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ORIGINAL ARTICLE

Energy and nutrient intakes of Swedish children in relation to consumption of and habits associated with school lunch

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Abstract

Aims: School lunches are provided free in Sweden, although some children choose not to eat school lunch. The aim of this study was to analyse Swedish children's total energy and nutrient intakes on weekdays by the frequency of school lunch consumption and to analyse energy and nutrient intakes from school lunches by sex. Factors associated with children's school lunch habits were also studied. **Methods:** Children in grades 2 and 5 (n=1905) completed a food diary (school lunch data available for 1840 children) and the mean energy and nutrient intakes per day and per school lunch were calculated. The children also completed questions on the frequency of school lunch consumption and school lunch habits. Logistic regression was used to assess factors associated with school lunch habits. **Results:** Children who reported eating school lunch every day had significantly higher energy and absolute nutrient intakes than children reporting eating school lunch less than five times a week, but not standardized for energy. Boys had significantly higher energy and absolute nutrient intakes from school lunches than girls, but not standardized for energy. Younger children and children who liked school lunches had higher odds of eating school lunch every day. Children in grade 5, those with a foreign background and those disliking school lunches had higher odds of omitting the main lunch component. ***Conclusions:*** **Regular school lunch consumption was associated with a higher total intake for most nutrients, but not a better nutrient density. School lunch habits were associated with age, ethnic background and liking school lunches.**

Key Words: *School meals, school lunches, children, nutrient intake, energy intake*

Introduction

Sweden is one of three countries where free school lunches are served in compulsory grades, the other countries being Finland [1] and Estonia [2]. According to Swedish law, school meals must be provided free and must be nutritious [3,4], meaning that schools are required to be compliant with the nutrient-based standards in the National Food Agency (NFA) guidelines [5] or to adhere to the nutrient criteria measured in a web tool [6,7]. Data gathered with the web tool have shown that only 27% of the participating schools reached all the nutrition criteria for dietary fibre, iron, vitamin D and quality of fat [8]. Although there is room for improvement, the nutritional quality of school lunches has improved since the implementation of the Swedish Education Act on nutritious school meals in 2011 [6].

School lunches in Sweden often consist of a choice of one or more cooked dishes, a salad buffet, milk or water to drink and crispbread with spread [5]. Children typically serve themselves with food and therefore choose what ends up on their plates. In Finland, where the system of self-serving is also generally applied, studies on children and adolescents have shown that some components of the school

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meal are often omitted [1,9,10]. Research from Sweden has shown that children eat less of the school lunch than the 30% reference value for energy intake stated in the guidelines [5], which affects the nutritional contribution of these meals [11,12]. A national food consumption survey showed that pupils' intakes from school lunches mostly reached the reference values, but that there is room for improvement, particularly regarding dietary fibre, vitamin D, sodium and quality of fat [12]. Some children also skip school lunch on a regular basis, especially older children (⩾10 years) [13–15].

Although free school lunches are served in Sweden, some children still choose not to have school lunch or omit some components of the meal. It is therefore of interest to study differences in intake across groups and the factors associated with school lunch habits, although data are lacking. The aim of this study was to analyse Swedish children's total energy and nutrient intakes on weekdays by frequency of school lunch consumption and to analyse energy and nutrient intakes from school lunches by sex. An additional aim was to study the factors associated with children's school lunch habits.

Table I. Characteristics of the study participants (n=1905).

Variable	n (%)
Grade	
2	889 (46.7)
5	1016 (53.3)
Sex	
Male	961 (50.4)
Female	944 (49.6)
Area of residence	
Large city	634 (33.3)
Medium-sized city	428 (22.5)
Rural area	843 (44.3)
Ethnicity[a]	
Child and parent born in Sweden	1446 (78.3)
Parent or child born outside Sweden	401 (21.7)
BMI[b] **(kg m^2)**	
<25	1422 (82.8)
⩾25	252 (14.7)
⩾30	44 (2.6)
Parents' education[c]	
High school or lower	998 (53.7)
College/university	861 (46.3)

[a]58 (3.0%) observations missing.
[b]ISO-BMI; 187 (9.8%) observations missing.
[c]Classified by the parent with the highest education level in the household; 46 (2.4%) observations missing.

Methods

The present study was based on secondary analyses of the Swedish national food consumption survey *Riksmaten barn*, which was performed in 2003 by the NFA. Data were collected using a food diary and a food consumption questionnaire. Results from this study and more detailed descriptions of the methods used have been presented elsewhere [12,13,16].

Participants

The original study included children aged 4 years and school children in grade 2 (usually aged 8 years) and grade 5 (usually aged 11 years). For the purpose of this study, only the school children were included. A total of 2499 children were selected from a nationally representative cluster sample of Swedish municipalities and 1905 children (76%) were finally included in the study (Table I). Of these, 1840 children had recorded at least one school lunch in their food diary and background data on these children have been presented elsewhere [12]. In the group with no school lunches recorded (n=65), there were significantly more children with a foreign background, significantly fewer children with a body mass index (BMI) ⩾25 kg/m^2 and significantly more children who reported in the questionnaire that they sometimes skipped school lunch and regularly omitted the main lunch component when eating school lunch [12]. Written consent was obtained from the parents of the participating children.

Data variables

Information on total energy and nutrient intake per day (n=1905) and dietary intake from school lunches (n=1840) was collected from an open, estimated four-day food diary, with all days of the week evenly represented in the sample. All food items and beverages consumed by the children were recorded, either by the children themselves or with the help of an adult. Staff at the NFA coded and analysed these food items and beverages using the food composition database of the NFA version 04.1.1 [17] and the computer software MATs [18]. As school lunches are served on weekdays, weekends were excluded. The children recorded consumption of one to four school lunches and therefore the mean intake was used for each participant calculated as the total intake from school lunches divided by the number of recorded days with school lunches. The nutrients studied were those included in the Swedish guidelines for school lunches [5]. Both absolute intake (data not presented) and intake standardized for energy were studied (E% or nutrient density per MJ). The nutrient density of the school lunches per MJ consumed was calculated as the nutrient values for each subject divided by energy content for that subject.

Information on school lunch consumption and school lunch habits were collected from a questionnaire. Responses to the following three questions about the school lunch were analysed and the response alternatives are given in parentheses: (a) 'On how many of the five school days per week do you usually eat school lunch?' (number of days per week); (b) 'How often do you only take bread, salad, a beverage and/or sour milk [a dairy product similar to yoghurt] for school lunch?' (number of days per week); and (c) 'What do you think of the school lunches?' (ordinal scale of five response alternatives ranging from 'most often very tasty' to 'most often not at all tasty'). Background information (age, sex, weight, height, area of residence, ethnicity and parents' education) was also collected.

Analyses

SPSS version 20.0 was used for the statistical analyses [19]. The results were considered significant for $p<0.05$. As multiple tests were performed, the chances of committing a type I error were increased and therefore the significance of the different test results must be interpreted with care.

When data were missing, cases were excluded analysis by analysis, which means that the number of children included in the different tests varied. Two-sided independent sample *t*-tests were conducted to compare groups: boys' and girls' intake from school lunch and the total intake during the day for pupils who reported in the questionnaire that they always ate school lunch and pupils who reported having school lunch less than five times a week. Data regarding the children's intake in relation to different age groups have been presented elsewhere [12]. The variables were not normally distributed and the sample contained outliers, but as the sample size was large, the lack of normality should not constitute a problem [20,21]. The means and the 5% trimmed means were generally similar, indicating that the outliers should not have affected the results in a major way [20]. Mean values and 95% confidence intervals (CIs) are presented. In cases where the assumption of homogeneity of variance was not fulfilled, i.e. when values for Levene's test were significant ($p<0.05$), the results provided by SPSS for when equal variances were not assumed are presented.

Based on the questionnaire data, direct logistic regression, when all predictors are entered at the same time [21], was used to assess the impact of seven explanatory variables (school grade, sex, area of residence, ethnicity, BMI, parents' education and liking school lunches) on two dependent variables: whether the children reported eating school lunch every day or not (model 1) and if they reported consuming only bread, salad, a beverage and/or sour milk for lunch, henceforth referred to as omitting the main lunch component, at least once weekly (model 2). Odds ratios (ORs) with 95% CIs were used.

Model 1 correctly classified 87.3% of cases, which was above what might be expected by chance (77%). As a result of the unequal group sizes, it was not possible to use the recommendation that the accuracy should be 25% better than the chance criteria because the predictive accuracy in this case would have to be close to 100% (proportional chance criterion) or >100% (maximum chance criterion). The model was accurate in predicting children who always had school lunches (97.9%), but not children who skipped school lunches (13.8%), although the specificity of the model improved with the explanatory variables included. Model 1 did not fit well for 59 children (3.7%) who were outliers. These children had been categorized as pupils who always had school lunches when in reality they had reported that they sometimes skipped school lunch. The majority were children in grade 5 (47 children) and none had stated that they disliked the school lunches.

Model 2 correctly classified 76.2% of cases. The hit ratio should be 69.6% (proportional chance criterion) and this was fulfilled for all cases and for children who never omitted the main lunch component (89.8%), but not for pupils who omitted the main lunch component at least once a week (48.8%). Model 2 did not fit well for 36 children (3.1%) who were outliers. Most of them (33 children) had stated that they omitted the main lunch component at least once a week, but were predicted not to. Almost all of them were in grade 2 (33 children).

Results

Table I describes the characteristics of the total population (n=1905).

Differences in total intake in relation to frequency of school lunch consumption

A total of 225 (12%) children reported eating school lunch less than five times a week in the questionnaire: 37 (4%) of the children in grade 2 and 188 (19%) of the children in grade 5. Pupils who reported eating school lunch every day had a significantly higher intake of energy and all nutrients on weekdays than pupils who reported eating school lunch less often (data not displayed). When standardized for energy, the intake of vitamin D (p=0.022), folate (p=0.023) and sodium ($p\leqslant0.001$) was still significantly higher

Table II. Total mean daily energy intake and nutrient intake standardized for energy (*E*% or per MJ) on weekdays for all participants (*n*=1905) and a comparison between children who always eat school lunch and children who eat school lunch on less than five days a week.

Nutrient	All (*n*=1905)		Eats school lunch every day (*n*=1639)[a]		Eats school lunch <5 days/week (*n*=225)[a]		*p*[b]
	Mean	95% CI	Mean	95% CI	Mean	95% CI	
Energy (kJ)	7298	7199–7398	7383	7276–7490	6830	6540–7119	<0.001*
Protein (*E*%)	15.7	15.6–15.8	15.7	15.6–15.9	15.4	15.0–15.8	0.071
Carbohydrate (*E*%)	51.4	51.2–51.7	51.4	51.1–51.7	51.8	50.9–52.6	0.383
Dietary fibre (g/MJ)	1.8	1.8–1.9	1.8	1.8–1.9	1.8	1.7–1.9	0.355
Total fat (*E*%)	32.2	32.0–32.4	32.2	32.0–32.4	32.2	31.5–33.0	0.968
SFA (*E*%)	14.5	14.4–14.6	14.5	14.4–14.6	14.5	14.1–15.0	0.975
PUFA (*E*%)	3.8	3.8–3.9	3.8	3.8–3.9	3.8	3.6–3.9	0.603
Vitamin D (μg/MJ)	0.7	0.7–0.7	0.7	0.7–0.7	0.6	0.6–0.7	0.022*
Vitamin C (mg/MJ)	12	11–13	12	11–13	10	9–12	0.08
Folate (μg/MJ)	26	26–27	27	26–27	25	24–26	0.023*
Iron (mg/MJ)	1.2	1.2–1.2	1.2	1.2–1.2	1.2	1.1–1.2	0.13
Sodium mg/MJ	389	385–393	391	387–395	371	360–381	<0.001*

PUFA: polyunsaturated fatty acids; SFA: saturated fatty acids.
[a]A total of 41 values missing in the *t*-tests.
[b]Two-sided independent sample *t*-tests comparing the two groups; *significant mean difference at the 0.05 level.

in pupils eating school lunch every day, although the differences were small (Table II).

Differences between boys and girls in school lunch intake

Boys reported significantly higher absolute intakes of energy and all nutrients (except vitamin C) from school lunches than girls (data not displayed). Most of these differences did not remain statistically significant when the variables were standardized for energy, indicating that most of the differences could be attributed to boys eating more than girls. Dietary fibre density was the only difference that was statistically significant, with girls having a higher intake than boys (p=0.007). The difference was small, however, and unlikely to be of practical importance (Table III).

Determinants of school lunch habits

The results from the logistic regression (based on questionnaire and background data) for determinants of school lunch habits are given in Table IV. The strongest predictor of reporting always eating school lunch was liking the school lunches (model 1). Compared with children who disliked the school lunches, the OR for children who liked the school lunches was 10.5 (CI 7.2–15.2); the OR was 2.9 (CI 1.9–4.7) for children who were neutral to school lunches. Pupils in grade 5 were less likely to always have school lunch (OR 0.3, CI 0.2–0.5) than those in grade 2.

The children's statements about liking school lunches was the strongest predictor of omitting the main lunch component (model 2). Both children stating that they liked school lunches (OR 0.1, CI 0.1–0.2) and children being neutral to school lunches (OR 0.3, CI 0.2–0.4) were less likely to report omitting the main lunch component than children not liking school lunches. Children in grade 5 were more likely to omit the main lunch component than children in grade 2 (OR 3.8, CI 2.8–5.2) and children with a foreign background were more likely to omit the main lunch component than children from a Swedish background (OR 1.7, CI 1.2–2.4).

Discussion

Children who reported eating school lunch every day had significantly higher daily energy and nutrient intakes than children who reported eating school lunch less often. This could be attributed to the higher energy intake found in this group, except for vitamin D, folate and sodium, where the nutrient intake was also significantly higher after adjusting for energy intake. Although children eating school lunch less than five times a week constituted a minority in the studied sample (12%) and no causation may be implied, it is still interesting to note that school lunch consumption was associated with better total intakes, but also a higher intake of sodium, which is not supposed to be high in a healthy diet. Previous data on Swedish adolescents have shown that an irregular meal pattern is related to poorer food choices and lower nutrient intakes [22]. Studies from other Nordic countries imply that free school lunches could contribute positively to children's nutrient intake [9,23] and that eating a balanced school lunch

Table III. Mean energy intake and nutrient intake standardized for energy (*E*% or per MJ) from school lunches for all participants who had consumed school lunches during the study period (*n*=1840) and comparison between boys and girls.

Nutrient	All (*n*=1840)		Boys (*n*=933)		Girls (*n*=907)		*p*[a]
	Mean	95% CI	Mean	95% CI	Mean	95% CI	
Energy (kJ)	1919	1881–1956	2043	1989–2096	1791	1741–1841	<0.001*
Protein (*E*%)	19.1	18.9–19.3	19.2	18.9–19.5	19.0	18.7–19.3	0.405
Carbohydrate (*E*%)	47.5	47.0–48.0	47.2	46.5–47.9	47.8	47.1–48.5	0.242
Dietary fibre (g/MJ)	1.9	1.9–2.0	1.9	1.8–1.9	2.0	1.9–2.1	0.007*
Total fat (*E*%)	34.1	33.7–34.5	34.3	33.7–34.9	33.9	33.3–34.5	0.338
SFA (*E*%)	14.9	14.7–15.1	15.1	14.8–15.4	14.7	14.4–15.0	0.083
PUFA (*E*%)	4.1	4.0–4.2	4.1	3.9–4.2	4.1	4.0–4.2	0.799
Vitamin D (μg/MJ)	0.8	0.7–0.8	0.8	0.7–0.8	0.8	0.7–0.8	0.973
Vitamin C (mg/MJ)	9	9–10	9	8–9	9	9–10	0.107
Folate (μg/MJ)	27	27–28	27	26–28	28	27–29	0.225
Iron (mg/MJ)	1.3	1.3–1.4	1.4	1.3–1.4	1.3	1.3–1.4	0.702
Sodium (mg/MJ)	538	529–546	531	520–542	544	533–556	0.102

PUFA: polyunsaturated fatty acids; SFA: saturated fatty acids.
[a]Two-sided independent sample *t*-tests comparing the two groups; *significant mean difference at the 0.05 level.

Table IV. Logistic regression with model 1 (*n*=1607, 16% missing values) modelling the likelihood of eating school lunch every day (coded as 1, *n*=1404) and with model 2 (*n*=1147, 40% missing values) modelling the likelihood of omitting the main lunch component, at least once weekly (coded as 1, *n*=381).

Explanatory variables	Model 1: Eating school lunch every day			Model 2: Omitting the main component		
	n	Odds ratio (95% CI)	*p*	*n*	Odds ratio (95% CI)	*p*
Grade						
Grade 2 (reference)	722			538		
Grade 5	885	0.321 (0.213–0.483)	<0.001*	609	3.780 (2.770–5.159)	<0.001*
Sex						
Boy (reference)	816			575		
Girl	791	0.965 (0.694–1.341)	0.832	572	1.242 (0.931–1.658)	0.141
Area of residence						
Whole variable			0.599			0.067
Large city (reference)	527			373		
Medium-sized city	357	1.246 (0.793–1.958)	0.339	269	0.658 (0.444–0.976)	0.038
Rural area	723	1.147 (0.780–1.687)	0.486	505	0.991 (0.701–1.400)	0.957
Ethnicity						
Swedish background[a] (reference)	1266			909		
Foreign background[b]	341	0.959 (0.645–1.426)	0.836	238	1.728 (1.222–2.445)	0.002*
BMI						
<25 (reference)	1321			938		
⩾25	286	0.869 (0.554–1.364)	0.541	209	1.257 (0.855–1.849)	0.245
Parents' education						
High school/lower (reference)	861			595		
College/university	746	1.373 (0.976–1.930)	0.068	552	0.801 (0.595–1.079)	0.145
Liking school lunches						
Whole variable			<0.001*			<0.001*
Dislikers (reference)	276			218		
Neutral	185	2.948 (1.866–4.657)	<0.001*	128	0.269 (0.165–0.440)	<0.001*
Likers	1146	10.476 (7.212,15.216)	<0.001*	801	0.108 (0.074–0.156)	<0.001*

reference: reference category; *significant at the 0.05 level.
[a]Defined as child and parents both born in Sweden.
[b]Defined as child or parent born outside Sweden.
Omnibus test of model coefficients: model 1, χ^2(df=9)=258.927, p<0.001; model 2, χ^2 (df=9)=323.788, p<0.001.
The Hosmer–Lemeshow goodness of fit test: model 1, χ^2 (df=8)=6.803, p=0.558; model 2, χ^2 (df=8)=8.326, p=0.402.
Nagelkerke pseudo R^2: model 1, 28%; model 2, 34%.

– that is, eating all components of the meal in the intended proportions – is associated with healthier overall eating patterns [10].

Boys had a significantly higher nutrient intake than girls for almost all studied variables, which could be attributed to boys eating larger portions than girls. This is in line with previously published data from *Riksmaten barn* showing that boys had a higher energy intake than girls during the whole day [16]. Children of the same age vary in body weight and physical activity level and therefore in energy requirements [24]. As a result, it cannot be concluded whether the difference in energy intake is due to differences in physiological needs; the differences between boys and girls were fairly small.

Factors significantly contributing to eating school lunch every day were school grade and liking the school lunches, with younger children and likers of school lunches having higher odds of always eating school lunch. Children in the older age group, children of foreign backgrounds and non-likers of school lunches had higher odds of omitting the main lunch component and only choosing the additional components of the school lunch. The result that liking the school lunches was the strongest predictor of eating school lunch and for not omitting the main lunch component is not surprising, but is still an important finding when striving to increase the number of children eating school lunches. According to research from Finland, adolescents having a positive attitude towards school lunches were more inclined to eat larger portions of the main lunch component and the additional components of the meal – that is, vegetables, milk, bread and margarine [25] – but the children and adolescents often omitted some components of the meal [1,9,10]. In the present study, children with a foreign background had higher odds of omitting the main lunch component and the reasons for this remain unknown, but it could be speculated that this is associated with cultural preferences or religious reasons. The guidelines encourage schools to provide alternatives for religious reasons [5], but it is not compulsory to follow this advice. Children in grade 5 were more inclined to skip school lunch or omit the main lunch component. We have previously shown that pupils in grade 5 were less likely to reach the recommended intakes of key nutrients from school lunches than children in grade 2 [12]. The tendency to skip school lunch with increasing age is in agreement with other studies from Sweden [14,15], but research has also shown that school lunch consumption may increase again after grade 7 [14].

In a longitudinal study of Swedish school children regarding health behaviours, Elinder et al. [14] found socioeconomic differences, with children of more highly educated parents having better health behaviours over time than children of less educated parents. This included the consumption of lunch on school days, where especially girls of less educated parents decreased their frequency of school lunch consumption over time. In the present study, parents' education did not contribute significantly to eating school lunch every day or to omitting the main lunch component, although it was close to being significant in model 1. Considering the results from the study by Elinder et al. [14] and that parental education and occupation have previously been related to children's nutrient intake and eating habits [16,26], the results from the present study could also be due to a type II error [21]. The groups on the outcome variable were unequal in size, with a minority of the children stating that they ate school lunch less than five times a week (n=203, 13% of the children in model 1) and the results may therefore be due to a lack of power in the analyses. The models were limited in predicting children who chose to skip school lunch or omitted the main lunch component and more studies are needed to find additional determinants for this group of children. Research from Finland on older children showed that determinants such as frequency of family meals and perception of body image were associated with eating a balanced school lunch [27].

The present study has some limitations. As a result of many non-responses to the question items used in the regression models and missing values on the explanatory variables, some children (298 in model 1 and 758 in model 2) had to be excluded from the two models and thus the results must be interpreted with care. Other limitations include possible under-reporting. In the original study on which these secondary analyses were based, it was estimated that 6% of children in grade 2 and 25% of children in grade 5 under-reported their energy intake [16]. The data collection took place in 2003 and it is possible that the situation is different now after the introduction of the law on nutritious school meals. Although no causation may be implied, there have been modest improvements in the nutritional quality of school meals in the past few years [6]. The data in the food records also consisted of a limited number of recorded school lunches (one to four meals per child) and the average intake from these meals was used. To make use of all the information from all meals for each individual child, repeated measurements and more advanced statistical methods are needed and therefore using the mean intake was a suitable approach for this study. In spite of these limitations, this study is unique in that it presents data based on a large, nationally representative sample from Sweden.

Regular school lunch consumption was associated with a higher total intake for most of the nutrients, but nutrient density was in general not better. School lunch habits were associated with age, liking school lunches and ethnic background. Boys had higher energy and nutrient intakes from school lunches than girls, but the nutrient density was not better. The results from the present study may form a basis for future interventions in relation to improvements in energy and nutrient intakes from school lunches in certain groups.

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