The Effect of Ending the National Free School Fruit Program in Norway – a Natural Experiment

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This master's thesis is carried out as part of the education at the University of Agder and is therefore approved as a part of this education. However, this does not imply that the University answers for the methods that are used or the conclusions that are drawn.

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SAMMENDRAG

Bakgrunn: Norske barn spiser i dag for lite frukt og grønnsaker og for mye tilsatt sukker. Sosiale ulikheter i helse og kosthold er et folkehelseproblem og et viktig satsningsområde. Flere initiativer er gjennomført for å redusere ulikheten og øke inntaket av frukt og grønt blant barn og unge. Et av tiltakene som har vist positiv effekt er gratis skolefrukt i grunnskolen som ble innført i 2007. I 2014 ble dette tiltaket avskaffet. Effekten av å avslutte gratis skolefruktordningen er ikke tidligere blitt undersøkt og vil kunne gi et viktig bidrag til kunnskapsbasen for folkehelsearbeid.

Hensikt: Hensikten med denne studien var å analysere effekten av å avslutte den nasjonale gratis skolefruktordningen på norske sjette- og syvendeklassingers inntak av frukt, grønnsaker og usunn snacks. Effekten ble sett i sammenheng med sosioøkonomisk status og kjønn.

Metode: Datamateriale fra prosjektet *Fruits and Vegetables Makes the Mark* i 2008 og 2018 ble brukt i analysene (n=1472). Det ble gjennomført repeterte tverrsnittsundersøkelser. Sjette og sjuendeklassinger fra to Norske fylker rapporterte inntak av frukt, grønnsaker og usunn snacks i et modifisert 24-timers kostintervju og matvarefrekvens spørreskjema. Gratis skolefrukt ble gitt til elever ved kombinerte skoler (1-10 klasse), men ikke til elever ved barneskoler (1-7 klasse). Dette dannet grunnlaget for et naturlig design. Foreldrenes utdanningsnivå ble brukt som indikator på sosioøkonomisk status. Hovedanalysen var flernivåanalyser av repeterte målinger med frukt og grønnsaker, og usunn snacks som utfallsvariabler.

Resultater: Inntak av frukt gikk ned 0,27 porsjoner per dag for skolene med gratis skolefrukt og 0,01 porsjoner per dag for skolene uten ble observert etter programmet avsluttet. Denne forskjellen var statistisk signifikant (tid x gruppe interaksjon, p=0,047). Andelen som oppga å spise frukt og grønnsaker 4/5 dager per skoleuke sank mer ved skolene som fikk gratis skolefrukt enn ved kontrollskolene (p<0,001). Gjennomsnittlig inntak av usunn snaks økte med 0,87 ganger per uke for intervensjonsgruppen og sank med 0,5 ganger for kontrollskoler (tid x gruppe p=0,012), uavhengig av kjønn og sosioøkonomisk status. Ingen effekt ble funnet på inntak av grønnsaker eller frukt og grøntinntak hele dagen.

Konklusjon: Å avslutte tiltaket om gratis skolefrukt hvor elevene fikk utlevert en frukt eller grønnsak hver skoledag reduserte barnas inntak av frukt og økte inntaket av usunn snacks. Effekten ser ikke ut til å være statistisk forskjellig for gutter og jenter eller høy og lav sosioøkonomisk status.

Nøkkelord: skolebarn; frukt og grønnsaker; skolefruktprogram; naturlig eksperiment; Norge

SUMMARY

Background: Norwegian children eat too little fruits and vegetables, and too much added sugar compared with the recommended intake. Social inequalities in health and diet is a big public health concern and a priority to the government. Several initiatives have been tested, and one of the interventions showing a positive effect on increasing fruit and vegetable intake and reduction of inequalities is the free school fruit program that started in 2007. In 2014 the program was ended.

Objectives: The objectives of the study were to analyze the effect of ending the national free school fruit program on the intake of fruits, vegetables, and unhealthy snack among Norwegian 6th an 7th graders. The effect was assessed in relation to socioeconomic status and sex.

Design: Data from the *Fruits and Vegetables Makes the Mark* (FVMM) project in 2008 and 2018 were used for the analysis (n=1472). The free fruit program was provided by the state at all combined schools (1st – 10th grade) and not at regular primary schools (1st – 7th grade).6th and 7th graders from two Norwegian counties reported their intake of fruits, vegetables and unhealthy snacks in a modified 24-hour recall – and a food frequency questionnaire. Parental education level was used as an indicator of socioeconomic status. The main analyses conducted were multilevel mixed methods with fruits, vegetables and unhealthy snacks as outcome variables.

Results: The main analysis showed a decreased intake of fruits at school by 0.27 and 0.01 portions/day, respectively, for the freefruit08 and the control schools. The difference between the decrease of the freefruit08 schools and the controls were statistically significant (time x group p=0.047). There was no difference for intake of vegetables or fruits and vegetables combined. No significant interaction was observed for all day intake of fruits, vegetables or FV. The percentage of pupils eating FV 4 or 5 days/ school week decreased more among the freefruit08 schools than the control schools (time x group p<0.001). The intake of unhealthy snacks increased by 0.87 times/week for the freefruit08 and decreased by 0.50 times/week for the control schools (time x group p=0.012). No significant third-order interactions were observed for any outcome variables, indicating that the effect of ending the free fruit program was not significantly different for boys and girls or low and high parental education.

Conclusions: Ending the free school fruit program implemented by the Norwegian government from 2007 to 2014, providing a piece of fruit or vegetables every school day, decreased children´s intake of fruits and increased consumption of unhealthy snacks. The effect of ending the program does not seem to be significantly different for boys and girls, and high and low socioeconomic status. No effect was found on the intake of vegetables.

Keywords: School children; natural experiment; withdrawal; fruits and vegetable intake; school fruit program; Norway

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LIST OF ABBREVIATIONS

24 HR	24- hour recall questionnaire
DLW	Doubly Labeled Water
FV	Fruits and Vegetables
FVMM	Fruits and Vegetables Makes the Mark – project
FFQ	Food Frequency Questionnaire
IGI	Intervention Generated Inequalities
RR	Relative Risk
SES	Socioeconomic status
WHO	World Health Organization

1.0 INTRODUCTION

The diet among today's school children in Norway is mostly in line with the recommendations of the Norwegian Directorate of Health (Hansen, Myhre, & Andersen, 2017). However, there are still some nutritional challenges: The intake of fruits, vegetables and fish is relatively low, while the intake of saturated fat and added sugar is too high in relation to the recommendations. The average intake of fruits and vegetables is about half of the recommended five servings a day (500 g) (Hansen et al., 2017). There are also some demographical differences, of which, girls eat more fruits and berries than boys, and children with low parental education have a lower intake of fruits and vegetables compared to those with higher parental education level (Hansen et al., 2017). Several initiatives have been tested to increase the intake of fruits and vegetables among Norwegian children and reduce social inequalities (Ministry of Health and Care services, 2007).

One of the efforts made by The Norwegian authorities in 1996 was a subscription program for school fruit where the pupils subscribing received a piece of fruit or a carrot each day of school. The subscription program was made nationwide in 2003 and was subsidized by the Norwegian Government with 1.0 Norwegian Krone per pupil per school day, the rest was paid by their parents. In this program, each school has to decide if they want to participate. If the school chooses to participate, parents can sign up their children to receive the fruit at school. The participation rate is rather low, and only 10% of Norwegian school children participate in the program.

In 2007, a free school fruit program was implemented at all secondary schools (8^{th} -10^{th} grade) and combined primary- and secondary schools (1^{st} -10^{th} grade) in Norway. The aim was to increase the FV intake among *all* school children in Norway on a short- and long-term basis. Evaluation of the program showed that more children ate fruits when receiving free fruits (Bere, Hilsen, & Klepp, 2010; Øverum & Bere, 2014). The proportion of pupils eating fruits and vegetables at school increased from 2001 to 2008 (Bere, Hilsen, & Klepp, 2010). Also, a decrease in consumption of unhealthy snacks was observed (Øverby, Klepp, & Bere, 2012). Both the World Health Organization and the Norwegian authorities recommended that the free school fruit program should be extended to include *all* children (including primary schools, 1^{st} -7^{th} grade) (World Health Organization, 2013; Dahl, Bergsli, & van der Wel, 2014).

Seven years later, a new Norwegian government ended the program, despite the positive effects. The reason for ending the program was to release funds to other measures in the education sector (Ministry of Education and research, 2014). There has not yet been conducted an evaluation of ending the program, which could lead to valuable information and contribute to the evidence base of public health interventions. Studies of intervention withdrawal might widen the range of opportunities to evaluate efforts (Craig, Gibson, Campbell, Popham, & Katikireddi, 2018). The withdrawal of the governmental efforts gave us an excellent opportunity to evaluate the effect of ending the intervention, using a natural experimental design.

1.1 OBJECTIVES

The objectives of the present study were to analyze the effect of ending the national free school fruit program on the intake of fruits, vegetables, and unhealthy snack among Norwegian 6th an 7th graders. The effect was assessed in relation to socioeconomic status and sex.

This master´s thesis is structured as follows: in chapter two, a widened theoretical background for the study objectives is presented. The research paper is presented in chapter three, including the background of the study, methods, results and a discussion of the results. Chapter four contains an elaboration on the research paper with methodological end ethical considerations and a further discussion of the study findings, and its meaning in a public health view. Finally, in chapter five, a conclusion of the study is provided. References are provided at the end (chapter 6.0). Research clearance, the consent form and the questionnaire used in the FVMM-study are attached as additional files. Also, the article manuscript, in accordance with submission guidelines from the International Journal of Behavioral Nutrition and Physical Activity, is attached.

2.0 THEORETICAL BACKGROUND

In the following chapter, the theoretical background for the studies objectives will be presented and form the basis for the research paper.

2.1 FRUIT AND VEGETABLE CONSUMPTION

An unhealthy diet and physical inactivity are according to the *World Health Organization* (WHO) among the leading causes of noncommunicable diseases, including cardiovascular disease, type 2 diabetes and certain types of cancer (World Health Organization, 2004). These are among the greatest public health challenges in today´s society. An unhealthy diet is the second largest risk factor, after high systolic blood pressure, for death for both sexes in Norway, according to *the Global Burden of Diseases* (Norwegian Institute of Public Health, 2016, p. 93). As much as 46% of early deaths are caused by behavioral factors (tobacco use, unhealthy diet, use of drugs and physical inactivity), of which nutritional factors are responsible for 18%.

WHO has developed a strategy to address these challenges, whereas limiting the intake of fat, sugar, and salt, and increasing the intake of whole grains, nuts, legumes, and fruits and vegetables (FV) are stated goals (Agudo & Joint FAO, 2005; World Health Organization, 2004) The strategy involves formulations of recommendations as well as the provision of support to countries developing and implementing evidence-based strategies. According to the *Norwegian National Plan of Action for a Healthier Diet* (2017-2021) the goal is a 50% increase in the portion of children and adolescents eating of FV daily (one or more times/day) (Norwegian Ministries, 2017, p. 8). Another goal is a 50% decrease in the consumption of candy and sugar-sweetened soft drinks from 2017 to 2021.

2.1.1 RECOMMENDATIONS OF FRUIT AND VEGETABLE INTAKE

The Norwegian Directorate of Health (2014) recommends a daily intake of at least 250 grams of fruits and 250 grams of vegetables for adults and children over the age of 10. For children under the age of 10, there is no specific quantity recommendation, but a rule of thumb has often been five servings the size of the child's handful (Norwegian Directorate of Health, 2014). The recommendations for FV are based on national and international research on the health benefits of FV consumption (Nasjonalt råd for ernæring, 2011). *World Cancer Research Fund* recommends eating at least five portions/servings (at least 400 g) of a variety of non-starchy vegetables and fruits every day because higher consumption of plant foods probably protects

against certain types of cancer (World Cancer Research Fund & American Institute for Cances Research, 2007). FV also contribute to cardiovascular health and a daily intake of 400-500 g fresh fruits and vegetables is recommended by the WHO to reduce the risk of coronary heart disease, stroke and high blood pressure (2003, p. 89). Amongst Norwegian children and adolescents, a positive correlation was found between intake of FV and fiber and all minerals and vitamins intake (Andersen, Øverby, & Lillegaard, 2004). Andersen, Øverby, and Lillegaard also found a negative relation between FV and the amount of energy from sugar and saturated fat. In a Danish study, the estimated life expectancy was increased by 0.8 and 1.3 years, respectively, when simulating an intake of 400 g and 500 g fruits and vegetables (Gundgaard, Nielsen, Olsen, & Sørensen, 2003).

A systematic review by Aune and colleagues on the FV intake and the risk of cardiovascular disease, total cancer, and all-cause mortality show a dose-response relation and argue that the results support public health recommendations to increase FV intake and recommendations for the prevention of diseases (Aune et al., 2017). They estimated that 5.6 million premature deaths worldwide in 2013 may be attributable to FV intake below 500 g/day, and 7.8 million to an FV intake below 800 g/day if the associations are causal. The result show a dose-response relation, where a 8–16% reduction in the relative risk (RR) of coronary heart disease, 13–18% reduction of stroke, 8–13% reduction in the RR of cardiovascular disease, 3–4% reduction in the RR of total cancer and 10–15% reduction in the RR of all-cause mortality for each 200 g/day increment in intake of fruit, vegetables, and FV combined (Aune et al., 2017, p. 1040). These results might argue to raise the Norwegian recommendations to 800 g/day. On the other hand, the reduction of risk was steeper at the lower range of intake, which indicates that the effect is greatest among the people that do not meet the current recommendations of 500 g/day.

2.1.2 Fruit and vegetable intake in Norway

The average intake of FV among Norwegian men and women were 363 g/day and 387 g/day, respectively (Totland et al., 2012). Only 34% of men and 41% of women met the recommendations of a minimum of 250 g fruits per day. The recommended level of vegetables of at least 250 grams per day was achieved by about 15% of men and women (Totland et al., 2012).

2.1.3 FRUIT AND VEGETABLE CONSUMPTION IN NORWAY AMONG SCHOOL-CHILDREN

Studies show that children's FV intake tracks into adolescence, and the preference and eating habits established in childhood tend to be maintained into adulthood (Maynard et al., 2006; Stea et. al., 2018). This makes increasing FV intake among children an important issue in the public health policy. In Norway, there has been a political agreement that early intervention is crucial for dealing with the health-related social inequalities and the social gradient (Ministry of health and care services, 2002; Norwegian Directorate of Health, 2005; Norwegian Ministry of Health Care Services, 2006).

According to data from the nationwide diet survey among 4th and 8th graders in Norway, UNGKOST 3, the average intake of vegetable, fruits, and berries among 4th graders was 193 and 198 grams per day for boys and girls, respectively (Hansen et al., 2017). In the 8th grade, the average intake for girls were 198 grams and 176 grams for boys. This amount equals about half of the recommendations of five servings of FV each day (Hansen et al., 2017).

2.2 UNHEALTHY SNACK CONSUMPTION

The definition of unhealthy snacks is unclear and might differ from study to study, a review of the definitions of "snacking" refers to it as eating foods or consuming caloric beverages between regular meals (Hess, Jonnalagadda, & Slavin, 2016). Snack foods tend to be energy dense and of little nutritional value (Bes-Rastrollo et al., 2010). Energy-dense foods such as sweets, desserts, salty snacks, and sugar-sweetened beverages have often been reported to be the main constituents of snacks (Myhre, Løken, Wandel, & Andersen, 2015). Some studies suggest that the consumption of nutrient-poor snacks may be associated with high body mass index (BMI), eating in the absence of hunger, eating away from home or work, social modeling, and food insecurity (Hess et al., 2016). Consumption of sugar-sweetened beverages has been associated with an increased risk of type-2 diabetes and excess weight gain and should, therefore, be limited (Becker et al., 2014). High intake of unhealthy snack is not only associated with overweight. A study of dietary habits and behavior problems at school among Norwegian 14-year-olds showed that a high intake of soda with sugar, and consumption of takeaway and fast food were associated with increased risk of behavioral problems, also when adjusting for parental education (Western, Skårdal, Ask, & Øverby, 2017).

2.2.1 RECOMMENDATIONS FOR UNHEALTHY SNACKS

The *Nordic Nutrition Recommendation* recommend limiting the amount of added sugar to a maximum of 10% of total energy intake (E%) (Becker et al., 2014). This is especially important for children and people with low energy intake as high intake of unhealthy snacks might be consumed at the expense of more nutritious food.

2.2.2 UNHEALTHY SNACK CONSUMPTION

Norkost 3 is a national nutrition survey conducted in Norway in 2010-2011 (Totland et al., 2012). The results from Norkost 3 showed that among Norwegian adults, added sugar contribute with 7% of the total energy intake. Sugar-sweetened soda and juice were the most significant contributors of added sugar. The mean number of snacks was 1.6 per day for men and 1.9 per day for women. Snacks contributed to 17% and 21% of the total energy intake among men and women, respectively. In Norkost 3 *snacks* includes both unhealthy and healthy food.

2.2.3 CONSUMPTION OF UNHEALTHY SNACKS IN NORWAY AMONG SCHOOL-CHILDREN

In 2000, *UNGKOST-2000* found that among 4th graders the average amount of added sugar was 17.3 E% and 19.1 E% among 8 grades. Compared to the same survey conducted in 2015 (Ungkost 3) a reduction of about 5-6 percentage points of added sugar can be seen (Hansen et al., 2017). Still, the amount of added sugar is above the recommendations, both for 4th graders (12 E%) and 8th graders (12.4 E%). The average daily intake of sweets among 4th and 8th grades was 20 g and 30 g, and 1.5 dl and 2 dl juice/soda with added sugar (Hansen et al., 2017, p. 15). A study of intake of added sugar among Norwegian children and adolescents showed that high consumers of added sugar had a 30-40% lower intake of FV than low consumers (Øverby, Lillegaard, Johansson, & Andersen, 2004).

2.3 DIETARY ASSESSMENT METHODS

There are several techniques for measurements of habitual dietary intake available, however, it is difficult to measure diet accurately (Agudo & Joint FAO, 2005). Inaccurate dietary assessments may be a serious concern in epidemiological studies assessing the impact of nutrition on health (Shim, Oh, & Kim, 2014). Validity refers to the dietary assessment methods ability to measure the true dietary intake (Livingstone, Robson, & Wallace, 2004). Doubly labeled water (DLW) is considered to be the gold standard reference method for validation of energy intake (Burrows, Martin, & Collins, 2010). Nevertheless, DLW is seldom used due to

the high costs, the burden for the participants, and the high technical skills required for analysis (Burrows et al., 2010). Therefore, other dietary assessment methods are often used in research.

Dietary intake can be assessed by subjective reports and objective observations (Shim et al., 2014). Duplicate diet approach and food consumption record by a trained research staff are examples of objective observations. Duplicate diet approach consists of collections and analyzes of duplicate samples from a subject´s normal diet to estimate potential dietary exposures. Food consumption records collect dietary information by objective observation at the household level (Shim et al., 2014). A limitation to observational approaches is that they are resource-and time-consuming, and therefore not suitable for large scale studies. Subjective methods that assess individual dietary intake include the 24-hour dietary recall (24 HR), dietary record, dietary history and food frequency questionnaire (FFQ). The 24 HR and dietary record are mainly open-ended surveys that collect detailed information about food consumed over a specific period. Although both provide detailed intake data, they are both vulnerable to bias, are time-consuming and require a high level of motivation from the participants. The FFQ is a form of a dietary checklist which asks responders how often and how much food they ate over a specific time period. This questionnaire makes it possible to assess usual intake and is easy to use on a large sample, on the other hand, the questions are closed-ended and have low accuracy. What methods to choose should be determined by the research aim, hypothesis, design and available recourses (Shim et al., 2014).

Some assessment measures are better suited to use on children than others, and the unique challenges should be addressed. Children under the age of 7-8 years are not sufficiently aware of their food intake and may have limited abilities to conceptualize time, therefore parents often report their children's intake by proxy (Livingstone et al., 2004).

2.4 Demographical differences and social inequalities in health

Norway is a wealthy country, with good health and high life expectancy (Dahl, Bergsli, & van der Wel, 2014). However, social inequality in health has been reported in a number of European countries, including Norway (Mackenbach et al., 2008). Social inequalities refer to the systematic difference in health that we find when comparing groups in society (Norwegian Institut of Public Health, 2018). In general, low socioeconomic status (SES) may lead to poorer health. Unequal distribution of recourses leads to different degrees of economic, political, social

and cultural advantage among groups, which may be translated into differences in health outcome and health behavior (Galobardes, Lynch, & Smith, 2007).

There is a social gradient in health that runs from top to bottom of the socioeconomic spectrum, which means the higher SES, the better health (Marmot, Friel, Bell, Houweling, & Taylor, 2008). This means that everyone is affected by health inequalities. Reducing the inequality in health is a stated national goal, as well as it is a global goal to reduce the differences between countries (Marmot et al., 2008; Norwegian Directorate of Health, 2005). The *Commission on Social Determinants of Health* states that *"if systematic differences in health for different groups of people are avoidable by reasonable action, their existence is, quite simply, unfair"* (Marmot et al., 2008, p. 1661).

Gender also contributes to social inequalities, whereas Norwegian women have a higher life expectancy than men, 84.1 years vs. 79.9 years, respectively (Norwegian Institute of Public Health, 2016). The differences are, however, reduced from 2005 to 2015. According to numbers from *the Global Burden of Diseases,* the difference between life expectancy and Healthy life expectancy are larger for women (11.5 years) than for men (9.5 years) (Norwegian Institute of Public Health, 2016).

Some studies suggest that SES inequalities in health are smaller in woman than men (Dahl, 1993; Valkonen, 1989), however, these differences are inconsistent and are likely to vary according to health measures and life stage (Matthews, Manor, & Power, 1999).

2.4.1 SOCIAL INEQUALITIES IN NUTRITION AND DIETARY HABITS

Socioeconomic differences in diet and dietary patterns have been observed in several studies (Drewnowski & Darmon, 2008; Martikainen, Brunner, & Marmot, 2003; Whichelow & Prevost, 1996). These differences are also found among Norwegian adolescents (Øverby et al., 2004). Broadly these studies show that people who consume healthier diets are from higher socioeconomic groups (Martikainen et al., 2003). Socioeconomic differences have been observed in the consumption of FV, where the people with the highest education eat the most FV (Fismen et al., 2016). In UNGKOST 3, it was a tendency that the 4th graders where both parents had primary or secondary school as highest education level, had a lower intake of vegetables, fish, water and a higher intake of unhealthy snacks (Hansen et al., 2017, p. 16). The

biggest difference was observed among boys. The same tendency of a lower intake of vegetables was shown for 8th graders.

The intake of unhealthy snack is also linked to the social gradient, where children with parents without higher education eat more unhealthy snacks (Bolt-Evensen, Vik, Stea, Klepp, & Bere, 2018). Øverby et al. (2004) found an association between 4- year-olds intake of sugar and mothers education level in a Norwegian study. There was a larger percentage of mothers with long education among the low added sugar consumers compared with high consumers. Similar results were reported for the consumption of soft drinks and sweetened beverages in a study of American 4th-6th graders (Cullen, Ash, Warneke, & De Moor, 2002) and Norwegian 6th and 7th graders (Bolt-Evensen et al., 2018). UNGKOST 3 revealed no differences between boys and girls in their intake of added sugar (Hansen et al., 2017).

2.4.2 INDICATORS OF SOCIOECONOMIC STATUS

There are numerous ways to describe and measure socioeconomic conditions (Galobardes et al., 2007). There is no single best indicator of SES that is suitable for all study aims. Each indicator measures different aspects of SES and has its pros and cons. A single measure of SES might show an association with a health outcome, but not encompass the entirety of the effect of SES on health (Galobardes, Shaw, Lawlor, Lynch, & Smith, 2006a). Some people state that a single measure of SES is unlikely to be sufficient and that life-course SES needs to be accepted for, especially when used as a confounding factor in research (Smith, Blane, & Bartley, 1994). However, most indicators of SES are correlated with each other because they all measure aspects of the underlying socioeconomic stratification (Galobardes et al., 2006a). Examples of indicators of SES used in health research measured at an individual level is education, income, occupation, different scales based on several variables and housing.

Many public health studies report data using only individual-level measuring, however, Krieger, Williams, and Moss (1997) argue that it might not tell the full story of the child's socioeconomic class. According to them, household-class, meaning the social class position of the household in which an individual resides may be better to construct childhood class position. SES can also be measured in household-level, with regards to the standard of living and familial resources and neighborhood-level, with regards to community-based hazard and recourses (Krieger et al., 1997). For children, it is most common to use parental education and occupation,

household income, and household conditions as an indicator for the child's socioeconomic position (Galobardes, Shaw, Lawlor, Lynch, & Smith, 2006b).

Education is a useful indicator of SES as it is generally available for both sexes, excludes few members of the population and is less subject to negative adult health selection (Lynch & Kaplan, 2000). One reason why education level might influence health is that exposure to formal education involves gathering facts, learning concepts, and finding out how to access information. Also, a higher level of education generally leads to better jobs, higher income, and better housing, neighborhood and working conditions. Income is the indicator of SES that measures the material resources most directly, however, it is also the indicator that can change the most on a short-term basis (Galobardes et al., 2006a).

2.5 SCHOOL-BASED INTERVENTIONS TO PROMOTE HEALTHY NUTRITION

There is increasing evidence that chronic disease risk begins in fetal life and continue into old age (Joint WHO/FAO, 2003). Early interventions may therefore be important. In Norway, the ten-year elementary school is mandatory and free for children and adolescents aged 6-16. This makes schools unique arenas for health promotion among *all* children, regardless of their socioeconomic background. The school setting has good potential for shaping children´s behavior in general, which makes it an optimal setting for healthy diet promotion.

According to *the National Strategy to Reduce Social Inequalities in Health*, schools can help reduce inequalities in health through the reduction of social inequalities in learning (Norwegian Ministry of Health Care Services, 2006). For example, by encouraging healthy eating habits and promote physical activity. In the strategy it is claimed that provision for healthy meals for everyone at school in itself can help level out social inequalities and improve the benefits of learning (Norwegian Ministry of Health Care Services, 2006).

A systematic review and meta-analysis including 91 interventions (55 in US/Canada, 36 in Europe/New Zealand), presented the effect of direct provision (both free, reduced and full price) of fruits and vegetables in schools on FV intake in children (Micha et al., 2018). The results show that a provision at school increased the intake of fruits with 0.27, vegetables with 0.04 and FV with 0.28 servings/ day. Also, policies on school meal standards increased the habitual fruit intake by 0.76 serving/d, but not the habitual intake of vegetables. The systematic review

concludes that specific school food environment policies can improve targeted dietary behaviors. Several studies aiming to increase the FV intake among children by providing FV at school found that the effect on FV also reduced unhealthy snacking during school breaks (Tak, Te Velde, Singh, & Brug, 2010; Øverby, Klepp, & Bere, 2012). A Norwegian study recording the food intake of 4-year-olds, 4th graders and 8th graders found that high consumers of added sugar had a 30-40% lower intake of FV than children who had lower consumption of added sugar (Øverby et al., 2004).

2.5.1 DETERMINANTS OF HEALTHY EATING

To develop effective nutrition intervention to increase FV intake and lower the consumption of unhealthy snack, we need to understand and target the determinants influencing eating behaviors (Baranowski, Lin, Wetter, Resnicow, & Hearn, 1997). The consumption of FV among schoolchildren is a complex phenomenon where the personal, social, and physical environment may have mutual influence (De Bourdeaudhuij et al., 2007). There are various factors affecting the consumption of FV. A systematic review aiming to find determinants of FV consumption among children identified age, gender, socio-economic position, preference, parental intake, and home availability/accessibility as positive determinants (Rasmussen et al., 2006). They found that girls tend to have a higher or more frequent intake of FV than boys and that low socioeconomic position was associated with low or less frequent intake for FV.

2.5.2 INTERVENTIONS TO PROMOTE HEALTHY EATING

Several types of interventions have been tested with varying results. Single-component programs provide free or subsidized fruit to children to increase availability, whereas multicomponent programs provide a range of components such as nutrition education, communication with parents to increase family support, and improvement of the school environment to enable healthy choices (Cleghorn, Greenwood, Cade, Christian, & Evans, 2012). In a review comparing different types of school-based interventions, multicomponent programs tended to result in a larger increase in FV intake, however, they were diverse and could be difficult to replicate. It might also be difficult to determine which components contribute to the effect when using multicomponent interventions (Hildonen et al., 2007). The degree of implementation and the children´s appreciation of the intervention seems to be important factors for a successful intervention and are associated with higher intake levels of FV (Hildonen et al., 2007). Single-component interventions like free or subsidized FV

distribution at school may be less effective, but easier to implement than multicomponent programs, and may, therefore, be useful options for governments (Cleghorn et al., 2012).

In 2008, a systematic review was conducted to inform the *European Commission* information about the development process and support the new proposal for school fruits and vegetables (de Sa & Lock, 2008). The Review was supposed to examine the effectiveness of interventions to promote FV consumption in school. Their findings show that school schemes are effective at increasing both intake and knowledge. In fact, 70% of the 30 included studies found an increased FV intake and no decreased intake. It was also indicated that FV schemes can have long-term impacts on consumption. A meta-analysis on the impact of a range of school-based interventions on the daily consumption of FV in children (5-12 years) showed an improvement of daily FV consumption by one-quarter to one-third of a portion for all types of interventions combined (Cleghorn et al., 2012). However, when analyzing fruits and vegetables separately, most schemes failed to increase vegetable intake and the effect seems to be caused by an increased fruit intake.

Intervention generated inequalities

Researchers have raised concern that some public health interventions may increase inequalities in the population (Lorenc, Petticrew, Welch, & Tugwell, 2013), where those with the highest intervention needs (high-risk groups) are less likely to benefit from it. Lorenc et. al. (2013) aims, in their systematic review of reviews, to provide indications on which type of interventions that are more likely to produce "intervention generated inequalities (IGI)", and which have potential to reduce inequalities. They compare "upstream" and "downstream" types of intervention, whereas upstream is explained as interventions focusing on social or policy level determinants, and downstream as intervention focusing on individual factors. In this review, they found that downstream interventions, especially mass media campaigns, do not appear to reduce inequalities, and may, in fact, increase them (Lorenc et al., 2013). When evaluating an intervention, it will, therefore, be important to include socioeconomic factors, to investigate potential IGIs.

Providing people the motivation and skills to change behavior cannot be effective if environments and policies makes it difficult or impossible to choose healthful behaviors (Sallis, Owen & Fisher., 2015, p 43-62). Ecological models are likely to be important in understanding behavior with complex etiology that must be maintained over time, such as nutrition. With

ecological models, multiple levels of influence on health behavior are examined, including community, environmental, and policy levels, which are absent from most other models. Multilevel interventions might produce greater and longer-lasting changes than single-level approaches (Sallis, Owen & Fisher., 2015).

2.5.3 NORWEGIAN FREE FRUIT PROGRAM

A stated goal form the Norwegian government is to increase FV intake among school children in Norway (Ministry of Health and Care services, 2007, p. 51). The Norwegian authorities initiated an FV subscription program where the pupils subscribing received a piece of fruit or a carrot each day of school for grades 1-10 in 1996. This was made nationwide in 2003 and was subsidized by the Norwegian Government with 1.0 Norwegian Krone per pupil per school day, the rest was paid by their parents. An official free school fruit program, financed by the state, was implemented in all elementary schools (grades 8-10) and combined schools (grades 1-10) in autumn 2007 in Norway (Ministry of Education and Research, 2006, pp. 75-76). This initiative was based on the systematic inequalities in nutrition among families, and associations between good nutrition and good learning outcomes in school. In 2008 it was also required by law that the school leader was obligated to give their pupils free FV (Ministry of Education and Research, 2008, p. 37).

The effect of the nationwide free school fruit scheme in Norway was evaluated in the *Fruits and Vegetables Make the Mark* (FVMM) – study in 2008 (Bere, Hilsen, & Klepp, 2010; Øverum & Bere, 2014). They compared the effect of the free Fruit program against the subscription program, and no FV program. Evaluation of the program showed that more children ate fruits when receiving free fruits. The proportion of pupils eating fruits and vegetables at school increased from 30% to 85%, including the children who needed it the most (boys and children with low parental education) (Bere, Hilsen, & Klepp, 2010). The increase in intake was largest within the schools which was included in the national free school fruit program, and smallest within the schools that did not participate in any program. The effect was significant for the intake of fruits at school, but no group effect was found for vegetable intake. There was no difference in effect for boys and girls or low and high parental education. FVMM also tested the free school fruit programs effect on reducing the frequency of consumption of unhealthy snacks (Øverby, Klepp, & Bere, 2012). The decrease in unhealthy snack consumption was largest among schools included in the free school fruit program.

Interestingly the effect was also largest among children with low SES, which might contribute to a reduction in the observed social inequalities in health and nutrition.

A pilot of a free school fruit program was evaluated in a school-randomized trial with a cohort of 1950 pupils (sixth and seventh graders). They were followed in a three-year period, from 2001/2002 to 2004/2005. The results showed a better effect of the free fruit program compared to the subscription program in increasing FV intake (effect sizes 0.9 and 0.2 portions/day at school, respectively, compared with control schools) (Bere & Klepp, 2004). The results from the Norwegian free fruit program is consistent with findings from similar projects in other countries, for example in the US (Bartlett et al., 2013)

Despite the effects shown when evaluating the project, the free school fruit program was ended in 2014 (Ministry of Education and research, 2014, pp. 21-25). The Governments purpose of ending the program was to give the school owners more freedom and to use the funds on other school items (Ministry of Education and research, 2014).

3.0 THE RESEARCH PAPER

In this chapter, the main section of the research paper is presented. The paper as whole is attached as appendix 5 and presented after the submission guidelines of International Journal of Behavioral Nutrition and Physical Activity.

3.1 INTRODUCTION

According to *the Global Burden of Diseases* an unhealthy diet is the second largest risk factor, after high systolic blood pressure, for death for both sexes in Norway (Norwegian Institute of Public Health, 2016). Low intake of fruits and vegetables (FV) and a high intake of salt are the most significant dietary risk factors (Norwegian Institute of Public Health, 2016). *The Norwegian directorate of health* recommends a daily intake of at least 250 grams of fruits and 250 grams of vegetables for adults and children over the age of 10. For children, there is no specific quantity recommendation, but a rule of thumb has been five servings the size of the child's handful (Norwegian Directorate of Health, 2014). Norwegian children consume about half of the recommended intake of fruits and vegetables, and too much added sugar. Sweets, chocolate, and soft drinks are the biggest contributors to added sugar amongst children (Hansen, Myhre, & Andersen, 2017).

Several studies have shown that children's FV intake tracks into adolescence and the preference and eating habits established in childhood tend to be maintained into adulthood (Maynard et al., 2006; Stea et. al., 2018) Which makes increasing FV intake among children an important issue in the public health policy. In Norway, there has been a political agreement that early intervention is crucial for dealing with the health-related social inequalities and the social gradient (Ministry of health and care services, 2002; Norwegian Directorate of Health, 2005; Norwegian Ministry of Health Care Services, 2006). Socioeconomic differences might appear in the consumption of FV, where people with the highest education eat most FV (Fismen et al., 2016). Health promotion initiatives are often more effective among families with a high socioeconomic background which leads to larger health disparities instead of helping to reduce the socioeconomic gap (Garcia, 2006).

The national Norwegian authorities have made a considerable effort to increase the FV intake among school children as a strategy to reduce social inequalities in health (Norwegian Ministry of Health Care Services, 2006). An official free school fruit program, financed by the state, was

implemented in all lower secondary schools (grades 8-10) and combined schools (grades 1-10) in Norway, autumn 2007 (Ministry of Education and Research, 2006). The effect of the nationwide free school fruit scheme in Norway was evaluated in the Fruits and Vegetables Make the Mark (FVMM) study in 2008 (Bere, Hilsen, & Klepp, 2010; Øverby, Klepp, & Bere, 2012). The results show an increase in pupils' intake of FV at school from 2001 to 2008. The increased intake was largest within schools included in the national free school fruit program, and smallest within schools that did not participate in any program. The effect was significant for intake of fruits at school, but no group effect was found for vegetable intake. The free fruit program did also show an effect on the consumption of unhealthy snacks, whereas pupils attending schools that received free fruit had a significantly lower intake of unhealthy snacks compared to the groups that had a prescription program or no program at all (Øverby et al., 2012).

Despite the effects shown when evaluating the project, the free school fruit program was ended in 2014 (Ministry of Education and research, 2014). There is limited knowledge of the effect of ending such a free fruit program. Studies of intervention withdrawal might widen the range of opportunities to evaluate interventions and add to the evidence base (Craig, Gibson, Campbell, Popham, & Katikireddi, 2018). The withdrawal of the governmental intervention gave us an excellent opportunity to evaluate what effect of ending the intervention, using a natural experimental design. This can provide useful knowledge to the public health policy and research.

The aim of the present study was to evaluate the effect of ending the nationwide free school fruit program on children's (age 10-12 years) intake of FV and unhealthy snack. The effect will be assessed in relation to socioeconomic status (SES) and sex.

3.2 METHODS

3.2.1 STUDY DESIGN AND SAMPLE

The study was conducted among primary school children from two Norwegian counties. Initially, Hedmark and Telemark counties were chosen because the subscription program was about to start in these two counties in the school year 2001–2002. Both Hedmark and Telemark are situated in the south-east of Norway and are considered similar regarding socioeconomic composition and geography. The first study was conducted in 2001. 48 schools were randomly

selected and invited to participate, of which nineteen schools from Telemark and nineteen schools from Hedmark agreed to participate. A follow-up study was conducted in 2008 and 2018. Eighteen schools participated in all three studies and constitute the sample of the present study (2008 (n=911) and 2018 (n=561)), of which ten schools from Hedmark (n=923) and eight schools from Telemark (n=549) (Figure 1).

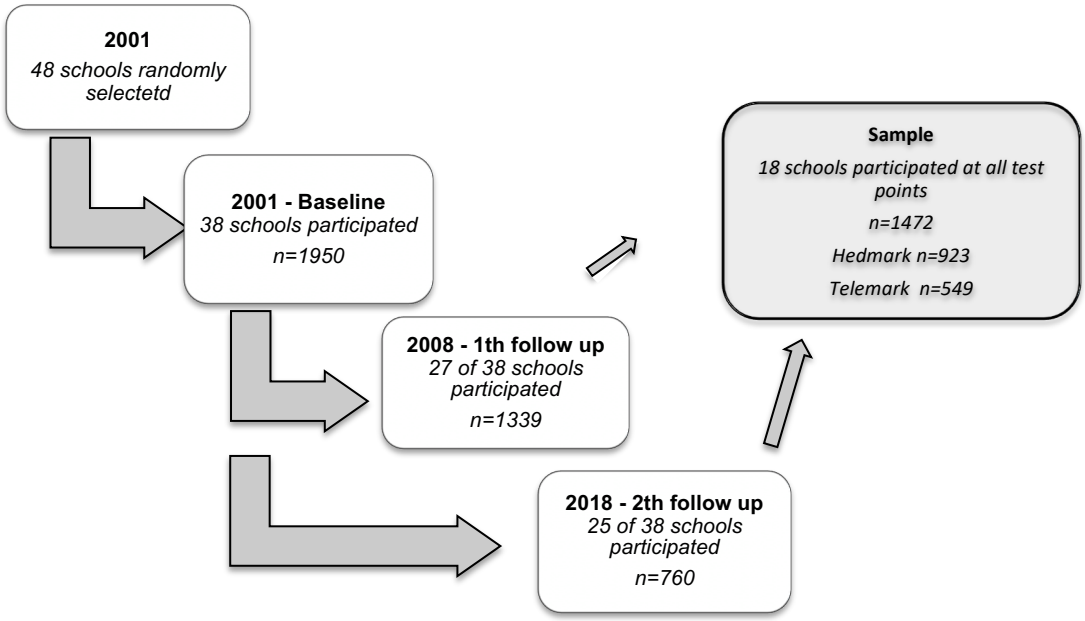

Figure 1. Study design, showing how many schools and pupils (n) participating at each test point and in the present sample.

Four of the schools were combined schools (1-10 grade) (n=279) and therefore received the nationwide free FV program in 2008. The Free Fruit program was primarily intended for all Norwegian lower secondary schools (grades 8-10), but since some schools were combined schools (grades 1–10), these were also included in the program. 6th and 7th grades (age 10-12 years) from the combined schools that received free fruit represent our "intervention group" (freefruit08 schools). The primary schools (grades 1-7) (control schools) did not receive free fruit, decided by the government. The free school fruit program constitutes a natural experiment, since treatment assessment are a result of national school fruit policies, rather than being controlled in the traditional sense of a randomized trial.

A total of 1472 pupils from the eighteen schools completed the questionnaire in 2008 and 2018 and they also brought home a questionnaire to be completed by one of their parents. The questionnaire was read out aloud by a trained project worker, and the questionnaire was completed by the children in their classroom. About 45 min was used to complete the questionnaire. All the pupils were tested on weekdays (Tuesday to Friday). In 2008 the participation rate was higher than in 2018 (78% and 44%, respectively for the 27 schools participating in 2008 and 25 schools from 2018) (Table 1).

Parents answered a similar questionnaire to the child questionnaire. In the 18 schools, 668 parents answered in 2008 and 431 in 2018. Both in 2008 and 2018 79% percent of the respondents were female. In the present study only the parental education level was used.

In 2001, none of the schools had any organized school fruit programs. In September 2008 five schools participated in the free school fruit program (free fruit 08), ten schools participated in the subscription of FV program (Subscription 08) and twelve schools did not participate in any school fruit program (No program 08). In 2018 three schools had a version of a free school fruit or free lunch (including FV), eleven schools had a subscription program, and four schools had no program.

3.2.2 INSTRUMENT

The questionnaires used in the FVMM study were designed and validated for pupils aged 10-12 years) (Andersen, Bere, Kolbjornsen, & Klepp, 2004). Both questionnaires included a modified 24-HR, a FFQ, questions assessing attitudes towards FV, demographic questions and questions concerning other health-related behaviors.

The modified 24-HR was divided into five periods/meals throughout the day (before school/breakfast, at school/lunch, after school, dinner, and in the evening/ supper) to make it easier for the children to remember. The kids were told to record all fruits, berries, and vegetables measured in number (eg. one apple, one banana) or in portion (eg. a portion of fruit salad) for the previous day. One portion was set at about 80 g (ranging from 65 g (one carrot etc.) to 105 g (one apple/one orange)). The portion of fruits from each period of the day was added together, making a fruit score (portions/day). The same was done for vegetables, making a vegetable score, and fruit and vegetables were summed together in a combined FV score. 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*.

In addition to the fruit-, vegetable-, and FV-score, the question: "How often do you eat fruits and/or vegetables at school?" from the FFQ was included in the analyses. The response alternatives were «every school day, 4, 3, 2 and 1 d/week, less than once a week, never, and don't know». The FFQ was dichotomized into eating FV at school 4-5 d/week or less than 4 d/week, indicating eating FV at most school days. The 24-HR and the FFQ has been validated, and a test-retest study shows consistent reliability among 6th graders (Andersen et al., 2004). A validation study of self-reported FV intake showed that 6th graders were capable of recording yesterday's intake of vegetables but overestimated the intake of fruit. The ability to rank subjects based on the FFQ was rather low, but equal to similar studies (Andersen et al., 2004).

A sum score of unhealthy snacks was made from the following 3 items: "How often do you drink sugar-sweetened soft drink?", "How often do you eat potato chips?" and "How often do you eat candy (chocolate, mixed candy etc)?". All items had 10 response alternatives, and were scored as follows: (never (0), less than once a week (0.5), once a week (1), twice a week (2), . . . , 6 times a week (6), every day (7), several times every day (10), giving the unhealthy snacks scale a range from 0 to 30 times/week. The unhealthy snack score showed good reliability in a test-retest by sixth graders with 14 days apart (Andersen et al., 2004).

Parents education level was reported by the parents and used as a measure for SES. It was reported with the following response options: elementary school, high school, college or university (three years or less) and college or university (more than three years). This was later dichotomized into lower (no college or university education) and higher (college or university education) level of education.

3.2.3 STATISTICAL ANALYSIS

For descriptive analyses, independent sample t-tests were conducted for continuous variables and chi-square for dichotomous variables for pairwise comparisons. The main analyses were multilevel mixed models with fruits, vegetables, FV, at school and all day, and unhealthy snacks as separate outcome variables. Year (2008 and 2018), group, sex, and parental education level was used as fixed effects, and school was used as a random effect. A significant time x group interaction ($p<0.1$), indicating different changes in consumption over time for the different

groups (Free fruit program 2008, not free fruit program 2008), was used to test the effect of ending the school fruit program. To assess potential differences in the effect of ending the school fruit program for different groups (based on sex and parental education level), the third-order interaction time x group x sex and time x group x parental education level were examined. An examination of the residuals of the continuous variables did not reveal unacceptable departures from normality.

Pupils that did not attend school the day before the survey day (28 in 2001, 19 in 2008 and 13 in 2018) were excluded from the analyses of intake of FV at school but included in all other analyses.

To conduct a school attrition analysis, pupils at the 18 schools in the present study sample were pairwise compared at baseline with those at the 20 schools that did not participate in 2008 or 2018, regarding all variables. All analyses were conducted using the *Statistical Package of Social Sciences (SPSS), version 24* (SPSS inc., Chicago, IL, USA). The significance level was set at $p<0.05$.

3.2.4 ETHICS

Informed consent was signed by the parents prior to each study and collected by a contact person at the schools. The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Norwegian Center of Research Data (NSD) at all time points and The National Committees for Research Ethics in Norway (REK) in 2001, and by The Faculty's Ethics Committee of the University of Agder (FEC) in 2018.

3.3 RESULTS

Unadjusted all day FV intake for the 6th and 7th grade pupils at the eighteen schools increased from 2.4 to 3.2 portions/d ($p<0.001$) from 2001 to 2008 and decreased from 3.2 to 2.6 portions/d ($p<0.001$) from 2008 to 2018 (Table 1). FV intake at school increased from 0.4 to 0.8 portions per day from 2001 to 2008 but did not change significantly from 2008 to 2018. The percentage of pupils reporting to eat FV 4 or 5 times/week at school did, however, change from 28% in 2001 to 65% in 2008 and 56% in 2018 ($p=0.002$). The intake of unhealthy snacks decreased

from 6.9 to 4.6 times/week from 2001 to 2008 (p<0.001), a further decrease was observed from 2008 to 2018 (from 4.6 to 4.3 times/week, p=0.016).

Table 1: Description of the participants and the main variables in the 2001-, 2008-, and 2018-surveys: The Fruits and Vegetables Make the Marks Project

	2001	2008	2018	P value[1] 01-08	P value[1] 08-18
All					
Number of schools	38	27	25		
Eligible pupils	2287	1712	1734		
Participating pupils	1950	1339	760		
Participation rate (%)	85	78	44		
Sample					
Number of schools	18	18	18		
Pupil data					
Participating pupils	963	911	561		
Sex, female (%)	49	52	53	0.258	0.064
Age, seventh graders (%)	48	49	53	0.777	0.094
FV intake all day (portions/d)[2]	2.4 ± 2.33	3.2 ± 2.8	2.6 ± 2.1	<0.001*	<0.001*
FV intake at school (portions/d)[2]	0.4 ± 0.6	0.8 ± 0.9	0.7 ± 0.7	<0.001*	0.245
Eating FV 4-5 d/week at school (%)	28	65	56	<0.001*	0.002*
Unhealthy snacks (times/week)[2]	6.9 ± 4.3	4.6 ± 3.3	4.3 ± 2.8	<0.001*	0.016*
Parent data					
Participating parents	809	668	431		
Participation rate (%)	84	73	77		
Sex, female (%)	85	79	79	0.006*	0.988
Age (mean, years)[2]	40.1 ± 5.8	40.9 ± 5.1	42.7 ± 5.5	0.004*	<0.001*
Higher education (%)	43	55	69	<0.001*	<0.001*

[1] Based on *t* test for continuous variables and the chi-square test for the dichotomous variables
[2] Mean ± SD

In 2001 and 2018 there was no difference between the groups (free fruit 08 and no free fruit 08) in intake of FV, fruits or vegetables at school (Table 2). In 2008 the group receiving free fruits had a higher intake of fruits at school compared with those that did not (0.65 portions/d and 0.47 portions/d, respectively, p=0.003). No significant difference was found for FV and vegetables. The intake of all day FV and fruits was different between the groups in 2018 (p=0.028, p=0.024) but not significant for the intake of vegetables (p=0.300). The percentage of pupils reporting to eat FV four or five days a week was 27 percentage points more for the freefruit08 schools than the control schools in 2008 (p<0.001). In 2018 there were no significant difference between the different schools (p=0.061). The percentage of pupils reporting to eat FV most school days were the same in 2008 and 2018 (58%) among the control schools, indicating that the change was made in the freefruit08 schools. The intake of unhealthy snacks was significantly lower among the schools receiving free fruit compared to those who did not

in 2001 (6.26 times/week, 7.02 times/week, respectively, *p*=0.043) and 2008 (4.26 times/week, 4.81 times/week, *p*=0.042), but higher in 2018 (4.93 times/week, 4.20 times/week, *p*=0.042)

Table 2 Unadjusted differences between the groups (free fruit 08 and no free fruit 08) at each test point and changes from 2001 to 2008 and 2008 to 2018. (Mean values and 95% confidence interval)

	2001		2008		2018		Change 01-08	Change 08-18
	Mean	95% CI	Mean	95% CI	Mean	95% CI		
At school								
FV (portions/d)								
Free fruit 08	0.34	0.25,0.43	0.73	0.68,0.79	0.57	0.43,0.71	0.39	-0.16
No Free fruit 08	0.36	0.32,0.41	0.71	0.64,0.77	0.70	0.63,0.77	0.35	-0.01
p-value[1]		0.659		0.081		0.126		
Fruit (portion/d)								
Free fruit 08	0.23	0.16,0.30	0.65	0.56,0.73	0.39	0.27,0.50	0.42	-0.31
No Free fruit 08	0.23	0.19,0.26	0.47	0.42,0.53	0.51	0.46,0.57	0.24	0.04
p-value[1]		0.883		**0.003**		0.087		
Vegetables (portions/d)								
Free fruit 08	0.11	0.05,0.16	0.19	0.13,0.24	0.18	0.09,0.27	0.08	-0.01
No Free fruit 08	0.13	0.11,0.17	0.23	0.20,0.27	0.19	0.15,0.22	0.10	-0.04
p-value[1]		0.397		0.223		0.860		
All day								
FV (portions/d)								
Free fruit 08	2.30	1.94,2.65	3.25	2.88,3.62	2.15	1.70,2.59	0.95	-1.1
No Free fruit 08	2.44	2.29,2.61	3.17	2.96,3.38	2.70	2.51,2.89	0.73	-0.47
p-value[1]		0.446		0.126		**0.028**		
Fruit (portion/d)								
Free fruit 08	1.34	1.12,1.57	2.06	1.80,2.31	1.20	0.88,1.53	0.72	-0.86
No Free fruit 08	1.57	1.44,1.69	2.00	1.85,2.14	1.61	1.48,1.74	0.43	-0.39
p-value[1]		0.130		0.155		**0.024**		
Vegetables (portions/d)								
Free fruit 08	0.95	0.74,1.16	1.20	1.00,1.40	0.94	0.68,1.20	0.25	-0.26
No Free fruit 08	0.88	0.80,0.97	1.18	1.06,1.29	1.09	0.98,1.19	0.3	-0.09
p-value[1]		0.518		0.873		0.300		
FFQ 4 or 5								
Free fruit 08 (% yes)	28	20,36	85	80,90	46	34,58	57	-40
No Free fruit 08 (% yes)	28	25,31	58	54,62	58	53,62	30	0
p-value[1]		0.975		**<0.001**		0.061		
Unhealthy snacks								
Free fruit 08 (times/week)	6.26	5.65,6.87	4.26	3.84,4.68	4.93	4.12,5.73	-2.00	0.67
No Free fruit 08 (times/week)	7.02	6.71,7.32	4.81	4.55,5.07	4.20	3.96,4.43	-2.21	-0.61
p-value[1]		**0.043**		**0.042**		**0.030**		

[1] Based on a one-way ANOVA
Numbers presented in bold text are significant p<0.05

The main analysis of fruits and vegetable intake between 2008 and 2018 showed that the time x group interaction was significant for intake of fruits at school (*p*=0.047), but not for vegetables

and FV combined. The decrease in fruit intake at school were -0.27 and 0.01 portions/day, respectively, for the free fruit 08 group and the control group (Table 3).

No significant interaction was observed for intake of fruits, vegetables or FV all day. Time x group interaction was also significant for eating FV 4 or 5 days/ school week (<0.001), and consumption of unhealthy snacks (p=0.012). The freefruit08 schools had a 35 percentage points lower portion of pupils eating FV most school days in 2018 than in 2008, compared with the control group where the change was -2 percentage points. The biggest difference was found in the consumption of unhealthy snacks, where the free fruit 08 group increased their intake by 0.87 times/week, and the control group decreased their intake by -0.50 times/week.

Table 3: Adjusted changes in fruits and vegetables (FV) intake at school and all day(portions/d), percentage of pupils eating FV 4 or 5 days/week and unhealthy snacks (times/week) from 2008 to 2018 in relation to the school fruit program. (Mean values and 95% confidence intervals)

	2008		2018		Change 08-18	P for time x group interaction[1]
	Mean	95% CI	Mean	95% CI		
At school						
FV (portions/d)						0.173
Free fruit 08	0.82	0.57, 1.06	0.53	0.22, 0.85	-0.29	
No Free fruit 08	0.77	0.64, 0.89	0.72	0.58, 0.85	-0.05	
Fruit (portion/d)						**0.047**
Free fruit 08	0.66	0.49, 0.84	0.40	0.15, 0.64	-0.27	
No Free fruit 08	0.51	0.42, 0.60	0.52	0.42, 0.62	0.01	
Vegetables (portions/d)						0.619
Free fruit 08	0.16	0.03, 0.28	0.14	-0.03, 0.31	-0.02	
No Free fruit 08	0.26	0.19, 0.32	0.20	0.12, 0.27	-0.06	
All day						
FV (portions/d)						0.270
Free fruit 08	3.26	2.54, 3.98	2.19	1.25, 3.12	-1,07	
No Free fruit 08	3.18	2.79, 3.56	2.63	2.21, 3.04	-0.55	
Fruit (portion/d)						0.128
Free fruit 08	2.09	1.71, 2.47	1.21	0.64, 1.77	-0.88	
No Free fruit 08	1.97	1.77, 2.17	1.60	1.37, 1.82	-0.37	
Vegetables (portions/d)						0.902
Free fruit 08	1.18	0.80, 1.59	0.99	0.46, 1.52	-0.19	
No Free fruit 08	1.19	0.97, 1.41	1.03	0.80, 1.27	-0.16	
FFQ 4-5 times/week						**<0.001**
Free fruit 08 (% yes)	85	70, 100	50	32, 69	-35	
No Free fruit 08 (% yes)	61	53, 69	59	50, 68	-2	
Unhealthy snacks						
Free fruit 08 (times/week)	3.67	3. 16	4.54	3.69, 5.38	0.87	**0.012**
No Free fruit 08 (times/week)	4.67	4.35, 4.88	4.17	3.85, 4.49	-0.50	

[1]Based on multilevel mixed models adjusted for parental education, sex and school
Numbers presented in bold text are significant p<0.05

No significant third-order interactions (time x group x sex or time x group x parental education level) were observed for any outcome variables, indicating that the effect of ending the free fruit program was not significantly different for boys and girls or low and high parental education.

Table 4 shows unadjusted percentage and confidence interval of pupils reporting to eat FV 4 or 5 days per school day stratified on groups. The table reveals no differences in change from 2008 to 2018 between boys and girls, and low and high parental education for either the freefruit08 schools or the control schools.

Table 4: Proportion of pupils reporting to be eating fruits and vegetables at school 4 or 5 times/week stratified on groups (School fruit program in 2008) and sex/parental education level (percentage and 95% confidence intervals)

		2001		2008		2018		Change 2001-08 p.p.	Change 2008-18 p.p.
	N	Percentage	95% CI	Percentage	95% CI	Percentage	95% CI		
Free Fruit 08									
Boys	191	15	6, 23	79	70,88	38	22, 54	64	-41
Girls	66	44	31, 56	91	85,97	55	37, 72	47	-36
Low parental education	44	31	20, 43	80	69,91	57	27, 87	48	-23
High parental education	140	30	12, 42	91	85,98	41	24, 59	62	-50
Not free fruit 08									
Boys	574	23	18, 28	52	46,58	53	45, 60	29	1
Girls	414	33	28, 38	65	59,70	62	56, 68	32	-3
Low parental education	307	29	24, 34	55	49,62	57	48, 67	27	2
High parental education	475	30	24, 36	66	59,72	62	56, 68	36	4

In the attrition analysis, the results revealed no significant differences at baseline when comparing the 18 schools included in the present study sample with the 20 schools that did not participate in 2008 or 2018. The only difference showed that among the schools not

participating at all test points, 34% reported eating FV at school 4 or 5 days a week whereas 28% reported the same among the present study sample (p=0.007).

3.4 DISCUSSION

This study examined the effect of ending the free school fruit program on the intake of fruits, vegetables, FV, and unhealthy snacks among 6th and 7th graders in two Norwegian counties. The results indicated a negative effect of ending the free fruit program on the intake of fruits at school (-0.27 and 0.01 portions/d change for the freefruit08 schools and control schools, respectively) (Table 3). The portion of pupils reporting to consume FV at most school days did also decrease more for the freefruit08 schools. The time x group interaction was not significant for vegetable consumption or FV intake combined, however, the tendency of a greater negative effect for the freefruit08 schools was present for all variables. Pupils at the schools that received free fruit in 2008 had a lower intake of fruits and FV combined and a higher intake of unhealthy snacks compared to pupils at control schools in 2018 (Table 2). In 2008 the situation was the opposite: the freefruit08 schools had a higher intake of FV and lower intake of unhealthy snacks.

To our knowledge, no previous studies have evaluated the effect of ending a free fruit program by using data from schools that previously received free fruit. However, several studies have done follow-ups among the students who received the interventions some years after it ended (Fogarty et al., 2007; Te Velde et al., 2008). In the National Schools Fruit Scheme (NSFS) from England, the school-based fruit distribution appeared to have a short-term effect in increasing FV intake of the pupils, but results were not obtained after the provision of free fruits ended (Fogarty et al., 2007). However, findings from an evaluation of the FVMM project three years after showed that there might also be a long-term effect of providing free fruit in school (Bere, Veierød, Skare, & Klepp, 2007).

The reason for the negative intervention effect might be caused by the reduction of availability and accessibility of FV at the schools. Availability and accessibility have been identified as some of the strongest determinants of children´s and adolescents´ FV intake by an extensive review of children´s fruit and vegetable intake (Rasmussen et al., 2006), also findings from Norwegian studies support this (Bere & Klepp, 2004, 2005).

One possible reason why the freefruit08 schools had a larger decrease in FV intake, could be that the schools who did not receive free fruit had to make a greater effort themselves to increase the FV consumption among their pupils, while the schools receiving FV for free did not need to have the same focus. One can assume that the freefruit08 schools went back to their old routines when the program ended, while the control schools might have found some good alternatives to increase the FV intake and continued with this.

In the present study, no third-order interaction was found, indicating that the effect of ending the program did not differ according to parental education or sex, and thereby seems to affect all pupils.

A negative effect was also found on the intake of unhealthy snacks, where the intake increased with almost one time a week (0.87 times/week) among the schools that ended the free fruit program and decreased by 0.5 times/week at the control schools. In 2008 the freefruit08 schools ate significantly less unhealthy snacks compared to the control group (4.26 vs 4.81, respectively), while in 2018 the results had shifted and the pupils at freefruit08 schools ate significantly more unhealthy snacks than the control schools (4.93 and 4.20, respectively) (Table 2). The increase in eating unhealthy snacks in the intervention group might be caused by the decrease in fruit consumption among the schools that ended the free fruit program. Several studies show an association between a higher FV intake and a lower intake of unhealthy snacks (Bere, Vierød & Klepp, 2005; Tak, Te Velde, Singh, & Brug, 2010; Øverby et al., 2012). The results after ending the free fruit program show that the relationship might also be reversed, by providing less FV the schools increased the pupils unhealthy snacking. One assumption might be that when FV are not available, the need for energy might be harder to satisfy and the cravings for unhealthy snacks may increase. For some, unhealthy snacks may work as a replacement for the lower intake of FV, just as it might be the other way around. When given the choice between a healthy snack (sliced or whole fruits) and an unhealthy snack (sweet or salty), the children more often choose the unhealthy snacks (Beets et al., 2014).

The strengths of the present study are that it includes repeated data from a large number of randomly selected schools and an evaluation of the governmental initiative to end the free fruit program in a natural setting. The natural experimental design might be seen as both a strength and a limitation in the present study. A strength because it gives us the opportunity to evaluate the efforts in a real-life setting and a limitation because it often contributes to a bigger risk for

bias and confounding (Craig et al., 2012). A limitation of this study is the non-randomization of the groups. However, no initial difference in parental education or sex were found between the groups (data not presented), indicating homogeneity in the sample. Data presented in table 2 show no significant difference in FV intake between the groups at baseline. However, the freefruit08 schools reported eating unhealthy snacks 0.76 times/week less than the control schools in 2001 (p=0.043).

The unhealthy snacks score is limited because it only includes three kinds of unhealthy snacks (candy, sugar-sweetened soft drink, and potato chips), and we had no data on other snacks eaten. However, the aim was not to present accurate data on unhealthy snacks, but rather to investigate differences between the groups and time.

A second limitation of the study is that three schools (one in the freefruit08 group and two in the control) still had some kind of free fruits or free lunch paid by the municipalities. Therefore, some of the effects might be underestimated in the results, indicating that the effect could be even bigger than what we can find in this study. Also, most of the schools in the control group had a subscription program in 2018, while none of the intervention schools had the same.

There have been different project workers coding the 24-HR at each test point, which makes it possible that the FV intake is interpreted differently each year. This makes it harder to compare the FV intake from 2018 to the intake in 2008 and 2001. Still, the main aim of the study was to evaluate the effect of ending the free fruit program by comparing the schools receiving free fruits with the control schools, thus, the possibly different interpretation of FV intake is of less importance.

3.5 CONCLUSION

Ending the free school fruit program implemented by the Norwegian government from 2007 to 2014, providing a piece of fruit or vegetable every school day, decreased children´s intake of fruits and increased consumption of unhealthy snacks. Ending the program seems to have similar effect for all groups at school, regardless of sex and socioeconomic status. No effect was found on the intake of vegetables. Such evaluations of natural experiments are rare, but important in order to understand the effects of various health efforts implemented.

4.0 ELABORATIONS ON THE RESEARCH PAPER

The following chapter will contain further elaborations on the study and the research paper. First by a discussion of the methodological and ethical considerations, then a further discussion of the findings in the research paper, and what it means in a public health view.

4.1 METHODOLOGICAL CONSIDERATIONS

The Norwegian government decided to give the free fruit program to all secondary schools (8-10 grade) and combined schools (1-10 grade), but not to pupils in primary schools, making it a natural experiment where we did not choose the exposed and unexposed groups.

4.1.1 STUDY DESIGN

The present study was a repeated cross-sectional survey conducted in 2001, 2008, and 2018, by using a natural experimental design.

Natural experimental design

The term "natural experiment" lacks an exact definition, but the common thread in most definitions is that exposure to the intervention of interest has not been manipulated by the researcher (Craig et al., 2012). Natural experiments have become a popular and very useful tool in community research to investigate changes in structural framework conditions causing changes at an individual level (Ugreninov & Birkelund, 2013). The free school fruit program might be viewed as a change of structural condition targeting Norwegian children at the population level. The perfect opportunity to investigate the effect of the free school fruit program presented itself when the Norwegian government introduced the program only to secondary schools and combined schools and thereby making it possible to compare the effect to pupils attending primary schools. A condition for this comparison is that the freefruit08 schools and control schools are comparable in terms of all conditions relatable to the outcome (observed and unobserved), this was discussed in the research article and was found to be satisfying. It is rarely possible to conduct controlled trails in large population groups because of both practical and ethical reasons (Ugreninov & Birkelund, 2013). Since a natural experimental design does not have the same randomization and control as a randomized controlled trail, it is more prone to bias. Potential biases and how we tried to minimize them in the present study will be discussed in the following paragraphs.

Repeated cross-sectional surveys

The present study consists of a repeated cross-sectional survey with data collected three times, 2001, 2008 and 2018. The sample consists of the same schools, but not the same pupils. The design makes it possible to observe a change at the population level and trends in society. A limitation to the repeated cross-sectional design is that it cannot tell us anything about individual changes, only the change of average intake (Asher et al., 2006). However, to answer the objectives of the present study, repeated cross-sectional surveys can give an estimate of the change of the average intake of FV and unhealthy snacks when starting and ending a free fruit program. A longitudinal design would not give us the opportunity to estimate the effect of ending the program on the schools that previously received free fruit but would rather show us the effect for the individuals. Longitudinal studies are often more expensive than cross-sectional surveys and have a high risk of drop-outs (Polit & Beck, 2010).

Two counties in Norway

In the FVMM study, schools in Hedmark and Telemark were selected for participation. The reason why these counties were chosen was that they had not yet started a test-trail for free school fruit, which was intended to start later that year. This made it possible to conduct a baseline survey in 2001, and thereby evaluate the effect of the free fruit program. Hedmark and Telemark are two Norwegian counties, both situated in south-eastern Norway and are seen as similar in regard to geography and socioeconomic composition. They both are rural counties that mainly consists of smaller towns and villages. Because of the difference in demography's and infrastructure, generalization of the results towards more urban Norwegian counties may be difficult. However, the largest cities in Norway are relatively small on a global scale, and the differences between the Norwegian counties is rather small, which could make generalization possible.

4.1.2 STUDY SAMPLE

The pupils in the 18 schools that participated at all test points contribute to the study, and the 20 schools that did not attend all the test points were excluded. The statistical power is reduced by not including all possible schools and increases the risk of type II errors. However, in order to see the effect of ending the intervention, it is only relevant to observe schools that were tested in 2008. Also, a t-test revealed no differences between the current sample and the 20 schools not included.

There was an even distribution of girls and boys, and 6th and 7th graders in the study sample. No difference was found for sex and age between each test point. The age of the parents, however, was higher in 2018 than in 2008 and 2001. This reflects the community development in Norway, where women are older when they get their first child compared to 2008 and 2001 (Statistisk sentralbyrå, 2019). The proportion of pupils with high parental education level increased from 43% in 2001 to 55% in 2008 and 69% in 2018. This trend is also in line with the community development.

Generalization and external validity

In 2001 and 2008 the participation rate was relatively high, 85% and 78%, respectively. In 2018 the participation rate was 44%, which makes it hard to say if the sample reflects the population and increases the risk of nonresponse bias, as there may be a preexisting difference between the children who participate and those who don't. A low participation rate increases the risk of selection bias, which can be a threat to the external validity of studies (Polit & Beck, 2010).

The percentage of pupils having parents with a higher education level is way higher in our sample in 2018 (69%) compared to the Norwegian population in general (33%) (Statistisk sentralbyrå, 2018). However, the numbers form the Norwegian population include people from 16 years and older, and the proportion of low education might be affected by people under 20 years who is still in school and were most does not have children yet. In 2001 and 2008 the percentage of pupils with higher parental education level was significantly lower, 43% and 55%, respectively ($p<0.001$). This is also in line with community development and is also reflected in the Norwegian population in 2001 and 2008 (Statistisk sentralbyrå, 2018). No difference between the parental education level of the freefruit08 schools and the control schools were found (results not reported), which indicates that the results from the main analysis were not affected. A higher education level is often associated with better dietary habits and higher consumption of FV (Fismen et al., 2016). Socioeconomic position is a strong predictor of survey non-participation. A multilevel study of the socio-economic patterns of survey participation in a study of food purchasing behavior found that non-respondents were older, less educated and exhibited different purchasing behaviors (Turrell, Patterson, Oldenburg, Gould, & Roy, 2003). They also found that the non-respondents had a greater number of immigrants from non-English speaking countries, which might also be the case in the present study, and could lead to language barriers. In 2018 26% of the children had one or two parents who did not have Norwegian ethnicity (data not reported). Both the consent form and the

questionnaires required a certain level of Norwegian understanding which might have excluded children with non-Norwegian backgrounds from participating.

4.1.3 MEASUREMENTS OF FRUITS, VEGETABLES, AND UNHEALTHY SNACKS

There are several techniques of measurements of habitual dietary intake available, however, it is difficult to measure diet accurately (Agudo & Joint FAO, 2005). To collect individual information, questionnaires or records are mainly used. Food diary/record require the subject to report all foods consumed for a specific time period. Some also require the weight for all consumed foods. This is time-consuming and requires a lot of work from the participants and is not suitable in a large sample of children.

In the present study, the intake of FV and unhealthy snacks are subjective, and are self-reported by the pupils. When using self-reported data there are some known biases to be aware of (Polit & Beck, 2010). For example, social desirability bias where the pupils may have answered what they think the project workers wanted to hear (Polit & Beck, 2010). According to a systematic review of the validity of dietary assessment methods in children, it is most likely that the pupils would over-report their FV intake. Thus, the intake may be even lower than reported in this study (Burrows, Martin, & Collins, 2010).

The use of self-reported questionnaires has its advantages as they are less expensive and time consuming compared to the use of interviews. Therefore, they were better to use in the present study with a large sample size. (Polit & Beck, 2010). On the other hand, it might be hard for some children to fill in a questionnaire, and an interview may give a more accurate reporting of their FV intake. The cognitive abilities required to self-report food intake includes an adequately developed concept of time, a good memory and attention span, and knowledge of the names of foods (Livingstone & Robson, 2000). Some children might have a narrow understanding of what to report when asked for fruits and vegetables. In the 24-HR, some participants reported eating strawberry yoghurt, jam or reported vegetables when asked for fruits, and the opposite. Their understanding and knowledge of FV might have been a limitation to the study. To address this challenge the project workers made examples when reading the questions out loud and were available for questions during the period when the pupils filled in the questionnaire. Another way to deal with these challenges might have been to use parents by a proxy response. However, 6th and 7th graders spend much of the day away from their parents,

and it will, therefore, be difficult for parents to report their children's FV intake at school and between meals.

24-hour recall questionnaire

In the present study a questionnaire, including a modified 24-hour recall and a food frequency questionnaire was used. The modified 24- HR consists of reporting all FV consumed within the past 24- hours (Agudo & Joint FAO, 2005). The 24-HR was used to produce data on FV intake on group-level, while the FFQ part was used to rank individuals according to their intake.

Recall bias may occur with self-reports, especially for information asked in retrospective (Polit & Beck, 2010). To reduce the risk of recall bias, the 24-HR was divided into five meals, to make it easier for the children to remember all the FV they ate the day before. Also, the questions were read out loud and explained (with examples) while the pupils filled in their answer.

A limitation to the measurement of FV intake in the present study is that in the modified 24-HR the children reported their intake of FV only for the day before. Studies evaluating dietary measurements suggest that repeated 24-HR´s conducted at least 3 times and that includes both weekdays and weekend days is the most accurate method for reporting energy intake in children (Burrows et al., 2010). The 24-HR used in the study was conducted Tuesday to Friday to record their intake on a weekday, and it does not provide reliable estimates of the usual intake. However, the aim of this study was not to report energy intake or to make an overview of the FV intake among Norwegian children but to use the difference between the two groups over time to investigate the effect of ending the free school fruit program.

Modified recall underestimated vegetable intake by 4.5% and overestimated fruit consumption by 12.5% when compared to a full 24-HR (Neuhouser, Patterson, Kristal, Eldridge, & Vizenor, 2001). When testing the validity of the present 24-HR by comparing it to a 7-day record, the questionnaire gave a valid estimate of vegetables but overestimated the intake of fruits and juice (Andersen, Bere, Kolbjornsen, & Klepp, 2004). Andersen and colleagues argue that the overestimation could be due to an underestimation of intake by the reference method (Andersen et al., 2004). Furthermore, social desirability bias might have led to an over-reported intake if the children are aware of the health benefits of eating FV.

Six different project workers carried out the questionnaire in 2018, these were not the same as the ones in 2008 or 2001. Differences between the different project workers might potentially cause bias, however, inter- and intra-variations were small, and no significant difference was observed in the FV intake between the persons in a validity and reproducibility test of the questionnaire (Andersen et al., 2004). The reproducibility was tested by completing the survey once, and then again after 14 days. No difference between the two time periods for boys and girls combined, and boys alone indicating good reproducibility. However, girls recorded a higher intake of FV the first time than the second time (Andersen et al., 2004).

Food frequency questionnaire

Initially, in 2001, the 24HR was included to see the difference in intake between the groups while the FFQ were included to range individuals and correlate to determinants. An FFQ contains a structured list of foods or food groups, and the participants are asked to estimate the frequency of consumption of these foods/food groups. Both the 24-HR and the FFQ have good compliance (Agudo & Joint FAO, 2005). In the present FFQ, the children were asked to report how often they normally eat specific types of food, when thinking about the last three months. Cade and colleagues (2004) found, in their review of the validity of FFQ´s, that the length of the reference period for the FFQs was important for the validity when compared to reference methods. FFQs asking to recall the past month were slightly higher correlated to the reference methods than those recalling the last year. Additionally, the number of questions seems to affect the validity, whereas the FFQs containing most questions had a higher correlation coefficient than those with the smallest number of questions (Cade et al., 2004).

In a study validating the present FFQ among 6th graders in Norway, the ability to rank children according to FV based on the frequency part was rather low (Andersen et al., 2004). The correlation coefficients found between the FFQ and the diaries ranged from 0.21 to 0.32 which indicates a low validity. However, the results were similar or higher than found in similar methods (Andersen et al., 2004)

Unhealthy snacks

The variable “unhealthy snacks” consists of data from the FFQ, and the score is based on questions regarding chips, soda, and candy. A limitation to the unhealthy snacks score is that it only contains these three items, and we have no data on other snacks eaten or how much eaten each time. However, the aim was not to present accurate data on unhealthy snack intake, but

rather to assess differences between the free fruit group and the control group over time. Based on data from a previous test-retest study involving 114 children from 6th grade (Andersen et al., 2004), 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/week; $P = 0.24$) in 2 assessments with 14 d in between (data not previously reported). This shows good reliability. However, the questions assessing the consumption of unhealthy snacks were not validated.

4.1.4 OTHER MEASUREMENTS

Besides the dietary measurements, the questionnaire was also used to collect descriptive information about the sample. Other measurements will be discussed in the following chapter.

Socioeconomic status

In the present study parental education was used as an indicator of SES for the 6th and 7th graders. Parents of pupils at the participating schools reported their highest education level in a self-administrated questionnaire. Education can be measured by a continuous variable (years of completed education) or as a categorical variable, as in the present study where parents reported educational milestones, such as completion of high school and higher education. By using the categorical variable, we assume that specific achievements are important in determining SES, compared to a continued measure where it is assumed that every year of education contributes equally to a person's SES and that the length of education is more important. In comparison to education, income is a variable that can change a lot on a short-term basis, while education is relatively stable throughout adulthood (Galobardes et al., 2006)

The education level was dichotomized to higher or lower parental education level, this gives more statistical power as there are more pupils in each group, but it does not give estimates of the SES hierarchy. To better understand the challenges of the social gradient, differentiation at upper, as well as lower levels of education, need to be examined. Furthermore, one variable may not capture the multidimensional nature of SES, and Braveman and colleagues (2005) argue that SES might function most powerfully in terms of a combination of variables. However, in the present study, the percentage of parents reporting a low education level was low and by combining groups the statistical power of the analysis increased. Also, by

dichotomizing education in two groups, the interaction in the analysis is easier to understand and more intuitive.

Parental education was assessed as the education level of the parent who responded to the questionnaire. This may not represent the overall level of education within the family. There were more often women (79%) than men who responded to the parent´s questionnaire. Friestad and Klepp (2006) found that maternal education and occupation appear less strongly related to adolescents (age 13 to 21) health behavior than measures of father´s occupation and education. They emphasize the importance of measuring the influence of both the fathers and mothers separately, as combined measures of parental education would conceal their relationships.

4.1.5 STATISTICAL ANALYSES

Multilevel models were used in the present study because of the clustered sample. Multilevel methods are powerful analysis models that contain variables measured at different levels of the hierarchy, like in the present study, where the pupils are nested within their schools (Kreft & Leeuw, 1998; West, 2009). The analyses take into account that the observations of the participants are not statistically independent because they are clustered in one unit, which might lead to correlations between outcomes for pupils at the same school (Shin, 2009). Individual development is not applicable in the analysis, as it is not the same persons tested at each test point. By using multilevel measures, it is possible to provide potential evidence of group differences by revealing potential common change patterns within groups and differential change patterns across groups (Shin, 2009).

When analyzing the data in the present study, the variations in the change in consumption of FV and unhealthy snacks between the schools that received free fruit in 2008 and the control schools across time, are of interest. All models in the present study include school as a random factor, and year, group, sex, and parental education as fixed factors with one separate model for consumption of fruits, vegetables, and FV, and the frequency of eating unhealthy snacks and FV at school. A random factor is a categorical factor with levels that can be thought of as being randomly sampled from a larger population level (West, 2009). In the present study, school can be thought of as a random factor, as not all schools in a population of interest (Hedmark and Telemark) are included. In contrast, fixed factors are categorical factors where all levels are included in the study, and not randomly sampled from some larger population (West, 2009).

Any effects of these variables are labeled as random effects and fixed effects. Normally distributed residuals are a criterion for use of the analysis and the assumptions were met in the present study.

One of the largest advantages of multilevel analysis is that it can be used on both continuous and other kinds of outcome variables, also dichotomous variables like “eating FV 4 or 5 times a week at school” (Twisk, 2006, p. 38).

Potential effect modifications can be investigated by adding interaction terms to the statistical model (Twisk, 2006). In the main analysis, *P* values <0.10 were considered significant for interaction terms because interaction terms have less power and therefore the “significant” levels of interaction terms are usually set slightly higher than 0.05 (e.g. *P*-values <0.10) (Twisk, 2006, p. 74).

4.2 ETHICAL CONSIDERATIONS

The act on medical and health research in Norway states that medical and health research must take ethical, medical, health sciences and privacy factors into account (the Health Research Act, 2008). Ethical approval and research clearance for the FVMM-study was obtained from The Norwegian Social Science Data Services (NSD) at all test points and Regional Committees for Medical and Health Research Ethics (REK) in 2001, and by The Faculty’s Ethics Committee of the University of Agder (FEC) in 2018.

Since the children are under 16 years, informed consent was collected from a parent prior to all test points. In health research, the consent must be informed, voluntary, expressed and documented (the Health Research Act, 2008). The consent form in the present study included information about the purpose of the study, the protocol, and the rights to withdraw the consent at any time. The participation rate in the present study was rather low in 2018, however, it would not be ethically right to pressure the schools to collect more consents, as the consent must be voluntary.

All participants were non-identified by use of a subject ID. No connections to personal data were made, as there is no connection between subject ID and the children’s name or personal information. In 2001 and 2008, ID codes were conducted from class lists from participating

schools. In 2018, all children got a random ID, where the only connection was made to which school they attended. Later the number of schools and the ID numbers were changed by the project manager. Which made the analysis blinded for the project workers when conducting the analysis.

Information about habitual nutrition may be considered as sensitive information to some people. When developing a nutrition questionnaire to be used on children, it is important to be aware not to trigger an unhealthy relationship to certain types of food. Children are easily influenced and might be affected by the questions, by the project worker or by other pupils. The children were therefore placed individually and were told not to speak about their answers or look at the person next to them. This was also important to reduce the risk of bias.

4.3 FURTHER DISCUSSION OF THE FINDINGS

The results of the present study show that ending the free school fruit program has taken us further away from the public health goals in the Norwegian National Plan of Action for a Healthier Diet (2017-2021) (Norwegian Ministries, 2017). The goal was a 50% increase in daily FV intake and a 50% decrease of candy and sugar-sweetened soft drink consumption by 2021. However, the present study shows the opposite results, a decreased percentage of pupils eating FV most school days, and an increased intake of unhealthy snacks in the freefruit08 schools. An unhealthy diet is a big threat to public health and will probably be a priority to the Norwegian government for years to come. Evaluations of the government efforts should be conducted in the future, as this may be a way to meet the dietary goals. According to UNGKOST 3, the tendency in Norway is a decreased intake of added sugar, and an increased intake of fruits and vegetables in 2015 compared to 2000 (Hansen, Myhre, & Andersen, 2017). The results of the present study show that the when ending the free school fruit program this positive change seems to be reversed. This was also confirmed by the results of the control group, as we did not find the same negative effect.

Findings from the present study support the empirical data and theory described in the theoretical background chapter. Earlier findings show a positive effect of the nationwide free school fruit scheme, where the results show increased intake of FV and decreased consumption of unhealthy snacks (Bere, Hilsen, & Klepp, 2010; Øverby, Klepp, & Bere, 2012). The results of the present study show the opposite effect when ending the program. Both the positive effect of starting a free fruit program, and the negative effect of ending it supports theories that free

school fruit might be a good way to meet the challenges of low FV consumption among Norwegian children. One of the reasons why the program is effective is that it targets one of the strongest determinants of FV consumption among children: availability/accessibility (Rasmussen et al., 2006). It may be reasonable to assume that when fruits are offered for free for all pupils, more children will eat it. Earlier studies show that parental support and parents' intake is a determinant of children's FV intake (Rasmussen et al., 2006). When using school as an arena for the promotion of healthy eating, we can increase the availability for all children, regardless of their parent's intake and likings. School interventions may be a way to reach children who do not meet the recommended 500 g FV a week, whiteout targeting them as a risk group, but rather to even out the differences in determinants of healthy eating.

Providing free fruit to school children, like in the present study, is an example of a single-component program. Multicomponent programs do, however, tend to have a greater effect of increasing FV intake according to systematic reviews of different types of school-based interventions (Cleghorn, Greenwood, Cade, Christian, & Evans, 2012; Van Cauwenberghe et al., 2010). An example would be to combine the provision of free fruit with an education program focusing on increasing knowledge of healthy food, and cooking classes where children learn how to prepare healthy food and get an opportunity to taste different types of vegetables and fruit. However, a FVMM study showed no synergetic effect between the free fruit and an educational program (Øverby, Stea, te Velde, Bjelland, Klepp & Bere, 2019). They argue that future studies should focus on more extensive parental involvement, increased home availability, and have a longer intervention period. By using multicomponent intervention, it is easier to target different types of determinants of healthy eating, both environmental and individual.

All effects of ending the Norwegian school fruit program appear to be on fruit intake, and no effects on vegetable intake were found. The same result was found when evaluating the effect of the program from 2001 to 2008 (Bere et al., 2010). Similar results are also reported from FV programs in other countries (Davis, Cullen, Watson, Konarik, & Radcliffe, 2009; Eriksen, Haraldsdóttir, Pederson, & Flyger, 2003; Ransley et al., 2007; Tak, te Velde, & Brug, 2009) despite the fact that all programs included provision of both fruits and vegetables (most often carrots). Intake of fruits had a greater increase from 2001 to 2008 and a greater decrease from 2008 to 2018 than vegetables. Increasing the vegetable intake among children and adolescents still remain a great challenge and it does not seem like the free fruit program helps meet these

challenges. One of the reasons why fruit seems to have a greater effect might be because fruits are more often distributed in FV school programs. This is probably due to practical reasons, such as fruit often comes in more convenient portion sizes, and that does not need any preparation, compared to most vegetables which often need preparation and cooking. Also, it is more common to eat a portion of fruits (one apple, one banana, one bag of grapes) at school, than to eat vegetables. The children may eat some pieces of cucumber or bell pepper on their sandwiches (a Norwegian school lunch traditionally consist of packed sandwiches from home), but not enough to count as a full portion (>80g). In Norway, it is most common to eat vegetables for dinner, as dinner often is the only hot meal throughout the day (Kreft & Leeuw). In a Norwegian study about meal patterns for vegetables only 40% of the adolescent´s reported that they had eaten vegetables before dinner (Vejrup, Lien, Klepp, & Bere, 2008).

No gender differences were found. The lack of gender differences might indicate that structural efforts like free school fruit could be a way to reduce the inequalities between boys and girls.

School-based interventions may be considered as "upstream" interventions, because it focuses on policy level as a social determinant, rather than focusing on individual factors like campaigns or brochures (Lorenc, Petticrew, Welch, & Tugwell, 2013). Upstream interventions are considered to be able to reduce socioeconomic inequalities, while downstream interventions are more likely to produce "intervention generated inequalities (IGIs)" (Lorenc et al., 2013). In the present study, there is no sign of IGIs as there was no difference between pupils with high and low SES in the effect of ending the free school fruit. In fact, Øverby, Klepp, and Bere (2012) found a larger effect on the consumption of unhealthy snacks of the free fruit program among children with low SES. Socioeconomic inequalities in health and health behavior is a big public health issue. The results of the FVMM studies might be applied to other structural interventions like free school lunch or physical activity in school. By providing the intervention to *all* kids and making it more available by providing it for free, structural interventions might help reduce the social inequalities in health.

5.0 CONCLUSIONS

Ending the free school fruit program implemented by the Norwegian government from 2007 to 2014, providing a piece of fruit or vegetables every school day, decreased children´s intake of fruits and increased consumption of unhealthy snacks. Ending the program seems to have a similar effect for all groups at school, regardless of sex and socioeconomic status. No effect was found on the intake of vegetables.

The results support earlier findings of the effect of similar programs, indicating that providing free fruit at school might help reach the goal of increasing FV intake among children and reduce social inequalities. Such evaluations of natural experiments are rare, but important in order to understand the effects of various health efforts implemented.

By removing the free school fruit program, the Norwegian government reduced the opportunities to reach the goals of *the National Action Plan for a Healthier Diet*, set by the same government

6.0 REFERENCES

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Spørreskjema om kosthold og fysisk aktivitet - FG6/ATN/(M)EAT 2018

Kjære elev

Dette er et spørreskjema om kosthold og fysisk aktivitet.

Det er viktig at du besvarer spørsmålene så ærlig som mulig. Vi vil gjerne at du besvarer alle spørsmålene, men er det spørsmål du ikke kan eller vil svare på kan du la det være.

Alle svarene er hemmelige. Det er ingen du kjenner som får vite hva du har svart. Du skal ikke skrive navnet ditt på skjemaet.

Er det noe du lurer på, kan du spørre prosjektmedarbeideren fra Universitetet i Agder.

Det er frivillig å svare på disse spørsmålene, og du kan trekke deg når som helst.

TAKK FOR HJELPEN!

Elling Bere
Professor
Prosjektleder

Helene Kristin Olsen
Masterstudent

Svar først på disse spørsmålene

1. Hvilken dag er det i dag?

(1) ☐ Mandag
(2) ☐ Tirsdag
(3) ☐ Onsdag
(4) ☐ Torsdag
(5) ☐ Fredag

2. Var du på skolen i går?

(1) ☐ Ja
(2) ☐ Nei

Del A

Hva spiste du i går og hvordan kom du deg til skolen?

Først ber vi deg om å svare på noen spørsmål om hvor mye frukt og bær, grønnsaker, potet og kjøtt du spiste **i hele går**. Det er viktig at du skriver opp alt.

Dagen i går er delt opp i 5 perioder: Frokost, på skolen, etter skolen, middag, middag og kvelds.

For hver periode skal du føre opp hvor mye frukt og bær, grønnsaker, poteter og kjøtt du spiste.

For å skrive ned hvor mye du spiste skal du tenke på følgende:

Frukt og **bær** måles i antall (f.eks. ett eple, en banan) eller i porsjon (f.eks. en porsjon fruktsalat)

Grønnsaker måles i antall (f.eks. en gulrot) eller i porsjon (f.eks. en porsjon salat, en porsjon brokkoli)

Poteter måles i antall (f.eks. 2 poteter) eller i porsjon (f.eks. en porsjon potetstappe eller en porsjon stekte poteter)

Kjøtt måles i antall (f.eks. pølseskiver på brødskiven) eller porsjon (til middag)

Hvis du spiste noe som ikke kan måles i stykker, porsjoner eller antall, må du beskrive best mulig hvor mye du spiste (f.eks. 2 never bringebær, 1½ skive kålrot, 3 ringer paprika).

Kjøtt deles i rødt kjøtt (f.eks. svin, lam og storfe) og hvitt kjøtt (kylling og kalkun).

Tenk tilbake til i går tidlig

Frokost

3. **Spiste du frokost i går tidlig?**
   ☐ Ja ☐ Nei

4. **Spiste du frukt eller bær i går tidlig?**
   ☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **frukt** og **bær** du spiste her:

5. **Spiste du grønnsaker i går tidlig?**
   ☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **grønnsaker** du spiste her:

6. **Spiste du kjøtt i går tidlig?**
   ☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **kjøtt** du spiste her:

7. **Hvordan kom du deg til skolen i går?**

(1) ☐ Gikk (e.l.)
(2) ☐ Syklet
(3) ☐ Ble kjørt i bil
(4) ☐ Tok buss (e.l.)

Tenk på tiden da du var på skolen i går

8. Spiste du skolemat/ lunsj i går?

☐ Ja ☐ Nei

På skolen

9. Spiste du frukt eller bær til skolematen eller i friminuttene i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **frukt** og **bær** du spiste her:

10. Spiste du grønnsaker til skolematen eller i friminuttene i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **grønnsaker** du spiste her:

11. Spiste du kjøtt til skolematen eller i friminuttene i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **kjøtt** du spiste her:

12. Kastet du noe av nistematen/skolelunsjen i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye mat og drikke du kastet her:

Tenk på tiden etter skoletid i går, men før middag

Etter skolen

13. Hvordan kom du deg hjem fra skolen i går?

(1) ☐ Gikk (e.l.)
(2) ☐ Syklet
(3) ☐ Ble kjørt i bil
(4) ☐ Tok buss (e.l.)

14. Spiste du frukt eller bær etter skoletid i går, men før middag?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **frukt og bær** du spiste her:

15. Spiste du grønnsaker etter skoletid i går, men før middag?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **grønnsaker** du spiste her:

16. Spiste du kjøtt etter skoletid i går, men før middag?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **kjøtt** du spiste her:

Tenk tilbake til middagstid i går

Middag

17. Spiste du middag i går?

☐ Ja ☐ Nei

18. Spiste du potet til middag i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **potet** du spiste her:

19. Spiste du grønnsaker til middag i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **grønnsaker** du spiste her:

20. Spiste du kjøtt til middag i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **kjøtt** du spiste her:

21. Spiste du frukt eller bær til middag eller som dessert i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **frukt og bær** du spiste her:

Tenk tilbake til tiden etter middag i går

22. Spiste du kveldsmat i går?

☐ Ja ☐ Nei

Kvelds

23. Spiste du frukt eller bær etter middag eller til kvelds i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **frukt og bær** du spiste her:

24. Spiste du grønnsaker etter middag eller til kvelds i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **grønnsaker** du spiste her:

25. Spiste du kjøtt etter middag eller til kvelds i går?

☐ Ja ☐ Nei

Hvis ja, skriv ned hva slags og hvor mye **kjøtt** du spiste her:

Del B

Dine meninger om frukt og grønnsaker. Nå kommer en rekke utsagn om frukt og grønnsaker. Hvor enig er du i de forskjellige utsagnene? Alternativene er **helt uenig, litt uenig, litt enig** eller **helt enig**. Hvis du ikke har noen mening, eller du ikke vet hva du skal svare, så krysser du av for **verken enig eller uenig**. Her er det ikke noe svaralternativ som er riktig eller galt. Svar slik du føler passer best for deg. Ikke bry deg om at noen spørsmål kan virke litt rare. HUSK: Kun ett kryss for hvert spørsmål!

1. Hjemme har vi vanligvis frukt stående fremme i en skål

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

2. Frukt og grønnsaker passer veldig godt som snacks/mellommåltid

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

3. Hjemme har vi som regel grønnsaker til middag hver dag

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

4. Frukt er noe av det beste jeg vet

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

5. Det hender at mor/far kutter opp frukt eller grønnsaker til meg som snacks

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

6. Jeg er glad i rå grønnsaker

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

7. Hjemme får jeg lov å spise frukt og grønnsaker når jeg vil

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

8. Mer frukt og grønnsaker gjør at måltidene smaker bedre

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

9. Hjemme har vi vanligvis alltid frukt og grønnsaker i kjøleskapet

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

Del C

Hva spiser du vanligvis? Når du fyller ut disse spørsmålene skal du tenke på hva du vanligvis spiser/drikker. Tenk gjerne på hva du har spist/drukket de siste 3 månedene. Tenk på både hva du spiser hjemme, på skolen og i fritiden. Kryss av i den ruten du føler passer best for deg.

1. Hvor ofte spiser du potet?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

2. Hvor ofte spiser du grønnsaker til middag?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

3. Hvor ofte spiser du grønnsaker på brødskivene? (f.eks. agurk, paprika, tomat)

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver eneste dag
(10) ☐ Flere ganger hver dag

4. Hvor ofte spiser du andre grønnsaker (f.eks. gulrot til skolemat)?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

5. Hvor ofte spiser du eple, appelsin, pære og banan?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

6. Hvor ofte spiser du annen frukt og bær (andre frukter og bær enn eple, appelsin, pære og banan)?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

7. Hvor ofte spiser du pommes frites?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

8. Hvor ofte spiser du potetgull?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

9. Hvor ofte spiser du godterier (sjokolade, blandet godt osv.)?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

10. Hvor ofte spiser du nudler (som f.eks. Mr Lee)?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

11. Hvor ofte spiser du boller, muffins, kake eller annen søt gjærbakst?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

12. Hvor ofte drikker du juice?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

13. Hvor ofte drikker du saft?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

14. Hvor ofte drikker du brus MED sukker (f.eks. Solo, Pepsi, Fanta, Coca-Cola)?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

15. Hvor ofte drikker du brus UTEN sukker (f.eks. Solo lett, Solo pluss, Pepsi MAX, Coca-Cola light, Tab X-tra)?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

16. Hvor ofte drikker du vann fra springen?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

17. Hvor ofte drikker du reint kjøpevann? (uten kullsyre og smak)

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

18. Hvor ofte drikker du vann med kullsyre og/ eller smak?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

19. Hvor ofte spiser du RØDT kjøtt som pålegg (skinke, pølse)?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

20. Hvor ofte spiser du pålegg av kylling/kalkun?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

21. Hvor ofte spiser du RØDT kjøtt til middag (som kotelett, karbonader, pølse, kjøttdeig)?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

22. Hvor ofte spiser du kylling/kalkun til middag?

(1) ☐ Aldri
(2) ☐ Sjeldnere enn 1 gang i uken
(3) ☐ 1 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 3 ganger i uken
(6) ☐ 4 ganger i uken
(7) ☐ 5 ganger i uken
(8) ☐ 6 ganger i uken
(9) ☐ Hver dag
(10) ☐ Flere ganger hver dag

Del D

1. Får du frukt på skolen?

(1) ☐ Ja, gratis
(2) ☐ Ja, abonnerer
(3) ☐ Nei

2. Hvor ofte har du med deg frukt og grønnsaker hjemmefra på skolen?

(1) ☐ 5 ganger i uken eller mer
(2) ☐ 4 ganger i uken
(3) ☐ 3 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 1 ganger i uken
(6) ☐ Sjeldnere enn en dag i uken
(7) ☐ Aldri
(8) ☐ Vet ikke

3. Hvor ofte spiser du frukt og grønnsaker på skolen?

(1) ☐ 5 ganger i uken eller mer
(2) ☐ 4 ganger i uken
(3) ☐ 3 gang i uken
(4) ☐ 2 ganger i uken
(5) ☐ 1 ganger i uken
(6) ☐ Sjeldnere enn en dag i uken
(7) ☐ Aldri
(8) ☐ Vet ikke

4. Hvor mange porsjoner frukt og grønnsaker tror du at en på din alder bør spise hver dag?

(1) ☐ Ingen
(2) ☐ 1
(3) ☐ 2
(4) ☐ 3
(5) ☐ 4
(6) ☐ 5
(7) ☐ Mer enn 5

5. Hvor mange porsjoner frukt og grønnsaker tror du at du spiser hver dag?

(1) ☐ Ingen
(2) ☐ 1
(3) ☐ 2
(4) ☐ 3
(5) ☐ 4
(6) ☐ 5
(7) ☐ Mer enn 5

Del E

1. Hvor langt er det fra ditt hjem til skolen?

☐ Km

2. Hvordan kommer du deg vanligvis til/fra skolen? Skriv ned antall dager i uken for hver årstid. Totalt skal summen bli 5 i alle linjer

Årstid		Går e.l.	Sykler	Blir kjørt i bil	Tar buss	Totalt
Høst (sept- nov)	Til skolen					=5 dager
	Fra skolen					=5 dager
Vinter (des- feb)	Til skolen					=5 dager
	Fra skolen					=5 dager
Vår (mars- mai)	Til skolen					=5 dager
	Fra skolen					=5 dager

3. Hvor lang tid bruker du på å gå *til og fra* skolen:

	Til	Fra	
(1)	☐	☐	Mindre enn 10 minutter
(2)	☐	☐	10-20 minutter
(3)	☐	☐	20-30 minutter
(4)	☐	☐	30 minutter eller mer
(5)	☐	☐	Går aldri

4. Hvor lang tid bruker du på å sykle *til og fra* skolen:

	Til	Fra	
(1)	☐	☐	Mindre enn 10 minutter
(2)	☐	☐	10-20 minutter
(3)	☐	☐	20-30 minutter
(4)	☐	☐	30 minutter eller mer
(5)	☐	☐	Sykler aldri

5. Bruker du sykkelhjelm?

(1) ☐ Ja
(2) ☐ Av og til
(3) ☐ Nei
(4) ☐ Sykler aldri

6. Har du gratis skyss (skolebuss) til skolen?

(1) ☐ Ja
(2) ☐ Nei

7. Dersom du tar buss, hvor langt er det fra der du bor til busstoppet?

(1) ☐ Mindre enn 250 meter
(2) ☐ 250 -500meter
(3) ☐ 500 meter til 1 km
(4) ☐ 1- 2 km
(5) ☐ 2- 3 km
(6) ☐ 3 km eller lenger

8. Er du med i noen form for organisert trening eller idrett?

(1) ☐ Ja
(2) ☐ Nei
(3) Hvis ja, skriv ned hva:

9. Utenom skoletid: Hvor mange GANGER i uken driver du idrett eller aktivitet så mye at du blir andpusten og/eller svett?

(1) ☐ Hver dag
(2) ☐ 4 - 6 ganger i uken
(3) ☐ 2 - 3 ganger i uken
(4) ☐ En gang i uken
(5) ☐ En gang i måneden
(6) ☐ Mindre enn en gang i måneden
(7) ☐ Aldri

10. Utenom skoletid: Hvor mange timer per dag pleier du å se på TV, PC, nettbrett og/eller telefon?

(1) ☐ Ingen
(2) ☐ Mindre enn en ½ time om dagen
(3) ☐ ½ - 1 time
(4) ☐ 2 - 3 timer
(5) ☐ 4 timer
(6) ☐ Mer enn 4 timer

Hvor enig er du i det som står her? HUSK: Kun ett kryss for hvert spørsmål

11. Jeg liker å gå/sykle til skolen

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

12. Jeg er redd for at noe farlig skal skje på vei til skolen

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

13. Skoleveien min er trafikksikker

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

14. Jeg går/sykler til og fra skolen selv om det er dårlig vær

(1) ☐ Helt uenig
(2) ☐ Litt uenig
(3) ☐ Verken enig eller uenig
(4) ☐ Litt enig
(5) ☐ Helt enig

Del F

1. Er du gutt jente

(6) ☐ Gutt
(7) ☐ Jente

2. Vennligst sett kryss ved de personene som bor hjemme hos deg (hvis din mor og far ikke bor sammen, svar da for det hjemmet du bor det meste av tiden).

(1) ☐ Mor
(1) ☐ Far
(1) ☐ Stemor
(1) ☐ Stefar

Her kan du krysse av for inntil 2 alternativer

3. I hvilket land er du født?

☐

4. I hvilket land er din mor født?

☐

5. I hvilket land er din far født?

☐

6. Hva veide du sist du veide deg?
(Hele kg) Skriv tydelig!

(1) _____ kg

7. Hvor høy var du sist du målte deg?
(Hele cm)

(1) _____ cm

8. Har du noen gang prøvd å røyke (minst en sigarett)?

(1) ☐ Ja
(2) ☐ Nei

9. Har du noen gang prøvd å snuse?

(1) ☐ Ja
(2) ☐ Nei

10. Har du noen gang prøvd å drikke alkohol?

(1) ☐ Ja
(2) ☐ Nei
(3) ☐ Vet ikke

11. Prøver du å slanke deg?

(1) ☐ Nei, vekten min er passe
(2) ☐ Nei, men jeg trenger å slanke meg
(3) ☐ Ja

12. Har du egen sykkel (uten el-motor)?

(1) ☐ Ja
(2) ☐ Nei

13. Har du egen el-sykkel?

(1) ☐ Ja
(2) ☐ Nei

14. Hvor mange timer sover du vanligvis om natten?

☐ Timer

Takk for hjelpen!

Universitetet i Agder
Att: Elling Bere
Elling.bere@uia.no

Vår dato: 21.08.2018 Vår ref:60714 MSS/LR Deres dato: Deres ref:

VURDERING AV BEHANDLING AV SÆRSKILTE KATEGORIER PERSONOPPLYSNINGER I PROSJEKTET: *EN SPØRREUNDERSØKELSE OM KOSTHOLD, FYSISK AKTIVITET OG MILJØ - FVMM/ATN 2018 SURVEY*

NSD - Norsk senter for forskningsdata AS viser til meldeskjema innsendt 09.05.2018. Meldingen gjelder behandling av personopplysninger til forskningsformål.

Etter avtale med den behandlingsansvarlige, Universitetet i Agder, har NSD foretatt en vurdering av om den planlagte behandlingen er i samsvar med personvernlovgivningen.

Resultat av NSDs vurdering:

NSD vurderer at det vil bli behandlet særskilte kategorier personopplysninger om helseforhold og etnisk bakgrunn frem til 31.12.2019.

NSDs vurdering er at behandlingen vil være i samsvar med personvernlovgivingen, og at lovlig grunnlag for behandlingen er samtykke.

Vår vurdering forutsetter at prosjektansvarlig behandler personopplysninger i tråd med:

- opplysninger gitt i meldeskjema og øvrig dokumentasjon
- dialog med NSD, og vår vurdering (se under)
- Universitetet i Agder sine retningslinjer for datasikkerhet, herunder regler om hvilke tekniske hjelpemidler det er tillatt å bruke
- Universitetet i Agder sine retningslinjer for bruk av databehandler.

Nærmere begrunnelse for NSDs vurdering:

1. Beskrivelse av den planlagte behandlingen av personopplysninger

FORMÅL
Formålet med dette prosjektet er å undersøke utviklingen i kosthold og fysisk aktivitet over tid. Universitetet i Agder gjennomførte en tilsvarende undersøkelse i 2001 og 2008. Dette gir unike data for å kunne evaluere den nasjonale ordningen med gratis skolefrukt som varte fra 2007 til 2014. I tillegg kan man i dette datamaterialet se på utviklingen over tid på sentrale kostparametere, transportvaner og holdninger til et bærekraftig kosthold. Dette sett opp mot

sosioøkonomisk status og kjønn. Det inkluderes nå også en undersøkelse på videregående skoler for å se på langtidseffekten av gratis skolefrukt..

UTVALG OG REKRUTTERING
Det rekrutteres tre utvalg i forbindelse med studien:
1) 6. og 7. klassinger ved 38 skoler i Hedmark og Telemark,
2) Elevenes foreldre
3) personer som bor i Hedmark og Telemark og er født i 2000/ 2001.

Totalt består utvalget av maksimalt 1300 barn, 8000 ungdom og 1000 foreldre/voksne. Undersøkelsen på 6. og 7. trinnet gjennomføres ved hjelp av papirskjema i skoletiden. Foreldre og barn rekrutteres via skolen.

Det har ikke lykkes prosjektleder å få gjennomført ungdomsundersøkelsen i skoletiden ved de videregående skolene og rekruttering vil derfor skje via Facebook. Det er ønskelig å innhente besvarelser på elektronisk spørreskjema fra 1000 ungdommer. Ved for lav svarprosent vil utvalget utvides til å også omfatte Agder-fylkene.

De 38 skolene i del 1 er skolene som i 2001 var med i prosjektet Fruits and Vegetables Make the Marks (FVMM, NSD prosjektnr. 12395). En rekrutterer ungdommer i Hedmark og Telemark født i 2000/2001 for å kunne sammenligne med FVMM data fra 2001 og 2008.

DATAMATERIALE
Det innhentes blant annet opplysninger om kosthold, aktivitet, transportvaner og holdninger til et bærekraftig kosthold, samt sosioøkonomisk status og kjønn. Det vil registreres navn på skole i forbindelse med undersøkelsen på 6. og 7. trinn.

METODE
Opplysningene innhentes gjennom papirbasert spørreskjema blant elever på 6. og 7. trinn. Papirskjema kodes for å kunne kobles mot foreldrenes besvarelse som gjennomføres elektronisk.

Spørreundersøkelse blant ungdommer gjennomføres elektronisk.

INFORMASJON OG SAMTYKKE
Barneskolene kontaktes først på e-post, så på telefon. Lærerne informerer elevene og foreldrene ved å levere ut informasjonsskriv med samtykkeerklæring.

Ungdommene rekrutteres og får informasjon via Facebook, samt i informasjonstekst innledningsvis i elektronisk spørreskjema.

BEHANDLINGENS VARIGHET
Ifølge e-post fra forsker, mottatt den 31.07.2018, og i tråd med informasjonen til de registrerte, vil opplysningene behandles frem til 31.12.2019. Innen 31.12.2019 skal personidentifiserbare opplysninger slettes fra datamaterialet, eller bearbeides på en slik måte at enkeltindivider ikke kan identifiseres.

2. Personvernprinsipper

NSDs vurdering er at behandlingen følger personvernprinsippene, ved at personopplysninger;

- skal behandles på en lovlig, rettferdig og åpen måte med hensyn til den registrerte (se punkt 3 og 4)

- skal samles inn for spesifikke, uttrykkelig angitte og berettigede formål og der personopplysningene ikke viderebehandles på en måte som er uforenelig med formålet (se punkt 1 og 3)
- vil være adekvate, relevante og begrenset til det som er nødvendig for formålet de behandles for (se punkt 6)
- skal lagres på en slik måte at det ikke er mulig å identifisere de registrerte lengre enn det som er nødvendig for formålet (se punkt 5 og 6)

3. Lovlig grunnlag for å behandle særskilte kategorier personopplysninger

Særskilte kategorier - Samtykke ((art. 6.1. a), art. 9.2 a)
Det fremgår av meldeskjema vi har fått tilsendt at det vil bli innhentet samtykke fra de registrerte. NSD vurderer at den planlagte behandlingen av personopplysninger er lovlig fordi:

- det skal innhentes uttrykkelig samtykke fra de registrerte og
- forsker har oppfylt den særskilte rådføringsplikten

Samtykke dokumenteres ved at det innhentes samtykkeerklæringer hvor foreldre til elever under 15 år har underskrevet. Samtykke fra elever ved videregående skole innhentes ved at den forespurte besvarer et elektronisk spørreskjema og at kobling mot IP loggføres.

4. De registrertes rettigheter

NSD vurderer at den registrerte har krav på å benytte seg av følgende rettigheter: informasjon, innsyn, retting og sletting av personopplysninger, begrensning, dataportabilitet, protest.

NSD finner at informasjonsskrivet stilet til elever og foreldre mottatt den 31.07.2018 vil gi de registrerte god informasjon om hva behandlingen innebærer og om hvilke rettigheter de har. Vi ber likevel om at det tydeliggjøres hvordan man går frem for å benytte seg av sine rettigheter, d.v.s. hvem man kontakter f.eks. dersom man ønsker å trekke seg fra studien og få opplysningene anonymisert. Vi foreslår at dette tilføyes avslutningsvis hvor det blant annet står «Dersom du har spørsmål eller andre henvendelser omkring prosjektet, vennligst ta kontakt med:...»

NSD finner at informasjonsskrivet stilet til ungdommene er noe mangelfullt, og ikke gir de registrerte god nok informasjon om hva behandlingen innebærer og om hvilke rettigheter de har. Vi forutsetter derfor at følgende endres/tilføyes før det gis til utvalget;

- Formuleringen «Det er **viktig** at du leser forklaringen for hvordan du fyller ut skjemaet nøye. Ved å fylle ut denne undersøkelsen kan få mulighet til å være med i trekningen av 10 gavekort. Hvert gavekort er på 1000 kroner», bør ikke stå innledningsvis i informasjonsskrivet. Fokuset på en potensiell belønning skal ikke gå på bekostning av annen viktig informasjon om hva deltakelsen innebærer. Vi foreslår at formuleringen står avslutningsvis under overskriften «Hva innebærer det for deg å delta?»
- Det må påføres hvordan den enkelte går frem dersom man vil benyttes seg av rettighetene sine, som f.eks. å trekke seg fra undersøkelsen. Dette må fremgå tydeligere under overskriften «Hvor kan jeg finne ut mer?»

Reviderte informasjonsskriv må sendes til personverntjenester@nsd.no, husk å oppgi prosjektnummer.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har Universitetet i Agder plikt til å svare innen en måned. Vi forutsetter at prosjektansvarlig informerer institusjonen så fort som

mulig og at Universitetet i Agder har rutiner for hvordan henvendelser fra registrerte skal følges opp.

5. Informasjonssikkerhet

I følge meldingen skal personopplysningene behandles ved hjelp av datamaskin i nettverkssystem tilknyttet internett tilhørende virksomheten, privat datamaskin, og på server i Universitetet i Agders nettverk. Vi minner om at Universitetet i Agder er pålagt å ha kontroll på behandlingen av personopplysninger og vi anbefaler derfor ikke at personopplysninger behandles på privat utstyr uten at dette kravet kan innfris. Dette er en vurdering Universitetet i Agder må foreta. Da også studenter fra to andre forskningsinstitusjoner skal benytte opplysninger fra prosjektet, anbefaler vi at det sikres at disse dataene ikke inneholder indirekte identifiserende opplysninger.

Alle lagringsenheter beskyttes med brukernavn og passord.

Koblingsnøkkel oppbevares på passordbeskyttet pc. Kun prosjektansvarlig skal ha tilgang til denne i følge informasjonen til de som forespørres om deltakelse.

NSD forutsetter at personopplysningene behandles i tråd med personvernforordningens krav og institusjonens retningslinjer for informasjonssikkerhet.

6. Varighet

Ifølge meldeskjema skal personopplysninger behandles frem til 31.12.2019. Opplysninger som kan knyttes til en enkeltperson skal da slettes/anonymiseres.

Universitetet i Agder må kunne dokumentere at datamaterialet er anonymisert.

Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan bli identifisert. Det gjøres ved å:

- Slette navn, fødselsnummer/andre ID-nummer, adresse, telefonnummer, epostadresse, IP-adresse og andre nettidentifikatorer
- Slette eller grovkategorisere alder, bosted, navn på skole, institusjon, og andre bakgrunnsopplysninger

For en utdypende beskrivelse av anonymisering av personopplysninger, se Datatilsynets veileder: https://www.datatilsynet.no/globalassets/global/regelverk-skjema/veiledere/anonymisering-veileder-041115.pdf

Meld fra om endringer

Dersom behandlingen av personopplysninger endrer seg, kan det være nødvending å melde dette til NSD via Min side. På våre nettsider informerer vi om hvilke endringer som må meldes. Vent på svar før endringen gjennomføres.

Informasjon om behandlingen publiseres på Min side, Meldingsarkivet og nettsider

Alle relevante saksopplysninger og dokumenter er tilgjengelig:

- via Min side for forskere, veiledere og studenter
- via Meldingsarkivet for ansatte med internkontrolloppgaver ved Universitetet i Agder.

NSD tar kontakt om status for behandling av personopplysninger
Etter avtale med Universitetet i Agder vil NSD følge opp behandlingen av personopplysninger ved planlagt avslutning.

Vi sender da en skriftlig henvendelse til prosjektansvarlig og ber om skriftlig svar på status for behandling av personopplysninger.

Se våre nettsider eller ta kontakt ved spørsmål. Vi ønsker lykke til med behandlingen av personopplysninger.

Med vennlig hilsen

Marianne Høgetveit Myhren
seksjonsleder

Marie S. Schildmann
seniorrådgiver

.....

Lovhenvisninger

NSDs vurdering er at den planlagte behandlingen av personopplysninger:

- er regulert av personopplysningsloven, jf. § 2.
- oppfyller prinsippene i personvernforordningen om:
  - lovlighet, rettferdighet og åpenhet jf. art. 5.1 a)
  - formålsbegrensning jf. art. 5.1 b)
  - dataminimering jf. art. 5.1 c)
  - lagringsbegrensning jf. art. 5.1 e).
- kan finne sted med hjemmel i personvernforordningen art. 6.1 a), art. 9.2 a)
- gjennomføres på en måte som ivaretar de registrertes rettigheter jf. personvernforordningen **art. 11-22**

NSD legger til grunn at institusjonen også sørger for at behandlingen gjennomføres i samsvar med personvernforordningen:

- art. 5.1 d) og art. 5.1. f) og art. 32 om sikkerhet
- art. 26-29 ved felles behandlingsansvar med andre institusjoner eller bruk av databehandler
- kapittel 5 ved overføring av personopplysninger til tredjeland/internasjonale organisasjoner

Ansatteprosjekter - Kommentar

Navn: Elling Tufte Bere

Kommentar: Kommentert versjon av FEK søknad FVMM_ATN survey 2018.pdf

Kommentar: Hei!
Under forutsetning av at prosjektet gjennomføres som beskrevet i søknaden har FEK ingen etiske betenkeligheter med prosjektet .
Lykke til!

Mvh FEK

Karakter:

Evaluering: Godkjent

Avbryt

Appendix 4: Ethical approval of the present master´s theses by the Faculty's Ethics Committee of the University of Agder (FEC)

UiA - Søknad om etisk godkjenning av forskningsprosjekt er kommentert

R

Request@UiA <request@uia.no>
heleno17@student.uia.no
torsdag 25. oktober 2018 22:33
Vis detaljer

25/10/2018 22:32:23 CEST - Anne Valen-Sendstad Skisland Additional comments
Vi informerer om at din søknad er ferdig behandlet og godkjent.

Kommentar fra godkjenner:
Din søknad om etisk godkjenning av prosjektet "Hva var effekten av å avslutte gratis skolefruktordningen på inntak av frukt, grønnsaker og usunn snacks, og sosio-demografiske forskjeller i kosthold? 2018 vs 2008 data. er godkjent under forutsetning av at det gjennomføres som beskrevet i søknaden. Lykke til

På vegne av FEK
Anne V-S Skisland

Vennligst benytt Tjenesteportalen for oppdateringer på din henvendelse/bestilling.

Med vennlig hilsen
Universitetet i Agder

Ref:MSG1432023

Effect of ending the nationwide free school fruit scheme in Norway on the intake of fruits, vegetables and unhealthy snacks: a natural experiment

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Rationale

Abstract

Background:

The study evaluates the effect of ending the nationwide free school fruit program on the intake of fruits, vegetables and unhealthy snack among Norwegian 6th an 7th graders. The effect is assessed in relation to socioeconomic status and sex.

Methods:

The present study is a follow-up study with a natural experimental design, using data from the Fruits and Vegetables Make the Marks (FVMM) study from 2001, 2008 and 2018. Eigtheen schools participated at all test points (2008 (n=911) and 2018 (n=561)). Four schools received free fruit in 2008 (freefruit08 schools), and fourteen schools did not (control schools). Sixth and seventh grade pupils and their parents completed a modified 24 h-recall and a food frequency questionnaire, recording their intake of fruits, vegetables and unhealthy snacks. The main analyses were multilevel mixed models with fruits, vegetables, FV at school and all day and unhealthy snacks as separate outcome variables

Results:

The main analysis showed a decreased intake of fruits at school by 0.27 and 0.01 portions/day, respectively, for the freefruit08 and the control schools. The difference between the decrease of the freefruit08 schools and the controls were statistically significant (time x group p=0.047). There was no difference for intake of vegetables and fruits and vegetables combined. No significant interaction was observed for all day intake of fruits, vegetables or FV. The percentage of pupils eating FV 4 or 5 days/ school week decreased more among the freefruit08 schools than the control schools (time x group p<0.001). The intake of unhealthy snacks increased by 0.87 times/week for the freefruit08 and decreased by 0.50 times/week for

the control schools (time x group p=0.012). No significant third-order interactions (time x group x sex or time x group x parental education level) were observed for any outcome variables, indicating that the effect of ending the free fruit program was not significantly different for boys and girls or low and high parental education.

Conclusions:

Ending the free school fruit program implemented by the Norwegian government from 2007 to 2014, providing a piece of fruit or vegetables every school day, decreased children´s intake of fruits and increased consumption of unhealthy snacks. The effect of ending the program does not seem to be significantly different for boys and girls, and high and low socioeconomic status. No effect was found on the intake of vegetables.

Keywords:

school children; withdrawal; fruits and vegetable intake; School fruit program; Norway

71 # Introduction

72 According to *the Global Burden of Diseases* an unhealthy diet is the second largest risk
73 factor, after high systolic blood pressure, for death for both sexes in Norway [1]. Low intake
74 of fruits and vegetables and a high intake of salt are the most significant dietary risk factors
75 [1]. *The Norwegian directorate of health* recommends a daily intake of at least 250 grams of
76 fruits and 250 grams of vegetables for adults and children over the age of 10. For children,
77 there is no specific quantity recommendation, but a rule of thumb has been five servings the
78 size of the child's handful [2]. Norwegian children consume about half of the recommended
79 intake of fruits and vegetables (FV), and too much added sugar (whereas sweets, chocolate,
80 and soft drinks are the biggest contributors amongst children) [3].

81 Several studies have shown that children's FV intake tracks into adolescence and the
82 preference and eating habits established in childhood tend to be maintained into adulthood [4,
83 5]. This makes increasing FV intake among children an important issue in the public health
84 policy. In Norway, there has been a political agreement that early intervention is crucial for
85 dealing with the health-related social inequalities and the social gradient [6-9].
86 Socioeconomic differences might appear in the consumption of FV, where people with the
87 highest education eat most FV [10]. Health promotion initiatives are often more effective
88 among families with a high socioeconomic background which leads to larger health
89 disparities instead of helping to reduce the socioeconomic gap [11].

90 The national Norwegian authorities have made a considerable effort to increase the FV intake
91 among school children as a strategy to reduce social inequalities in health [7]. An official free
92 school fruit program, financed by the state, was implemented in all lower secondary schools
93 (grades 8-10) and combined schools (grades 1-10) in Norway, autumn 2007 [12]. The effect
94 of the nationwide free school fruit scheme in Norway was evaluated in the Fruits and

Vegetables Make the Mark (FVMM) project in 2008 [13, 14]. The results show an increase in pupils' intake of FV at school from 2001 to 2008. The increased intake was largest within schools included in the national free school fruit program, and smallest within schools that did not participate in any program. The effect was significant for intake of fruits at school, but no group effect was found for vegetable intake. The free fruit program did also show an effect on the consumption of unhealthy snacks, whereas pupils attending schools that received free fruit had a significantly lower intake of unhealthy snacks compared to the groups that had a prescription program or no program at all [13].

Despite the effects shown when evaluating the project, the free school fruit program was ended in 2014 [15]. There is limited knowledge of the effect of ending such a free fruit program. Studies of intervention withdrawal might widen the range of opportunities to evaluate interventions and add to the evidence base [16]. The withdrawal of the governmental intervention gave us an excellent opportunity to evaluate what effect it had to end the intervention, using a natural experimental design. This can provide useful knowledge to the public health policy and research.

The aim of the present study was to evaluate the effect of ending the nationwide free school fruit program on children's (age 10-12 years) intake of FV and unhealthy snack. The effect will be assessed in relation to socioeconomic status (SES) and sex.

Methods

Study design and sample

The study was conducted among primary school children from two Norwegian counties. Initially, Hedmark and Telemark counties were chosen because the subscription program was about to start in these two counties in the school year 2001–2002. Both Hedmark and

Telemark are situated in the south-east of Norway and are considered similar regarding socioeconomic composition and geography. The first study was conducted in 2001. 48 schools were randomly selected and invited to participate, of which nineteen schools from Telemark and nineteen schools from Hedmark agreed to participate. A follow-up study was conducted in 2008 and 2018, of which eighteen schools participated in all three studies and constitute the sample of the present study, 2008 (n=911) and 2018 (n=561), of which ten schools from Hedmark (n=923) and eight schools from Telemark (n=549) (figure 1). Four of the schools were combined schools (1-10 grade) (n=279) and therefore received the nationwide free FV program in 2008. Sixth and seventh graders (age 10-12 years) were included in the study. The Free Fruit program was primary intended for all Norwegian lower secondary schools (grades 8-10), but since some schools were combined schools (grades 1–10), these were also included in the program. 6^{th} and 7^{th} grades from the combined schools that received free fruit represent our intervention group. The primary schools (grades 1-7) (control group) did not receive free fruit, decided by the government. The free school fruit program constitutes a natural experiment, since treatment assessment are a result of national school fruit policies, rather than being controlled in the traditional sense of a randomized trial.

A total of 1472 pupils from the eighteen schools completed the questionnaire in 2008 and 2018 and they also brought home a questionnaire to be completed by one of their parents. The questionnaire was read out aloud by a trained project worker, and the questionnaire was completed by the children in their classroom. About 45 min was used to complete the questionnaire. All the pupils were tested on weekdays (Tuesday to Friday). In 2008 the participation rate was way higher than in 2018 (78% and 44%, respectively for the 27 schools participating in 2008 and 25 schools from 2018) (table 1).

147 Parents answered a similar questionnaire to the child questionnaire. In the 18 schools, 668
148 parents answered in 2008 and 431 in 2018. Both in 2008 and 2018 79% percent of the
149 respondents were female. In the present study only the parental education level was used.
150
151 In 2001, none of the schools had any organized school fruit programs. In September 2008 five
152 schools participated in the free school fruit program (free fruit 08), ten schools participated in
153 the subscription of FV program (Subscription 08) and twelve schools did not participate in
154 any school fruit program (No program 08). In 2018 three schools had a version of a free
155 school fruit or free lunch (including FV), eleven schools had a subscription program, and four
156 schools had no program.
157
158 **Instrument**
159 The questionnaires used in the FVMM study were designed and validated for pupils aged 10-
160 12 years) [17]. Both questionnaires included a modified 24-h recall, a food frequency
161 questionnaire (FFQ), questions assessing attitudes towards FV, demographic questions and
162 questions concerning other health-related behaviors.

163 The modified 24-h recall was divided into five periods/meals throughout the day (before
164 school/breakfast, at school/lunch, after school, dinner, and in the evening/ supper) to make it
165 easier for the children to remember. The kids were told to record all fruits, berries, and
166 vegetables measured in number (eg. one apple, one banana) or in portion (eg. a portion of
167 fruit salad) for the previous day. One portion was set at about 80 g (ranging from 65 g (one
168 carrot etc.) to 105 g (one apple/one orange)). The portion of fruits from each period of the day
169 was added together, making a fruit score (portions/day. The same was done for vegetables,
170 making a vegetable score, and fruit and vegetables were summed together in a combined FV
171 score. 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*.

In addition to the fruit-, vegetable-, and FV-score, the question: "How often do you eat fruits and/or vegetables at school?" from the FFQ was included in the analyses. The response alternatives were «every school day, 4, 3, 2 and 1 d/week, less than once a week, never, and don't know». The FFQ was dichotomized into eating FV at school 4-5 d/week or less than 4 d/week, indicating eating FV at most school days. The 24-h recall and the FFQ has been validated, and a test-retest study shows consistent reliability among 6th graders [17]. A validation study of self-reported FV intake showed that 6th graders were capable of recording yesterday's intake of vegetables but overestimated the intake of fruit. The ability to rank subjects based on the FFQ was rather low, but equal to similar studies [17].

A sum score of unhealthy snacks was made from the following 3 items: "How often do you drink sugar-sweetened soft drink?", "How often do you eat potato chips?" and "How often do you eat candy (chocolate, mixed candy etc)?". All items had 10 response alternatives, and were scored as follows: (never (0), less than once a week (0.5), once a week (1), twice a week (2), . . . , 6 times a week (6), every day (7), several times every day (10), giving the unhealthy snacks scale a range from 0 to 30 times/week. The unhealthy snack score showed good reliability in a test-retest by sixth graders with 14 days apart [17].

The parent´s education level was reported by the parents and used as a measure for SES. It was reported with the following response options: elementary school, high school, college or university (three years or less) and college or university (more than three years). This was later dichotomized into lower (no college or university education) and higher (college or university education) level of education.

195 **Statistical analysis**

196 For descriptive analyses, independent sample t-tests were conducted for continuous variables
197 and chi-square for dichotomous variables for pairwise comparisons. The main analyses were
198 multilevel mixed models with fruits, vegetables, FV at school and all day and unhealthy
199 snacks as separate outcome variables. Year (2008 and 2018), group, sex, and parental
200 education level was used as fixed effects, and school was used as a random effect. A
201 significant time x group interaction ($p<0.1$), indicating different changes in consumption over
202 time for the different groups (Free fruit program 2008, not free fruit program 2008), was used
203 to test the effect of ending the school fruit program. To assess potential differences in the
204 effect of ending the school fruit program for different groups (based on sex and parental
205 education level), the third-order interaction time x group x sex and time x group x parental
206 education level were examined. An examination of the residuals of the continuous variables
207 did not reveal unacceptable departures from normality.
208
209 Pupils that did not attend school the day before the survey day (28 in 2001, 19 in 2008 and 13
210 in 2018) were excluded from the analyses of intake of FV at school but included in all other
211 analyses.
212
213 To conduct a school attrition analysis, pupils at the 18 schools in the present study sample
214 were pairwise compared at baseline with those at the 20 schools that did not participate in
215 2008 or 2018, regarding all variables. All analyses were conducted using the *Statistical*
216 *Package of Social Sciences (SPSS), version 24* (SPSS inc., Chicago, IL, USA). The
217 significance level was set at $p<0.05$.
218

Ethic

Informed consent was signed by the parents prior to each study and collected by a contact person at the schools. The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Norwegian Center of Research Data [18] at all time points and The National Committees for Research Ethics in Norway [19] in 2001, and by The Faculty's Ethics Committee of the University of Agder (FEC) in 2018.

Results

Unadjusted all day FV intake for the 6th and 7th grade pupils at the eighteen schools increased from 2.4 to 3.2 portions/d (p<0.001) from 2001 to 2008 and decreased from 3.2 to 2.6 portions/d (p<0.001) from 2008 to 2018 (table 1). FV intake at school increased from 0.4 to 0.8 portions per day from 2001 to 2008 but did not change significantly from 2008 to 2018. The percentage of pupils reporting to eat FV 4 or 5 times/week at school did, however, change from 28% in 2001 to 65 % in 2008 and 56% in 2018 (p=0.002). The intake of unhealthy snacks decreased from 6.9 to 4.6 times/week from 2001 to 2008 (p<0.001), a further decrease was observed from 2008 to 2018 (from 4.6 to 4.3 times/week, p=0.016).

In 2001 and 2018 there was no difference between the groups (free fruit 08 and no free fruit 08) in intake of FV, fruits or vegetables at school (Table 2). In 2008 the group receiving free fruits had a higher intake of fruits at school compared with those that did not (0.65 portions/d and 0.47 portions/d, respectively, p=0.003). No significant difference was found for FV and vegetables. The intake of all day FV and fruits was different between the groups in 2018 (p=0.028, p=0.024) but not significant for the intake of vegetables (p=0.300). The percentage

of pupils reporting to eat FV four or five days a week was 27 percentage points more for the freefruit08 schools than the control schools in 2008 (p<0.001). In 2018 there were no significant difference between the different schools (p=0.061). The percentage of pupils reporting to eat FV most school days were the same in 2008 and 2018 (58%) among the control schools, indicating that the change was made in the freefruit08 schools. The intake of unhealthy snacks was significantly lower among the schools receiving free fruit compared to those who did not in 2001 (6.26 times/week, 7.02 times/week, respectively, p=0.043) and 2008 (4.26 times/week, 4.81 times/week, p=0.042), but higher in 2018 (4.93 times/week, 4.20 times/week, p=0.042)

The main analysis of fruits and vegetable intake between 2008 and 2018 showed that the time x group interaction was significant for intake of fruits at school (p=0.047), but not for vegetables and FV combined. The decrease in fruit intake at school were -0.27 and 0.01 portions/day, respectively, for the free fruit 08 group and the control group (table 3).

No significant interaction was observed for intake of fruits, vegetables or FV all day. Time x group interaction was also significant for eating FV 4 or 5 days/ school week (<0.001), and consumption of unhealthy snacks (p=0.012). Whereas the freefruit08 schools had a 35 percentage points lower portion of pupils eating FV most school days in 2018 than in 2008, compared with the control group where the change was -2 percentage points. The biggest difference was found in the consumption of unhealthy snacks, where the free fruit 08 group increased their intake by 0.87 times/week, and the control group decreased their intake by -0.50 times/week.

No significant third-order interactions (time x group x sex or time x group x parental education level) were observed for any outcome variables, indicating that the effect of ending the free fruit program was not significantly different for boys and girls or low and high parental education.

Table 4 shows unadjusted percentage and confidence interval of pupils reporting to eat FV 4 or 5 days per school day stratified on groups. The table reveals no differences in change from 2008 to 2018 between boys and girls, and low and high parental education for either the freefruit08 schools or the control schools.

In the attrition analysis, comparing the 18 schools included in the present study sample with the 20 schools that did not participate in 2008 or 2018 the results revealed no significant differences at baseline. The only difference showed that among the schools not participating at all test points, 34% reported eating FV at school 4 or 5 days a week whereas 28% reported the same among the present study sample (p=0.007).

Discussion

This study examined the effect of ending the free school fruit program on the intake of fruits, vegetables, FV, and unhealthy snacks among 6th and 7th graders in two Norwegian counties. The results indicated a negative effect of ending the free fruit program on the intake of fruits at school (-0.27 and 0.01 portions/d change for the freefruit08 schools and control schools, respectively) (Table 3). The portion of pupils reporting to consume FV at most school days did also decrease more for the freefruit08 schools and they had an increased consumption of unhealthy snacks by almost one portion/d, while the control schools decreased their intake by half a portion. The time x group interaction was not significant for vegetable consumption or FV intake combined, however, the tendency of a greater negative effect for the freefruit08 schools was present for all variables. Pupils at the schools that received free fruit in 2008 had a lower intake of fruits and FV combined and a higher intake of unhealthy snacks compared to pupils at control schools in 2018 (Table 2). In 2008 the situation was the opposite: the freefruit08 schools had a higher intake of FV and lower intake of unhealthy snacks.

To our knowledge, no previous studies have evaluated the effect of ending a free fruit program by using data from schools that previously received free fruit. However, several studies have done follow-ups among the students who received the interventions some years after it ended [20, 21]. In the National Schools Fruit Scheme (NSFS) from England, the school-based fruit distribution appeared to have a short-term effect in increasing FV intake of the pupils, but results were not obtained after the provision of free fruits ended [20]. However, findings from an evaluation of the FVMM project three years after showed that there might also be a long-term effect of providing free fruit in school [22].

The reason for the negative intervention effect might be caused by the reduction of availability and accessibility of FV at the schools. Availability and accessibility have been identified as some of the strongest determinants of children´s and adolescents´ FV intake by an extensive review of children´s fruit and vegetable intake [23], also findings from Norwegian studies support this [24-26]

One possible reason why the intervention group had a larger decrease in FV intake, could be that the schools who did not receive free fruit had to make a greater effort themselves to increase the FV consumption among their pupils, while the schools receiving FV for free did not have to have the same focus. One can assume that the intervention schools went back to their old routines when the program ended, while the control schools might have found some good alternatives to increase the FV intake and continued with this.

In the present study, no third-order interaction was found, indicating that the effect of ending the program did not differ according to parental education, and thereby seems to affect all

pupils. In 2018 41% (95% CI: 24,59) children of parents with high education reported eating FV 4 or 5 times a week at school, and 57 % (95% CI: 27,87) of the children with low parental education. No third-order interaction was found for sex, and the effect appears to be similar for boys and girls.

A negative effect was also found on the intake of unhealthy snacks, where the intake increased with almost one time a week (0.87 times/week) among the schools that ended the free fruit program and decreased by 0.5 times/week at the control schools. In 2008 the freefruit08 schools ate significantly less unhealthy snacks compared to the control group (4.26 vs 4.81, respectively), while in 2018 the results had shifted and the pupils at freefruit08 schools ate significantly more unhealthy snacks than the control schools (4.93 and 4.20, respectively) (Table 2). The increase in eating unhealthy snacks in the intervention group might be caused by the decrease in fruit consumption among the schools that ended the free fruit program. Several studies show an association between a higher FV intake and a lower intake of unhealthy snacks [13, 27, 28]. The results after ending the free fruit program show that the relationship might also be reversed, by providing less FV the schools increased the pupils unhealthy snacking. One assumption might be that when FV are not available, the need for energy might be harder to satisfy and the cravings for unhealthy snacks may increase. For some, unhealthy snacks may work as a replacement for the lower intake of FV, just as it might be the other way around. When given the choice between a healthy snack (sliced or whole fruits) and an unhealthy snack (sweet or salty), the children more often choose the unhealthy snacks [29].

The strengths of the current study are that it includes repeated data from a large number of randomly selected schools and an evaluation of the governmental initiative to end the free fruit

345 program in a natural setting. The natural experimental design might be seen as both a strength
346 and a limitation in the present study. A strength because it gives us the opportunity to evaluate
347 the intervention in a real-life setting and a limitation because it often contributes to a bigger
348 risk for bias and confounding [30]. A limitation of this study is the non-randomization of the
349 groups. However, no initial difference in parental education or sex were found between the
350 groups (data not presented), indicating homogeneity in the sample. Data presented in table 2
351 show no significant difference in FV intake between the groups at baseline. However, the
352 freefruit08 schools reported eating unhealthy snacks 0.76 times/week less than the control
353 schools in 2001 (p=0.043).
354
355
356 The unhealthy snacks score is limited because it only includes three kinds of unhealthy snacks
357 (candy, sugar-sweetened soft drink, and potato chips), and we had no data on other snacks
358 eaten. However, the aim was not to present accurate data on unhealthy snacks, but rather to
359 investigate differences between the groups and time.
360
361 A second limitation of the study is that three schools (one in the freefruit08 group and two in
362 the control) still had some kind of free fruits or free lunch paid by the municipalities. Therefore,
363 some of the effects might be underestimated in the results, indicating that the effect could be
364 even bigger than what we can find in this study. Also, most of the schools in the control group
365 had a subscription program in 2018, while none of the intervention schools had the same.
366
367 There have been different project workers coding the 24-h recall at each test point, which
368 makes it possible that the FV intake is interpreted differently each year. This makes it harder
369 to compare the FV intake from 2018 to the intake in 2008 and 2001. Still, the main aim of the

study was to evaluate the effect of ending the free fruit program by comparing the schools receiving free fruits with the control schools, thus, the possibly different interpretation of FV intake is of less importance.

Conclusion

Ending the free school fruit program implemented by the Norwegian government from 2007 to 2014, providing a piece of fruit or vegetables every school day, decreased children´s intake of fruits and increased consumption of unhealthy snacks. Ending the program seems to have similar effect for all groups at school, regardless of sex and socioeconomic status. No effect was found on the intake of vegetables. Such evaluations of natural experiments are rare, but important in order to understand the effects of various health efforts implemented.

Figure 1. Study design, showing how many schools and pupils (n) participating at each test point and in the present sample.

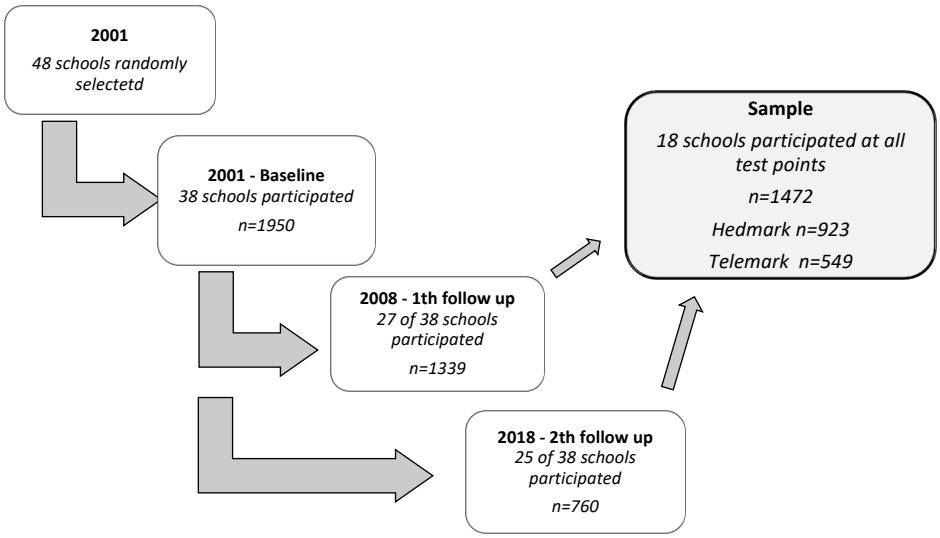

Table 1

Description of the participants and the main variables in the 2001-, 2008-, and 2018-surveys: The Fruits and Vegetables Make the Marks Project

	2001	**2008**	**2018**	**P value[1] 01-08**	**P value[1] 08-18**
All					
Number of schools	38	27	25		
Eligible pupils	2287	1712	1734		
Participating pupils	1950	1339	760		
Participation rate (%)	85	78	44		
Sample					
Number of schools	18	18	18		
Pupil data					
Participating pupils	963	911	561		
Sex, female (%)	49	52	53	0.258	0.064
Age, seventh graders (%)	48	49	53	0.777	0.094
FV intake all day (portions/d)[2]	2.4 ± 2.33	3.2 ± 2.8	2.6 ± 2.1	<0.001*	<0.001*
FV intake at school (portions/d)[2]	0.4 ± 0.6	0.8 ± 0.9	0.7 ± 0.7	<0.001*	0.245
Eating FV 4-5 d/week at school (%)	28	65	56	<0.001*	0.002*
Unhealthy snacks (times/week)[2]	6.9 ± 4.3	4.6 ± 3.3	4.3 ± 2.8	<0.001*	0.016*
Parent data					
Participating parents	809	668	431		
Participation rate (%)	84	73	77		
Sex, female (%)	85	79	79	0.006*	0.988
Age (mean, years)[2]	40.1 ± 5.8	40.9 ± 5.1	42.7 ± 5.5	0.004*	<0.001*
Higher education (%)	43	55	69	<0.001*	<0.001*

[1] Based on *t* test for continuous variables and the chi-square test for the dichotomous variables

[2] Mean ± SD

Table 2 Unadjusted differences between the groups (free fruit 08 and no free fruit 08) at each test point and changes from 2001 to 2008 and 2008 to 2018. (Mean values and 95% confidence interval)

	2001		2008		2018		Change 01-08	Change 08-18
	Mean	95% CI	Mean	95% CI	Mean	95% CI		
At school								
FV (portions/d)								
Free fruit 08	0.34	0.25,0.43	0.73	0.68,0.79	0.57	0.43,0.71	0.39	-0.16
No Free fruit 08	0.36	0.32,0.41	0.71	0.64,0.77	0.70	0.63,0.77	0.35	-0.01
p-value[1]		0.659		0.081		0.126		
Fruit (portion/d)								
Free fruit 08	0.23	0.16,0.30	0.65	0.56,0.73	0.39	0.27,0.50	0.42	-0.31
No Free fruit 08	0.23	0.19,0.26	0.47	0.42,0.53	0.51	0.46,0.57	0.24	0.04
p-value[1]		0.883		**0.003**		0.087		
Vegetables (portions/d)								
Free fruit 08	0.11	0.05,0.16	0.19	0.13,0.24	0.18	0.09,0.27	0.08	-0.01
No Free fruit 08	0.13	0.11,0.17	0.23	0.20,0.27	0.19	0.15,0.22	0.10	-0.04
p-value[1]		0.397		0.223		0.860		
All day								
FV (portions/d)								
Free fruit 08	2.30	1.94,2.65	3.25	2.88,3.62	2.15	1.70,2.59	0.95	-1.1
No Free fruit 08	2.44	2.29,2.61	3.17	2.96,3.38	2.70	2.51,2.89	0.73	-0.47
p-value[1]		0.446		0.126		**0.028**		
Fruit (portion/d)								
Free fruit 08	1.34	1.12,1.57	2.06	1.80,2.31	1.20	0.88,1.53	0.72	-0.86
No Free fruit 08	1.57	1.44,1.69	2.00	1.85,2.14	1.61	1.48,1.74	0.43	-0.39
p-value[1]		0.130		0.155		**0.024**		
Vegetables (portions/d)								
Free fruit 08	0.95	0.74,1.16	1.20	1.00,1.40	0.94	0.68,1.20	0.25	-0.26
No Free fruit 08	0.88	0.80,0.97	1.18	1.06,1.29	1.09	0.98,1.19	0.3	-0.09
p-value[1]		0.518		0.873		0.300		
FFQ 4 or 5								
Free fruit 08 (% yes)	28	20,36	85	80,90	46	34,58	57	-40
No Free fruit 08 (% yes)	28	25,31	58	54,62	58	53,62	30	0
p-value[1]		0.975		**<0.001**		0.061		
Unhealthy snacks								
Free fruit 08 (times/week)	6.26	5.65,6.87	4.26	3.84,4.68	4.93	4.12,5.73	-2.00	0.67
No Free fruit 08 (times/week)	7.02	6.71,7.32	4.81	4.55,5.07	4.20	3.96,4.43	-2.21	-0.61
p-value[1]		**0.043**		**0.042**		**0.030**		

[1] Based on a one-way ANOVA

Numbers presented in bold text are significant $p<0.05$

Table 3: Adjusted changes in fruits and vegetables (FV) intake at school and all day(portions/d), percentage of pupils eating FV 4 or 5 days/week and unhealthy snacks (times/week) from 2008 to 2018 in relation to the school fruit program. (Mean values and 95% confidence intervals)

	2008		2018		Change 08-18	P for time x group interaction[1]
	Mean	95% CI	Mean	95% CI		
At school						
FV (portions/d)						0.173
Free fruit 08	0.82	0.57, 1.06	0.53	0.22, 0.85	-0.29	
No Free fruit 08	0.77	0.64, 0.89	0.72	0.58, 0.85	-0.05	
Fruit (portion/d)						**0.047**
Free fruit 08	0.66	0.49, 0.84	0.40	0.15, 0.64	-0.27	
No Free fruit 08	0.51	0.42, 0.60	0.52	0.42, 0.62	0.01	
Vegetables (portions/d)						0.619
Free fruit 08	0.16	0.03, 0.28	0.14	-0.03, 0.31	-0.02	
No Free fruit 08	0.26	0.19, 0.32	0.20	0.12, 0.27	-0.06	
All day						
FV (portions/d)						0.270
Free fruit 08	3.26	2.54, 3.98	2.19	1.25, 3.12	-1,07	
No Free fruit 08	3.18	2.79, 3.56	2.63	2.21, 3.04	-0.55	
Fruit (portion/d)						0.128
Free fruit 08	2.09	1.71, 2.47	1.21	0.64, 1.77	-0.88	
No Free fruit 08	1.97	1.77, 2.17	1.60	1.37, 1.82	-0.37	
Vegetables (portions/d)						0.902
Free fruit 08	1.18	0.80, 1.59	0.99	0.46, 1.52	-0.19	
No Free fruit 08	1.19	0.97, 1.41	1.03	0.80, 1.27	-0.16	
FFQ 4-5 times/week						**<0.001**
Free fruit 08 (% yes)	85	70, 100	50	32, 69	-35	
No Free fruit 08 (% yes)	61	53, 69	59	50, 68	-2	
Unhealthy snacks						
Free fruit 08 (times/week)	3.67	3. 16	4.54	3.69, 5.38	0.87	**0.012**
No Free fruit 08 (times/week)	4.67	4.35, 4.88	4.17	3.85, 4.49	-0.50	

[1]Based on multilevel mixed models adjusted for parental education, sex and school
Numbers presented in bold text are significant $p<0.05$

Table 4: Proportion of pupils reporting to be eating fruits and vegetables at school 4 or 5 times/week stratified on groups (School fruit program in 2008) and sex/parental education level (percentage and 95% confidence intervals)

		2001		2008		2018		Change 2001-08 p.p.	Change 2008-18 p.p.
	N	Percentage	95% CI	Percentage	95% CI	Percentage	95% CI		
Free Fruit 08									
Boys	191	15	6, 23	79	70,88	38	22, 54	64	-41
Girls	66	44	31, 56	91	85,97	55	37, 72	47	-36
Low parental education	44	31	20, 43	80	69,91	57	27, 87	48	-23
High parental education	140	30	12, 42	91	85,98	41	24, 59	62	-50
Not free fruit 08									
Boys	574	23	18, 28	52	46,58	53	45, 60	29	1
Girls	414	33	28, 38	65	59,70	62	56, 68	32	-3
Low parental education	307	29	24, 34	55	49,62	57	48, 67	27	2
High parental education	475	30	24, 36	66	59,72	62	56, 68	36	4

Declarations

Ethical approval

Ethical approval and research clearance for the FVMM-study was obtained from The Norwegian Social Science Data Services and Regional Committees for Medical and Health Research Ethics.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

KIK and EB developed the project in 2001. THS contributed in creating several of the follow-up surveys. HKO and five other project-workers conducted the data for the 2018 follow-up survey. HKO analyzed the data and drafted the manuscript under the supervision of EB and DE. All authors critically revised the article and approved the final manuscript.

Consent for publication

Not applicable

Availability of data and materials

Please contact author for data requests

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