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Correlates of fruit and vegetable intake among Norwegian schoolchildren: parental and self-reports

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Abstract

Objectives: To identify correlates of 6th and 7th graders' (age 10–12 years) fruit and vegetable intake, to investigate parent–child correlations of fruit and vegetable intake, and to compare parents' and children's reports of children's accessibility, skills and preferences with respect to fruit and vegetables.
Design: The results presented are based on the baseline survey of the 'Fruits and Vegetables Make the Marks Project', where 38 schools participated.
Setting: Fruit and vegetable intake was measured by food frequency questions. Theoretical factors, based on Social Cognitive Theory, potentially correlated to intake were measured, including behavioural skills, accessibility, modelling, intention, preferences, self-efficacy and awareness of 5-a-day recommendations.
Subjects: In total, 1950 (participation rate 85%) 6th and 7th graders and 1647 of their parents participated.
Results: Overall, 34% of the variance in the pupils' reported fruit and vegetable intake was explained by the measured factors. The strongest correlates to fruit and vegetable intake were preferences and accessibility. The correlation between the children's and their parents' fruit and vegetable intake was 0.23. The parents perceived their children's accessibility to be better than what was reported by the children ($P < 0.01$), while the children reported their skills to be better than what was perceived by their parents ($P < 0.01$).
Conclusion: The results from this study clearly point to a need for nutrition interventions aimed at parents. An important next step will be to investigate whether the identified correlates predict future fruit and vegetable intake, and whether they mediate any changes in intake in an intervention study.

Keywords
Fruit
Vegetables
Correlates
Schoolchildren
Norway

Epidemiological evidence for the health benefits of eating fruit and vegetables is convincing[1]. In Norway, the average intake of fruit and vegetables among adults is only about half the recommended amount[2,3]. This also holds true for children and adolescents[2,4]. To increase fruit and vegetable intake, knowing what factors determine intake in specific target groups is essential[5].

Correlates of fruit and vegetable intake among children and adolescents have been studied in a number of settings, and statistically significant relationships have been found between fruit and vegetable intake and factors such as knowledge levels[6,7], outcome expectations[6,8–10], preferences[6,10–14], self-efficacy[6,9,10,12,15], family and peer influences[6,14,16–18], availability and/or accessibility[6,9,19–22], as well as demographic factors including gender, age and socio-economic status[16]. The reported strengths of these relationships are, however, rather low. Most reported bivariate correlation coefficients between a determinant and adolescent fruit and vegetable intake are moderate to weak (0.1–0.2), and none above 0.4 have been reported. Furthermore, only a few analytical studies investigating correlates of fruit and vegetable intake among European children and adolescents have been conducted[7,18,23,24].

Social Cognitive Theory (SCT) can serve as a useful theoretical framework when investigating factors associated with fruit and vegetable intake[25,26]. SCT postulates that behaviour, including dietary behaviour, is the result of environmental factors (such as easily accessible fruit and vegetables or observation of important others performing the behaviour) and personal factors (such as preferences or self-efficacy). SCT also postulates that behaviour can affect environment and cognitions, and that all three factors (behavioural, personal and environmental) affect one another in constant reciprocal relationships[26].

Parents are important sources of influence on their children's diets[11,27]. They are responsible for the eating environment at home, decide what food to purchase and what to serve, and serve as important role models. Few studies have assessed parent–child correlations in food intake[27]. One study assessing mother–child correlations of

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fruit and vegetable intake showed a strong correlation for fruit intake ($r = 0.36$), but no correlation for vegetable intake ($r = 0.00$)[18].

When assessing environmental influences of children's fruit and vegetable intake, parents are believed to be able to provide more objective information than their children on factors such as their own intake (modelling) and their children's fruit and vegetable accessibility at home. Parents are also seen as being able to assess their children's behavioural skills and preferences regarding fruits and vegetables. Having children and their parents respond to parallel questions assessing potential determinants for the children's fruit and vegetable intake allows us to compare children's and their parents' reports, and to assess the relative importance of parental intake as correlated to children's eating behaviours. Parent–child comparisons regarding correlates to the children's intake, including children's accessibility, skills and preferences, have not previously been investigated.

The purpose of the present study was to identify environmental and psychosocial correlates of 6th and 7th graders' fruit and vegetable intake, applying SCT and utilising data provided by both pupils and their parents. Furthermore, we investigated the parent–child correlations of fruit and vegetable intake, and compared parents' and children's reports of children's accessibility, skills and preferences with respect to fruit and vegetables.

Methods

Sample and procedure

The results presented here are based on the baseline survey of the 'Fruits and Vegetables Make the Marks Project.' The project included 38 schools from Hedmark and Telemark counties in Norway. Small schools with fewer than 10 pupils per grade level were excluded from the sampling frame. Among the remaining primary schools in these two counties, 48 (24 per county) were selected randomly and invited to participate, and 19 schools from each county agreed to participate. All 6th and 7th graders in these 38 schools were invited to take part in the baseline survey. Informed consent was sought from both parents and the children prior to the study. Ethical approval and research clearance was obtained from The National Committees for Research Ethics in Norway and from The Norwegian Social Science Data Services.

A survey questionnaire was completed by pupils in the classroom, in the presence of a trained project worker. One school lesson (45 min) was used to complete the questionnaire. A total of 1950 (out of 2287 eligible, 85%) pupils completed the questionnaire and brought home a parent questionnaire to be completed by one of their parents. Fifty-nine (3%) children–parents refused to participate, one class (27 children, 1%) was not able to carry out the survey, and 251 (11%) children did not attend this specific school lesson and were not re-contacted. Of the 1950 pupils who completed the questionnaire, 984 were boys and 966 were girls. A total of 1028 pupils were in 6th grade and 922 were in 7th grade. Age or date of birth was not recorded, but based on available data from similar surveys; the average age of the sample is estimated to be 11.8 years. Overall, 1647 parents (84% of the participating pupils) completed the parent questionnaires; 84% of these were mothers/female guardians. The average age of the parents was 40.0 years.

Instrument

Two questionnaires were developed to measure the intake of fruit and vegetables among the children and their parents and to identify correlating factors of the children's intake. Repeated pre-testing, a test–retest study of both questionnaires and a validation study of the children's questionnaire were conducted prior to the baseline survey, indicating that the instruments had acceptable to good reliability. With respect to the potentially correlating factors, Pearson's test–retest correlation coefficients ranged from 0.51 to 0.74 for the children and from 0.78 to 0.84 for the parents[28]. The measure of fruit and vegetable intake had good reproducibility. Spearman's test–retest correlation coefficients between the test and the retest assessments were 0.75 for the children[29] and 0.80 for the parents (not previously reported). The Spearman's correlation coefficient between the children's fruit and vegetable intake and the validation method (7-day food diaries) was 0.32, which is similar to results found in other studies[29].

Pupil questionnaire

Behavioural factors. Fruit and vegetable *Intake* was measured by four frequency questions: 'How often do you eat vegetables for dinner?,' 'How often do you eat other vegetables (e.g. carrot for school lunch)?', 'How often do you eat apple, orange, pear or banana?' and 'How often do you eat other fruits or berries?' All four questions had 10 response alternatives ranging from 'never' = 0 to 'several times a day' = 10. Fruit and vegetable *Behavioural Skills* were measured by five statements, including: 'It happens that I cut up fruits or vegetables for myself as a snack'. The five items were measured on a 5-point scale ranging from 'I fully disagree' to 'I fully agree', and were scored from −2 to 2.

Environmental factors. Accessibility assessed the physical environment, and included five availability and accessibility statements, such as: 'Mother or father sometimes cuts up fruit or vegetables for me as a snack'. The *Modelling* scale assessed the perceived behaviour of important others (mother, father, friends and siblings, and home economics teacher): e.g. 'My mother eats lots of fruit and vegetables'. The accessibility and modelling items were scaled and scored as the *Behavioural Skills* items.

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Personal factors. Four personal factors were believed to be related to fruit and vegetable behaviours: intention (to eat 5-a-day), fruit and vegetable preferences, self-efficacy with respect to 5-a-day, and awareness of the Norwegian fruit and vegetable recommendation (5-a-day). *Intention* was measured by one item: 'I intend to eat at least 5 servings of fruit and vegetables a day'. *Preferences* were measured by four items, including: 'Fruit and vegetables make my meals taste better'. *Self-efficacy* was measured by three items, including: 'For me, it would be easy to eat more than 5 servings of fruit and vegetables every day'. The *Intention*, *Preferences* and *Self-efficacy* items were scaled and scored as the *Behavioural Skills* items described above. *Awareness* (of 5-a-day) was measured by one question: 'How many servings of fruit and vegetables should a person at your age eat every day?' This question had seven response alternatives ranging from 'none' = 0 to 'more than 5 a day' = 6.

Parent questionnaire

The parent questionnaire assessed items relating to the fruit and vegetable intake of the children. *Child's Behavioural Skills*, a behavioural factor, included four statements comparable to four of the pupil *Behavioural Skills* items, including: 'It happens that my child cuts up fruit or vegetables for him-/herself as a snack'. *Parent's Own Fruit and Vegetable Intake*, an environmental factor (modelling) for the pupils, was measured by the same four food frequency questions as for the pupils. *Child's Accessibility* was measured by five items, corresponding to the pupil items, such as: 'I (or my partner) sometimes cut up fruit or vegetables for my kid as a snack'. *Child's Preferences* were measured by two items: 'My kid likes fruit very much' and 'My kid likes vegetables very much'. The *Child's Behavioural Skills*, *Child's Accessibility* and the *Child's Preferences* items were also scaled and scored as the *Behavioural Skills* items.

All scales, including the number of items in the scale, range, number of participants, mean value, standard deviation and Cronbach's alpha value, are presented in Table 1. In addition to these measures, demographic items and items regarding other health behaviours were included in this study, and were used in the attrition analysis for this paper.

Statistics

Missing values on any items were substituted by the mean value for the remaining group on the respective item. To achieve a score on a scale, more than 50% of the scale items had to be answered. A total of 268 children and 40 parents had one or more missing values substituted. While the missing substitution increased the number included in the analyses, it did not alter the findings presented in this paper. Multiple regression assumptions regarding normality, linearity and homoscedasticity were found to be acceptable, and therefore parametric statistics have been used. Multiple regression analyses were performed to determine the explained variance of the children's fruit and vegetable intake. Analyses were performed first with only the pupil scales as independent variables, then with only the parent scales as independent variables, and then with both pupil and parent scales combined. Regression coefficients (B) and standardised regression coefficients (β) are given for each independent variable. The unique amount of variance in intake explained by an independent variable is given by the square of the semi-partial correlation (sri2)[30,31]. For each of the three analyses, the multiple correlation (R), the variance explained (R^2) and the adjusted variance explained (adj. R^2) are given. Pearson's correlation coefficients were computed to show the non-adjusted relationship between each variable and the intake, the relationship between the variables, and between the single items. Paired sample t-tests were used to assess differences in mean values in the parent–child comparisons, and two-sample t-tests were used to assess mean differences in the attrition analysis. Non-parametric tests were also applied, but the results did not differ from the parametric tests, and are therefore not reported.

Table 1 Description of the variables assessed, with the number of items, mean score, standard deviation (SD) and Cronbach's alpha

SCT domain	Scale	No. of items	Range	*n*	Mean	SD	Cronbach's alpha
Pupils							
Behavioural	*Intake* (times/week)	4	0/40	1926	14.1	7.2	NA
	Behavioural Skills	5	−10/10	1948	1.1	4.1	0.62
Environmental	*Accessibility*	5	−10/10	1947	3.9	3.6	0.49
	Modelling	4	−8/8	1913	2.0	2.7	0.46
Personal	*Intention* (to eat 5-a-day)	1	−2/2	1936	0.2	1.3	NA
	Preferences	4	−8/8	1939	2.6	3.7	0.68
	Self-efficacy (to eat 5-a-day)	3	−14/14	1943	0.1	2.6	0.44
	Awareness (of 5-a-day)	1	0/6	1914	3.5	1.5	NA
Parents							
Behavioural	*Child's Behavioural Skills*	4	−8/8	1631	0.5	3.7	0.62
Environmental	*Parent's Intake* (times/week)	4	0/40	1632	14.2	5.8	NA
	Child's Accessibility	5	−10/10	1645	5.2	3.1	0.43
Personal	*Child's Preferences*	2	−4/4	1629	1.6	2.1	0.60

SCT – Social Cognitive Theory; NA – not applicable.

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The chi-square test was used for dichotomous items in the attrition analysis.

Results

All independent variables were significantly correlated to the pupils' fruit and vegetable intake (Table 2). *Behavioural Skills*, *Preferences* and *Accessibility* were most strongly correlated to intake. As *Behavioural Skills* was highly correlated with *Intake* (0.57), and since it can be seen as a measure of aspects of fruit and vegetable eating behaviour, it (and its corresponding parent scale) has not been included as a determinant of intake in the multivariate analyses.

The six remaining pupil measures alone explained 31% of the variance in the pupils' fruit and vegetable intake (Table 3, analysis A), with *Intention* being the only non-significant variable. Overall, 12% of the variance was explained by a unique contribution to the explanation, while the remaining 19% was variance shared by two or more concepts. *Accessibility* and *Preferences* contributed most of the unique variance explained: 5% and 4%, respectively. The three parent measures explained 12% of the variance in the pupils' fruit and vegetable intake (Table 3, analysis B). *Child's Accessibility* was not significant. About 8% of the variance was explained by a unique contribution to the explanation. *Child's Preferences* and *Parent's Intake* contributed most of the unique variance explained – 6% and 2%, respectively. Together, the nine pupil and parent scales explained 34% of the variance in the pupils' fruit and vegetable intake (Table 3, analysis C). *Intention* and *Child's Accessibility* were the only variables that did not contribute significantly to the explanation. About 12% of the variance was explained by a unique contribution to the explanation. *Accessibility* and *Preferences* contributed most of the unique variance

Table 2 Pearson's correlation between all variables

		1	2	3	4	5	6	7	8	9	10	11	12
Pupils													
1	*Intake* (FFQ)	1											
2	*Behavioural Skills*	0.57	1										
3	*Accessibility*	0.44	0.50	1									
4	*Modelling*	0.24	0.32	0.34	1								
5	*Intention* (to eat 5-a-day)	0.30	0.44	0.29	0.24	1							
6	*Preferences*	0.45	0.63	0.40	0.27	0.51	1						
7	*Self-efficacy* (to eat 5-a-day)	0.34	0.46	0.31	0.22	0.48	0.49	1					
8	*Awareness* (of 5 a day)	0.25	0.18	0.16	0.07	0.32	0.23	0.24	1				
Parents													
9	*Child's Behavioural Skills*	0.29	0.35	0.15	0.08	0.16	0.31	0.20	0.10	1			
10	*Parent's Intake* (FFQ)	0.23	0.13	0.20	0.17	0.05**	0.13	0.10	0.05*	0.30	1		
11	*Child's Accessibility*	0.20	0.17	0.29	0.12	0.06*	0.09	0.09	0.06*	0.39	0.49	1	
12	*Child's Preferences*	0.29	0.33	0.12	0.09	0.15	0.33	0.19	0.07	0.66	0.20	0.25	1

FFQ – food frequency questions.
Most correlations are significant at the 0.01 level (two-tailed).
* Correlation significant at the 0.05 level (two-tailed).
** Correlation not significant at the 0.05 level (two-tailed)

Table 3 Explaining the variance in children's fruit and vegetable intake using pupil and parent variables (multiple regression)

	Analysis A ($n = 1846$)				Analysis B ($n = 1596$)				Analysis C ($n = 1534$)			
	B	β	*P*-value	sri2	*B*	β	*P*-value	sri2	*B*	β	*P*-value	sri2
Pupils												
Accessibility	0.52	0.27	<0.01	0.054					0.50	0.26	<0.01	0.047
Modelling	0.12	0.05	0.03	0.002					0.13	0.05	0.03	0.002
Intention (to eat 5-a-day)	−0.02	0.00	0.90	0.000					−0.01	0.00	0.93	0.000
Preferences	0.51	0.26	<0.01	0.042					0.40	0.21	<0.01	0.024
Self-efficacy (to eat 5-a-day)	0.26	0.10	<0.01	0.006					0.24	0.09	<0.01	0.005
Awareness (of 5-a-day)	0.58	0.12	<0.01	0.013					0.59	0.12	<0.01	0.014
Parents												
Parent's Intake (FFQ)					0.18	0.15	<0.01	0.017	0.12	0.10	<0.01	0.007
Child's Accessibility					0.13	0.06	0.04	0.002	−0.02	−0.01	0.66	0.000
Child's Preferences					0.82	0.25	<0.01	0.057	0.48	0.14	<0.01	0.017
R	0.558				0.342				0.587			
R^2	0.311				0.117				0.345			
Adj. R^2	0.309				0.115				0.341			
Sum sri2				0.118				0.077				0.116

FFQ – food frequency questions.
Analysis A – only pupils' scales are included as independent variables in the model; Analysis B – only parents' scales are included as independent variables in the model; Analysis C – pupils' and parents' scales are included as independent variables in the model.

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explained — 5% and 2%, respectively. Analysis A was also done on a reduced sample including only pupils whose parents had participated. The results did not differ from those reported in Table 3. The results are presented by gender and grade combined, since no significant gender or grade interactions were seen for any of the factors.

Based on the applied frequency measure, children and their parents reported eating fruits and vegetables equally as often (14.1 vs. 14.2 times/week). The correlation between children's and parents' fruit and vegetable intake was 0.23 (Table 2), the correlations for fruits and vegetables were 0.18 ($P < 0.001$) and 0.22 ($P < 0.001$), respectively.

The parent–child correlations on the parallel scales, *Behavioural Skills*, *Accessibility* and *Preferences*, were moderate (0.30–0.35) (Table 2). The parents perceived the accessibility for their children to be better than that reported by the children. The children, on the other hand, reported their skills to be better than what was perceived by their parents (Table 4). Correlations between parents' and children's responses on single parallel accessibility and skills items ranged from 0.13 to 0.40, all statistically significant (Table 4).

Compared to children with participating parents ($n = 1647$), the children without participating parents ($n = 303$) ate less fruit and vegetables. Furthermore, they had significantly lower scores on the scales assessing skills, accessibility and preferences. Pupils with non-participating parents also were more likely to be boys, in 7th grade, living with a single parent, and to have experimented with cigarette smoking (Table 5).

Discussion

This study shows that a large portion of 6th and 7th graders' fruit and vegetable intake can be explained by environmental and personal factors, as postulated by SCT.

Preferences and accessibility seem to be the strongest correlates to the children's fruit and vegetable intake. This is consistent with findings from previous studies. Woodward *et al.*[14] showed that 12- to 15-year-old pupils' liking of a particular fruit or vegetable (apple, orange juice, potato and tomato) was associated with their usage of that type, and was also more strongly associated with intake than perceived healthfulness, perceived friends' usage and perceived parents' usage (only orange juice and potato). Domel *et al.* reported correlations between preferences and consumption among 4th- and 5th-grade pupils by asking participants how much they liked 10 frequently consumed fruits and vegetables[12,13]. Correlation between fruit preferences and fruit consumption were reported to be 0.25 and 0.20, and between vegetable preferences and vegetable consumption correlations were 0.28 and 0.27 in two separate studies[12,13]. Resnicow *et al.*[10] reported a correlation of 0.29 between fruit and vegetable preferences and fruit and vegetable intake using the same preference measures as Domel's, but combining fruit and

Table 4 Parent–child comparisons on parallel items of accessibility and behavioural skills

		Pupils		Parents			
	n (pairs)	Mean	SD	Mean	SD	*P*-value*	Pearson's correlation**
***Accessibility* items**							
At home we usually always have fruit and vegetables in the refrigerator	1638	1.2	1.2	1.5	0.9	<0.01	0.19
At home I am (my child is) allowed to eat fruit and vegetables whenever I (he/she) want(s)	1634	1.6	0.8	1.7	0.7	<0.01	0.13
Mother or father do (I or my partner) sometimes cut up fruit or vegetables for me (my child) as a snack	1627	−0.2	1.5	−0.1	1.5	<0.01	0.23
At home we usually have vegetables at dinner every day	1622	0.3	1.4	1.0	1.2	<0.01	0.22
At home we usually have fruit available in a (fruit-) bowl	1642	1.2	1.3	1.1	1.2	0.11	0.40
Sum	1572	4.0	3.7	5.2	3.2	<0.01	0.30
***Behavioural Skills* items**							
It happens that I cut (my child cuts) up fruit or vegetables for myself (him-/herself) as a snack	1631	0.2	1.4	−0.3	1.5	<0.01	0.21
It happens often that I find (my child finds) myself (him-/herself) fruit and vegetables at home between meals	1625	1.0	1.2	1.0	1.2	0.03	0.31
I (my child) always finish (eats up) my (his/her) vegetables for dinner	1630	0.7	1.4	0.4	1.4	<0.01	0.33
I eat (my child eats) fruit or vegetables at every meal	1613	−0.7	1.1	−0.6	1.2	0.18	0.18
Sum	1569	1.3	3.3	0.5	3.7	<0.01	0.34

SD – standard deviation.
* Paired samples *t*-test.
** All correlations are significant at the 0.01 level.

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Table 5 Comparison of pupils with parents participating and pupils without parents participating

	Pupil and parent data ($n = 1647$)	Pupil data only ($n = 303$)	*P*-value*
Sex (% female)	51	42	< 0.01
Grade (% 6th grade)	54	44	< 0.01
Live with single parent (%)	16	29	< 0.01
Tried smoking a cigarette (%)	13	23	< 0.01
Tried alcohol (%)	45	51	0.05
Trying to lose weight (%)	8	11	0.03
TV/PC usage (h day^{-1})	2.0	2.3	0.03
Physical activity (times/week)	3.3	3.3	0.76
FV intake (times/week)	14.3	13.2	0.02
Behavioural Skills	1.2	0.5	0.01
Accessibility	4.0	3.4	0.01
Modelling	2.0	1.8	0.18
Intention (to eat 5-a-day)	0.3	0.1	0.14
Preferences	2.8	2.1	< 0.01
Self-efficacy (to eat 5-a-day)	0.1	0.1	0.83
Awareness (of 5-a-day)	3.5	3.4	0.27

TV/PC – television/personal computer; FV – fruit and vegetable.
* Chi-square test for all dichotomous items, otherwise independent samples *t*-test.

vegetable preference into one scale. Reynolds *et al.*[6], also using the preferences measures developed by Domel and colleagues, found that preferences, as a part of a motivation latent construct together with perceived self-efficacy and outcome expectancies, was a correlate to 4th-grade children's fruit and vegetable intake.

Few studies have investigated the relationship between availability/accessibility of fruit and vegetables at home and children's intake of fruit and vegetables. Kratt *et al.*[21] showed that children (4th graders) from homes with high levels of fruit and vegetables available/accessible had a higher consumption of fruit and vegetables than children from homes with medium and low levels of fruit and vegetables available/accessible. Significant differences were found between all three groups. Hearn *et al.*[20] have shown that home availability and accessibility of fruits and vegetables is positively related to 3rd graders' fruit and vegetable consumption. The availability measures used in these two studies were similar; parents were asked whether a number of different fruit and vegetables had been available and accessible at home the previous week. Reynolds, using the availability measures developed by Hearn and colleagues, reported that availability had a direct effect on consumption in two out of four subsamples, and an indirect effect through motivation (same latent construct as described above) in the other two. A study asking 4th–6th graders the same kinds of questions found significant correlations between fruit and vegetable consumption and both fruit availability ($r = 0.17$) and vegetable availability ($r = 0.28$)[17].

The relationships between preferences and intake and availability/accessibility and intake appear higher in our study than reported elsewhere. This could be because we used somewhat different measures for preferences and availability, as well as a different method for assessing intake. Our measure of preferences was a more general measure, asking, on a 5-point scale, to what degree the participants agreed with statements about how well they liked fruit and/or vegetables in general. Our accessibility items were more situational than other availability/accessibility measures, assessing whether fruit or vegetables in general were available or accessible, and usual/habitual accessibility was measured (rather than availability/accessibility for the past week). Fruit and vegetable intake was also measured as the usual/habitual intake (over the last three months) with food frequency questions. Most other studies measured actual intake with a single 24-hour recall[6,21] or with 3–7 days of recording[10,12,13,17,20]; only one other study measured intake by food frequency questions[14].

All other variables, besides preferences and accessibility, were correlated to the children's intake, but in the multiple regression analysis, because of their correlation with other constructs, their contribution to explaining the variance diminished. Ideally, the inter-correlation between independent variables should be low, while each variable should be strongly associated with the behaviour[31]. Large inter-correlation between the independent variables makes it difficult to assess which variables predict behaviour and by how much[31]. In regression analysis A (Table 3, analysis A), 31% of the variance in the intake was explained. Only 12% of the variance in intake was explained by unique contribution of the significant independent variables, almost exclusively by preferences and accessibility. The remaining 19% of the variance was explained by the shared variance of two or more independent variables. This is a common problem, as variables related to the same behaviour naturally correlate with one another. This 'shared variance' problem creates

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challenges to developing more precise measures of the various constructs.

The correlation observed between the children's and their parents' fruit and vegetable intake indicates that the parents' intake is a potential determinant for the children's intake. Parents' intake also contributed to some unique variation in the explanation of the children's intake. The parent–child correlations for fruit and vegetables separately were of the same magnitude as for fruit and vegetables combined, indicating that there is an association between children's and their parents' intake for both fruit and vegetables, not for fruit only, as previously reported[18].

The parent–child correlations of the three parallel scales (*Behavioural Skills*, *Accessibility* and *Preferences*) appear rather low. Since these scales should measure the same phenomenon, but still are only moderately correlated, it is clear that one cannot be substituted for another. Parents and their children seem to perceive the children's accessibility and skills differently. Overall, the participating parents perceived their children's accessibility to be much higher than did the children themselves. At the same time, the children perceived their own skills to be higher than did their parents. The observed discrepancy in perceived accessibility is of major concern since accessibility, as shown, is a strong correlate for the children's intake of fruits and vegetables. If the parents perceive the accessibility to be good enough, as indicated in this study by high mean item scores, such perceptions could be barriers to increasing intake of fruits and vegetables among children.

Children whose parents did not participate differed from children with participating parents with regard to demographic variables, health-related behaviours and fruit and vegetable intake measures. However, when conducting the regression analysis (presented in Table 3, analysis A) among only those children whose parents participated, the results did not change. Thus, we do not believe that the attrition observed in this study reduces the generalisability of the findings.

Conclusions and implications

A significant amount of the variance in 6th and 7th graders' fruit and vegetable intake was explained by the factors included in this study. Preferences and accessibility to fruits and vegetables were most strongly correlated to fruit and vegetable intake among children. Both the children's fruit and their vegetable intake correlated with their parents' respective intake. Children and their parents perceived the children's accessibility to and skills related to fruit and vegetables differently.

Accessibility to fruit and vegetables appears to be an important factor for children's fruit and vegetable intake. Parents tended to perceive their children's accessibility to fruit and vegetables to be better than what the children themselves perceived. Since parents are in control of access to fruit and vegetables at home and their intake is correlated to the children's intake, nutrition interventions aimed at parents are clearly needed.

An important next research step will be to investigate whether the identified correlates predict future fruit and vegetable intake in both prospective cohort studies as well as longitudinal experimental intervention studies. Also important is studying whether these correlates mediate changes in intake. Such mediation studies are clearly lacking[5,32].

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