Why do parents’ education level and income affect the amount of fruits and vegetables adolescents eat?

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Background: There are large socioeconomic disparities in food behaviours. The objective of the present study is to longitudinally explore socioeconomic disparities in adolescents’ fruit and vegetable (FV) intake and to assess mediators of the disparity. Methods: A longitudinal study containing 896 adolescents from 20 randomly selected elementary schools within two Norwegian counties (response rate 84%). Questionnaires were administered in May 2002 (mean age 12.5 years) and again in May 2005. FV intake was measured by four food frequency questions (times/week). Socioeconomic status was based on parents’ reports of their own educational level and family income (both dichotomized). Data were analysed with repeated mixed models. Results: A disparity in adolescents’ FV intake was observed with family income (1.1 times/week, P = 0.05). An interaction between parental education and time (survey) was found for parental education (P = 0.04) and the educational disparity was greater in 2005 (2.4 times/week, P = 0.001) than in 2002 (1.3 times/week, P = 0.03). In multiple mediation analyses, a total of 92% (2002) and 60% (2005) of the educational disparity and 89% of the income disparity, were explained. For both, the adolescents’ reports of the accessibility of FV at home explained most of the disparity. Conclusions: Perceived accessibility appears to be the strongest mediator of the relationship between adolescents’ FV intake and their parents’ educational level and income and may therefore be an important target for future interventions that aim to reduce socioeconomic disparities in adolescents’ FV intake.

Keywords: adolescents, fruits, mediators, socioeconomic disparity, vegetables.

Introduction

A diet high in fruits and vegetables (FV) is inversely related to several chronic diseases¹ and an increased intake would improve global public health.² In Norway, children and adolescents consume only about half of the national 5-a-day recommendation.³ As food preferences and habits established in childhood tend to be maintained into adulthood⁴ ⁵ ⁶ in order to achieve maximum prevention potential, it is important to get children to eat more FV.

Despite the Norwegian welfare state and the large Norwegian GDP per capita, there are large social inequalities in health in Norway.⁶ Social inequalities are also seen in health-related behaviours such as eating behaviours.⁷ However, few Norwegian studies have investigated social inequalities in adolescents’ FV intake.

Internationally, low socioeconomic status (SES) is associated with low or less frequent intake of FV. In a comprehensive review of determinants of FV consumption among children and adolescents, positive associations between parental education and children’s or adolescents’ FV intake were observed in all of 11 reviewed studies and for family income, a positive association was observed in 7 of 14 studies.⁸ SES is not regarded to have a direct effect on behaviour and therefore important and modifiable mediators of the socioeconomic disparity need to be identified for intervention development.

Little is known about the mechanisms underlying socioeconomic disparities in FV intake. Health consciousness, lack of time and perceived high cost of healthy eating were observed to vary with SES (based on area of living) in a qualitative study of Australian women.⁹ In another study of Australian women, parts of the educational inequality in fruit intake were mediated by family and friends’ support for healthy eating and health considerations and family support, health considerations and nutritional knowledge mediated inequality in vegetable intake.¹⁰ ¹¹ Nutritional knowledge has also been reported to mediate parts of educational inequality in the purchase of healthy foods and food-cost concerns mediated parts of household income disparities in the same food purchasing index.¹² ¹³ No studies, as far as we know, have assessed mediators of socioeconomic disparities in children’s or adolescents’ FV intake.

A number of personal modifiable determinants of adolescents’ FV intake have been identified in previous Norwegian studies, such as perceived accessibility of FV at home, modelling, intention to eat 5-a-day, preferences for FV, self-efficacy to eat 5-a-day and knowledge of recommended intake levels.¹² ¹³ These variables have also been identified as correlates of intake in a recent systematic review of the literature.⁸

The aim of the present study was to explore if these personal modifiable factors mediate differences in FV intake levels between adolescents of parents with higher education and low income compared with parents without higher education and a lower income, using longitudinal data, following pupils from the age of 12.5–15.5 years. A secondary aim was to assess if the educational and income disparities in intake levels changed as the adolescents aged.

Methods

This study is part of the Fruits and Vegetables Make the Marks (FVMM) project. FVMM is an intervention project that
includes 38 randomly selected elementary schools in two Norwegian counties. The pupils within the 20 control schools constitute the study sample of the present study. Data from follow-up surveys completed in May 2002 and May 2005 were used for the analyses. The questionnaire surveys were completed by the pupils in the classroom in the presence of a trained project worker during one 45 min class period. The FVMM cohort includes 896 control pupils (84%), of which 813 and 728, respectively, participated in the May 2002 (mean age 12.5 years) and May 2005 (mean age 15.5 years) surveys and also reported same gender on all occasions. Participating pupils brought home a parent questionnaire to be completed by either of their parents at the baseline survey of the project (September 2001). A total of 738 parents returned the questionnaire; 85% of the recipients were mothers or female guardians, the mean age of the parents was 39.7 (ranging from 24 to 79 years) years. Research clearance was obtained from The Norwegian Social Science Data Services.

FV intake was measured by four frequency questions. The survey asked how often pupils ate vegetables for dinner, other vegetables (e.g., carrot for school lunch), apples, oranges, pears or bananas, other fruits or berries. All four questions had 10 response alternatives ranging from 'Never' = 0 to 'Several times a day' = 10, giving a scale ranging from 0 to 40 times/week. In a sample of 114 sixth grade pupils, the test–retest correlation of this scale was 0.75. The correlation between the scale and a validation method (7 day food diaries) was 0.32 in a separate validation study of 85 sixth grade pupils, which is similar to the results found in other studies of the same age group. All scales of the potential mediators (except knowledge) included one to five statements with response alternatives ranging from 'I fully disagree' to 'I fully agree'. These scales have been analysed for reliability, with test–retest correlations ranging from 0.51 (intention) to 0.74 (preferences). Knowledge (awareness of the 5-a-day recommendation) was measured by one question: "How many servings of fruit and vegetables should a person your age eat every day?" This question had seven response alternatives ranging from 'None’ to ‘More than 5-a-day.’ Details of all scales used in the present study are published in the open access journal *International Journal of Behavioral Nutrition and Physical Activity*, www.ijbnpa.org; see Bere and Klepp. In order to increase the statistical power, missing values on any items were substituted by 85 values for the remaining group on the respective item. To avoid a score on a scale, >50% of the scale items had to be answered. One or more missing values were substituted by 85 children in 2002 and 15 children in 2005. The parent’s educational level was assessed individually with one question: ‘What level of education do you have?’ This question had four response alternatives: ‘Elementary school’, ‘high school’, ‘college or university (3 years or less)’ and ‘college or university (more than 3 years)’. This variable was dichotomized (lower: no college or university education/higher: having attended college or university). Family income was assessed by an open question on total household income. This variable was also dichotomized (low or high family income).

A variable functions as a mediator when it meets the following conditions (figure 1): (i) variations in levels of the independent variable (parental education/income) significantly account for variations in the presumed mediator (i.e. Path a), (ii) variations in the mediator significantly account for variations in the dependent variable (i.e. Path b) and (iii) when Paths a and b are controlled, a previously significant relation between the independent and dependent variables is no longer significant, with the strongest demonstration of mediation occurring when Path c is zero.

All analyses conducted were different repeated mixed models. All models were adjusted for school as a random effect. First, parental education/income was regressed on FV intake (Path c unadjusted, $Y_{FV} = \tau X_{edu}$) and on the individual potential mediators independently ($Y_{Mi} = \tau X_{edu}$ Path a), in order to assess socioeconomic disparities in the respective variables (table 1). Interaction between parental education/income and time (2002 vs. 2005) was checked and results were stratified on time if interactions were statistically significant. Since all potential mediators included in this study have been reported to correlate significantly to FV intake (Path b, Pearson’s $r$-values were 0.24–0.45), these analyses were not repeated in the present study. Only factors significantly related to the respective educational/income variable were included in the further analyses. In the next phase, parental education/income was related to FV intake adjusting for single potential mediators individually (Path c adjusted for single mediators, $Y_{FV} = \tau X_{edu} + \beta X_{Mi}$) (Model I, table 2) and all potential mediators together (Path c adjusted for all mediators, $Y_{FV} = \tau X_{edu} + \beta X_{M1} + \ldots + \beta X_{M6}$) (Model II, table 3). This final analysis was repeated excluding each potential mediator at a time (Model III, table 3) in order to state each mediator’s unique contribution to the explanation of the variance in the socioeconomic disparity in FV intake. The proportions mediated by the presumed mediators were calculated by subtracting the adjusted relationship between parental education and FV intake (e.g. $\tau$) from the unadjusted ($\tau$) and dividing the sum by the unadjusted value (i.e. $\tau - \tau / \tau$). By subtracting the proportion mediated in Model III from the proportion mediated in Model II, the unique contribution to the multimediator model (Model 2) by each moderator was calculated. An examination of the residuals did not reveal unacceptable departures from normality. Attrition analyses were conducted on baseline data (September 2001, n = 896). Dropouts in May 2002 (n = 83), May 2005 (n = 168) and those adolescents’ without parental data (n = 158) were compared with the remaining sample on all variables described. All analyses were conducted using SPSS 14.

**Results**

**Parental education**

Table 1 shows that adolescents of parents with higher education reported to eat FV more often than adolescents of parents without higher education. As an interaction between parental educational level and time was observed ($P = 0.04$), the results were stratified (and the further mediation analyses were also conducted separately for 2002 data and for 2005 data). The educational disparity in FV intake was greater in 2005 (15.1 vs. 12.7 times/week for adolescents of parents, respectively, with and without higher education) than in 2002 (14.0 vs. 12.8 times/week, respectively). In addition, pupils of parents with higher education reported significantly higher values for perceived accessibility, preferences and knowledge (interaction not significant). Interactions between education...
level and time were seen for modelling and intention \((P = 0.01\) and \(P = 0.02\), respectively). In both, the differences between the educational levels were significant only in 2005.

In the single mediation analyses, all potential mediators mediated parts of the educational disparity in FV intake (table 2) but only in 2002 did the single mediators decrease the educational difference to a level below statistical significance. Perceived accessibility alone explained much of the educational disparity in FV intake: 90\% (2002) and 52\% (2005), more than any other variable. In the multiple mediation analyses (table 3), the mediators together explained 92\% (2002) and 60\% (2005) of the educational disparity, with perceived accessibility contributing the largest amount [45\% (2002) and 14\% (2005)]. The other factors contributed little to the explanation in the multiple mediator models; much of the explanation of the variance was explained by shared variance of two or more of the potential mediators.

### Family income

No interaction was observed between family income and time \((P = 0.86)\); therefore, the results for family income are presented together for 2002/2005 (and only in the text).

A disparity in adolescents’ FV intake was observed with family income \((13.1 \text{ vs. } 14.2 \text{ times/week, respectively})\). In addition, pupils of families with a high income reported higher accessibility of FV at home \((5.0 \text{ vs. } 4.1, P < 0.001)\) and stronger modelling \((3.2 \text{ vs. } 2.6, P = 0.003)\). Intention, preferences, self-efficacy and knowledge did not show any disparity based on family income.

In the single mediation analyses, both perceived accessibility and modelling mediated large parts of the family income disparity, 80 and 39\%, respectively. In the multiple mediation analyses, perceived accessibility and modelling together explained 89\% of the family income disparity, with perceived accessibility contributing 50\% and modelling 9\% uniquely and with 30\% being explained by shared variance of the two.

### Attrition analyses

No significant differences were seen between the dropouts in May 2002 and the remaining sample at the baseline survey of the project (September 2001). The dropouts in May 2005 had a lower FV intake \((12.1 \text{ vs. } 14.5 \text{ times/week, } P < 0.001)\), lower perceived accessibility of FV at home \((3.0 \text{ vs. } 3.9, P = 0.004)\), lower intentions \((-0.2 \text{ vs. } 0.2, P < 0.001)\) and lower preferences \((1.8 \text{ vs. } 2.9, P = 0.003)\) than the remaining sample. No significant differences were seen between those adolescents with or without parental data.
Table 3 Multiple mediation analyses: effect of parental educational level on adolescents’ FV intake after adjusting for accessibility, modelling, intention, preferences, self-efficacy and knowledge (model II), and after exclusion of single factors (models III)

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<th>Estimate</th>
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<td>0.4</td>
<td>0.14</td>
<td>(1 − β)/t</td>
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<td>0.7</td>
<td>0.17</td>
<td>(1 − β)/t</td>
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<td>0.1</td>
<td>0.91</td>
<td>(1 − β)/t</td>
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<td>0.1</td>
<td>0.77</td>
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<tr>
<td>Knowledge</td>
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<td>0.14</td>
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<td>1.0</td>
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Unadjusted difference in FV intake; 2002 (β = 1.3), 2005 (β = 2.4)

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<td>Knowledge</td>
<td>0.3</td>
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*Greater knowledge, health considerations and greater support from family and friends may also cause people with higher education levels to prioritize FV purchase more than that of people with less education. However, more research is clearly needed in order to figure out how to increase accessibility in low SES homes.

The results of this study may also support findings from previous papers that state that socioeconomic disparities might develop during adolescence, the educational disparities in FV intake, modelling and intention in the present study were greater in 2005 than in 2002. However, for family income no significant interactions between income and time (survey) on FV intakes were observed. The difference in FV intake among adolescents of families with high versus low income was less than that reported for parental education, yet significant.

There are some limitations to this study. First, there is a problem of covariation. Several of the scales are correlated. A correlation matrix of the scales used in the present study was previously published by Bere and Klepp. Such intercorrelation between the variables makes it difficult to assess which variable predicts behaviour and to what extent. However, both in the single- and the multimediator analyses, perceived accessibility clearly appeared as a greater mediator than the other variables. Second, the adolescents themselves answered questions about home accessibility; therefore, the responses were a subjective measure that may not necessarily have reflected the true accessibility. However, parents within the FVMM cohort also reported disparities of similar magnitude in adolescents’ home accessibility (data not reported), indicating good interobserver reliability. Third, parental education was assessed as the educational level of the parent who responded to the questionnaire, which did not necessarily reflect the overall level of education within the family. Respondents of the parent questionnaire were more often women (85%) than men. Fourth, the dropouts in May 2005 were significantly different from the study sample; they scored
lower on several scales. By losing this group the variation in the sample decreased and therefore it was probably more difficult to detect differences within the sample. The results found should therefore be convincing. Fifth, data for the present study were collected in May. The disparities reported might be different during other parts of the year due to availability of local produce, price and/or seasonal products.

Conclusions

This study contributes to the knowledge of how to decrease socioeconomic disparities in eating behaviours and health. Parental educational disparity in adolescents’ FV intake increased as the adolescents aged. Home accessibility appears to be the strongest mediator of the relationship between parents’ educational level (as well as for family income) and adolescents’ FV intake and might therefore be an important target for future interventions that aim to reduce socioeconomic disparities in adolescents’ FV intakes.

Funding

Norwegian Research Council.

Conflicts of interest: None declared.

Key points

- The educational disparity in adolescents’ FV intake increased from 2002 (age 12.5 years) to 2005 (age 15.5 years).
- Accessibility of fruit and vegetables at home appears to be the strongest mediator of the relationship between parents’ educational level (and family income) and adolescents’ fruit and vegetable intake.
- Future interventions aiming to reduce socioeconomic disparities in adolescents’ fruit and vegetable intake should aim to increase the accessibility of fruits and vegetables in the adolescents’ homes.

References

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