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Estimation of typical food portion sizes for children of different ages in Great Britain

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It is often the case in dietary assessment that it is not practicable to weigh individual intakes of foods eaten. The aim of the work described was to estimate typical food portion weights for children of different ages. Using the data available from the British National Diet and Nutrition Surveys of children aged $1\frac{1}{2}$–$4\frac{1}{2}$ years (1992–1993) and young people aged 4–18 years (1997), descriptive statistics were obtained, and predicted weights were calculated by linear, quadratic and exponential regression for each age group. Following comparison of energy and nutrient intakes calculated from actual (from an earlier weighed intake study) and estimated portion weights, the final list of typical portion sizes was based on median portion weights for the 1–3- and 4–6-year age groups, and age-adjusted means using linear regression for the 7–10-, 11–14- and 15–18-year age groups. The number of foods recorded by fifty or more children was 133 for each of the younger age groups (1–3 and 4–6 years) and seventy-five for each of the older age groups. The food portion weights covered all food groups. All portion sizes increased with age with the exception of milk in tea or coffee. The present study draws on a unique source of weighed data on food portions of a large sample of children that is unlikely to be repeated and therefore provides the best possible estimates of children's food portion sizes in the UK.

Food portion sizes: Children: UK

Accurate energy and nutrient intakes can only be estimated if an accurate portion size of each food consumed is available alongside appropriate compositional data. Portion sizes can be difficult to obtain in both children and adults because descriptions in the absence of food scales are reliant on conceptualisation of food portion sizes.

Although average portion size data, derived from weighed dietary surveys, are available in the UK[1] no such data are available for children. Although not advised for use in assessing individual diets, these average portions are useful for pooled data of normal healthy individuals and have provided the data for tools to estimate individual food portion size such as the *Photographic Atlas of Food Portion Sizes*[2].

Most surveys of children's diets have been carried out using a variety, or combination, of methods to estimate food portion size, adding an extra burden to both researcher and participants. Thus food models, photographs and household measures have been used. In the absence of age-appropriate portion size data many of these tools have been based on adult portion sizes and could potentially introduce considerable error. Livingstone & Robson[3] point out, 'the assumption that inclusion of any quantification tool will improve the estimation capabilities of children has not been verified.' Thus it seems that no dietary assessment method is perfect, but practical considerations are an important part of improving compliance to study procedures. A list of typical food portions would therefore provide a useful tool in devising food portion estimation tools for the assessment of diets for children of different age groups.

The British National Diet and Nutrition Survey (NDNS) collected weighed intake data from nationally representative samples of 1675 children aged $1\frac{1}{2}$–$4\frac{1}{2}$ years[4] and 1701 young people aged 4–18 years[5] and thus provides the only large database from which the average portion sizes eaten by British children can be estimated. As food portion size will normally increase with age and, indeed, may be greater in the mid-teens than in adulthood due to higher energy demands[6],

Abbreviation: NDNS, British National Diet and Nutrition Survey.

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children's portion sizes must be calculated separately for the different age ranges. For comparison of the energy and nutrient intakes with recommendations it is convenient if these age ranges match those used for the UK dietary reference values[6], namely 1–3, 4–6, 7–10, 11–14 and 15–18 years.

The overall aim of the present study was to produce and test a set of typical food portion weights for children of ages 1–3, 4–6, 7–10, 11–14 and 15–18 years using food portion information from the recent dietary surveys of children (NDNS of children aged $1\frac{1}{2}$–$4\frac{1}{2}$ years and of young people aged 4–18 years).

Methods

Using the data available from the NDNS of children, average portion weights for different age groups were calculated. These were then substituted for actual weights in weighed food diaries of children surveyed in previous studies at the Universities of Dundee[7,8] and Edinburgh[9], and results of average energy and nutrient intakes were compared with those estimated using the actual portion weights.

The databases from the two NDNS surveys were obtained from the Data Archive at the University of Essex. Individual records on weights of food eaten (i.e. weight served minus leftovers) were extracted and merged with demographic information, for example, age and sex using Microsoft Access. Children were grouped according to the age ranges of the UK dietary reference values[6], namely 1–3, 4–6, 7–10, 11–14 and 15–18 years. Food portion information was examined and foods eaten by $\geq 1\,\%$ of all children were identified. These foods were then grouped by similar type and composition (for example, flake cereals consisted of the market leader for cornflakes and bran flakes, plus supermarket own brands) and a list was compiled of these grouped foods eaten by $\geq 2\,\%$ of all children. Typical portion sizes were calculated for all foods consumed by $\geq 10\,\%$ of all children. Typical portion sizes for foods consumed by only 2–9·9 % of all children were also calculated but were recorded as estimates. As some foods have different portion weights depending on the form in which they are weighed (for example, oranges with or without peel), it was necessary to apply a factor to some weights in order to report them in the same form as the majority of weights in the food grouping. This was done using standard published factors[10–13]. Food groupings were allocated a new code and food name in order to ease future calculations. Different codes (where number of consumers permitted) were allocated to foods likely to have different serving sizes dependent on the mode of use. Examples of these are: milk on cereal; milk as a drink; milk in tea or coffee; milk in a hot milky drink; cheese (average); cheese on bread; cheese on toast; baked beans (average); baked beans on toast.

The mean portion weight of each subject's consumption of each of the foods was calculated. This was carried out so that each subject contributed a single portion weight, thus avoiding the possibility that someone who always ate large or small portions could skew the results due to a high frequency of eating occasions. The data were then transferred to SPSS (versions 10–14; SPSS, Inc., Chicago, IL, USA) for further analysis. Distribution curves were produced for each food by age group. For the purposes of the present study all weights recorded were included unless they were less than 1 g. Thus the average portion encompasses the full range of possibilities including, for example, one crisp or pea. Statistical comparisons (parametric and non-parametric) were made for the portion sizes calculated for both boys and girls to assess if there was a need to report them separately. For each age group descriptive statistics were obtained, and predicted weights were calculated by linear, quadratic and exponential regression. The predicted values enabled portion weights to be estimated for age groups where $< 2\,\%$ of children consumed the food but, for the purposes of the present paper, weights are only given where the food was eaten by at least fifty subjects in each age group. Non-consumers were excluded from the portion size analysis.

The testing of the use of the calculated typical portion sizes has been summarised in an abstract[14] and will be reported in full in due course. In brief, fifty weighed food diaries collected for previous studies, from each of the three age ranges, 1–3, 4–6 and 11–14 year-old (no such data were available for the other age groups) were re-analysed for energy and nutrients using the actual and five calculated weights (mean, median, age-adjusted by linear, quadratic and exponential regression) for each food. Paired *t* tests were then used to detect significant differences in energy and each nutrient, derived from actual and calculated portion weights. The number of weighed food diaries analysed was a pragmatic choice based on availability and quality of the data. As the purpose of the study was to ascertain which calculation of portion size was most appropriate for each age group, any comparisons that showed significant differences were discarded. Where no statistical difference was apparent Bland–Altman plots were carried out to assess level of agreement[15].

Results

A total of 3374 weighed dietary records from the two NDNS provided data from which to extract portion weights. The number of children in each of the age groups 1–3, 4–6, 7–10, 11–14 and 15–18 years was 1457, 574, 481, 475 and 387 respectively, hence the minimum number of weighed records used to calculate an average portion weight for an age group was thirty-eight (10 % of the total).

Paired *t* tests on the data showed that the energy and nutrients calculated from median portion weights for the 1–3-year age group, median and age-adjusted linear regression for the 4–6-year age group and mean and age-adjusted linear regression for the 11–14-year age group gave no significant differences from those calculated using actual weights. All other estimated portion weights gave some nutrient values that were significantly different from those calculated using actual portion weights. Bland–Altman plots (for examples, see Figs. 1 and 2) to assess agreement, displaying the differences between the values calculated using the actual and the estimated weights, showed that the mean differences were small and that most of the individual values lay within 2 standard deviations of the mean. The final list of typical children's portion sizes was based on median portion weights for the 1–3- and 4–6-year age groups and age-adjusted linear regression for the 7–10-, 11–14- and 15–18-year age groups.

The number of foods recorded by fifty or more children is higher for the younger age groups (1–3 and 4–6 years) due to a larger sample size. Table 1 presents median portion sizes for 133 foods. Only seventy-five foods were eaten by

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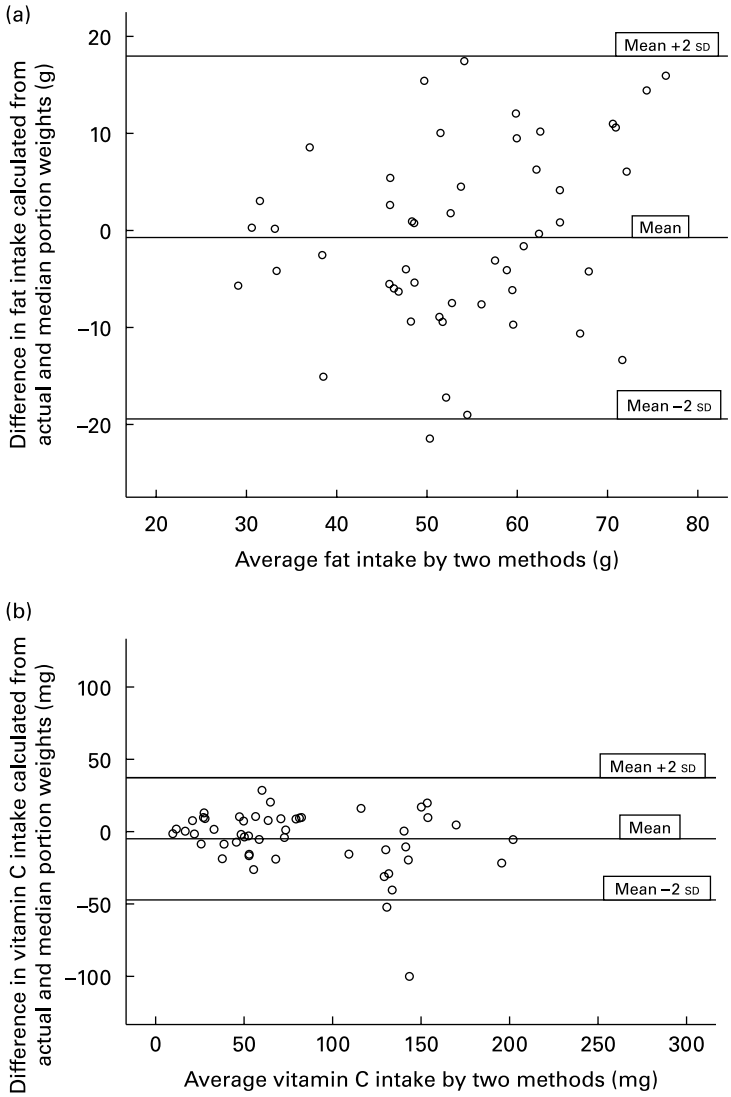

Fig. 1. Bland–Altman plots for fat (a) and vitamin C (b) intakes derived from actual and median calculated portion sizes for children aged 4–6 years.

fifty or more children in each of the older age groups and the age-predicted portion weights of these are reported in Table 2. The food portion weights presented in Tables 1 and 2 cover all food groups, including pasta, rice, pizza, bread, breakfast cereals, biscuits, cakes (1–6-year-old only), puddings (1–6-year-old only), milk (served in various forms), cheese, yogurt, eggs, meat, meat dishes, fish, vegetables (including potatoes in different forms), fruit, crisps and savoury snacks, chocolate and sugar confectionery, and beverages. Differences in food portion weights between boys and girls were seen for a small number of foods but these were not consistent across the age range, therefore typical portion weights are reported by age group but not by sex. At worst twenty-eight out of the seventy-five food portion sizes reported for the 15–18-year-old showed significant differences between girls and boys when using both non-parametric and parametric comparisons. However, the linear regression for this age group was run for the combined group of boys and girls, as the majority of foods showed no significant differences between sexes. The number of foods reported for this group would have been considerably lower if sex-specific portion sizes were given due to reduced sample size.

All portion sizes increased with age with the exception of milk in tea or coffee.

Discussion

Results from two large national dietary surveys provided a suitable database to calculate the typical food portion sizes of over 100 different foods. These portion sizes were shown to give similar mean results in nutritional analyses to using actual weights in fifty weighed food diaries from each of the age groups 1–3, 4–6 and 11–14 years. Details of the surveys that these data were originally collected for have been published[7–9] and although all tended to have a slightly higher proportion of girls than boys the samples covered all socio-economic groups and can be considered a representative sample of the population. In both the NDNS and these dietary

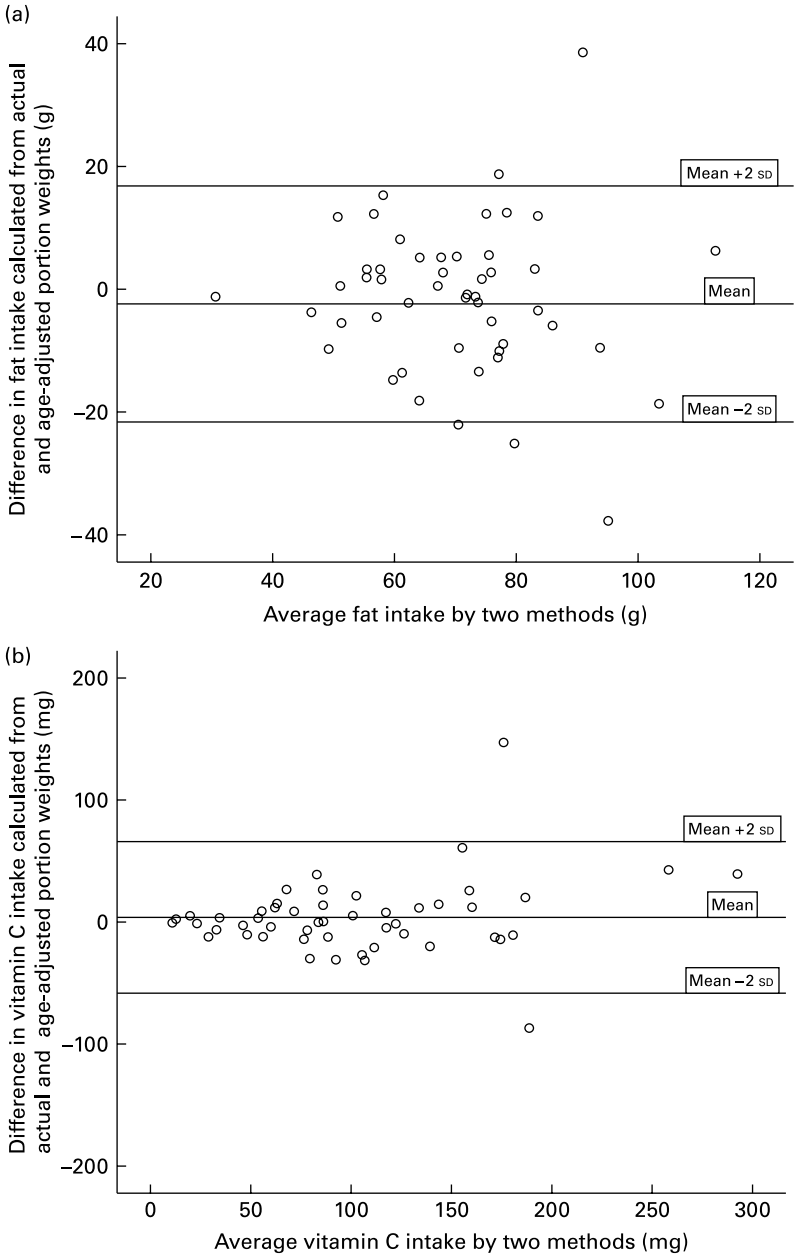

Fig. 2. Bland–Altman plots for fat (a) and vitamin C (b) derived from actual and linear predicted calculated portion sizes for children aged 11–14 years.

surveys about half of the participants had a head of household in a non-manual occupation[4,5,8] or with university entrance qualifications[7] or were in the most affluent deciles for a multiple index of deprivation.

No method of dietary assessment is perfect and the weighed intake method, despite being considered as the most precise method for estimating food and nutrient intake, is still subject to underreporting and is unsuitable for those who lack motivation or have poor numeracy and literacy skills[16]. Thus the food portions reported and the diaries used to test the data may not be representative of this group of the population. Nevertheless in the absence of anything else, the data provided in the present study are likely to provide some useful guidance for those who aim to assess children's food intake.

Using linear regression to predict portion weights for age groups where data were limited has allowed the assignment of typical portion weights for the whole age range. However, in the present study the data reported are limited to those calculations based on fifty subjects eating the particular food in each age group. This was a pragmatic choice but provides the reader with robust estimates as indicated by the CI given in Table 2. Despite higher intakes of energy intake by 15–18-year-old boys compared with girls[5] less than half of the median portion sizes were significantly different when boys and girls were compared. It was therefore decided to report a combined portion size for all foods and thus avoid reducing the number of items available due to the smaller sample size that would be obtained if the food portions were reported separately for boys and girls.

Table 1. Median portion sizes (g) and interquartile ranges (IQR) of a variety of foods consumed by children aged 1–3 and 4–6 years

Age range (years)…	1–3 (*n* 1457)			4–6 (*n* 574)		
Food group	*n*	Median	IQR	*n*	Median	IQR
Pasta and rice						
Pasta, boiled	337	63	37–94	202	84	52–118
Pasta, canned in sauce	458	86	50–126	214	84	51–125
Rice, boiled	172	50	30–77	124	77	45–100
Pizza						
Pizza, thin base	121	60	35–93	119	82	58–106
Other cereals						
Yorkshire pudding	253	22	11–42	117	35	20–51
Breads						
Bread, white and softgrain, sliced	994	31	22–42	464	46	36–61
Bread, wholemeal, brown and granary, sliced	486	30	20–42	164	48	30–61
Bread, white and softgrain, toasted	821	25	17–34	342	35	27–48
Bread, wholemeal, brown and granary, toasted	252	21	14–29	59	30	20–47
Bread, rolls, white	351	34	21–46	232	45	39–55
Bread, white, crusty	167	28	16–41	84	46	28–60
Crumpets/pikelets/Scotch pancakes	125	35	25–49	60	54	39–80
Breakfast cereals						
Rice Krispie-type cereals	428	18	11–26	223	24	17–34
Flake cereals	434	19	11–26	182	24	17–33
Weetabix	532	19	15–27	178	25	18–38
Coated cornflakes	229	21	14–30	155	30	21–36
Sugar-puffed cereals	152	19	12–26	72	26	18–32
Hoop or loop cereals	112	20	12–27	70	30	22–38
Biscuits						
Sandwich biscuits	468	16	12–24	192	21	14–27
Chocolate biscuits, fully coated sandwich	287	24	18–25	167	24	22–26
Short sweet biscuits	348	14	9–22	134	17	9–24
Digestive-type biscuits	239	15	13–23	114	21	14–30
Chocolate biscuits, fully coated biscuit only	148	20	14–23	86	24	19–26
Digestives, half-coated chocolate	140	17	13–25	74	25	17–32
Ice-cream wafer	145	5	3–5	78	3	3–4
Cheese-flavoured biscuits	113	17	9–29	66	26	16–31
Cookies	122	14	10–22	85	20	15–30
Crackers	107	9	7–16	71	16	11–22
Buns, cakes and pastries						
Sponge sandwich cake with filling (sponge made with fat)	132	35	23–52	79	45	28–60
Fairy/fancy cakes	124	28	21–40	98	36	28–55
Chocolate mini rolls	80	26	23–28	51	27	25–31
Chocolate cake/gateau (sponge made without fat)	78	30	24–46	66	45	31–64
Slab cakes	79	33	23–44	50	43	27–60
Doughnuts, jam and iced	69	50	37–69	67	70	55–75
Yogurts, desserts and puddings						
Yogurt	526	119	90–128	207	122	100–133
Ice-cream	473	49	33–64	238	60	46–75
Fromage frais	348	53	43–61	174	52	44–61
Dairy desserts	163	60	48–78	90	63	56–90
Custard	139	79	50–112	98	90	75–120
Jelly	140	80	44–119	82	114	64–126
Choc ice	94	42	36–45	59	48	39–56
Milk and cream						
Milk on cereal	1268	80	54–107	524	101	73–130
Milk as a drink	1093	136	103–178	419	153	118–192
Milk in tea or coffee	576	54	32–79	196	49	30–69
Milk in a hot milky drink	118	129	94–181	110	172	118–202
Cheese						
Hard cheese	656	19	12–27	285	25	17–37
Hard cheese on bread	361	20	11–27	180	25	17–36
Hard cheese on toast	116	25	14–36	54	34	21–46
Cheese spread	215	13	7–16	96	15	12–23
Processed cheese	75	18	11–25	81	21	18–25
Eggs and egg dishes						
Eggs, boiled	287	50	31–58	119	50	30–60
Eggs, fried/poached	222	40	24–54	107	50	42–60
Butter, margarine and spreads						
Soft margarine and low-fat spread	1191	5	3–7	482	7	5–9
Butter	410	5	3–8	177	8	5–11
Meat and meat products and alternatives						
Sausages	588	42	24–57	297	50	36–68

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Table 1. *Continued*

Age range (years)...	1–3 (*n* 1457)			4–6 (*n* 574)		
Food group	*n*	Median	IQR	*n*	Median	IQR
Cooked chicken/turkey	565	28	16–47	241	47	30–69
Ham	387	18	11–26	222	23	16–38
Roast meat	343	24	12–38	122	41	23–65
Burgers	215	36	23–44	105	42	36–64
Bacon	192	15	9–24	103	25	15–42
Frankfurters	184	42	26–56	80	48	33–70
Sausage rolls	192	54	34–70	101	60	49–70
Chicken/turkey nuggets/fingers/goujons	140	47	32–67	197	61	42–75
Meat pies, including chicken	134	54	32–86	74	86	65–116
Processed cold meat	103	22	13–34	56	25	18–38
Chicken/turkey/vegetable burger	84	36	20–59	57	64	52–85
Fish and fish products						
Fish fingers	342	43	28–56	174	56	47–75
Oily fish, canned	162	23	15–40	79	41	23–58
Oily fish, canned on bread	105	23	15–36	66	36	22–56
Vegetables						
Carrots, raw	141	20	10–33	90	28	18–50
Tomatoes, raw	250	23	11–35	139	32	20–42
Cucumber, raw	224	16	10–27	171	22	14–30
Lettuce, raw	109	7	4–13	104	15	9–20
Carrots, boiled	788	23	13–35	336	34	21–45
Baked beans in tomato sauce	661	52	31–84	317	70	45–91
Baked beans in tomato sauce on toast	136	74	40–105	61	101	75–140
Peas/mixed vegetables, boiled	654	19	11–31	268	30	19–43
Cauliflower, boiled	270	23	12–40	118	37	21–60
Cabbage, boiled	239	19	10–35	106	37	21–59
Peas, processed	205	25	15–38	69	34	21–48
Broccoli, boiled	186	19	11–29	124	35	23–51
Sweetcorn, boiled	182	20	12–32	113	33	24–54
Brussels sprouts, boiled	161	18	9–31	53	35	16–45
Swede/turnip, boiled	157	22	12–40	60	30	18–40
Runner beans, boiled	94	15	7–25	55	28	14–40
Potatoes						
Potato chips	981	56	36–85	458	79	56–102
Roast potatoes	423	36	18–57	204	60	35–96
Potatoes, old, boiled	491	54	29–82	204	82	51–113
Potatoes, new, boiled	358	49	28–74	156	64	38–99
Potatoes, old, mashed	251	60	35–90	170	85	52–120
Potato waffles/fritters/hash browns	156	39	25–54	133	54	43–81
Potatoes, old, baked, weighed with skin	104	70	40–98	81	100	69–152
Fruit						
Apples, eating, weighed with skin and core	378	63	38–94	292	96	63–109
Apples, eating, flesh only	324	50	32–75	75	53	32–92
Tangerines/mandarins/clementines/satsumas, flesh only	224	49	37–65	106	60	46–72
Oranges, flesh only	178	59	36–107	61	87	50–115
Bananas, flesh only	677	68	47–88	276	86	63–101
Grapes	223	42	25–63	96	51	32–76
Raisins/sultanas	138	15	9–21	63	17	14–25
Fruit juice						
Fruit juice	492	110	77–140	259	140	105–189
Nuts and seeds						
Peanut butter, smooth	123	9	5–15	62	12	8–18
Sugar and preserves						
Sugar, white	699	4	2–5	344	5	3–7
Jam and marmalade	444	8	4–11	211	12	8–18
Syrup and honey	117	6	4–10	59	9	6–14
Sugar confectionery						
Chew sweets	234	18	12–34	140	23	14–36
Ice lollies	214	45	30–60	134	55	45–64
Boiled sweets	187	10	6–14	122	10	5–17
Sugar-coated jelly sweets	184	34	17–40	76	30	15–42
Gum sweets	110	21	10–35	66	22	10–34
Coated chew sweets	123	30	16–48	87	38	23–55
Chocolate confectionery						
Chocolate with/without addition	451	20	11–30	247	20	12–32
Kit Kat	170	21	20–22	135	22	21–26
Coated small sweets	315	25	14–36	137	26	15–37
Chocolate-covered caramel	161	29	16–33	96	26	18–43

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Table 1. *Continued*

Age range (years)...	1–3 (*n* 1457)			4–6 (*n* 574)		
Food group	*n*	Median	IQR	*n*	Median	IQR
Chocolate-covered caramel biscuit	94	27	20–32	62	31	28–45
White chocolate	248	20	12–31	73	14	10–26
Crisps, nuts and savoury snacks						
Crisps	712	25	17–28	407	26	24–28
Cereal-based snacks	474	20	13–24	224	21	18–25
Potato rings	195	29	15–30	90	30	23–30
Potato puffs	179	19	13–20	67	18	17–20
Soups, savoury sauces and pickles						
Soup	251	125	82–181	78	170	125–212
Gravy, thickened	730	30	17–45	261	43	25–52
Tomato ketchup	396	7	5–12	222	12	8–17
Mayonnaise	143	7	3–11	95	11	8–15
Gravy, unthickened	131	27	14–45	65	45	24–69
Marmite	173	2	1–3	67	2	1–3
Beverages						
Tea, infusion	543	86	59–114	179	108	84–137
Soft drinks, concentrated, not low energy	900	30	23–40	346	39	28–47
Soft drinks, carbonated, not low energy	659	145	109–187	360	200	150–258
Soft drinks, still, reconstituted (with and without sugar)	428	200	142–250	195	213	185–260
Soft drinks, concentrated, low energy	555	28	20–36	306	36	28–45
Soft drinks, carbonated, low energy	195	130	103–171	196	176	136–234
Milkshake powder	95	6	3–8	68	10	6–14

One hundred and thirty-three foods are reported for the 1–3- and 4–6-year age groups and seventy-five foods are reported for the 7–10-, 11–14- and 15–18-year age groups. These foods represent those most frequently reported in the NDNS of $1\frac{1}{2}$ to $4\frac{1}{2}$-year-old in 1992–1993 and 4–18-year-old in 1997. The portion weights of the most frequently reported foods together with portion information from packet foods will provide a tool for measuring nutrient intake in the absence of weighed food diaries but should be used with caution. It is important that the portion sizes reported are not simply used as default portion sizes as they are based on data that are now 13 and 9 years old and there are already data from the USA showing that portion sizes of specific foods, for example, soft drinks, hamburgers, and French fries have increased over the last 20 years[17,18]. However, some recent work from Liverpool, UK showed that although 9–10-year-old children's selection of fruit and vegetable portions were subject to a large variation, the median portion weights were similar to those reported here[19].

The data collected in this project can to be used to develop children's portion size assessment tools such as photographs and interactive computer software packages. The typical median and percentile information on these typical portion weights have already been used in developing and validating concise, simple tools to assess dietary intake of large groups of primary schoolchildren living in the UK (funded by the Foods Standards Agency and the Department of Health). Furthermore, a set of food photographs for children of different ages, based on portion weights supplied by this project, has been tested at the University of Newcastle[20,21]. This pilot work found that, at least for the limited range of foods tested, that providing children with images depicting age-appropriate portion sizes enabled them to estimate portions (as served) with accuracy approaching that of adults. This set of food photographs should form a complementary tool to the *Photographic Atlas of Food Portion Sizes* [2] produced for use with adults. The data will also be useful in dietary assessment for the NDNS rolling programme. In order to reduce respondent burden the new rolling programme[22] is moving away from the weighed intake method and pilot work is currently testing 24 h recall and unweighed diary methods. Both these methods require respondents (including children) to estimate the quantities they consume rather than weigh them. Tools to help adults estimate portion sizes are available but tools for children are urgently needed (Food Standards Agency, personal communication) and at the time of writing are about to be developed.

The data used in the present study were derived from the NDNS, which is the major dietary survey which influences nutrition policy in the UK. The results from this survey are used by government and it is clearly important that data that can be of benefit to the wider scientific community are fully and appropriately used. It is recognised that this type of survey has limitations but it remains the largest survey of its type in the UK (and indeed Europe), it is more representative of age, sex and region than anything else that has been or is currently available. In this respect, the survey is a unique source of weighed data on food portions and is not dependent on conceptualisation of food portions, food photographs or indeed estimates derived from adult weights. Many of the food model and photograph estimation aids used in the past were based on adult portion sizes (which are in themselves open to wide variation and possibly even greater subjective bias as concerns over obesity rise). This survey provides an evidence base of actual measured food portions and therefore circumnavigates vested interests that may wish to suggest 'ideal' portion sizes (as depicted on some labels). There is no doubt that portions sizes are changing and that actual measured data will provide a benchmark for a given time frame but at the very least they set parameters for possible ranges, many of which could not even have been imagined 30 years previously.

Table 2. Portion sizes (g) and 95 % confidence intervals of a variety of foods consumed by children aged 7–10, 11–14 and 15–18 years predicted from linear regression equations

Age range (years)...	7–10 (*n* 481)			11–14 (*n* 475)			15–18 (*n* 387)		
Food group	*n*	Predicted weight	95 % CI	*n*	Predicted weight	95 % CI	*n*	Predicted weight	95 % CI
Pasta and rice									
Pasta, boiled	176	130	126, 134	165	166	160, 171	161	202	194, 209
Pasta, canned in sauce	172	137	132, 142	96	165	157, 174	57	195	183, 207
Rice, boiled	137	116	112, 121	146	149	143, 155	124	183	175, 192
Pizza									
Pizza, thin base	167	120	114, 126	149	152	144, 159	103	185	173, 196
Other cereals									
Yorkshire pudding	114	48	45, 50	104	57	54, 61	104	68	63, 73
Breads									
Bread, white and softgrain, sliced	405	58	57, 59	385	71	70, 72	310	85	83, 86
Bread wholemeal, brown and granary, sliced	128	56	54, 57	109	68	66, 71	108	81	78, 85
Bread, white and softgrain, toasted	304	46	45, 47	289	56	55, 58	224	67	65, 69
Bread, rolls, white	245	56	54, 57	272	66	64, 68	216	76	74, 79
Bread, white, crusty	106	63	60, 66	114	80	77, 84	94	98	93, 104
Breakfast cereals									
Rice Krispie-type cereals	163	34	33, 35	127	43	41, 44	63	51	49, 54
Flake cereals	134	35	34, 36	139	43	41, 45	93	52	49, 54
Coated cornflakes	142	41	40, 42	101	51	49, 53	54	62	59, 65
Weetabix	111	34	33, 35	95	40	39, 42	57	47	45, 50
Biscuits									
Chocolate biscuits, fully coated sandwich	205	26	25, 26	144	27	26, 28	93	29	28, 30
Sandwich biscuits	137	30	29, 32	83	37	35, 39	52	44	41, 47
Chocolate biscuits, fully coated biscuit only	88	25	24, 26	72	28	27, 30	54	32	30, 34
Yogurts, desserts and puddings									
Yogurt	169	122	119, 125	143	129	125, 133	96	136	131, 142
Ice-cream	212	74	71, 76	166	84	81, 87	95	95	90, 100
Milk and cream									
Milk on cereal	410	131	129, 133	385	158	155, 161	244	185	181, 190
Milk as a drink	277	186	183, 190	182	214	208, 219	133	242	234, 250
Milk in tea or coffee	214	52	51, 54	258	49	47, 51	262	45	42, 48
Cheese									
Hard cheese	269	32	31, 33	274	38	37, 39	235	44	42, 46
Hard cheese on bread	170	33	32, 34	189	39	38, 41	183	46	44, 48
Eggs and egg dishes									
Eggs, fried/poached	107	54	52, 56	126	60	58, 63	109	67	63, 71
Eggs, boiled	113	54	52, 56	91	58	55, 61	58	62	57, 66
Butter, margarine and spreads									
Soft margarine and fat spreads	418	9	8·9, 9·2	406	11	10·7, 11·2	325	13	12·6, 13·2
Butter	132	10	9, 10	117	12	11, 12	112	14	13, 15
Meat and meat products									
Sausages	260	64	62, 65	225	74	71, 76	157	84	81, 89
Cooked chicken/turkey	231	67	64, 69	189	83	80, 86	175	100	96, 104
Ham	213	33	31, 34	204	39	37, 41	154	46	43, 49
Bacon	133	37	35, 39	145	44	41, 47	107	52	48, 56
Roast meat	95	60	57, 63	102	77	73, 81	70	94	89, 100
Sausage rolls	115	71	68, 75	91	81	76, 86	56	91	84, 98
Burgers	112	65	62, 68	109	80	76, 85	66	96	90, 102
Chicken/turkey slices	85	33	30, 35	100	42	39, 44	75	50	47, 54
Meat pies, including chicken	95	114	110, 119	93	142	136, 147	76	169	161, 178

Table 2. *Continued*

Age range (years)...	7–10 (*n* 481)			11–14 (*n* 475)			15–18 (*n* 387)		
Food group	*n*	Predicted weight	95 % CI	*n*	Predicted weight	95 % CI	*n*	Predicted weight	95 % CI
Fish									
Oily fish, canned	93	47	44, 50	92	57	54, 61	85	68	63, 72
Oily fish, canned on bread	75	45	42, 48	71	54	50, 58	64	64	59, 70
Vegetables									
Carrots, raw	82	39	36, 41	62	45	42, 49	60	52	47, 58
Cucumber, raw	180	26	24, 27	195	28	26, 30	167	31	28, 34
Tomatoes, raw	158	37	36, 39	178	43	41, 45	196	48	45, 51
Lettuce, raw	148	20	19, 21	190	24	22, 25	187	28	26, 30
Baked beans in tomato sauce	286	97	94, 100	265	119	115, 122	192	141	135, 146
Carrots, boiled	264	45	44, 46	241	56	54, 57	200	67	64, 69
Peas/mixed vegetables, boiled	221	43	42, 45	206	54	52, 56	146	66	63, 69
Broccoli, boiled	114	48	45, 50	94	61	58, 64	91	75	70, 79
Sweetcorn, boiled	118	50	48, 53	83	63	59, 67	84	76	70, 82
Cauliflower, boiled	91	56	53, 59	73	72	68, 76	66	88	82, 93
Potatoes									
Potato chips	425	111	109, 113	412	137	135, 140	333	165	161, 168
Roast potatoes	191	94	91, 97	191	123	118, 127	151	152	145, 158
Potatoes, old, boiled	162	111	108, 115	144	140	135, 145	125	170	163, 177
Potatoes, new, boiled	153	104	101, 108	128	134	128, 139	97	163	156, 171
Potatoes, old, mashed	156	124	120, 129	130	158	152, 164	80	193	184, 202
Potatoes, old, baked, weighed with skin	119	139	134, 145	134	169	163, 176	119	200	191, 210
Fruit									
Apples, eating, weighed with skin and core	257	93	92, 95	206	106	103, 109	145	119	115, 123
Bananas, flesh only	204	86	85, 88	149	95	93, 98	128	105	101, 109
Fruit juice									
Fruit juice	236	165	161, 168	222	192	187, 197	173	220	213, 227
Sugar and preserves									
Sugar, white	287	7	6·9, 7·3	300	9	8·4, 9·0	237	10	9·9, 10·8
Jam and marmalade	175	17	16, 18	118	21	20, 22	81	25	24, 27
Chocolate confectionery									
Chocolate with/without addition	210	31	30, 32	191	36	35, 38	132	42	40, 45
Kit Kat	176	28	27, 29	148	31	30, 32	83	34	32, 36
Chocolate-covered caramel	139	35	33, 36	123	38	36, 40	77	42	39, 45
Chocolate-covered caramel biscuit	97	41	39, 42	93	46	44, 48	58	52	49, 55
Crisps and savoury snacks									
Crisps	383	26	26, 27	362	28	27, 29	274	30	29, 31
Cereal-based snacks	218	23	22, 23	192	25	24, 26	97	27	26, 28
Savoury sauces and pickles									
Gravy, thickened	230	59	57, 61	229	74	71, 76	183	89	85, 92
Tomato ketchup	194	14	14, 15	161	17	16, 18	117	20	19, 21
Mayonnaise	128	13	13, 14	121	15	14, 16	157	18	16, 17
Beverages									
Tea, infusion	199	149	146, 152	233	182	178, 185	225	215	210, 220
Soft drinks, carbonated, not low energy	352	241	237, 245	385	286	281, 291	306	333	325, 340
Soft drinks, concentrated, not low energy	269	48	47, 49	205	57	56, 59	137	67	64, 69
Soft drinks, concentrated, low energy	260	47	46, 49	212	58	56, 59	102	68	66, 71
Soft drinks, carbonated, low energy	214	221	215, 226	216	261	255, 268	160	303	293, 312
Soft drinks, still, reconstituted	163	220	215, 225	144	236	228, 244	60	253	241, 264

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References

1. Food Standards Agency (2001) *Food Portion Sizes*, 3rd ed. London: The Stationery Office.
2. Nelson M, Atkinson M & Meyer J (1997) *A Photographic Atlas of Food Portion Sizes*. London: MAFF Publications.
3. Livingstone MBE & Robson PJ (2000) Measurement of dietary intake in children. *Proc Nutr Soc* **59**, 279–293.
4. Gregory JR, Collins DL, Davies PSW, Hughes JM & Clarke PC (1995) *National Diet and Nutrition Survey: Children Aged $1\frac{1}{2}$ to $4\frac{1}{2}$. Volume 1: Report of the Diet and Nutrition Survey*. London: H.M. Stationery Office.
5. Gregory J & Lowe S (2000) *National Diet and Nutrition Survey: Young People Aged 4–18 Years. Volume 1: Report of the Diet and Nutrition Survey*. London: The Stationery Office.
6. Department of Health (1991) *Dietary Reference Values for Food Energy and Nutrients for the United Kingdom. Department of Health Report on Health and Social Subjects* no. 41. London: H.M. Stationery Office.
7. Longbottom P, Wrieden WL & Pine C (2002) Is there a relationship between the food intakes of Scottish $5\frac{1}{2}$ to $8\frac{1}{2}$ year olds and those of their mothers? *J Hum Nutr Diet* **15**, 271–279.
8. Lietz G, Barton KL, Longbottom PJ & Anderson AS (2002) Can the EPIC food-frequency questionnaire be used in adolescent populations? *Public Health Nutr* **5**, 783–789.
9. Payne JA & Belton NR (1992) Nutrient intake and growth in pre-school children. Comparison of energy intake and sources of energy with growth. *J Hum Nutr Diet* **5**, 287–298.
10. Holland B, Unwin ID & Buss DH (1989) *Milk Products and Eggs, 4th Supplement to McCance and Widdowson's The Composition of Foods*, 4th ed. Cambridge: The Royal Society of Chemistry.
11. Chan W, Brown J, Lee SM & Buss DH (1995) *Meat, Poultry and Game, 5th Supplement to McCance and Widdowson's The Composition of Foods*, 4th ed. Cambridge: The Royal Society of Chemistry and MAFF.
12. Holland B, Unwin ID & Buss DH (1992) *Fruit and Nuts, 1st Supplement to McCance and Widdowson's The Composition of Foods*, 5th ed. Cambridge: The Royal Society of Chemistry and MAFF.
13. Nelson M, Atkinson M & Meyer J (1997) *Food Portion Sizes. A User's Guide to the Photographic Atlas of Food Portion Sizes*. London: MAFF Publications.
14. Barton KL, Wrieden WL, Longbottom PJ, Adamson AJ & Ogston SA (2003) How accurate are standard children's food portion sizes for estimation of dietary intakes of children of different ages? *Proc Nutr Soc* **62**, 85A.
15. Bland JM & Altman DG (1986) Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet* **i**, 307–310.
16. Gibson RS (2005) *Principles of Nutritional Assessment*, 2nd ed. New York: Oxford University Press.
17. Nielsen SJ & Popkin BM (2003) Patterns and trends in food portion sizes, 1977–1998. *J Amer Med Assoc* **289**, 450–453.
18. Young LR & Nestle M (2003) Expanding portion sizes in the US marketplace: implications for nutrition counseling. *J Am Diet Assoc* **103**, 231–234.
19. Mullarkey D, Johnson B & Hackett A (2007) Portion size selection of fruits and vegetables by 9- to 10-year-old children in Liverpool. *J Hum Nutr Diet* **20**, 459–466.
20. Foster E, Matthews J, Nelson M, Harris JM, Mathers JC & Adamson AJ (2006) Accuracy of estimates of food portion size using food photographs – the importance of using age-appropriate tools. *Public Health Nutr* **9**, 509–514.
21. Foster E, Matthews JNS, Lloyd J, Marshall L, Nelson M, Barton KL, Wrieden WL, Cornelissen P, Harris J & Adamson AJ (2007) Children's estimates of food portion size: the development and evaluation of three portion size assessment tools for use with children. *Br J Nutr* (Epublication ahead of print version 15 August 2007).
22. Ashwell M, Barlow S, Gibson S & Harris C (2006) National diet and nutrition surveys: the British experience. *Public Health Nutr* **9**, 523–530.

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