

Final Technical Report to the Food Standards Agency

Children's Food Portion Sizes: Estimation of typical portion sizes for children of different ages

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1. Executive Summary

1.1 Aims and Objectives

The overall aim of the project 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.

The individual objectives were:

- To extract food portion information from recent dietary surveys of children (NDNS of children aged 1½-4½ years and of young people aged 4-18 years).
- To collate current information on portion sizes of packaged and fast foods (commonly eaten by children) and of school meals.
- To produce a list of typical food portion sizes for each age range.
- To trial the use of typical food portion weights in dietary surveys.
- To recommend and justify the list of portion sizes for foods eaten by children.

1.2 Approach

1.2.1 Calculated Portion Weights

Food intake data of 3374 children aged 1½ to 4½ and 4 to 18 years, reported in the National Diet and Nutrition Surveys (NDNS) was standardised, merged and grouped in Microsoft Access by an age group allocated to each child to match the corresponding age ranges used for Dietary Reference Values. Food portion data were examined and foods eaten by ≥ 1% of all children were established. These foods were grouped by similar type and composition, and a list was compiled of grouped foods eaten by ≥ 2% of all children, and then reported by age group. It was decided to record portion size for all foods consumed by 10% or more of all children and that portion size for foods consumed by 2-9.5% of all children would be recorded as estimates. Food groupings were allocated a new code and food name in order to ease future calculations. Foods that were likely to have a different serving size depending on the mode of use (e.g. milk on cereal and as a drink) were allocated separate codes. The mean portion weight for each subject's consumption of each of the grouped foods was calculated and the data were transferred to SPSS for further analysis. The data were split by age group and thereafter statistical tests and calculations were carried out to obtain the mean, standard deviation, median, 25th and 75th percentiles, minimum and maximum, and predicted values 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.

A database was constructed in Microsoft Access to compare the use of the calculated portion sizes against actual weights recorded in food diaries collected for previous studies at the Universities of Edinburgh and Dundee. Food weights from 50 diaries in each of the age groups 1-3, 4-6 and 11-14 years were available and were entered into the database entry form and checked by a second researcher (no such data was available for the other age groups). The resulting tables were then linked to tables containing data on the calculated portion sizes and nutrient data (derived from the NDNS nutrient data bank), for the most commonly eaten food in each of the food groupings. This enabled the creation of a file containing the average daily nutrient consumption for each of the diaries using the calculated portion weights and the actual weights. Mean daily energy (kJ) and nutrient intakes for each subject's diary in the form of protein, fat, carbohydrate, total sugars, NSP, iron, calcium, folate, and vitamin C were exported to SPSS and paired t-tests carried out for each nutrient (derived from actual and calculated portion weights). If no statistical difference was apparent then Bland Altman plots were carried out to assess agreement.

1.2.2 Manufactured and catered portion weights

A range of companies including food manufacturers, supermarkets, restaurant chains and school meals' contractors were contacted and information on portion sizes used for children obtained. The final lists of manufactured and catered portion sizes (as weights served) were selected following the examination of the NDNS databases of foods eaten by children and as advised by the Food Standards Agency. Supermarkets were visited and an extensive search of websites made to obtain further information.

1.3 Key Findings

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. Overall 119 foods were consumed by 10% or more of children and 134 (for which portion sizes were stated as estimates) by 2-9.5%. The foods reported in the final list covered all food groups, including pasta, rice, pizza, bread, breakfast cereals, biscuits, cakes, puddings, milk, cheese, yogurt, eggs, meat, meat dishes, fish, vegetables, fruit, crisps and savoury snacks, confectionery and beverages.

Mean daily energy and nutrient values were calculated from the food diaries using the mean, median, and age adjusted portion weights. Each set of values was significantly correlated with their counterparts, calculated using the actual weights (e.g. energy using actual portion weight versus energy using each type of calculated portion weight). Paired t-tests showed that the energy and nutrient data from the following portion weights gave no significant differences from those calculated using actual weights:

- Age group 1(1-3y) median
- Age group 2(4-6y) median and age adjusted (linear regression)
- Age group 4(11-14y) mean and age adjusted (linear regression)

For the manufactured foods, package sizes were collected for an extensive range of foods that may be eaten by children. This included pasta dishes, pot snacks, pizza, individual packets of breakfast cereals, cereal and breakfast bars, biscuits (especially those marketed for children), desserts, milk drinks, cheese, fromage frais, yogurts, coated chicken and turkey, burgers, sausages, meat pies, potato products, fruit snacks, ice cream, savoury snacks and confectionery. Children's complete ready meals (a relatively recent introduction to supermarkets) were also included but most breads were excluded, as this information is included in the adult food portion book.

1.4 Technical Evaluation and Interpretation

As the calculated portion sizes could only be tested in three age groups it was necessary to use the data from the two younger age groups and the 11-14 year olds to deduce the most appropriate data for the 7-10 and 15-18 year olds. The age adjusted (linear regression) portion weights gave no significant differences in energy and nutrient values from those calculated using the actual weights for both the 4-6 and 11-14 year olds. It was also assumed that they provided more robust figures than the median or mean for some foods that were eaten by small numbers of children in some age groups. However the median values were the only ones that gave non-significant differences for the youngest age group and showed a better profile of non-significant p-values for the 4-6 year olds. Thus the final list of typical children's portion sizes was based on the following.

- Age Group 1 (1-3 year olds) - median
- Age Group 2 (4-6 year olds) - median

- Age Group 3 (7-10 year olds) - age adjusted (linear regression)
- Age Group 4 (11-14 year olds) - age adjusted (linear regression)
- Age Group 5 (15-18 year olds) - age adjusted (linear regression)

These, together with the extensive list of manufactured and catered portion sizes will be useful in assessing the diets of groups of children. In addition the typical weights can be used as a guide for researchers devising dietary assessment tools for children.

2. Glossary of Terms and Abbreviations

Age Group 1	1-3 years
Age Group 2	4-6 years
Age Group 3	7-10 years
Age Group 4	11-14 years
Age Group 5	15-18 years
Age-related predicted weight	Portion weight calculated for the middle of each age group from regression equations based on linear, quadratic and exponential models.
Bland Altman plots	A method, based on graphical techniques and simple calculations, to compare a new measurement technique with an established method. In this case the use of calculated typical portion sizes is compared with the use of weighed portion sizes in dietary analysis.
CHO	Carbohydrate.
Course Order	The order in which foods are typically eaten in a meal.
CPHNR	Centre for Public Health Nutrition Research (formerly the Centre for Applied Nutrition Research).
EXP / Exponential Regression	A calculation carried out in SPSS to obtain values which when entered into the equation $y = b_0(\exp(b_1(x)))$ provides an age-related predicted weight, where $x = \text{age}$ & $y = \text{portion weight}$.
g	gram.

kJ	kilojoule = 1000 joules A unit used to measure the energy value of a food.
LIN / Linear Regression	A calculation carried out in SPSS to obtain values which when entered into the equation $y = b_1(x) + b_0$ provides an age-related predicted weight, where x = age & y = portion weight.
NDNS Nutrient databank	A specially adapted nutrient databank used in the NDNS of children aged 1½-4½ years and updated for the NDNS of young people aged 4-18 years, containing nutritional information on over 6000 foods.
Mean	The average value.
Median	The median of a distribution divides it in two equal parts, such that half the cases in the distribution fall, or have a value, above the median, and the other half fall, or have a value below the median.
mg	milligram = 1/1000 of a gram.
ml	millilitre = 1/1000 of a litre
Microsoft Access	Access 2000, computer database software.
n	Number.
NDNS	National Diet and Nutrition Surveys – a major component of the Food Standards Agency's Dietary Survey Programme providing cross-sectional information on the dietary habits and nutritional status of nationally representative samples of the British population.

NSP	Non-starch polysaccharides: a precisely measurable component of foods. The best measure of dietary fibre.
QUA/ Quadratic Regression	A calculation carried out in SPSS to obtain values which when entered into the equation $y = b_0 + b_1(x) + b_2(x^2)$ provides an age-related predicted weight, where $x = \text{age}$ & $y = \text{portion weight}$.
Regression	If there exists an association between two variables (e.g. portion weights and age) this method estimates the value of one variable (portion weight) from knowledge of the other (age). Various models can be used to predict the relationship between the variables, e.g. linear, quadratic and exponential.
SD/ Std Dev	Standard deviation.
SPSS	Computer statistics software.
μg	microgram = 1/1000000 of a gram.
UK	United Kingdom.

3. Introduction

The dietary intake of groups of adult individuals can be estimated using the published food portion sizes¹ to assign weights to data collected from 24 hour recalls, diet histories, food diaries and food frequency questionnaires. In conjunction with published food composition tables² or nutritional information on food labels such surveys have been shown to provide information that is similar to that collected from the more costly and time-consuming weighed food record method³ or estimated food records.⁴ Food portion weights have been calculated from weighed dietary surveys and, as such, are based on average weights of a large variety of foods eaten by adults. Although not advised for use in assessing individual diets they are useful for pooled data of normal healthy individuals.

To date there has been no equivalent source of typical children's food portion sizes and the estimation of children's dietary intake, in cases where food weighing has not been possible, has been dependant on children's cognitive abilities or, in the case of younger children, the ability of parents to estimate portion sizes. As food portion size will normally increase with age and, indeed, may be greater at adolescence than in adulthood, children's portion sizes must be calculated separately for the different age ranges. Ideally these should match those used for the dietary reference values⁵ published by the Department of Health, namely 1-3, 4-6, 7-10, 11-14 and 15-18 years.

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 but as Livingstone⁶ points out, "the assumption that inclusion of any quantification tool will improve the estimation capabilities of children has not been verified." Nevertheless, a Norwegian study in older teenagers⁷ demonstrated good correlation for most nutrients when comparing the use of a quantitative food frequency questionnaire (portions estimated using household measures) and a 7-day weighed intake. An earlier study by Livingstone⁸ showed that the diet history method (using a range of methods to estimate portion size) tended to overestimate the energy intakes of 7-18 year-olds, whereas the weighed diet records tended to underestimate them. This was the conclusion after comparison with total energy expenditure measured by the doubly labelled water method. Thus it seems that no

dietary assessment method is perfect, but the easier a method the more likely it is that participants will comply. A list of typical food portions would therefore provide a useful tool in the assessment of diets for groups of children of similar age.

Recent studies of the dietary intake of children in the British National Diet and Nutrition Surveys have collected weighed intake data from nationally representative samples of 1675 children aged 1½-4½⁹ and 1701 young people aged 4-18 years¹⁰. Thus there is a large database from which the average portion sizes eaten by children can be calculated. Additionally several studies have been carried out in the Universities of Edinburgh¹¹, and Dundee^{12, 13} which have collected weighed food diaries from children aged 1½-13 years. These can be used to corroborate the values obtained from the NDNS. Information on standard portion sizes served for school meals can be collected from providers both in Dundee and other parts of the UK and portion weights of manufactured foods and fast foods eaten by children are available from supermarkets and from information supplied by the retailers and manufacturers.

Collation of a set of children's portion sizes will enable surveys to be carried out without the need for weighed food diaries and should thus improve compliance. It should also enable realistic portion sizes to be assigned in surveys carried out using food frequency questionnaires. Nevertheless it must be pointed out that the use of typical portion weights are limited and should not be used to provide a reliable estimate of the diet of individuals.

4. Aims and Objectives

The overall aim of the project 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

The individual objectives were:

- To extract food portion information from recent dietary surveys of children (NDNS of children aged 1½-4½ years and of young people aged 4-18 years).
- To collate current information on portion sizes of packaged and fast foods (commonly eaten by children) and of school meals.
- To produce a list of typical food portion sizes for each age range.
- To trial the use of typical food portion weights in dietary surveys.
- To recommend and justify the list of portion sizes for foods eaten by children.

5. Experimental Procedures

5.1 Overview

Using the data available from the NDNS of children aged 1½-4½ years and of young people aged 4-18 years average portion weights for different age groups were calculated and tested using weighed food diaries of children surveyed in previous studies at the Universities of Edinburgh and Dundee. Retail outlets, restaurant chains, supermarkets, food manufacturers and school meals' suppliers were contacted to obtain information on packaged and ready to eat foods consumed by children.

5.2 Methods

5.2.1 Calculated Portion Weights

The databases from the NDNS were obtained from the Data Archive at the University of Essex and individual records on weights of food eaten (i.e. served minus leftovers) were extracted. This data was standardised, merged and grouped in Microsoft Access by an age group allocated to each child to match the standard age ranges of the Dietary Reference Values⁵. Food portion information for 1457 children in age group 1 (1-3 years), 574 in age group 2 (4-6 years), 481 in age group 3 (7-10 years), 475 in age group 4 (11-14 years) and 387 in age group 5 (15-18 years) were examined and groups of similar foods eaten by $\geq 1\%$ of all children were established. These foods were grouped by similar type and composition and a list was compiled of grouped foods eaten by $\geq 2\%$ of all children, (see Appendices 1 and 2). It was decided to record portion size for all foods consumed by more than 10% of all children and that portion size for foods consumed by 2-9.5% of all children would be recorded as estimates. As some foods have different portion weights depending on the form in which they are weighed (e.g. 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. These factors are given in appendix 3 e.g. oranges weighed with peel and pips were multiplied by 0.72 to ensure consistency with the majority, which were weighed without peel and pips.

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. These were: milk on cereal; milk as a drink; milk in tea/coffee; hot drink made with milk; milk

in a milkshake; cheese (average); cheese on bread; cheese on toast; cheese on baked potato; tuna (average); tuna on bread; 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 in order to eliminate bias due to some children consuming a food more frequently than others. The data were then transferred to SPSS for further analysis. Distribution curves were produced for each food by age group. 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.

The data were split by age group and statistical tests and calculations were carried out to obtain the mean, standard deviation, median, 25th and 75th percentiles, minimum and maximum, and predicted weights calculated by linear, quadratic and exponential regression, (see Appendix 4). The predicted values enabled portion weights to be estimated for age groups where <2% of children consumed the food. Predicted weights (y) were calculated by obtaining values for b_0 b_1 b_2 from SPSS regression calculations on portion weights and entering them into equations in excel as follows linear $y = b_1(x) + b_0$; exponential $y = b_0(\exp(b_1(x)))$; quadratic $y = b_0 + b_1(x) + b_2(x^2)$ where x = the mean age of the NDNS data for each age group. The number of records included in each regression analysis was equal to the number of consumers for the food being tested.

Testing: To test the use of the calculated typical portion sizes, 50 weighed food diaries collected for previous studies in Edinburgh¹¹ and Dundee^{12, 13}, from each of the three age ranges, 1-3, 4-6 and 11-12 year olds were reanalysed for energy and nutrients using the actual and 5 calculated weights (mean, median, age-adjusted by linear, quadratic and exponential regression) for each food, (no such data was available for the other age groups). A database was constructed in Microsoft Access to validate the calculated portion sizes against the weighed food diaries. Weights of the foods in each diary were entered into the database entry form and checked by a second researcher. Any foods where no calculated portion weight was available e.g. steak, were entered in the missing foods part of the data entry form for further inspection. The resulting tables were then linked to tables containing data on the calculated portion sizes and nutrient data (derived from the NDNS nutrient databank

used for the 4 to 18 NDNS⁹) for the most commonly eaten food in each of the food groupings. This enabled the creation of a file containing the average daily nutrient intake for each of the diaries using the calculated portion weights and the actual weights. Mean daily energy (kJ) and nutrient intakes for each subject's diary in the form of protein, fat, carbohydrate, total sugars, NSP, iron, calcium, folate, and vitamin C were exported to SPSS. Statistics (paired t-tests) were then computed for each nutrient, derived from actual and calculated portion weights. 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 statistical difference were discarded. Where no statistical difference was apparent Bland Altman plots were carried out to assess level of agreement.

5.2.2 Manufactured and catered portion weights

A range of companies including food manufacturers, supermarkets, restaurant chains, and contractors and local authorities, serving school meals were contacted and information on portion sizes used for children was obtained. The foods selected for the final list of manufactured and catered portion sizes were advised from examination of the databases of foods eaten by children and by the Food Standards Agency. Supermarkets were visited and an extensive search of websites made to obtain further information.

6. Results

6.1 Calculated Portion Weights

A total of 3374 weighed dietary records from the 2 NDNS^{9,10} 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 38 (10% of the total). The foods reported in the final list (Appendices 1 & 2) covered all food groups, including pasta, rice, pizza, bread, breakfast cereals, biscuits, cakes, puddings, 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 mean food portion weights between boys and girls were seen for a small number of foods but these were not consistent across the age range. Typical portion weights are thus reported by age group but not by gender.

Portion size calculated for all foods consumed by more than 2% of all children as mean, median, and linear, quadratic and exponential predicted portion weights are given in Appendix 4. Overall 119 foods were consumed by 10% or more of children and 134 (for which portion sizes will be stated as estimates) by 2-9.5%. The original research proposal stated that portion size would only be recorded for foods eaten by more than 15-20% of each age group. However as this would have eliminated many important foods this figure was reduced to 10% of each age group.

During the entry process for the weighed food diaries, foods which appeared more than once in one or more of the 3 age groups, and for which no calculated portion weights are available were: All Bran; artichoke roll; black pudding; bran flakes with additions; cauliflower cheese; chapattis; cheesecake; chocolate éclair; chicken drumsticks; cottage cheese; crispy pancakes; dhal; doner kebabs; dried fruit (large e.g. dates, apricots); fig rolls; French bread pizza; French toast/fried bread; fresh fruit salad; fried rice; fudge; grapefruit; lamb chops; meat (red) curry; milkshake syrup; muesli; noodle dishes; oatcakes; omelette; onion rings (in batter); pakora; pickled onions; popadums; potato scones; potato shapes; puff pastry; Raisin Splitz; Ready Brek (made up); rusks; scotch eggs; spaghetti and sausages; Special K; spring rolls; Start; steak; stewed fruit; stir fry; stovies/corned beef hash; tablet; trifle; uncoated white fish; and vegetable curry. These foods were excluded from the analysis, as no

typical portion sizes were available to compare to actual weights, and it was felt that substituting a weight of a similar food was defeating the purpose of the testing process which was comparing “like with like”. To be included in the testing process, the food had to be one of the foods used when compiling the grouped foods, i.e. consumed by >1% of the NDNS sample. The foods where no typical food portion size was available were on the whole either home made dishes where it would not be possible to calculate typical food portion sizes or foods where a manufactured portion weight would be given. It was not possible to provide typical food portion weight for these foods as none of the foods had been consumed by $\geq 2\%$ of the NDNS sample, therefore insufficient data was available to calculate estimated portion sizes.

The results of the paired t-tests carried out on the average daily nutrient intakes for each of the diaries using the calculated and actual portion weights, are reported in Appendix 5. The nutrient data from the following portion weights showed no statistical difference from those calculated using actual weights:

- Age Group 1 (1-3y): median
- Age Group 2 (4-6y): median and age adjusted (linear regression)
- Age Group 4 (11-14y): mean and age adjusted (linear regression)

All other estimated portion weights gave some nutrient values that showed a statistically significant difference from those calculated using actual portion weights.

Bland Altman plots (see Appendix 6) to assess agreement, displaying the differences between the values calculated using the actual and the above estimated weights, showed that the mean differences were small and that most of the individual values lay within 2 standard deviations of the mean difference.

As the calculated portion sizes could only be tested in three age groups it was necessary to use the data from the two younger age groups and the 11-14 year olds to deduce the most appropriate data for the 7-10 and 15-18 year olds. The age adjusted (linear regression) portion weights gave no significant differences in energy and nutrient values from those calculated using the actual weights for both the 4-6 and 11-14 year olds. It was also assumed that they provided more robust figures than the median or mean for some foods that were eaten by small numbers of children in some age groups (see Appendix 2). However the median values were the only ones that gave non-significant differences for the youngest age group and showed a better profile of non-significant p-values for the 4-6 year olds (see

Appendix 5). From observation of the differences between the nutrient values calculated from the actual and estimated weights the use of the following, as the final typical portion weights, are recommended:

- Age Group 1 (1-3y): median
- Age Group 2 (4-6y): median
- Age Group 3 (7-10y): age adjusted linear
- Age Group 4 (11-14y): age adjusted linear
- Age Group 5 (15-18y): age adjusted linear

Typical portion weights for each age group based on the above recommendation are given in Appendix 7.

6.2 Manufactured and catered portion weights (as weights served)

6.2.1 School Meals' Data

School meals' portion data were assimilated by contacting various school meals' suppliers. In some cases, these are the recommended minimum guidelines only and the actual portion sizes served will depend on the individual caterer. Average portion sizes for foods were difficult to provide as they varied according to the contractor/supplier. Portion sizes are reported by 'course order' (as would be found on a menu) and then alphabetically within 'course order' (see Appendix 8).

6.2.2 Fast Food Outlet and Restaurant Chain Data

Fast food outlets and restaurant chains were approached for children's food portion data. The portion sizes for those outlets that provided data were collated and are again presented by 'course order' and then alphabetically within 'course order' by fast food outlet/restaurant chain with children's complete meals reported at the end of the file (see Appendix 9).

6.2.3 Manufactured and Supermarket Foods

For the manufactured foods, package sizes were collected for an extensive range of foods that may be eaten by children. This included pasta dishes, pot snacks, pizza, individual packets of breakfast cereals, cereal and breakfast bars, biscuits, especially those marketed for children, desserts, milk drinks, cheese, fromage frais, yogurts, coated chicken and turkey, burgers, sausages, meat pies, potato products, fruit snacks, ice cream, savoury snacks and confectionery. Children's complete ready

meals (a relatively recent introduction to supermarkets) were also included but most breads were excluded, as this information is included in the adult food portion book. The process of data collection for manufactured and supermarket foods was complicated by the vast, and ever increasing, array of foods on the market. For this reason it was decided to omit certain 'character' foods (e.g. Harry Potter ranges) that may be transient. However, other children's 'character' foods (e.g. Little Miss and Mr Men) were included as such characters were thought to be more enduring. Manufactured portion data are reported by the food groupings as presented for the calculated average portion weights. The food items are subsequently listed alphabetically under each food grouping, the exception being the commercial toddlers' foods, which are arranged alphabetically by food manufacturer, as they are not familiar trademark names (see Appendix 10).

7. Discussion and Conclusions

Results from two large national dietary surveys provided a suitable database to calculate the typical food portion sizes of over 100 different foods and to provide estimates for a further 134 foods. These portion sizes were shown to give similar mean results in nutritional analysis to using actual weights in 50 weighed food diaries from each of the age groups 1-3, 4-6 and 11-14 years. However this validation was limited in that at least 50 foods across the three studies were excluded from the analysis, as no typical portion sizes were available. In this case the actual weight of these foods were excluded as well. In practice it would be expected that researchers would give the nearest possible weight or use a portion weight from the list of manufactured and catered portion sizes if they were analysing an estimated or unweighed diary. For a food frequency questionnaire or a similar tool where only known popular foods are listed this should not be a problem and the question then arises as to whether such a tool gives similar group results to a weighed diary. The Department of Health funded project to develop and validate a concise, simple tool to assess the dietary intake of large groups of primary schoolchildren living in the UK found that a 24 hour tick list questionnaire (using commonly consumed foods) gave slightly higher mean energy intakes than those calculated from weighed food diaries¹⁵. However because of the timescale of this project the sizes used were informed by preliminary results from this project and not the final ones and further work on testing the use of the portion sizes is advised.

A further limitation of the work is that the data used for calculation and testing (with the exception of the weighed food diaries from the 11-14 year olds) was 5 to 12 years old and there may have been a change in the foods and the amounts of food eaten by children. However the data on which the calculated typical food portions is of a comparable age, 10–11 years old for the NDNS of children aged 1½-4½ years⁹ and 5-6 years old for that of young people aged 4-18 years¹⁰.

It should be noted that within some age groups the number of records of a food was less than 10% of that age group although more than 10% for all children e.g. thin based pizza was eaten by <10% of 1-3 year olds but 19.5% of all children. In these cases estimates have been provided. In some cases the opposite was found and foods that were eaten by less than 10% overall were eaten by more than 10 % of some age groups e.g. garlic bread was eaten >10% of 7-10 year olds.

In conclusion, this project has enabled a set of typical children's food portions, for different age ranges, to be produced covering an extensive range of food items. These have been shown to give similar mean energy and nutrient values when used to analyse weighed food diaries of 50 children of 3 different age ranges. These portion sizes provide a quicker and less costly method than weighed intakes to assess the diets of groups of children. In addition, the typical weights can be used as a guide for researchers devising dietary assessment tools for children. Several enquiries have been received from other researchers wanting to use the typical food portion sizes generated by this project. In particular work has been carried out in collaboration with groups at the Universities of Newcastle and Leeds who are 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). For example a set of food photographs for children of different ages, based on portion weights supplied by this project, is being tested at the University of Newcastle. This should form a complementary tool to the Photographic Atlas of Food Portion Sizes¹⁴ produced for use with adults. The data will also be useful in the Low Income Diet and Nutrition Survey for estimating nutrient intake in low-income families.

Further studies to validate the use of typical food portions in dietary surveys of 7-10 and 15-18 year olds should be carried out. In addition it would be useful to assess the maximum number of food records in a survey that are needed to validate the use of the standard portion sizes. Computerised dietary analysis systems for children could also be developed, similar to those used for food frequency questionnaires for adults (e.g. Q builder from Tinuviel Software, Warrington).

7. Acknowledgements

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9. Appendices

1. List of grouped food names (showing foods included) for which portion weights were recorded, for all age groups.
2. List of grouped food names for which portion weights were recorded, by age group.
3. Factor alteration to synchronise certain foods included in new food categories.
4. Mean, median and linear, quadratic and exponential predicted portion weights, by age group.
5. Results of paired samples t-tests between selected nutrients derived from actual and calculated portion weights.
6. Bland Altman plots for selected nutrients derived from actual and linear calculated portion sizes.
7. Final typical portion weights.
8. School meals' portion weights.
9. Fast food outlets' portion weights.
10. Supermarket / food manufacturers' portion weights.