Dental health, dental care, and dietary habits in children in different parts of Sweden

Christina Stecksén-Blicks, Sigrid Arvidsson and Anna-Karin Holm
Department of Pedodontics, University of Umeå, Umeå, and Department of Pedodontics, Public Dental Health Service, Vänersborg, Sweden

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An epidemiological study of dental health, dental health care, and sociodemographic data in 817 4-, 8-, and 13-year-old children was carried out in 1980/81 in two areas in the county of Västerbotten, northern Sweden, and in one area in the northern part of the county of Älvsborg, in southwestern Sweden. Dietary habits and nutrient intake were studied in 738 of the children. The aim of the study was to examine the dental health in the different areas and to study the importance of variations in related background factors. The results showed great differences in dental health in all age groups between the two counties. There were also differences between the two areas in the north, but these were not as evident. A discriminant function analysis showed that age when organized dental care started and tooth-brushing frequency had greater explanatory power on dental caries than food habit factors. □ *Epidemiology, dental caries; gingivitis; prevention*

Christina Stecksén-Blicks, Department of Pedodontics, University of Umeå, S-901 87 Umeå, Sweden

Dental health in Sweden has improved markedly during the last 10–15 years. This has been reported in studies conducted both in the north (1, 2) and in the south (3). The improvement has mainly been ascribed to a very concrete and active concentration on preventive measures, including organized dental care given on a yearly basis to all children and young people from 3 to 19 years. The preventive programs organized by the Public Dental Health Service are basically the same in all counties in Sweden. However, because of local shortages in resources allocated to preventive dentistry, there may be some variations between counties.

Several studies have demonstrated that certain foods and consumption patterns, mainly a frequent consumption of sugar, are essential factors in the etiology of caries (4–8). Sugar consumption frequency and caries prevalence have also been shown to vary with socioeconomic factors (5, 7, 9). In the above-mentioned studies the dietary habits (1–3) and social conditions of the children (2, 3) were not studied.

In 1980/81 the Swedish National Food Administration initiated a nutrition survey of 2-, 4-, 8-, and 13-year-old children in five different areas in various parts of Sweden. Two of the areas were situated in the county of Västerbotten, in northern Sweden. These areas had also been studied in 1967, when a similar study was carried out in 1401 children aged 4, 8, and 13 years. General and dental health was examined and analyzed in relation to the dietary habits and socioeconomic background of the children (5).

The dietary study planned in 1980/1981 was more extensive and included a study of the nutrient intake. It was also considered valuable to examine the dental health of the children to study whether differences in dental health between areas could be explained by differences in dietary habits or in other background factors. For various reasons it was not possible to study the dental health of all children included in the nutrition survey.

The aim of the present study was therefore to examine the dental health of 4-, 8-, and 13-year-old children in three of the areas, to compare data among areas, and to study the impact of dietary habits, dental care, and mother's educational level on dental health.

Materials and methods

The material comprised three age groups (4, 8, and 13 years) in three areas representing different sociodemographic characteristics. Two parishes in Umeå, a university town, were chosen as the first area. The second area consisted of two sparsely populated districts in the mountain foreland, Dorotea and Vilhelmina communities, situated in the county of Västerbotten in the north of Sweden. Both areas had been included in the 1967 study. A mixed rural and urban area in the county of Älvsborg in the southwest of Sweden constituted the third area. The three areas will in the following be referred to as Umeå, mountain area, and SW area.

A random sample of 935 children was selected. The remaining group, consisting of 901 children, was reduced by a non-response of 9% (primary dropouts) with the majority concentrated in Umeå. The commonest reasons for not joining the study were lack of time and the repeated studies by different disciplines engaging the families in the town.

The material included in the dental health examination thus consisted of 817 children with mean ages 4 years 5 months, 8 years 5 months, and 13 years 5 months. In the dietary study the material was reduced by another 9% (secondary dropouts), most often due to incomplete 7-day records. Thus, the analyses in which dietary data are included are based on the remaining 738 children. The distribution of socioeconomic groups of the fathers and the level of dental caries were almost the same for the dropouts and the studied children, according to official registers and records of the Public Dental Health Clinics.

Organized dental care including regular yearly visits to the dental clinic are supposed to start at the age of 3 years. At these visits, the children are examined and restorative treatment is performed. Children needing individual prophylaxis by dental assistants are selected. In the two northern areas, the dentist-to-dental assistant ratio is 1 : 1.8–2.0, and in the SW area 1 : 1.0–1.1. In this area the start of the organized dental care had been delayed in all age groups (Table 1).

The current fluoride content of the drinking water is 0.3 mg/l in Umeå, 0.1–1.2 mg/l in the mountain area, and 0.1–0.3 in the SW area. It has not been possible to map the time of exposure to fluoride in the drinking water in detail.

The children were examined by two of the authors, C. Stecksén-Blicks in the northern areas and S. Arvidsson in the SW area. The two examiners were calibrated before the start of the study. Caries examination included two posterior bitewing radiographs when approximal surfaces could not be inspected. Decayed, missing, and filled teeth and surfaces were recorded (dmft, dmfs, DMFT, DMFS). In the 8-year-olds the dmf values included only primary molars and canines. Initial caries lesions on approximal surfaces (caries that had penetrated only 2/3 of the enamel) were included in the dmfs/DMFS values, but not initial caries lesions on buccal/lingual surfaces (white spot lesions). To check the validity of the diagnoses of caries on bitewing radiographs of the 8- and 13-year-old children, these were read by both examiners. In 95% of the surfaces examined there was total agreement on the diagnosis. In the remaining 5% the diagnosis made by the clinical examiner was chosen.

Standardized questions about preventive measures were asked by the examiners in connection with the caries examination (Table 1).

Gingivitis was assessed in accordance with the criteria of Ainamo & Bay (10), and recorded at 16, 21, 24, 36, 31, 44, 55, 61, 64, 75, 71, and 84, respectively—that is, at a total of 24 measuring points.

The dietary intake of 4- and 8-year-old children was estimated by 7-day records of food intake. In the 13-year-old group dietary history was performed. The difference in methods among age groups was based on experience from a pilot study. The instructions for 7-day recording, the dietary history interviews, and the collection of some complementary dietary and sociodemographic

Table 1. Caries-preventive measures and education of the mother. Relative distribution for each age group

	Umeå			Mountain			SW		
	4 years $n = 93$	8 years $n = 95$	13 years $n = 101$	4 years $n = 93$	8 years $n = 98$	13 years $n = 97$	4 years $n = 80$	8 years $n = 80$	13 years $n = 80$
Information at child health centers									
Yes	72	62	–	76	56	–	76	65	–
Organized dental care									
Age at start (mean)	3.1	3.3	4.7	3.0	3.1	3.9	3.6	5.4	5.8
Fluoride tablets in preschool ages									
Daily	12	16	21	5	3	5	3	13	5
Sporadically	30	25	28	5	4	16	4	4	9
No	58	59	51	90	93	79	93	83	86
Fluoride toothpaste									
Yes	53	84	89	65	76	84	73	90	83
Fluoride mouth-rinsings at school									
Yes	–	94	94	–	71	59	–	89	90
Toothbrushing frequency									
<1/day	7	9	9	11	9	1	43	35	33
1/day	33	31	20	35	32	16	56	65	66
≥ 2/day	60	60	71	54	59	83	1	0	1
Mother's education									
Primary	9	15	24	19	32	51	26	44	59
Secondary	63	46	37	77	65	47	59	45	33
University	28	39	39	4	3	2	15	11	8

information were handled by jointly trained dietitians, one for each area. The dietary interview methods are presented in detail in a separate paper (11).

The dietary information obtained was carefully checked and processed by use of a computerized food data bank, developed by the Swedish National Food Administration. This data bank contains information on energy and nutrient contents of 800 foods and 500 dishes. The results of the nutrition survey have been published elsewhere (11–13).

The following definitions for meals were used:

Breakfast: the first meal in the morning, given that it was not only a sucrose snack.

Lunch, dinner: a hot meal or a cold prepared meal (e.g. a cold salad + sandwich). Lunch: 1000–1400 h; dinner: 1400–2000 h.

Snacks: all intakes outside breakfast, lunch, and dinner.

Statistical methods

The Kolmogorov-Smirnov test and Student's *t* test were used to test differences between distributions and mean values, respectively. Discriminant function analysis was used to explain differences in caries indices between areas (14).

Results

Dental caries

4-year-olds. Significant differences were demonstrated in the distribution of dmfs between the areas ($p < 0.01$, $p < 0.0001$) (Fig. 1). The data also showed that 5% of

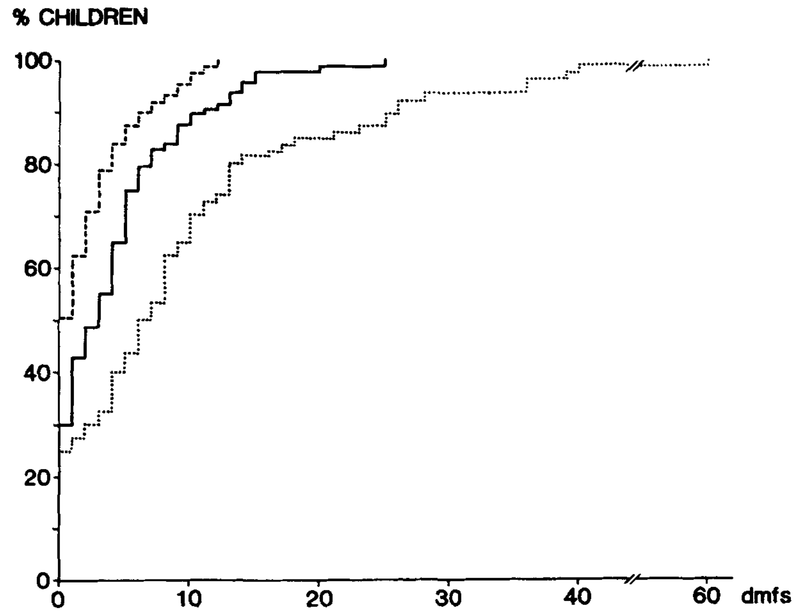

Fig. 1. The cumulative frequency distribution of dmfs in 4-year-old children. Umeå (– – –); mountain area (——); and SW area (· · ·).

the children in Umeå, 10% in the mountain area and 30% in the SW area had more than 10 dmfs. There were statistically significant differences in mean dmft and dmfs indices between the SW area and the areas in the north ($p < 0.001$) and in mean dmfs values between Umeå and the mountain area ($p < 0.001$) (Table 2).

8-year-olds. There were significant differences in the distribution of dmfs between Umeå and the SW area, on the one hand, and between the mountain area and the SW

Table 2. Caries prevalence and gingival bleeding index (GBI)

	Umeå			Mountain			SW		
	4 years $n = 93$	8 years $n = 95$	13 years $n = 101$	4 years $n = 93$	8 years $n = 98$	13 years $n = 97$	4 years $n = 80$	8 years $n = 80$	13 years $n = 80$
Percentage caries-free									
Primary dentition	51	19	–	30	9	–	25	2	–
Permanent dentition	–	23	6	–	21	1	–	3	5
dmft									
Mean	2.0	4.1	–	3.0	5.0	–	5.8	8.0	–
SD	2.7	3.0	–	2.9	3.0	–	5.0	2.6	–
dmfs									–
Mean	2.0	6.6	–	4.0	8.5	–	9.7	15.2	–
SD	3.0	6.0	–	4.9	6.6	–	11.7	8.6	–
DMFT									
Mean	–	2.2	5.9	–	2.2	7.7	–	3.8	11.4
SD	–	2.0	3.0	–	1.5	4.2	–	3.0	5.6
DMFS									
Mean	–	2.7	7.9	–	2.6	11.3	–	6.2	18.2
SD	–	2.6	4.9	–	2.2	8.2	–	4.1	11.8
GBI %									
Mean	4.0	9.0	6.0	11.0	18.0	15.5	27.0	34.0	37.9
SD	7.2	10.8	7.8	11.0	18.2	17.0	14.6	15.0	21.0

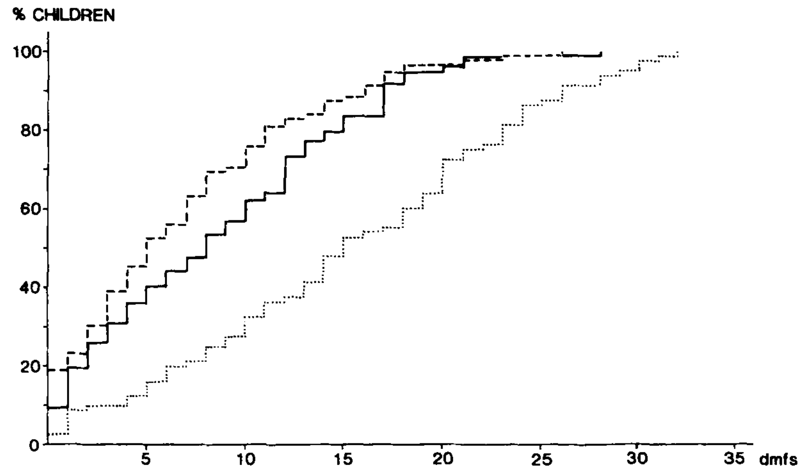

Fig. 2. The cumulative frequency distribution of dmfs in 8-year-old children. Symbols as in Fig. 1.

area, on the other ($p < 0.0001$) (Fig. 2). There were obvious differences in all mean caries indices between the SW area and the two northern areas ($p < 0.001$) (Table 2).

13-year-olds. There were significant differences in the distribution of DMFS between Umeå and the SW area, on the one hand, and between the mountain area and the SW area, on the other ($p < 0.0001$) (Fig. 3). There were significant differences in mean DMFS indices between the mountain area and the SW area ($p < 0.001$) (Table 2). When initial caries lesions were excluded, there were statistically significant differences in mean DMFS values only between Umeå and the SW area ($p < 0.001$). Caries or fillings on approximal surfaces were found in 54% of the children in Umeå, 66% in the mountain area, and 89% in the SW area. If initial caries lesions on approximal surfaces were excluded, the corresponding figures were 40%, 53%, and 70%, respectively, and mean DMFS values 6.9 ± 4.1, 9.9 ± 6.3, and 10.5 ± 6.1, respectively.

Gingivitis

There were great differences in mean values for GBI % among the three areas, with the highest values in the SW area (Table

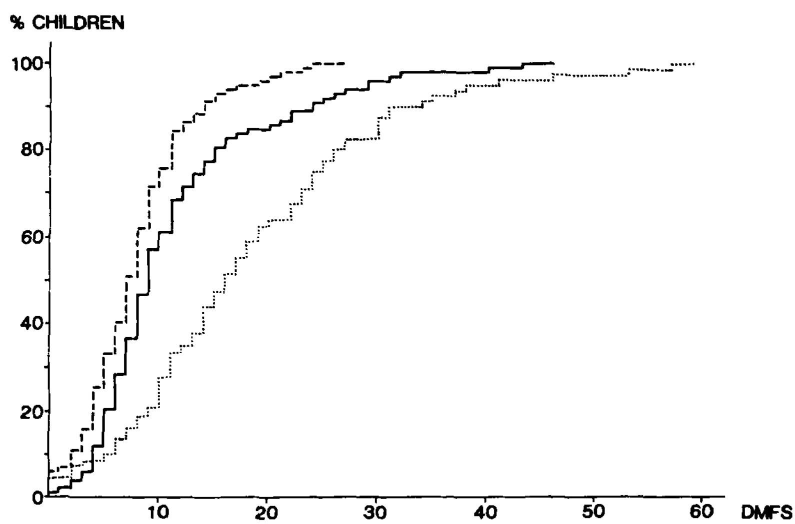

Fig. 3. The cumulative frequency distribution of DFS in 13-year-old children. Symbols as in Fig. 1.

2). There were no statistically significant differences between sexes except in the 13-year-olds, of which boys had generally higher indices than girls.

Sociodemographic data

There were differences in recorded sociodemographic data in the three areas. Thus, more mothers in Umeå had a university education, and their employment level was also higher than in the other areas (Table 1). In Umeå, one of the parents was the daily caretaker of the 4-year-olds in only 35%, whereas the corresponding figure in the mountain area was 62%. Families with more than two children were commoner in the mountain area than in the two other areas.

Dietary habits

There were no great variations in the meal pattern among the areas, as is shown in Fig. 4 and Table 3. The distribution of energy intake was fairly equal in all areas. The lack of some information in the 13-year-old group is due to variations in the methods used in the dietary study.

There were no obvious differences among areas in the total sugar intake or in the sucrose intake within the groups, except in 13-year-olds, whose daily intake of sucrose was lower in SW than in the areas in the north. The total sugar intake was 22% of the total caloric intake, and sucrose constituted about 10% of the total caloric intake in all age groups. The number of snacks per day was higher in the 4-year-olds than in the 8-year-olds.

Discriminant function analysis

A discriminant function analysis was performed to try to explain the differences in caries prevalence (dmfs/DMFS) among the three areas. The following variables were included in the analysis;

Information at Child Health Center (yes, no)
Age when organized dental care started
Daily fluoride tablets (yes, no)
Use of fluoride toothpaste (yes, no)
Fluoride mouth rinsings at school (yes, no)
Toothbrushing frequency (≥ 2/day)
Mother's educational level (primary, secondary, university)
Sucrose consumption (g/day)
Sucrose in snacks (g/day)
Number of snacks/day
Number of meals/day

With these variables 66% of the 4-year-olds, 73% of the 8-year-olds, and 76% of the 13-year-olds could be correctly classified with regard to caries prevalence (dmfs/DMFS). In all age groups the highest number of children was correctly classified in the SW area. Common to all age groups was that the variables 'age when organized dental care started', and 'toothbrushing frequency' had the highest discriminating power.

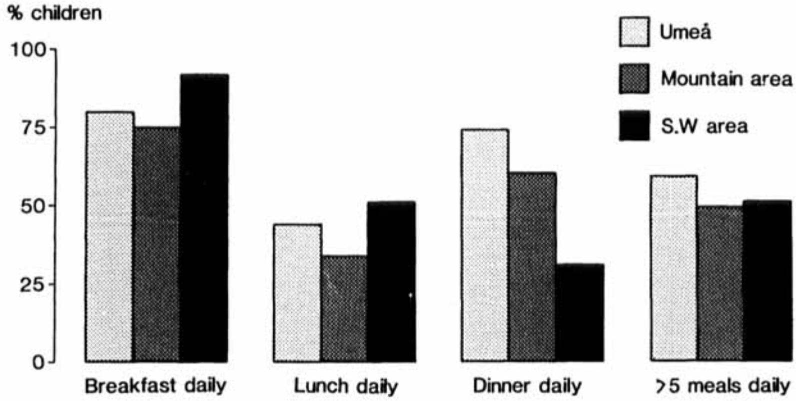

Fig. 4. Meal pattern in 8-year-old children. Data derived from 7-day records.

Table 3. Food habit factors. Percentage distribution for each age group. Data derived from 7-day record (4- and 8-year-olds) and from dietary history (13-years-olds)

	Umeå			Mountain			SW		
	4 years $n = 82$	8 years $n = 79$	13 years $n = 97$	4 years $n = 82$	8 years $n = 83$	13 years $n = 90$	4 years $n = 74$	8 years $n = 71$	13 years $n = 80$
Total sugar intake, g/day	96	107	167	96	111	160	96	110	147
Sucrose intake, g/day	40	48	69	43	48	79	43	48	56
Sucrose intake in snacks, g/day	25	31	40	28	31	44	28	32	34
Snacks > twice/day	72	67	–	75	63	–	85	58	–
Snacks > thrice/day	31	20	–	39	15	–	39	14	–
Mean number of meals/day	5.5	5.3	5.5	5.4	5.1	6.1	5.4	5.0	4.9
Mean number of snacks/day	2.7	2.5	–	2.8	2.5	–	2.9	2.4	–

Discussion

Very obvious differences were found in the prevalence of caries and gingivitis between the area in the SW and the areas in the north. There were, however, also differences between Umeå and the mountain area but not as pronounced as in any of the age groups.

The difference in caries prevalence was to a great extent due to a considerably higher number of initial carious lesions of the permanent teeth of the children in the SW area. Differences between examiners can never be completely eliminated, but, as these examiners were calibrated before the start of the study and bitewing radiographs were read by both, the inconsistencies were probably small.

The greatest inequalities in background data among areas were found in the use of some of the caries-preventive measures and in the number of years with organized dental care. Early information at the Child Health Centers had been given to the same extent in all areas (Table 1), but children in the SW area had not been called to the dental clinic for their first examination until the age of 5 or 6 years. Children in this area also had less chance of receiving individual prophylaxis, since the number of dental assistants providing this treatment was considerably lower.

The number of children taking part in the fluoride mouth rinsings in the mountain area was lower than in the other areas. This was mainly due to the variations in the natural amount of fluorides in the drinking water in this area. Thus, 35% of the children consumed water with more than 0.8 mg F/l. It has in this study not been possible to map the fluoride intake in detail. The number of children who took part in the rinsing program in the SW area was about the same as in Umeå. The rinses in the SW were, however, only fortnightly. Another important vehicle for fluoride is fluoride toothpaste, which many authors consider to be one of the main reasons for the decline in caries prevalence during recent years (15–17). The great difference in toothbrushing frequency between the areas in the north and the SW area thus gives these children a considerably lower exposure to fluorides. The great difference in toothbrushing habits is difficult to explain but may reflect a generally lower interest in dental health and another attitude to prevention. The lower brushing frequency is also reflected in significantly higher mean GBI indices in the SW area compared with the northern areas (Table 2).

With the great difference in caries prevalence between areas, differences in dietary habits or at least in the sugar consumption habits would have been expected. However, these turned out to be fairly equal in the three areas, with very much the same meal pattern and the same frequency of snack-eating. Differences among areas could be noted in the daily sugar and sucrose intake in the 13-year-olds being lowest in the SW area. This may be due to difficulties in obtaining valid data in a dietary history, as virtually no differences could be found in 4- and 8-year-olds, for whom a 7-day record was taken. However, the reliability of the dietary history method has been shown to be good (11).

The results of the discriminant function analysis showed that 'age when organized dental care started' was one of the most discriminating variables. In this material, this finding may be explained by the fact that children in the SW area not only were included in an organized dental care at a higher age than the children in the north but also that less prophylaxis was included in this care. Variables connected with dietary habits and education of the mother were less discriminating in this material.

The sugar-eating habits of Swedish children constitute a major challenge to dental health, both with regard to the total sugar intake and the frequency of intake during the day. Most of the sucrose intake ($\geq$ 60%) was in all age groups consumed in the form of snacks, which is in accordance with data published from Great Britain (18). These habits do not seem to have changed markedly during the last 10–15 years (19). In spite of this, the prevalence of caries is continuously decreasing (1–3, 19). This is probably due to the existence of a comprehensive dental care delivery system, in which all children are examined and treated yearly and whose basic idea is a strong preventive approach mainly based on a frequent use of fluorides. There are, however, obviously variations in this program, with lower degrees of ambition in the preventive work. It is evident that such variations may lead to dangerous consequences for the dental health of Swedish children, which ought to be considered in all discussions about resources allocated to preventive dentistry.

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