Introduction of a school fruit program is associated with reduced frequency of consumption of unhealthy snacks[1–3]

Nina Cecilie Øverby, Knut-Inge Klepp, and Elling Bere

ABSTRACT

Background: A diet high in fruit and vegetables (FV) is inversely related to chronic diseases, and some studies suggest that increasing the intake of FV reduces the intake of unhealthy snacks.

Objectives: The objectives were to analyze changes in the frequency of consumption of unhealthy snacks (soda, candy, and potato chips) from 2001 to 2008 in Norwegian children, to assess whether being part of a school fruit program reduces the frequency of unhealthy snack consumption, and to explore differences in sex and socioeconomic status.

Design: Within the project Fruits and Vegetables Make the Marks, 1488 sixth- and seventh-grade pupils from 27 Norwegian elementary schools completed a questionnaire in 2001, and 1339 sixth- and seventh-grade pupils from the same schools completed the same questionnaire in 2008. In 2001, none of the schools had any organized school fruit program. In 2008, 15 schools participated in a program and 12 did not participate in any program.

Results: From 2001 to 2008, the frequency of unhealthy snack consumption decreased from 6.9 to 4.6 times/wk ($P < 0.001$). The decrease was largest in the schools that had been included in the national free school fruit program (−2.8 times/wk). The effect of the school fruit programs was significant in reducing the frequency of unhealthy snack consumption in children of parents without higher education (from 7.8 to 4.0 times/wk; $P = 0.004$).

Conclusions: The frequency of unhealthy snack consumption decreased from 2001 to 2008 in schoolchildren in Norway. The decrease was most evident among children at schools participating in the national free school fruit program and in children with a low socioeconomic status. *Am J Clin Nutr* 2012;96:1100–3.

INTRODUCTION

A diet high in fruit and vegetables (FV) is inversely related to several chronic diseases (1), and an increased intake is recommended by WHO (1) and national health authorities (2). Eating more FV could mean eating less of something else (3, 4). A few studies have explored whether interventions aimed to increase the intake of FV also decrease the consumption of unhealthy snacks. Bere et al (3) found that, after an intervention significantly increasing FV intake, some subgroups showed significant reductions in intake of fizzy drinks/sweets/crisps. A Dutch school-based intervention that promoted FV intake also found that increasing FV was associated with a decreased intake of unhealthy snacks (4). It was found that children in the intervention group brought FV to schools significantly more often than did the control group and that the intervention group brought significantly fewer unhealthy snacks from home to be eaten at school (4). Neither of the 2 studies assessed energy intake (3, 4).

Children and adolescents in Norway have a high intake of unhealthy snacks (5) and a low intake of FV in comparison with the national recommendations (6). Because food preferences and habits established in childhood to a large extent tend to be maintained into adulthood (7, 8), it is important to encourage children to eat more FV and further reduce intakes of unhealthy snacks. Efforts have been made by national Norwegian authorities to increase the intake of FV. Among the initiatives is an FV subscription program for grades 1–10 that was initiated in 1996 and was made nationwide in 2003 (9). Furthermore, from autumn 2007, an official free fruit program (without parental payment) was implemented in all secondary elementary schools (8th–10th grades) and combined schools (1st–10th grades). The pupils who subscribe or are a part of the free fruit program receive a piece of fruit or a carrot each school day. By initiating this program, the government desired to increase FV intakes and additionally reduce social health inequalities (10, 11). Bere at al (9) evaluated the effect of these programs and found that there was an increase in pupils' fruit intake from 2001 to 2008, especially among the schools implementing the free fruit program. The intention of these programs was not to reduce unhealthy snack intakes. However, because some studies indicate that such interventions might cause such an effect, we aimed to investigate whether there was a change in frequency of unhealthy snack (soda, candy, and potato chips) consumption from 2001 to 2008 in Norwegian schoolchildren. Furthermore, we investigated whether taking part in a school fruit program was associated with a reduced frequency of unhealthy snacks consumption at participating schools and to what extent such a potential association differed by sex or by socioeconomic status.

[1] From the University of Agder, Department of Public Health, Sport and Nutrition, Kristiansand, Norway (NCØ and EB), and the University of Oslo, Faculty of Medicine, Department of Nutrition, Oslo, Norway (K-IK).

[2] Supported by the Norwegian Research Council (both the 2001 and 2008 studies).

[3] Address correspondence to NC Øverby, University of Agder, Faculty of Health and Sport, Servicebox 422, 4604 Kristiansand, Norway. E-mail: nina.c.overby@uia.no.

Received December 28, 2011. Accepted for publication August 14, 2012.
First published online October 3, 2012; doi: 10.3945/ajcn.111.033399.

SUBJECTS AND METHODS

Design and study sample

In 2001, 48 schools from Hedmark and Telemark counties (24 schools in each county) were randomly selected and invited to participate in the research project Fruits and Vegetables Make the Marks (FVMM). Nineteen schools from each county agreed to participate. All sixth- and seventh-graders (ages 10–12 y) in these 38 schools were invited to take part in a questionnaire survey (3, 12, 13). These 38 schools were contacted again in 2008 and invited to once more participate in a similar survey. At that time, 27 schools—14 in Hedmark and 13 in Telemark—agreed to participate, and all sixth- and seventh-graders in these 27 schools were invited to take part in the survey. Pupils from these 27 schools, from both 2001 and 2008, constitute the study sample of the current study.

Initially, Hedmark and Telemark counties were chosen because the subscription program was about to start in these 2 counties in the school year 2001–2002. A questionnaire survey was conducted in September 2001. The 2008 survey was also conducted in the month of September. In September 2001, no schools had any organized school fruit program. In September 2008, 5 schools participated in the free school fruit program (schools with grades 1–10) (Free fruit 08), 10 schools participated in the subscription program (Subscription 08), and 12 schools did not participate in any official school fruit program (No program 08). The free fruit program was implemented from fall 2007 in the 5 Free fruit 08 schools. The 10 schools participating in the subscription program in 2008 entered the program between fall 2001 and fall 2008.

The questionnaire surveys were completed by the pupils in the classroom in the presence of a trained project worker. One school lesson (45 min) was used to complete the questionnaire. A total of 1488 of 1727 eligible pupils (86%) in 2001 and 1339 of 1712 eligible pupils (78%) in 2008 completed the questionnaire and brought home a parent questionnaire to be completed by one of their parents. In the case of 1230 and 996 pupils, respectively, one of their parents completed the parent questionnaire. Descriptions of the samples in 2001 and 2008 are presented in **Table 1**.

TABLE 1
Description of the participants and the main variables in the 2001 and 2008 surveys: the Fruits and Vegetables Make the Marks Project

	2001	2008	*P* value[1]
No. of schools	27	27	—
No. of eligible pupils	1727	1712	—
Pupil data			
No. participating	1488	1339	—
Participation rate (%)	86	78	—
Sex, female (%)	50	52	0.21
Age, seventh-graders (%)	47	49	0.50
Unhealthy snacks (times/wk)	6.9 ± 4.4[2]	4.6 ± 3.2	<0.001
Parent data			
No. participating	1230	996	—
Participation rate (%)	83	74	—
Sex, female (%)[3]	85	78	<0.001
Age (y)[3]	39.9 ± 5.5	41.1 ± 5.1	<0.001
Higher education (%)[3]	42	54	<0.001

[1] Based on *t* tests for continuous variables and the chi-square test for dichotomous variables.
[2] Mean ± SD (all such values).
[3] Refers to the sex, age, and education of parents filling out the questionnaire.

Instrument

A sum score of unhealthy snacks was made from the following 3 items: "How often do you drink soda (including sugar)?", "How often do you eat candy (eg, chocolate, mixed candy)", and "How often do you eat potato chips?" All items had 10 response alternatives (never, less than once a week, once a week, twice a week, . . . , 6 times a week, every day, several times every day), and they were scored (0, 0.5, 1, 2, . . . , 7, 10), giving the unhealthy snacks scale a range from 0 to 30 times/wk.

Based on data from a previous test-retest study involving 114 children from sixth grade (14), scores on the unhealthy snacks scale were significantly ($P < 0.001$) correlated (Pearson's correlation coefficient; $r = 0.71$), and mean values were not significantly different (paired-samples *t* test; 5.2 compared with 5.5 times/wk; $P = 0.24$) in 2 assessments with 14 d in between (data not previously reported). The pupils reported their own sex. As an indicator of socioeconomic status, parents recorded their own level of education (lower: having no college or university education; higher: having attended college or university). Written informed consent was obtained from parents and children before participation in the study. Research clearance was obtained from The Norwegian Social Science Data Services.

Statistical analyses

Describing the sample, differences between the 2001 and 2008 participants were analyzed by using a *t* test for continuous variables and chi-square statistics for the categorical variables (Table 1). The main analyses conducted were multilevel mixed models with the unhealthy snacks scale as the outcome variable. All models included school as a random effect and time (2001 or 2008), group, sex, and parental educational level as fixed effects as well as relevant interaction terms. A significant time × group interaction ($P \leq 0.005$), indicating different changes in frequency of consumption of unhealthy snacks over time for the different groups, was used to test for the effect of the school fruit programs. To assess potential differences in the effect of the school fruit programs for different groups (based on sex and parental educational level), the third-order interactions time × group × sex and time × group × parental educational level were examined. An examination of the residuals did not reveal unacceptable departures from normality.

To conduct a school attrition analysis, pupils at the 27 schools in the study sample were compared with those of the 11 schools participating in 2001 but not in 2008, regarding sex, parental educational level, and unhealthy snacks at school and all day. A *t* test was used for continuous variables and chi-square statistics for the categorical variables. No significant differences between the study sample and pupils at schools not participating in 2008 were observed. All analyses were conducted by using PASW Statistics 18 (SPSS Inc).

RESULTS

Unadjusted, the frequency of unhealthy snack consumption decreased from 6.9 to 4.6 times/wk from 2001 to 2008 ($P <$ 0.001; Table 1), a result that was only slightly changed in the

TABLE 2
Change in consumption of unhealthy snacks from 2001 to 2008 in relation to the different school fruit programs for the total sample and stratified by parental educational level: the Fruits and Vegetables Make the Marks Project[1]

	2001		2008			
	Intake	95% CI	Intake	95% CI	Change from 2001 to 2008	*P* for time × group interaction
	times/wk		*times/wk*		*times/wk*	
All	6.6	6.3, 6.9	4.4	4.1, 4.7	−2.2	0.009
Free fruit, 2008	6.6	5.9, 7.2	3.8	3.1, 4.4	−2.8	
Subscription, 2008	6.9	6.4, 7.3	4.6	4.1, 5.0	−2.3	
No program, 2008	6.4	6.0, 6.8	4.9	4.4, 5.3	−1.5	
Higher education	5.9	5.3, 6.3	4.1	3.7, 4.5	−1.8	0.32
Free fruit, 2008	5.4	4.6, 6.2	3.5	2.8, 4.2	−1.8	
Subscription, 2008	6.3	5.8, 6.8	4.3	3.7, 4.6	−2.1	
No program, 2008	6.0	5.5, 6.5	4.6	4.0, 5.1	−1.4	
No higher education	7.3	7.0, 7.7	4.7	4.3, 5.1	−2.6	0.004
Free fruit, 2008	7.8	6.9, 8.6	4.0	3.0, 5.0	−3.8	
Subscription, 2008	7.4	6.8, 8.0	4.9	4.2, 5.6	−2.5	
No program, 2008	6.7	6.2, 7.3	5.1	4.5, 5.8	−1.6	

[1] Multilevel linear mixed models adjusted for all variables presented in the table and school as a random effect.

main fully adjusted analysis (6.6–4.4 times/wk, respectively, $P < 0.001$; **Table 2**).

In the main analysis, the time × group interaction was significant ($P = 0.009$), and the decrease in frequency of unhealthy snack consumption was largest in the schools that had been included since 2007 in the national free school fruit program (Free fruit 08) and smallest in the schools not taking part in any of the school fruit programs (Table 2). No significant third-order interactions (time × group × sex or time × group × parental education level) were observed for any of the outcome variables, which indicated that the effect of the school fruit programs was not significantly different between boys and girls or between those whose parents had a low and high education.

However, a significant time × parental educational level interaction was observed ($P = 0.01$), and the decrease in frequency of unhealthy snack consumption was greater for children of parents without a higher education (from 7.3 times/wk in 2001 to 4.7 times/wk in 2008) than for children of parents with higher education (from 5.9 to 4.1 times/wk, respectively). Stratified on parental educational level, the effect of the school fruit programs was significant in reducing the frequency of unhealthy snack consumption for children of parents without higher education (time × group $P = 0.004$), but not significant for children of parents with higher education (time × group: $P = 0.32$; Table 2).

DISCUSSION

This study showed a general decrease in frequency of unhealthy snack consumption among schoolchildren in Norway from 2001 to 2008. The decrease was most evident among pupils attending schools with national free school fruit programs and in children with parents with a low educational level.

The decrease in frequency of snack consumption is encouraging and in line with the health authorities' goals for this time period (10). No study has assessed changes in snack consumption in schoolchildren in this time period in Norway; however, the decrease is comparable with results from Norwegian household budget studies showing a general decrease, at least in sugar consumption in the general population (15). The FVMM study also previously reported a decrease in soft drink consumption in this time period (16).

The results from this study suggest that the decrease could have been attributed to the free fruit program and a possible increase in fruit intake. The current study shows that the decrease in frequency of unhealthy snack consumption was largest in schools with the free fruit program and smallest in schools with no program, and Bere et al (9) previously reported a larger increase in fruit intake in schools with the free fruit program in the same time period. Many argue that by increasing the intake of FV, a decrease in snack consumption will automatically happen, although some cast doubt on this assumption (17). However, few studies have explored this relation. Previous results from FVMM, describing results from a pilot study evaluating the effect of a free school fruit program, found that pupils who participated in the free program significantly reduced their consumption of unhealthy snacks compared with children not receiving free or paid fruit (3). The Schoolgruiten intervention in the Netherlands had several strategies to promote FV intake by improving availability, accessibility, and exposure to FV at school and encouraging children and their parents to bring FV from home for their midmorning snack. The results showed that children in the intervention arm brought FV more often and unhealthy snacks more seldom than the control group, which indicated that unhealthy snacks were replaced by FV (4). The behavior choice theory may offer an explanation for the observed results in the Dutch study and the current study. The theory postulates that people make choices among alternatives (4). Replacement is one important concept. When FV are available, the need for energy is satisfied, and there is not the same need to consume unhealthy snacks. In line with this, studies have shown that an increased intake of low-energy food as FV increase fullness and satiety (18, 19).

Social inequalities are seen in health behaviors such as eating habits in Norwegian adolescents (5), and reducing such inequalities is an important goal for the Norwegian health authorities (20). It is therefore encouraging that the decrease in frequency of snack consumption was most evident among children from a lower socioeconomic background. Children with a low socioeconomic background had a higher frequency of unhealthy snack intake in 2001 and still somewhat higher in 2008 compared with children of

highly educated parents; however, the decrease was substantial. Health promotion initiatives are often more effective among families with a high socioeconomic background (21), which leads to larger health disparities instead of helping to reduce the socioeconomic gap. One reason why a free FV initiative may work in this population is because it improves the availability of FV at no cost to parents, whereas most initiatives focus on information/education only. Another possible reason is that the study focused on increasing healthy choices (FV), which is more effective than focusing on reducing intakes of energy-dense foods (18). Restrictions can lead to increases in preferences of the selected foods, whereas focusing on what is healthy may be a more effective way of changing people's diet.

A limitation of the study was the nonrandomization of the different groups. The Free Fruit 08 groups constitute all combined schools (with grades 1–10), and the subscription schools were self-selected. The pupils attending the different types of schools may have been different, even though that was not likely. Data presented in Table 2 indicate no baseline differences between the groups regarding the frequency of consumption of unhealthy snacks. The trends and results reported in this study are clear, and a potential group effect was expected to be small. A second limitation of the study was that some schools now organize their own school fruit programs. School fruit has been a hot topic in Norway over recent years, possibly because of long-term sustained public efforts. Within the No program 08 group, one of the schools had their own free fruit program; therefore, the results presented in this study may have underestimated the association between introducing a school fruit program and the observed reduction in frequency of reported intake of unhealthy snacks. A further limitation was that this study assessed secular trends in different groups according to school participation in school fruit programs, and we were not able to conduct any mediation analyses as could have been done in an intervention trial. The study therefore cannot determine whether a decrease in frequency of unhealthy snack intake is caused by an increase in intake of FV. There were also limitations with the food-frequency questionnaire. Only 3 unhealthy snack items were included in the questionnaire, and we had no data on other snack foods eaten. Furthermore, there were no validity data on the questions assessing unhealthy snack intakes. However, the aim of the current study was not to present accurate data on unhealthy snack intake but rather to assess differences in frequency of intake between groups over time. The questionnaire did not attempt to assess energy intake, and portion size was therefore not included. The strengths of the current study were that it included repeated data from a large number of randomly selected schools and an evaluation of the public efforts to increase FV intake at schools in a natural setting.

In conclusion, the results of this study show that children attending a school with a school fruit program have a decreased frequency of unhealthy snack consumption, which indicates that an increased fruit intake does replace unhealthy snack consumption. Furthermore, the decrease in frequency of unhealthy snack consumption was most evident in children with parents without a high education, which might contribute to a reduction in the observed social inequalities in eating patterns and health.

The authors' responsibilities were as follows—K-IK: conceived the 2001 study; EB: conceived the 2008 study and analyzed the data; EB and NCØ: designed the study; NCØ: drafted the manuscript; and EB and KIK: critically revised the manuscript. All authors contributed to the interpretation and approved the final version of the manuscript. KIK has been employed since 2006 by the Norwegian Directorate of Health, which is partially responsible for implementing the national school fruit programs. EB and NCØ had no conflicts of interest.

REFERENCES

1. World Health Organization. Diet, nutrition and the prevention of chronic diseases. Report of a Joint WHO/FAO Expert Consultation. World Health Organ Tech Rep Ser 2003;916.
2. National Nutrition Council. Dietary advice for promotion of public health and prevention of chronic diseases. Oslo, Norway: Norwegian Directorate of Health, 2011.
3. Bere E, Veierod MB, Klepp KI. The Norwegian School Fruit Programme: evaluating paid vs. no-cost subscriptions. Prev Med 2005;41:463–70.
4. Tak NI, te Velde SJ, Singh AS, Brug J. The effects of a fruit and vegetable promotion intervention on unhealthy snacks during midmorning school breaks: results of the Dutch Schoolgruiten Project. J Hum Nutr Diet 2010;23:609–15.
5. Øverby NC, Lillegaard IT, Johansson L, Andersen LF. High intake of added sugar among Norwegian children and adolescents. Public Health Nutr 2004;7:285–93.
6. Andersen LF, Overby N, Lillegaard IT. Intake of fruit and vegetables among Norwegian children and adolescents. Tidsskr Nor Laegeforen 2004;124:1396–8.
7. Kelder SH, Perry CL, Klepp KI, Lytle LL. Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviors. Am J Public Health 1994;84:1121–6.
8. Lien N, Lytle LA, Klepp KI. Stability in consumption of fruit, vegetables, and sugary foods in a cohort from age 14 to age 21. Prev Med 2001;33:217–26.
9. Bere E, Hilsen M, Klepp KI. Effect of the nationwide free school fruit scheme in Norway. Br J Nutr 2010;104:589–94.
10. Norwegian Ministries. Recipe for a healthier diet. Norwegian Action Plan on Nutrition (2007-2011). Oslo, Norway: Norwegian Ministries, 2007.
11. Ministry of Health and Care Services. National strategy to reduce social inequalities in health (2006-2007). Oslo, Norway: Norwegian Ministry of Health and Care Services, 2007.
12. Bere E, Veierod MB, Bjelland M, Klepp KI. Outcome and process evaluation of a Norwegian school-randomized fruit and vegetable intervention: Fruits and Vegetables Make the Marks (FVMM). Health Educ Res 2006;21:258–67.
13. Bere E, Veierod MB, Skare O, Klepp KI. Free school fruit–sustained effect three years later. Int J Behav Nutr Phys Act 2007;4:5.
14. Andersen LF, Bere E, Kolbjornsen N, Klepp KI. Validity and reproducibility of self-reported intake of fruit and vegetable among 6th graders. Eur J Clin Nutr 2004;58:771–7.
15. Norwegian Directorate of Health. Trends in the Norwegian Diet 2011;2010:1–28 (Oslo, Norwegian Directorate of Health.) Available from: http://www.helsedirektoratet.no/publikasjoner/utviklingen-i-norsk-kosthold-2010-kortversjon/Publikasjoner/utviklingen-i-norsk-kosthold-2010-kortversjon.pdf (in Norwegian).
16. Stea TH, Overby NC, Klepp KI, Bere E. Changes in beverage consumption in Norwegian children from 2001 to 2008. Public Health Nutr 2012;15:379–85.
17. Cohen DA, Sturm R, Scott M, Farley TA, Bluthenthal R. Not enough fruit and vegetables or too many cookies, candies, salty snacks, and soft drinks? Public Health Rep 2010;125:88–95.
18. Epstein LH, Gordy CC, Raynor HA, Beddome M, Kilanowski CK, Paluch R. Increasing fruit and vegetable intake and decreasing fat and sugar intake in families at risk for childhood obesity. Obes Res 2001;9:171–8.
19. Rolls BJ, Drewnowski A, Ledikwe JH. Changing the energy density of the diet as a strategy for weight management. J Am Diet Assoc 2005;105:S98–103.
20. The Norwegian Directorate for Health and Social Affairs. The challenge of the gradient. Action plan to reduce social inequalities in health. Oslo, Norway: The Norwegian Directorate for Health and Social Affairs, 2005.
21. García A. Is health promotion relevant across cultures and the socioeconomic spectrum? Fam Community Health 2006;29:20S–7S.