet-%20Sodium%20Survey%202014%20SCOTLAND_FINAL%20PDF.pdf Published 2016 (accessed 27/06/16).

[3] National Diet and Nutrition Survey: Assessment of dietary sodium - Adults (19 to 64 years) in Northern Ireland 2015; https://www.food.gov.uk/northern-ireland/nutritionni/national-diet-and-nutrition-survey-assessment-of-dietary-sodium. Published 2016 (accessed 06/10/16).

[4] http://data-archive.ac.uk/ (accessed 22/10/15).

[5] An assessment of dietary sodium levels among adults (aged 19-64) in the general population, based on analysis of sodium in 24 hour urine samples. Oct 2006 http://webarchive.nationalarchives.gov.uk/20101211052406/http://www.food.gov.uk/multimedia/pdfs/englandsodiumreport.pdf (accessed 22/10/15).

[6] Joint Health Surveys Unit (NatCen and UCL). A survey of 24 hour and spot urinary sodium and potassium excretion in a representative sample of the Scottish population. Food Standards Agency Scotland, 2007: http://tna.europarchive.org/20110116113217/http://www.food.gov.uk/multimedia/pdfs/scotlandsodiumreport.pdf (accessed 22/10/15).

[7] An assessment of dietary sodium levels among adults (aged 19-64) in the general population in Wales based on analysis of dietary sodium in 24 hour urine samples. Feb 2007. http://webarchive.nationalarchives.gov.uk/20101211052406/http://www.food.gov.uk/multimedia/pdfs/walessodiumreport.pdf (accessed 22/10/15).

[8] An assessment of dietary sodium levels among adults (aged 19-64) in the UK general population in 2008, based on analysis of dietary sodium in 24 hour urine samples, June 2008; http://tna.europarchive.org/20110116113217/http://www.food.gov.uk/multimedia/pdfs/08sodiumreport.pdf (accessed 22/10/15).

[9] National Diet and Nutrition Survey - Assessment of dietary sodium in adults (aged 19 to 64 years) in England, 2011 report. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/127916/Sodium-Survey-England-2011_Text_to-DH_FINAL1.pdf (accessed 22/10/15).

[10] A survey of 24 hour urinary sodium excretion in a representative sample of the Scottish population as a measure of salt intake. Published April 2011. http://www.foodstandards.gov.scot/survey-24-hour-urinary-sodium-excretion-representative-sample-scottish-population-measure-salt (accessed 22/10/15).

[11] Due to small cell sizes (less than 30) for the number of complete 24-hour urine collections provided by children aged 4 to 6 years (12 complete collections) and 7 to 10 years (12 complete collections), data in this chapter are only presented for participants in Wales aged 11 years and over.

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

[13] Scientific Advisory Committee on Nutrition (2003). Salt and Health. The Stationery Office. http://www.sacn.gov.uk/pdfs/sacn_salt_final.pdf (accessed 22/10/15).

[14] The RNI for a vitamin or mineral is the amount of the nutrient that is considered to be sufficient for 97.5% 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. For children and adults, health benefits would be gained from a reduction in average salt consumption. The population maximum targets for average salt consumption do not represent an optimal or ideal level of salt consumption but, they represent achievable population goals.

[15] 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

[16] Bingham S and Cummings J H. The use of 4-aminobenzoic acid as a marker to validate the completeness of 24h urine collections in man. Clin Sci (Lond) 1983; 64(6):629-35.

[17] Exclusions in the NDNS RP for participants taking PABA included those with conditions which could lead to a bad reaction to PABA (e.g. lactose intolerance; a previous allergic reaction to hair dye, sunscreen or a vitamin preparation) or who were taking sulphonamides were excluded from taking PABA.

[18] The COMA and 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 aged 7 to 10 years and no more than 6g/day for those aged 11 years and over.

[19] Johansson G, Bingham S, Vahter M (1999). A method to compensate for incomplete 24-hour urine collections in nutritional epidemiology studies. Public Health Nutrition: 2(4), 587-591.

[20] Descriptive statistics and cumulative frequencies for adjusted sodium excretion and estimated salt intake data for the England 2011 sodium survey are presented in tables E.9-E.12 of the National Diet and Nutrition Survey (NDNS): Assessment of dietary sodium for adults (19 to 64 years) in England, 2014 report (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/509399/Sodium_study_2014_England_Text_final.pdf). These tables differ to those presented in the published England 2011 report as the sodium excretion data have been multiplied by a method-specific factor (see table B of chapter 5 of the England 2014 report for more details).

[21] https://www.gov.uk/government/statistics/national-diet-and-nutrition-survey-results-from-years-1-to-4-combined-of-the-rolling-programme-for-2008-and-2009-to-2011-and-2012 (accessed 11/05/17)

8 Detailed age breakdowns for young people and adults in Wales for key nutrients and disaggregated foods and comparisons with the UK as a whole

Sonja Nicholson, Caireen Roberts, Elizabeth Stickley, Nida Ziauddeen, David Pell, Toni Steer, Alison Lennox and Polly Page

Erratum note: Correction to fruit and vegetable consumption estimates including from composite dishes (section 8.5)
In the first publication of this report (in December 2015), consumption estimates for fruit and vegetables, fruit juice and "5-A-Day" portions, including composite dishes, were incorrectly calculated. Fruit and vegetable components of food groups that should have been excluded (see Appendix A of this report) were mistakenly included. These were: soft drinks, confectionery, biscuits, cakes, sugar, preserves (including jam) and sweet spreads, savoury snacks and ice cream. The results presented in this chapter have been updated to correctly exclude all of the food groups that should be excluded as part of the "5-A-Day" calculations. The corrected values for Years 2-5 are therefore slightly lower than the values originally published but the overall conclusions on fruit and vegetable consumption are unchanged. Details of the methodology for estimating fruit and vegetable consumption and calculating "5-A-Day" portions can be found in Appendix A.

8.1 Introduction

Dietary data for all participants in the Wales sample in Years 2 to 5 combined of the NDNS RP are presented in chapter 5 for five standard age groups: 1.5 to 3 years, 4 to 10 years, 11 to 18 years, 19 to 64 years and 65 years and over. Within two of the standard age groups, 11 to 18 years and 19 to 64 years, there are sub-age groups of particular interest in terms of intakes of specific foods or nutrients (for example, alcohol intake in young people aged 16 to 24 years), or those who have specific requirements (such as folate intake for women of child bearing age). Results in this chapter are therefore presented for four separate age groups: 11 to 15 years, 16 to 24 years, 25 to 49 years and 50 to 64 years for NDNS RP Wales Years 2 to 5 combined and NDNS RP UK Years 1 to 4 combined to allow informal comparisons between the Wales sample and the UK as a whole sample. Results are also subdivided by sex for these age groups. Due to small numbers in some of the age/sex groups in the Wales sample (males aged 11 to 15 years, 16 to 24 years and 50 to 64 years and females aged 16 to 24 years), caution should be exercised when interpreting findings for these age/sex groups.

For ease of reading, the NDNS RP Wales Years 2 to 5 combined sample is referred to as "Wales" and the NDNS RP UK Years 1 to 4 sample is referred to as "the UK as a whole" in the rest of this chapter.

Further details on the dietary data are given in chapter 5, section 5.1. The comparisons provided in this chapter are observed differences only. Differences between these particular age groups within Wales, and between Wales and the UK as a whole, have not been tested for statistical significance.[1]

In this chapter, nutrient intakes have been limited to key macronutrients and micronutrients of policy interest and are described from food sources only (not including supplements).

Results for food consumption include vegetables, fruit, meat and fish after disaggregation (including the contribution from composite dishes, both homemade dishes and manufactured products, containing these ingredients but excluding the other components of these dishes).[2] A definition of all the categories of foods included in table 8.6 is provided in appendix R. The values in these tables refer to mean values for the total NDNS RP population in Wales and the UK as a whole, including non-consumers.

8.2 Energy and macronutrient intake

This section presents key findings on the daily intakes of energy and macronutrients estimated from the food consumption data for the four age groups in Wales, with UK as whole figures alongside for comparison.[3] Mean daily intakes of macronutrients have been compared with the UK DRVs.[4]

- Mean intakes of total energy[5] were slightly lower for the 11 to 15, 16 to 24 and 25 to 49 years age groups and about 100 kcal lower in the 50 to 64 years age group in Wales compared with the UK as a whole. Food energy showed a similar pattern to that for total energy[5] for all age/sex groups.

- Mean intakes of total fat as a percentage of food energy in Wales were similar to or slightly lower than the UK as a whole for all four sex-combined age groups. Mean intakes for all age/sex groups in both Wales and the UK as a whole met the recommendation of contributing no more than 35% of food energy.
- Mean intakes of saturated fatty acids as a percentage of food energy were similar or slightly lower in Wales than in the UK as a whole for all four sex-combined age groups. Mean intakes of saturated fatty acids exceeded the recommendation of providing no more than 11% of food energy in all age/sex groups. Mean intakes for sex-combined age groups in Wales ranged from 12.2% of food energy in those aged 16 to 24 years to 12.8% in those aged 50 to 64 years.

- Mean intakes of *trans* fatty acids as a percentage of food energy were similar or slightly lower in Wales than the UK as a whole in all four sex-combined age groups. Mean intakes met the recommendation of remaining below 2% of food energy in all age/sex groups. This apparent difference in intake between Wales and the UK as a whole is at least partly due to lower *trans* fatty acid composition values for many processed foods in the dataset from Year 3 onwards.[6]

- Mean intakes of non-milk extrinsic sugars (NMES) as a percentage of food energy were similar or lower in Wales than the UK as a whole for all four age groups. Mean intakes did not meet the recommendation of providing less than 11% of food energy in any age/sex group apart from females aged 25 to 49 years (10.8% of food energy) and adults aged 50 to 64 years (10.5% of food energy).

- There was no consistent pattern of differences between Wales and the UK as a whole for NSP intake across the detailed age groups. Mean intakes increased with age for sex-combined age groups, ranging from 12.0g for those aged 11 to 15 years to 13.9g for those aged 50 to 64 years. Mean intakes of NSP did not meet the recommendation which is set at a population average intake of 18g per day.

(**Tables 8.1a-8.1c**)

8.3 Alcohol

This section reports on alcohol intake in grams per day and as a percentage of total energy for the Wales sample (including non-consumers). The numbers of reported consumers were too low in the younger age groups to provide meaningful data. Consumers are those who reported consumption of alcoholic beverages in the four-day food diary.[7]

Weekend days are slightly under-represented in the data and this should be taken into account when interpreting findings on alcohol intake (see chapter 5, section 5.1, table 5A).

There was no consistent pattern of differences between Wales and the UK as a whole for alcohol intake for males or females across the detailed age groups.

(Tables 8.2a-8.2c)

8.4 Vitamins and minerals

This section presents daily intakes of selected vitamins and minerals for the Wales sample, namely vitamin D, vitamin C, folate, iron and calcium, from food sources only (excluding dietary supplements) and compares them with the UK Reference Nutrient Intakes (RNIs).[8] The proportions of participants with intakes below the Lower Reference Nutrient Intakes (LRNIs)[9] are also shown. The RNIs and LRNIs for the vitamins and minerals presented are shown in tables 5.14 and 5.32 (chapter 5).

Mean intakes of the selected vitamins and minerals were generally slightly lower in Wales than in the UK as a whole for the sex-combined age groups although this was only true across all the age groups for vitamin C. This pattern was seen more consistently for males than for females (although results for males are based on small cell sizes). Females in the 11 to 15 and 16 to 24 years age groups in Wales had mean iron and calcium intakes below the RNI and females in the 25 to 49 years age group had a mean iron intake below the RNI. Males aged 11 to 15 years had mean iron and calcium intakes below the RNI. The small cell sizes should be borne in mind when interpreting differences between Wales and the UK as a whole.

(Tables 8.3a-8.5c)

8.5 Vegetables, fruit, meat and fish consumption including from composite dishes

This section reports on consumption of vegetables, fruit, meat and fish based on disaggregated data for the Wales sample. This includes the contribution from composite dishes (both homemade dishes and manufactured products), but excludes the other components of those dishes.[2] The number of portions of fruit and vegetables consumed per day has also been calculated from the disaggregated data in line with the "5-A-Day" criteria,[10] including up to one portion each of fruit juice and baked beans or pulses per day (see appendix A).

Erratum note: correction to fruit and vegetable consumption data

Fruit and vegetable consumption figures in this section have been corrected for an error in the estimation of fruit, vegetables and fruit juice and the calculation of "5-A-Day" portions. Fruit and vegetable components of some food groups (soft drinks, confectionery, biscuits, cakes, sugar, preserves and sweet spreads, savoury snacks and ice cream) were included in the estimates when they should have been excluded. This has now been corrected and the corrected values are slightly lower than the original published values.

Based on disaggregated data for total fruit and vegetables combined (excluding fruit juice), consumption was lower in Wales compared to the UK as a whole for all sex-combined age groups, except for those aged 11 to 15 years, where mean intakes were similar to the UK as a whole. Mean consumption of fruit juice was also lower in Wales than in the UK as a whole in all age groups.

Mean total vegetable consumption (not including potatoes) for sex-combined age groups in Wales increased with age from 105g per day for those aged 11 to 15 years to 174g per day for those aged 50 to 64 years. Mean total fruit consumption (not including juice) was lowest in the 16 to 24 years age group (42g per day) and highest in the 50 to 64 years age group (105g per day).

The average number of portions consumed, calculated using the “5-A-Day” criteria,[10] also increased with age from 2.7 portions per day for those aged 11 to 15 years to 3.9 portions per day for those aged 50 to 64 years, a similar pattern to the UK as a whole. The proportion of participants achieving “5-A-Day” ranged from 7% of those aged 11 to 15 years and 8% of those aged 16 to 24 years to 26% of those aged 50 to 64 years.

The average number of portions consumed and the proportion of those achieving “5-A-Day” was lower in Wales compared with the UK as a whole for the 50 to 64 years age group (3.9 portions and 26% compared with 4.6 portions and 37%) and similar or lower for the other sex-combined age groups.

There was no consistent pattern of differences between Wales and the UK as a whole for consumption of red and processed meat based on disaggregated data for males or females across the detailed age groups. Mean consumption of red and processed meat based on disaggregated data in Wales was lowest in those aged 16 to 24 years (55g per day) and highest in those aged 50 to 64 years (71g per day).

The current recommendation is that, for adults, average intakes of red and processed meat should not exceed 70g per day.[11] While mean intakes for females in all age groups met the recommendation, mean intakes for males were generally close to or exceeded the recommendation in all age groups in line with the finding for the UK as a whole.

Consumption of oily fish in Wales was below the recommendation of one portion (140g) per week[12] in all four sex-combined age groups. There were small differences in consumption of oily fish between Wales and the UK as a whole but no consistent pattern across age/sex groups, and any differences are unlikely to be of nutritional importance given the low intakes.

(Tables 8.6a-c)

[1] It should be noted that for some dietary variables the UK as a whole values in this Wales report will not exactly match the values in the UK report due to an update in the coding of diluent water for soft drinks after publication of the UK report. The updated dataset has been used to produce values for this report.

[2] For the NDNS RP, 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.

[3] https://www.gov.uk/government/publications/national-diet-and-nutrition-survey-results-from-years-1-to-4-combined-of-the-rolling-programme-for-2008-and-2009-to-2011-and-2012 (accessed 19/05/15).

[4] 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

[5] Total energy intake includes energy from alcohol.

[6] New, lower analytical values for *trans* fatty acids in a range of processed foods were added to the nutrient databank in Years 3 and 4 onwards. Therefore there is a higher proportion of the new, lower composition values in the Wales dataset, based on Years 2-5 than in the UK dataset, based on Years 1-4. This is likely to be the main explanation for the apparently lower trans fatty acid intakes in Wales compared with the UK

[7] Consumers also include those who consumed alcohol in recipe dishes and other foods.

[8] The RNI for a vitamin or mineral is the amount of the nutrient that is sufficient for 97.5% 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.

[9] 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.

[10] http://www.nhs.uk/Livewell/5ADAY/Pages/5ADAYhome.aspx (accessed 19/05/15).

[11] Scientific Advisory Committee on Nutrition. Iron and Health. London: TSO, 2010

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

9 Comparison of equivalised income tertiles and the Welsh Index of Multiple Deprivation (WIMD) tertiles for key nutrients and disaggregated foods

Toni Steer, Caireen Roberts, Sonja Nicholson, David Pell, Nida Ziauddeen, Polly Page and Alison Lennox

Erratum note: Correction to fruit and vegetable consumption estimates, including from composite dishes (section 9.2.4 and 9.3.4)
In the first publication of this report (in December 2015), consumption estimates for fruit and vegetables, fruit juice and "5-A-Day" portions, including composite dishes, were incorrectly calculated. Fruit and vegetable components of food groups that should have been excluded (see Appendix A of this report) were mistakenly included. These were: soft drinks, confectionery, biscuits, cakes, sugar, preserves (including jam) and sweet spreads, savoury snacks and ice cream. The results presented in this chapter have been updated to correctly exclude all of the food groups that should be excluded as part of the "5-A-Day" calculations. The corrected values for fruit and vegetable consumption are therefore slightly lower than the values originally published but the overall conclusions are unchanged. Details of the methodology for estimating fruit and vegetable consumption and calculating "5-A-Day" portions can be found in Appendix A.

9.1 Introduction

This chapter presents consumption of selected foods and intake of key nutrients by participants in Wales in Years 2 to 5 combined of the NDNS RP by equivalised household income (section 9.2) and by the Welsh Index of Multiple Deprivation (WIMD) (section 9.3).

Results are presented for males and females combined for three standard age groups; 4 to 10 years, 11 to 18 years and 19 to 64 years and subdivided into tertiles. Numbers are too small in these age groups for results to be further split by sex. The number of participants aged 1.5 to 3 years and 65 years and over are too small to be subdivided into tertiles and are therefore not presented in this chapter nor included in the tables.
In this chapter, the nutrient intakes presented have been limited to key macronutrients and micronutrients of policy interest and are described from food sources only (not including supplements).

Results for food consumption include vegetables, fruit, meat and fish after disaggregation (including the contribution from composite dishes, both homemade dishes and manufactured products, containing these ingredients but excluding the other components of these dishes).[1] A definition of all the categories of foods included in table 9.6 is provided in appendix R. The values in these tables refer to mean values for the total NDNS RP population in Wales, including non-consumers.

Equivalisation is a standard methodology that adjusts household income to account for different demands on resources by considering the household size and composition.[2] Equivalised income tertile 1 is the group with the lowest equivalised household income and tertile 3 is the group with the highest equivalised household income.

WIMD is the official measure of relative deprivation for small areas in Wales. It is designed to identify those small areas where there are the highest concentrations of several different types of deprivation.[3] In this chapter, the areas have been split into tertiles, with tertile 1 containing the most deprived areas and tertile 3 containing the least deprived areas.

This chapter presents a summary of reported intakes across tertiles for the three age groups (4 to 10 years, 11 to 18 years and 19 to 64 years) highlighting any patterns, for example where there is an increase or decrease across the tertiles. Statistical comparisons have been carried out only for adults aged 19 to 64 years and, therefore, commentary focuses on this age group. No statistical analysis has been carried out for children aged 4 to 10 years and 11 to 18 years due to low numbers in some tertiles for these sex-combined age groups. While observed differences are reported for these age groups, they should be interpreted with caution.

For adults aged 19 to 64 years, statistical analysis compares equivalised income tertiles 1 and 2 to the highest equivalised income group (tertile 3) and WIMD tertiles 1 and 2 to the least deprived WIMD group (tertile 3); refer to appendix Y for a more detailed explanation of the statistical analysis. Not all statistically significant differences are described in the text, especially where there is no clear pattern by tertile, however, all statistically significant differences are annotated in tables 9.1 to 9.12. Some values that appear to be identical in the tables may be marked as significantly different from each other, this is due to rounding of values. For ease of reading, the term ‘equivalised household income tertile’ has been abbreviated throughout the chapter to ‘income tertile’.

9.2 Comparison of equivalised household income tertiles for key nutrients and disaggregated foods

9.2.1 Energy and key macronutrient intake by equivalised household income

This section presents key findings on the daily intakes of energy and macronutrients estimated from the food consumption data for children aged 4 to 10 years, 11 to 18 years and adults aged 19 to 64 years by income tertiles. Differences in the 4 to 10 years and 11 to 18 years age groups are observed only and should be interpreted with caution because of the low numbers. Mean daily intakes of macronutrients are compared with the UK DRVs.[4]

- No clear pattern was observed for total energy or food energy intake by income tertile in adults aged 19 to 64 years.

- There were no clear patterns across the income tertiles in mean intake of total fat, saturated fatty acids or *trans* fatty acids for adults aged 19 to 64 years either in grams per day or as a percentage of food energy. Mean intake of saturated fatty acids exceeded the recommendation of no more than 11% of food energy intake in all income tertiles. Mean intake of *trans* fatty acids met the recommendation of no more than 2% of food energy intake in all income tertiles.

- Mean protein intake in absolute terms (grams per day) and as a percentage of total and food energy was significantly lower in income tertile 1 (68.7g, 15.9% and 16.7% respectively) compared to income tertile 3 (79.2g, 17.5% and 18.6% respectively) for adults aged 19 to 64 years.

- Mean intake of non-milk extrinsic sugars (NMES) both in absolute terms (grams per day) and as a percentage of total and food energy was significantly higher in income tertile 1 (64.8g, 12.5% and 13.4% respectively) compared with income tertile 3 (49.0g, 9.7% and 10.3% respectively) for adults aged 19 to 64 years.

- Mean intake of non-starch polysaccharides (NSP) was significantly lower in income tertiles 1 (12.2g) and 2 (12.7g) compared with income tertile 3 (15.2g) for adults aged 19 to 64 years.

- For children aged 4 to 10 years the data suggest that mean intakes of energy, total fat and saturated fatty acids, NMES and NSP were slightly lower in income tertile 1 compared with income tertile 3 though there was not a consistent pattern across the tertiles for all nutrients. For children aged 11 to 18 years, no clear pattern for energy or nutrients was observed.

(Table 9.1)

9.2.2 Alcohol intake by equivalised household income

This section reports on alcohol intakes in grams per day and as a percentage of total energy for the 11 to 18 years and 19 to 64 years age groups (including non-consumers). Numbers were too small to report alcohol intake by consumers only. No statistical comparisons were carried out for the 11 to 18 years age group due to small numbers in some tertiles. In the Years 2 to 5 combined data for the Wales sample, Saturdays and Sundays are slightly under-represented and this should be taken into account when interpreting findings on alcohol intake (see chapter 5, section 5.1, table 5A).

For adults aged 19 to 64 years, there was no clear pattern across the income tertiles. Mean alcohol intake in grams per day was significantly lower in income tertiles 1 (14.5g) and 2 (12.6g) compared with income tertile 3 (15.5g). However, the significant difference did not remain when alcohol intake was expressed as a percentage of total energy intake.

(Table 9.2)

9.2.3 Vitamins and minerals by equivalised household income

This section presents daily intakes of selected vitamins and minerals, namely vitamin D, vitamin C, folate, iron and calcium, from food sources only (excluding dietary supplements) for children aged 4 to 10 years and 11 to 18 years and adults aged 19 to 64 years and compares them with the Reference Nutrient Intakes (RNIs).[5] The proportion of participants with intakes below the Lower Reference Nutrient Intakes (LRNIs)[6] are also shown. The RNIs and LRNIs for the vitamins and minerals presented in this section are shown in tables 5.14 and 5.32 (chapter 5). Differences in the 4 to 10 years and 11 to 18 years age groups are observed only and should be interpreted with caution because of the low numbers.

- In adults aged 19 to 64 years mean iron intake was significantly lower in income tertiles 1 (10.0mg) and 2 (9.5mg) compared with income tertile 3 (11.6mg). However mean intakes were close to or above the RNI in all tertiles. The proportion of adults aged 19 to 64 years with intakes below the LRNI was 15% in income tertile 1. The proportion was significantly higher in income tertile 2 (28%) than in income tertile 3 (7%).

- In adults aged 19 to 64 years mean calcium intake was lowest in income tertile 1 (767mg) and highest in income tertile 3 (829mg) though the difference was not statistically significant and mean intake was above the RNI in all tertiles. In adults, 9% in tertile 1, 5% in tertile 2 and 2% in tertile 3 were below the LRNI; none of the differences were significant.

- The mean daily intake of vitamin C for adults aged 19 to 64 years was lowest in income tertile 1 (57.5mg) and highest in income tertile 3 (78.0mg) though the difference was not statistically significant. All income tertiles had a mean daily intake of vitamin C above the RNI. The proportion of those with intakes below the LRNI was very low in all income tertiles.

- Mean vitamin D intake in adults aged 19 to 64 years was lower in income tertiles 1 (2.8µg) and 2 (2.7µg) than in income tertile 3 (3.4µg), with the difference being significant between income tertiles 2 and 3 for this age group.

- Mean folate intake for adults aged 19 to 64 years was lowest in income tertile 1 (227µg) and highest in income tertile 3 (259µg), with the difference being significant. All income tertiles had a mean daily folate intake above the RNI. The proportion of those with intakes below the LRNI was low and there was no clear pattern by income.

- For children aged 4 to 10 years and 11 to 18 years, differences between tertiles were generally in the direction of lower mean intakes and a higher percentage below the LRNI in the lower income tertiles.

(Tables 9.3 – 9.5)

9.2.4 Vegetables, fruit, meat and fish consumption, including from composite dishes by equivalised household income

Erratum note: correction to fruit and vegetable consumption data
Fruit and vegetable consumption figures in this section have been corrected for an error in the estimation of fruit, vegetables and fruit juice and the calculation of "5-A-Day" portions. Fruit and vegetable components of some food groups (soft drinks, confectionery, biscuits, cakes, sugar, preserves and sweet spreads, savoury snacks and ice cream) were included in the estimates when they should have been excluded. This has now been corrected and the corrected values are slightly lower than the original published values.

This section reports consumption of vegetables, fruit, meat and fish based on disaggregated data for children aged 4 to 10 years and 11 to 18 years and adults aged 19 to 64 years. This includes the contribution from composite dishes (both homemade dishes and manufactured products), but excludes the other components of those dishes.[1] The number of portions of fruit and vegetables consumed per day has also been calculated from the disaggregated data in line with the "5-A-Day" criteria, including up to one portion each of fruit juice and baked beans or pulses per day (see appendix A).

- Mean daily total fruit and vegetable consumption (excluding fruit juice) in adults aged 19 to 64 years was significantly lower in the lower income tertiles 1 (182g) and 2 (250g) compared to the highest income tertile 3 (312g). Mean consumption of "5-A-Day" fruit and vegetable portions was also significantly lower in income tertiles 1 (2.7 portions) and 2 (3.6 portions) compared to income tertile 3 (4.4 portions). This pattern was reflected in the percentage of adults achieving "5-A-Day" with 12% in income tertile 1 and 21% in income tertile 2 achieving the target compared with 30% in income tertile 3.

- In children aged 4 to 10 years and 11 to 18 years the data suggest a similar pattern with higher fruit and vegetable consumption in the highest income tertile although results should be interpreted with caution because of small cell sizes.

- There was no clear pattern for adults aged 19 to 64 years in consumption of total or red meat by income tertile. In the 11 to 18 years age group the data suggest higher consumption in the highest tertile.

- Mean total fish and oily fish consumption for adults aged 19 to 64 years was lowest in income tertile 1 (17g and 4g per day respectively) and highest in income tertile 3 (26g and 12g per day respectively) though the differences were not statistically significant.

(Table 9.6)

9.3 Comparison of Welsh Index of Multiple Deprivation (WIMD) tertiles for key nutrients and disaggregated foods

9.3.1 Energy and key macronutrient intake by WIMD

This section presents key findings on the daily intakes of energy and macronutrients estimated from the food consumption data for children aged 4 to 10 years and 11 to 18 years and adults aged 19 to 64 years by WIMD tertiles with tertile 1 containing the most deprived areas of Wales and tertile 3 containing the least deprived areas of Wales. A definition of WIMD is provided in section 9.1 of this chapter. Mean daily intakes of macronutrients are compared with the UK DRVs.[4] Differences in the 4 to 10 years and 11 to 18 years age groups are observed only and should be interpreted with caution because of the low numbers.

- No clear pattern in mean daily intakes of total or food energy was observed between WIMD tertiles in adults aged 19 to 64 years.

- No clear pattern was observed for mean intakes of total fat, saturated fatty acids or *trans* fatty acids between WIMD tertiles for adults aged 19 to 64 years, either in terms of absolute intake (grams per day) or when expressed as a percentage of food energy. All age groups had mean intakes of saturated fatty acids above the recommendation of no more than 11% of food energy intake and mean *trans* fatty acids intakes that met the recommendation of less than 2% of food energy intake.

- No clear pattern was observed in protein intake across the WIMD tertiles for adults aged 19 to 64 years as a percentage of food energy or in absolute terms (grams per day).

- Overall, no clear pattern was observed in mean intakes of total carbohydrate by WIMD tertile in terms of absolute intake (grams per day) or when expressed as a percentage of food energy for all age groups.

- Mean intake of NMES in adults aged 19 to 64 years in terms of absolute intake (grams per day) and expressed as a percentage of food energy was highest in WIMD tertile 1 (58.0g and 12.3% respectively) and lowest in WIMD tertile 3 (53.4g and 11.4% respectively) though the differences were not statistically significant.

- Mean NSP intake was significantly lower in WIMD tertile 1 (most deprived) (12.7g) than WIMD tertile 3 (least deprived) (14.4g) in adults aged 19 to 64 years.

- In children aged 11 to 18 years the data suggest higher intakes of energy, protein and NSP in the least deprived tertile (tertile 3) than the most deprived tertile (tertile 1). No pattern was seen in children aged 4 to 10 years.

(Table 9.7)

9.3.2 Alcohol intake by WIMD

This section reports on alcohol intakes in grams per day and as a percentage of total energy for 11 to 18 years and 19 to 64 years age groups (including non-consumers). Numbers were too small to report alcohol intake by consumers only. In the Years 2 to 5 combined data for the Wales sample, Saturdays and Sundays are slightly under-represented and this should be taken into account when interpreting findings on alcohol intake (see chapter 5, section 5.1, table 5A).

Adults aged 19 to 64 years had a mean intake in grams per day that was significantly lower in WIMD tertile 1 (12.6g) compared with WIMD tertile 3 (16.0g). When expressed as percentage of total energy from alcohol the difference did not reach statistical significance.

(Table 9.8)

9.3.3 Vitamins and minerals by WIMD

This section presents daily intakes of selected vitamins and minerals, namely vitamin D, vitamin C, folate, iron and calcium, from food sources only (excluding dietary supplements) for children aged 4 to 10 years and 11 to 18 years and adults aged 19 to 64 years and compares them with the UK RNIs.[5] The proportion of participants with intakes below the Lower Reference Nutrient Intakes (LRNIs)[6] are also shown. The RNIs and LRNIs for the vitamins and minerals presented are shown in tables 5.14 and 5.32 (chapter 5). Differences in the 4 to 10 years and 11 to 18 years age groups are observed only and should be interpreted with caution because of the low numbers.

- No clear patterns were observed for mean iron intake in adults aged 19 to 64 years by WIMD tertile. For adults aged 19 to 64 years, mean iron intake was above 90% of the RNI in all WIMD tertiles. The proportion with intakes below the LRNI was 17% in WIMD tertile 1 and 23% in WIMD tertile 2, both significantly higher than in WIMD tertile 3 (9%).

- No clear patterns were observed for mean daily calcium intakes in adults aged 19 to 64 years. All WIMD tertiles had a mean intake greater than 90% of the RNI and the proportion of those with intakes below the LRNI was 7% in tertiles 1 and 2 and 2% in tertile 3.

- No clear pattern in mean vitamin C intake was observed for adults aged 19 to 64 years. Mean vitamin C intakes were greater than the RNI in all WIMD tertiles. The proportion of those with intakes below the LRNI was very low in all WIMD tertiles.

- No clear pattern for mean vitamin D intake was observed in adults aged 19 to 64 years.

- In adults aged 19 to 64 mean folate intake was significantly lower in WIMD tertiles 1 (227µg) and 2 (234µg) compared with WIMD tertile 3 (272µg). Mean folate intakes were greater than the RNI in all WIMD tertiles. The proportion of those with intakes below the LRNI was very low.

- For children aged 11 to 18 years, differences between WIMD tertiles for these age groups were generally in the direction of lower mean intakes and a higher percentage below the LRNI in the most deprived WIMD tertile (tertile 3).

(Tables 9.9 - 9.11)

9.3.4 Vegetables, fruit, meat and fish consumption, including from composite dishes, by WIMD

Erratum note: correction to fruit and vegetable consumption data
Fruit and vegetable consumption figures in this section have been corrected for an error in the estimation of fruit, vegetables and fruit juice and the calculation of "5-A-Day" portions. Fruit and vegetable components of some food groups (soft drinks, confectionery, biscuits, cakes, sugar, preserves and sweet spreads, savoury snacks and ice cream) were included in the estimates when they should have been excluded. This has now been corrected and the corrected values are slightly lower than the original published values.

This section reports consumption of vegetables, fruit, meat and fish based on disaggregated data for children aged 4 to 10 years and 11 to 18 years and adults aged 19 to 64 years. This includes the contribution from composite dishes (both homemade dishes and manufactured products), but excludes the other components of those dishes.[1] The number of portions of fruit and vegetables consumed per day has also been calculated from the disaggregated data in line with the "5-A-Day" criteria, including up to one portion each of fruit juice and baked beans or pulses per day (see appendix A).

- Total fruit and vegetable consumption for adults aged 19 to 64 years was significantly lower in the lower WIMD tertiles 1 (210g) and 2 (261g) compared with the highest WIMD tertile 3 (287g). A similar pattern was seen for children aged 11 to 18 years, but this did not reach statistical significance.

- Mean consumption of "5-A-Day" fruit and vegetable portions for adults aged 19 to 64 years was significantly lower in WIMD tertile 1 (3.1 portions per day) compared with WIMD tertile 3 (4.1 portions per day). A similar pattern was seen for children aged 11 to 18 years where mean consumption of "5-A-Day" fruit and vegetable portions was significantly lower in WIMD tertile 1 (2.4 portions per day) compared with WIMD tertile 3 (3.1 portions per day). The percentage of adults aged 19 to 64 years achieving "5-A-Day" was lowest in WIMD tertile 1 (16%) and highest in WIMD tertile 3 (25%), however this difference was not significant. The percentage of children aged 11 to 18 years achieving "5-A-Day" was significantly lower in WIMD tertile 1 (1%) compared with WIMD tertile 3 (9%).

- No clear pattern by WIMD tertiles was observed in mean total meat or mean red meat consumption in any age group with the exception of children aged 11 to 18 years where the data suggest that mean red meat consumption was higher in WIMD tertile 3.
- No clear pattern was observed in mean total fish consumption for adults aged 19 to 64 years. Mean oily fish consumption for adults aged 19 to 64 years was slightly but not significantly lower in WIMD tertile 1 (5g per day) than in WIMD

tertile 3 (8g per day). Mean consumption of total and oily fish in children was low in all WIMD tertiles. The data suggest higher consumption of total but not oily fish in the least deprived WIMD tertile (tertile 3).

(Table 9.12)

9.4 Summary of main findings by equivalised household income and WIMD

There were some observed differences in food consumption, energy and nutrient intakes by equivalised household income tertiles and WIMD tertiles. Differences tended to be clearest between the lowest and highest tertiles and analysis by equivalised income and WIMD generally showed consistent results. However, differences between tertiles were not consistently seen for all age groups. Small cell sizes in the 4 to 10 years and 11 to 18 years age groups meant that statistical comparisons were not undertaken on these groups.

Overall, there were few clear differences by equivalised household income or WIMD for energy or macronutrient intake. Adults aged 19 to 64 years in the lowest income/most deprived tertile had higher mean NMES intakes than those in the highest income/least deprived tertiles. NSP intake in adults aged 19 to 64 years was significantly lower in the lowest income/most deprived tertiles.

Mean intake of micronutrients tended to be lower in the equivalised income tertiles 1 and 2 compared with the highest income tertile (tertile 3) for adults aged 19 to 64 years. However the pattern was less clear when split by WIMD tertiles. Where mean intakes fell below recommendations this was generally the case for all tertiles.

Mean fruit and vegetable consumption expressed in grams and as “5-A-Day” portions showed clear differences between tertile 1 and tertile 3 when split by equivalised income and by WIMD. However, mean consumption in all tertiles was below the recommendation of “5-A-Day”. No clear pattern for total meat or red meat was observed for any age group. Mean oily fish consumption was lower in the lowest income/most deprived tertiles compared with the higher/least deprived tertiles. However, in all age groups and all tertiles oily fish consumption was below the dietary recommendation.

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[1] For the NDNS RP 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. Disaggregation has not been carried out for previous surveys.

[2] Household income was established by means of a card on which banded incomes were presented (see appendix D). Information was obtained from the household reference person (HRP) or their partner. They were asked to

estimate their total household income in the last 12 months, before any deductions for tax, including income from earnings, self-employment, benefits, pensions, and interest from savings.

Equivalised income adjusts income to take account of the number of persons (adults and children) in the household. Equivalised household income was calculated using the McClements scoring system, described below:

A score was allocated to each household member, and these were added together to produce an overall household McClements score:

First adult (HRP)	0.61
Spouse/partner of HRP	0.39
Other second adult	0.46
Third adult	0.42
Subsequent adults	0.36
Dependant aged 0-1	0.09
Dependant aged 2-4	0.18
Dependant aged 5-7	0.21
Dependant aged 8-10	0.23
Dependant aged11-12	0.25
Dependant aged13-15	0.27
Dependant aged16+	0.36

The equivalised income was derived as the annual household income divided by the McClements score. This equivalised annual household income was attributed to all members of the household, including children. Households were ranked by equivalised income, and tertiles t1 – t3 were identified within age groups in the overall sample.

All individuals in each household were allocated to the equivalised household income tertiles to which their household had been allocated. (Reference: McClements D. Equivalence scales for children. Journal of Public Economics 1977;8:191-210.)

[3] http://wales.gov.uk/statistics-and-research/welsh-index-multiple-deprivation/?lang=en (accessed 18/05/15).

[4] 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

[5] The RNI for a vitamin or mineral is the amount of the nutrient that is sufficient for 97.5% 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.

[6] 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.

10 Comparisons between Wales and the UK

Toni Steer, Caireen Roberts, Sonja Nicholson, Nida Ziauddeen, Polly Page and David Pell

Erratum note: Correction to fruit and vegetable consumption estimates including from composite dishes (section 10.5)
In the first publication of this report (in December 2015), consumption estimates for fruit and vegetables, fruit juice and "5-A-Day" portions, including composite dishes, were incorrectly calculated. Fruit and vegetable components of food groups that should have been excluded (see Appendix A of this report) were mistakenly included. These were: soft drinks, confectionery, biscuits, cakes, sugar, preserves (including jam) and sweet spreads, savoury snacks and ice cream. The results presented in this chapter have been updated to correctly exclude all of the food groups that should be excluded as part of the "5-A-Day" calculations. The corrected values for Years 2-5 are therefore slightly lower than the values originally published but the overall conclusions on fruit and vegetable consumption are unchanged. Details of the methodology for estimating fruit and vegetable consumption and calculating "5-A-Day" portions can be found in Appendix A.

10.1 Introduction

This chapter presents comparisons between Wales Years 2 to 5 combined sample and the whole of the UK Years 1 to 4 combined sample of the NDNS RP.[1,2] Results are presented by standard age groups; 1.5 to 3 years, 4 to 10 years, 11 to 18 years, 19 to 64 years and 65 years and over. Results are also subdivided by sex (except for children aged 1.5 to 3 years and adults aged 65 years and over where numbers were insufficient to subdivide by sex). Further details on the dietary data are given in chapter 5, section 5.1.

In this chapter, the nutrient intakes have been limited to key macronutrients and micronutrients of policy interest and are described from food sources only (not including supplements).

Results for food consumption include vegetables, fruit, meat and fish after disaggregation (i.e. including the contribution from composite dishes, both homemade dishes and manufactured products, containing these ingredients but excluding the other components of these dishes).[3] A definition of all the categories of foods included in table

10.6 is provided in appendix R. The values in these tables refer to mean values for the total NDNS RP population in Wales and the UK as a whole, including non-consumers.

Results were tested at the 95% significance level. Statistically significant differences between Wales and the UK as a whole are highlighted in the tables (refer to appendix Y for a more detailed explanation of the statistical analysis). The text in this chapter focuses on statistically significant differences and overall patterns of differences of food consumption and nutrient intakes considered to be of public health interest (rather than all of the statistically significant results).

For ease of reading, the NDNS RP Wales Years 2 to 5 combined sample is referred to as "Wales" and the NDNS RP UK Years 1 to 4 combined sample is referred to as "the UK as a whole" in the rest of this chapter.

10.2 Energy and macronutrient intake

This section presents daily intakes of energy and macronutrients estimated from the food consumption data. Mean daily intakes of macronutrients are compared with the UK DRVs.[4]

- Mean daily total energy intake was significantly lower in girls aged 4 to 10 years in Wales compared with the UK as a whole (1404 kcal compared with 1489 kcal). For adults aged 19 to 64 years (males and females combined), mean daily total energy intake was also significantly lower in Wales than in the UK as a whole (1780 kcal compared with 1861 kcal). Differences in the other age/sex groups were generally in the same direction but did not reach statistical significance.

- Mean intake of total fat in absolute terms (grams per day) and as a percentage of food energy in women aged 19 to 64 years was significantly lower in Wales compared with the UK as a whole (54.9g and 32.9% compared with 60.1g and 34.5%). The same pattern was seen in most other age/sex groups but the differences did not reach statistical significance.

- There were no statistically significant differences in mean intake of saturated fatty acids between Wales and the UK as a whole. However, the data suggested a slightly lower mean intake as a percentage of food energy in girls and women in Wales compared with the UK as a whole, although the differences did not reach statistical significance. For all age/sex groups in both Wales and the UK as a whole, mean intakes of saturated fatty acids were above the recommendation of no more than 11% of food energy from saturated fatty acids.

- For all age groups, with the exception of children aged 1.5 to 3 years, mean intakes of *trans* fatty acids were significantly lower in Wales compared with the UK as a whole. In both Wales and the UK as a whole mean intakes met the recommendation of remaining below 2% of food energy. This apparent difference in intake between Wales and the UK as a whole is mainly due to lower *trans* fatty acid composition values for many processed foods in the dataset from Year 3 onwards.[5]

- There were no statistically significant differences in mean protein intakes in absolute terms (grams per day) nor as a percentage of food energy between Wales and the UK as a whole for any age/sex group.

- There was no consistent pattern of differences in mean carbohydrate intakes between Wales and the UK as a whole across the age/sex groups, either in grams per day or as a percentage of food energy. Mean intake of carbohydrate in grams per day was significantly lower in girls aged 4 to 10 years in Wales (191g) compared with the UK as a whole (205g). In women aged 19 to 64 years mean intake as a percentage of food energy was significantly higher in Wales (49.6%) compared with the UK as a whole (48.2%).

- Mean intake of non-milk extrinsic sugars (NMES) tended to be slightly lower in most age/sex groups in Wales compared with the same age groups in the UK as a whole. In boys aged 11 to 18 years mean intake was significantly lower (73.9g) compared with the UK as a whole (84.0g). For girls aged 4 to 10 years mean NMES intake in absolute terms (grams per day) and as a percentage of food energy was significantly lower in Wales (47.2g and 12.5%) compared with the UK as a whole (58.5g and 14.6%). Adults aged 65 years and over in Wales also had a significantly lower mean intake of NMES both in absolute terms (grams per day) and as a percentage of food energy compared with the UK as a whole (44.0g and 10.3% compared with 51.6g and 11.5%). Adults aged 65 years and over in Wales were the only age group in either Wales or the UK as a whole, where the mean intake of NMES met the recommendation of no more than 11% of food energy.

- No clear pattern was observed in either direction in any of the age/sex groups for mean non-starch polysaccharides (NSP) intakes. In both Wales and the UK as a whole, mean NSP intakes were well below the adult population average recommendation of at least 18g per day.

(Tables 10.1a-10.1c)

10.3 Alcohol

This section reports on alcohol intakes in grams per day and as a percentage of total energy for both the total sample (including non-consumers) and for consumers only (those who reported consumption of alcoholic beverages in the four-day diary).[6] In the Years 2 to 5 combined data for the Wales sample, Saturdays and Sundays are slightly under-represented, whilst for the Years 1 to 4 UK sample Saturdays and Sundays are slightly over-represented and this should be taken into account when interpreting findings on alcohol intake (see chapter 5, section 5.1, table 5A).

Mean alcohol intake expressed as a percentage of total energy for female consumers aged 19 to 64 years was significantly higher in Wales (9.7%) compared with the UK as a whole (7.8%). There were no other statistically significant differences in mean alcohol intake in absolute terms (grams per day) or when expressed as percentage of total energy for the total population (including non-consumers) or consumers only between Wales and the UK as a whole sample in any other age/sex group.

(Tables 10.2a-10.2c)

10.4 Vitamins and minerals

This section presents daily intakes of selected vitamins and minerals: iron, calcium, vitamin C, folate and vitamin D, from food sources only (excluding dietary supplements). Mean daily intakes of these vitamins and minerals are compared with the UK Reference Nutrient Intakes (RNIs)[7] and the proportions of participants with intakes below the Lower Reference Nutrient Intakes (LRNIs)[8] are provided. The RNIs and LRNIs for the vitamins and minerals presented are shown in tables 5.14 and 5.32 (chapter 5).

- There were no significant differences between Wales and the UK as a whole for mean iron intakes or the percentage below the LRNI for any age/sex group with the exception of girls aged 4 to 10 years where mean intake in Wales was significantly lower than in the UK as a whole (7.6mg compared with 8.4mg). Intakes expressed as a percentage of the RNI and the percentage below the LRNI were similar in Wales compared to the UK as a whole.

- Mean calcium intake was significantly lower in girls aged 11 to 18 years in Wales (622mg) compared with the UK as a whole (670mg) and was slightly lower in Wales than the UK in most other age/sex groups although the differences did not reach statistical significance. Mean calcium intake for both boys and girls aged 11 to 18 years in Wales and the UK as a whole was below 90% of the RNI. For girls aged 11 to 18 years, 16% in Wales and 19% in the UK as a whole had intakes below the LRNI.

- Mean vitamin C intake was significantly lower in all age/sex groups in Wales compared with the UK as a whole with the exception of children aged 1.5 to 3 years and girls aged 11 to 18 years; mean intake was also lower in these age groups in Wales compared with the UK as a whole but the difference did not reach statistical significance. Mean intake in all age/sex groups in Wales and the UK as a whole exceeded the RNI.

- Mean intakes of folate were significantly lower in Wales compared with the UK as a whole in men aged 19 to 64 years (265µg compared with 287µg) and adults aged 65 years and over (234µg compared with 265µg). No age/sex group had a mean folate intake which fell below 90% of the RNI.

- There were no significant differences between Wales and the UK as a whole for mean vitamin D intakes for any age/sex group. In Wales and the UK as a whole, children aged 1.5 to 3 years and men and women aged 65 years and over had a mean intake of vitamin D that fell below 90% of the RNI.[9]

(**Tables 10.3a-10.5c**)

10.5 Vegetables, fruit, meat and fish consumption, including from composite dishes

Erratum note: correction to fruit and vegetable consumption data
Fruit and vegetable consumption figures in this section have been corrected for an error in the estimation of fruit, vegetables and fruit juice and the calculation of "5-A-Day" portions. Fruit and vegetable components of some food groups (soft drinks, confectionery, biscuits, cakes, sugar, preserves and sweet spreads, savoury snacks and ice cream) were included in the estimates when they should have been excluded. This has now been corrected and the corrected values are slightly lower than the original published values.

This section reports on consumption of vegetables, fruit, meat and fish based on disaggregated data. This includes the contribution from composite dishes (both homemade dishes and manufactured products), but excludes the other components of those dishes.[3] The number of portions of fruit and vegetables consumed per day has also been calculated from the disaggregated data in line with the "5-A-Day" criteria, including up to one portion each of fruit juice and baked beans or pulses per day (see appendix A).

- There were no significant differences between Wales and the UK as a whole for mean total fruit consumption for any age/sex group with the exception of adults aged 65 years and over where mean intake was significantly lower in Wales (105g) compared with the UK as a whole (130g).

- Mean total vegetable consumption was significantly lower in Wales than in the UK as a whole for men aged 19 to 64 years (159g compared with 182g), girls aged 4 to 10 years (80g compared with 98g), women aged 19 to 64 years (165g compared with 183g) and adults aged 65 years and over (150g compared with 186g). For the remaining age/sex groups there was no consistent pattern in differences between Wales and the UK as a whole.

- Where the "5-A-Day" criteria can be applied (see appendix A), women aged 19 to 64 years in Wales had a significantly lower mean consumption of portions of fruit and vegetables compared with the same age/sex group in the UK as a whole (3.6 and 4.0 respectively). Adults aged 65 years and over in Wales also had a significantly lower mean consumption of portions of fruit and vegetables compared with the same age group in the UK as a whole (3.6 portions and 4.5 portions per day respectively). The percentage of the population achieving "5-A-Day" was also significantly lower in Wales compared with the UK as a whole, for "5-A-Day".

- There were no significant differences in mean total meat and red meat consumption in any age/sex group between Wales and the UK as a whole, with the exception of adults aged 19 to 64 years where mean consumption of total meat was significantly lower in Wales than the UK as a whole (101g compared with 109g).

- Mean oily fish consumption was similar for all age and sex groups in Wales and the UK as a whole, with the exception of women aged 19 to 64 years where mean oily fish intake was significantly lower in Wales (35g per week)[10] compared with the UK as a whole (54g per week).[10] No age/sex groups met the recommendation for oily fish consumption.

(Tables 10.6a–10.6c)

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[1] The Wales sample includes core and boost participants. The UK as a whole sample also includes the core and boost participants from Wales. In the UK data, the Wales cases were weighted down to represent the proportion of participants that the Wales core participants represent in the UK NDNS RP survey population.

[2] It should be noted that for some dietary variables the UK as a whole values in this Wales report will not exactly match the values in the UK report due to an update in the coding of diluent water for soft drinks after publication of the UK report. The updated dataset has been used to produce values for this report.

[3] For the NDNS RP, 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.

[4] 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.

[5] New, lower analytical values for *trans* fatty acids in a range of processed foods were added to the nutrient databank in Years 3 and 4 onwards. Therefore there is a higher proportion of the new, lower composition values in the Wales dataset, based on years 2-5 than in the UK dataset, based on Years 1-4. This is likely to be the main explanation for the apparently lower *trans* fatty acid intakes in Wales compared with the UK.

[6] Consumers also include those who consumed alcohol in recipes and other foods.

[7] The Reference Nutrient Intake (RNI) for a vitamin or mineral is the amount of the nutrient that is sufficient for 97.5% 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.

[8] The adequacy of vitamin or mineral intake can be expressed as the proportion of individuals with intakes below the Lower Reference Nutrient Intake (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.

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

[10] Weekly equivalent oily fish consumption has been calculated using unrounded data rather than the rounded figures in tables 10.6a-c.