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Serving of free school lunch to secondary-school pupils – a pilot study with health implications

Anne Selvik Ask[1], Sigrunn Hernes[1], Ingebjørg Aarek[1], Frøydis Vik[1], Cornelia Brodahl[2] and Margaretha Haugen[1,3,*]

[1]Faculty of Health and Sport, Agder University, Kristiansand, Norway: [2]Faculty of Engineering and Science, Agder University, Kristiansand, Norway: [3]Department of Food Safety and Nutrition, Division of Environmental Medicine, Norwegian Institute of Public Health, PO Box 4404 Nydalen, N-0403 Oslo, Norway

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Abstract

Objective: To study whether service of a free school lunch has an impact on weight development and food intake among pupils at a lower secondary school, and to assess the association between self-perceived school behaviour and food intake.

Design: A controlled intervention study involving service of a free healthy school lunch to 9th grade pupils took place over 4 months, from January to May 2007. Weight and height were measured before and after the intervention. The pupils also completed a short FFQ and a questionnaire concerning self-perceived school behaviour and the classroom environment before and after the intervention. A healthy food score was calculated using the FFQ data.

Setting: All 9th graders at three different lower secondary schools in southern Norway were invited to participate. One school was randomly selected as the intervention school.

Subjects: Fifty-eight pupils (91 %) from the intervention school and ninety-two pupils (77 %) from the control schools participated.

Results: BMI did not increase among the girls at the intervention school, but increased significantly among the boys at the intervention school and among the control school groups. The healthy food score correlated positively with the trait 'satisfied with schoolwork' ($P < 0{\cdot}001$). Fifteen per cent of the variance in food score could be explained by gender and the trait 'satisfied with schoolwork'.

Conclusions: Serving of a healthy free school lunch to secondary-school pupils may result in restricted weight gain. Further studies are needed to clarify the impact of school meals on overweight and academic performance.

Keywords
Pilot study
School lunch
Weight
Body mass index
Food intake
School behaviour

A major public health crisis will emerge in many Western countries if steps are not taken to stop the increase in child and youth obesity[1,2]. In Norway, overweight/obesity in schoolchildren has increased from 9·8 % in 1993 to 12·3 % in 2000 among 8th graders, and an overall increase in fat mass has been demonstrated[3,4]. Several governmental strategies have been tried, most of which have been educational and informational. In 2007, a national action plan was launched by the Norwegian government[5] to improve the food intake of the entire population. The action plan discusses the introduction of a free school lunch. We have previously shown that serving a healthy breakfast to lower secondary-school pupils improves overall diet and reduces weight gain[6]. Several studies have confirmed the importance of a healthy breakfast in relation to adolescents' overall nutrient profile and academic performance[7,8], but no study has reported on lunch introduction in an affluent society. In Norway, pupils usually bring packed lunches from home, because no school lunch is provided by the government[9,10]. It has been observed among lower secondary-school pupils that packed lunches from home often are thrown away[9,11]. Pupils instead buy fast food, snacks or sweets from a local kiosk or the school canteen. School canteens are often run by the pupils themselves, and most commonly offer baguettes, waffles, milk (regular or chocolate), juice, cakes and, perhaps, fruit. Accordingly, serving a healthy school lunch has the potential to improve the diets of pupils and the social environmental setting of schools[12–14]. Academic performance has been explored in several studies concerning breakfast intake, while only two studies have looked at school performance and quality of the entire diet and meal pattern[14,15]. It is therefore of interest to evaluate if academic

*Corresponding author: Email margaretha.haugen@fhi.no

performance can be correlated to dietary intake and meal pattern.

The aims of the present study were to evaluate whether serving a free healthy lunch would improve the dietary quality and impact on weight gain among 9th grade pupils. We also wanted to evaluate whether there is an association between the pupils' food intake and their self-perceived school behaviour and performance.

Methods

Study design

A controlled intervention study was conducted in which a healthy school lunch was served to 9th grade pupils. The study was carried out on 9th grade pupils because pupils at this level have three home economics lessons per week, and lunch preparation was a part of the syllabus. The intervention period was 4 months. Before the study started in January 2007, and after it was completed in May 2007, the pupils answered two short questionnaires during a lesson: an FFQ and a questionnaire concerning self-perceived school behaviour and the classroom environment. Weight and height were also measured. Moreover, the teachers were asked to answer seven questions on class behaviour in an attempt to secure an objective evaluation of changes in behaviour following the service of lunch. Informed written consent was obtained from all parents and pupils. The study was approved by the Regional Ethical Committee and by the National Data Inspectorate.

Subjects

All 184 pupils in the 9th grade at three different lower secondary schools in southern Norway were invited to participate in an intervention study involving free lunches. One hundred and fifty of the pupils chose to participate. One school was randomly selected as the intervention school. At this school, sixty-four pupils were available and sixty-one gave a written consent to participate in the measurements. Three pupils were unavailable at the time of re-examination, resulting in a total of fifty-eight pupils, with a participation rate of 91 %. Of the 119 eligible pupils at the control schools, ninety-five chose to participate but three pupils were not present at the final evaluations, resulting in ninety-two participating control pupils (participation rate 77 %). All sixty-four pupils at the intervention school participated in the lunch programme, and all expressed their satisfaction with the project. Pupils who did not complete the FFQ satisfactorily before and after the intervention were not included in the statistical analyses on food score. This left fifty-three pupils from the intervention school and eighty-eight pupils from the control schools for assessment of the intervention. Five teachers at the intervention school and ten teachers at the control schools chose to complete the teacher's questionnaire twice.

Measurements

Working in teams of two, five researchers carried out the weight and height examinations. The weight measurements were performed on the same Seca® personal scale and height was measured using a Seca® stadiometer, with pupils being asked to stand up straight. BMI (kg/m^2) was calculated, and the International Obesity Taskforce gender-specific cut-offs at age 15 years were used to determine overweight and obesity[16].

Food score

The FFQ consisted of three questions on bread consumption, eleven questions on liquid intake, eight questions on different dinner alternatives and four questions on snacks and sweets. Bread intake frequency ranged from never to seven or more times daily. Seven frequencies were used for the questions on drinks and solid foods including never/seldom, weekly and daily. Eleven food items from the FFQ were chosen as the basis for a healthy food score. Intake of bread (half- and wholemeal), low-fat milk, boiled potatoes, vegetables and fruit was given a high score, whereas frequent intake of white bread, full-fat milk, soft drinks, sweets and chocolates was given a low score. Frequent intake of healthy food items was given the highest score (18), and frequent intake of unhealthy food items was given the lowest score (Table 1). Missing data were given a score of 0. The lowest and highest possible scores if pupils filled in the questionnaire correctly were 41 and 135, respectively.

Table 1 Scores given to intake of eleven food items; the scores were added to calculate a healthy food score

Food item	Intake: frequency and scores
Wholemeal bread	<4 times/week = 6 4–6 times/week = 12 ≥7 times/week = 18
Wholemeal crisp bread	<4 times/week = 6 4–6 times/week = 12 ≥7 times/week = 18
White bread	<4 times/week = 6 4–6 times/week = 4 ≥7 times/week = 2
Two questions for two types of low-fat milk	Never/seldom = 4 1–3 glasses/month = 5 1–6 glasses/week = 10 1–3 glasses/d = 15 ≥4 glasses/d = 12
Full-fat milk	0–3 glasses/month = 8 1–6 glasses/week = 4 ≥1 glasses/d = 2
Sugar-sweetened soft drinks	0–3 glasses/week = 4 ≥4 glasses/week = 1
Boiled potatoes for dinner	0–4 times/week = 6 ≥5 times/week = 12
Raw vegetables	0–4 times/week = 6 ≥5 times/week = 12
Sweets	0–2 times/week = 6 3–4 times/week = 4 ≥5 times/week = 1
Chocolates	0–2 times/week = 6 3–4 times/week = 4 ≥5 times/week = 1

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Lunch preparation and serving

The offered lunch consisted of wholemeal bread, different kinds of cheese, cold cuts of lean meat, fish and jam. Low-fat milk and fresh fruit and vegetables were also served. The pupils sliced the bread, arranged the cold cuts on serving trays, cut up the fruit and vegetables and served the milk under the supervision of the home economics teacher. They consumed the lunch in their own classroom together with teachers.

Assessment of school behaviour and environment

A questionnaire concerning self-perceived school behaviour, the school environment and achievement was answered on the same day as the FFQ[17]. The questions were divided into six main categories, covering friendship and support, relationship with classmates, own behaviour and experience with schoolwork, experience and relationship with teachers, and obedience. Each category was divided into between four and seven sub-questions. We also asked the pupils to state their grades in home economics, Norwegian, mathematics and social sciences.

The pupils' school behaviour characteristics were derived using factor analysis (principal component method with Varimax rotation), based on thirty-three questions from the school environment questionnaire. School behaviour characteristics were derived at the start of the study for all 150 pupils, as follows: using principal component analysis, the data were reduced by forming linear combinations of the original observed variables. Correlated variables were grouped together. The coefficients defining these linear combinations are called 'factor loadings' and are actually the correlations of each item with the relevant factor. The factors that best represented the data were chosen on the basis of eigenvalues and the understanding of the factor loadings. Varimax rotation redistributed the explained factor variance in a way that a simpler structure was achieved. We considered the factors for which the loading coefficient was higher than 0·2 or lower than −0·2, as these values roughly correspond to a statistical significance of $P = 0{\cdot}05$. Factor scores were created by multiplying factor loadings with the corresponding standardized value for each item, and then summing across the items. For each pupil, the factor scores indicate the extent to which the attitude conforms to the respective patterns. A negative (or positive) factor score means that the behaviour characteristics are inversely (or positively) correlated with the factor.

Statistical analysis

Data are presented as means and standard deviations for weight, BMI and food score. Differences between pre- and post-intervention food score, weight and BMI were assessed using a paired *t*-test for continuous variables and a Wilcoxon signed-rank test for nominal variables and repeated-measures ANOVA. The Spearman correlation coefficient was used to correlate school behaviour traits with grades and food score. Multiple linear regression analyses were used to investigate the impact of school behaviour traits on food score before study start. The analyses were thoroughly checked for possible violations of the model assumptions. The Spearman correlation coefficient was also used to evaluate reproducibility of the attitude traits before and after the lunch intervention period. All of the statistical tests were two-sided, and *P* values below 0·05 were considered significant. All statistical analyses were performed using the SPSS statistical software package version 14·0 (SPSS Inc., Chicago, IL, USA).

Results

At study start, 15 % of the seventy-four participating boys were overweight and 1 % (one case) was obese. Of the seventy-six participating girls, 13 % were overweight while none was obese. In the intervention school, 18 % of the boys and 16 % of the girls were overweight. Thirteen per cent of the boys and 11 % of the girls were overweight in the control schools. However, there were no statistically significant differences in BMI or height between male and female pupils in either the intervention school or the control schools at study start (Mann–Whitney *U* test). Both the weight and the BMI of boys at the intervention school increased significantly during the intervention period (both $P < 0{\cdot}001$), while weight ($P = 0{\cdot}043$), but not BMI, increased significantly among the girls there (Tables 2 and 3). In the control group, both weight and BMI increased significantly among the boys (both $P < 0{\cdot}001$) and the girls ($P < 0{\cdot}001$ and $P = 0{\cdot}017$, respectively). Two overweight girls, one in each group, could be reclassified as having a normal weight after the intervention, while two boys in the intervention group and three boys in the control group went from normal weight to overweight during the study period. We found no overall effect of the intervention on weight or BMI (Tables 2 and 3) using repeated-measures ANOVA.

At study start, the girls in both groups had a significantly higher healthy food score than the boys ($P = 0{\cdot}003$), but this difference disappeared after the intervention period. A reduced food score, which implies less frequent intake of healthy food items and/or more frequent intake of unhealthy food items, was observed after the intervention period for both the intervention and the control groups, and for both girls and boys (Tables 2 and 3). For boys, food score correlated positively with grades in Norwegian (Spearman correlation coefficient, $r_S = 0{\cdot}37$; $P < 0{\cdot}01$), social sciences ($r_S = 0{\cdot}35$; $P < 0{\cdot}01$) and home economics ($r_S = 0{\cdot}26$; $P < 0{\cdot}05$). No correlation between food score and grades was observed for girls.

Weekly intake of breakfast, lunch and dinner by the intervention group did not change to a statistically significant degree. Significantly fewer pupils at the control schools ate breakfast at the end of the study period

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Table 2 Results for 4 months of serving a healthy school lunch to male 9th graders, Norway, January–May 2007

	School lunch (*n* 27)				Control schools (*n* 48)					
	Before		After		Before		After			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	*F*†	*P* value
Weight (kg)	60·9	11·2	63·3***	11·5	62·5	12·0	65·0***	12·3	0·024	0·877
BMI (kg/m^2)	20·7	3·1	21·3***	3·3	20·8	2·9	21·2***	3·1	0·004	0·949
Food score	85	15	80*	15	80	18	78*	18	1·237	0·270

Mean values were significantly different from those before the intervention (Wilcoxon signed-rank test): *$P<0·05$, ***$P<0·001$.
†*F* statistic for interaction of school and before and after intervention results (repeated-measures ANOVA).

Table 3 Results for 4 months of serving a healthy school lunch to female 9th graders, Norway, January–May 2007

	School lunch (*n* 26)				Control schools (*n* 40)					
	Before		After		Before		After			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	*F*†	*P* value
Weight (kg)	54·7	11·7	55·7*	11·3	54·0	8·0	55·3***	7·5	0·047	0·829
BMI (kg/m^2)	20·5	3·5	20·7	3·4	20·2	2·8	20·5*	2·5	0·125	0·725
Food score	89	16	85**	18	90	21	83***	19	0·210	0·648

Mean values were significantly different from those before the intervention (Wilcoxon signed-rank test): *$P<0·05$, **$P<0·01$, ***$P<0·001$.
†*F* statistic for interaction of school and before and after intervention results (repeated-measures ANOVA).

($P=0·002$), but the frequency of packed lunch brought from home and intake of dinner did not change. At study start, the frequency of breakfast was negatively correlated with BMI among boys ($P<0·05$), while lunch frequency was not observed to have any effect on BMI.

We identified three main school attitudes among the pupils. Table 4 presents the factor loading matrix for these three main traits. Trait 1 (positive) characterized pupils who enjoyed schoolwork regardless of other pupils' views and scored highly on satisfaction with schoolwork. Trait 2 (obedience) characterized well-behaved children, while trait 3 (mischief) characterized obstinate pupils who scored highly on popularity with classmates. The three traits identified at study start correlated well with the same traits 4 months later: for trait 1, $r_S=0·67$; for trait 2, $r_S=0·60$; and for trait 3, $r_S=0·63$ ($P<0·001$ for all). Trait 1 correlated positively with grades for mathematics ($r_S=0·39$; $P<0·001$), social sciences ($r_S=0·63$; $P<0·001$) and home economics ($r_S=0·39$; $P<0·001$). Trait 3 correlated positively with grades in home economics ($r_S=0·25$; $P=0·004$). Trait 1 correlated positively with food score ($r_S=0·36$; $P<0·001$). Using a linear regression model, 15 % of the variance in food score could be explained by gender and trait 1 (Table 5). Neither of the two other traits correlated significantly with food score.

The teachers' pupil-behaviour assessment scores were significantly higher for the intervention school than for the control schools at study start ($P=0·007$). For both groups, the teachers' assessment scores were improved following intervention. A statistically significant improvement was observed in the control group ($P=0·04$).

Discussion

A free, healthy school lunch, consisting of wholemeal bread, different kinds of unsweetened spread, low-fat milk and fruit/vegetables, was offered to 9th grade pupils for 4 months. At the end of the study period, the BMI of the girls had not increased, while a significant increase was seen among the boys. The service of a free school lunch did not improve the food score, i.e. intakes of fruit, vegetables, low-fat milk and wholegrain bread, or reduce the intake of snacks, sugar-sweetened beverages and candy/chocolate. The healthy food score correlated positively with the trait 'satisfaction with schoolwork', which may lead to the conclusion that interested and positively minded pupils have a healthier diet than those with a more troublesome attitude towards school.

The prevalence of overweight among the 150 participating pupils (participation rate 81 %) was higher than previously reported in Norway[3,4,18,19]. However, in three of the former studies weight and height were self-reported[3,18,19], and in the study by Juliusson *et al.*[4] the response rate for the age group 13–15 years was 50 %. Both the self-reported weight and height measurements and the response rate could explain the differences, but the sample size in our study is too small to justify a comparison. However, the prevalence of overweight registered in the present study indicates the importance of prevention strategies[5,13].

Different strategies, including nutritional programmes and physical activity, have been investigated in connection with the prevention of obesity among children and adolescents, but the results are meagre[20]. As the Norwegian

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Table 4 Factor loading matrix for the three main traits identified by principal component analysis among male and female 9th graders, Norway, January–May 2007

Question regarding school environment	Enjoy schoolwork	Well behaved	Obstinate
Classmates			
Most of my classmates are my friends			0·734
Most of my classmates will help me if I need help	0·206	0·204	0·682
My classmates appreciate my company			0·759
I appreciate my classmates			0·729
Attention			
When the teacher teaches I listen	0·492	0·508	
When in groups I do my share of the work	0·439	0·508	
When in groups I concentrate on my work	0·361	0·518	
When the lesson starts I am ready to start working	0·518	0·547	
I switch to a new task quickly and quietly	0·550	0·518	
When working on projects I concentrate on the task	0·540	0·418	
Teachers			
The teachers explain project tasks well		0·735	
Our teachers are good tutors		0·702	0·255
Teachers explain well what to do when I work alone		0·693	
Project work is explained well by the teachers		0·690	0·266
Teachers explain changes of assignment well		0·628	
Experience with schoolwork			
Schoolwork is meaningful to me	0·629		
Schoolwork is pleasant	0·588	0·313	
Schoolwork is interesting	0·649		
Schoolwork is very valuable	0·604		
Behaviour			
I do not have serious fights with my classmates	0·430		
I am not corrected by my teacher because I am restless	0·363	0·354	
I do not get into trouble with other students	0·435		
I am not sent out of the classroom because I am noisy	0·681		
I do not oppose my teachers	0·523		0·241
I do not swear at my teachers	0·515		
I attend lessons on time	0·550		
Discipline			
I do not talk with my classmates without permission	0·265	0·508	−0·436
I do not bother my classmates	0·427	0·588	−0·218
I do not leave my seat without permission	0·394	0·497	
I do not talk without permission	0·260	0·518	−0·344
I do not interrupt lessons	0·362	0·578	−0·257
I do not annoy teachers	0·533	0·414	
I do what the teachers tell me to do	0·623		0·224

Table 5 Food score as a function of gender and school pattern ($r^2 = 0{\cdot}15$, $P < 0{\cdot}001$) among male and female 9th graders, Norway, January–May 2007. Beta values are unstandardized coefficients

Explanatory variable	Beta	95 % CI	*P* value
Gender	8·12	1·86, 14·38	0·011
Score enjoy schoolwork	5·22	2·08, 8·36	0·001

school system does not provide any organized lunch service, one of the aims of the current study was to evaluate whether a free lunch could reduce weight gain. This aim may seem too ambitious for a 4-month intervention period, and the results of this pilot study are indeed preliminary. Our finding that weight gain was reduced among girls, but not among boys, after the intervention period may also imply that the study period was too short to evaluate weight development. However, we are not aware of any studies in which such a comprehensive nutritional programme has been introduced, i.e. where there has been a change from a packed lunch from home to a full, free school lunch. In an earlier pilot study, we found that serving breakfast to 10th grade pupils reduced weight gain in both girls and boys[6], and other studies have observed an improved nutritional profile among pupils participating in school breakfast schemes[7,21]. Furthermore, in the present study, the frequency of breakfast was negatively correlated with BMI among boys and no effect was observed in relation to lunch frequency. Given that overweight has been directly associated with skipping breakfast, it is interesting to speculate about whether breakfast programmes should be prioritized at the expense of school lunch programmes[8,22], not least in the context of weakening the link between socio-economic status and overweight[22,23]. Other research groups have reported that children who were served a nutritious breakfast showed increased cognitive performance. This has been observed in both nutritionally deprived and well-nourished children[24].

With the service of a free, healthy lunch including fruit/vegetables, we would have expected an increase in food score[25,26]. Earlier studies in which free fruit was

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added to school lunches have reported increased fruit intake[27–29]. One reason for the reduced food score registered in our study could be the different times during the year that registration took place. The first registration was carried out in late January, while the second registration took place at the very end of May. Various national celebrations take place during May, and hot dogs, sugar-sweetened sodas and cakes are often served at such events. The significantly reduced food score of the control groups may confirm that May is a less healthy month regarding food intake. It is therefore possible that the results would have been different if the intervention period had been longer and the second registration had taken place at the same point during the year as the first registration. Furthermore, there was very little potential for improvement among the pupils at the intervention school. Seventy-seven per cent of the pupils brought a packed lunch from home four or five times weekly (data not shown). The corresponding figure for the control schools was 75 %. Only 2 % of all pupils admitted to buying lunch from kiosks or supermarkets every day, which confirmed that the pupils at the three schools already followed good lunch practices. It is also possible that eagerness to please played a part at the time of the first, but not the second, registration.

Nutritional knowledge and dietary locus of control have not been shown to have an impact on BMI[30]. In our study, all three school classes had three home economics lessons a week, covering both nutritional theory and practical cooking skills. However, this was not reflected in the food score. A health promotion programme featuring peer-led teaching on healthy living, covering nutrition, physical activity and a healthy body image, has been shown to have impact on weight among 4th to 7th grade pupils[30]. In an attempt to evaluate whether certain characteristics of school behaviour could predict body weight and food intake, three traits of self-perceived behaviour were identified. None of the scores relating to the three different traits correlated with weight, although a high school satisfaction score was positively correlated with grades and food score. Food score also correlated positively with the grades of boys in our study. Academic performance and diet quality (taking into account the entire diet) have been explored in two studies[14,15], and their conclusions are highly consistent with our findings. In one of the studies, academic performance was more strongly correlated with the meal pattern (three main meals daily) than with socio-economic status[15]. Although our study is a pilot study, we have been able to demonstrate an association between diet quality and academic performance, despite a lack of information on the socio-economic status/cultural level of families[14,31]. This information might be of interest to public bodies when planning school meals or looking for educational goals.

The teachers' assessments of school behaviour before and after intervention are difficult to interpret, as both groups were more positive after the intervention period. However, the teachers at the intervention school expressed qualitatively a positive attitude towards the serving of lunch, referring to it as a positive break during the school day. The pupils had more social contact and mingled during the lunch.

Challenges will have to be overcome in the fight against obesity in childhood and during adolescence. Several strategies have been tried but no consensus has been reached, and it is obvious that various strategies will have to be employed[2,20]. In Norway, we do not serve any school meals, but the introduction of a cold or warm lunch has been discussed. In the interests of combating obesity and boosting cognitive performance, further investigations of school lunch quality should be carried out before any conclusions are reached or any decisions are made. Breakfast may be a healthier alternative than lunch, but the introduction of additional school hours may be necessitated by the service of both meals.

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