Outcome and process evaluation of a Norwegian school-randomized fruit and vegetable intervention: Fruits and Vegetables Make the Marks (FVMM)

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Abstract

This study reports the effect of the Fruits and Vegetables Make the Marks intervention, a school-based fruit and vegetable intervention consisting of a home economics classroom component and parental involvement and encouraged participation in the Norwegian School Fruit Programme, all delivered during the school year of 2001–02. Nine randomly chosen schools received the intervention and 10 schools served as control schools. Participating pupils completed questionnaires at baseline (September 2001), at Follow-up 1 (May–June 2002) and at Follow-up 2 (May 2003). A total of 369 pupils (69%; mean age, 11.3 years at baseline) participated in all three surveys. No effect of the intervention was found for intake of fruit and vegetables eaten at school or all day, neither at Follow-up 1 nor at Follow-up 2. On analysing the effects on potential mediators, significant differences between intervention and control groups were found for Awareness of the five-a-day recommendations only. The intervention programme was rated as very good by the teachers, and the pupils reported that they enjoyed it. However, the intervention failed to change fruit and vegetable intake, probably because it did not succeed in changing the pupils’ preferences for or the accessibility of fruit and vegetables—the two strongest correlates of children’s fruit and vegetable intake.

Introduction

In Norway, the majority of children do not eat fruit and vegetables in accordance with the national recommendations of at least five portions of fruit and vegetables a day [1, 2]. A number of school-based interventions have demonstrated that increasing children’s fruit and vegetable intake is possible [3], even though effects, for the most part, have been small and the long-term persistence of such changes is largely unknown [4].

Extensive reviews of previous school-based fruit and vegetable interventions provide useful recommendations for successful programmes [3, 5–7]. Programmes should consist of multi-components (such as including both school and home environments), include education directed at behavioural change, be of adequate time and duration, include messages specifically targeting fruit and vegetable intake (as opposed to healthy eating in general) and be based on an appropriate theoretical framework.

Social Cognitive Theory (SCT) provides a useful and frequently applied framework for behaviour change [8, 9]. SCT postulates that behaviour, including dietary behaviour, is the result of environmental factors (such as easily accessible fruit and vegetables or observation of important others performing the behaviour) and personal factors (such as preferences and self-efficacy). SCT also postulates that behaviours can affect the environment and cognitions and that all three factors (behavioural,
personal and environmental) affect each other in constant reciprocal relationships [8].

The present study was designed to investigate whether a school-based educational programme based on 'state-of-the-art' intervention strategies and applying a theoretical framework based on SCT would lead to a significant increase in the overall fruit and vegetable consumption among sixth grade children. The present paper reports outcome and process evaluation of the Fruits and Vegetables Make the Marks (FVMM) intervention.

Method

The study sample presented in this paper is part of a larger cohort, the FVMM cohort. This cohort consists of pupils who were in sixth and seventh grade classes during the school year of 2001–02 in 38 schools in two Norwegian counties, Hedmark and Telemark. Two parallel intervention studies, one in each county, were conducted in sixth grade classes during this school year. This paper evaluates the intervention conducted in Telemark County. The parallel intervention conducted in Hedmark County is presented elsewhere [10].

Design and procedure

A total of 24 randomly chosen schools were invited to take part in the FVMM project in Telemark County, and 19 schools agreed to participate. These schools were then randomly assigned to an intervention group or a control group. The intervention was delivered in the sixth grade classes from October 2001 to April 2002. Three surveys were conducted; baseline (September 2001), Follow-up 1 (May–June 2002) and Follow-up 2 (May 2003). At each survey, questionnaires were completed by the pupils in their classrooms in the presence of a trained project worker who guided the pupils through the dietary assessment component (24-hour recall) of the survey. One school lesson (45 min) was used to complete the questionnaire. Participating home economics teachers completed two questionnaires assessing the implementation of the curriculum and their evaluation of its different activities. Ethical approval and research clearance were obtained from The National Committees for Research Ethics in Norway and the Norwegian Social Science Data Services.

Study sample

A total of 538 sixth graders were invited to participate. Twenty-one children refused to participate; 67 children did not attend class at the time of the baseline survey, and they were not re-contacted. Of the 450 pupils who participated at baseline, 78 pupils were not able, for various reasons, to participate at Follow-up 1 or Follow-up 2 and three pupils were excluded due to inconsistent responses. Thus, 369 children (69%) completed all three surveys and composed the study sample employed in this paper, 169 boys and 200 girls, 190 intervention and 179 control pupils. Average age was 11.3 years at baseline, 12.0 at Follow-up 1 and 13.0 at Follow-up 2.

Teachers at eight of the nine intervention schools completed the home economics questionnaires.

Intervention programme

The intervention consisted of three components:

(i) Classroom component

The curriculum was based on our previous experience [11, 12], international research literature [3, 5–7] and focus group interviews with sixth grade pupils [13] and was designed to be consistent with the objectives stated in the National Curriculum [14]. The curriculum was delivered during sixth grade home economics classes by the regular home economics teacher following a 1-day training workshop. The curriculum was delivered in seven sessions over a 7-month period from October 2001 to April 2002. Each session lasted for a duration of three school lessons (i.e. 3 × 45 min). The pupils received an introduction to the health benefits of eating fruit and vegetables and recommendations regarding healthy levels of fruit and vegetable intake. As home economics is typically taught in a school-kitchen setting, every session included preparation of dishes based on a variety of fruit and vegetables (to increase pupils’ practical skills, sense...
of self-efficacy and taste preferences for fruit and vegetables). In addition, each session started by having the pupils prepare fruit and vegetables for consumption during the sessions as snacks. A number of small-group activities included taste testing (preferences) and information concerning fruit and vegetables about quality, usability, taste and availability in their local areas. Pupils monitored their own fruit and vegetable intake for 3 days, followed by self-assessment and goal setting for future intake (awareness/perceived personal need for increased consumption). A ‘fruit and vegetable event’ was conducted for either parents or younger children within the schools. During the events, various fruit and vegetable dishes were served, and pupils informed their parents or the younger children about the project. The home economics teachers were encouraged to include more fruit and vegetables throughout the school year as part of the regular home economics curriculum.

As part of the intervention, each school received NOK 50 (~EUR 6) per pupil for the school year to facilitate the increased use of fruit and vegetables.

(ii) Parental involvement

Six newsletters were distributed to the parents during the intervention period. The aims of the newsletters were to increase communication between parents and their children concerning fruit and vegetables and to stimulate increased availability and accessibility of fruit and vegetables at home. Each newsletter had a special theme (1: berries, 2: vegetables, 3: fruits, 4: potatoes, 5: salads, 6: fruits, berries and vegetables), and they all included health-related information, theme recipes, concrete activities for parents and children to do together (e.g. gathering wild berries or growing vegetables and herbs at home) and a competition for the children to win a fruit and vegetable gift certificate.

The project was introduced to the parents at parents’ meetings at school, where information concerning fruit, vegetables and health was provided and questions from the parents were answered by project staff members.

(iii) School Fruit Programme

A national fruit and vegetable subscription programme [15] exists in Norway. All elementary schools are offered to take part in this programme, and it is up to the schools to decide whether to participate or not. At participating schools, pupils who subscribe receive a piece of fruit or a carrot each school day, usually at lunch (in Norway, most school children bring their own sandwiches for lunch, as no school meals are typically offered). The subscription cost for the parents was (and still is) NOK 2.50 per school day (~EUR 0.30). The programme is subsidized by the Norwegian Government by NOK 1.00 per pupil per school day. The fee is paid by the parents for a semester at a time.

All schools in Norway, including intervention and control schools in the present study, were offered the subscription programme in the school year of 2001–02. Project staff encouraged the intervention schools, by a letter to the school principals, to take part in this subscription programme as part of the overall intervention. The subscription programme started in October 2001 and lasted throughout the school year (i.e. June 2002).

Instruments

The pupil questionnaire included a 24-hour fruit and vegetable recall, questions assessing potential mediators of their fruit and vegetable intake and intervention evaluation items. The home economics teachers responded to two separate evaluation questionnaires (mid- and post-intervention) assessing the implementation of the curriculum and their evaluation of its different activities.

Fruit and vegetable intake

A written 24-hour fruit and vegetable recall was used to assess pupils’ fruit and vegetable intake. The 24-hour recall was read aloud to the pupils by a project worker. Fruit and vegetable intake the previous day was recorded for school days (i.e. the survey was conducted on weekdays Tuesday through Friday). The 24-hour recall separated the
day into five time periods (before school, at school, after school, at dinner and after dinner). The pupils recalled the types of fruit and vegetables they ate at the different time periods in household measures (e.g. 1 apple, 12 grapes) or in portions (e.g. one portion of mixed green salad). The household measures were coded into portions per day, and one portion was set at $\sim 80$ g [ranging from 65 g (one carrot) to 105 g (one apple/one orange)]. The conversions from household measures to portions were based on household measures and food weights published by The Norwegian National Association for Nutrition and Health [16]. Juices and potatoes were not included in the fruit and vegetable calculations. Measures of the pupils’ fruit and vegetable intake at school (abbreviated: FV at school) and their total fruit and vegetable intake the previous day (abbreviated: FV all day) are used in this paper to assess the intervention effect on fruit and vegetable intake.

In a prior test–re-test study, the 24-hour recall provided consistent responses over a 14-day test–re-test period [17]. In a validation study, same-age pupils were capable of recalling the previous day’s intake of vegetables, but overestimated their fruit intake compared with the validation method (7 days recording of pre-coded diaries) [17].

**Process-evaluation variables**

A number of process-evaluation items were included in the Follow-up 1 survey (individual-level variables) and in the home economics teacher questionnaires (school-level variables).

**Overall project assessment.** Home economics teachers were asked to rate the project as poor, fair, good or very good.

**Home economics curriculum.** Home economics teachers reported their implementation of the seven sessions as not implemented (scored 0), partly implemented (scored 0.5) or fully implemented (scored 1). These seven scores were added, giving a scale ranging from 0 to 7. Pupils’ enjoyment of the curriculum was measured by four questions (presented in Table III). These questions were added, giving a scale ranging from $-5$ to 8 and categorized into tertiles: low ($-5$ to 2), medium (3 and 4) and high (5 to 8) levels of enjoyment.

**Newsletters.** Home economics teachers reported on how many of the newsletters they handed out (0 to 6). Family usage of the newsletters was measured by three questions (presented in Table III). These questions were added, giving a scale ranging from $-3$ to 6, and then categorized into tertiles: low ($-3$ to 0), medium (1 and 2) and high (3 to 6) usage of the newsletters.

**Parent meeting.** Whether a parent meeting was held or not.

**School Fruit Programme.** Whether the school participated in the School Fruit Programme or not was assessed by information from the Norwegian Fruit and Vegetable Marketing Board. The pupils were asked whether they subscribed to the programme or not.
Statistical analysis

Of the study sample, some pupils (16 at baseline, 25 at Follow-up 1 and 18 at Follow-up 2) did not attend school the day before the survey day. They were therefore excluded from the respective FV at school analyses, but they were included in all other analyses presented in this paper.

The effects of the intervention on fruit and vegetable intake and on the potential mediators were analysed on follow-up values by mixed-model regression (the Linear Mixed Models procedure, SPSS 12.0). In addition to condition, the models included baseline score, pupil’s gender and school (random, nested within condition). The models were tested for interaction effects between condition and gender, and because no interaction effects were seen, boys and girls were combined in all analyses. The residuals were examined and model assumptions were met.

The effect of the different levels of the categorized process-evaluation variables on FV all day were analysed on follow-up values by mixed-model regression (the Linear Mixed Models procedure, SPSS 12.0), using a sub-sample consisting of intervention schools only. In addition to the respective process-evaluation variables, the models included FV all day baseline score and pupil’s gender.

For assessing potential differences between pupils participating in all three surveys, and those not participating in all surveys (attrition analyses), the two-sample t-test was used for baseline comparisons as regards fruit and vegetable intake and the psychosocial variables.

SPSS version 12.0 was used for all analyses. All P-values are two sided.

Results

Main effects of the intervention

No effect of the intervention was seen for intake of fruit and vegetables eaten at school or all day, neither at Follow-up 1 nor at Follow-up 2 (Table I). As regards the psychosocial scales, significant differences between intervention and control groups were only found for Awareness (Table II).

Process evaluation

Seven of the home economics teachers rated the project as very good, while one teacher rated the project as good.

The implementation of the curriculum ranged from 2.5 to 7. Only one school implemented all sessions as planned, but six of the eight schools answering the questionnaires had values of 5.5 or above. No relation between the amount of the curriculum implemented and the effect of the intervention were seen for FV all day neither at Follow-up 1 nor at Follow-up 2 (data not shown). The mean score of the pupils’ Curriculum enjoyment scale

| Table I. Effect of the FVMM intervention on fruit and vegetable intake at school and all day |
|-----------------------------------------------|-----------------|-----------------|
| Variable | Group          | Baseline       | Follow-up 1     | Follow-up 2     |
|          |                | Crude mean     | Adjusted mean   | Crude mean     | Adjusted mean |
| FV at school (portions per day) | Intervention | 0.41 (0.25, 0.63) | 0.40 (0.22, 0.52) | 0.23 (0.06, 0.38) |
|          | Control        | 0.34 (0.15, 0.51) | 0.30 (0.17, 0.44) | 0.34 (0.20, 0.51) |
| P-value  |               | 0.40            | 0.53            | 0.23            |
| FV all day (portions per day) | Intervention | 2.80 (2.22, 3.43) | 2.25 (1.80, 2.60) | 1.98 (1.58, 2.30) |
|          | Control        | 2.61 (1.97, 3.15) | 2.10 (1.73, 2.51) | 2.14 (1.79, 2.50) |
| P-value  |               | 0.51            | 0.76            | 0.41            |

Intervention group n = 190; control group n = 179.

aLinear Mixed Model adjusted for gender and school as a random factor nested within condition. bLinear Mixed Model adjusted for baseline scores, gender and school as a random factor nested within condition.
was 3.3 (Table III). The pupils who indicated high enjoyment of the curriculum showed significant effect of the intervention, both at Follow-up 1 and at Follow-up 2, compared with the pupils who liked the curriculum the least (Table IV).

All six newsletters were reported handed out to the pupils except for one letter in one school. The mean score of the newsletter usage scale was 1.5 (Table III). The pupils with high usage of the newsletters showed significant effect of the intervention, both at Follow-up 1 and at Follow-up 2, compared with the pupils with low usage of the newsletters (Table IV).

Parent meetings were held at five of the nine intervention schools. The pupils at intervention schools who arranged parent meetings did not show any greater effect of the intervention compared with pupils at intervention schools not arranging the parent meeting neither at Follow-up 1 nor at Follow-up 2 (data not shown).

Of the nine intervention schools, four participated in the School Fruit Programme at both Follow-up 1 and at Follow-up 2, and of the 10 control schools three participated at Follow-up 1 and five at Follow-up 2. A total of 42 intervention pupils and 26 control pupils subscribed at Follow-up 1, and 28 and 46 at Follow-up 2, respectively. Overall, no large differences in the proportions of individual subscribers were found between the intervention group and the control group at Follow-up 1 (22% versus 15% subscribers) or Follow-up 2 (15% versus 26% subscribers).

**Attrition**

No statistically significant differences were found between pupils participating in all three surveys ($n = 369$) and pupils not participating in all surveys ($n = 81$) as regards baseline values of fruit and vegetable intake and psychosocial variables ($0.20 \leq P \leq 0.65$).
The results presented in this paper show that a school-based randomized intervention, designed on what we perceived as state-of-the-art intervention strategies, did not have any effect in increasing school children’s intake of fruit and vegetables. The intervention consisted of several components including education directed at behavioural change, it was rather extensive (lasted throughout a whole school year), and it included messages specifically targeting fruit and vegetable intake—as several extensive reviews have concluded that school-based fruit and vegetable interventions should be in order to be successful [3, 5–7]. An important point, however, is that most fruit and vegetable interventions reviewed have not been especially successful. The five-a-day multi-component

Table III. Descriptives of Curriculum enjoyment and Newsletter usage process-evaluation items and scales within the intervention group

<table>
<thead>
<tr>
<th>Curriculum enjoyment</th>
<th>Range/response alternatives</th>
<th>Mean</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How did you like the home economics fruit and vegetable teaching</td>
<td>Very good (2), good (1), less good (−1), bad (−2), did not have such teaching (0)</td>
<td>0.72</td>
<td>0.09</td>
</tr>
<tr>
<td>2. Did you like the fruit and vegetable dishes you made at school?</td>
<td>Most of them (2), some (1), no (−1), we did not make such dishes (0)</td>
<td>1.24</td>
<td>0.06</td>
</tr>
<tr>
<td>3. Have you increased your skills in making fruit and vegetable dishes during this school year?</td>
<td>A lot (2), some (1), no (−1), don’t know (0)</td>
<td>0.69</td>
<td>0.07</td>
</tr>
<tr>
<td>4. Has the home economy teaching made you more positive towards fruit and vegetables?</td>
<td>Much (2), some (1), no (−1), don’t know (0)</td>
<td>0.59</td>
<td>0.08</td>
</tr>
<tr>
<td>Scale</td>
<td>−5/8</td>
<td>3.25</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Table IV. Effect of Curriculum enjoyment and Newsletter usage on FV all day within the intervention group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Baseline</th>
<th>Follow-up 1b</th>
<th>Follow-up 2b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Crude mean</td>
<td>Adjusted mean</td>
<td>CI</td>
</tr>
<tr>
<td>Curriculum enjoyment</td>
<td>Low (n = 64)</td>
<td>2.5</td>
<td>2.5</td>
<td>(1.9, 3.2)</td>
</tr>
<tr>
<td></td>
<td>Medium (n = 47)</td>
<td>2.8</td>
<td>2.8</td>
<td>(2.0, 3.5)</td>
</tr>
<tr>
<td></td>
<td>High (n = 73)</td>
<td>3.0</td>
<td>3.0</td>
<td>(2.4, 3.6)</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>0.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newsletter usage</td>
<td>Low (n = 57)</td>
<td>2.3</td>
<td>2.3</td>
<td>(1.6, 3.0)</td>
</tr>
<tr>
<td></td>
<td>Medium (n = 57)</td>
<td>2.4</td>
<td>2.4</td>
<td>(1.7, 3.1)</td>
</tr>
<tr>
<td></td>
<td>High (n = 58)</td>
<td>3.4</td>
<td>3.4</td>
<td>(2.8, 4.0)</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discussion

The results presented in this paper show that a school-based randomized intervention, designed on what we perceived as state-of-the-art intervention strategies, did not have any effect in increasing school children’s intake of fruit and vegetables. The intervention consisted of several components including education directed at behavioural change, it was rather extensive (lasted throughout a whole school year), and it included messages specifically targeting fruit and vegetable intake—as several extensive reviews have concluded that school-based fruit and vegetable interventions should be in order to be successful [3, 5–7]. An important point, however, is that most fruit and vegetable interventions reviewed have not been especially successful. The five-a-day multi-component
programmes in the United States reported intervention effects in the order of 10–15% [4, 19, 20], an exception being the High 5 project, which achieved an effect of 66% on fruit and vegetable intake after the first year of intervention (follow-up difference divided by baseline intake) and 39% after the second year [21]. However, in two separate mediation analyses, the mediators explained each <10% of the observed increase in fruit and vegetable intake [22, 23]. Therefore, it is unknown what caused most of the change in intake and which of the ‘multi-components’ really did work. The positive effects of the High 5 intervention was, however, not confirmed by an observational study conducted in the school cafeteria [21].

The focus on cognitive and practical barriers to eating behaviour change has been suggested as a possible explanation for the limited impact of fruit and vegetable campaigns [24]. An alternative is an environmental approach; creating changes in the children’s food environment as compared with cognitive changes. Few environmental interventions have, however, been conducted. A recent review reported only three stand-alone environmental interventions promoting fruit and vegetables in school settings [25]. All other environmental interventions reported in this review were parts of larger multi-component interventions, which did not separately evaluate the environmental component (i.e. the High 5 project described above). More recently, we have shown that, with the same research instruments as used in the present study, increasing the accessibility of fruit and vegetables at school (fruit at no parental cost) is effective in increasing school children’s intake of fruit and vegetables [10, 26].

A major problem with the present intervention is that it did not increase reported Preferences or Accessibility at home. Interventions work by mediating variables [27], and as the Preferences and Accessibility at home scales have showed to be the strongest correlates of fruit and vegetable intake among Norwegian sixth and seventh graders (Pearson’s correlation coefficients were 0.45 and 0.44, respectively) [28], they possess the greatest mediation potential. A positive change in these two factors would theoretically result in an increased intake. Previous research suggests that children’s dislike of foods can be transformed into liking of foods with repeated tasting or ‘exposure’ to those foods [23, 29]. Therefore, the taste testing and the repeated eating of fruit and vegetables were included in the curriculum to increase the children’s preferences. The newsletters were made to stimulate the parents to increase availability and accessibility of fruit and vegetables at home. In spite of the fact that the pupils liked the curriculum and that several families read the newsletters, it did not create any changes in the children’s preferences or perception of the accessibility at home.

The intervention did, however, increase the pupil’s Awareness of the five-a-day recommendation. Reynolds and colleagues [23] found that Awareness (similar scale, but they called it knowledge) was a significant mediator in the High 5 Alabama study (fourth graders), but that it only explained 9.8% of the increase in fruit and vegetable intake. In the same study, they found that the five-a-day Power Plus intervention in Minnesota did have an effect on both intake and Awareness, but that the effect in intake was not due to the increase in Awareness [23]. In the baseline survey of the FVMM project, Awareness was significantly correlated with intake (Pearson’s $r = 0.25$) [28]. Data from the control groups of the FVMM project showed that seventh graders aware of the recommendation ate on average 2.1 portions per day compared with 1.6 portions per day for those not aware (E. Bere, unpublished data). The difference among aware and not aware parents was greater than for the pupils (2.7 versus 1.9 portions per day, respectively, for parents aware and parents not aware) (unpublished data). The reason why the observed increase in Awareness in the present study did not affect any increase in intake could be that the effect of the intervention was too small or that the differences in intake between those aware and those not aware are not large enough. Due to greater differences between aware and not aware parents, increasing awareness of the five-a-day recommendation could be a more important strategy to increase fruit and vegetable intake for adults than for children.
In the present study, the intervention schools were encouraged to take part in the national School Fruit Programme. Neither at Follow-up 1 nor at Follow-up 2 was the subscription rate much higher in the intervention group than in the control group. The formal letter to the intervention schools’ principals encouraging them to take part in the programme clearly did not result in increased participation in the subscription programme, nor did the FVMM intervention.

Only one school reported to have implemented all sessions as planned, and a few schools reported rather low degrees of implementation. However, no relations were observed between the degree of implementation and fruit and vegetable intake. The intervention was rated as very good by most of the teachers, and the pupils reported that they enjoyed it. The usage of the newsletters could, however, have been better. The pupils who enjoyed the curriculum the most and the pupils with the highest usage of the newsletters had a significantly higher intake of fruit and vegetables compared with those in the lowest groups at both follow-up surveys. This indicates that the intervention had an effect for those who liked it the most and for those who used the newsletters. These pupils, however, had a higher fruit and vegetable intake at baseline, and the intervention seemed to increase the already existing differences in fruit and vegetable intake.

The strength of the present study is that it is a school-randomized study [30] including a rather large number of schools. Sixty-nine percentage of the eligible pupils participated in all three surveys. No differences were found between the study sample (who participated in all three surveys) and those only participating at baseline, and we do not believe that this attrition caused any substantial bias in the results presented.

**Conclusion**

This paper shows that the FVMM intervention, based on state-of-the-art intervention strategies recommended by several review articles, did not have any effect in increasing school children’s intake of fruit and vegetables. The reason probably being that the intervention did not succeed in changing the pupils’ preferences for, or the accessibility of, fruit and vegetables—the two strongest correlates of children’s fruit and vegetable intake.

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**References**

Promoting fruit and vegetables among school children


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