British Journal of Nutrition (2012), **107**, 405–415
doi:10.1017/S0007114511002911

National Diet and Nutrition Survey: fat and fatty acid intake from the first year of the rolling programme and comparison with previous surveys

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(Received 29 October 2010 – Revised 9 March 2011 – Accepted 27 April 2011 – First published online 18 July 2011)

Abstract

High saturated fat intake is an established risk factor for several chronic diseases. The objective of the present study is to report dietary intakes and main food sources of fat and fatty acids (FA) from the first year of the National Diet and Nutrition Survey (NDNS) rolling programme in the UK. Dietary data were collected using 4 d estimated food diaries (*n* 896) and compared with dietary reference values (DRV) and previous NDNS results. Total fat provided 34–36 % food energy (FE) across all age groups, which was similar to previous surveys for adults. Men (19–64 years) and older girls (11–18 years) had mean intakes just above the DRV, while all other groups had mean total fat intakes of <35 % FE. SFA intakes were lower compared with previous surveys, ranging from 13 to 15 % FE, but still above the DRV. Mean MUFA intakes were 12·5 % FE for adults and children aged 4–18 years and all were below the DRV. Mean *n*-3 PUFA intake represented 0·7–1·1 % FE. Compared with previous survey data, the direction of change for *n*-3 PUFA was upwards for all age groups, although the differences in absolute terms were very small. *Trans*-FA intakes were lower than in previous NDNS and were less than 2 g/d for all age groups, representing 0·8 % FE and lower than the DRV in all age groups. In conclusion, dietary intake of fat and FA is moving towards recommended levels for the UK population. However, there remains room for considerable further improvement.

Key words: Dietary intake: National Diet and Nutrition Survey: Fat: Fatty acids: UK

Fat has an essential role in our diet. It is the most energy-dense nutrient providing 37 kJ (9 kcal)/g; it is the medium for the absorption of fat-soluble vitamins; it is a primary contributor to palatability of food; and it has a crucial role in membrane structures, the immune system and brain development[1]. However, high intakes of specific types of fat are also an established risk factor for several chronic diseases, such as CVD, obesity, diabetes and cancer[2,3]. There is evidence that replacing SFA with PUFA could decrease the risk of CHD[4].

Recommendations on fat intakes have been established in several countries. In the UK, the Department of Health recommends a maximum daily intake of total fat of 35 % of food energy (FE), SFA of 11 % FE, PUFA of 6·5 % FE and *trans*-fat of 2 % FE[5]. It is important to monitor the consumption of fat and fatty acids (FA) in populations using dietary surveillance programmes to determine how well recommendations are being met[4].

In the UK, household food purchase surveys have been carried out for many years to monitor food purchases; these show that purchases of fat (including all types of fat) have remained stable since 2005–06, and that whole milk, which is a contributor to fat intake, is on a downward trend[6]. However, household surveys do not necessarily reflect individual food intake. Therefore, the National Diet and Nutrition Survey (NDNS) was set up in 1992 following the 1986–87 Dietary and Nutritional Survey of British Adults to obtain national representative information on individual intakes in Great Britain[7]. The NDNS comprised a series of cross-sectional surveys, each covering a different age group. The 1997 NDNS of young people aged 4–18 years showed that mean SFA intake was 14 % FE for boys and girls, which was above the dietary reference value (DRV) of no more than 11 % of FE[8]. Similarly, the 2000–01 NDNS of adults aged 19–64 years showed that SFA intakes were above the DRV for both men and women at 13 %[9].

Abbreviations: DRV, dietary reference values; FA, fatty acids; FE, food energy; FSA, Food Standards Agency; NDNS, National Diet and Nutrition Survey.

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Dietary surveillance programmes have been implemented in other Western countries in Europe[10–14], the USA[15] and Canada[16,17]. The European Nutrition and Health Report 2009 provides an overview of dietary assessment studies in Europe, which includes data from the 2000–01 NDNS adult survey[18]. To assess dietary intake, most surveys have used 24 h dietary recalls[10,15,17], FFQ[10–12] or food records. To assess dietary intake, it has been shown that quantitative food diaries of all foods and drinks consumed by cohort participants are associated with less error than are FFQ[19–22]. The repeated 24 h recall is another often used method to assess dietary intake, which is similar to the food record in terms of diet quality and misreporting; however, it is considered less applicable in children under the age of 10 years.

As well as monitoring fat intake, it is also important to set up initiatives to reduce it. In February 2008, the Food Standards Agency (FSA) published its saturated fat and energy intake programme, which outlines the actions needed to help consumers reduce their saturated fat intakes and balance the amount of energy they consume with their energy needs[23].

The aim of the present study was to report dietary intakes and main food sources of total fat, SFA, MUFA, PUFA and *trans*-fat in adults and children from the first year of the NDNS rolling programme collected in 2008–09; dietary data were collected using 4 d estimated food diaries. Resulting nutrient intakes were compared with the appropriate DRV[5] and with data from previous surveys[9,24].

Subjects and methods

Subjects and study design

Subjects were participants of the NDNS rolling programme, the methodology of which has been described in detail elsewhere[25]. Briefly, the NDNS is a survey of the food consumption, nutrient intakes and nutritional status of people aged 1·5 years and older in private households, living in the UK and is designed to represent the UK population. Data for the first year of the NDNS rolling programme were collected between February 2008 and March 2009. Previously, the NDNS comprised a series of cross-sectional surveys, each covering a different age group (pre-schoolchildren, 1·5–4·5 years; young people, 4–18 years; adults, 19–64 years; older adults, 65 years and over).

The study sample was randomly drawn from the postcode address file, a list of all the addresses in the UK. A core sample of 3510 addresses was selected from 130 primary sampling units. From each primary sampling unit twenty-seven addresses were randomly selected. At each address, the interviewer established the number of households, and in cases where there were two or more, the interviewer selected one household at random. The twenty-seven addresses were randomly allocated to one of two groups: adult and child, if present, (*n* 9) and child only (*n* 18). Information describing the purpose of the study was sent to all selected addresses by post. This was followed by a face-to-face visit by an interviewer to each address to recruit participants in the eligible age range.

The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Oxfordshire A Research Ethics Committee. Informed consent was obtained from all subjects.

Dietary records

Following recruitment, a 4 d estimated food diary with detailed instructions was placed by the interviewer. After completion, the diary was collected by the interviewer who checked all entries for completeness of information. For children aged 11 years or younger, the parent/carer was asked to complete the 4 d food diary with help from the child as appropriate. Children aged 12 years and older were asked to complete the diary themselves, but details were confirmed with others, where necessary. For young children, a child minder, grandparent or friend's parent might complete parts of the diary.

Of the 3510 addresses selected, 11 % of households refused before the household selection could be carried out. Of those selected households, 64 % of households were fully productive, which led to 1131 fully productive participants by filling in three (1 % of participants) to four dietary recording days (99 % of participants).

The 4 d food diary assessed in each case included two weekend days. The participants were asked to describe portions using household measures, and the diaries included pictures of life-size spoons and a life-size glass to aid accurate recording. Trained interviewers reviewed the diaries with the participants and probed for additional information when necessary.

Food records were coded using the in-house program DINO (Diet In Nutrients Out), a Microsoft access-based dietary assessment system developed at MRC Human Nutrition Research, incorporating the FSA nutrient databank, which was also used in previous NDNS[26]. The FSA nutrient databank is based on McCance and Widdowson's Composition of Foods series[27], FSA food portion sizes[28] and manufacturer's data where applicable. Amendments to the nutrient databank are made regularly and may involve the creation of new food codes for novel or fortified food products, updates to existing food codes relating to the manufacturer reformulation or deletion of food codes. In the nutrient databank, *n*-3 PUFA was comprised of α-linolenic acid (18 : 3), stearidonic acid (18 : 4), EPA (20 : 5), clupanodonic acid (DPA, 22 : 5) and DHA (C22 : 6). *n*-6 PUFA included linoleic acid (18 : 2), γ-linolenic acid (18 : 3), dihomo-γ-linolenic acid (20 : 3), arachidonic acid (20 : 4) and adrenic acid (22 : 4).

Quality was assured by a random 10 % check of all diaries. After coding, each participant's mean energy and nutrient intake over the four diary days was calculated. For nutrients, if a participant fell outside the 2·5 and 97·5 % ranges for their age and sex group, as based on previous NDNS data, values were checked against the hand-written diaries and corrected if necessary, but not excluded.

The dietary records were compared with data from previous NDNS, the 2000–01 NDNS of adults including 1724

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participants[9] and the 1997 NDNS of young people including 1701 participants[24]. The dietary records from these previous NDNS were based on a 7 d record. Dietary assessment over a 7 d period will provide similar mean intakes to assessment over a 4 d period, but the variation and the percentage consumers will be different. Therefore, these previous surveys have been recalculated to enable comparisons with the data from 2008 to 2009 to represent 4 d. This was carried out by the bootstrap method of re-sampling to obtain 100 independent randomisations. Parameter estimates were taken from each bootstrap sample and were averaged over all bootstrap samples, ensuring an even spread of start days of the diaries[29].

Data from those aged 65 years and over (*n* 114) and those aged 1·5–3 years (*n* 83) were not included in these analyses due to limited sample size. This resulted in a sample size of *n* 896 for these analyses.

Statistical analysis

Data were normally distributed, and results are presented by groups according to sex and age (boys 4–10; boys 11–18; men 19–64; girls 4–10; girls 11–18; women 19–64 years). Weighting factor adjustments were used to adjust for non-response and to correct for the known socio-demographic differences between the composition of the survey sample and the total population of the UK, in terms of age by sex and Government Office Region[25]. This minimises selection bias and reduces non-response bias. The population figures used were taken from the 2008 mid-year population estimates[30]. The percentage contributions of food groups (including cereal and cereal products, milk and milk products, fat spreads, meat, meat dishes and meat products, fish and fish dishes, savoury snacks, fruits and nuts) to intakes of total fat, SFA, MUFA and *trans*-fat were calculated. Means of intakes of the current dietary intake data were compared with the appropriate DRV[5], and with those of the previous surveys: the 2000–01 NDNS of adults aged 19–64 years[9] and the 1997 NDNS of young persons aged 4–18 years[8]. After testing for equality with an *F* test, statistical significance was tested using an independent Student's *t* test. A test for trend for age was performed using a linear model including age categories.

Data analysis was carried out using SPSS for MS Windows 14.0 (SPSS, Inc., Chicago, IL, USA) and SAS (version 9.1; SAS Institute, Cary, NC, USA), and a *P* value of $<0{\cdot}001$ was considered statistically significant to account for multiple testing.

Results

Total fat intake

Total fat intakes are shown in Table 1 (for sex groups combined), Table 2 (males) and Table 3 (females). Total fat provided 34·5–35·1 % FE on average for all ages (4–64 years). Adult women, boys (4–18 years) and younger girls (4–10 years) had a mean total fat intake below the DRV of no more than 35 % FE, while mean intake for adult men and older girls (11–18 years) were just above the DRV. Of those aged 4–10 years, 53 % had intakes below the DRV for total fat, while 51 % of those aged 11–18 years and 48 % of those aged 19–64 years had intakes below the DRV for total fat.

Major contributors to total fat intake were meat and meat products, cereal and cereal products, and milk and milk products (Table 4). The contribution of meat and meat products increased with age, from 19 % for those aged 4–10 years to 25 % for those aged 11–18 years and 26 % for adults (*P* for trend $<0{\cdot}0001$). The contribution from milk and milk products decreased with age, from 20 % for those aged 4–10 years to 13 % for those aged 11–18 years and for adults (*P* for trend $<0{\cdot}0001$). The contribution of cereal and cereal products also decreased with age, from 23 % for young persons (4–10 and 11–18 years) to 18 % for adults (*P* for trend $<0{\cdot}0001$).

Compared with previous surveys, the intake of total fat was very similar in all groups; the only statistically significant decrease was found for fat intake expressed/g in boys aged 4–10 years (6·4 g/d (95 % CI 2·5, 10·2)).

SFA intake

SFA intakes are shown in Table 1 (for sex groups combined), Table 2 (males) and Table 3 (females). SFA intake provided 12·8–13·6 % FE on average for all ages (4–64 years). All age groups had a mean SFA intake higher than the DRV for SFA of no more than 11 % FE. The proportion of individuals with a SFA intake of below 11 % FE was 14 % for those aged 4–10 years, 23 % for those aged 11–18 years and 31 % for adults (19–64 years).

Major contributors to SFA intake were milk and milk products, cereal and cereal products, and meat and meat products (the supplementary Table S1 for this article can be found at http://www.journals.cambridge.org/bjn). The contribution of milk and milk products decreased with age (*P* for trend $<0{\cdot}0001$), whereas the contribution of meat and meat products increased with age (the supplementary Table S1 for this article can be found at http://www.journals.cambridge.org/bjn; *P* for trend $<0{\cdot}0001$).

Compared with previous surveys, SFA intakes as a percentage of FE were lower in the present survey, which was statistically significant for all children aged 4–10 years ($-1{\cdot}1$ % FE (95 % CI $-1{\cdot}5$, $-0{\cdot}7$) and 11–18 years ($-1{\cdot}0$ % FE (95 % CI $-1{\cdot}3$, $-0{\cdot}6$)); subdivided by sex, the decrease was statistically significant for boys aged 4–10 and 11–18 years and girls aged 4–10 years. However, for adults, no statistically significant changes were observed. In general, the differences in absolute intake of SFA were relatively small (1–3 g/d).

Trans-Fat intake

Trans-Fat intakes are shown in Table 1 (for sex groups combined), Table 2 (males) and Table 3 (females). *Trans*-FA provided 0·8 % FE on average for all ages (4–64 years) (Tables 1–3), and all groups had mean intakes lower than the DRV of 2 % FE. Major contributors to *trans*-fat intake were meat and meat products, milk and milk products and cereal and cereal products (the supplementary Table S1 for this article can be found at http://www.journals.cambridge.org/bjn).

Table 1. Intake data of fats and fatty acids of year 1 of the National Diet and Nutrition Survey (NDNS) rolling programme 2008–09 by age category compared with previous NDNS data (Means and standard deviations)

	All 4–10 years					All 11–18 years					All 19–64 years					
	2008–09		1997			2008–09		1997			2008–09		2000–01			
	Mean	SD	Mean	SD	*P*†	Mean	SD	Mean	SD	*P*†	Mean	SD	Mean	SD	*P*†	2008–09 *P* for trend for age‡
Bases (*n* unweighted)	238		837			224		864			434		1724			
Energy (food)																
MJ	6·56	1·34	6·73	1·58	0·113	7·96	2·18	7·85	2·31	0·469	7·59	2·35	7·70	2·56	0·389	<0·0001
kcal	1558	319	1601	375	0·085	1891	517	1867	550	0·517	1803	558	1829	608	0·394	<0·0001
Energy (total)*																
MJ	6·56	1·34	6·73	1·58	0·113	8·07	2·25	7·94	2·35	0·409	8·19	2·80	8·14	2·71	0·707	<0·0001
kcal	1558	319	1601	375	0·085	1917	534	1889	559	0·459	1949	668	1934	646	0·678	<0·0001
Fat																
g	59·9	14·9	63·6	17·9	0·002	74·0	23·5	74·6	25·1	0·722	71·4	27·9	72·2	29·8	0·611	<0·0001
% FE	34·5	4·4	35·6	4·6	0·001	35·0	4·7	35·8	5·4	0·024	35·1	6·7	35·1	6·8	0·980	0·0193
% TE	34·5	4·4	35·6	4·6	0·001	34·7	5·0	35·4	5·4	0·042	32·9	7·0	33·3	6·9	0·268	0·0160
SFA																
g	23·6	6·7	26·2	7·9	<0·001§	27·4	10·0	29·1	10·8	0·021	26·1	11·3	27·3	12·6	0·043	0·0261
% FE	13·6	2·5	14·7	2·6	<0·001§	12·9	2·4	13·9	2·7	<0·001§	12·8	3·4	13·2	3·4	0·014	0·0084
% TE	13·6	2·5	14·7	2·6	<0·001§	12·8	2·5	13·7	2·7	<0·001§	12·0	3·4	12·6	3·4	0·002	<0·0001
MUFA																
g	21·1	5·5	20·7	6·3	0·390	27·3	9·0	24·7	8·7	<0·001§	25·5	10·5	24·0	10·4	0·006	<0·0001
% FE	12·2	1·9	11·6	1·9	<0·001§	13·0	2·4	11·9	2·3	<0·001§	12·5	3·0	11·7	2·8	<0·001§	0·0479
% TE	12·2	1·9	11·6	1·9	<0·001§	12·8	2·4	11·8	2·3	<0·001§	11·7	3·0	11·1	2·8	<0·001§	0·0693
n-3 PUFA																
g	1·5	0·5	1·4	0·7	0·063	2·1	1·0	1·9	1·1	0·005	2·2	1·3	1·9	1·0	<0·001§	<0·0001
% FE	0·9	0·3	0·8	0·3	0·001§	1·0	0·4	0·9	0·4	0·009	1·1	0·5	1·0	0·5	<0·001§	<0·0001
% TE	0·9	0·3	0·8	0·3	0·001§	1·0	0·4	0·9	0·4	0·010	1·0	0·5	0·9	0·5	<0·001§	<0·0001
n-6 PUFA																
g	7·9	2·7	8·7	3·4	<0·001§	10·3	3·9	11·3	4·6	0·001§	10·6	4·7	10·9	5·3	0·249	<0·0001
% FE	4·5	1·2	4·9	1·5	0·002	4·9	1·3	5·5	1·7	<0·001§	5·2	1·5	5·3	1·9	0·334	<0·0001
% TE	4·5	1·2	4·9	1·5	0·002	4·9	1·3	5·4	1·6	<0·001§	4·9	1·5	5·0	1·8	0·151	<0·0001
Trans-Fat																
g	1·4	0·5	2·4	1·0	<0·001§	1·7	0·7	2·8	1·3	<0·001§	1·6	0·8	2·4	1·5	<0·001§	0·0040
% FE	0·8	0·2	1·4	0·4	<0·001§	0·8	0·2	1·3	0·4	<0·001§	0·8	0·4	1·2	0·5	<0·001§	0·8219
% TE	0·8	0·2	1·4	0·4	<0·001§	0·8	0·2	1·3	0·4	<0·001§	0·8	0·4	1·1	0·5	<0·001§	0·0622

FE, food energy; TE, total energy.
* Total energy intake includes alcohol intake.
† *P* value represents the difference between the present survey and previous surveys.
‡ *P* for trend indicates a trend across the three age groups.
§ *P* value <0·001.

Table 2. Intake data of fats and fatty acids of year 1 of the National Diet and Nutrition Survey (NDNS) rolling programme 2008–09 by age category compared with previous NDNS data in males (Means and standard deviations)

	Boys 4–10 years					Boys 11–18 years					Men 19–64 years					
	2008–09		1997			2008–09		1997			2008–09		2000–01			
	Mean	SD	Mean	SD	*P*†	Mean	SD	Mean	SD	*P*†	Mean	SD	Mean	SD	*P*†	2008–09 *P* for trend for age‡
Bases (*n* unweighted)	119		440			114		416			181		833			
Energy (food)																
MJ	6·71	1·37	7·08	1·67	0·015	8·92	2·20	8·84	2·41	0·746	8·63	2·33	9·07	2·65	0·020	<0·0001
kcal	1591	325	1684	397	0·011	2117	523	2103	573	0·797	2051	555	2154	630	0·020	<0·0001
Energy (total)*																
MJ	6·71	1·37	7·08	1·67	0·015	9·07	2·26	8·95	2·46	0·630	9·48	2·89	9·71	2·75	0·283	<0·0001
kcal	1591	325	1684	397	0·011	2154	537	2131	585	0·683	2255	691	2308	654	0·296	<0·0001
Fat																
g	60·2	15·1	66·6	19·2	<0·001§	81·6	25·2	83·6	26·5	0·426	81·8	28·3	85·8	31·4	0·093	<0·0001
% FE	34·0	4·3	35·4	4·5	0·003	34·5	4·7	35·6	5·1	0·016	35·5	6·5	35·5	6·3	0·907	0·0007
% TE	34·0	4·3	35·4	4·5	0·003	34·0	5·1	35·3	5·3	0·014	32·8	7·2	33·2	6·5	0·453	0·2782
SFA																
g	23·8	6·8	27·3	8·4	<0·001§	30·4	11·1	32·7	11·4	0·039	30·0	11·6	32·3	13·6	0·013	<0·0001
% FE	13·4	2·6	14·5	2·5	<0·001§	12·7	2·5	13·9	2·5	<0·001§	13·0	3·3	13·3	3·3	0·157	0·3227
% TE	13·4	2·6	14·5	2·5	<0·001§	12·5	2·6	13·7	2·5	<0·001§	12·0	3·4	12·5	3·3	0·061	<0·0001
MUFA																
g	21·2	5·6	21·7	6·8	0·402	30·2	9·4	27·9	9·2	0·011	29·3	10·6	28·8	11·0	0·498	<0·0001
% FE	11·9	1·8	11·5	1·9	0·032	12·8	2·3	11·9	2·2	<0·001§	12·8	2·9	12·0	2·8	<0·001§	0·0002
% TE	11·9	1·8	11·5	1·9	0·032	12·6	2·4	11·8	2·2	<0·001§	11·8	3·0	11·2	2·7	0·010	0·8622
n-3 PUFA																
g	1·5	0·5	1·5	0·7	0·747	2·2	1·0	2·1	1·3	0·204	2·4	1·4	2·2	1·1	0·080	<0·0001
% FE	0·8	0·3	0·8	0·3	0·145	0·9	0·3	0·9	0·5	0·260	1·1	0·5	1·0	0·4	0·004	<0·0001
% TE	0·8	0·3	0·8	0·3	0·145	0·9	0·3	0·9	0·5	0·301	1·0	0·5	0·9	0·4	0·012	0·0006
n-6 PUFA																
g	7·9	2·6	9·1	3·5	<0·001§	11·2	4·2	12·3	4·8	0·014	11·9	5·0	12·8	5·7	0·027	<0·0001
% FE	4·5	1·1	4·8	1·4	0·006	4·8	1·3	5·3	1·5	<0·001§	5·2	1·5	5·3	1·8	0·168	<0·0001
% TE	4·5	1·1	4·8	1·4	0·006	4·7	1·3	5·2	1·5	<0·001§	4·8	1·5	5·0	1·7	0·111	0·0089
Trans-Fat																
g	1·5	0·5	2·6	1·1	<0·001§	1·8	0·7	3·2	1·4	<0·001§	1·9	0·8	2·9	1·7	<0·001§	<0·0001
% FE	0·8	0·2	1·4	0·4	<0·001§	0·8	0·2	1·3	0·4	<0·001§	0·8	0·3	1·2	0·5	<0·001§	0·6343
% TE	0·8	0·2	1·4	0·4	<0·001§	0·8	0·2	1·3	0·4	<0·001§	0·8	0·3	1·1	0·5	<0·001§	0·0510

FE, food energy; TE, total energy.
* Total energy intake includes alcohol intake.
† *P* value represents the difference between the present survey and previous surveys.
‡ *P* for trend indicates a trend across the three age groups.
§ *P* value <0·001.

Table 3. Intake data of fats and fatty acids of year 1 of the National Diet and Nutrition Survey (NDNS) rolling programme 2008–09 by age category compared with previous NDNS data in females (Means and standard deviations)

	Girls 4–10 years					Girls 11–18 years					Women 19–64 years					
	2008–09		1997			2008–09		1997			2008–09		2000–01			
	Mean	SD	Mean	SD	*P*†	Mean	SD	Mean	SD	*P*†	Mean	SD	Mean	SD	*P*†	2008–09 *P* for trend for age‡
Bases (*n* unweighted)	119		397			110		448			253		891			
Energy (food)																
MJ	6·41	1·31	6·34	1·37	0·632	6·95	1·63	6·92	1·77	0·829	6·56	1·86	6·61	1·87	0·708	0·9630
kcal	1523	310	1509	325	0·690	1652	388	1646	421	0·868	1558	442	1570	445	0·719	0·9361
Energy (total)*																
MJ	6·41	1·31	6·34	1·37	0·632	7·02	1·70	6·99	1·78	0·854	6·92	2·02	6·88	1·91	0·811	0·0778
Kcal	1523	310	1509	325	0·691	1668	403	1663	423	0·900	1645	480	1635	455	0·783	0·0877
Fat																
g	59·5	14·8	60·3	15·7	0·622	65·9	18·4	66·1	20·3	0·920	61·1	23·4	61·4	23·3	0·876	0·6210
% FE	35·0	4·4	35·9	4·7	0·094	35·7	4·6	36·0	5·6	0·534	34·7	7·0	34·7	7·1	0·927	0·8606
% TE	35·0	4·4	35·9	4·7	0·094	35·4	4·7	35·6	5·6	0·696	33·0	6·9	33·4	7·1	0·461	0·0159
SFA																
g	23·4	6·6	24·9	7·0	0·056	24·1	7·3	25·7	9·0	0·046	22·2	9·4	23·4	10·2	0·120	0·2039
% FE	13·8	2·4	14·8	2·7	<0·001§	13·1	2·3	13·9	2·8	0·002	12·6	3·4	13·1	3·6	0·034	0·0095
% TE	13·7	2·4	14·8	2·7	<0·001§	13·0	2·4	13·7	2·8	0·003	12·0	3·3	12·6	3·6	0·012	<0·0001
MUFA																
g	20·9	5·5	19·6	5·4	0·021	24·3	7·6	21·8	7·1	<0·001§	21·7	8·9	20·1	8·0	0·011	0·8368
% FE	12·4	2·0	11·7	1·9	0·001§	13·1	2·4	11·9	2·4	<0·001§	12·3	3·0	11·4	2·8	<0·001§	0·5786
% TE	12·4	2·0	11·7	1·9	0·001§	13·0	2·5	11·7	2·4	<0·001§	11·6	2·9	11·0	2·8	0·002	0·0080
n-3 PUFA																
g	1·5	0·6	1·3	0·6	0·004	1·9	0·9	1·6	0·8	0·004	2·0	1·1	1·7	0·9	0·001§	<0·0001
% FE	0·9	0·3	0·8	0·3	0·002	1·0	0·4	0·9	0·4	0·007	1·1	0·5	1·0	0·6	0·001	<0·0001
% TE	0·9	0·3	0·8	0·3	0·002	1·0	0·4	0·9	0·4	0·007	1·1	0·5	0·9	0·6	0·004	0·0004
n-6 PUFA																
g	7·8	2·8	8·3	3·2	0·238	9·3	3·3	10·3	4·0	0·006	9·2	4·0	9·3	4·3	0·762	0·0007
% FE	4·6	1·4	4·9	1·5	0·087	5·0	1·3	5·6	1·8	<0·001§	5·3	1·6	5·3	1·9	0·930	<0·0001
% TE	4·6	1·4	4·9	1·5	0·087	5·0	1·3	5·6	1·8	<0·001§	5·0	1·6	5·1	1·9	0·688	0·0026
Trans-fat																
g	1·4	0·5	2·3	0·8	<0·001§	1·5	0·6	2·4	1·1	<0·001§	1·4	0·6	2·0	1·1	<0·001§	0·6511
% FE	0·8	0·2	1·4	0·4	<0·001§	0·8	0·2	1·3	0·4	<0·001§	0·8	0·4	1·1	0·5	<0·001§	0·9242
% TE	0·8	0·2	1·4	0·4	<0·001§	0·8	0·2	1·3	0·4	<0·001§	0·8	0·4	1·1	0·5	<0·001§	0·2817

FE, food energy; TE, total energy.
* Total energy intake includes alcohol intake.
† *P* value represents the difference between the present survey and previous surveys.
‡ *P* for trend indicates a trend across the three age groups.
§ *P* value <0·001.

Table 4. Percentage contribution of food types to average daily total fat intake, by age and sex

	Males				Females				All				
	4–10 years	11–18 years	Subtotal boys	19–64 years	4–10 years	11–18 years	Subtotal girls	19–64 years	1·5–3 years	4–10 years	11–18 years	19–64 years	*P* for trend across ages
Bases (*n* unweighted)	119	114	233	181	119	110	229	253	121	238	224	434	
Food type													
Cereals and cereal products	23	22	22	17	22	21	22	19	16	23	22	18	<0·0001
Pasta, rice and other miscellaneous cereals	6	8	7	5	4	8	6	5	4	5	8	5	0·1771
White bread	2	2	2	2	2	2	2	2	2	2	2	2	0·7544
Wholemeal and all other breads	2	1	1	1	0	1	0	2	1	1	0	1	0·0073
Breakfast cereals	2	1	1	1	1	1	1	1	1	1	1	1	0·3063
Biscuits	5	4	5	3	5	4	5	4	4	5	4	3	0·0011
Buns, cakes, pastries and fruit pies	5	4	5	3	7	4	5	3	3	6	4	3	<0·0001
Milk and milk products	20	13	16	14	21	14	17	12	36	20	13	13	<0·0001
Whole milk (3·8 % fat)	6	3	4	2	4	2	3	1	17	5	2	2	<0·0001
Semi-skimmed milk (1·8 % fat)	3	3	3	2	3	2	3	3	3	3	2	2	0·0191
Skimmed milk	0	0	0	0	0	0	0	0	0	0	0	0	<0·0001
Cheese	5	4	5	7	7	6	6	5	7	6	5	6	0·8291
Yogurt, fromage frais and other dairy desserts	2	1	1	1	2	1	2	1	4	2	1	1	<0·0001
Ice cream	3	2	2	1	3	2	2	1	2	3	2	1	<0·0001
Eggs and egg dishes	2	3	3	4	3	3	3	4	4	3	3	4	0·0002
Fat spreads	11	8	10	9	9	8	8	10	10	10	8	9	0·8278
Butter	4	3	4	2	2	2	2	3	3	3	2	3	0·6733
Reduced fat spread	6	4	5	6	5	5	5	5	6	6	5	5	0·6350
Low-fat spread	1	1	1	1	1	1	1	1	1	1	1	1	0·1291
Meat and meat products	19	26	23	27	20	23	22	24	15	19	25	26	<0·0001
Bacon and ham	1	3	2	3	1	1	1	2	0	1	2	2	0·0009
Beef, veal and dishes	2	3	3	4	2	3	3	5	2	2	3	5	<0·0001
Lamb and dishes	1	1	1	2	1	1	1	2	1	1	1	2	0·0009
Pork and dishes	0	1	1	2	1	1	1	1	0	1	1	2	0·0003
Coated chicken and turkey	2	4	3	1	3	2	2	1	2	2	3	1	0·0008
Chicken and turkey dishes	3	5	4	5	3	5	4	6	1	3	5	5	<0·0001
Burgers and kebabs	1	3	2	2	1	2	2	1	0	1	2	1	0·1631
Sausages	4	3	4	4	5	4	4	3	5	5	3	4	0·0095
Meat pies and pastries	3	3	3	2	3	3	3	2	3	3	3	2	0·2368
Fish and fish dishes	3	2	2	4	2	2	2	5	3	3	2	5	<0·0001
White fish coated or fried including fish fingers	2	1	2	1	1	1	1	2	2	2	1	1	0·1979
Other white fish, shellfish or fish dishes and canned tuna	1	0	0	1	0	1	1	1	0	1	0	1	0·0002
Oily fish	1	0	0	2	1	1	1	2	1	1	1	2	<0·0001
Vegetables and potatoes	8	11	10	11	8	11	10	12	6	8	11	11	0·0001
Vegetables (not raw) including vegetable dishes	2	1	2	3	2	2	2	4	2	2	2	4	<0·0001
Chips, fried and roast potatoes and potato products	6	9	7	7	6	7	7	5	4	6	8	6	0·2042
Other potatoes, potato salads and dishes	1	0	0	1	0	1	1	1	1	1	1	1	0·0120
Savoury snacks	5	5	5	3	5	6	6	3	3	5	6	3	<0·0001
Nuts and seeds	1	1	1	1	0	1	1	2	1	1	1	1	<0·0001
Fruit	0	0	0	0	0	0	0	1	1	0	0	1	0·0105
Sugar, preserves and confectionery	5	6	5	3	5	5	5	4	4	5	6	3	<0·0001
Chocolate confectionery	4	5	4	3	4	5	4	3	3	4	5	3	0·0404
Non-alcoholic beverages	0	0	0	1	0	0	0	0	0	0	0	0	0·0003

The major contributors differed with age, the contribution of milk and milk products decreased with age (30 % for those aged 4–10 years, and 22 % for those aged 11–18 years and adults; P for trend $<0{\cdot}0001$), while the contribution of meat and meat products to *trans*-fat intake increased with age (17 % FE for those aged 4–10 years and 22 % for adults; P for trend $<0{\cdot}0001$) (the supplementary Table S1 for this article can be found at http://www.journals.cambridge.org/bjn).

Compared with previous surveys, the intake of *trans*-FA (in g as well as % FE and total energy) was significantly lower in all age and sex groups ($P<0{\cdot}001$ in all groups).

Unsaturated fat intake (MUFA, and n-3 and n-6 PUFA)

Intakes of unsaturated FA (MUFA, *n*-3 and *n*-6 PUFA) are shown in Table 1 (for sex groups combined), Table 2 (males) and Table 3 (females). MUFA provided 12·2–13·0 % FE across all age groups (4–64 years; Table 1). MUFA intake increased slightly with age for males, from 11·9 % FE for boys aged 4–10 years to 12·8 % FE for boys 11–18 years and adult men (Table 2, P for trend $<0{\cdot}001$). In females, MUFA intake varied from 12·4 % FE in girls 4–10 years to 13·1 % FE for girls aged 11–18 years and 12·3 % FE for adult women (Table 3, P for trend 0·58).

The major contributing food groups to MUFA intake were meat and meat products, cereal and cereal products, and milk and milk products (the supplementary Table S1 for this article can be found at http://www.journals.cambridge.org/bjn). For those aged 4–10 years, the major contributing food group to MUFA intake was milk and milk and products, which decreased with age (P for trend $<0{\cdot}0001$). The contribution of meat and meat products to MUFA intake increased with age (P for trend $<0{\cdot}0001$; the supplementary Table S1 for this article can be found at http://www.journals.cambridge.org/bjn).

Compared with previous surveys, MUFA intakes showed slight increases in absolute intakes as well as percentage FE for all groups, which was statistically significant in all sex-combined age groups (4–64 years) and sex-specific groups, except for boys aged 4–10 years: increases were 0·6 % FE (95 % CI 0·3, 0·9) for children aged 4–10 years; 1·1 % FE (95 % CI 0·8, 1·4) for children aged 11–18 years; 0·8 % FE (95 % CI 0·5, 1·1) for adults.

On average, *n*-3 PUFA intake provided 0·9–1·1 % FE for all age groups (4–64 years; Table 1). The intake of *n*-3 PUFA slightly increased with age, from 0·8–1·0 % for boys and girls aged 4–18 years to 1·1 % FE for adult men and women (Tables 1–3, $P<0{\cdot}001$). The food groups mainly contributing to *n*-3 PUFA intake were vegetables and potatoes, cereal and cereal products, and meat and meat products (the supplementary Table S1 for this article can be found at http://www.journals.cambridge.org/bjn).

Compared with previous surveys, an upward change was observed for the intake of *n*-3 PUFA for all groups with a significantly higher intake for children aged 4–10 years (0·08 % FE (95 % CI 0·03, 0·13) and adults (0·11 % FE (95 % CI 0·06, 0·17), although the differences in absolute terms were very small (0·08–0·28 g/d).

The intake of *n*-6 PUFA provided on average 4·5–5·2 % FE across all age groups (4–64 years; Table 1). Intake of *n*-6 PUFA increased with age, from 4·5 % for children aged 4–10 years to 5·2 % for adults. The main food groups contributing to *n*-6 PUFA intake were cereal and cereal products, meat and meat products, and vegetables and potatoes (the supplementary Table S1 for this article can be found at http://www.journals.cambridge.org/bjn). Compared with previous surveys, there was a slight decrease in the intake of *n*-6 PUFA, which was statistically significant for children aged 4–10 years (−0·8 g/d (95 % CI 0·03, 0·1)) and children aged 11–18 years (−1·0 g/d (95 % CI −0·4, 1·6)) when expressed as g intakes and only statistically significant in children aged 11–18 years (−0·6 % FE (95 % CI −0·4, 0·8)) when expressed as percentage FE ($P<0{\cdot}001$); thus, the direction was downwards for all groups for both absolute intakes and percentage FE.

Discussion

The results of the first year of the NDNS rolling programme indicated that intakes of fat and FA in the UK population showed a slight shift towards recommended dietary guidelines, compared with past NDNS. However, the intakes of total fat were still higher than recommended for many individuals, particularly men and younger girls, both groups having an average intake above the DRV. In addition, mean intakes of saturated fat were higher than recommended in all groups. Intakes of MUFA showed significant increases in most groups compared with past surveys, except for those aged 4–10 years. Intake of *n*-3 PUFA increased slightly, while that for *n*-6 PUFA declined slightly.

The intake of *trans*-fat has decreased significantly in the UK over recent decades. *Trans*-FA are derived from two sources in the diet: they occur naturally in meat and dairy products from ruminant animals, and are created artificially through food processing. The level of *trans*-fats from artificial sources has been reduced in recent years, which is in line with recommendations made by the Scientific Advisory Committee on Nutrition (SACN)[31]. This has resulted in lower total intakes of *trans*-FA but with a relatively higher contribution of *trans*-FA coming from natural sources. Hence, the contribution to *trans*-FA from cereal and cereal products was reduced from past surveys, while that from meat and meat products and milk and milk products was increased. Ideally, *trans*-FA from industrial sources should disappear from all foods. However, *trans*-FA will be available from ruminant sources and some *trans*-FA such as conjugated linoleic acid will remain and may have beneficial effects for health[32].

In general, the present results showed a trend for milk and milk products consumption to decrease with age, whereas the intake of meat and meat products increased with age, which explains the shift in food groups contributing to total fat, SFA, MUFA and PUFA intakes. Compared with previous surveys, the intake of meat has increased, with chicken and turkey being the most commonly consumed type of meat[25]. Intakes of fat and FA vary widely among national surveys carried out in different countries.

The European Health and Nutrition survey 2009 showed that total fat intake expressed as percentage FE was above the WHO recommended 30% FE in all European countries included in the present study[18]. Fat intake was particularly high in France (aged 7–9 and 10–14 years), Greece, Portugal (aged 7–9 years), Spain and the UK. Not only was total fat intake high, but also saturated fat intake exceeded the recommend level of 10% total energy in all these countries, with the exception of boys 7–9 years in Italy. PUFA intake was generally below the recommended intake of 6–11% FE.

In terms of food groups contributing to fat intake, the present results are similar to other studies: European Prospective Investigation into Cancer and Nutrition (EPIC)[33] and in an Irish national dietary survey[14] also found that milk and milk products together with meat and meat products made the greatest contribution to total fat intakes and were among the main contributors to SFA, MUFA and PUFA intake.

The main food sources of very long-chain *n*-3 PUFA are fish and shell fish. Despite a trend towards increasing *n*-3 PUFA intake observed in the present study, a small shift in consumption of oily fish to white fish, shellfish or fish products was observed[25]. However, it should be noted that in the 2008–09 data, canned tuna was categorised with white fish, shellfish or fish products, whereas in previous NDNS, canned tuna was classified with oily fish. A similar preference for white fish over oily fish has been observed in other studies, for example in the study of Sichert–Hellert *et al.*[34] in 2009. White fish contains less *n*-3 PUFA compared with oily fish; thus, there is still room to further increase *n*-3 PUFA intake by encouraging more consumption of oily fish rather than that of white fish.

In interpreting the present results, it is important to take into account its strengths and weaknesses. A major strength of the current NDNS is that 4 d food diaries were used to assess dietary intake of fats and FA compared with other national surveys that mainly used single 24 h dietary recalls[10,16,17], FFQ[10–12,15] or 2 d food diaries[13]. It has been shown that estimated food diaries measure food intake more accurately compared with FFQ[19–22], especially of commonly consumed products such as meat and meat products, fruits and vegetables, and milk and milk products.

Another strength of the NDNS is that the data were weighted according to socio-demographic differences between the composition of the survey sample and that of the total population of the UK, in terms of age by sex and Government Office Region[30]. By weighting, the data should closely represent the UK population. It may be that specific subgroups within the UK population have specific fat intakes that require specific monitoring or interventions, but this is beyond the scope of these analyses.

Notably, estimated food diaries were used in the present study, rather than weighed diaries, as used in previous NDNS. This was done to reduce the burden for participants, and this optimised response rates and completeness of dietary records. Bingham *et al.*[35] has shown that average food and nutrient intakes from weighted and estimated diaries were similar. Furthermore, a comparison study was conducted to compare repeat 24 h dietary recalls with 4 d food diaries, and these showed similar response rates[25]. Additionally, the diary was considered on balance to be a more flexible and adaptable method to cover the wide population age range in the survey and to cover every day of the week, whereas the 24 h recall method presented problems with interviews over the weekend. In addition, it was thought to be more suitable for young children who may have more than one carer.

The inclusion of both weekend days should be considered when interpreting the results, since it has been shown that there is day-to-day variation in the intake of some food and nutrients, particularly in certain age groups, such as older teenagers and young adults[36]. Alcohol and convenience foods are consumed more frequently by these groups on Fridays and Saturdays. For all age groups, Sundays remain a day with high meat and vegetable intake, thought to be due to the traditional Sunday lunch. However, fat intake does not seem to change over the weekdays[36], and thus the outcomes of the present study were probably not affected by this. Furthermore, selection of diary days in the subsequent years of the rolling programme has been adjusted so that when data from all years are combined, each day will be equally represented.

In addition, when comparing the data of the present study with previous NDNS results, the differences in duration of dietary assessment should be taken into account. Dietary assessment over 4 d will provide similar mean intakes to assessment over 7 d, but the variation will be different as the percentage of consumers of particular foods. Moreover, estimates of proportions of individuals above or below certain cut-off values, such as dietary recommendations for saturated fat intake, will be affected by assessments of different duration. Therefore, in order to enable comparison of the rolling programme data with that from the past NDNS, the past surveys of 7 d, specifically the 2000–01 NDNS of adults aged 19–64 years in 2000–01 and the 1997 NDNS of young people aged 4–18 years[8], have been recalculated for 4 d of assessment[29].

As with all survey methods that rely on self-reported behaviour, the use of estimated diaries is subject to problems of reporting error and bias, such as undereating and/or underreporting[37,38]. Underreporting is one of the major contributors to reporting error in dietary assessment studies. Research on underreporting in previous NDNS has shown that this could be up to 27–29% of energy needs in adult men and women[39] and up to 20–21% in young individuals[40]. Thus, underreporting could have led to underestimation of fat and FA intake, a factor that should be considered when interpreting the results. Doubly labelled water analysis currently being carried out on a subsample of the year 1 participants will allow estimation of underreporting in future work.

The FSA nutrient databank used for each NDNS will have had some amendments made to the food composition data compared with the data used in previous NDNS. We recognise that observed changes in nutrient intake may be due to having updated food composition data rather than changes in actual intake. For example, manufacturers have reduced the content of *trans*-fat in foods markedly in the last couple of years. However, it is important to continuously update the food

composition database so that it best reflects the foods as they are consumed.

The present results were compared with DRV in the UK. The DRV for fat and FA, as established by the Department of Health in the UK, applies to adults and children aged 5 years and above. It could be argued that specific DRV are needed for those aged under 5 years, especially since excessive intake at a younger age may potentially be associated with an increased risk of future chronic diseases[2,41]. Uauy & Dangour[41] have suggested that during the first 6 months of life, dietary fat should contribute 40–60 % of total energy to cover energy needed for growth; from age 6 months to 3 years, fat intake should gradually be reduced, depending on the physical activity of the child, to approximately 30–35 % of energy. However, these are recommendations for new guidelines and were not applied in the present study.

Although a slight improvement in fat and fatty acid intake in the UK population was observed in the first year of the NDNS rolling programme, there is still room for further improvement, especially concerning total fat and saturated fat intakes.

Household surveys have shown little change over the last year; however, purchases of foods containing high amounts of fat have shown some improvements over the past few years, for example the increasing preference for semi-skimmed milk over full-fat milk[6]. However, to achieve the current DRV regarding saturated fat intake, more drastic changes in fat intake in the UK are necessary. From consumers' studies, it has been suggested that it is very difficult to reduce fat intake[42]. The reason why this may be so is that fat in foods increases palatability. The food industry could therefore play a major role in reducing the fat content in foods, specifically saturated fat, while maintaining the same palatability.

In conclusion, although dietary intakes of fats and FA are moving in the direction of the dietary recommendations in the UK, there is still room for considerable improvement, particularly in levels of saturated fat intake.

Acknowledgements

The authors would like to thank the Operations Team at NatCen and all interviewers involved for the collection of data; statisticians Dr Adrian Mander and Mark Chatfield for contributions to the survey design; and Melanie Farron-Wilson and Mary Day at the FSA for contributions to food composition issues. We also thank all participants of the survey for providing their dietary information. G. K. P. analysed and interpreted the data, and wrote the manuscript. A. M. S., G. S., B. B., B. T., H. H. and C. R. designed, coordinated and supervised the survey. G. K. P. and A. O. prepared the data for analysis. C. J. P., C. R., A. O., S. K. N., C. W. and A. M. S. contributed to the interpretation of results and editing of the manuscript. S. P. contributed to survey design and data collection. A. O. provided statistical guidance and contributed to editing of the manuscript. All authors approved the final draft before publication. None of the authors has a conflict of interest to declare. The NDNS is funded by the FSA and the Department of Health.

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