



An investigation of school meals eaten by primary schoolchildren

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of school meals

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Abstract *The present study compared the calculated nutritional content of midday meals eaten by primary schoolchildren (n=90, 45 boys, 45 girls, mean age 10.5 ± 0.4 years), in the Portsmouth area, with the Caroline Walker Trust (CWT) published guidelines. Comp-Eat 5 was used to determine the dietary content of children's midday meals. Children's lunchtime meals were not deficient in essential micronutrients; however, the macronutrient content of their diet differed significantly from the published guidelines. Data analysis also revealed that significant differences were evident between the macronutrient content of the two meal subgroups (food provided by the school, referred to as "school meals" and food brought from home, referred to as a "packed lunch"). In conclusion, several changes need to be made to midday meals, eaten by primary schoolchildren, before they will meet the CWT guidelines, and the two meal subgroups require separate solutions.*

Introduction

Since the standards for school meals were relaxed with the revision of the Education Act in 1980, concern has grown over the nutritional content of school meals; several studies have shown them to contain excess fat and lack nutritional balance (DoH, 1989; MAFF, 1996; Noble and Kipps, 1994; Eves *et al.*, 1997). There is evidence to suggest that the consumption of an inadequately balanced diet, particularly one that is high in fat, may lead to the development of coronary heart disease, obesity and several forms of cancer in adult life, whilst diets high in extrinsic sugars predispose children to dental decay (DoH, 1994). A review of data from the report on the "Diets of British schoolchildren" (DoH, 1989) by the School Meals Campaign found sufficient evidence to warrant a reintroduction of nutritional standards.

Consequently an expert working group, part of The Caroline Walker Trust (CWT), have developed nutritional recommendations for school meals (CWT, 2001). While they are not official standards, they are based on dietary reference values (DoH, 1991) and provide caterers with guidelines with which to compare their school meal provision. A summary of these guidelines can be found in Table I; the second column gives the recommendations in relation to children's daily requirements, whilst column three provides absolute values based on an average child. Although the guidelines in Table I give no mention to fruit and vegetable consumption, documentation provided with the guidelines highlights



Nutrient	Relative to daily requirements	Example value ^a
Energy	30 per cent of estimated average requirement (EAR)	557kcal
Fat	Not more than 35 per cent of food energy ^b	21.7g
SFA	Not more than 11 per cent of food energy ^b	6.8g
Carbohydrate	Not less than 50 per cent of food energy	74.3g
NMES	Not more than 11 per cent of food energy ^b	16.3g
NSP	Not less than 30 per cent of calculated reference value ^c	4.5g
Protein	Not less than 30 per cent of reference nutrient intake (RNI)	8.5g
Calcium	Not less than 35 per cent of RNI	193mg
Iron	Not less than 30 per cent of RNI	3.5mg

Notes: NMES = non-milk extrinsic sugars, NSP = non-starch polysaccharides, SFA = saturated fatty acids

^aThese figures are provided by the CWT and are based on an average child; ^bAs there is no absolute requirement for sugars or fats (except essential fatty acids), these values represent a maximum; ^cThe dietary reference value for non-starch polysaccharides (NSP) is 18g for adults, and children should eat proportionately less, based on their lower body size. For pragmatic reasons, this has been calculated for these guidelines as a percentage of the energy recommendation, to give the calculated reference value. The calculated NSP guideline is 8g per 1,000kcal

Table 1.
Caroline Walker Trust:
nutritional guidelines
for school meals
(7-9 year olds)

the importance of attaining the appropriate combination of the five food groups as recommended in the 1994 COMA report (DoH, 1994).

Two published studies have compared the nutritional content of children's midday meals to the CWT guidelines. The first study, conducted in Manchester, used a large age range of children (5 to 11 years of age), but compared them all, regardless of age, with the CWT guidelines using the same absolute values, giving no consideration to each child's nutritional needs. This meant that the chosen reference values for each nutrient were perhaps not as appropriate as they could have been (Mock *et al.*, 1997). The second study, conducted in Lothian (Scotland), investigated school meal choices in children 7-8 years of age via parental proxy report; whilst they did make comparisons relative to each child's nutritional requirements, they did not report values for non-milk extrinsic sugars (NMES) or saturated fatty acids (Ruxton *et al.*, 1993). Neither of these studies provided data on children's fruit and vegetable consumption, nor did they calculate the ratio of polyunsaturated fatty acids to saturated fatty acids, an important indicator of a balanced fat intake.

Not all schoolchildren eat a meal provided by the school, many bring a packed lunch from home. The number choosing each meal option alters from one school to the next. Gardner Merchant (1998) found that 41 per cent of children never ate a school dinner, and 79 per cent of children surveyed preferred a packed lunch (this choice was more popular among girls than boys). However, Booth *et al.* (1991) found that only 15 per cent of senior schoolchildren ate a packed lunch and 36-68 per cent of children used the school cafeteria, depending on their age, with the remainder choosing to eat away from the school.

Comparisons have been made between the nutritional content of meals provided by the school and other meal options, such as packed lunches. Wharton (1987) found no evidence to suggest that school meals made a greater contribution to children's diets than other lunches. The DoH (1989) also found that there was no nutritional difference between school meals and other types of lunch. However, Nelson and Paul (1983) having compared the nutritional contribution of school meals to that of other weekday lunches in a sample of 191 children 5 to 17 years of age, concluded that school meals contributed less energy and nutrients than other lunches. Mock *et al.* (1997) compared the nutritional composition of different meal combinations with the CWT guidelines, but did not conclude which type was healthier.

No previous study has investigated school meals eaten by primary schoolchildren living in the south of England. There is a need to make comparative analysis of school meals relative to each child's daily requirements and not assume that all children have the same nutritional needs. Furthermore, there is a need to investigate children's fruit and vegetable consumption and the ratio between polyunsaturated and saturated fatty acids; these have not been reported by previous studies. The present study set out to test the hypothesis that lunchtime meals eaten by primary schoolchildren do not meet the CWT guidelines, and that a difference exists between school and packed lunches.

Subjects, materials and methods

Participants were primary schoolchildren ($n = 90$, 45 boys, 45 girls, mean age 10.5 years \pm 0.4) randomly selected from three schools in the Portsmouth area of Hampshire. The University of Portsmouth Ethics Committee approved all study procedures. Parent(s)/guardian(s) were required to provide informed consent before their child could participate in the study and children were informed that they were volunteers who could withdraw at any time. Children were also assigned personal identification numbers to ensure anonymity.

Children were observed whilst they ate their midday meal, in small groups of no more than ten, to record data on unusual foods and abnormal portion sizes. Once children had finished their meals they were individually interviewed about the content of their school meal using a specially designed prompting form (the report form and interview technique were piloted prior to use). Interviews were carried out on all weekdays for one school week and one person conducted all of the interviews. Children who did not complete at least three interview days were excluded from the study as their records would provide insufficient data to determine their eating pattern; similar criteria have been used elsewhere (Mock *et al.*, 1997).

The nutritional content of children's meals were analysed using Comp-Eat 5 (Carlston Bengston Consultants Ltd, Harrow). Values provided in the present study are based on the reference values calculated by Comp-Eat for each child, thus making them relative to each child's individual requirement. For example the average energy intake for child no. 1 was 687kcal, which was 32.0 per cent

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of their estimated average requirement (EAR), whilst the average energy intake for child no. 8 was 640kcal, but this was 34.2 per cent of their EAR. Energy provided by NMES was estimated by subtracting energy from sugar in milk, fresh/dried fruit and vegetables from energy provided by all sugars, a technique reported elsewhere (Mock *et al.*, 1997). Findings from the nutritional analysis were then compared to the CWT published guidelines, using values from column two in Table I. A single sample *t*-test (*T'*) was used to determine whether any significant differences existed between the group mean for each nutrient and the relevant CWT nutritional standard; this method of analysis has been used elsewhere (Mock *et al.*, 1997). Children were divided into two meal subgroups: school meals and packed lunches. Each subgroup was then compared with the CWT guidelines in a similar manner and differences between subgroups were examined using *t*-tests. Gender differences were also investigated. A 95 per cent significance level was used for all statistical analyses.

Results

A participation rate of 79 per cent was attained for this study ($n = 71$, 37 boys, 34 girls); there was no gender difference in participation, ensuring that results were not influenced by gender bias. Children's personal details are described in Table II, as are the number and combination of meals that they ate during the period of investigation. Table III presents a comparison of the nutritional analysis of children's school meals with the CWT guidelines. Analysis is provided for all meals and then each meal type. Table IV further describes the differences between the two meal-type groups. Gender differences have not been shown separately, as there were only two significant differences. Midday meals consumed by girls were significantly higher in both energy content

Table II.
Meal numbers
assessed, personal
details (age, height,
weight and BMI)

	All	Gender	
		Boys	Girls
<i>Number of meals assessed</i>	314	167	147
School meals	101	55	46
Packed lunches	213	112	101
<i>Age (years)</i>			
Mean	10.5	10.5	10.5
Standard deviation	0.4	0.4	0.4
<i>Height (m)</i>			
Mean	1.42	1.42	1.43
Standard deviation	0.1	0.1	0.1
<i>Weight (kg)</i>			
Mean	36.9	37.4	36.3
Standard deviation	6.6	7.0	6.1
<i>Body mass index (kg/m²)</i>			
Mean	18.2	18.6	17.7
Standard deviation	2.4	2.9	1.6

Nutrient	CWT standard	All meals	Meal type	
			School meal	Packed lunch
Energy (per cent EAR)	30.0	36.8*** (8.6)	36.1** (10.0)	37.1*** (8.0)
Fat (per cent food energy)	35.0	43.4*** (5.8)	45.7*** (6.0)	42.4*** (5.5)
SFA (per cent food energy)	11.0	12.9*** (3.6)	11.7 (2.3)	13.5*** (3.9)
Carbohydrate (per cent food energy)	50.0	48.3** (5.0)	45.0*** (3.4)	49.9 (4.9)
NMES (per cent food energy)	11.0	17.9*** (5.6)	15.3*** (4.6)	19.0*** (5.7)
NSP (per cent of recommendation)	30.0	29.7 (9.7)	33.1 (10.8)	28.2 (8.8)
Protein (per cent RNI)	30.0	64.3*** (16.2)	74.7*** (17.6)	59.7*** (13.2)
Calcium (per cent RNI)	35.0	39.1* (16.2)	33.4 (11.6)	41.7** (17.3)
Iron (per cent RNI)	30.0	31.4 (8.1)	33.4 (8.5)	30.5 (7.9)
Vitamin A (per cent RNI)	30.0	34.0 (21.1)	37.9 (19.2)	32.3 (21.9)

Notes: SFA = saturated fatty acids; NSP = non-starch polysaccharides; NMES = non-milk extrinsic sugars

Significantly different from CWT standard: * $p = 0.05$; ** $p = 0.01$; *** $p = 0.001$

Table III.
Comparison of
nutritional analysis
from meals eaten at
school (mean and
standard deviation)
against the Caroline
Walker Trust
guidelines ($n = 314$)

Nutrient	Meal type		Significant difference
	School meal	Packed lunch	
Energy (per cent EAR)	36.1	37.1	NS
Fat (per cent food energy)	45.7	42.4	$p = 0.03$
SFA (per cent food energy)	11.7	13.5	$p = 0.02$
Carbohydrate (per cent food energy)	45.0	49.9	$p < 0.001$
NMES (per cent food energy)	15.3	19.0	$p = 0.01$
NSP (per cent recommendation)	33.1	28.2	NS
Protein (per cent RNI)	74.7	59.7	$p = 0.001$
Calcium (per cent RNI)	33.4	41.7	$p = 0.02$
Iron (per cent RNI)	33.4	30.5	NS
PUFA:SFA ratio	0.85	0.35	$p < 0.001$

Notes: SFA = saturated fatty acids; NSP = non-starch polysaccharides; NMES = non-milk extrinsic sugars

Table IV.
Comparison of
nutritional analysis
from packed lunches
with nutritional
analysis from school
dinners

($p < 0.001$) and NSP ($p = 0.02$) than those eaten by the boys. Analysis of fruit and vegetable consumption revealed that 31 per cent of all children ate no fruit or vegetables with their midday meal on any day during the period of investigation. More boys (38 per cent) than girls (24 per cent) ate no fruit and vegetables, but, the difference was not significant, and there was no difference between the two meal types.

Discussion and conclusions

The number of packed lunches eaten (68 per cent) was more than double the quantity of school meals eaten (32 per cent), thus children in this study demonstrated a preference for packed lunches over meals provided by the school. Although meal choice at school may be strongly related to the number of free school meals provided, researchers suggest that factors such as the taste of the food, the choice/range of food, sitting with friends, the temperature and smell of the food and queues may influence a child's choice (Gardner Merchant, 1998; Booth *et al.*, 1991).

Children's lunchtime meals were not deficient in essential micronutrients; however, the macronutrient content of their diet differed significantly from the published guidelines. Table III shows that children's midday meals were significantly higher in energy, fat, SFA, NMES and protein, whilst being significantly lower in carbohydrate than the CWT guidelines (CWT, 2001). These results may represent trends that will have negative implications for children's present and future health. The incidence of high fat, SFA and sugar content of midday meals has been reported by other studies (DoH, 1989; MAFF, 1996; Eves *et al.*, 1997). Calcium levels were higher than recommended, whilst values for NSP and iron met, but did not exceed the recommendations.

Table IV demonstrates that significant differences were evident between the two meal subgroups. School meals derived a significantly higher proportion of energy from fat and protein, but were lower in saturated FA, carbohydrate, NMES and calcium than packed lunches. This meant that when the data was grouped by meal type and then compared against the CWT guidelines, only packed lunches were found to be excessively high in SFA, whilst only school meals did not meet the carbohydrate requirements. Previous research also found packed lunches to be higher in carbohydrate content than meals provided by the school (Ruxton *et al.*, 1993).

Children who ate packed lunches derived a significantly higher proportion of energy from SFA and NMES than children who had meals provided by the school. This may be explained by the amount of crisps, chocolate and sweets that they ate. These findings concur with research by Mock *et al.* (1997), although they did not report the significance level of the differences. Meals provided by the school had significantly lower carbohydrate content than packed lunches and failed to meet the CWT guidelines. This again concurs with the findings of Mock *et al.* (1997). The difference may be explained by the contribution that bread makes to the packed lunch. The significantly higher NSP content of school dinners found in this study may be explained by the number of children choosing baked potatoes as a staple part of their meal. Whilst the low number of children eating sandwiches made from wholemeal/granary bread explains the lower NSP content of packed lunches. This contradicts the work of Mock *et al.* (1997) who found that school meals were lower in NSP than packed lunches; however, they did not make calculations relative to energy requirements. Table IV demonstrates that in the present study, school dinners had a well-balanced fatty acid ratio, whilst packed

lunches had a relatively poor ratio. This is a consequence of the significantly higher SFA content of packed lunches combined with their lower overall fat content.

The CWT guidelines do not specify the number of portions of fruit and vegetables that a child should eat with their midday meal. However, the 1994 COMA report recommends consumption of at least five portions per day, thus, the midday meal might be expected to contain a *pro-rata* number of portions. The present study found that nearly one third (31 per cent) of all children ate no fruit or vegetables with their midday meal during any of the observation days. As adequate fruit and vegetable consumption has been associated with a decreased incidence of several forms of cancer, local education authorities and schools should work together to improve fruit and vegetable consumption among young children. Fortunately, this matter is being addressed with the introduction of “The national school fruit scheme”, a unique government-funded programme designed to ensure that all children receive at least one piece of fresh fruit during the school day. Pilot studies commenced in autumn 2000, but the scheme may not be fully operational until 2004.

It should be acknowledged that whilst the participation rate in the present study was high, the results presented here only represent a small study population; a larger study would be useful to confirm these findings. The Comp-Eat software is limited by its inability to account for the effect that sunlight, storage, preparation and cooking have on foods. A further constraint on a study of this nature is the difference between what children choose/are given for the midday meal and what they eat. In a survey of 7-11 year-old primary schoolchildren ($n = 1,544$) it was found that the mean energy content of their school meals was 524kcal with a mean protein content of 17.3g, but, once unconsumed food was taken into consideration children consumed 493kcal and 15.9g of protein which is a wastage of 5.9 per cent and 8.1 per cent respectively (Bender *et al.*, 1977). However, as the present study makes no attempt to measure waste it cannot directly assess children’s nutritional status.

It is concluded that the nutritional content of the children’s meals deviated considerably from the standards provided by the CWT, with significant differences also evident between the two meal subgroups, thus supporting both research hypotheses. In order for midday meals to meet these guidelines several changes need to be implemented. Providers of school dinners should aim to increase the amount of energy derived from carbohydrate, by increasing the carbohydrate portion of the meal and decreasing others accordingly. This would decrease the percentage of energy derived from fat; providing children with a roll/bread to accompany their meal could do this. Children taking a packed lunch should be encouraged to decrease their consumption of crisps, sweets and chocolate. School could provide education to encourage children to make healthier choices, and perhaps educate parents to make better food purchases and, therefore provide a healthier meal for their child. Finally, children’s fruit and vegetable consumption needs to be increased.

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