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Evans, CEL, Mandl, V, Christian, MS et al. (1 more author) (2016) Impact of school lunch type on nutritional quality of English children's diets. Public Health Nutrition, 19 (1). pp. 36-45. ISSN 1368-9800

https://doi.org/10.1017/S1368980015000853

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Impact of school lunch type on nutritional quality of English children's diets

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Running title: comparisons between school meal type

Key words: children, school meal, packed lunch, dietary quality, food intake, nutrients

Word Count: 3642

Acknowledgements

The authors acknowledge the involvement of schools and children for their involvement in the project

Financial Support

This research was funded by the University of Leeds and received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. This project was originally commissioned by the MRC NPRI (MRC registry code G0501297). The views and opinions expressed therein are those of the authors and do not necessarily reflect those of the NPRI programme or the MRC.

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Conflict of interest

CELE, VM, MSC and JEC have no further financial support. CELE, VM, MSC and JEC have no other relationships with companies that might have an interest in the submitted work. CELE, VM, MSC and JEC have no non-financial interests that may be relevant to the submitted work.

Statement on ethics

This study was approved by the University of Leeds Ethics Committee. The trial registry code is G0501297.

Author contributions

CELE and VM designed the research protocol and statistical analysis plan, VM and CELE wrote the first manuscript, carried out the analysis and contributed to all versions of the manuscript. JEC secured the funding for the original project and contributed to all versions of the manuscript. MSC managed the data collection of the NPRI project and contributed to the final version of the manuscript.

ABSTRACT

Background: Nutrient and food standards exist for school lunches in English primary schools although packed lunches brought from home are not regulated. The aim of this study was to determine nutritional and dietary differences by lunch type.

Design: A cross-sectional survey was carried out in 2007 assessing diet using the Child and Diet Evaluation Tool (CADET), a validated 24 hour estimated food diary. The data were analysed to determine nutritional and dietary intake over the whole day by school meal type; school meals and packed lunches.

Setting: 54 primary schools across England

Participants: 2709 children aged 6 to 8 years

Results: Children having a packed lunch consumed on average 11.0g more total sugars (CI 6.6 – 15.3g) and 101mg more sodium (CI 29 – 173mg) over the whole day. Conversely, children having a school meal consumed, on average, 4.0g more protein (CI 2.3 – 5.7g), 0.9g more fibre (NSP) (CI 0.5 – 1.3g) and 0.4mg more zinc (0.1 – 0.6mg). There was no difference in daily energy intake by lunch type. Children having a packed lunch were more likely to consume snacks and sweetened drinks; whilst children having a school meal were more likely to consume different types of vegetables and drink water over the whole day.

Conclusions

Compared with children having a school meal, children taking a packed lunch to school consume a lower quality diet over the whole day, including higher levels of sugar and sodium and fewer vegetables. These findings support the introduction of policies that increase school meal uptake.

INTRODUCTION

The increasing prevalence[1; 2] and economic burden[3] of childhood obesity in the UK, and elsewhere, have led to the UK Government's decision to introduce policies to improve the quality of children's diets. Research in this area has identified important dietary risk factors for obesity, which include a high proportion of energy dense foods high in fats and sugars as well as large intakes of sugar sweetened beverages.[1; 4; 5] In addition, low consumption of fruits and vegetables and fibre are strongly associated with a range of important health outcomes in adults including CVD and some cancers.[6; 7; 8] This has resulted in a number of western countries including the UK, focusing on improvements in school food and introducing school meal standards.[9; 10] Further changes in school meal policy are planned for 2014 whereby all young school children (aged 4 to 7 years) in England will be offered a free school meal.[11]

Food and nutrient based standards were introduced by law into primary schools in England between September 2006 and 2008[12; 13], and were based on recommendations from the School Meal Review Panel formed in 2006.[14] Before these standards, school meals had not been regulated for many years in the UK, although the Caroline Walker Trust provided recommendations in 2001 for schools to follow voluntarily.[15; 16] Information on how to implement the standards was consequently provided for schools by the School Food Trust. Nutrient based standards included minimum or maximum standards for a school meal (averaged over a menu cycle, commonly one to three weeks) for 13 nutrients and energy (energy alone had both a minimum and maximum recommended level).[17] In addition to the nutrient based standards, a number of foods were restricted such as low quality meat, savoury snacks and confectionery products in order to exclude foods high in sodium, saturated fats and sugars.[18] More nutritious foods such as fruit and vegetables and bread without spreads were made part of every school meal. When first introduced, the standards were enforced by Ofsted who inspect schools periodically; however, since the change of government in 2011, further amendments were made to the law and school compliance to the standards is no longer formally assessed.[19]

Cross-sectional studies carried out by the School Food Trust indicate that the quality of school meals has improved since the introduction of the school meal standards, both in primary schools[20] and secondary schools.[21] School meals are now higher in vegetables and lower in sugars and sodium than they were in

the past. Analysis of the Low Income Diet and Nutrition Survey[22] by Stevens and Nelson[23] reported similar findings: children who had a packed lunch had higher daily intakes of total fat, saturated fat and sodium at lunchtime than children having a free school meal in this study of low income children. A separate study of packed lunches only, also found that sugars, saturated fat and sodium were particularly high in children's packed lunches.[24] Although there is strong evidence that school meals have improved lunch-time intake for children, it is necessary to determine the impact of meal type on children's diets over the whole day to determine whether differences at lunchtime are maintained over the rest of the day. There are few published studies comparing the nutritional intake over the whole day by school meal type that have collected data after the introduction of the school meal standards in 2006. Evans et al. reviewed cross-sectional studies comparing daily intake by school meal type carried out before the introduction of standards,[25] and concluded that even before the improvements in school meals, packed lunches were less healthy in terms of sugars, fats and sodium. A recent study on older primary school children aged 9 to 10 years, published since the review and looking at consumption of specific foods by meal type, reported that children having packed lunches had more savoury snacks and importantly, that lunchtime intake makes a significant contribution to overall dietary intake.[26]

Approximately half of primary school children bring a packed lunch from home[27] and this has remained stable in the last few years.[26] The quality of packed lunches therefore remains a concern, and it is important that information on both packed lunches and school meals is periodically collected in order to assess the impact of policy changes affecting school lunches. [28] This study uses data collected from a large number of primary school children across England to determine the effect of meal type on important nutrients over the whole day, as well as the consumption of common children's foods.

METHODS

Study design

Data was collected in 2007 from 2709 children attending 54 primary schools randomly selected from all state schools across England. One class from year 2 was randomly sampled from each school. The schools reflected a wide range of social classes and ethnic backgrounds. The data analysed here are part of a cluster

randomised controlled trial and further details on sampling procedures are provided in the published trial protocol.[29] Power calculations were based on identifying differences in daily fruit and vegetable consumption of 0.5 portions with power of 80% and significance level of p less than 0.05.

Dietary data was collected using the "Child and Diet Evaluation Tool" called CADET which has previously been validated in a similar age group[30]. CADET is a paper-based 24-hr estimated food diary with foods separated into different categories and times of the day. During the school day the trained administrators completed the diary for each child. After school, parents recorded all the food their child ate during the day by ticking the foods their child consumed at each meal or snack time. CADET uses gender and age appropriate portion sizes for each food category that are estimated using results on portions from the children's NDNS.[31] In addition to dietary data, personal information was requested including gender, education level of parents, ethnicity and postcode (on which index of multiple deprivation (IMD) was estimated) and information on aspects of diet including school meal type. This tool was chosen for being one of the few valid but simple tools that accurately reflects the diet of children.

A selection of nutrients were analysed to determine whether there was a difference in daily nutrient intake between school meals and packed lunches. These included energy (Kcal and KJ/day), total and saturated fat (g/day), carbohydrate (g/day), starch (g), total sugar (g/day), protein (g/day), fibre (NSP) (g/day), calcium (mg/day), iron (mg/day), zinc (mg/day), folate (mg/day), vitamin A (mcg/day), vitamin C (mg/day) and sodium (mg/day). These nutrients were chosen because they are included in the nutrient standards for school meals.

A range of foods was analysed to determine differences in consumption by food type. The CADET diary contains 117 food groups; however, this included individual fruits and vegetables. Vegetables were categorised into five groups, namely dark green, red and orange, legumes, starchy and other. Fruits were categorised into two groups; fresh or frozen (combined) or dried. After combining fruit and vegetable types there were 85 food groups in total. Foods consumed by at least 10% of children were reported in the tables for ease of use.

Statistical analysis

All statistical analyses were carried out using STATA 11.0.[32] In order to compare nutrient intake multilevel regression modelling was used to take into account the clustering effect of children within schools. The variation in nutrients between children in a school having the same school meal may be smaller than variation for all children and therefore multilevel regression is required. A separate regression model was performed for each nutrient. The normality of the variables was checked by generating histograms and inspecting the mean value in comparison with the standard deviation. Variables showing a skewed distribution were transformed to the natural logarithm before carrying out any statistical tests. Model fit was checked by inspecting histograms of the residuals. Results were displayed unadjusted for all children (model 1) and adjusted for age, gender, index of multiple deprivation (IMD) in quartiles and ethnicity (model 2).

The percentage and 95% confidence interval of children consuming each food were calculated, as well as the percentage by each lunch type. In order to test whether children having a packed lunch were more or less likely to consume a certain food or drink, logistic regression was used to generate the odds of consuming each food compared with children having a school meal. P values and 95% confidence intervals were also generated. For each food, two models were presented, model 1 which was adjusted for clustering of children within schools only and model 2; a fully adjusted model adjusting for age, gender, IMD quartiles and ethnicity.

Children were excluded from the analysis if they had energy values above 4,000kcal per day. If there was no information on school meal type children were excluded from the regression models but were included in the descriptive analysis. These children were compared with children having school meals and packed lunches to assess any potential response bias.

RESULTS

Dietary data was collected from 2709 children. Thirty-seven children were excluded because of unfeasibly high daily energy intakes of more than 4000kcal, leaving 2672 children in the preliminary analysis. Background descriptive information on the total group and boys and girls only is provided in table 1. The children in this group have similar BMI values compared to national data collected by the Health Survey

for England for this age group.[33] There were no obvious differences between genders in terms of anthropometric measures.

Information on school lunch type was available from 2373 children; however this information was missing from 299 (11%) of children. The number of boys and girls was similar, with 50% of the total sample being boys. The proportion of boys and girls having a school meal, where information on meal type was available, was similar; 44% of boys had a school meal and 45% of girls had a school meal with the remaining children reporting taking a packed lunch. Some of the children with missing lunch information may have gone home for lunch. The results from the total sample of 2373 children indicated that anthropometric measures were similar in both groups of children, those having school meals and those having packed lunches.

Adjusting only for clustering within schools and no other factors, daily energy intake for boys and girls combined was similar for those having a school meal or a packed lunch. However, daily intake of some nutrients was different when comparing school meal type. Vitamin A and vitamin C were log transformed for analysis as they were not normally distributed. Children having a school meal had higher mean daily intakes of protein, fibre (NSP) and zinc (see table 2). Conversely, mean daily intakes of carbohydrate, total sugars and sodium were all higher in children taking a packed lunch to school. The results for boys and girls separately were broadly similar to the results from all children (data not shown). The adjusted models included fewer children due to missing data on ethnicity and IMD (see table 2). Differences in daily nutrient intakes between meal type, broadly remained the same in these models and were not attenuated for most nutrients. In the fully adjusted models children having school meals consumed higher amounts of protein, fibre and zinc and lower levels of total sugars and sodium as seen in the unadjusted models. In addition, daily folate consumption was also significantly higher in children having a school meal. These results were similar for boys and girls separately (data not shown).

Frequencies of consumption for all children, children having a school meal and children having a packed lunch were generated for all of the food groups from the CADET assessment tool. The results for 33 foods were consumed by less than 10% of the sample and were excluded from further analysis. The frequencies

and confidence intervals are displayed in table 3 for the 47 remaining foods plus total vegetables and total fruit. The most commonly consumed foods in this group of children were bread, spreads, milk, yoghurts, crisps (potato chips), vegetables and potatoes. The most common drinks were sweetened drinks and juices.

Odds ratios calculated for each food indicated that there were many foods that were more likely to be consumed (over the whole day) by children having a school meal; and other foods that were more likely to be consumed (over the whole day) by children having a packed lunch (table 4). The most popular foods more likely to be consumed by children having a packed lunch included bread, spreads, ham, cheese-spread, crisps, jam, yoghurt, chocolate biscuits, cake, cereal bars and dried fruit. Popular foods more likely to be consumed by children having a school meal included hot food such as all types of vegetables, including dark green vegetables and legumes, pasta, stew, fish fingers, pizza, sausages, rice, potatoes, gravy and custard. Children having a packed lunch were more likely to have sweetened drinks and fruit juice over the whole day while children having a school meal were more likely to drink water during the day.

DISCUSSION

This large survey of children across England investigated differences in daily consumption of important nutrients and foods, by school meal type, consumed at lunchtime. The results suggest that children having a school meal consume a healthier diet over the whole day compared to children who take a packed lunch to school. Children having a school meal, on average, consumed lower levels of total sugars and sodium and higher levels of protein, fibre, zinc and folate over the whole day. The differences were in the region of 5 to 10% for all nutrients. Children having a school meal were more likely to have all types of vegetables and drink water during the day; and were less likely to consume sweet and savoury snacks and sweetened drinks. These differences in foods consumed explain why, sugar and sodium consumption are lower and zinc, folate and fibre intakes are higher in children who have a school meal. There were no appreciable differences in energy, total fat or saturated fat intakes over the whole day between meal types.

The data from this study were collected in the same year the food standards for school meals were introduced into primary schools. The changes may not have been fully implemented in all schools; however, it was expected that if there was no improvement in packed lunches but an improvement in

177 school meals the gap may have widened compared with data from before 2006. A review of surveys
178 carried out between 1990 and 2007[25] reported that daily energy and saturated fat intakes were higher if
179 children had a packed lunch. However we did not see a difference in these nutrients. This may be because
180 food companies have made efforts to reduce saturated fat from snack foods such as crisps (potato chips), in
181 recent years and these improvements have affected packed lunches more than school meals.

182 The review of studies carried out between 1990 and 2007 broadly concurred with the results from this
183 study regarding sodium and sugar intakes. The children having packed lunches in this study had, on
184 average, equivalent to an extra two spoons (10g) of sugar per day than those having a school meal. This
185 equates to about a 10% difference in sugar consumption over the day for an average child. The higher
186 sugar intake of children having a packed lunch reflects the higher consumption of biscuits, yoghurts, cakes
187 and sweetened drinks in these lunches which has also been reported in other surveys[24; 34; 35]. The difference
188 in sodium consumption between meal types reported in this study is about 100mg, a smaller difference
189 compared with the review of studies before 2007. This attenuated difference could be due to lowered
190 sodium content of key lunchtime foods such as bread and crisps (potato chips). The food composition data
191 were updated prior to this analysis to reflect lower sodium levels of these foods. However, the lower
192 sodium intake by children having a school meal reflects the persistent difference in dietary pattern with
193 more meat, potatoes, gravy and vegetables consumed by children having a school meal and more bread,
194 spreads, ham, cheese spread and crisps by children having a packed lunch.

195 Previous research studies looking at lunchtime intake rather than intake over the whole day, generally
196 report larger differences in nutrient intake between lunch type, compared with whole day intake. A survey
197 of more than 10,000 primary school children carried out by the School Food Trust in 2009[36] reported
198 differences between lunch type of many of the same nutrients that were found in this study. We have
199 shown that the differences in lunchtime intake of some nutrients persist over the whole day but this was not
200 the case for all nutrients. The School Food Trust reported higher levels of total fat and saturated fat and
201 calcium in packed lunches which we did not see in our analysis of intake over the whole day. This
202 indicates that there may be some compensation during the rest of the day outside school for some nutrients
203 but not others. Stevens analysed nutrient intake of school meals and packed lunches from the Low Income

Diet and Nutrition Survey over both lunchtime and over the whole day and found that although there were differences in lunchtime intake by meal type these differences rarely persisted over the whole day. [37] This may have been because the sample size was smaller than our analysis and therefore the study was not powered to see more modest differences.

In the case of iron, few differences were seen between the two types of lunches on whole day intake. In the previous review[25], a higher content of iron in packed lunches was reported which may have been due to the financial restrictions of providing red meat in school meals. Compared with the recommended nutrient intake (RNI) for iron for this age group, both groups were on average consuming adequate amounts of iron.

Compared with the RNIs set by the Department of Health (DoH) mean values of starch, fibre and zinc were lower than recommended for the whole sample and sodium and sugar intakes were higher than recommended. The long term improved health impact of a decrease in the region of 10% of key nutrients such as sugars and sodium is not clear as the majority of the evidence available on diet and health outcomes is from research on adults not children. There is little published evidence that children who have a packed lunch are more likely to be overweight or obese or have worse health markers. Indeed, we saw no difference in daily energy intake by lunchtime meal type in this large study. However, a study in London on markers of CVD and type 2 DM risk by Whincup et al. reported that adolescents having school meals had significantly lower systolic blood pressure and fasting insulin levels[38] which may be linked to our results in terms of sugar and sodium consumption. A US school based study reported improvements in blood lipid profiles with the introduction of a healthier school lunch lower in total and saturated fat[39] providing some evidence of the potential importance of lunch time meals in children on long term health.

There are notable strengths of this study. It included a large number of children in more than 50 schools across the whole of England. The children were representative of the region with broadly similar levels of deprivation to the national average[40] and a similar proportion of children having a school meal compared to the national average of 45% at this time.[41] Compared to the National Diet and Nutrition Survey, intakes were generally higher in our survey, probably due to the difference in dietary assessment methodology.[42] Compared with the original NDNS carried out in 1997 in the UK, daily intake was higher

231 in energy and all nutrients with the exception of sodium in our study. A further strength was the advanced
232 statistical methods applied to these data. Multilevel regression analysis was used that took into
233 consideration the similarity of pupils clustered within schools, and furthermore, results were reported as
234 unadjusted and adjusted for social factors. Results were similar for both models indicating that age,
235 gender, ethnicity and deprivation were broadly similar in both groups.
236 There are limitations to the study that need to be highlighted. This study is based on a cross-sectional, self-
237 reported, one day food diary that uses estimated portion sizes based on age and gender. This may lead to
238 unreliable reporting of energy and nutrient intake. The difficulties of accurately measuring dietary intake
239 are well established.[42] Some of the parents did not complete the non-diet data and therefore the adjusted
240 models included fewer children which could result in bias.
241 In summary, half of families in England choose to send their child with a packed lunch to school and
242 children having a packed lunch generally consume a less healthy diet over the whole day, higher in sugars
243 and sodium and lower in fibre and zinc even after adjusting for IMD and ethnicity. Sweet snack foods and
244 drinks and savoury snacks are more commonly consumed by children having a packed lunch, findings
245 which are consistent with previous studies. In order to improve children's diets we recommend that
246 policies are implemented that increase the proportion of school children of all ages having a school meal.
247 Cost of school meals may be an important reason why more families do not choose a school meal and
248 historical data indicates that as the cost of school meals increases, uptake decreases.[43] Potentially
249 successful policies may include increasing the number of children eligible for a free school meal or
250 subsidising the cost of school meals. The current UK government has recently introduced free school
251 meals for all 4 to 7 year olds in England at a cost of £600M per year. We further suggest that high quality
252 prospective studies are carried out to determine the benefits of school meals to children on markers of
253 health such as blood pressure and blood sugars in order to quantify the health benefits by school lunch type.

Tables

Table 1 Characteristics of children and schools included in the analysis. Figures are not adjusted for clustering within schools

Descriptor	N	All children	Boys	Girls
Children (Mean(SD))				
Age (years)	2656	7.02 (0.30)	7.02 (0.30)	7.01 (0.30)
Weight (kg)	2652	25.1(4.8)	25.3 (4.6)	24.9 (4.8)
Height (cm)	2652	122.8(5.5)	123.4 (5.6)	122.2 (5.4)
BMI (kg/m2)	2651	16.6(2.3)	16.5 (2.2)	16.6(2.4)
Standardised BMI	2651	0.4(1.1)	0.4 (1.1)	0.3 (1.1)
Schools (Median(IR))				
Free School Meals (%)	2656	11(4,25)	11(4,24)	11(4,26)
KS2 achievement**	2441	4.2(3.9,4.4)	4.2 (3.9,4.3)	4.2 (3.9,4.4)
EAL (%)**	2656	2(1,9)	2 (1,7)	2 (0,10)
IMD score**	2282	16.8(9.4,30.9)	16.7 (9.4,30.8)	17.2 (9.4,30.9)

Abbreviations: SD: standard deviation; BMI: body mass index; EAL: English as a second language; IMD: index of multiple deprivation. KS2: Key stage 2 level (target is 4 for all students by age 11 years)
**Median and Interquartile range provided

Table 2 Mean (se) for anthropometric measures and daily nutrient intakes of 2373 children aged 6 to 8 years by school lunch type adjusted for clustering within schools only (model 1) and fully adjusted (model 2) for age, gender, ethnicity and Index of Multiple Deprivation (IMD)*. Results are for school meals compared with packed lunches

	School meal (n= 1053)	Packed lunch (n= 1320)	All children (n=2373)	Difference (model 1)	95% CI (model 1)	P value (model 1)	Difference (model 2)	95% CI (model 2)	P value (model 2)
Anthropometric measures									
Age (Years)	7.00 (0.01)	7.02 (0.01)	7.02 (0.01)	-0.02	-0.05 – 0.01	0.16			
Weight (kg)	25.2 (0.1)	25.0 (0.1)	25.1 (0.1)	0.2	-0.2 – 0.6	0.28			
Height (cm)	122.8 (0.2)	122.7 (0.2)	122.8 (0.1)	0.2	-0.3 – 0.6	0.45			
BMI	16.6 (0.1)	16.6 (0.1)	16.6 (0.1)	0.1	-0.1 – 0.2	0.38			
Standardised BMI	0.41 (0.03)	0.38 (0.03)	0.38 (0.03)	0.04	-0.04 – 0.11	0.34			
Energy/nutrients									
Energy (KJ)	6752 (80)	6884 (57)	6662 (53)	-132	-310 - 46	0.15	-98	-285 - 87	0.29
Protein (g)	57.4 (0.8)	53.4 (0.5)	53.9 (0.5)	4.0	2.3 – 5.7	<0.01	4.3	2.6 – 6.0	<0.01
Carbohydrate (g)	227.2 (2.6)	236.6 (2.0)	226.4 (1.9)	-9.3	-15.4 - -3.2	<0.01	-7.9	-14.4 - -1.5	0.02
Total fat (g)	58.0 (0.9)	59.3 (0.6)	57.5 (0.6)	-1.3	-3.3 – 0.6	0.18	-1.2	-3.2 – 0.9	0.26
SFA (g)	21.1 (0.4)	21.1 (0.2)	20.6 (0.2)	0.0	-0.8 - 0.9	0.95	0.1	-0.8 – 1.0	0.82
Total sugar (g)	118.7 (1.9)	129.6 (1.5)	120.9 (1.4)	-11.0	-15.3 - -6.6	<0.01	-10.3	-15.0 - -5.7	<0.01
Starch (g)	105.6 (1.0)	103.8 (0.7)	104.7 (0.6)	1.7	-0.7 – 5.1	0.3	2.3	-1.1 – 5.7	0.18
Fibre (g of NSP)	12.5 (0.2)	11.6 (0.1)	11.7 (0.1)	0.9	0.5 – 1.3	<0.01	1.0	0.5 – 1.4	<0.01
Calcium (mg)	739.0 (11.1)	734.6 (8.7)	716.9 (7.5)	4.4	-21.7 – 30.5	0.74	5.5	-22.3 – 33.3	0.39
Iron (mg)	9.4 (0.1)	9.3 (0.1)	9.1 (0.1)	0.1	-0.2 - 0.4	0.40	0.2	-0.1 – 0.5	0.15
Zinc (mg)	6.5 (0.1)	6.2 (0.1)	6.2 (0.1)	0.4	0.1 - 0.6	<0.01	0.40	0.2 – 0.6	<0.01
Folate (µg)	199.4 (2.8)	192.8 (2.1)	190.3 (1.9)	6.6	0.1 – 13.0	0.05	9.2	2.6 – 15.8	<0.01
Vitamin C* (mg)	81.5 (3.1)	82.3 (2.0)	78.3 (2.0)	2.4	-2.9 – 7.7	0.37	5.0	-0.6 – 10.7	0.08
Vitamin A* (µg)	6.3 (0.04)	6.31 (6.25)	533.8 (19)	11.8	-34.8 – 58.5	0.62	13.2	-14.6 – 41.1	0.35
Sodium (mg)	2045 (32)	2145 (21)	2057 (20)	-101	-173 – -29	<0.01	-91	-167 - -15	0.02

*calculated using natural logarithm. Abbreviations: SFA (saturated fatty acids)

Table 3: Percent of children (and 95% confidence interval) consuming each food type for all children (N=2672), children having a school meal (N=1053) and children having a packed lunch (N=1320) for foods consumed by more than 10% of all children.

Percent consuming Foods	All children (%)	95% CI (all children)	School meal (%)	95% CI (school meal)	Packed lunch (%)	95% CI (packed lunch)
Bread & Cereals						
Bread	76.7	75.1-78.3	63.2	60.2-66.1	90.2	88.5-91.8
Sugar cereals	11.6	10.4-12.9	11.9	9.9 – 13.8	11.5	9.8-13.2
Hi fibre cereal	27.3	25.6-29.0	28.1	25.4-30.8	28.9	26.5-31.4
Other cereals	27.4	25.7-29.1	27.4	24.7-30.1	28.9	26.4-31.3
Milk on cereal	46.4	44.6-48.3	47.3	44.3-50.3	49.4	46.7-52.1
Spreads	54.5	52.6-56.4	36.8	33.9-39.8	71.8	69.4-74.2
Jam	14.4	13.0-15.7	11.8	9.8-13.7	17.5	15.4-19.6
Snack foods						
Cake	34.0	32.2-35.8	38.7	35.8-41.7	31.3	28.8-33.8
Cereal bar	13.1	11.8-14.3	10.9	9.0-12.8	15.8	13.8-17.7
Chocolate biscuit	26.5	24.8-28.2	14.8	12.7-17.0	36.3	33.7-38.9
Other biscuit	25.9	24.2-27.5	25.5	22.9-28.2	26.8	24.4-29.2
Sweets	13.7	12.4-15.0	14.4	12.3-16.6	14.1	12.2-16.0
Chocolate	17.4	16.0-18.9	16.9	14.6-19.2	19.1	17.0-21.2
Crisps	40.7	38.8-42.5	24.1	21.5-26.7	55.1	52.4-57.8
Cheese/meat/fish						
Hard cheese	25.7	24.1-27.4	25.5	22.9-28.2	27.0	24.6-29.4
Cheese spread	17.4	15.9-18.8	8.7	7.0-10.4	24.8	22.4-27.1
Sliced chicken	18.5	17.0-20.0	21.9	19.4-24.4	17.7	15.6-19.7
Meat stew	12.7	11.5-14.0	15.4	13.2-17.6	11.4	9.7-13.2
Ham	23.6	22.0-25.2	13.0	11.0-15.0	32.9	30.3-35.4
Sausage	17.0	15.6-18.5	19.8	17.4-22.3	16.1	14.1-18.0
Pizza	10.5	9.4-11.7	13.2	11.2-15.2	7.3	5.9-8.8
Fish fingers	11.3	10.1-12.5	15.7	13.4-17.9	6.8	5.5-8.2
Gravy	16.0	14.6-17.4	24.5	21.9-27.1	10.3	8.7-11.9
Kétchup	13.3	12.0-14.6	14.6	12.5-16.8	13.1	11.3-14.9
Rice/pasta/potatoes						
Boiled rice	12.3	11.1-13.6	14.2	12.0-16.3	11.6	9.9-13.3
Plain pasta	8.0	6.9-9.0	10.1	8.2-11.9	6.4	5.1-7.8
Tomato pasta	6.7	5.8-7.7	8.3	6.6-9.9	5.4	4.2-6.6
Cheese pasta	3.8	3.1-4.5	6.0	4.5-7.4	2.3	1.5-3.1
Meat pasta	10.9	9.7-12.0	13.2	11.2-15.2	9.3	7.7-10.9
Boiled potatoes	36.9	35.1-38.8	51.0	48.0-54.0	28.6	26.1-31.0
Fried potatoes	32.0	30.3-33.8	42.0	39.0-45.0	25.6	23.2-28.0
Desserts						
Yoghurt	50.3	48.4-52.2	38.5	35.5-41.4	63.9	61.3-66.5
Ice cream	14.0	12.6-15.3	14.8	12.7-17.0	13.6	11.7-15.4
Custard	13.3	12.0-14.6	23.0	20.4-25.5	5.5	4.2-6.7
Fruits/vegetables						
Total vegetables	84.5	83.1-85.8	90.6	88.8-92.4	82.0	79.9-84.0
Dark green veg	18.5	17.0-19.9	24.3	21.7-26.9	15.8	13.9-17.8
Orange/red veg	46.4	44.5-48.3	48.7	45.7-51.7	45.8	43.1-48.4
Legumes	20.4	18.8-21.9	25.5	22.8-28.1	16.7	14.7-18.8

Starchy veg	32.1	30.3-33.9	40.2	37.2-43.1	28.0	25.5-30.4
Other vegetables	50.0	48.0-51.7	56.9	53.9-59.9	47.2	44.5-49.9
Total fruit	89.7	88.6-90.9	90.4	88.6-92.2	91.2	89.7-92.7
Fresh/tinned fruit	89.0	87.8-90.1	89.9	88.1-91.8	90.3	88.7-91.9
Dried fruit	10.0	8.9-11.1	5.6	4.2-7.0	14.3	12.4-16.2
Drinks						
Milk drink	59.7	57.9-61.6	64.8	61.9-67.7	57.7	55.0-60.3
Soft drink	52.9	51.0-54.8	44.4	41.4-47.4	62.1	59.5-64.7
Low cal drink	11.5	10.3-12.7	10.8	8.9-12.7	13.6	11.8-15.5
Juice	43.8	41.9-45.7	42.2	39.2-45.1	49.6	46.9-52.3
Water	78.1	76.5-79.7	86.5	84.4-88.6	73.6	71.3-76.0

Table 4 Probability of consuming each food type for children having a school meal compared with children having a packed lunch (odds ratios and 95% confidence intervals and p values).

Selected foods	Odds ratio (model 1))	95% CI (model 1)	P value (model 1)	Odds ratio (model 2)	95% CI (model 2)	P value (model 2)
Cereals						
Bread	0.17	0.13-0.21	<0.01	0.16	0.13-0.21	<0.01
Sugar cereals	1.04	0.80-1.33	0.79	1.08	0.83-1.42	0.56
Hi fibre cereal	0.96	0.80-1.15	0.66	0.99	0.82-1.19	0.88
Other cereals	0.91	0.75-1.09	0.30	0.93	0.76-1.13	0.46
Milk on cereal	0.92	0.78-1.08	0.31	0.93	0.78-1.10	0.40
Spreads on bread	0.22	0.19-0.27	<0.01	0.22	0.18-0.27	<0.01
Jamo on bread	0.63	0.50-0.81	<0.01	0.57	0.44-0.74	<0.01
Snack foods						
Cake	1.63.	1.33-2.01	<0.01	1.63	1.31-2.03	<0.01
Cereal bar	0.70	0.54-0.92	0.01	0.69	0.52-0.91	<0.01
Chocolate biscuit	0.29	0.24-0.36	<0.01	0.31	0.25-0.39	<0.01
Other biscuit	0.92	0.75-1.12	0.41	0.89	0.72-1.11	0.31
Sweets	1.03	0.82-1.31	0.78	1.07	0.83-1.38	0.61
Chocolate	0.86	0.70-1.07	0.17	0.85	0.68-1.07	0.16
Crisps	0.26	0.21-0.31	<0.01	0.26	0.21-0.32	<0.01
Cheese/meat/fish						
Hard cheese	0.89	0.73-1.09	0.27	0.85	0.69-1.05	0.13
Cheese spread	0.29	0.23-0.37	<0.01	0.30	0.23-0.39	<0.01
Sliced chicken	1.24	0.98-1.57	0.08	1.28	1.00-1.64	0.05
Meat stew	1.52	1.17-1.97	<0.01	1.59	1.21-2.10	<0.01
Ham	0.29	0.23-0.36	<0.01	0.29	0.22-0.36	<0.01
Sausage	1.38	1.08-1.75	<0.01	1.39	1.08-1.79	0.01
Pizza	2.02	1.48-2.76	<0.01	1.99	1.42-2.77	<0.01
Fish fingers	2.85	2.06-3.94	<0.01	2.62	1.85-3.71	<0.01
Gravy	2.67	2.05-3.46	<0.01	2.71	2.07-3.54	<0.01
Kétchup	1.17	0.92-1.50	0.21	1.23	0.95-1.59	0.12
Rice/pasta/potatoes						
Boiled rice	1.32	1.01-1.73	0.04	1.44	1.07-1.92	0.02
Plain pasta	1.57	1.13-2.19	<0.01	1.58	1.12-2.24	0.01
Tomato pasta	1.58	1.11-2.24	0.01	1.67	1.16-2.40	<0.01
Cheese pasta	2.62	1.60-4.27	<0.01	2.64	1.55-4.47	<0.01
Meat pasta	1.53	1.16-2.01	<0.01	1.56	1.17-2.08	<0.01
Boiled potatoes	2.74	2.26-3.32	<0.01	2.93	2.39-3.59	<0.01
Fried potatoes	2.13	1.75-2.59	<0.01	2.15	1.76-2.64	<0.01
Desserts						
Yoghurt	0.34	0.28-0.41	<0.01	0.34	0.28-0.41	<0.01
Ice cream	1.10	0.85-1.41	0.47	1.12	0.86-1.46	0.39
Custard	6.55	4.75-9.04	<0.01	6.43	4.58-9.02	<0.01
Fruits/vegetables						
Total vegetables	2.58	1.95-3.42	<0.01	2.63	1.96-3.55	<0.01
Dark green veg	1.72	1.36-2.16	<0.01	1.81	1.42-2.31	<0.01
Red/orange veg	1.33	1.10-1.61	<0.01	1.36	1.11-1.67	<0.01
Legumes	1.74	1.40-2.17	<0.01	1.66	1.32-2.09	<0.01
Starchy veg	1.85	1.53-2.24	<0.01	1.91	1.56-2.33	<0.01
Other veg	1.53	1.28-1.82	<0.01	1.58	1.32-1.91	<0.01
Total fruit	0.85	0.63-1.15	0.29	0.84	0.61-1.16	0.29

Fresh/tinned fruit	0.90	0.67-1.21	0.48	0.88	0.65-1.20	0.42
Dried fruit	0.35	0.25-0.48	<0.01	0.36	0.26-0.51	<0.01
Drinks						
Milk drink	1.23	1.02-1.48	0.03	1.23	1.01-1.50	0.04
Soft drink	0.46	0.38-0.55	<0.01	0.46	0.38-0.55	<0.01
Low cal drink	0.77	0.59-0.99	0.05	0.76	0.58-0.99	0.05
Juice	0.72	0.60-0.86	<0.01	0.78	0.65-0.94	0.01
Water	2.64	2.06-3.39	<0.01	2.71	2.09-3.52	<0.01

Abbreviation:IMD: index of multiple deprivation.

Model 1 (N=2373) is adjusted for clustering within schools only and model 2 (N=2172) is the fully adjusted model adjusted for age, gender, ethnicity and IMD quartiles (Index of multiple deprivation) in addition to clustering within schools.

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