

Predictors and dietary consequences of frequent intake of high-sugar, low-nutrient foods in 1-year-old children participating in the ABIS study

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Foods rich in sugar have been suggested to contribute to the increasing prevalence of obesity in children. The aim of this report is to investigate the dietary pattern in 1-year-old children who frequently receive foods rich in sugar but low in nutrients and to study associated demographic and parental factors. During 1977–9, 21 700 infants were invited to participate in this prospective, population-based, longitudinal cohort study. Screening questionnaires were completed for 16 070 infants after delivery. Follow-up questionnaires from 10 762 children at 1 year of age are included in the analysis. It was found that 24% of the children received sweets/pastries more often than one or two times per week. They had a higher intake of French fries, potato crisps and cream as well as a lower intake of fruit and vegetables. A frequent intake of sugar-rich, low-nutrient foods was significantly associated with several maternal factors (high intake of sweets/pastries during pregnancy, young age, mother living alone) as well as presence of older siblings. Maternal smoking during pregnancy and maternal overweight were of borderline significance. Parental education level was inversely associated with the frequency of intake of sweets/pastries in the child. Children who frequently receive sweets/pastries also have an otherwise unfavourable dietary pattern. Several parental and demographic factors were associated with this feeding pattern, especially high intake of sweets/pastries during pregnancy. Screening of pregnant women for risk predictors like consumption of sweets/pastries, young age and smoking could be possible ways of identifying children at future risk for low dietary quality.

High-sugar foods: Low-nutrient foods: Children: Risk predictors: Dietary quality

Refined sugars, as well as dietary fat, have been suggested to contribute to development of obesity in children (Ludwig *et al.* 2001; Foreyt & Poston, 2002). Consumption data from Sweden show that total consumption of sugar during the last 30 years has been relatively stable, however, use has shifted from those in desserts and as granulated sugar/cube sugar towards more use in commercially produced foods like soft drinks and sweets (National Food Administration, 2003).

Foods rich in refined sugars contribute 'empty calories' since they often contain few nutrients but have high energy content. Small children have a high energy and nutrient need per kg body weight and nutrition recommendations therefore aim at limiting intake of refined sugars and foods contributing with 'empty calories' (Nordic Council of Ministers, 2004). Sweet foods, often rich in fat, like chocolate, cakes/cookies and sweets, have traditionally been consumed about once a week (Saturday sweets) in Sweden. However, the frequency of intake may have changed as the production of these foods has increased and they have become more available to consumers.

A frequent intake of foods high in added sugar but low in nutrients may lower the nutritional value of the total diet. In a Norwegian study, a high intake of added sugar showed negative association with intakes of micronutrients, fruit and vegetables in children (Overby *et al.* 2004). It is also possible

that frequent consumption of sugar-rich foods is associated with a certain, less varied eating pattern that additionally decreases total nutrient intake. More use of added sugar and sugar-sweetened beverages as well as a poorer diet quality has been shown in children who regularly eat foods from fast-food places (Bowman *et al.* 2004).

A number of parental socio-demographic characteristics have been associated with children's dietary patterns (North & Emmett, 2000; Kranz & Siega-Riz, 2002; Aranceta *et al.* 2003; Rogers & Emmett, 2003; Vereecken *et al.* 2004; Northstone & Emmett, 2005). Poorer dietary quality and high added sugar intake has been observed in groups of lower socio-economic status (Kranz & Siega-Riz, 2002; Shahar *et al.* 2005). In addition, mothers' attitudes and beliefs as well as preferences have been shown to be predictors of children's dietary intake (Gibson *et al.* 1998; Vereecken *et al.* 2004).

Identifying children at risk of poor diet quality, and possibly future obesity, will be important when planning prevention strategies. Such strategies should probably start as early as possible in life. If risk individuals can be identified before the child is born, extra support and nutritional guidance can be given to these parents.

The aim of the present report is to investigate the dietary pattern in 1-year-old children who frequently receive low-nutrient foods

that are high in added sugar (sweets/pastries), and compare this to the dietary pattern in children who less frequently receive these foods. Second, demographic and parental factors associated with a frequent intake of sweets/pastries as well as early introduction of sweets and sugar-sweetened drinks are studied.

Material and methods

The present report is based on the 1-year follow-up of infants who are part of the ABIS study (All Babies in Southeast Sweden). Parents to 21 700 newborn babies were invited to participate in this prospective cohort study from 1 October 1997 to 1 October 1999. Mothers of 16 070 infants completed a screening questionnaire after delivery. That questionnaire was completed just before leaving the maternity ward or at home (and in the latter case returned to the responsible nurse/doctor at the time of regular infant check-up within a week). Follow-up questionnaires from 1 year of age were available from 11 081 participants. In order to limit the variation in age at examination, children examined between 9 and 18 months (n 10 762) were included in the analysis. Among the included children there was a slight under-representation of younger parents, low education level in the mother, parents of foreign origin and smoking during pregnancy compared to the 16 070 children participating at birth. In addition to the follow-up questionnaires, 9849 detailed food diaries, covering the gradual inclusion of different foods during the first year, were available.

Baseline data about the parents and associated factors were collected from the screening questionnaires at birth. The 1-year follow-up questionnaire contained a food frequency questionnaire regarding twenty-six different foods in addition to questions regarding breastfeeding and time of introduction of certain solid foods. The frequency categories most often used were: (A) daily, (B) three to five times per week, (C) one or two times per week and (D) more seldom. The detailed food diary included additional information about breastfeeding duration and time (date) of introduction of food items (including sweets and sugar-sweetened drinks) during the first year. The food diary was handed out at screening and collected at the 1-year examination. Participants were instructed to register every new food item that was included in the child's diet at the time they were introduced. Data from the detailed food diary were only used to examine the timing for introduction of sweets and sugar-sweetened drinks. All other data were collected from the 1-year follow-up questionnaire.

Definitions

Frequent maternal intake of sweets/pastries during pregnancy is defined as mother eating chocolate or sweets or cakes/cookies three to five times per week or more. A frequent intake of sweets/pastries in the 1-year-old child is defined as eating chocolate or sweets or cakes/cookies more often than one or two times per week. Early introduction of sweets and sugar-sweetened drinks was defined as introducing these foods at day 240 of the child's life or earlier.

Statistical analysis

Data are presented as means and standard deviations. Pearson χ^2 was used to compare the frequency distribution of foods in those with a frequent consumption of sweets/pastries and those

without. Odds ratios (OR) with 95% CI were estimated using logistic regression. Time of introduction of sweets and sugar-sweetened drinks was compared using a t test. A significance level of $p < 0.05$ was considered statistically significant. SPSS for Windows version 11.5.1 (SPSS Inc., Chicago, IL, USA) was used for all statistical analysis.

Ethics

The present study was part of the ABIS study (All Babies In Southeast Sweden), which has been approved by the Research Ethics Committees of the Faculty of Health Sciences, Linköping University and the Medical Faculty of Lund University. Mothers gave their consent after careful written as well as oral information and information via videotape.

Results

Characteristics of the parents and the infants are presented in Table 1 and based on 10 762 included infants. The average age of the participating infants at the time of the follow-up was 12.0 (SD 1.1) months.

The proportion of children that received either chocolate, sweets or cakes/cookies more often than one or two times per week was 24%. These children had a lower frequency of intake of fruit and berries, vegetables, potatoes and beef (Table 2(A)) compared to the children who received these foods more seldom. They also had a higher frequency of intake of bread, cheese, milk/yoghurt/sour milk, cream, eggs, pork and sausage as well as potato crisps and French fries (Table 2(A, B)).

A frequent intake of sweets/pastries (more than one or two times per week) at the age of 1 year was significantly associated with a frequent maternal intake of sweets/pastries during pregnancy, the child having older siblings, and the mother being < 25 years when giving birth to the child (Table 3). The mother living alone at the time of birth of the child was also positively associated with frequent intake of these foods in the child while maternal smoking during pregnancy and a maternal BMI > 25 were of borderline significance. Parental education level was inversely associated with the frequency of intake of sweets/pastries in the child.

Data from the food introduction diary showed that mean time for introduction of sweets and sugar-sweetened drinks were on days 277 and 266 from birth, respectively. Frequent eaters of sweets and pastries at 1 year were introduced to sweets and sugar-sweetened beverages on average 25 (95% CI 21, 30; $P < 0.001$) and 24 (95% CI 20, 29, $P < 0.001$) d earlier than other children, respectively. Parental and demographic factors associated with early introduction of sweets were mother having a BMI > 25 , mother smoking during pregnancy and frequent intake of sweets/pastries during pregnancy (Table 3). Duration of exclusive breastfeeding was inversely associated with introduction of sweets as well as introduction of sugar-sweetened drinks. Other factors associated with early introduction of sugar-sweetened drinks were maternal BMI > 25 , younger than 25 years of age at the time of the child's birth, smoking during pregnancy and mother living alone at the time of the child's birth. The mother being from Sweden and maternal education level were inversely associated with introduction of sugar-sweetened drinks.

Table 1. Characteristics of the parents at the time of delivery and the characteristic of the child at birth and at the 1-year follow-up*
(Mean values and standard deviations)

Characteristic	Mean	SD
Maternal age at delivery (years)	29.8	4.5
Paternal age at delivery (years)	32.2	5.4
Education level of mother (%)		
≤ 9 years	7.3	
10–12 years	59.4	
≥ 13 years	33.3	
Education level of father (%)		
≤ 9 years	13.2	
10–12 years	62.2	
≥ 13 years	24.7	
Maternal smoking during pregnancy (%)	9.3	
Swedish mother (%)	94.3	
Non-Swedish mother (%)	5.7	
Swedish father (%)	93.9	
Non-Swedish father (%)	6.1	
Primiparous (%)	39.2	
Marital status at birth of child (%)		
Single mother	1.6	
Co-habitant	55.5	
Married	42.9	
Maternal BMI at 1-year follow-up	23.7	3.9
Paternal BMI at 1-year follow-up	25.0	3.0
<i>n</i>	10762	
Boys (%)	51.9	
Girls (%)	48.1	
Age at follow-up (months)	12.0	1.1
Weight at 1 year (g)	10170	3164
Length at 1 year (cm)	76.0	13.6

* Children examined at the age of 9–18 months are included in the analysis.

Discussion

The present study indicates that children who are frequently fed sweets, chocolate, cookies and cakes also have more frequent intakes of other less healthy foods like potato crisps, French fries and cream compared to children that are less frequently fed sugar-rich, low-nutrient foods. In addition, they have less frequent intakes of foods that are considered healthy like fruit and berries, vegetables and potatoes. A frequent intake of sweets/pastries in the child showed association with maternal intake of sweets/pastries during pregnancy, the child having older siblings but also with maternal age (<25 years), marital status and low parental education level. Similar associations were seen between these factors and early introduction of sweets and sugar-sweetened drinks.

Other studies have linked sugar intake to reduced dietary quality in children (Bowman *et al.* 2004; Overby *et al.* 2004). In the population of children in the present study, a frequent intake of sweets/pastries was associated with more frequent intakes of typically high-fat foods like potato crisps, French fries and cream. High-fat foods are considered a risk factor for development of obesity, which together with a high sugar consumption might further increase this risk (Foreyt & Poston, 2002). At the age of 1 year, a high intake of dietary fat has not been associated with increased risk of future obesity (Parsons *et al.* 1999), on the contrary, a higher fat intake is recommended (Nordic Council of Ministers, 2004). However, a high nutrient quality of the diet is also recommended for these children, limiting space for

foods of low nutritional value. Besides, from the age of 2 years, current nutrition recommendations are the same as for the general population. Dietary habits and taste preferences are founded early (Pepino & Mennella, 2005). Therefore, healthy food choices at an early stage in life can be of great importance for children's future development and well-being.

There was a strong association between the mother's intake of sweet foods during pregnancy and the child's intake of these foods at the age of 1 year. Previous studies have shown that the parents' eating habits and consumption predicts their children's food intake (Oliveria *et al.* 1992; Woodward *et al.* 1996; Gibson *et al.* 1998; Hannon *et al.* 2003; Cooke *et al.* 2004; Vereecken *et al.* 2004; Lee *et al.* 2005; Wardle *et al.* 2005). Especially, parental fruit and vegetable intake has been shown to be predictors of the children's intake of these foods (Gibson *et al.* 1998; Cooke *et al.* 2004; Vereecken *et al.* 2004; Wardle *et al.* 2005). In an American study, poor diet quality of the mother was shown to be a valid indicator of poor diet quality of her infant or toddler (Lee *et al.* 2005). In addition to genetic factors, parents functioning as role models is one suggested explanation for this association (Fisher *et al.* 2002). Availability of foods is another possible explanation that is supported by this study. Frequent intakes of sweets/pastries was more common in children who had older siblings, suggesting that children eat what is available for their older siblings. It has also been suggested that the mothers' choice of foods during pregnancy can influence the child's future food preference (Mennella *et al.* 2001).

Table 2(A). Frequency distribution (percentage of children) of intake of selected foods between the children who received sweets/pastries more often than one or two times per week and the children who received sweets/pastries one or two times per week or more seldom ($n \geq 10\,567$)

Food	Daily		3–5 times/week		1–2 times/week		More seldom		P value
	Sweets > 1–2 times /week	Sweets ≤ 1–2 times /week	Sweets > 1–2 times /week	Sweets ≤ 1–2 times /week	Sweets > 1–2 times /week	Sweets ≤ 1–2 times /week	Sweets > 1–2 times /week	Sweets ≤ 1–2 times /week	
Fruit or berries	66.0	72.7	24.0	19.2	7.9	5.8	2.1	2.3	< 0.001
Vegetables	65.0	77.0	26.6	17.8	6.8	3.9	1.5	1.3	< 0.001
Potatoes	33.5	43.2	59.8	52.5	6.0	3.8	0.7	0.5	< 0.001
Eggs	0.4	0.1	3.3	1.5	24.3	15.5	72.0	82.9	< 0.001
Meat (beef)	1.1	1.4	26.6	31.3	53.0	52.0	19.2	15.2	< 0.001
Pork, sausage	3.5	2.0	50.9	41.0	40.4	46.7	5.2	10.3	< 0.001
Cheese	18.3	13.7	27.2	23.1	22.0	21.1	32.4	42.1	< 0.001
Cream, crème fraîche	2.3	1.5	13.9	8.7	35.9	26.7	47.9	63.1	< 0.001
Potato crisps	0.3	0.1	0.4	0.1	14.0	2.3	85.2	97.6	< 0.001
Fried potatoes, French fries	0.4	0.0	1.4	0.1	20.1	5.8	78.1	94.1	< 0.001

Table 2(B). Frequency distribution (percentage of children) of intake of selected foods between the children who received sweets/pastries more often than one or two times per week and the children who received sweets/pastries one or two times per week or more seldom ($n \geq 10\,567$)

Food	0 times/d		1–2 times/d		3–5 times/d		6–10 times/d		More often		P value
	Sweets > 1–2 times /week	Sweets ≤ 1–2 times /week	Sweets > 1–2 times /week	Sweets ≤ 1–2 times /week	Sweets > 1–2 times /week	Sweets ≤ 1–2 times /week	Sweets > 1–2 times /week	Sweets ≤ 1–2 times /week	Sweets > 1–2 times /week	Sweets ≤ 1–2 times /week	
Bread	2.1	4.9	87.3	88.6	10.0	6.1	0.5	0.3	0.1	0.1	< 0.001
Milk/sour milk/yoghurt	2.9	3.9	67.5	72.8	28.2	22.2	1.2	1.0	0.2	0.0	< 0.001

Table 3. Associations between parental demographic factors and children's intake of sweets/pastries at 1 year of age as well as time for introduction of sweets and sugar-sweetened drinks

	Intake of sweets/pastries > 1–2 times/week			Introduction of sweets and sugar at day 240 or earlier			Introduction of sugar-sweetened drinks at day 240 or earlier		
	OR	95 % CI	P	OR	95 % CI	P	OR	95 % CI	P
High maternal intake of sweets during pregnancy	2.184	1.957, 2.437	0.000	1.216	1.043, 1.416	0.012	1.147	0.998, 1.319	0.054
Child having older siblings	1.507	1.335, 1.702	0.000	0.919	0.781, 1.083	0.313	0.877	0.755, 1.019	0.086
Mother being <25 years old when giving birth	1.382	1.157, 1.651	0.000	1.207	0.944, 1.542	0.133	1.691	1.366, 2.093	0.000
Father being <25 years old when child was born	1.059	0.818, 1.372	0.663	1.089	0.769, 1.542	0.632	1.142	0.840, 1.551	0.397
Maternal smoking during pregnancy	1.209	1.998, 1.465	0.052	1.371	1.045, 1.798	0.023	1.906	1.508, 2.410	0.000
Mother living alone at time of birth of child	1.901	1.151, 3.139	0.012	1.307	0.646, 2.647	0.456	2.671	1.356, 5.261	0.005
Maternal BMI > 25 at 1-year examination	1.124	0.996, 1.269	0.058	1.306	1.107, 1.540	0.002	1.341	1.155, 1.557	0.000
Paternal BMI > 25 at 1-year examination	0.986	0.882, 1.102	0.803	0.943	0.807, 1.101	0.455	0.948	0.822, 1.092	0.457
Paternal education level	0.904	0.819, 0.998	0.046	1.000	0.871, 1.150	0.993	0.926	0.813, 1.054	0.244
Maternal education level	0.888	0.799, 0.987	0.028	0.957	0.824, 1.111	0.562	0.692	0.603, 0.794	0.000
Father being from Sweden	0.819	0.641, 1.047	0.111	0.907	0.640, 1.286	0.090	0.744	0.537, 1.031	0.075
Mother being from Sweden	0.783	0.605, 1.013	0.063	0.736	0.516, 1.049	0.583	0.551	0.389, 0.781	0.001
Duration of exclusive breastfeeding	0.983	0.954, 1.013	0.260	0.919	0.881, 0.960	0.000	3.339	0.885, 0.954	0.000

OR, odds ratio adjusted for all other variables presented in the table.

It should be recognized that the mother's and children's dietary intake in the present study to a large degree is reported by the same person and could lead to overestimation of agreement between the two dietary patterns. However, the two food frequency questionnaires were carried out 1 year apart and should eliminate a memory effect in the reporting of dietary intake.

Parental education level has previously been reported to be associated with children's dietary pattern (Aranceta *et al.* 2003; Rogers & Emmett, 2003; Cooke *et al.* 2004; Northstone & Emmett, 2005). A high intake of snack foods (Aranceta *et al.* 2003) and junk food (Northstone & Emmett, 2005) was more common in children of low-educated mothers while a higher vegetable intake (Cooke *et al.* 2004) was observed in children of parents with more education. In the population in the present study, both parents' education level was negatively associated with frequency of intake, while maternal education level was also negatively associated with early introduction of sugar-sweetened drinks. Other measures of socio-economic status like smoking during pregnancy and overweight (BMI > 25) were associated with two of the feeding practices studied. Association to parental smoking was previously shown in a study from the UK where children of non-smokers consumed a diet that conformed more to guidelines on healthy eating (Rogers & Emmett, 2003). Parental overweight has been shown to be an independent risk factor for overweight in children (Danielzik *et al.* 2004), but has to our knowledge not previously been related to early feeding of sugar-rich foods. Maternal age and marital status are also factors that according to the present study should be considered when identifying individuals at risk for a disadvantaged feeding pattern.

As many as 24 % of 1-year-old children received chocolate, sweets or cakes/cookies more often than one or two times per week. This group of children had a less favourable dietary pattern which frequently included foods rich in fat. Several parental and demographic factors were associated with this feeding pattern, especially high intake of sweets/pastries during pregnancy. Screening of pregnant women for risk predictors like consumption of sweets, young age and smoking could be possible ways of identifying children at future risk for low dietary quality.

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