*Public Health Nutrition: 15(3), 379–385* doi:10.1017/S1368980011001959

# Changes in beverage consumption in Norwegian children from 2001 to 2008

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Submitted 6 June 2010: Accepted 22 June 2011: First published online 11 August 2011

## Abstract

*Objective:* To analyse (i) differences in beverage pattern among Norwegian children in 2001 and 2008; (ii) beverage intake related to gender, parental education and family composition; and (iii) potential disparities in time trends among the different groups.
*Design:* Within the Fruits and Vegetables Make the Marks (FVMM) project, 6th and 7th grade pupils filled in a questionnaire about frequency of beverage intake (times/week) in 2001 and 2008.
*Setting:* Twenty-seven elementary schools in two Norwegian counties.
*Subjects:* In 2001 a total of 1488 and in 2008 1339 pupils participated.
*Results:* Between 2001 and 2008, a decreased consumption frequency of juice (from 3·6 to 3·4 times/week, $P = 0{\cdot}012$), lemonade (from 4·8 to 2·5 times/week, $P < 0{\cdot}001$) and regular soft drinks (from 2·7 to 1·6 times/week, $P < 0{\cdot}001$), but an increased consumption frequency of diet soft drinks (from 1·2 to 1·6 times/week, $P < 0{\cdot}001$), were observed. From 2001 to 2008, boys increased their frequency of juice consumption (from 3·1 to 3·3 times/week) whereas girls decreased their frequency of juice consumption (3·8 to 3·4 times/week; interaction time × gender $P = 0{\cdot}02$). Children with higher educated parents increased their frequency of juice consumption (3·6 to 3·8 times/week) whereas those with lower educated parents decreased their frequency of juice consumption (3·3 to 3·0 times/week; interaction time × parental education $P = 0{\cdot}04$).
*Conclusion:* A lower frequency of consumption of sugar-sweetened beverages was observed among pupils in 2008 than in 2001. This is in accordance with the Norwegian health authority's goals and strategies for this time period, and is an important step to improve the dietary health of adolescents.

**Keywords**
Children
Time trends
Beverage consumption

Norwegian national studies carried out in the period 1997–2001 among children and adolescents showed a high intake of added sugar, with sugar-sweetened beverages (SSB) as a major source[1,2]. Boys aged 13 years reported an average daily intake of approximately 500 ml sugar-sweetened soft drinks[3]. Another study in 2005 showed that a total of 63 % and 27 % of Norwegian 9th and 10th graders, respectively, reported to drink regular and diet soft drinks twice weekly or more, and 24 % and 8 % reported drinking regular soft drinks and diet soft drinks once weekly or more at school[4]. The national dietary survey of Norwegian children and adolescents revealed a negative association between the intake of added sugar and intakes of micronutrients, fruit and vegetables[3]. Marshall *et al.*[5] have also reported that both 100 % juice as well as SSB intakes were negatively associated with adequate intakes of multiple nutrients and overall diet quality. Juice (100 %) has been included in the Norwegian fruit and vegetable recommendation since 1996[6]; however, a recently published proposal for Norwegian food-based guidelines specifies that only one glass of juice per day is recommended[7].

From the early 2000s to today, there has been an increased focus on the positive association between greater intake of SSB and weight gain and obesity among children and adolescents[8]. Previous studies have described that both SSB and fruit juice are associated with an increased risk of tooth decay[9,10]. Moreover, in the last 10 years, several studies have shown a positive association between consumption of SSB and weight gain and higher BMI, both in children and teenagers[8,11]. Other studies have revealed a positive association, independent of body weight, between consumption of SSB and high blood pressure in adolescents, and the risks for developing type 2 diabetes and CHD later in life[12–14]. A recent study by Odegaard *et al.*[15] reported an increased risk for

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development of type 2 diabetes with a consumption of ≥2 drinks/week, both of SSB and fruit juice.

Several previously published studies have shown that boys tend to drink more soft drinks than girls[16–18], whereas there has been a limited focus on other sociodemographic factors, such as the association between parental education and/or family structure. The Young Hunt study in Norway reported recently that higher level of parental education, in particular the mother's education, was inversely associated with daily soft drinks consumption among both girls and boys[16]. Another study showed a positive association between parental education and adolescents' diet, including fruit juice consumption[19].

Recently a number of national health initiatives have begun in Norway in order to reduce the consumption of sugar-sweetened foods and beverages. From 2007 to 2011 the national health authority had a specific goal to reduce the number of people drinking soft drinks and lemonade by 20 %[20]. The initiatives to reach this goal have mainly been focusing on structural/environmental changes. In order to accelerate changes in diet and to reduce social inequalities, the Norwegian Consumer Council together with the food industry have published guidelines specifying that the marketing of unhealthy foods aimed at children should be prohibited[21]. Norwegian health authorities have also supported the WHO initiative to reduce marketing of unhealthy foods and beverages aimed at children and young people[22]. In addition, the state has levied a special tax on non-alcoholic beverages containing added sugar or sweeteners which helps to limit consumption of sugary beverages[23]. The tax increased from NOK 1·52 to NOK 1·68 between 2002 and 2008 and to NOK 2·76 in 2010[23,24]. Further, as a result of the increased focus on reducing intake of added sugar, Norwegian food and beverage manufacturers have been challenged to introduce a number of new products with a reduced content of added sugar over recent years. The Norwegian Directorate of Health has also published recommendations related to school meals, specifying that school owners should prevent access to soft drinks[20]. Thus, few Norwegian schools sell soft drinks. Based on the results of a study performed by Bere *et al.*[4], rules concerning soft drinks consumption at school, not only sales, were suggested to the lower odds for drinking soft drinks at school. In addition, during the last few years the publicity about the potential negative health effects of added sugar has been great, and a decrease in regular soft drinks consumption has been reported between 2001 and 2007 in the general Norwegian population[25].

However, no published studies have reported differences in intake of SSB among adolescents in Norway before and after these initiatives, nor the potential disparities in time trends in different sociodemographic groups. Thus, the objective of the present study was to analyse: (i) differences in intakes of fruit juice, lemonade, regular and diet soft drinks among Norwegian children in 2001 and 2008; (ii) beverage intake related to gender, parental education and family composition; and (iii) potential disparities in time trends among the different groups.

## Materials and methods

### *Sample and procedure*

The present study is a part of the Fruits and Vegetables Make the Marks (FVMM) project. In 2001 the FVMM collected dietary data among 6th and 7th grade classes in thirty-eight randomly selected elementary schools from two of Norway's nineteen counties. A new study was conducted in 2008 in which twenty-seven of the original schools participated. During both data collections, the same questionnaire was completed by the children in the presence of a trained project worker in the classroom. One school lesson (45 min) was used to complete the questionnaire. The present study included 1488 children in 6th and 7th grade from these twenty-seven Norwegian elementary schools in 2001 and 1339 children in 2008. In total 2827 children participated (out of 3439 eligible; participation rate 82·2 %). The main reason why children did not participate in the study was absence from school on the survey day. Participating children brought home a parent questionnaire to be completed by one of their parents; in the case of 1230 and 996 pupils, respectively, in 2001 and 2008, one of their parents completed this parent questionnaire on behalf of both parents. Informed consent was obtained from parents and children prior to participation in the study. Ethical approval and research clearance were obtained from The Norwegian Social Science Data Services.

The questionnaire included questions concerning habitual beverage consumption, including 'How often do you drink regular soft drinks, diet soft drinks, lemonade and fruit juice?' In Norway, the consumption pattern of syrup and water (called lemonade) is different from the soft drinks pattern in adolescents. Lemonade is usually consumed during the week, and soft drinks during weekends[26]. Thus, the consumption of lemonade and soft drinks are analysed separately in the study. All four items had ten response alternatives and were recoded into frequency of consumption per week (never = 0, less than once weekly = 0·5, once weekly = 1, twice weekly = 2, …, six times weekly = 6, every day = 7, several times daily = 10). Based on data from a previous test–retest study involving 114 children of 6th grade, individual scores were significantly ($P < 0{\cdot}001$) correlated (Pearson's correlation coefficient) for consumption frequency of juice ($r = 0{\cdot}78$), lemonade ($r = 0{\cdot}75$), regular soft drinks ($r = 0{\cdot}72$) and diet soft drinks ($r = 0{\cdot}44$)[27].

Stewart and Menning[28] have reported that family structure is likely to affect adolescents' eating habits. Adolescents living in non-traditional families were more likely than adolescents living with two biological/adoptive parents to display unhealthy eating habits. Thus, questions regarding gender and number of parents in the household were also registered by the children participating in the present study.

Number of parents in the household was assessed by 'Tick the alternative showing the persons living at home with you'. Response alternatives were mother, father, stepmother and stepfather. Participants could tick more than one alternative if they lived with two parents. If parents were separated, the participants were supposed to tick the alternative showing the parent with whom they lived with most of the time. All responses were added, and then dichotomized into living with one parent or living with two parents.

Parental educational level was assessed individually in the questionnaire filled in by one of the parents, with one question 'What level of education do you have?' The question had four response alternatives: (i) elementary school; (ii) high school; (iii) college or university (3 years or less); and (iv) college or university (more than 3 years). This variable was dichotomized (lower = no college or university education; higher = having attended college or university).

### *Statistical analyses*

To compare beverage intake levels between the 2001 and 2008 cohort we used an independent-samples *t* test (Table 1). We also used multilevel linear mixed models (Tables 2 and 3) in order to take into account the nested design of the study and adjust for gender, parental education level, the number of parents in the household and time of data collection (2001 or 2008). The models were also adjusted for school as a random effect. In addition, we compared the distribution of the genders, parental education and number of parents in the household between the two cohorts using the $\chi^2$ test (Table 1). To assess the overall association between gender, parental education, family composition and beverage consumption, we combined all available data (Table 2). Finally, to explore potential disparities in time trends for beverage consumption between subgroups, we included interaction terms into the multilevel mixed models (Table 3). All multilevel linear mixed models that were used to estimate the associations were adjusted for all variables presented for each model. In addition, assumptions for the multilevel linear mixed models were checked and met. A significant interaction term ($P < 0{\cdot}05$) indicates that the time trend differed between the subgroups. All statistical analyses were performed using the SPSS statistical software package version 16·0 (SPSS Inc., Chicago, IL, USA).

## Results

Table 1 gives a description of the participants and shows that there were no differences in gender or number of parents in the household in 2001 and 2008. About 20 % reported to live with only one parent most of the time.

**Table 1** Description of participants included in 2001 and 2008; 6th and 7th grade Norwegian pupils, the Fruits and Vegetables Make the Marks (FVMM) project

| | 2001 | 2008 | *P* value* |
|---|---|---|---|
| Gender (%) | | | |
| Male | 50 | 48 | |
| Female | 50 | 52 | 0·21 |
| Parents in household (%) | | | |
| 1 | 19 | 20 | |
| >1 | 81 | 80 | 0·72 |
| Parental education (%) | | | |
| Low | 58 | 46 | |
| High | 42 | 54 | <0·001 |
| Frequency of beverage consumption (times/week) | | | |
| Juice | | | |
| Mean | 3·6 | 3·4 | 0·012 |
| 95 % CI | 3·5, 3·8 | 3·2, 3·5 | |
| Median | 3·0 | 3·0 | |
| Q1, Q3 | 1·0, 3·0 | 1·0, 5·0 | |
| Lemonade | | | |
| Mean | 4·8 | 2·5 | <0·001 |
| 95 % CI | 4·6, 4·9 | 2·4, 2·7 | |
| Median | 5·0 | 2·0 | |
| Q1, Q3 | 3·0, 7·0 | 0·5, 4·0 | |
| Regular soft drinks | | | |
| Mean | 2·7 | 1·6 | <0·001 |
| 95 % CI | 2·6, 2·8 | 1·6, 1·7 | |
| Median | 2·0 | 1·0 | |
| Q1, Q3 | 1·0, 4·0 | 0·5, 2·0 | |
| Diet soft drinks | | | |
| Mean | 1·2 | 1·6 | <0·001 |
| 95 % CI | 1·1, 1·2 | 1·5, 1·7 | |
| Median | 0·5 | 1·0 | |
| Q1, Q3 | 0·0, 2·0 | 0·5, 2·0 | |

*Differences in gender, number of parents in the household and parental education were analysed using the $\chi^2$ test; differences in beverage intake were analysed using the independent-samples *t* test.

The parents participating in 2008 had higher education than those participating in 2001 ($P<0·001$). In 2001, 42% of the parents had higher education, while 54% of the parents had higher education in 2008. Comparing 2001 and 2008 unadjusted group means, children in 2001 more often drank fruit juice (3·6 *v.* 3·4 times/week, $P=0·012$), lemonade (4·8 *v.* 2·5 times/week, $P<0·001$) and regular soft drinks (2·7 *v.* 1·6 times/week, $P<0·001$; Table 1 and Fig. 1). For diet soft drinks children reported a less frequent intake in 2001 than in 2008 (1·2 *v.* 1·6, $P<0·001$).

Further, the frequency of beverage consumption based on data from 2001 and 2008 collectively was analysed according to differences in gender, parental education, number of parents in the household (Table 2). Table 2 also presents differences in frequency of beverage consumption according to study year. Adjusting for gender, parental education level and the number of parents in household did not change the crude time trends for consumption frequencies of lemonade, regular soft drinks and diet soft drinks reported above. On the other hand, there were no significant differences in frequency of fruit juice consumption reported by children in 2001 and 2008 after adjusting for these variables. Girls reported to drink fruit juice more often compared with boys (3·6 *v.* 3·2 times/week, $P=0·002$), whereas boys reported a more frequent intake of lemonade (3·8 *v.* 3·5 times/week, $P=0·003$) and regular soft drinks (2·3 *v.* 2·0 times/week, $P<0·001$) compared with girls. The present study showed no difference in intake frequency of diet soft drinks between boys and girls. Children with higher educated parents reported to drink fruit juice more often than children with lower educated parents (3·7 *v.* 3·2 times/week, $P<0·001$). Children with lower educated parents reported a more frequent intake of lemonade (3·8 *v.* 3·4 times/week, $P=0·002$), regular soft drinks (2·4 *v.* 1·8 times/week, $P<0·001$) and diet soft drinks (1·4 *v.* 1·1 times/week, $P<0·001$) than those with higher educated parents. The study showed no significant differences in frequency of beverage consumption between children living with single parents compared with those living with two parents.

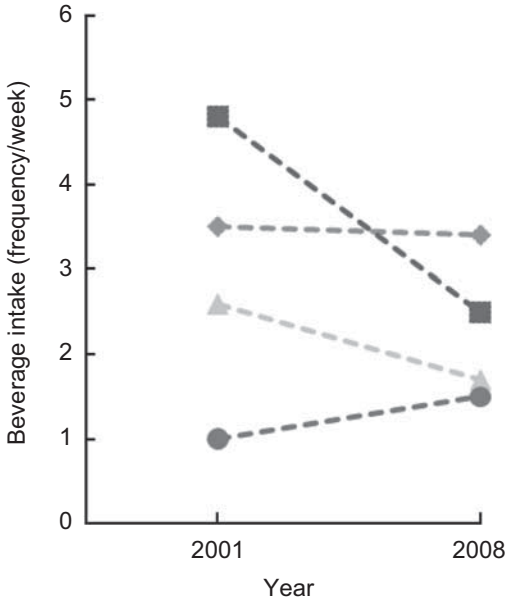


**Fig. 1** Difference in beverage intake (–◆–, juice; –■–, lemonade; –▲–, regular soft drinks; –●–, diet soft drinks) between 2001 and 2008 (unadjusted data) among 6th and 7th grade Norwegian pupils, the Fruits and Vegetables Make the Marks (FVMM) project

For frequency of fruit juice consumption, significant interactions were observed between time and gender and between time and parental education (Table 3). Boys increased their frequency of fruit juice consumption (from 3·1 to 3·3 times/week) whereas girls decreased their frequency of fruit juice consumption (3·8 to 3·4 times/week; interaction time × gender $P=0·02$). Further, children with higher educated parents increased their frequency of fruit juice consumption (3·6 to 3·8 times/week) whereas those with lower educated parents decreased their frequency of fruit juice consumption (3·3 to 3·0 times/week; interaction

**Table 2** Adjusted mean frequency of beverage consumption per week according to gender, parental education, number of parents in the household and year the study was performed; 6th and 7th grade Norwegian pupils, the Fruits and Vegetables Make the Marks (FVMM) project

| | | Juice | | | Lemonade | | | Regular soft drinks | | | Diet soft drinks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total (*n*) | Mean | 95% CI | *P** | Mean | 95% CI | *P** | Mean | 95% CI | *P** | Mean | 95% CI | *P** |
| Gender | | | | | | | | | | | | | |
| Boy | 1378 | 3·2 | 3·0, 3·5 | | 3·8 | 3·6, 4·0 | | 2·3 | 2·1, 2·4 | | 1·3 | 1·2, 1·5 | |
| Girl | 1422 | 3·6 | 3·4, 3·8 | 0·002 | 3·5 | 3·2, 3·7 | 0·003 | 2·0 | 1·8, 2·1 | <0·001 | 1·2 | 1·1, 1·3 | 0·14 |
| Parental education | | | | | | | | | | | | | |
| Low | 1156 | 3·2 | 3·0, 3·4 | | 3·8 | 3·6, 4·0 | | 2·4 | 2·2, 2·5 | | 1·4 | 1·3, 1·6 | |
| High | 1038 | 3·7 | 3·5, 3·9 | <0·001 | 3·4 | 3·2, 3·7 | 0·002 | 1·8 | 1·7, 2·0 | <0·001 | 1·1 | 1·0, 1·2 | <0·001 |
| Parents in household | | | | | | | | | | | | | |
| 1 | 531 | 3·4 | 3·1, 3·7 | | 3·7 | 3·4, 4·0 | | 2·2 | 2·0, 2·4 | | 1·3 | 1·1, 1·5 | |
| >1 | 2197 | 3·5 | 3·3, 3·6 | 0·48 | 3·5 | 3·3, 3·7 | 0·12 | 2·0 | 1·9, 2·2 | 0·16 | 1·3 | 1·2, 1·3 | 0·70 |
| Year | | | | | | | | | | | | | |
| 2001 | 1488 | 3·5 | 3·2, 3·7 | | 4·8 | 4·5, 5·0 | | 2·6 | 2·4, 2·7 | | 1·0 | 0·9, 1·2 | |
| 2008 | 1339 | 3·4 | 3·1, 3·6 | 0·60 | 2·5 | 2·2, 2·7 | <0·001 | 1·7 | 1·5, 1·8 | <0·001 | 1·5 | 1·4, 1·7 | <0·001 |

*Multilevel linear mixed models adjusted for all variables presented for each model.

**Table 3** Differences in mean* frequency of beverage consumption per week in 2001 and 2008 according to gender, parental education, number of parents in the household; 6th and 7th grade Norwegian pupils, the Fruits and Vegetables Make the Marks (FVMM) project

| | Juice | | | | | Lemonade | | | | | Regular soft drinks | | | | | Diet soft drinks | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2001 | | 2008 | | | 2001 | | 2008 | | | 2001 | | 2008 | | | 2001 | | 2008 | | |
| | Mean | 95 % CI | Mean | 95 % CI | *P*† | Mean | 95 % CI | Mean | 95 % CI | *P*† | Mean | 95 % CI | Mean | 95 % CI | *P*† | Mean | 95 % CI | Mean | 95 % CI | *P*† |
| Gender | | | | | | | | | | | | | | | | | | | | |
| Boy | 3·1 | 2·8, 3·4 | 3·3 | 3·0, 3·7 | | 4·9 | 4·6, 5·2 | 2·7 | 2·4, 3·0 | | 2·7 | 2·6, 2·9 | 1·8 | 1·6, 2·0 | | 1·0 | 0·9, 1·2 | 1·6 | 1·5, 1·8 | |
| Girl | 3·8 | 3·5, 4·1 | 3·4 | 3·1, 3·7 | 0·02 | 4·6 | 4·4, 4·9 | 2·3 | 2·0, 2·6 | 0·48 | 2·4 | 2·2, 2·6 | 1·6 | 1·4, 1·8 | 0·29 | 1·0 | 0·9, 1·2 | 1·4 | 1·3, 1·6 | 0·31 |
| Parental education | | | | | | | | | | | | | | | | | | | | |
| Low | 3·3 | 3·1, 3·6 | 3·0 | 2·7, 3·3 | | 5·0 | 4·7, 5·2 | 2·6 | 2·4, 2·9 | | 2·8 | 2·7, 3·0 | 1·9 | 1·7, 2·1 | | 1·2 | 1·1, 1·4 | 1·7 | 1·5, 1·9 | |
| High | 3·6 | 3·3, 3·9 | 3·8 | 3·5, 4·1 | 0·04 | 4·6 | 4·3, 4·8 | 2·3 | 2·0, 2·6 | 0·67 | 2·3 | 2·1, 2·5 | 1·4 | 1·2, 1·6 | 0·78 | 0·9 | 0·7, 1·0 | 1·4 | 1·2, 1·6 | 0·71 |
| Parents in household | | | | | | | | | | | | | | | | | | | | |
| 1 | 3·3 | 2·9, 3·7 | 3·5 | 3·0, 3·9 | | 4·9 | 4·5, 5·3 | 2·6 | 2·2, 3·0 | | 2·5 | 2·3, 2·8 | 1·8 | 1·6, 2·1 | | 1·0 | 0·8, 1·2 | 1·6 | 1·4, 1·8 | |
| >1 | 3·7 | 3·5, 3·9 | 3·3 | 3·1, 3·5 | 0·08 | 4·6 | 4·4, 4·8 | 2·4 | 2·2, 2·6 | 0·87 | 2·6 | 2·4, 2·7 | 1·5 | 1·4, 1·7 | 0·09 | 1·1 | 1·0, 1·2 | 1·5 | 1·4, 1·6 | 0·36 |

*Adjusted mean.
†Multilevel linear mixed models adjusted for all variables presented for each model.

time × parental education $P = 0{\cdot}04$). The study showed no further differences in beverage consumption frequency according to gender, parental education and number of adults in household in this time period.

## Discussion

In 2008, children reported a less frequent intake of fruit juice, lemonade and regular soft drinks, and a more frequent intake of diet soft drinks, than in 2001. These results from the present study confirm a trend in reduced consumption of SSB among Norwegians; after an increased consumption between 1989 and 2001, a subsequent decrease in regular soft drinks consumption has been reported between 2001 and 2007 in the general Norwegian population[25]. The Norwegian national study, Ungkost, showed a high intake of added sugar, with regular soft drinks as a major source among children and adolescents in 2000/2001[1]. These nutritional challenges resulted in an increased focus from Norwegian health authorities on reducing the intake of sugar-sweetened foods and beverages among children and adolescents. The strategies developed due to national initiatives challenged school owners to prevent access to soft drinks and promote good access to cold drinking water. In addition, national authorities have increased taxes on SSB and claimed that marketing of unhealthy foods and beverages aimed at children and young people should be prohibited[21,23].

Most likely, the increased focus to reduce the total consumption of added sugar may partly explain the reduced frequency of consumption of added sugar from SSB since 2001. In 2007, a report from the Norwegian Scientific Committee for Food Safety[29] concluded that replacing sugar with intense sweeteners in soft drinks may reduce the risk of weight gain. In addition, such a shift in beverage consumption will most probably reduce the incidence of caries. However, randomized controlled trials in children are very limited, and do not clearly demonstrate either beneficial or adverse metabolic effects of artificial sweeteners[30].

In other countries within the same age group, and time period, an increase in SSB and fruit juice consumption has been reported. In Ireland, both the portion size consumed and the frequency of consumption of SSB increased significantly among adolescents in 2005 compared with those in 1997[31]. Over the past few decades, consumption of SSB and fruit juice has increased considerably among children, adolescents and adults in the USA[32–34]. These dietary changes for SSB and fruit drinks have been explained by: (i) an increased proportion of persons of all ages consuming these beverages; (ii) the portion sizes have increased; and (iii) the number of servings has increased[34].

The present study showed that gender influenced the frequency of beverage consumption; boys reported to

drink SSB including lemonade and regular soft drinks more often than girls. On the other hand, girls reported to drink fruit juice more often than boys. A study by Vågstrand *et al.*[17] showed a significantly higher intake of soft drinks and fruit juices among boys compared with girls. In this latter mentioned study, soft drinks and fruit juice consumption were associated with each other but with opposite direction in Swedish boys and girls[17]. The association was negative in boys and positive in girls ($P = 0{\cdot}04$ for interaction). In addition, several other studies have reported that boys tend to drink more soft drinks than girls[16–18]. From 2001 to 2008, the differences in frequency of fruit juice consumption were significantly different between genders in the present study; boys reported a more frequent intake whereas girls reported a less frequent intake of fruit juice. The Norwegian Directorate of Health[6] has focused on decreasing the intake of added sugar and increasing the intake of vegetables, fruits and berries, including fruit and vegetable juices, among children and adolescents. However, it is interesting to notice that the present study shows that the consumption of fruit juice was significantly reduced from 2001 to 2008 due to a reduced consumption of fruit juice among girls. The reduced frequency of fruit juice intake among girls may be due to an increased consciousness and a rejection of energy-containing beverages, including naturally occurring carbohydrates. This potential relationship has not, to our knowledge, been studied.

An additional finding in the present study was the considerable variation in beverage consumption by parental educational level. More children with high educated parents reported high rates of fruit juice intake and low rates of lemonade, regular and diet soft drinks compared with children with low educated parents. In addition, children with higher educated parents drank fruit juice more often in 2008 than 2001, compared with children with lower educated parents. The differences in fruit juice consumption according to parental educational level may indicate that the introduced policy has increased social disparities. The Norwegian Hunt study recently confirmed that higher levels of parental education, in particular the mother's education, are clearly associated with lower prevalence odds ratio for drinking soft drinks daily (2·5 for girls and 1·9 for boys)[16]. Other studies have also reported that lower social status, measured as parental occupation or education plan of the child, seems to be associated with a higher intake of soft drinks[4,35]. Several studies of children and adolescents have reported an association between higher levels of parental education and healthier dietary habits among children and adolescents[16,36].

This social patterning should be recognized when planning future public health strategies. Thus, vulnerable health groups, specifically young boys and male adolescents, should be targeted in interventions to reduce intake of SSB.

The present study showed no significant differences in the consumption frequency of juice, lemonade, regular soft drinks and diet soft drinks among children according to number of parents in the household. Previously published research has not focused on family structure and beverage intake among children and adolescents. However, Stewart and Menning[28] reported that adolescents living in non-traditional families were more likely than adolescents living with two biological/adoptive parents to display unhealthy eating habits.

The strengths of the present study are that it comprises two cross-sectional surveys in a well-defined population and includes a high number of participants, covering a time span from 2001 to 2008 from the same region. Our research has some limitations. First, the variables of soft drink and lemonade consumption frequency have not been validated. However, the test–retest reliability of juice, lemonade and soft drink consumption frequency has been reported to be acceptable (see 'Materials and methods' section). Second, the questionnaire used in the study did not have information on volume obtained from beverages. Third, the participating pupils were from two of Norway's nineteen counties only, and no large cities are situated in these two counties. However, Oslo is the only large city in Norway (>250 000 inhabitants), and as Norway in general is a rather homogeneous country we believe the results are likely to be generalizable to the other counties as well.

## Conclusions

The present study shows a reduced consumption frequency of fruit juice, lemonade and regular soft drinks and an increased consumption frequency of diet soft drinks between 2001 and 2008. Gender and parental education seem to affect beverage choices, and boys living with lower educated parents are clearly an important target group for intervention strategies aimed at improving beverage choices.

## Acknowledgements

The study was funded by the Norwegian Research Council. The authors declare that they have no competing interest. K.-I.K. conceived the FVMM project. E.B. designed the present study and E.B., T.H.S. and N.C.Ø. interpreted the data. T.H.S. and N.C.Ø. analysed the data and drafted the manuscript, and E.B. and K.-I.K. revised it critically. All authors have approved the final version of the manuscript.

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