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Children's and parents' perceptions of the determinants of children's fruit and vegetable intake in a low-intake population

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Abstract

Objective: To study the differences between children's self-reports and parents' reports on environmental determinants of fruit and vegetable intake among 11-year-old children in the European country with the lowest reported consumption. A second objective was to examine the observed variance in fruit and vegetable intake among the children.

Design: A cross-sectional survey was performed in Iceland as a part of the Pro Children cross-Europe survey. Children's usual fruit and vegetable intake and its determinants were assessed through self-reports from the children (*n* 963) and their parents' reports.

Results: Children reported lower availability and accessibility of fruits at home than did their parents, while the reports of children and parents for vegetables were more in agreement. A larger proportion of the observed variance in children's fruit and vegetable intake could be explained by the child's perception than by the parent's perception of determinants. The strongest determinants for fruit and vegetable intake according to the children's reports were availability at home, modelling, demanding family rule and knowledge of recommendations. The strongest modelling determinant for fruit was the father's fruit intake while for vegetables it was eating vegetables together with the family.

Conclusion: Eleven-year-old children should be asked themselves what determines their fruit and vegetable intake. However, children reported determinants in the physical and social environment, of which the parents are a part, as an important determinant for their intake. Interventions aiming to increase fruit and vegetable intake among children must therefore target the parents.

Keywords
Fruits
Vegetables
Determinants
Schoolchildren
Iceland

Epidemiological evidence suggests that regular fruit and vegetable intake helps to promote health and prevent chronic disease[1–3]. The health benefits of fruits and vegetables seen in epidemiological studies are the main reason for the recommended intake of at least 400 g of fruits and vegetables per day[4]. However, large population groups, particularly in northern Europe, eat far less than the recommended amount of fruits and vegetables.

The present study is a part of the Pro Children cross-Europe survey, involving nine European countries. The survey aims to assess fruit and vegetable consumption among 11-year-old schoolchildren and their parents, and to elucidate the potential determinants of consumption at the individual, social and environmental level[5,6]. Knowing the determinants of behaviour is necessary to develop an intervention. Insight into the determinants of fruit and vegetable consumption where intake is low can possibly be used to increase intake in low-intake population groups. An intervention aimed at increasing fruit and vegetable intake among children is likely to maximize health benefits, as healthy food habits acquired in childhood tend to continue into adulthood[7] and children are more apt to change their food habits than adults[8,9]. Parents are determinants of the environment for young children; parent's behaviour has therefore been an obvious area for attention[9–12]. There are, however, only a few studies assessing child–parent agreement of the determinants of children's food intake, especially their fruit and vegetable intake: a Norwegian study and two Dutch studies[13–15]. In the Pro Children cross-Europe survey, children and parents were asked parallel questions on the environmental determinants of fruit and vegetable intake, making it possible to study differences in perception.

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The results from the Pro Children cross-Europe survey showed that fruit and vegetable intake among children was lowest in Iceland[16]. Sixty-four per cent of Icelandic children ate fruit less than once per day, and 61% ate vegetables less than once per day. Fruit and vegetable intake among mothers in Iceland was low[17]. Determinants of fruit and vegetable intake, based on children's self-reports, have been studied. Respectively, 31% and 39% of the variance in children's fruit intake and vegetable intake was explained by the determinants studied[18]. The major environmental determinants were availability at home, which was positively related to both fruit and vegetable intake, as was modelling and demand family rule, while active encouragement was negatively related to intake. Self-efficacy was the strongest personal determinant of fruit intake, followed by knowledge of recommendations, attitudes, preferences and liking. For vegetable intake, preferences and liking were the strongest personal determinants, followed by knowledge of recommendations and self-efficacy.

The present study focuses on determinants in the physical and the social environment, of which the parents are part, and which in turn influence the more proximal determinants found at the personal level. The objective of the present study was to study differences between children's self-reports and parents' reports on the physical and social environmental determinants of fruit and vegetable intake of children in Iceland. A second objective was to examine the observed variance in fruit and vegetable intake among the children.

Methods

Sample and procedure

A cross-sectional survey was performed in Iceland (in the autumn of 2003) as part of the Pro Children cross-Europe survey. A random national sample of thirty-three primary schools was selected from a list from Statistics Iceland. Research approval was obtained from the Icelandic Data Protection Authority. Approval to contact the schools was obtained from the Reykjavik School District Head Office and Service Centre. The headmasters of the schools were approached about their willingness to participate (thirty-two schools participated), and the class teachers were asked to collect the data using standardized instructions. Children in the sixth grade (born 1992) answered a self-administered questionnaire, with instructions and help from the teacher. The children were sent home with questionnaires for their parents. A total of 1235 children, and 981 parents, returned the questionnaire. All children and their parents received written information on the project. The parent–child pairs were identified through labelling of the otherwise anonymous questionnaires. The final sample consisted of 963 child–parent couples, 480 girls and 483 boys, 819 mothers and 93 fathers; fifty-one did not answer the question on the relationship to the child, or had a different relationship to the child other than being its mother or father.

Parents were asked about his/her and his/her partner's education and occupation. These answers were used as an approximate measure of the family's socio-economic status (SES), using the higher SES for the family. These answers were coded into five categories according to a standardized protocol with national adaptation, using the occupation-status list from Statistics Iceland (ISTARF 95).

Instrument

Self-administered questionnaires were developed for children and their parents to assess fruit and vegetable intake and identify the determinants of their fruit and vegetable intake. The dietary part of the questionnaire consisted of an FFQ with four questions on usual intake of fresh fruits, salad or grated vegetables, other raw vegetables and cooked vegetables. The answer categories ranged from never to more than twice per day on an 8-point scale. This dietary assessment showed high reliability and validity. The results have been presented elsewhere[19,20].

An overview of the variables assessed, and the children's and parents' questions on determinants of fruit and vegetable consumption, is presented in Table 1. The determinant parts of the questionnaires and their reliability and validity have been presented elsewhere[21].

Statistical analyses

The data were analysed using the SPSS statistical software package version 11 (SPSS Inc., Chicago, IL, USA). Repeated-measures ANOVA were executed with perception (child–parent) as the within-subject factor and the gender of the child (boy–girl) as the between-subjects factor for each of the variables. The main effect of perception shows whether there are significant differences between the perceptions of the child and the parent; the main effect of gender shows whether there are differences in perceptions between boys and girls (combining responses of parents and children); and the interaction effect shows whether the differences in perceptions between children and parents depend on the gender of the child. The significance level was set at $P < 0{\cdot}01$. The study had power to detect a difference of 0·25 points, on a 5-point scale, at 88·8% power. Hierarchical regression analyses were performed to determine the explained variance of the children's fruit and vegetable intake.

Results

The correlation coefficients between a child's and its parent's fruit and vegetable intake, based on the FFQ, were low. For fruit the correlation coefficient was 0·21 ($P < 0{\cdot}01$), for vegetables 0·17 ($P < 0{\cdot}02$) and for fruit and vegetables combined 0·24 ($P < 0{\cdot}01$).

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Table 1 Children's and parents' questions on the determinants of fruit and vegetable intake, an overview of the variables assessed. Parallel questions were asked on fruits (F) and vegetables (V); the labels on the response scales were similar for children and parents

Variable	Child's question	Parent's question
Availability at home (different kinds of F/V)	Are there usually different kinds of F/V available at home?[1]	How often do you have different kinds of F/V available at home?[1]
Availability of specific F/V	If you mention at home what F/V you would like to eat, will they be bought?[1]	How often do you buy specific F/V because your child asks for them?[1]
Accessibility at home	Does your mother or father usually cut up F/V for you?[1]	How often do you cut up F/V for your child to eat between meals?[1]
Modelling	My mother/father eats F/V every day[2]	Eating F/V every day is a habit for me[2]
Modelling (eat vegetables together)	I often eat vegetables together with my family[2]	How often do you eat vegetables together with your child?[1]
Active encouragement	My mother/father encourages me to eat F/V every day[2]	Do you have to persuade your child to eat F/V?[3]
Demand family rule	Do your parents tell you to eat F/V every day?[1]	How often do you oblige your child to eat F/V?[1]
Allow family rule	Are you allowed to eat as much F/V as you like?[1]	How often do you allow your child to eat as much F/V as he/she likes?[1]
Self-rated intake	Do you think that you eat much or little F/V?[4]	Do you think that your child eats enough F/V?[5]
Habit	To eat F/V every day is a habit for me[2]	Eating F/V every day is a habit for my child[2]
Knowledge of recommendations	How much F/V do you think you should eat?[6]	How much F/V should be included in a healthy diet for children, aged 10–12 years?[6]

The labels on the question were as follows. 1: Yes, always; Yes, most days/often; Sometimes; Seldom; Never. 2: I fully agree; I agree somewhat; Neither agree nor disagree; I disagree somewhat; I fully disagree. 3: Yes, he/she never eats F/V unprompted; Yes, sometimes; Almost never; No, he/she eats F/V often unprompted. 4: Very many F/V; Many F/V; Not many, not few; Few F/V; Very few F/V. 5: Yes, definitely; Yes, probably; No, probably not; No, definitely not. 6: No F/V; 1–3 times/week; 4–6 times/week; 1 time/d; 2 times/d; 3 times/d; 4 times/d; 5 times or more/d (re-coded to <2 times/d (0) or 2 times or more/d (1)).

Children's and parents' perceptions – fruit

Differences were found between children's and parents' reports for most of the determinants of fruit intake (Table 2). Parents reported more positively on availability and accessibility of fruits at home than did their children. Children reported more modelling, more active encouragement, more demand and considered eating fruit every day more a habit than their parents. Girls and their parents reported more positively on availability of specific fruits than did boys and their parents. In addition, boys and their parents rated their fruit intake as lower and also reported fruit intake to be less a habit than did girls and their parents. Parents of boys reported more encouragement and demand than parents of girls, while boys and girls reported similar encouragement and demands to eat fruit from their parents.

Children's and parents' perceptions – vegetables

Differences between children's and their parents' reports were found for most of the determinants of vegetable intake (Table 3). Children reported more positively on availability of specific vegetables than their parents. Children reported more active encouragement and more demands to eat vegetables than did their parents; children rated their vegetable intake as greater and reported the recommendation more accurately than their parents. Parents reported more positively that their children were allowed to eat vegetables as much as they liked. Girls and their parents rated their intake greater than did boys and their parents. Girls reported eating vegetables more often with their family than did boys, girls also reported more allowing rules, while the parents of girls and boys reported similarly on these determinants. Mothers of boys reported more encouragement than mothers of girls, while girls and boys reported similar encouragement.

Hierarchical regression model – fruit

Parents' reports of the assessed determinants did not explain the variance in children's fruit intake as strongly as the children's own reports, 9% and 18%, respectively (Tables 4 and 5). When looking at the parents' reports, availability at home and accessibility were positively related to children's fruit intake but became non-significant in later steps of the model. Active encouragement was negatively related to intake. When looking at the children's reports, gender was significant but became non-significant in later steps of the model. The availability at home reported by the children was positively related to fruit intake. Modelling of fathers (i.e. father eats fruit every day) and demanding family rule were both positively related to fruit intake. Children's knowledge of recommendations was also positively related to fruit intake.

Hierarchical regression model – vegetables

In general, the model explained more variance in vegetable than fruit intake, as with fruit intake more variance was explained by the children's own reports than the parent's. The variables assessed among parents explained 16% of the variance of children's vegetable intake (Table 6). The effect of gender and SES of the family were significant, with girls eating more vegetables than boys and children in families of high SES eating more vegetables than children in families of lower SES. Accessibility was positively related to children's vegetable intake but became non-significant in later steps of the model. Active encouragement

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Table 2 Children's and parents' perceptions of the determinants of fruit intake (947 child–parent couples), potential range, mean values with their standard errors, and results of repeated-measure ANOVA detailing the difference between the perception of the child and the parent, the difference between boys and girls and the interaction between the child's perception and gender: Pro Children cross-Europe survey among 11-year-old children and their parents, Iceland, 2003

		Children				Parents				Main effect of perception		Main effect of gender		Interaction effect perception × gender	
		Girls		Boys		Girls		Boys							
Variable	Range	Mean	SE	Mean	SE	Mean	SE	Mean	SE	*F*	*P*	*F*	*P*	*F*	*P*
Availability at home (different kinds of fruits)	−2 to 2	1·00	0·04	0·96	0·04	1·27	0·04	1·19	0·04	48·6	<0·01	1·7	0·20	0·2	0·66
Availability of specific fruits	−2 to 2	1·02	0·04	0·89	0·04	1·09	0·04	1·00	0·04	5·4	0·02	6·8	<0·01	0·1	0·70
Accessibility at home	−2 to 2	−0·35	0·05	−0·34	0·05	−0·19	0·04	−0·24	0·04	9·9	<0·01	0·2	0·69	0·5	0·49
Modelling (mother eats fruit every day)	−2 to 2	0·74	0·05	0·76	0·05	0·52	0·05	0·47	0·06	36·0	<0·01	0·1	0·80	0·5	0·50
Active encouragement (mother)	−2 to 2	0·94	0·06	0·69	0·07	−0·55	0·07	−0·20	0·08	300·2	<0·01	0·5	0·49	19·6	<0·01
Demand family rule	−2 to 2	0·31	0·05	0·31	0·06	−0·99	0·05	−0·90	0·05	492·1	<0·01	2·6	0·11	13·3	<0·01
Allow family rule	−2 to 2	1·70	0·03	1·65	0·03	1·71	0·03	1·74	0·03	3·0	0·08	0·25	0·87	2·5	0·12
Self-rated intake	−2 to 2	0·41	0·04	0·18	0·04	0·04	0·06	−0·23	0·07	76·2	<0·01	16·9	<0·01	0·2	0·63
Habit	−2 to 2	0·81	0·05	0·53	0·05	0·61	0·05	0·37	0·05	18·4	<0·01	20·2	<0·01	0·1	0·70
Knowledge of recommendations	0 to 1	0·56	0·02	0·53	0·02	0·61	0·02	0·57	0·02	4·8	0·03	2·4	0·12	<0·01	0·90

Table 3 Children's and parents' perceptions of the determinants of vegetable intake (942 child–parent couples), potential range, mean values and their standard errors, and results of repeated-measure ANOVA detailing the difference between the perception of the child and the parent, the difference between boys and girls and the interaction between the child's perception and gender: Pro Children cross-Europe survey among 11-year-old children and their parents, Iceland, 2003

		Children				Parents				Main effect of perception		Main effect of gender		Interaction effect perception × gender	
		Girls		Boys		Girls		Boys							
Variable	Range	Mean	SE	Mean	SE	Mean	SE	Mean	SE	*F*	*P*	*F*	*P*	*F*	*P*
Availability at home (different kinds of vegetables)	−2 to 2	0·95	0·04	0·86	0·05	1·00	0·04	0·90	0·04	1·2	0·27	4·1	0·04	0·03	0·86
Availability of specific vegetables	−2 to 2	0·77	0·04	0·64	0·05	0·53	0·05	0·42	0·06	21·9	<0·01	5·2	0·02	0·04	0·85
Accessibility at home	−2 to 2	−0·48	0·05	−0·48	0·06	−0·41	0·04	−0·55	0·04	<0·1	0·98	1·7	0·19	1·9	0·17
Modelling (mother eats vegetables every day)	−2 to 2	0·74	0·05	0·60	0·05	0·77	0·05	0·75	0·05	4·4	0·04	2·1	0·15	2·1	0·15
Modelling (eat vegetables together)	−2 to 2	0·77	0·05	0·52	0·05	0·49	0·04	0·43	0·04	4·6	0·03	9·2	<0·01	18·7	<0·01
Active encouragement (mother)	−2 to 2	0·58	0·06	0·39	0·07	0·12	0·07	0·32	0·07	14·5	<0·01	<0·1	0·95	8·4	<0·01
Demand family rule	−2 to 2	0·10	0·05	−0·16	0·06	−0·62	0·06	−0·66	0·05	144·8	<0·01	6·3	0·01	4·5	0·03
Allow family rule	−2 to 2	1·52	0·04	1·28	0·05	1·77	0·03	1·72	0·03	106·8	<0·01	13·7	<0·01	8·4	<0·01
Self-rated intake	−2 to 2	0·09	0·04	−0·08	0·05	−0·31	0·06	−0·50	0·06	85·1	<0·01	9·8	<0·01	0·1	0·80
Habit	−2 to 2	0·34	0·05	0·14	0·06	0·21	0·05	0·11	0·05	3·4	0·06	6·3	0·01	1·4	0·23
Knowledge of recommendations	0 to 1	0·40	0·02	0·36	0·02	0·23	0·02	0·22	0·02	57·6	<0·01	1·0	0·32	0·54	0·46

Table 4 Hierarchical regression model explaining the variance in children's fruit intake, parents' questionnaire (*n* 697): Pro Children cross-Europe survey among 11-year-old children and their parents, Iceland, 2003

	Step 1		Step 2		Step 3		Step 4	
Variable	β	*P*	β	*P*	β	*P*	β	*P*
Background variables								
Gender	0·08	0·04	0·07	0·07	0·04	0·30	0·03	0·36
Residence	−0·02	0·52	−0·02	0·64	0·01	0·76	0·02	0·69
Family SES	0·06	0·15	0·03	0·37	0·05	0·22	0·04	0·23
Physical–environmental								
Availability at home (different kinds of fruits)			0·10	<0·01	0·05	0·19	0·04	0·31
Availability of specific fruits			0·03	0·72	0·04	0·29	0·04	0·26
Accessibility at home (cut up fruits to eat between meals)			0·12	<0·01	0·08	0·05	0·08	0·06
Socio-environmental								
Modelling (mother eats fruit every day)					0·09	0·02	0·08	0·04
Modelling (eat fruits together)					−0·01	0·87	−0·01	0·85
Active encouragement (mother)					−0·23	<0·01	−0·22	<0·01
Demand family rule					0·03	0·50	0·02	0·56
Allow family rule					−0·02	0·50	−0·02	0·55
Personal								
Knowledge							0·07	0·08
Adjusted R^2	0·005		0·036		0·085		0·088	
R^2 change	0·009	0·10	0·035	<0·01	0·055	<0·01	0·004	0·08

SES, socio-economic status.

Table 5 Hierarchical regression model explaining the variance in children's fruit intake, child's questionnaire (*n* 745): Pro Children cross-Europe survey among 11-year-old children and their parents, Iceland, 2003

	Step 1		Step 2		Step 3		Step 4	
Variable	β	*P*	β	*P*	β	*P*	β	*P*
Background variables								
Gender	0·10	<0·01	0·10	<0·01	0·08	0·03	0·07	0·04
Residence	−0·01	0·70	−0·02	0·59	−0·01	0·70	−0·02	0·63
Family SES	0·06	0·10	0·03	0·44	0·02	0·55	0·02	0·54
Physical–environmental								
Availability at home (different kinds of fruits)			0·21	<0·01	0·17	<0·01	0·16	<0·01
Availability of specific fruits			0·01	0·84	−0·02	0·65	−0·02	0·54
Accessibility at home (cut up fruits to eat between meals)			0·05	0·21	<0·01	0·98	0·01	0·74
Socio-environmental								
Modelling (mother eats fruit every day)					0·07	0·13	0·04	0·31
Modelling (father eats fruit every day)					0·14	<0·01	0·14	<0·01
Modelling (friend eats fruit every day)					0·03	0·42	<0·01	0·97
Active encouragement (mother)					−0·07	0·22	−0·06	0·31
Active encouragement (father)					−0·05	0·36	−0·05	0·33
Demand family rule					0·16	<0·01	0·13	<0·01
Allow family rule					0·04	0·28	0·03	0·47
Personal								
Knowledge							0·28	<0·01
Adjusted R^2	0·010		0·056		0·104		0·182	
R^2 change	0·014	0·01	0·049	<0·01	0·056	<0·01	0·077	<0·01

SES, socio-economic status.

was negatively related to intake. When looking at the children's reports, the regression model explained 37 % of children's vegetable intake (Table 7). The effect of gender and SES of the family were significant, with girls eating more vegetables than boys and children in families of high SES eating more vegetables than children in families of low SES. The availability at home was positively related to vegetable intake. Eating vegetables together and demanding family rule were both positively related to vegetable intake. Children's knowledge of recommendations was also positively related to vegetable intake.

Discussion

Differences were found between children's self-reports and parents' reports on the environmental determinants of fruit and vegetable intake of the children in the Icelandic part of the Pro Children survey. A larger proportion of the observed variance in children's fruit and vegetable intake could be explained by the children's reports than by the parent's. The strongest determinants for fruit and vegetable intake according to the children's reports were availability at home, modelling, demanding family rule

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Table 6 Hierarchical regression model explaining the variance in children's vegetable intake, parents' questionnaire (*n* 664): Pro Children cross-Europe survey among 11-year-old children and their parents, Iceland, 2003

	Step 1		Step 2		Step 3		Step 4	
Variable	β	*P*	β	*P*	β	*P*	β	*P*
Background variables								
Gender	0·17	<0·01	0·16	<0·01	0·15	<0·01	0·15	<0·01
Residence	0·10	0·01	0·10	0·01	0·08	0·03	0·08	0·02
Family SES	0·16	<0·01	0·13	<0·01	0·12	<0·01	0·12	<0·01
Physical–environmental								
Availability at home (different kinds of vegetables)			0·06	0·10	0·03	0·44	0·03	0·47
Availability of specific vegetables			0·06	0·17	−0·03	0·49	−0·03	0·44
Accessibility at home (cut up vegetables to eat between meals)			0·13	<0·01	0·04	0·31	0·04	0·31
Socio-environmental								
Modelling (mother eats vegetables every day)					0·08	0·07	0·07	0·12
Modelling (eat vegetables together)					0·10	0·02	0·10	0·02
Active encouragement (mother)					−0·21	<0·01	−0·21	<0·01
Demand family rule					−0·01	0·78	−0·02	0·68
Make your child eat all vegetables with his/her meal					0·01	0·74	0·01	0·76
Make your child eat part of the vegetables with his/her meal					0·07	0·08	0·07	0·09
Make your child eat some of the vegetables with his/her meal					0·08	0·07	0·08	0·06
Allow family rule					<0·01	0·91	<0·01	0·90
Personal								
Knowledge							0·06	0·11
Adjusted R^2	0·064		0·094		0·163		0·165	
R^2 change	0·068	<0·01	0·034	<0·01	0·079	<0·01	0·003	0·11

SES, socio-economic status.

Table 7 Hierarchical regression model explaining the variance in children's vegetable intake, child's questionnaire (*n* 770): Pro Children cross-Europe survey among 11-year-old children and their parents, Iceland, 2003

	Step 1		Step 2		Step 3		Step 4	
Variable	β	*P*	β	*P*	β	*P*	β	*P*
Background variables								
Gender	0·20	<0·01	0·20	<0·01	0·15	<0·01	0·15	<0·01
Residence	0·07	0·06	0·03	0·44	0·02	0·49	0·02	0·48
Family SES	0·19	<0·01	0·16	<0·01	0·13	<0·01	0·13	<0·01
Physical–environmental								
Availability at home (different kinds of vegetables)			0·23	<0·01	0·10	<0·01	0·10	<0·01
Availability of specific vegetables			0·07	0·04	<0·01	0·96	0·01	0·85
Accessibility at home (cut up vegetables to eat between meals)			0·16	<0·01	0·06	0·08	0·05	0·10
Socio-environmental								
Modelling (mother eats vegetables every day)					−0·01	0·83	0·01	0·86
Modelling (father eats vegetables every day)					0·05	0·23	0·03	0·44
Modelling (friend eats vegetables every day)					0·06	0·07	0·05	0·15
Modelling (eat vegetables together)					0·36	<0·01	0·35	<0·01
Active encouragement (mother)					−0·03	0·61	−0·05	0·38
Active encouragement (father)					−0·06	0·24	−0·05	0·34
Demand family rule					0·16	<0·01	0·15	<0·01
Allow family rule					0·04	0·27	0·03	0·42
Personal								
Knowledge							0·17	<0·01
Adjusted R^2	0·085		0·195		0·339		0·366	
R^2 change	0·089	<0·01	0·112	<0·01	0·150	<0·01	0·028	<0·01

SES, socio-economic status.

and knowledge of recommendations. The strongest modelling determinant for fruit was the father's fruit intake while for vegetables it was eating vegetables together with the family. The background variables, gender and SES, seemed to be more important determinants of vegetable intake than of fruit intake.

Parents are very likely the most important models for their children; however, there was a low correlation between parent's and child's fruit and vegetable intake. This has been found in other studies, e.g. in a Norwegian study of children of similar age range where the correlation between the children's and their parents' fruit and vegetable intake was 0·23[13]. The low correlations that have been found between food preferences of parents and children have been referred to as the 'family paradox'[22,23]. It may indicate that other determinants are

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stronger than parents' intake or preference. A type of family influence that has received increasing research attention in recent years is the influence that parents may have on their children's dietary behaviour through food-related parenting practices[11,24]. Children may perceive some of the determinants differently from the parents and data obtained both from children and parents make it possible to obtain these 'perceptional biases'.

The Icelandic parents reported greater availability and accessibility of fruits at home than their children. This is consistent with previous studies such as the Norwegian study by Bere and Klepp[13] and the Dutch study by Reinaerts *et al.*[15], where parents reported the availability or accessibility of fruits and vegetables as much greater than did their 10–12-year-old children. Reports of children and parents were more in agreement for vegetables, maybe because they are more often eaten as part of meals served by parents. Availability is one of the determinants most consistently related to intake[6,25]. In the present study, availability of different kinds of fruits and vegetables at home, as reported by the children, was a significant determinant of intake. Availability may be a more significant determinant of intake where intake is low. A comparison of the nine countries in the Pro Children survey showed that the availability of vegetables was significant for vegetable intake of the Icelandic children, while it was non-significant in the other countries where the intake was higher[26]. Comparison of the nine countries in the Pro Children survey showed almost no country differences in the proportion of children reporting fruit to be available at home, except for Icelandic boys, who reported fruit availability to be lower[27]. The same tendency, although not significant, was seen for the availability at home of vegetables. Availability at school of both fruit and vegetables was also very low in Iceland. Making fruits and vegetables more easily available to the children might increase their intake, as has been seen in a Norwegian free fruit school programme[28–30].

Children rated their fruit and vegetable intake to be higher than did their parents, and they also reported more often than their parents that eating fruit was a habit for them. This is in line with the Dutch study of 9- to 10-year-old children and their parents by Tak *et al.*[14], who too found that children reported significantly higher intake levels of fruits and vegetables than their parents. The Dutch study by Reinaerts *et al.*[15] also found that children reported higher vegetable intake than their parents; however, fruit intake was similarly reported. Parents of children at that age may not know very well what their children eat as they are at school for a large part of the day, or at clubs, or at friends' houses, and also eat when parents do not see it. From this perspective children's reports of fruit and vegetable intake could be considered more accurate than their parents' reports. The higher intake levels reported by children than by parents in the present study are in contrast with the tentative idea that parents may express more social desirability than children in general. Some previous family studies have found that parents have higher social desirability than children because they may want to demonstrate 'good' parenting resulting in 'healthy' children[31]. This pattern of social desirability biases in the responses between parents and children was not found in either the present study or the Dutch studies above[14,15].

Our results on fruit and vegetable intake as well as on the determinants of the intake suggest that self-reports from 11-year-old children should be preferred above reports from their parents. It is necessary to take into account the ability of children of particular ages to report themselves. The development of an instrument has to take children's abilities into account. As Livingstone and Robson argue, from the age of 8 years there is a rapid increase in the ability of children to self-report food intake[32]. The accuracy of self-reports in young age groups is highly dependent on the complexity of the instrument used. The instrument used in the present study was developed so that it could be used by 11-year-old children to report themselves without parental assistance[19,21]. The reliability of the 100-item questionnaire was highly acceptable for the Icelandic 11-year-olds, but clearly it might be demanding for younger children[19,21]. As Livingstone and Robson suggest, future research should focus on refining dietary survey methods to make them more sensitive to different ages and to look for techniques that are able to identify misreporters[32].

Clear gender differences in fruit and vegetable intake were found, with girls' intake being more frequent than boys'. This is consistent with other European studies[6]. Girls also rated their fruit and vegetable intake higher, and they reported more often that eating fruit was a habit for them than did boys. This indicates that the perception children have of their own intake is fairly realistic, as more objective methods also show that girls' intake tends to be higher than that of boys of the same age[33].

Fathers seem to have stronger modelling effects on their children's fruit intake than mothers. Fathers' fruit intake reported by children was positively related to their fruit intake while the mothers' fruit intake, as reported by their children, was non-significant. Studies (mainly answered by mothers) have shown a positive relationship between parents' and children's intake of fruits and vegetables[6]. There are few studies on the relationship between fathers' fruit intake and their children's. In an Icelandic study of 6-year-old children and their parents, vitamin C in blood showed an even stronger correlation between the children and fathers than between the children and mothers[34]. It may also be that children eat fruits more often with their father than with their mother and it may therefore be related to eating together. Eating vegetables together as reported by the child was positively related to the child's intake in the present study. Seeing others consume a food may produce a form of

modelling or 'exposure by proxy' which could reduce rejection and increase acceptance[35].

Children reported more active encouragement and demanding rules from their parents to eat fruit and vegetables daily than did their parents. This may partly be because of a phrasing difference between the child and parent questions. Demand is a strong word, at least in Icelandic, and parents may hesitate to use it. This difference could, however, be partly explained by differences in perception; i.e. the parents do not see themselves as encouraging or demanding as their children do. Active encouragement as reported by parents was negatively related to both fruit and vegetable intake. The parent was asked 'Do you have to persuade your child to eat fruits/vegetables?' and it is probable that the parents of children with low fruit and vegetable intake are more likely to answer this question positively. Parents of boys reported more encouragement than parents of girls, which seems logical as boys have lower intake levels, and children's low intake might evoke parental encouragement. However, girls and boys reported similar encouragement from their parents. Active encouragement reported by the child was non-significantly related to their fruit and vegetable intake. It is unclear whether active encouragement is an effective way to increase the intake. Children who have low vegetable intake may always have been difficult to feed and, despite a parent's best intention, a child may act with the least desired response from the parent's perspective when it is pressured to eat[11,36]. Demanding family rule (reported by a child but not by the parent) seems to be a more effective way to increase intake, as it was positively related to both fruit and vegetable intake. In the cross-Europe survey the association between vegetable intake and demanding family rule was strongest in Iceland and in Norway (OR = 2·1)[26]. The parents were asked further about the rules regarding vegetables, i.e. if their children were supposed to eat all/part/some of the vegetable with the meal, but none of these was significantly related to children's vegetable intake. Presenting a child with vegetables to taste could be the most promising approach, so that the child tastes vegetables without pressure on how much is eaten. Studies have shown that mere exposure to food increases liking, but attempts to control intake reduce the strength of the exposure effect[36]. Wardle *et al.* suggested that repeatedly inviting children to eat small amounts of rejected or disliked food, without great emphasis on how much the child eats, is a good strategy for promoting the liking of vegetables[37].

Children's knowledge of national recommendations was positively related to their fruit and vegetable intake. The simple strategy of teaching these recommendations in elementary schools may be important to make daily intake more likely[26]. Parents' knowledge of recommendations was, however, non-significant, suggesting that parents' knowledge is not enough although it could be the first step, and parents' eating habits and feeding practices are more important determinants of their children's fruit and vegetable intake.

The strength of the present study is the large and representative sample, with a high participation rate. The limitations of the study were that determinants were measured by one item only; however, some of the determinants support each other, e.g. self-rated intake and habit. There may also be a phrasing or semantic difference between the child and parent questions; e.g. in the question on demanding family rule, the parent's question may be more authoritarian than the child's questions. The data are self-reported; therefore, all measures are perceived measures, but thorough validity and reliability studies have shown that the measures were valid and reliable[19,21]. As this was a cross-sectional study, it cannot express causality between the determinants and frequency of fruit and vegetable intake.

Conclusion

The present study shows that children and parents have different perceptions of the determinants of fruit and vegetable intake in a child population with low consumption. Children's perceptions explain more of the variance in intake. Children rather than their parents should be asked what determines their fruit and vegetable intake. However, children reported determinants in the physical and social environment, of which the parents are part, as an important determinant for their intake. Interventions aiming to increase fruit and vegetable intake among children must therefore target the parents. Such interventions ought to focus on practical guidance on how parents can promote healthy food habits.

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References

1. Hu FB (2003) Plant-based foods and prevention of cardiovascular disease: an overview. *Am J Clin Nutr* **78**, S544–S551.
2. Key TJ, Allen NE, Spencer EA & Travis RC (2002) The effect of diet on risk of cancer. *Lancet* **360**, 861–868.
3. Joshipura KJ, Ascherio A, Manson JE, Stampfer MJ, Rimm EB, Speizer FE, Hennekens CH, Spiegelman D & Willett WC (1999) Fruit and vegetable intake in relation to risk of ischemic stroke. *JAMA* **282**, 1233–1239.
4. World Health Organization (2003) *Diet, Nutrition and the Prevention of Chronic Diseases. Report of a Joint WHO/FAO Expert Consultation.* Geneva: WHO.
5. Klepp K-I, Perez-Rodrigo C, De Bourdeaudhuij I *et al.* (2005) Promoting fruit and vegetable consumption among European schoolchildren: rationale, conceptualization and design of the Pro Children project. *Ann Nutr Metab* **49**, 212–220.
6. Rasmussen M, Krolner R, Klepp KI, Lytle L, Brug J, Bere E & Due P (2006) Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies. *Int J Behav Nutr Phys Act* **3**, 22.
7. Lien N, Lytle LA & Klepp KI (2001) Stability in consumption of fruit, vegetables, and sugary foods in a cohort from age 14 to age 21. *Prev Med* **33**, 217–226.
8. Birch LL & Fisher JO (1998) Development of eating behaviours among children and adolescents. *Pediatrics* **101**, 539–549.
9. Savage JS, Fisher JO & Birch LL (2007) Parental influence on eating behavior: conception to adolescence. *J Law Med Ethics* **35**, 22–34.
10. Johnson SL & Birch LL (1994) Parents' and children's adiposity and eating style. *Pediatrics* **94**, 653–661.
11. Wardle J, Carnell S & Cooke L (2005) Parental control over feeding and children's fruit and vegetable intake: how are they related? *J Am Diet Assoc* **105**, 227–232.
12. Faith MS, Berkowitz RI, Stallings VA, Kerns J, Storey M & Stunkard AJ (2004) Parental feeding attitudes and styles and child body mass index: prospective analysis of a gene–environment interaction. *Pediatrics* **114**, e429–e436.
13. Bere E & Klepp K-I (2004) Correlates of fruit and vegetable intake among Norwegian school children: parental and self-reports. *Public Health Nutr* **8**, 991–998.
14. Tak NI, te Velde SJ, de Vries JH & Brug J (2006) Parent and child reports of fruit and vegetable intakes and related family environmental factors show low levels of agreement. *J Hum Nutr Diet* **19**, 275–285.
15. Reinaerts E, de Nooijer J & de Vries NK (2007) Parental versus child reporting of fruit and vegetable consumption. *Int J Behav Nutr Phys Act* **4**, 33.
16. Yngve A, Wolf A, Poortvliet E *et al.* (2005) Fruit and vegetable intake in a sample of 11-year-old children in 9 European countries: the Pro Children cross-sectional survey. *Ann Nutr Metab* **49**, 236–245.
17. Wolf A, Yngve A, Elmadfa I *et al.* (2005) Fruit and vegetable intake of mothers of 11-year-old children in nine European countries: The Pro Children Cross-sectional Survey. *Ann Nutr Metab* **49**, 246–254.
18. Kristjansdottir AG, Thorsdottir I, De Bourdeaudhuij I, Due P, Wind M & Klepp KI (2006) Determinants of fruit and vegetable intake among 11-year-old schoolchildren in a country of traditionally low fruit and vegetable consumption. *Int J Behav Nutr Phys Act* **3**, 41.
19. Haraldsdottir J, Thorsdottir I, de Almeida MD, Maes L, Perez Rodrigo C, Elmadfa I & Frost Andersen L (2005) Validity and reproducibility of a precoded questionnaire to assess fruit and vegetable intake in European 11- to 12-year-old schoolchildren. *Ann Nutr Metab* **49**, 221–227.
20. Kristjansdottir AG, Andersen LF, Haraldsdottir J, de Almeida MD & Thorsdottir I (2006) Validity of a questionnaire to assess fruit and vegetable intake in adults. *Eur J Clin Nutr* **60**, 408–415.
21. De Bourdeaudhuij I, Klepp KI, Due P, Rodrigo CP, de Almeida M, Wind M, Krolner R, Sandvik C & Brug J (2005) Reliability and validity of a questionnaire to measure personal, social and environmental correlates of fruit and vegetable intake in 10–11-year-old children in five European countries. *Public Health Nutr* **8**, 189–200.
22. Rozin P (1991) Family resemblance in food and other domains: the family paradox and the role of parental congruence. *Appetite* **16**, 93–102.
23. Eertmans A, Baeyens F & Van den Bergh O (2001) Food likes and their relative importance in human eating behavior: review and preliminary suggestions for health promotion. *Health Educ Res* **16**, 443–456.
24. Birch LL & Fisher JO (2000) Mothers' child-feeding practices influence daughters' eating and weight. *Am J Clin Nutr* **71**, 1054–1061.
25. Blanchette L & Brug J (2005) Determinants of fruit and vegetable consumption among 6–12-year-old children and effective interventions to increase consumption. *J Hum Nutr Diet* **18**, 431–443.
26. De Bourdeaudhuij I, Te Velde S, Brug J *et al.* (2008) Personal, social and environmental predictors of daily fruit and vegetable intake in 11-year-old children in nine European countries. *Eur J Clin Nutr* **62**, 834–841.
27. Sandvik C, De Bourdeaudhuij I, Due P *et al.* (2005) Personal, social and environmental factors regarding fruit and vegetable intake among schoolchildren in nine European countries. *Ann Nutr Metab* **4**, 255–266.
28. Bere E, Veierod MB & Klepp KI (2005) The Norwegian School Fruit Programme: evaluating paid vs. no-cost subscriptions. *Prev Med* **41**, 463–470.
29. Bere E, Veierod MB, Bjelland M & Klepp KI (2006) Free school fruit – sustained effect 1 year later. *Health Educ Res* **21**, 268–275.
30. Bere E, Veierod MB, Skare O & Klepp KI (2007) Free school fruit – sustained effect three years later. *Int J Behav Nutr Phys Act* **4**, 5.
31. De Bourdeaudhuij I & Van Oost P (2000) Personal and family determinants of dietary behaviour in adolescents and their parents. *Psychol Health* **15**, 751–770.

32. Livingstone MB & Robson PJ (2000) Measurement of dietary intake in children. *Proc Nutr Soc* **59**, 279–293.
33. Glynn L, Emmett P & Rogers I, ALSPAC Study Team (2005) Food and nutrient intakes of a population sample of 7-year-old children in the south-west of England in 1999/2000 – what difference does gender make? *J Hum Nutr Diet* **18**, 7–19.
34. Thorsdottir I, Gunnarsdottir I, Ingolfsdottir E & Palson G (2006) Fruit and vegetable intake: vitamin C and β-carotene intake and serum concentrations in six-year-old children and their parents. *Scand J Food Nutr* **50**, 71–76.
35. Wardle J, Herrera ML, Cooke L & Gibson EL (2003) Modifying children's food preferences: the effects of exposure and reward on acceptance of an unfamiliar vegetable. *Eur J Clin Nutr* **57**, 341–348.
36. Galloway AT, Fiorito LM, Francis LA & Birch LL (2006) 'Finish your soup': counterproductive effects of pressuring children to eat on intake and affect. *Appetite* **46**, 318–323.
37. Wardle J, Cooke LJ, Gibson EL, Sapochnik M, Sheiham A & Lawson M (2003) Increasing children's acceptance of vegetables; a randomized trial of parent-led exposure. *Appetite* **40**, 155–162.