Does socio-economic status moderate the associations between psychosocial predictors and fruit intake in schoolchildren? The Pro Children study

C. Sandvik1,2*, R. Gjestad3, O. Samdal2, J. Brug4 and K.-I. Klepp1

Abstract

This study tested whether socio-economic status (SES) moderated the association between the psychosocial constructs included in the attitude–social influence–self-efficacy (ASE) model and fruit intake in Norwegian schoolchildren. The sample consisted of 962 Norwegian sixth graders, mean age 11.3 years. They were split into three SES groups, and multi-group structural equation modeling (MSEM) was used. Children in the highest SES group reported eating fruit more frequently and reported more positive ASE variables than children in the lower SES groups. This was particularly true for social environmental factors, home availability of fruit and intention to eat fruit. MSEM showed that the relationships specified in the adapted ASE model were moderated by SES, as we did not find support for equal model structure across the three samples. Model modification for each SES group separately showed that the relation between home availability and fruit intake was not significant for the medium SES group. Future interventions aiming at increasing fruit intake in children need to be sensitive to such SES-related differences and should in particular affect factors that may impede fruit intake in the lower SES groups.

Introduction

Social class plays an important role in food choices; influencing availability and shaping social traits like class values and beliefs [1]. Normally, food consumption among adults differs according to socio-demographic variables [2]. De Irala-Estevez et al. [3] carried out a systematic review on the adult population in Europe and found that higher socio-economic status (SES) was associated with greater consumption of both fruit and vegetables. Most studies on children and adolescents also suggest that high SES groups in Europe eat more fruit and vegetables than low SES groups. A recent systematic review on determinants of fruit and vegetable consumption among children and adolescents [4] showed that although socio-economic position was operationalized in several ways, findings were quite consistent: Low SES was associated with lower intake of fruit and vegetables in 27 out of 36 papers. This finding was confirmed in a recent report from the Health Behaviour in School-aged Children (HBSC) study, which studied 11-, 13- and 15-year old schoolchildren in 41 countries and regions across the World Health Organization European Region and North America in 2005/2006. They found that low family affluence was significantly associated with lower levels of fruit

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consumption among both boys and girls in the majority of countries studied, but for girls only in Norway [5].

Adolescence is an important time in terms of health, as lifestyle and health behaviours with long-term effects are established [6]. Recent studies have shown the connection between the SES of the family and health during adolescence [7–10]. Torsheim et al. [11] found that adolescents with the lowest SES were more likely to self-rate their health as fair or poor, and that behavioural factors might be an important mediating mechanism for socio-economic differences in adolescent self-rated health. However, relatively little is known about the possible differences in correlates of dietary intake according to socio-economic positions of adolescents [12]. It is important to explore these to tailor interventions for fruit and vegetable promotion to the populations most at risk.

Behavioural or social science theories and conceptual models provide the basis for understanding dietary behaviours [13]. There is a considerable body of research that supports the value of the theory of planned behaviour (TPB) and similar theories in identifying the proximal determinants of various physical activity and nutrition behaviours [14]. The attitude–social influence–self-efficacy (ASE) model may be considered as an extension of the theory of reasoned action (TRA) [15] and integrates the two factors of the TRA (attitudes and subjective norms) with Bandura’s self-efficacy concept [16]. Although the model resembles TPB [17], it has evolved as a separate model, with a different methodological nature [18]. In particular, the subjective norm concept has been replaced by a wider ‘social influence’ construct, which is defined as a result of subjective norms (i.e. expectations about other people’s opinions about the behaviour of interest), examples of important others and direct social support and pressure related to fruit and vegetable intake [19].

The ASE model has previously been applied to explaining fruit (and vegetable) intake in adults [20] and in young adolescents [21–24]. These studies found relatively high rates of variance explained, and the latter concluded that the ASE model was well suited to explain fruit intake for the samples studied and that the explained variance was similar to or better than what has been found in previous studies applying the TPB or social cognitive theory [24].

The diet of children who are on the verge of puberty is still influenced by parents in several ways [25]. The family is the major provider of food and can therefore affect availability [26]. Parents may also still serve as important role models [27]. The ASE model puts more emphasis on and includes a wider range of social influence variables than the TPB and takes these issues into account.

While a number of studies have demonstrated SES-related differences in fruit and vegetable intake, we are aware of only a few studies that have investigated possible moderator effects of SES on correlates of dietary behaviour in children or adolescents [28–30] In this paper, we studied the relation between SES and self-reported fruit consumption in a sample of 11- to 12-year-old schoolchildren, as they are in an important stage of the life-course, being in transition from childhood’s family-centred influences towards a broader environment more open to influences of peers and non-family members [31]. In particular, we investigated if and how SES may moderate the associations between the proximal potential behavioural determinants recognized in the ASE model and fruit intake in primary schoolchildren. As two recent literature reviews have shown that taste preferences and home availability/accessibility were two of the determinants most consistently related to fruit and vegetable intake in children and adolescents [4, 32], these concepts were added to the original ASE model in this study. We chose to focus on fruit intake only in this paper, as it has been previously shown that fruit and vegetable intake are different behaviours, with different influencing factors [21, 23, 33].

**Materials and methods**

**Sample and procedure**

The sample for this study was taken from the Pro Children cross-sectional study [34]. A national
representative sample of 1347 Norwegian children, enrolled as sixth graders in the school year 2003–04, and their parents were invited to take part in the study. In total, 1196 children and 1009 parents provided completed questionnaires, giving response rates of 89.5% and 74.9%, respectively. For this paper, only children born in 1991 and 1992 (11–12 years when the data were collected) were included, and 1183 children met this criterion. Mean age was 11.3 years (±0.30). Table I provides further information on the sample.

Self-administered questionnaires were completed during one school lesson by the children. Parent questionnaires were given to the children to take home. Data were collected during October–December 2003. Ethical approval for the Pro Children study was obtained from the Norwegian Social Science Data Services and from the National Committee for Medical Research Ethics in Norway. The study was carried out in accordance with the universal ethical principles [35]. All invited children and their parents were informed that participation was voluntary and that their responses were confidential and would be treated anonymously. We used passive, informed parental consent. Parent and child data were matched using a common ID number given to each parent–child set of questionnaires, and information on the child’s gender, birth month and parents’ occupation was used to verify the coupling. Of the 1009 parents who completed the questionnaire, 1002 cases were parent–child matches. Further details on the data collection procedure as well as on the participants in the cross-sectional study have been published elsewhere [36–38].

Measures

The child questionnaire assessed attitudes, social influence, self-efficacy, intention and behaviour (fruit intake), in addition to preferences and home availability of fruit. Social influence was assessed by four sub-constructs measuring modeling, active parental encouragement, ‘demand family rule’ (i.e. if parents demanded that their children eat sufficient amounts of fruit) and parental facilitation (i.e. if parents actively facilitated fruit intake by cutting up fruit for their children between meals). Attitudes, modeling, active parental encouragement, self-efficacy and intention were assessed with a five-point Likert scale ranging from ‘I fully agree’ (+2) to ‘I fully disagree’ (−2). Answer categories for the demand family rule, parental facilitation and home availability items were from ‘yes, always’ (+2) to ‘never’ (−2). Preferences were measured for 12 different kinds of fruit, using five response categories from ‘I like very much’ (+2) to ‘I dislike very much’ (−2). In addition, the respondents could answer ‘have never tried’, which was coded as neutral (0). Preferences were treated as a composite measure, and a general preference scale was made by calculating the mean of the item scores for each child. Self-efficacy and intention were measured with one item only. Table IV provides an overview of the items and wording for each of the psychosocial constructs.

Table I. Characteristics of the sample

<table>
<thead>
<tr>
<th></th>
<th>Full sample</th>
<th>High SES</th>
<th>Medium SES</th>
<th>Low SES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>962</td>
<td>356</td>
<td>322</td>
<td>284</td>
</tr>
<tr>
<td>Number (%) of boys</td>
<td>488 (50.7%)</td>
<td>173 (48.6%)</td>
<td>168 (52.2%)</td>
<td>147 (51.8%)</td>
</tr>
<tr>
<td>Mean age (SD)</td>
<td>11.3 (.30)</td>
<td>11.3 (.30)</td>
<td>11.3 (.30)</td>
<td>11.3 (.32)</td>
</tr>
<tr>
<td>Age range</td>
<td>10.8–12.4</td>
<td>10.8–12.4</td>
<td>10.8–12.3</td>
<td>10.8–12.2</td>
</tr>
<tr>
<td>Number of classes/schools</td>
<td>73 classes/52 schools</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total response ratea</td>
<td>89.5%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Number of classes/schools, and response rate is based on the original Pro Children samples. For this study, children born in 1990, 1993 and 1994 were excluded from the sample, as were children without valid information on parental SES.
Fruit intake was assessed using the fruit item from a validated fruit and vegetable food frequency questionnaire (FFQ): How often do you usually eat fresh fruit? Eight response categories were used, ranging from ‘never’ to ‘every day, more than twice a day’. Details on the development and pilot testing of the items measuring the psychosocial constructs as well as the FFQ are given in De Bourdeaudhuij et al. [39] and in Haraldsdóttir et al. [40], respectively. The child questionnaire is also available online at http://www.prochildren.org.

Information on SES was taken from the parents’ questionnaire, where parents were asked questions about their education, their current employment status (employed, unemployed, etc), their position and whether they had any subordinates. Similar questions were asked about their spouse or partner’s education and work situation.

The coding of occupational social class in the Pro Children study was based on the standards of the Danish National Institute of Social Research, which is similar to the British Registrar General’s classification into five social classes [31, 41]. This measure is related to the skills needed to perform a particular occupation [42], and the coding instruction was therefore adapted to account for national variations in job structure and requirements.

A coding manual was developed to ensure equal coding in ambiguous cases. The occupational status of the parent with the highest occupational position was used to compute a common value for parents’ occupational status. This has been defined as ‘Family Social Class’ [43]. If information on one of the parents was missing, then information on the other parent was used [43]. The sample was then regrouped into three categories: high SES (social groups 1 and 2); medium SES (social group 3) and low SES (social classes 4 and 5 and the economically inactive).

Analyses
Firstly, attrition analyses were carried out to see whether the children who were excluded from further analysis because of missing data from parents ($N = 181$) differed significantly from the children who were included. Distribution of the children in the different SES groups was computed, and frequency of fruit intake was assessed for each SES group. Means and standard deviations for all psychosocial constructs were calculated by SES group using univariate analysis of variance. Bonferroni post-hoc tests were used to test for significant differences in psychosocial constructs by SES group. The significance level was set to 0.05. All descriptive analyses were carried out using SPSS 15.0 for Windows.

The measurement models for social influence and home availability of fruit were tested in LISREL for the full sample using polychoric correlations and asymptotic covariance matrices as input to account for ordinal variables, with robust maximum likelihood as the estimation method. To investigate whether the structural relationships between the individual and environmental factors in the ASE model, preferences and availability varied over SES groups, we used multi-group structural equation modeling (MSEM). MSEM is a technique used to compare two or more groups, where the same theoretical model is applied to these groups simultaneously. The main question addressed in MSEM is if group membership moderates the relations specified in the model [44]. If the same model fits all three SES groups, this indicates that SES is not a significant moderator of the presumed relationships in the ASE model tested in this paper. If SES moderates the relations, MSEM enables us to describe the effect of SES group on the relations in the model [45]. The MSEM analysis was carried out in LISREL, version 8.80 [46].

PRELIS was used to prepare data for the structural equation models. Missing values in ordinal variables were imputed using imputation by matching (IM). In IM, cases with complete data that have similar patterns of scores on intact variables are used to impute values on variables with missing data. This method gives equal values as already specified for the categories [47]. Cases with missing data after IM were deleted. This provided a sample of 919 for the SEM analysis. For the MSEM, thresholds were estimated for all ordinal variables using the alternative parameterization outlined by Jöreskog and Yang-Wallentin [48]. Polychoric correlations and asymptotic covariance matrices.
were then estimated. This procedure transforms the observed ordinal variables into latent underlying, normally distributed continuous variables, with metric and variance. For intention and self-efficacy, which were both single-item measures, a pre-specified residual variance was added to take account of measurement error in the variable. An alpha level of 0.80 was chosen for this procedure, as this would represent a satisfactory level for a scale with sufficient number of variables and magnitude of covariances.

We imposed a model with similar structure and factorial invariance on the three subsamples and tested the model outlined in Fig. 1. Relations that were non-significant in all three groups were removed, and the model was re-estimated for all three groups simultaneously trying to achieve good fit for a common model and to find support for the same structural pattern in all three groups.

**Measures of model fit**

There are several statistical indices that measure how well the theoretical model fits the data. As these indices reflect different aspects of model fit, Kline [44] recommends reporting several. Model chi-square ($\chi^2$) is the most common fit test [49] and has been used to test the hypothesis that the relationships suggested in the model to be tested provide a plausible explanation of the data. In this study, Satorra–Bentler scaled $\chi^2$ was used to adjust

for ordinal data. This measure is also robust in relation to non-normality in data. Root mean square error of approximation (RMSEA), a parsimony-adjusted fit index, with 90% confidence intervals (90% CIs) and the probability of achieving close fit (RMSEA < 0.05) is also reported. This is the likelihood of getting an RMSEA below 0.05 when repeating the model-fit procedure on an indefinite number of samples. In addition, Bentler’s comparative fit index (CFI) and the standardized root mean square residual (SRMR) are reported. We used the criterion of RMSEA < 0.05 by Browne and Cudeck [50] as close fit and values beyond 0.10 as poor. We also used the rule of thumb by Hu and Bentler [51] that CFI greater than about 0.90 may indicate reasonably good fit, and for evaluation of SRMR, we used the recommendation by Kline [44] that values <0.10 are favourable.

**Results**

The coding of SES resulted in the exclusion of 11 children with missing parental data, 9 children whose parents were in education and 20 children whose parents were economically active, but information was insufficient to code SES. No values for missing data were imputed for SES, as this was the grouping variable for this study. This left us with a total of 962 children for further analyses. Table II shows the results from the attrition analyses. There

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**Fig. 1.** Adapted version of the ASE model.
was no significant difference in gender distribution between those children with completed parental data and those without. The distribution of SES groups differed, with more low SES children in the ‘no parental questionnaire’ group. There were no significant differences in mean fruit intake or in intention to eat fruit between the groups. The remaining analyses are therefore based on the sample with parental-reported SES only, unless otherwise stated.

Table III shows the distribution of fruit intake for the total sample and for each SES group. The overall $\chi^2$ for this distribution was 38.94 [degree of freedom (df) = 14], $P < 0.001$, which indicates that fruit intake differed significantly according to the SES group children belonged to. Frequency of intake was higher in the high SES group than in the medium and low groups. Mean and standard deviation for all constructs possibly related to fruit intake in the ASE model are reported in Table IV for each SES group separately. As this table shows, the mean values differed significantly between high and low SES groups for modeling, parental encouragement, demand family rule, intention and for the three home availability items. Further, the mean values differed significantly between high and medium SES groups for parental encouragement, and for one of the availability items. All differences were in the expected direction, i.e. indicating a more favourable level of these determinants in the high SES group compared with the medium and low SES groups. These analyses were also carried out for the total sample, including children with family social class from parents’ questionnaires and the group of children whose parents did not reply to the questionnaire. This gave only minor differences and did not change the overall results.

### Multi-group Structural Equation Modelling

The association between preferences and intake was non-significant in all three SES subgroups and was therefore removed from subsequent analyses. Furthermore, the association between self-efficacy and intake was non-significant in all subgroups, and so was the association between availability and intention. The association between preferences and intention was also non-significant for all three subgroups. The $\chi^2$ for the re-estimated model, where all non-significant relations were removed, was 87.47 (df = 192), $P = 1.00$. RMESA was 0.00, and the $P$-value for RMSEA < 0.05 = 1.00, indicating very good model fit and a robust model.

For the high SES group, the paths from attitude to intention, from social influence to intention and from self-efficacy to intention were all statistically significant. Further, the paths from availability and intention to intake were significant for this group. For the medium SES group, the path from self-efficacy to intention and the path from

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### Table II. Attrition analyses assessing differences in gender and SES and in mean fruit consumption and intention between groups with child- and parental-reported SES

<table>
<thead>
<tr>
<th>Gender</th>
<th>SES</th>
<th>Intention</th>
<th>Behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls</td>
<td>Boys</td>
<td>High</td>
</tr>
<tr>
<td>Child-reported</td>
<td>79 (54.1%)</td>
<td>67 (45.9%)</td>
<td>35 (19.3%)</td>
</tr>
<tr>
<td>Parent-reported</td>
<td>474 (49.3%)</td>
<td>488 (50.7%)</td>
<td>356 (37.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>553 (54.1%)</td>
<td>555 (45.9%)</td>
<td>391 (37.0%)</td>
</tr>
</tbody>
</table>

*Of the 181 children with no parental questionnaire completed, 35 did not provide enough information to code child-reported SES.*
availability to fruit intake were not significant. For the low SES group, the pattern of significant relations was similar to the high SES group. As the MSEM did not support the same structural pattern for all three groups, we modified the model for each group separately to find the model that fitted best for each SES group, keeping only significant relations between the psychosocial factors, intention and intake within each group.

Model specification for the SES groups separately
The final model for the high SES group is presented in Fig. 2. This model has the same structural pattern

Table III. Fruit intake distribution for the total sample and by SES; percent (%); The Norwegian Pro Children study

<table>
<thead>
<tr>
<th></th>
<th>Total sample (N = 954)</th>
<th>High SES (N = 352)</th>
<th>Medium SES (N = 320)</th>
<th>Low SES (N = 282)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One day per week or less</td>
<td>19.9</td>
<td>15.3</td>
<td>18.5</td>
<td>27.6</td>
</tr>
<tr>
<td>2–4 days/week</td>
<td>32.3</td>
<td>27.6</td>
<td>37.5</td>
<td>32.3</td>
</tr>
<tr>
<td>5–6 days/week</td>
<td>17.9</td>
<td>23.0</td>
<td>17.2</td>
<td>12.4</td>
</tr>
<tr>
<td>Every day, once, or more</td>
<td>29.8</td>
<td>34.0</td>
<td>26.8</td>
<td>27.6</td>
</tr>
</tbody>
</table>

*Eight children did not reply to the fruit intake item, hence the different N.

Table IV. Mean values and standard deviations for the ASE model's psychosocial constructs including preferences and availability by SES; The Norwegian Pro Children study

<table>
<thead>
<tr>
<th>Construct/scale</th>
<th>No. of items</th>
<th>Range</th>
<th>High SES, mean (SD)</th>
<th>Medium SES, mean (SD)</th>
<th>Low SES, mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferences</td>
<td>12</td>
<td>−2/2</td>
<td>1.36 (0.57)</td>
<td>1.32 (0.55)</td>
<td>1.36 (0.58)</td>
</tr>
<tr>
<td>Attitudes</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To eat fruit every day makes me feel good</td>
<td>1</td>
<td>−2/2</td>
<td>1.20 (0.92)</td>
<td>1.14 (0.95)</td>
<td>1.21 (0.92)</td>
</tr>
<tr>
<td>To eat fruit every day gives me more energy</td>
<td>1</td>
<td>−2/2</td>
<td>1.37 (0.82)</td>
<td>1.31 (0.85)</td>
<td>1.38 (0.86)</td>
</tr>
<tr>
<td>Social influence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modeling</td>
<td>3</td>
<td>−2/2</td>
<td>0.66 (0.84)</td>
<td>0.52 (0.82)</td>
<td>0.42** (0.83)</td>
</tr>
<tr>
<td>Parental encouragement</td>
<td>2</td>
<td>−2/2</td>
<td>0.36 (1.25)</td>
<td>0.11* (1.26)</td>
<td>0.03** (1.31)</td>
</tr>
<tr>
<td>Demand family rule</td>
<td>1</td>
<td>−2/2</td>
<td>−0.48 (1.15)</td>
<td>−0.68 (1.11)</td>
<td>−0.86*** (1.12)</td>
</tr>
<tr>
<td>Parental facilitation</td>
<td>1</td>
<td>−2/2</td>
<td>−0.56 (1.03)</td>
<td>−0.59 (1.03)</td>
<td>−0.63 (1.09)</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If I decide to eat fruit every day, I can do it</td>
<td>1</td>
<td>−2/2</td>
<td>1.68 (0.78)</td>
<td>1.58 (0.90)</td>
<td>1.59 (0.91)</td>
</tr>
<tr>
<td>Intention</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want to eat fruit every day</td>
<td>1</td>
<td>−2/2</td>
<td>1.45 (0.89)</td>
<td>1.29 (0.99)</td>
<td>1.22** (1.06)</td>
</tr>
<tr>
<td>Home availability of fruit</td>
<td>3</td>
<td>−2/2</td>
<td>1.32 (0.77)</td>
<td>1.23 (0.79)</td>
<td>1.15* (0.85)</td>
</tr>
<tr>
<td>If you tell at home what fruit you would like to eat, will it be bought?</td>
<td>1</td>
<td>−2/2</td>
<td>1.32 (0.77)</td>
<td>1.23 (0.79)</td>
<td>1.15* (0.85)</td>
</tr>
<tr>
<td>Are there usually different kinds of fruits available in your home?</td>
<td>1</td>
<td>−2/2</td>
<td>1.03 (0.89)</td>
<td>0.83* (0.93)</td>
<td>0.74*** (0.99)</td>
</tr>
<tr>
<td>Is there usually fruit available at home that you like?</td>
<td>1</td>
<td>−2/2</td>
<td>1.36 (0.75)</td>
<td>1.25 (0.75)</td>
<td>1.11*** (0.89)</td>
</tr>
</tbody>
</table>

When asterisks are placed in the column for SES3, they indicate a significant difference between SES1 and SES3. When placed in the column for SES2, they indicate the significance of the difference between SES1 and SES2. None of the differences between SES2 and SES3 were statistically significant. *P < 0.05; **P < 0.01; ***P < 0.001.
as for the MSEM analysis. It could explain 39.3% of the variation in fruit intake and 54.5% of the variation in intention to eat fruit. The fit indices for this model were $\chi^2 = 22.23$ (df = 60), $P = 1.00$; CFI = 1.00, SRMR = 0.13, RMSEA = 0.00. The 90% CI for RMSEA was 0.00–0.00, and $P$-value for close fit (RMSEA < 0.05) was 1.00.

The final model for the medium SES group is presented in Fig. 3. For this group, the correlation between attitude and availability was freed. As for the multi-sample analysis, the paths from self-efficacy to intention and from availability to intake were not significant for this group. This model could explain 38.8% of the variation in fruit intake and 45.4% of the variation in intention to eat fruit. The fit indices for this model were $\chi^2 = 27.96$ (df = 61), $P = 1.00$, CFI = 1.00, SRMR = 0.09, RMSEA = 0.00. The 90% CI for RMSEA was 0.00–0.00, and $P$-value for close fit (RMSEA < 0.05) was 1.00.

The final model for the low SES group is presented in Fig. 4. For this model, the association between availability and fruit intake was not statistically significant (0.20). Furthermore, the modification index suggested freeing the correlation between self-efficacy and social influence and between availability and attitude. These relations were freed, and did not change the statistical significance or the magnitude of the associations between the psychosocial predictors and intention or fruit intake. This model could explain 25.7% of the variation in fruit intake and 51.4% of the variation in intention to eat fruit. The fit indices for this model were $\chi^2 = 30.74$ (df = 58), $P = 1.00$; CFI = 1.00; SRMR = 0.09, RMSEA = 0.00. The 90% CI for RMSEA was 0.00–0.00, and $P$-value for close fit (RMSEA < 0.05) was 1.00.

**Discussion**

The results from this study demonstrated that while, overall, the reported fruit intake was low for all children, this was especially the case for low SES children. A considerable proportion of the low SES children reported eating fruit only once a week or less, indicating a particular need for interventions. Children in the highest SES group reported more positive ASE variables than children in the lower
SES groups. This was particularly true for social environmental factors, home availability of fruit and the intention to eat fruit. The MSEM analysis demonstrated that the relationships specified in the adapted ASE model employed were moderated by SES as we did not find support for equal model structure across the three samples. Model modification for each SES group separately showed that the relation between home availability and fruit intake was not significant for the medium and low SES groups, whereas for the medium SES group, the relation between self-efficacy and intention to eat fruit was not significant.

The associations between reported fruit intake and parental occupational status were as expected and in line with what has been reported by others [4, 52]. The pattern of differences in the psychosocial constructs was quite intriguing in that we found little or no difference in the individual factors (attitude, self-efficacy, taste preferences) despite the reported SES differences in most of the social influence factors, i.e. how the children perceived their parents. The only exception to this was parental facilitation, i.e. whether parents usually cut up fruit for their children in between meals. The average score for this measure was negative, indicating parents were not likely to facilitate fruit intake this way. Unexpectedly, this proportion was similar for all three SES groups. Since cutting up fruit for the children is expected to increase accessibility and consumption of fruit [53], this is an area where there is room for improvement in all SES groups. For children with low preferences for fruit, increased accessibility in addition to high availability may be necessary to increase their consumption, as previously shown by Cullen et al. [54].

The difference in intention between high and low SES groups is supported by an earlier finding that intention is moderated by home availability (C. Sandvik et al., submitted). The lack of difference in taste preferences according to SES may reflect the fact that all humans have an innate preference for sweet food [55]. However, both Bere et al and Sandvik et al found differences in taste preferences for fruits and vegetables between boys and girls [36, 56]. Children from different SES groups also reported differences in perceived availability of fruit at home, both in variety, availability
of fruit the children liked and whether parents were sensitive to children’s likes and dislikes when buying fruit. This is in line with what has been found among US children [45, 57] and adolescents [58]. A recent Australian study also reported differences in the availability of both fruit and vegetables and unhealthy foods related to socio-economic position [12].

The MSEM did not provide support for an identical model for all three SES groups. The strength of the relations in the structural model and explained variance differed somewhat between the groups. However, the level of variance explained in all SES groups was as good as or better than that found in other studies [22, 23, 29, 59, 60], with the exception of [61] and [33], indicating that this adapted version of the ASE model is suitable for explaining fruit intake in children of this age. The goodness-of-fit measures also varied somewhat between groups, indicating slightly worse fit for the high SES group than the medium and low SES groups.

The findings of non-significant relations between preferences and intention and preferences and intake for this sample disagreed with previous research and need further exploration. They may be due to low variance in the preference measure for this sample, as the standard deviation for this construct was rather low at the same time as mean values were high regardless of SES group (cf. Table IV). Also, the predictive validity of this measure has been shown to be lower for a Norwegian sample than for children from other countries in the pilot study for this questionnaire [39].

The effects of self-efficacy on intention and of availability on fruit intake were clearly moderated by SES, with self-efficacy being most strongly related to intention to eat fruit for the low SES group. This agrees with what Kratt et al. [45] have reported previously and what they interpreted as a necessity for different child strategies for eating fruit and vegetables depending on the level of availability in the home, i.e. when availability is low, the child’s skills and efficacies need to be stronger to enable them to eat fruit.

The non-significant relation between availability and intake for the medium and low SES groups may be caused by lower availability at home; if fruit is not sufficiently available, it may not affect intake

![Fig. 4.](image-url)
either. Kratt et al. [45] have reported that children from families with low availability of fruit and vegetables had a different model structure for explaining their fruit and vegetable intake than children from medium and high availability groups, as homes with higher availability also had a richer and generally stronger set of motivating factors for parent and child consumption than homes with low fruit and vegetable availability. In the MSEM, factor loadings were fixed over groups. This may have caused the relation between availability and intake to be significant for the low SES group in the MSEM but not in the separate SES group analysis.

The novelty of this study is the use of a national representative sample with a high response rate. We measured SES with parental-reported data, as children this age may not be able to report reliably on parents’ education and occupation [62-64]. We were able to achieve a high response rate among parents [38]. Further, analyses based on the total sample showed only minor or no differences in intention, fruit intake and in mean scores and SES differences related to the psychosocial constructs compared with the results presented for the children with completed parental data.

The measure of fruit intake and the psychosocial constructs were carefully developed and validity studies were carried out in both areas [39, 40]. Fruit intake was measured by the FFQ, which is suitable for ranking individuals according to their usual intake [40].

As this study used a cross-sectional design, we cannot draw any conclusions regarding causality and the direction of effects. Although SEM is viewed as a confirmatory technique [49], where the model is specified a priori, the direction of causation cannot be determined by data [65].

This study points to some of the factors that may cause social differences in fruit and vegetable intake and that could be targeted in focussed interventions aimed at reducing social inequality in dietary intake. Traditionally, health interventions such as health education and mass media campaigns have reached the middle class first and foremost [66, 67] and potentially increase differences in health and health-related behaviour related to social class [68]. Interventions that include changes in availability and accessibility may be better suited to also reaching lower SES families. This was included in the Pro Children intervention study [69].

The ‘Fruits and Vegetables Make the Marks’ study has previously shown that provision of free school fruit in a restricted study population increased schoolchildren’s fruit and vegetable intake for all groups of children, including children from lower SES families and those with low baseline intakes [70]. This highlights the importance of national, political measures and their potential to increase intake of fruit and vegetables in all schoolchildren, including those in medium to low SES groups. In the Norwegian context, there is currently a free school fruit programme running in all secondary schools, with an option for a paid subscription in primary schools. Given the observed SES differences reported here, it should be considered whether to include primary schools in the free school fruit programme as well.

Further research is necessary to see if the results reported here are generalizable to other areas of dietary intake and to other countries or regions.

Conclusion

We found that children in the high SES group ate fruit more frequently than children in the low SES group and that children in the high SES group had higher mean scores on psychosocial correlates of fruit intake, in particular for intention, social environmental factors and home availability. Furthermore, the association of these correlates with intake was moderated by SES. These differences need to be taken into account when future interventions aimed at increasing fruit intake in schoolchildren are planned and executed.

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