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Free school fruit: can an extra piece of fruit every school day contribute to the prevention of future weight gain? A cluster randomized trial

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Abstract

Background: Several school fruit programs are initiated with the aim to improve diet and thereby contribute to reduce the prevalence of overweight. To date, no published studies have demonstrated that school fruit schemes do prevent overweight.
Objective: The aim of the present study was to assess if increased consumption of fruits and vegetables, due to free school fruit, have an impact on future weight status.
Design: An intervention study including 10- to 12-year-old children from nine schools in two Norwegian counties (Hedmark and Telemark) participating in the Norwegian School Fruit Program for free during the school year 2001/2002 and children from 29 control schools. Follow-up studies were performed in 2005 and 2009. The cohort includes 1950 pupils (984 boys, 966 girls) at baseline, 1,602 participants in 2005 and 320 participants in the 2009 survey, of which 282 also had participated in 2005.
Results: In 2005, there was no significant difference between the free fruit group and the control group regarding weight status, Body mass index, or perceived weight status. In 2009, a significant difference in prevalence of overweight was observed (15% vs. 25%, $p = 0.04$). In the crude logistic analysis, the OR for being overweight was 0.52 (95% CI: 0.28–0.97) for the intervention group compared to controls. When adjusting for school, sex, grade level and parental education, the association was no longer statistically significant.
Conclusions: These results indicate that free school fruit might contribute to prevent future excessive weight gain. However, the study results are limited by low participation rate.

Keywords: *school fruit scheme*; *free fruit*; *fruits and vegetables*; *overweight*; *weight status*

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A diet high in fruits and vegetables (FV) might be protective against excessive weight gain (1, 2), and an inverse association between fruit intake and weight status among adults has been indicated by RCTs, prospective observational studies, and cross-sectional studies (3). There are also studies indicating that this relation is present already among children and adolescents (4, 5). However, there is a lack of intervention studies evaluating feasible interventions to implement among free-living individuals. There is also a lack of long-term studies, especially with observations more than 5 years post intervention (6).

Childhood and adolescence are seen as important stages in life for promoting FV consumption. The European Union (EU) initiated a school fruit program from the school year 2009/2010, and the European Commission is allocating approximately €90 million per year for the provision of FV in European schools. EU's main argument for initiating this program is reduced overweight and obesity prevalence (7). The US Department of Agriculture's Fresh Fruit and Vegetable program (FFVP) also aim to combat obesity by providing fresh FV during the school day in selected schools (8, 9). However, there are no studies to date demonstrating that school fruit schemes do prevent overweight.

The rationale for the risk-reducing effect of FV on overweight may in part be exerted through their possible reduction upon total energy intake due to low energy content and high satiation (3), that is, by its high content of fiber and water, leading to dilution of the energy density

and delaying gastric emptying. In addition, it has been shown that an increased FV intake might substitute consumption of more obesogenic foods (10, 11).

Studies assessing the weight impact of FV intervention studies are dearly lacking (4, 12), for example, only one out of 18 studies reviewed on school-based food and nutrition policies evaluated the impact of the intervention on weight status (13).

Within the Fruits and Vegetables Make the Marks project (FVMM), all pupils at nine schools received free school fruit, that is, with no parental payment, for a period of almost one full school year (9 months). The effect on FV consumption has been reported to be 0.8 portions/school day (an increase of 267% from baseline) by the end of the intervention period (11). Furthermore, lasting effects have been reported 1 year (14), 3 years (15), and possibly also 7 years (16) after the end of the intervention. The potential effect of this intervention regarding weight status has previously not been reported.

The aim of the present study is to assess if this increased consumption of FV over a 7-year period, due to the free school fruit program, might have an impact on participants' reported weight status 7 years later.

Subjects and methods

Design and study sample

A total of 38 randomly drawn elementary schools from two different counties participated in the FVMM project, and nine schools within one of the counties were randomly selected as intervention schools and participated in the Norwegian School Fruit Program for free during the school year 2001/2002 (11). In the present study, the remaining 29 schools serve as control schools. The free subscription program started in October 2001, and lasted throughout the school year (i.e. until June 2002). Questionnaire surveys were conducted in September 2001 (baseline), May 2002, May 2003, May 2005, and September 2009.

Sample size and number of clusters were determined according to an expected increase in FV consumption of 45% in the intervention group. With this, the study aimed to include 40 schools with 2 classes per school, in total 1,600 pupils at baseline and 1,300 in the follow-up-study. The allocation, randomization, and enrollment of clusters were done by the project group. Small schools with fewer than 10 pupils per grade level were excluded from the sampling frame (17).

The FVMM cohort includes 1,950 pupils (6th and 7th graders at baseline): 984 boys and 966 girls, 585 in the free fruit group and 1,365 in the control group. Average age was 11.8 years at baseline. A total of 320 pupils (16%) participated at the follow-up survey in September 2009, and constitute the study sample for the present study, of which 282 also participated in the 2005 survey. Descriptive data of the study sample are presented in Table 1. At baseline, 296 of the study sample had a parent/guardian who completed a parent questionnaire. The average parental age was 40.5 years, and 86% of the parents were mothers/female guardians.

Instruments

A survey questionnaire was completed by the pupils in the classroom in the presence of a trained project worker (surveys conducted within 2001–2005). The 2009 survey was sent by regular mail to the participant's homes. Self-reported height and weight were included in the 2005 and 2009 surveys. Body mass index (BMI) was calculated based on these measures of height and weight. Age and sex-specific cut off points (18) were used to categorize adolescents in the 2005 survey, while a BMI of 25 or above was used in 2009 as the criteria for being categorized as overweight (including obese). Self-reported perceived weight status were assessed by the following question at all surveys; 'Are you on a (slimming) diet', with the following response alternatives: 'NO, my weight is OK', 'NO, but I should be on a (slimming) diet', and 'YES'. The two last alternatives were seen to indicate that the responders perceive themselves as too heavy/overweight. A new variable was calculated by combining these two to: (1 = I am too heavy, 0 = my weight is OK). The pupils reported their own sex and parents recorded their level of education at baseline (lower: no college or university education/higher: having attended college or university). FV intake was based on two different measures; 24-h recall (portions/day) and a food frequency questions (FFQ, times/week). Consumption of unhealthy snacks (FFQ, times/week) was calculated as previously described (11).

Ethics

This study was conducted according to the guidelines laid down in the Declaration of Helsinki. Written informed consent was obtained from parents and children prior to participation in the study. Research clearance was obtained from The Norwegian Social Science Data Services.

Statistical analyses

Describing the sample, differences between the intervention and the control group, and between the study sample and those participating in the baseline survey but not in the 2009 survey (attrition) were analyzed using *t*-test for continuous variables and chi-square statistics for the categorical variables (Table 1).

As we did not have baseline data for weight status, we assume there is no baseline difference between the groups, and the effects of the intervention on weight status were considered if there were differences in overweight prevalence in the intervention and control group at follow-up. Multivariate logistic regression analyses were performed with weight status as the dependent variable. Model 1 included intervention condition only (free fruit vs. control).

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Table 1. Baseline characteristics from 2001 to 2002 of all particpants, those lost to follow-up, and those remaining in the trial[a]

	(a) All participants ($n=1,950$) (full cohort)			(b) Attrition ($n=1,950$)			(c) Remaining participants ($n=320$) (Present study sample)			(d) Lost to follow-up ($n=1,630$) (attrition)		
	Free fruit	Control	*p*	Attrition	Present study sample	*p*	Free fruit	Control	*p*	Free fruit	Control	*p*
N	585	1,365		1,630	320		112	208		473	1,157	
Sex (% girls)	49	50	0.49	47	62	<0.001	59	64	0.36	46	48	0.54
Class grade (% 7th grade)	45	48	0.21	47	48	0.65	44	51	0.22	46	48	0.41
Parental education (% high)[b]	48	39	<0.001	40	49	0.009	53	46	0.23	47	38	0.001
Group (% free fruit pupils)[c]				29.0	35.0	0.03						
FV[d] intake baseline (portions/day)	2.2	2.5	0.01	2.4	2.5	0.90	2.2	2.6	0.12	2.2	2.5	0.05
FV[d] intake baseline (times/week)	13.9	14.2	0.36	14.0	14.5	0.27	13.7	15.0	0.13	13.9	14.1	0.69
Unhealthy snacks baseline (times/week)	6.6	7.3	0.002	7.2	6.5	0.009	6.7	6.3	0.50	6.6	7.5	<0.001

Participants are children from schools in the Norwegian counties Hedmark and Telemark.
(a): Baseline characteristics differences between those in the free fruit and control group in the full cohort. (b): Baseline characteristics differences between those lost to follow-up (attrition) and the present study sample (persons having data in both 2001/2002 and 2009).
(c): Baseline characteristics differences between the free fruit and control in the present study sample. (d): Baseline characteristics differences between the free fruit and control in the 'loss to follow-up'group.
[a]The table is made according to principles in Dumville et al. (20).
[b]High parental education is defined as parents having attended college or university.
[c]'free fruit pupils' are those who particpated in the Norwegian School Fruit Programme for free during 2001/2002.
[d]'FV': Fruit and vegetables.

Model 2 included sex and age (class level) + Model 1. Model 3 included parental education level + Model 2.

Results

At baseline, there were differences in FV intake (portions/day), frequency of unhealthy snack consumption, and parental educational level between the intervention and the control groups (Table 1, column a). Due to the low participation rate in 2009 (16%), comparisons between those participating and those lost to follow-up are also presented in Table 1. First, the present study sample was compared to those participating at baseline (2001), but not in the 2009 survey (Table 1, column b). The present study sample ($n=320$) was overrepresented by girls, pupils of parents with higher education, and participants from the intervention group, and the study sample reported a significant lower consumption of unhealthy snacks at baseline than did the drop-outs (Table 1, column b). However, when analyzing the present study sample stratified according to the intervention and control group (Table 1, column c), there were no significant differences in the reported baseline characteristics. In the lost to follow-up group, the differences are similar to those reported in the full cohort (Table 1, column d).

In 2005 (i.e. 3 years after the end of the free fruit intervention), there was no significant difference between the free fruit and control groups regarding weight status, BMI, perceived weight status, or fruit and vegetable intake (Table 2). In 2009, a significant difference in the prevalence of overweight was observed as a smaller proportion of the participants in the free fruit group reported to be overweight than among the participants in the control group (15% vs. 25% overweight, $p=0.04$). No significant difference were seen for BMI, perceived weight status, or FV intake.

In the crude logistic analysis (Table 3, Model 1), the OR for being overweight in 2009 was 0.52 (95% CI = 0.28–0.97) for those receiving free fruit in the school year of 2001–2002 compared to controls. Further adjustment for sex, grade level, and parental education level only slightly changed the OR estimate, but the association between free fruit and weight status was no longer statistically significant (Table 3, Models 2–3).

Discussion

These results indicate that free school fruit might prevent future excessive weight gain. Furthermore, it indicates that it takes time from intervention implementation to effects are seen on weight status – recognizing the importance of long-term follow-up intervention studies for obesity prevention. No significant effect was observed 3 years after the end of the intervention, but 1 year of free school fruit at age 10–12 resulted in a 40% lower prevalence of overweight, compared to controls, 7 years later.

Table 2. Mean BMI and overweight prevalence in 2005 and 2009, fruit and vegetable intake, and perceived weight status at all time points

	Baseline 2001	Follow-up 2005	Follow-up 2009
	Crude (95% CI)	Crude (95% CI)	Crude (95% CI)
BMI[a] (mean)			
Free fruit	No data	20.5 (19.9, 21.1)	22.7 (22.0, 23.4)
Control		20.7 (20.2, 21.3)	23.2 (22.6, 23.8)
p		0.56	0.31
Overweight[b] (%)			
Free fruit	No data	9 (3, 14)	15 (8, 21)
Control		11 (6, 16)	25 (19, 31)
p		0.54	0.04
Fruit and vegetable intake (portions/day)			
Free fruit	2.2 (1.7, 2.6)	2.7 (2.3, 3.1)	2.3 (1.9, 2.7)
Control	2.6 (2.2, 3.0)	2.5 (2.1, 2.9)	2.1 (1.8, 2.3)
P	0.12	0.55	0.31
Stating themselves to be too heavy[c]			
Free fruit	21 (13, 29)	31 (22, 40)	40 (31, 49)
Control	24 (18, 30)	33 (26, 40)	44 (37, 50)
p	0.52	0.52	0.54

Participants are children from schools in the Norwegian counties, Hedmark and Telemark.
[a]BMI: body mass index.
[b]Overweight is defined in line with age and sex-specific cut off points according to Cole et al. (18).
[c]Perceived weight status.

This effect might have been due to the long-term effect seen for reported FV intake, and/or the reduced consumption of unhealthy snacks (14–16). Few intervention studies do follow the participants for several years as done in the present study (6), and few studies have reported effects in FV intake after the end of the intervention period (19). To our knowledge, there are no comparable studies reporting the effects of 7 years of sustained elevated FV intake on weight status. This extended follow-up period of an intervention proven to be effective in changing eating habits, represents the main strength of the present study.

There are limitations with the present study. No baseline measure of weight and height were included, and the subsequent measures were self-reported. Baseline data on perecived weight status were included, however, and there were no baseline difference between the proportions of intervention and control group particpants perceiving themselves to be too heavy. There are no reasons to believe that there is a differentiated underreporting of weight between the intervention and the control groups, as weight was no issue in the intervention. The participation rate in the 2009 survey was low, only 16%. Loss to follow-up can lead to bias in randomized trials, especially if the characteristics of people lost to follow-up differ between the randomized groups (20). In the present study, the group lost to follow-up differed between the randomized groups in the same way the groups differed in the full cohort. Furthermore, there were no differences in baseline characteristics between the intervention group and the control group in the presented study sample. According to Dumville et al., the attrition is only important if the differeing characteristics is correlated with the trial's outcome measures (20). In the present study, the directions of the loss do not support that this would effect the results. Among those lost to follow-up, a higher proportion of parents with high education were lost in the intervention than in the control group (Table 1, column c), and among those lost, the intake of unhealthy snacks was lower in the intervention group compared to the control group (Table 1, column c), both findings indicating that the prevalence of overweight probably would have decreased in the free fruit (intervention) group had those lost to follow-up been included. In addition, this is no perfect randomized study, and limitations regarding the study design and generalizability have been reported earlier (15).

Previous results show that free school fruit seem to increase intake of fruit with all its health benefits, reduce intake of unhealthy snacks, especially in lower SES families (10), and in addition prevent future excessive weight

Table 3. Odds ratio (OR) of being overweight in 2009 for the free fruit group compared to the control group

	Model I ($n=307$)			Model II ($n=301$)			Model III ($n=277$)		
	OR	CI		OR	CI		OR	CI	
Intervention vs. control	0.52	0.28	0.97	0.55	0.29	1.03	0.62	0.33	1.19
Boys vs. girls				1.24	0.71	2.19	1.22	0.67	2.23
7th vs. 6th graders				1.42	0.80	2.52	1.30	0.71	2.38
Low vs. high parental edu							1.56	0.85	2.86

Participants are children from schools in the Norwegian counties, Hedmark and Telemark.
Model I – Intervention versus control.
Model II – Include sex and age (class level) + Model I.
Model III – Include parental education level + Model II.

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gain. The sum of this suggests that free school fruit should be considered an important public health initiative.

Conclusion

The present study indicates that free school fruit might contribute to prevention of future excessive weight gain in Norwegian children.

Authors' contributions

KIK conceived the 2001 study. EB conceived the 2008 study. EB and NCØ designed the present study. EB analyzed the data and all authors contributed to the interpretation. NCØ drafted the introduction and discussion, EB drafted the methods and results, and KIK revised it critically. All authors have approved the final version of the manuscript.

Conflict of interest and funding

KIK has since 2006 been employed by the Norwegian Directorate of Health which in part is responsible for implementing the national school fruit programs. EB and NCØ declare no conflict of interest. This work was supported by the Norwegian Research Council (both 2001 and 2008 data). The Norwegian Research Council had no role in the design, analysis, or writing of this article.

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