

Gebremariam, M., Andersen, L. F., Bjelland, M., Klepp, K. I., Totland, T. H., Bergh, I. H., Lien, N. (2012). Does the school food environment influence the dietary behaviours of Norwegian 11-year-olds? The HEIA study. *Scandinavian journal of public health*, 40, 491-497.

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Does the school food environment influence the dietary behaviors of Norwegian 11-year-olds? The HEIA study.

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Abstract

Aims: The aim of the study is to investigate the influence of the school food environment on the dietary behaviors of 11-year-old Norwegian children in elementary schools.

Methods: Baseline data from a school-based intervention study: the Health In Adolescents Study was used. A total of 1425 11-year-old children from 35 schools from the Eastern part of Norway were included. School administrators provided information on the physical, political and socio-cultural school food environment and students reported their intake of fruits, vegetables, sugar-sweetened beverages (SSB) and snacks. Multilevel modeling was used to assess the school level variance in dietary behaviors and to investigate the association of school food environmental factors with these dietary behaviors.

Results: After adjustment for student characteristics, the school level accounted for a small proportion (1.1% - 3.0%) of the variance in the dietary behaviors investigated. None of the investigated school food environmental factors were found to be related to the children's reported intake of fruits, vegetables, snacks or SSB.

Conclusion: Most of the variance in the dietary behaviors investigated was at the personal level. Thus in this sample, the investigated school level factors do not appear to exert a strong influence on the dietary behaviors of children. Longitudinal studies using validated measures of the school food environment are needed.

Keywords: food environment, school, dietary behaviors, multilevel analysis

Background

Evidence indicates that children's dietary intakes are not consistent with national recommendations. In Norway, children eat fewer fruits and vegetables than is recommended for health [1, 2] and consume too much added sugar [3, 4]. In addition, studies show that dietary habits

established in childhood can track into adolescence and even into adulthood [5-7]. Investigation of factors influencing children's eating habits is therefore of public health importance. Individual (cognitive) determinants of dietary behaviors have been the most studied in the past [8]. The last decade has nevertheless seen an increased recognition of the role of the environment in influencing health behavior, with ecological models being increasingly used in the study of health behaviors including dietary behaviors [8]. Such models indicate that, in addition to individual cognitive factors, environmental factors can also directly influence behaviors [9, 10].

Children spend a significant amount of their time at school, a setting which has a good potential of shaping children's behavior in general, in addition to allowing for a large number of children to be reached irrespective of their socioeconomic position. Therefore, the school is seen as having a potential to play a significant role in influencing dietary habits [8, 11]. In Norway, national guidelines for healthy school meals were introduced in 2001. These guidelines provide, among other things, recommendations about improved access to healthy school meals and restrictions of unhealthy food items at school [12].

The school environment can be divided into four aspects based on the Analysis Grid for Environments Linked to Obesity (ANGELO), all of which have the potential of influencing dietary intake: physical, referring to what is available; economic, referring to the financial factors related to food; political, referring to the rules related to food; and socio-cultural, referring to attitudes, beliefs and values related to food [13]. However, methodological research in this area is in its infancy, and the assessment of these different aspects of the food environment is still under development.

Associations between selected factors in the school environment and different dietary habits of children have been documented in several studies [11, 14-16]. Many studies using multilevel modeling nevertheless found no significant school-level variance in dietary behaviors of children once individual-level characteristics were controlled for [17-22]. Many of these studies have however been criticized for focusing on too few school-level factors [11]. In addition, as most studies of school effects on dietary behaviors of children have been conducted in the US, where the school

food environment is different from the European one in general and the Norwegian one in particular, results cannot be directly extrapolated to these contexts. Data from 2006 indicate that 95% of 5th to 7th graders in Norway bring their school lunch from home [23].

The aim of the present study is to investigate the political, socio-cultural and physical food environment in 35 elementary schools in Norway and to assess its influence on the dietary behaviors of 11-year-olds.

Methods

Design and sample

Baseline data from a school-based intervention study, the HEalth In Adolescents (HEIA) study is used. The overall aim of the HEIA study was to develop and evaluate a multi-component intervention study aimed at healthy weight development through diet and physical activity (PA) [24]. Schools were included in this study if they had a minimum of 40 enrolled students in the 6th grade. Schools were thus recruited from the largest towns/municipalities in seven counties from the Eastern part of Norway. A total of 177 schools were invited, and 37 schools (21%) accepted the invitation. All 6th graders (n=2165) in these schools and their parents/legal guardians were invited to participate in the baseline (BL) study in September 2007. Parental consent was obtained for 1589 of the children and 1528 children filled in the questionnaire. A completed school management questionnaire filled in by the principals or another person in the school administration (appointed by the principal) was returned by 35 of the schools. Participants in this study are the 1425 participating children from these 35 schools.

Ethical clearance was obtained from the Regional Committees for Medical Research and the Norwegian Social Science Data Service.

Data collection

The children were taken to separate computer rooms in groups. They answered an internet-based questionnaire over a period of approximately 45 minutes. The school principal, or another person in the school administration, was asked to complete a questionnaire on school environment which was returned to the research team by regular mail in a pre-addressed and pre-stamped envelope.

Measures

Outcome measures: dietary behaviors

Consumption of fruits and vegetables (raw and cooked) was assessed by a frequency question with eight categories ranging from never/seldom to three times per day or more. Frequency of consumption of snacks (sweets/chocolate, salty snacks, sweet biscuits and buns/muffins) was assessed using questions with seven categories ranging from never/seldom to two times per day or more. Intake of beverages during weekdays was assessed using frequency questions with categories ranging from never/seldom to every weekday, and amount in glass (from one to four or more, with one glass = 1.67 deciliters). The beverages included in the present study are sugar-sweetened beverages (sum of sugar-sweetened carbonated soft drinks and fruit drinks) measured as dl/weekday.

Adequate test-retest correlation coefficients for the dietary intake variables were obtained from a separate test-retest study conducted at 10-14 days apart among 111 6th graders prior to the main data collection [24].

Individual-level covariates

Gender, parental education and family structure were included. Parental education was reported as a part of the parental informed consent for the adolescent. It was categorized into: low (12 years or less), medium (between 13 and 16 years) and high (more than 16 years). Educational status of the parent with the longest education or else the one available was used in the analyses. Family structure of the children was divided into two categories: those living with two parents versus all other living arrangements.

School-level covariates

An extensive school master questionnaire modified from a nationwide school survey [23] and covering different aspects of the school and its neighborhood's food environment was used.

Two aspects related to the school's socio-cultural environment were included. The perceived responsibility of the school for the diet of students was assessed using a statement with five response categories ranging from "not at all" to "to a high degree". The degree of priority given to food and nutrition beyond the mandatory was assessed using a statement with five response categories from "totally disagree" to "totally agree" with a neutral midpoint.

The physical environment was assessed by asking about the existence of a school fruit subscription program, with or without parental payment. The presence of a canteen/food booth in the school and its assortment were assessed. The principals were also asked about the presence of food sales outlets within walking distance from the school where foods or beverages could be purchased. This measure was validated using information obtained from an online search as part of an observational study of these stores, with almost perfect agreement noted.

Two aspects related to the school political environment were included. The presence of nutritional guidelines at the school and whether the guideline is written or oral was assessed. The existence of a school environmental committee with nutrition in its agenda was enquired.

Statistical analysis

Descriptive analyses of the school food environment and dietary behaviours were first conducted. To investigate the influence of factors in the school food environment on the dietary behaviors of the children, multilevel linear mixed modeling was used. The null multilevel models were first tested with the selected dietary behaviors as the response variables and no predictor variables to examine the between-school variance. Then, a model with the individual-level covariates was conducted to assess whether the between-school variance was simply due to a compositional

effect. It is also possible for large genuine between-school variations to be masked by differences in composition of the schools [25]. Thirdly, school-level characteristics were included in the model. Due to the possibility of a given study to have insufficient power to detect between-school variance while allowing for the detection of a fixed effect at the school level [26], the third model was used even in the presence of very small between-school variations, and the p-value for random effects was set to 0.1. SPSS version 19 was used for the analyses.

Attrition analysis was done using independent samples t-tests, comparing participating schools and schools which declined to participate in terms of number of students in 6th grade and overall size.

Results

A total of 1425 students, 688 girls and 737 boys, were included. Mean age was 11.2 (SD = 0.3). The proportion of children with parents with high education was 34% and that of children with parents with medium education was 36%. Those living with two parents constituted 79 % of the participants.

Dietary behaviors

On average, the children ate fruits 1.4 times/day and vegetables 1.6 times/day. Average consumption of SSB was 1.2 dl/weekday. Snacks were consumed on average 4.7 times per week (table 1).

School food environment characteristics (table 2)

Political environment

Nutritional guidelines at the school level were available in three of the schools only; one of these schools had a written and two had oral guidelines. This measure was not used in the multilevel analyses, due to the presence of few schools per category.

Eighteen of the schools had a school environment committee, of which ten reported to have nutrition as part of the agenda.

Socio-cultural environment

Seventeen respondents replied that the school had a high/very high degree of responsibility for the children's diet. Eight respondents reported that food and nutrition was a prioritized working area beyond the mandatory in their schools.

Physical environment

Of the schools included, five reported having a student canteen/food booth. Milk was offered in one of these school food sales outlets, fruit juice in four, fruit in two, vegetables in one, yoghurt in four, toast/pizza in two and bread sandwiches in one. Two of these canteens/food booths were open once a week, one was open twice a week, one was open thrice a week and one was open every day. Fruit and vegetable subscription programs were available in seventeen of the schools; four schools having free (no parental payment) and thirteen fee-based subscription programs. Twenty six of the schools reported one or more food sales outlets available within walking distance from the schools.

Association between the school environment and dietary behaviors

The null models showed that the between-school variances in the dietary behaviors were low; the intra-class correlation (ICC) showed that 1.1 % of the unexplained variation in vegetable intake was at the school level. The respective proportions for fruit intake, SSB intake and intake of snacks were 1.9%, 3.1%, and 3.7%. Adjustment for individual-level covariates decreased the ICCs to 1.8% and 3.0% respectively for SSB and snacks. In the final models, including both individual-level and school level covariates, none of the school-level food environment factors were found to be associated with the dietary behaviors investigated (tables 3 and 4).

Attrition analyses

The attrition analyses showed no difference between participating schools and schools which declined to participate in terms of number of students in 6th grade and overall size (data not shown).

Discussion

The results from this study indicate that there is a low school-level variance in the dietary habits of 11-year-old Norwegian children in elementary schools. This result is in line with the findings of several other studies among children of similar age [17-22]. Preferences as well as home environmental factors such as availability and accessibility of food items, and parental intake are frequently found to be more important determinants of dietary behaviors of children at this age, in addition to socio-demographic factors [5, 27, 28]. Behaviors most influenced by the school appear to be those developed later in life, i.e. during adolescence and performed with peers. Thus, for smoking and drinking habits, larger between-school variations are documented [20, 22]. Studies on tracking of dietary habits indicate that dietary habits are established early in life [5, 6], which might reflect the strong role of the family and home environment.

Methodological considerations are important when investigating between-school variations. Low between-school variation can be obtained if there is a low between-school variation in the school-level characteristics [26]. As the HEIA study was primarily an intervention study, small schools, rural schools and schools from the largest urban areas of Eastern Norway were not invited to participate. However, most of the school level variables included in the analysis of associations displayed variability between schools, except for fruit subscription. There were nonetheless a minimum of 4 schools per category of this variable, providing sufficient exposure contrast.

There is a lack of well validated measures of school food environment as methodological research in this area is in its infancy. Some measures of the school food environment used in this study were validated using objective measures, as indicated in the methodology section. Measures used

to assess the socio-cultural environment were also rather broad. Such measures might not allow for detection of associations. These factors should be taken into consideration when interpreting the results of this study.

Unlike what was documented in this study, a previous Norwegian study found that children provided with free fruit at school had a higher all day intake of fruits and vegetables compared to children in the Paid Fruit and No Fruit groups [29]. Such an association is expected as accessibility and availability are strong determinants of children's fruit and vegetable intake [28]. However, the same study found no significant differences between the paid fruit group and the no fruit group in terms of intake of fruits and vegetables all day [29], which is in line with our findings. In the current study, overall intake was the outcome measure. Thus, the possibility that intake at school increased but overall intake remained stable due to school fruit replacing fruit consumed at home cannot be ruled out. Such a finding has also previously been found in a study from Denmark [30].

The lack of association between the presence of food outlets in the school neighborhood and the dietary habits of the children can be explained by the fact that the children were not allowed to leave the school compounds during school hours (reported by principals), Therefore, the students could only access these stores before or after school hours. Association between food outlets and adolescents' food intake has previously been documented to be related to free school leaving policies [27]. The children probably also had a limited amount of pocket money at this age.

The presence of canteens/food booths in the schools did not appear to influence children's intakes, which might relate, among other things, to the fact that these were only available for students few days a week. In addition, factors such as the variety of items offered, opening hours and pricing are also important [12].

It is possible that schools where principals/school administrators reported perceiving high responsibility of the school for the nutrition of children and where nutrition is prioritized are indeed successful in influencing the knowledge of children regarding healthy eating. That might nevertheless fail to translate into improved eating habits as concern about health might not be very important for the dietary behavior of children at this age [5]. Due to their close proximity to and repeated contacts with students, teachers are likely to have more influence on the children.

Inclusion of teachers' attitudes and norms might therefore have been more informative, as principals' attitudes do not necessarily reflect those of teachers.

Finally, some of the effects at the school level might be influenced by factors at the family environmental level. Effects of school food environmental factors can thus potentially vary depending among other things on the availability/accessibility of foods at home and on parental modeling. The socio-economic status of the school might also influence intake. Inclusion of such factors in future studies might help to get a better insight.

Strengths and weaknesses of the study

The study has several strengths. It included several indicators of the school environment which can potentially influence dietary habits of children. It adds to the scarce literature on the potential impact of schools on the dietary habits of young children in the European and in particular Norwegian context. Multilevel modeling was used and several dietary behaviors were included. There was a high participation rate of students and school administrators of the schools included.

Weaknesses include a low response rate of schools initially invited to participate, with a potential selection bias. Due to ethical reasons, reason for non-participation was not enquired. Some schools (n=50) however provided a reason for non-participation, the most common reason being participation in other similar studies. In addition, attrition analyses showed that there was no significant difference between schools who participated in the study and schools which declined participation in terms of number of students in the 6th grade and overall size. Schools from every county invited for participation were included in the current sample.

As discussed above, the use of measures of the school food environment which have not been validated also constitutes a weakness. Use of objective measures for example direct observation of canteens/food booths; use of information about subscription programs from organizations responsible for these programs etc. whenever possible will provide better measures.

The assessment of the dietary habits in this study is not limited to what is consumed at school. Studies however indicate that children do not compensate for unhealthy behavior at school by consuming healthy foods at home [15]. Consumption at school is also likely to influence consumption at home and vice versa.

Conclusion

Most of the variance in the dietary behaviors investigated was at the personal level. Thus in this sample, the investigated school level factors do not appear to exert a strong influence on the dietary behaviors of children. Longitudinal studies using validated measures of the school food environment are needed.

There is also a great need for methodological studies aimed at developing reliable and valid measures of the school food environment.

Acknowledgements

We would like to thank all the participants who took part in this study, and the project staff.

Funding

This study was funded by the Norwegian Research Council [Grant number 155323/V50] with supplementary funds from the Throne Holst Nutrition Research Foundation, the University of Oslo and the Norwegian School of Sport Sciences.

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Table I. Intake of fruits, vegetables, sugar-sweetened beverages and snacks among Norwegian 11 year-olds: the HEIA study

Intake	Girls (n ^a =688)		Boys(n ^a =737)		Total (n ^a =1425)	
	Mean	CI	Mean	CI	Mean	CI
Fruits (times/day)	1.49	1.41 - 1.57	1.33	1.25 - 1.40	1.41	1.35 - 1.45
Vegetables (times/day)	1.65	1.55 - 1.76	1.51	1.40 - 1.61	1.58	1.51 - 1.65
SSB (dl/weekday)	1.00	0.90 - 1.10	1.40	1.24 - 1.55	1.19	1.10 - 1.28
Snacks (times/wk)	4.40	4.05 - 4.75	5.03	4.61 - 5.44	4.72	4.45 - 4.99

SSB, sugar-sweetened beverages (sugar-sweetened carbonated soft drinks and fruit drinks)

Snacks include sweets/chocolates, salty snacks, sweet biscuits and buns/muffins

^aN for total sample included shown, n= 1413 for fruits, n=1387 for vegetables, n=1327 for SSB, n=1311 for snacks

Table II. Characteristics of the school food environment in 35 Norwegian elementary schools: the HEIA study

Political school food environment

Nutritional guidelines at school	3 ^a
School environmental committee with food/nutrition in its agenda	10

Socio-cultural school food environment

High perceived responsibility for students' diet	17
Prioritization of food and nutrition beyond the mandatory	8

Physical school food environment

Presence of canteen at school	5
Fruit and vegetable subscription	17 ^b
No food outlets in the school neighborhood	8

Numbers indicate the number of schools where the indicator mentioned is present

^a 1 school had written and 2 had oral guidelines

^b 4 schools had free and 13 schools had fee-based subscription

Table III. School differences in intake of snacks and sugar-sweetened beverages (SSB) and the effect of individual and school-level factors: the HEIA study

	Snacks (n=1269)			SSB (n=1288)				
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3		
<i>Random effects</i>								
Between-school variance	0.814^a	0.660^a	0.380^b	0.089^a	0.049^b	0.022		
SE	0.351	0.317	0.240	0.040	0.030	0.022		
ICC	3.7%	3.0%	1.7%	3.1%	1.8%	0.8%		
<i>Individual covariates</i>								
Gender (Female)	-0.559^a	0.261	-0.565^a	0.261	-0.412^c	0.091	-0.414^c	0.091
Parents (Two parents)	-0.434	0.320	-0.429	0.320	-0.407^c	0.113	-0.401^c	0.113
Parental education								
Low	1.122^c	0.340	1.193^c	0.034	0.644^c	0.118	0.663^c	0.118
Medium	0.454	0.315	0.521	0.314	0.295^d	0.110	0.309^d	0.110
<i>School characteristics</i>								
No school committee with nutrition in agenda			0.137	0.397			0.074	0.124
Low perceived responsibility for students' diet			-0.074	0.375			-0.251	0.137
Low prioritization of food and nutrition			-0.882	0.443			-0.052	0.116
No canteen/food booth at school			0.599	0.496			0.167	0.154
Fruit and vegetable subscription ^e								
Absent			-0.186	0.609			-0.380	0.191
Present but with parental payment			-0.516	0.608			-0.224	0.192
Food outlets present			-0.193	0.494			-0.002	0.153

Results obtained from multilevel linear regression analyses with school as random effect

Model 1 = null model with no predictors, model 2= model with individual covariates, model 3 = model with individual and school level covariates

Values are expressed as estimates and standard errors (SE)

Significant values are shown in bold, with significance at ^a p=0.05, ^b p=0.10, ^c p=0.001, ^d p=0.01

^ereference category= free fruit and vegetable subscription

Table IV. School differences in intake of fruits and vegetables and the effect of individual and school-level factors: the HEIA study

	Fruits (n=1365)			Vegetables(n=1339)				
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3		
<i>Random effects</i>								
Between-school variance	0.019^a	0.018^a	0.013^b	0.020^b	0.020^b	0.013		
SE	0.010	0.010	0.009	0.015	0.015	0.014		
ICC	1.9%	1.9%	1.3%	1.1%	1.1%	0.7%		
<i>Individual covariates</i>								
Gender (female)	0.176^c	0.053	0.174^c	0.053	0.151^a	0.073	0.150^a	0.073
Parents (Two parents)	0.078	0.065	0.084	0.065	-0.057	0.089	-0.053	0.089
Parental education								
Low	-0.007	0.069	-0.014	0.069	0.007	0.094	0.002	0.094
Medium	0.019	0.064	0.017	0.064	-0.008	0.087	-0.007	0.088
<i>School characteristics</i>								
No school committee with nutrition in agenda			-0.023	0.077			-0.031	0.097
Low perceived responsibility for students' diet			0.013	0.073			-0.014	0.092
Low prioritization of food and nutrition			-0.093	0.086			-0.119	0.108
No canteen/food booth at school			0.037	0.096			0.109	0.121
Fruit and vegetable subscription ^d								
Absent			-0.195	0.119			-0.059	0.151
Present but with parental payment			-0.171	0.119			-0.029	0.152
Food outlets present			-0.016	0.096			-0.087	0.122

Results obtained from multilevel linear regression analyses with school as random effect

Model 1 = null model with no predictors, model 2= model with individual covariates, model 3 = model with individual and school level covariates

Values are expressed as estimates and standard errors (SE)

Significant values are shown in bold, with significance at ^a p=0.05, ^b p=0.10, ^c p=0.01

^dreference category= free fruit and vegetable subscription