

Daily Nutrient Intake Based on Lunch Time Meal Type in a Group of 11-14 Year Old Scottish School Children

Carina Norrison, Michael Clapham, Isobel Davidson and Laura Wyness*

School of Health, Queen Margaret University, Edinburgh EH21 6UU, U.K

*Corresponding Author: Laura Wyness, School of Health, Queen Margaret University, Edinburgh EH21 6UU, U.K.

Received: February 17, 2016; Published: June 08, 2016

Abstract

Background

The introduction of Scottish Nutrient Standards for School Lunches is a key component in improving the diet of the nation's school children. Lunch time meal options for Scottish school children include school meals, packed lunches and lunches purchased beyond the school gate.

Methods

To investigate the daily nutrient intake of secondary school children based on the three lunch types above and compares this with the nutrient standards. A cross-sectional analysis of 5-day estimated food diaries from 332 secondary school pupils aged 11-14 years was conducted.

Results

All lunch types had poor intakes of NSP, iron and fruit and vegetables, both at lunch time and over the whole day. Mean daily energy intake was 7.85 MJ (SD 2.48) for canteen lunches, 8.33 MJ (SD 2.18) for packed lunches and 9.1 MJ (SD 2.38) for street lunches. Mean daily saturated fat intake was for canteen lunches: 29.8g (SD 13.4), packed lunches: 34.1g (SD 14.3) and street lunches: 35.0g (SD 13.6). On canteen lunch days children consumed the least fat, SFA and NMES and the most folate and calcium. On packed lunch days children had the highest intakes of NSP, vitamin A, iron and fruit and vegetables.

Conclusion

Canteen lunch days showed the most favourable nutrient profile in terms of fat, SFA, NMES, folate and calcium. Packed lunch days showed the most favourable intakes of NSP, vitamin A, iron and fruit and vegetables. Findings suggest that children should be encouraged to have canteen lunches.

Keywords: Nutrient content; School lunch; Packed lunch; Secondary school

Introduction

Diet in childhood has an immediate impact on health, contributing to susceptibility to illness such as anaemia, obesity and dental disease [1,2]. Evidence indicates that adult susceptibility to disease is associated with nutrition in childhood and adolescence [3] and the early manifestations of chronic disease are being seen earlier in younger children than previously [4]. Additionally, the impact of poor nutrition on children is compounded because their body nutrient stores are smaller, making them less able to compensate for poor nutrient intakes [5].

As children grow older, particularly upon reaching adolescence, they gain more control over their food choices and eat more of their foods outside the home [5]. This tends to lead to diets becoming less 'healthy', for example, with less breakfast-eating, a reduction in di-

etary variety and decreasing fruit, vegetable and milk intake [6]. This makes achieving dietary targets more difficult. When children are given the opportunity to select their own food, they tend to make 'unhealthy' choices [7], the effect of which is shown in high intakes of total and saturated fat [8].

Despite the prominent coverage of children's diets in the popular media, the amount of recent scientific research in this area is relatively sparse (especially for older children) and few large-scale dietary surveys have been conducted. In 1983, a dietary survey of 2,397 British School children (with an enhanced sample of 884 primary school children) took place, commissioned by the then Department of Health and Social Security [9]. The National Diet and Nutrition Survey (NDNS) for young people aged 4-18 years [8] were carried out in 1997 and included a sample of 1,701 children. Both of the dietary surveys above utilised 7-day weighed dietary records. The Scottish component of the NDNS survey on young people age 4-18 years was comparatively small, with only 136 participants. A much larger survey with 1,491 Scottish participants aged 3-18 years, was commissioned by Food Standards Agency Scotland in 2005 [10] in an attempt to fill in some of the gaps not covered by the NDNS. This survey utilised food frequency questionnaires followed-up by dietary interview. The limited data available from dietary records of secondary school children is partly due to the onerous methodology.

A large effort has been made and continues to be made, to improve the diet of the nation's school children, with the introduction of nutrient-based standards for school meals being a key component of efforts. The Scottish Nutrient Standards for School Lunches (SNSSL) [11], which are based on the Eating for Health model for healthy eating [12] and the Caroline Walker Trust recommendations [13] were adopted by secondary schools in 2006. However, of note is that in Scotland, less than half (44%) of secondary school children opt for school meals [14]. Children at secondary school are often afforded the freedom to leave school premises at lunchtime and opt to buy lunch outside the school. There is limited evidence in the UK of the food and drink purchasing beyond the school gate [15]. The main lunch options for secondary school children are school meals, packed lunches or 'street' lunches (lunches purchased outside of school). No food or nutrient standards exist for packed lunches or street lunches although some schools may make recommendations to healthy packed lunches, in line with the food-based standards [16].

School lunches make a significant contribution to food intake, providing 25-33% of daily energy intake among children of primary school age [17,18]. Previous studies, in England, have compared food and nutrient intakes of pupils consuming school meals and packed lunches [16,19]. Four-day estimated food diaries were used to compare overall daily nutrient intake of 9-10 years olds [20] and 14-15 year olds [21] in England.

The present study is believed to be the first to investigate the contribution of nutrients from the different lunch options available on the overall diet of secondary school children in detail. We have reported, in a separate paper, on the lunch time nutrient intake in comparison with the SNSSL of children who have a school canteen lunch, buy lunch outside of school or bring a packed lunch to school. This paper examines how the food and drink consumed at lunch time on school days contribute to the daily nutrient intake and the impact of the type of lunch consumed on overall daily nutrient intake. The data were compared with Dietary Reference Values (DRVs) for key nutrients and the Government target for fruit and vegetables.

Methods

Recruitment

School children aged 11-14 years were recruited from two local secondary schools. Children who were on special diets were excluded from the study. Data were collected between September 2007 and January 2008. The student population in the two schools were around 900 and 1800 pupils. Both schools had similar catchment areas which included local authority housing, shared ownership, as well as private ownership. Informed consent by proxy was obtained by the parents or guardians of the school children. The author participated in school assemblies to introduce the project to the children and attended food technology classes prior to data collection to explain the study further and answer questions from pupils.

Dietary Assessment

The present study used food diaries for a period of five days (Monday to Friday) to record foods and drinks consumed and portion sizes. Diet diaries, information packs giving useful tips and information on how to complete the food diaries and large sealable plastic envelopes for returning the diaries and retained food wrappers, were distributed to all participating pupils during their food technology lessons. Participants were asked to consume their normal diets. To maximise accuracy, pupils were asked to provide as much detail as possible, including portion size in grams or millilitres for pre-packaged foods and descriptions of portion sizes for other foods, which were estimated using *Food Portion Sizes* [22]. To minimise any effect on participant behaviour by the study, pupils were reassured of their anonymity and that there were no 'wrong' answers, with the aim of maximising the honesty of the reports and answers. The author (CN) also visited the school canteens to meet with kitchen staff and determine the portion sizes of prepared dishes (including sandwiches, wraps and filled rolls) and to record the portion or pack sizes of manufactured foods and drinks. The children purchasing street lunches often took advantage of 'meal deals' offered by a local baker and included items such as jumbo sausage rolls and doughnuts. These were observed to be significantly larger than the portion sizes described in *Food Portion Sizes* [22], so an example of each item was purchased and weighed.

Nutritional analysis of the diaries was carried out using 'Win Diets' computer software [23]. Since this study was largely concerned with school meal choices and their influence on overall nutrient intake, ten key nutrients/foods for which standards had been defined were selected from those covered by the SNSSL for the purposes of this study: energy, fat, saturated fat, Non-Milk Extrinsic Sugars (NMES), Non-Starch Polysaccharides (NSP), vitamin A, folate, calcium, iron, and fruit and vegetable portions.

Statistical Analysis

Data analysis was performed using SPSS for Windows statistical software package version 21 (SPSS Inc., Chicago, IL, USA). Descriptive statistics (mean and standard deviation) were compiled for each lunch type. To ascertain the importance of the lunch time meal in terms of its contribution towards total nutrient intake, the percentage of total daily intake provided by lunch was calculated for canteen, packed and street lunches. The analysis follows the approach of Stevens and Nelson [24], with each day considered as the unit of sampling, rather than each child. One sample t-tests were used to compare the mean daily nutrient intakes for the lunch type groups. The differences between daily nutrient intake according to lunch type were assessed using one-way ANOVA, with post hoc comparisons using Tukey's tests. The percentage of the DRV provided by the whole day's intake was calculated and categorised according to whether canteen, packed and street lunches were consumed. Nutritional quality of the three lunch groups was compared in terms of percentage of DRV.

Results

A total of 332 pupils were recruited to the study, with 261 pupils completing the diet diaries for all five days. A further 28 pupils completed four days of the diet diary, 32 completed three days, 8 completed two days and three completed 1 day. However many day's diary a child completed, a day was included in the analysis if it was judged by the researcher to be trustworthy on the basis of completeness. Children were categorised as 'habitually' having a particular type of lunch if they ate them on four or five of the study days. Of the 332 children, almost 4 in 10 ($n=128$, 38.6%) did not have the same lunch types every day. A total of 32.8% children habitually had canteen lunches, 15.1% packed lunches and 13.6% had street lunches. The total number of days data for male and females in each lunch group were very similar (Table 1). However for nutrients where there was a gender difference in the requirements, the data was analysed separately. Considering the total number of lunches ($n=1532$) analysed in this study, a small number of lunches were mixed (more than one lunch type) ($n=134$, 8.7%). The very small number of skipped lunches ($n=8$, 0.5%) and mixed lunches were excluded from the statistical analysis. Although possible, no pupil was found to have food from all three sources.

Energy

Daily total energy intake significantly differed across all lunch types with the lowest mean intake on canteen days (1877 kcal/7.85 MJ/day) and highest on street lunch days (2174 kcal/9.1 MJ/day) (Table 2). Post-hoc comparisons using Tukey's test indicated that the

mean energy intake for canteen and packed lunch days was significantly lower than that of street lunch days (the highest value). The mean energy intake for canteen lunch days was also significantly lower than that for packed.

	Lunch Type			Total N (%)
	Canteen N(%)	Packed N (%)	Street N (%)	
Male	323 (48.8)	144 (21.8)	195 (29.5)	62 (100)
Female	362 (49.2)	165 (22.4)	209 (28.4)	736 (100)
Total	685 (100)	309 (100)	404 (100)	1398 (100)

Note: Figures exclude the 134 mixed lunches.

Table 1: Number of Days' Data from Males and Females.

Nutrient*	Lunch Type						P value*
	Canteen (n= 685)		Packed (n= 309)		Street (n= 404)		
	Mean	SD	Mean	SD	Mean	SD	
Energy (kcal) [2033]	1877	593	1990	521	2174	569	< 0.0001
Boys [2220]	1932	616	1972	533	2139	583	< 0.0001
Girls [1845]	1828	568	2011	503	2206	556	< 0.0001
Energy (MJ) [8.51]	7.85	2.48	8.33	2.18	9.10	2.38	< 0.0001
Boys [9.27]	8.09	2.57	8.26	2.23	8.96	2.44	< 0.0001
Girls [7.72]	7.65	2.38	8.42	2.11	9.24	2.33	< 0.0001
Fat (%) [33%]	35.5	7.5	38.1	7.4	38.7	6.5	< 0.0001
SFA (%) [10%]	14.3	4.5	15.2	4.6	14.4	4.0	0.009
NMES (%) [10%]	14.6	6.7	16.5	7.3	16.9	7.4	< 0.0001
NSP (g) [18]	10.9	4.5	11.1	4.5	10.7	4.4	0.474
Vitamin A (µg) [600]	513	369	592	398	486	361	0.001
Folate (µg) [200]	193	81	188	87	172	78	< 0.0001
Calcium (mg) [900]	879	410	857	404	820	401	0.069
Boys [1000]	902	423	851	459	804	396	0.036
Girls [800]	859	400	862	352	835	407	0.744
Iron (mg) [13.1]	9.6	3.8	9.8	3.6	9.6	3.5	0.667
Boys [11.3]	10.1	4.0	9.8	4.0	9.7	3.8	0.461
Girls [14.8]	9.1	3.6	9.8	3.2	9.6	3.3	0.082
Fruit/vegetables (portions) [5]	1.4	1.3	1.8	1.6	0.9	1.0	< 0.0001

Note: DRVs in square brackets. Energy: EAR for used; DRV: Fat, SFA, NMES, NSP; RNI: vitamin A, folate, calcium and iron; government target: Fruit and vegetables. In all the comparisons above between daily nutrient intake and DRVs, $p < 0.001$. *Differences assessed using One-way ANOVA.

Table 2: Daily Nutrient Intake According to Lunch Type.

Nutrient Intake

When total daily nutrient intake was considered, canteen lunches provided a significant nutritional advantage regarding fat, NMES and folate intake. A significant, though smaller, advantage remained for canteen lunch days where SFA was concerned ($p = 0.009$). A post hoc

Tukey test indicated that packed lunch days had a significantly higher mean vitamin A intake (592 µg/day) compared to canteen lunch days (513 µg/day) ($p= 0.006$) and street lunch days ($p= 0.001$). Regarding total fibre, calcium and iron intake, similar intakes were found with the three lunch types. Mean calcium intake among boys on street lunch days (804 mg/day) was significantly lower than mean intakes on packed (851 mg/day) and canteen (902 mg/day) lunch days ($p= 0.029$). Mean fruit and vegetable intake significantly differed across all lunch types with the highest intake (mean: 1.8/day, SD: 1.6/day portions) on packed lunch days.

Contribution of Lunch Time Meal to Daily Nutrient Intake

To ascertain the importance of the lunch time meal in terms of its contribution towards total nutrient intake, the percentage of total daily intake provided by lunch was calculated for canteen, packed and street lunches (Table 3). In terms of energy, fat and NMES, street lunches contributed the highest energy and percentage energy compared with canteen and packed lunches. Street lunches contributed the lowest percentage of daily intake of vitamin A, folate and calcium. Packed lunches provided a larger contribution to fruit and vegetable and vitamin A intake compared with canteen and street lunches. Canteen lunches contributed the least towards total daily intake of fat, SFA, NMES and the most towards total daily intake of folate, calcium and iron and fibre.

Nutrient	Canteen	Packed	Street
Energy	26.9%	27.9%	32.5%
Fat	24.4%	30.3%	34.3%
SFA	25.5%	34.6%	30.9%
NMES	22.6%	30.2%	38.0%
NSP	27.5%	23.4%	26.2%
Vitamin A	25.1%	34.0%	20.0%
Folate	26.1%	21.2%	17.4%
Calcium	27.0%	25.8%	21.5%
Iron	21.2%	19.4%	20.8%
Fruit/vegetables	20.0%	26.7%	20.8%

Note: DRV used were EAR: Energy; DRV: Fat, SFA, NMES, NSP; RNI: vitamin A, folate, calcium and iron; government target for fruit and vegetable intake.

Table 3: Percentage of Total Daily Intake Provided by Canteen, Packed and Street Lunch Compared to drvs.

Lunch Type Compared with Recommendations

To provide an indication of the extent to which the average lunch of each type met official recommendations, means as a percentage of the EAR (for energy), RNI (for other nutrients) and government target for portions of fruit and vegetables, were calculated (Table 4). The mean total daily energy intake for each lunch type was within 10% of the EAR (canteen and packed lunch days being slightly lower and street lunch days slightly higher). The mean intake for only canteen lunch days met the DRV for fat intake (94% of DRV). Street and packed lunch days contained more (109% and 119% of the DRV, respectively). Mean daily fibre intakes were relatively low across all lunch types compared to the DRV of 18 g/day, with between 59% and 62% of the DRV being met. Mean daily calcium intakes fell short of the RNI across all lunch types (between 91% and 98% of the RNI) (Table 4). Table 2 shows that mean calcium intakes for girls were above the RNI of 800 mg/day for all lunch types, but fell short of the RNI of 1000 mg/day among boys. Mean daily iron intakes fell short of the RNI by 25-27% across all lunch types, particularly among girls with 24% of girls failing to reach even the LRNI level.

Regarding the proportion of days meeting micronutrient targets, more canteen lunch days met the DRVs than packed and street lunch days for folate and calcium (Table 5). More packed lunch days met the DRVs than canteen or street lunch days for vitamin A and iron. For

all nutrients, street lunch days were the category with fewest days meeting the DRVs (with the exception of energy and iron where packed and canteen lunches had fewest days that met the target, respectively).

Nutrient	% of DRV			
	DRV*	Canteen (n=685)	Packed (n=309)	Street (n=404)
Energy (kcal/MJ)	2033/8.5	92%	93%	107%
Fat (g)	79.0	94%	109%	119%
SFA (g)	24.9	120%	137%	141%
NMES (g)	55.9	125%	146%	167%
NSP (g)	18	61%	62%	59%
Vitamin A (µg)	600	86%	99%	81%
Folate (µg)	200	98%	94%	86%
Calcium (mg)	900	98%	95%	91%
Iron (mg)	13.1	73%	75%	73%
Fruit/vegetables (portions)	5	28%	36%	18%

*DRVs represent EAR: Energy; DRV: Fat, SFA, NMES, NSP; RNI for 11-14 year olds: vitamin A, folate, calcium and iron; and government target for fruit and vegetable intake. DRVs used are the mean for the EAR or RNI for males and females aged 11-14 years. Numbers in bold indicate achievement of DRV or target was not made.

Table 4: Mean Daily Nutrient intake for Canteen, Packed and Street Lunch Days, As a Percentage of drvs.

Nutrient	Canteen	Packed	Street
Energy (kcal)	36.8%	46.3%	41.6%
Boys	39.0%	46.5%	52.8%
Girls	34.8%	46.1%	63.6%
Fat (g)	60%	45%	33.7%
SFA (g)	40.6%	27.8%	23.3%
NMES (g)	43.1%	29.1%	20.8%
NSP (g)	7.3% (37.8%)	9.4% (38.2%)	5.0% (35.9%)
Vitamin A (µg)	31.7% (72.3%)	38.5% (80.9%)	30.0% (72.0%)
Folate (µg)	42.9% (89.3%)	41.7% (84.5%)	33.9% (83.3%)
Calcium (mg)	43.5% (86.6%)	39.8% (85.1%)	38.8% (81.4%)
Boys	45.2% (88.2%)	38.2% (81.2%)	38.5% (79.0%)
Girls	42.0% (85.1%)	41.2% (88.5%)	37.8% (83.7%)
Iron (mg)	15.0% (73.4%)	18.8% (77.3%)	15.5% (77.5%)
Boys	16.4% (77.7%)	21.5% (72.9%)	13.8% (75.9%)
Girls	13.8% (69.6%)	16.4% (81.2%)	16.3% (78.9%)
Fruit/vegetables (portions)	2.5%	5.5%	0%

Note: DRVs represent EAR: Energy; DRV: Fat, SFA, NMES, NSP; RNI for 11-14 year olds: vitamin A, folate, calcium and iron; and government target for fruit and vegetable intake. For nutrients where there was a gender difference in the requirements, the data was analysed separately. Figures meeting LRNI are in brackets.

Table 5: Percentage of Days Meeting DRV (EAR/RNI/LRNI) or Fruit and Vegetable Recommendation.

Discussion

This paper has shown that the overall daily nutrient intake of schoolchildren varied according to lunch type. Canteen lunch days had the lowest total daily energy intake and the highest nutrient density of all lunch types. This study found canteen lunches to provide a lower proportion of daily energy intake than packed and street lunches, which supports the findings of other similar studies [25,26]. The daily energy intake on days where a school lunch was consumed was almost 300 calories (297 kcal/1.25 MJ) less than on the days that a street lunch was consumed. This indicates the importance of school meals in helping address the current problem of childhood obesity. On days when a canteen lunch was eaten, the food consumed at other times of day was generally less healthy than the canteen lunch. However, since canteen lunches provide an advantage over the other lunch types available to children, it is still worth encouraging uptake. Canteen lunches also provided a significant nutritional advantage in terms of fat, SFA, NMES and folate intake. Similar intakes of total fibre, calcium and iron intake were found with all three lunch types and although fruit and vegetable intake was slightly higher for packed lunches, the proportion of days that met the 5-a-day recommendation was extremely low for all lunch types.

Interestingly, this study showed that many children did not have the same lunch type every day. It was common practice for children to 'flit' from one lunch type to another, perhaps according to factors including the items on the canteen menu, what their friends were doing on a particular day or the weather. Of the children that did habitually have one lunch type, it was somewhat encouraging that it was more likely to be a canteen lunch than packed or street lunch. Another behaviour apparent from this study was that some children consumed food and drink from more than one type of lunch (canteen, packed and street) during a single lunchtime. Although less than 10% of the lunches consumed in this study included food items from more than one lunch type, encouragement of children to consume some healthy food from the canteen or some healthy packed lunch food, before leaving school, might decrease their appetite for consuming street food. This could have a beneficial impact on their daily diet.

Although the lunch time meal is undeniably an important part of the total food intake, it is ultimately the total daily diet that affects children's health, both now and in the future. Considerable resources have been invested in improving the nutritional quality of school meals (canteen lunches) and increasing their uptake. However, if children eating packed lunches, which are nutritionally inferior in some respects and street lunches, which have been found to be nutritionally poor, are compensated for by eating healthier food outside the school lunch time, their total daily intakes could still be acceptable. This study showed that canteen lunches provided a superior nutritional profile to packed or street lunches. In addition, the advantages in terms of nutrient intake provided by consuming a canteen lunch were still apparent when the whole day's nutrient intake was considered. On days when a canteen lunch was eaten, the food consumed at other times of the day was generally less conducive to good health than the food eaten at lunch time. The street lunch was the least healthy lunch time option and the nutrition it provided was so poor that this was not compensated for over the rest of the day. Regardless of whether a canteen, packed or street lunch was consumed, when total daily intake was analysed, no significant difference was found in the intakes of NSP, calcium and iron.

When total daily intake is considered, canteen lunches provide a significant nutritional advantage regarding fat, SFA and NMES intake. A significant, though smaller, advantage for canteen lunch days remains where folate is concerned. Encouragingly, the results indicated that canteen lunches contributed the least towards total daily intake of fat, SFA and NMES and the most towards total daily intake of folate, calcium, iron and fibre. Both the mean intakes and the percentage of days meeting the DRVs indicated that the areas of greatest concern were the intakes of NSP, iron and fruit and vegetables. The proportion of days meeting the DRV for NSP intake ranged from 5% (street lunch days) to 9.4% (packed lunch days). The main types of food contributing to NSP among children (11-18 years) are cereals and cereal products (42%) and vegetables and potatoes (29%) [27] and therefore these types of foods should be included more in young people's diets. It is concerning that not one of the street lunch days analysed in the present study met the '5-a-day' target of fruit and vegetables and only 2.5% of canteen and 5.5% of packed lunch days met this target. Achieving the recommended fruit and vegetable intake provides many health benefits, for example, childhood intake of fruit and vegetables has been linked with decreased incidence of cancer in adulthood [28]. Increasing fruit and vegetable intake in canteen lunches may be achieved by making soups, salads and fruit and vegetable snacks more appealing and accessible to children.

As the recommended intakes for iron and calcium differed for boys and girls, intake data was presented by gender to allow further examination. Low iron intakes are known to be of concern in children's diet [27] and the present study supported this. Of great concern was the fact that only 73.3% - 77.5% of days (depending on lunch type) met the LRNI for iron (Table 5). Iron was the micronutrient showing the greatest shortfall in intake in the present study, particularly among girls. It has been reported that iron deficiency has been considered a potent cause of cognitive impairment, learning disabilities and psychomotor instability and could lead to ADHD symptoms [29]. Cereals and cereal products contribute to around half of iron intake in children, with bread and fortified breakfast cereals the main source of iron intake [27]. Encouraging children to consume breakfast before school or by offering breakfast at school would be beneficial in terms of improving nutrient intake, maintaining a healthy weight and improving cognitive performance [18,30]. Calcium was the micronutrient for which the mean intake in the present study came closest to achieving the RNI. This nutrient is particularly important during adolescence in terms of maximising bone density and therefore protecting against bone thinning later in life [31]. Data from this study indicated that although girls appear to have an adequate mean daily calcium intake, mean intake among boys was below the recommended 1000 mg/day with all meal types (Table 2). Milk and milk products contribute to 48% of calcium intakes in young people [8] therefore encouragement of boys to consume such products would be beneficial.

School children have more freedom than their predecessors in many areas of life, including their food choices. Leaving school at lunch time to buy their own food is now a far more acceptable and frequent, option than for previous generations. In this study, 33% of school children habitually opted for a canteen lunch. This is lower than Scottish data that indicates that the proportion of school children opting for school meals reduced from 45% in 2007 to 39% in 2009, but has since increased to 44% in 2013 [32]. Although the introduction of SNSSL has improved the nutritional quality of canteen lunches, only the proportion of children who opt for these lunches will benefit. In this study, 15% of school children habitually had packed lunches. A similar proportion (15%) was reported by the Young Scot survey of 938 young people to have a packed lunch every day [33]. Guidance providing an option for packed lunches is available locally and disseminated through local authorities and schools to parents and young people [33]. Unlike the situation in schools, the food and drink available from nearby outlets is not required to meet nutritional regulations. Research indicates that the majority of the food and drink on offer from such outlets greatly contrasts with that offered in schools governed by nutritional standards [34,35]. The Scottish Government has recently provided guidance for local authorities, school, retailers and caterers on ways to positively influence the food environment around schools. Data from a current survey funded by the Food Standards Agency in Scotland should provide further insight on secondary school food choices at lunch time [36].

Strengths and Limitations

Since this study is largely concerned with school meal choices and their influence on overall nutrient intake, it was decided to consider ten nutrients selected from those covered by the SNSSL for the purposes of this study. Carbohydrates, protein and vitamin C were not included in the statistical analysis as data indicates these to be adequate [26]. Intake of salt is often above the recommended levels [26]. However, sodium was omitted from the analysis for the present study because it was decided that it was not practical to expect children to accurately record the amount of salt they added to food or know the amount of salt in foods prepared for them. There would also be considerable error introduced by the variability of sodium contents in brands of manufactured foods.

Since adolescents' diets are known to be extremely variable, the present study attempted to maximise the sample size more subjects are required to estimate average dietary intake than if the diet is homogenous [37]. In the present study, children were asked to record their diet for five days, in order to maximise the representativeness and validity of the data. The fact that the data were analysed 'per day' rather than 'per child' enabled data from children completing fewer than five days of records to be included in the analysis. The authors appreciate that a child could appear across different lunch types and therefore the analysis is not entirely independent.

A recent study [38] found that 63% of all secondary school pupils reported sometimes purchasing food and/or drink outside of school at lunchtime. Various studies [39,40] have highlighted the wide availability of foods high in fat, salt and sugar from outlets near schools. Research by Ellaway, *et al.* [40], supports the finding from this study, that a majority of the foods purchased by children and young

people outside school during the school day exceeded recommended levels of saturated fat and provided more than the recommended percentage of calories from fat and sugar. Evidence indicates that pupils choose to leave the school grounds at lunch time for a variety of reasons including not liking school food and a wider choice and better tasting food available outside school [40]. The eating environment in schools deterred some pupils from eating there, for example, the lack of space; drab or windowless canteen space; smells and less opportunity to socialise [41].

Conclusion

To our knowledge this is the first study that compares three types of school lunch using 5-day estimated food diaries. Overall, the diets of school children in this area of Fife, Scotland, were nutritionally poor. In particular, the study found poor intakes of NSP, iron and fruit and vegetables, both at lunch time and over the whole day. Canteen lunch days showed the most favourable nutrient profile in terms of fat, NMES, folate and calcium. Packed lunch days showed the most favourable intakes of NSP, vitamin A, iron and fruit and vegetables. The street lunch was the least healthy lunch time option and the nutrition it provided was so poor that this could not be compensated for over the rest of the day. This research study suggests that it would be beneficial in terms of overall nutrient intake to encourage pupils to have canteen lunches.

Acknowledgement

We are sincerely grateful for the continuous support provided over the years by our colleague Professor Isobel Davidson.

Conflict of Interest

The authors declare no conflicts of interest.

Bibliography

1. British Medical Association Board of Science and Education. *Adolescent Health* (2003).
2. Vereecken C., *et al.* "Eating Habits". Young People's Health in Context. Health Behaviour in School-Aged Children (HSBC) Study: International Report from the 2001/2001 Survey. *Copenhagen: World Health Organization* (2004).
3. Caballero B. "Early Nutrition and Risk of Disease in the Adult". *Public Health Nutrition* 4.6 (2001): 1335-1336.
4. World Health Organization. "Diet, Nutrition and the Prevention of Chronic Diseases". Report of a Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases. *WHO Technical Report Series* 916 (2003).
5. Koletzko B., *et al.* "Nutrition in Children and Adolescents in Europe: What is the Scientific Basis? Introduction". *British Journal Nutrition* 92 (suppl 2) (2004): S67-S73.
6. Lytle L., *et al.* "How Do Children's Eating Patterns and Food Choices Change over Time? Results From a Cohort Study". *American Journal of Preventive Medicine* 14.4 (2000): 222-228.
7. Ludvigsen A and Sharma N. "Burger Boy and Sporty Girl". *London: Barnardos* (2004).
8. Gregory JR., *et al.* "National Diet and Nutrition Survey: Young People aged 4 to 18 years". Report of the Diet and Nutrition Survey. *London: The Stationary Office* 1 (2000).
9. Department of Health. "The Diets of British School Children. Sub-committee on Nutritional Surveillance, Committee on Medical Aspects of Food Policy". *Report on Health and Social Subjects (London)* 36 (1989): 1-293.
10. Sheehy C., *et al.* "Survey of Sugar Intake among Children in Scotland". Food Standards Agency Scotland, Aberdeen, Research Project S14029 (2008).

11. The Scottish Executive. "Nutrition in Schools: The Scottish Nutrient Standards for School Lunches" (2003).
12. The Scottish Government. "Eating for Health: A Diet Action Plan for Scotland" (1996).
13. The Caroline Walker Trust. "Nutritional Guidelines for School Meals". Report of an Expert Working Group (1992).
14. The Scottish Government. "Summary Statistics for Attainment, Leaver Destinations and Healthy Living". *Statistical Bulletin Education Series* (2013).
15. Wills WJ., *et al.* "Children's Food and Drink Purchasing Behaviour - Beyond the School Gate: The Development of a Survey Module". *Nutrition - International Scholarly Research Network* (2013).
16. Stevens L., *et al.* "School Lunches v. Packed Lunches: A Comparison of Secondary Schools in England Following the Introduction of Compulsory School Food Standards". *Public Health Nutrition* 16.6 (2013): 1037-1042.
17. Ruxton CHS., *et al.* "The Contribution of Specific Dietary Patterns to Energy and Nutrient Intakes in 7-8 Year Old Scottish School Children. II Weekday Lunches". *Journal of Human Nutrition and Dietetics* 9.1 (1996): 15-22.
18. Ruxton CH and Kirk TR. "Breakfast: A Review of Associations with Measures of Dietary Intake, Physiology and Biochemistry". *British Journal of Nutrition* 78.2 (1997): 199-213.
19. Pearce J., *et al.* "Lunchtime Food and Nutrient Intakes of Secondary-School Pupils: A Comparison of School Lunches and Packed Lunches Following the Introduction of Mandatory Food-Based Standards for School Lunch". *Public Health Nutrition* 16.6 (2013): 1126-1131.
20. Harrison F., *et al.* "Food and Drink Consumption at School Lunchtime: The Impact of Lunch Type and Contribution to Overall Intake in British 9-10-Year-Old Children". *Public Health Nutrition* 16.6 (2013): 1132-1139.
21. Prynne CJ., *et al.* "The Quality of Midday Meals Eaten at School by Adolescents: School Lunches Compared with Packed Lunches and their Contribution to Total Energy and Nutrient Intakes". *Public Health Nutrition* 16.6 (2013): 1118-1125.
22. Food Standards Agency. "Food Portion Sizes". 3rd edition. London: *The Stationery Office* (2001).
23. Wise A. Win Diets [Research Version]. The Robert Gordon University, Aberdeen (2005).
24. Stevens L and Nelson M. "The Contribution of School Meals and Packed Lunch to Food Consumption and Nutrient Intakes in UK Primary School Children from a Low Income Population". *Journal of Human Nutrition and Dietetics* 24 (2011): 223-232.
25. McNeill G., *et al.* "Secondary Analysis of the Survey of Sugar Intake among Children in Scotland". Part 3: School meals in Scotland. London: *Food Standards Agency* (2009).
26. Nelson M., *et al.* "The Nutritive Contribution of School Dinners and Other Mid-Day Meals to the Diets of School Children". *Human Nutrition-Applied Nutrition Journal* 37.2 (1983): 128-135.
27. Bates B., *et al.* "National Diet and Nutrition". Survey Results from Years 1, 2, 3 and 4 (combined) of the Rolling Programme (2008/2009 -2011/2012). London: *Public Health England* (2014).
28. Maynard M., *et al.* "Fruit, Vegetables and Antioxidants in Childhood and Risk of Adult Cancer: The Boyd Orr Cohort". *Journal of Epidemiology and Community Health* 57.3 (2003): 218-225.
29. Konofal E., *et al.* "Effects of Iron Supplementation on Attention Deficit Hyperactivity Disorder in Children". *Paediatric Neurology* 38.1 (2008): 20-26.
30. Sjoberg A., *et al.* "Meal Pattern, Food Choice, Nutrient Intake and Lifestyle Factors in the Goteborg Adolescence Study". *European Journal of Clinical Nutrition* 57.12 (2003): 1569-1578.

31. Lanham-New SA, *et al.* "Importance of Vitamin D, Calcium and Exercise to Bone Health with Specific Reference to Children and Adolescents". *Nutrition Bulletin* 32.4 (2005): 364-377.
32. The Scottish Government. Statistical Bulletin Education Series. "Summary Statistics for Attainment, Leaver Destinations and Healthy Living". Edition 3 (2013)".
33. The Scottish Government. "Beyond the School Gate: Improving Food Choices in the School Community". Edinburgh: The Scottish Government (2014).
34. The Scottish Health Survey 2011, *Children 2* (2012).
35. Glasgow Centre for Population Health. "Exploring the Nutritional Quality of Out of School Foods Popular with School Pupils" (2012).
36. FSA (Food Standards Agency) in Scotland. "A Comparison of Secondary School Food Choices at Lunchtime" (2014).
37. Thompson FE and Byers T. "Dietary Assessment Resource Manual". *Journal of Nutrition* 124 (suppl 11) (1994): 2245S-2317S.
38. Macdiarmid JJ, *et al.* "Survey of Diet among Children in Scotland (2010)". Volume 2: Food and drink purchases around the school day. Research Project FS424019 (2012).
39. Smith D, *et al.* "Does the Local Food Environment around Schools Affect Diet? Longitudinal Associations in Adolescents Attending Secondary Schools in East London". *BMC Public Health* 13:70 (2013).
40. Ellaway A., *et al.* "Do Obesity-Promoting Food Environments Cluster around Socially Disadvantaged Schools in Glasgow, Scotland?". *Health and Place* 18 (2012): 1335-1340.
41. Young L., *et al.* "Ask the Children what they want. Involving Children and Young People in the Development and Implementation of Improvements to Enhance School Food Provision" (2014).

Volume 4 Issue 2 June 2016

© All rights reserved by Laura Wyness., *et al.*