Caries Risk Profiles in Two-year-old Children from Northern Sweden

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Aim: To investigate existing caries risk factors in preschool children and to illustrate their caries risk profiles graphically with aid of a computer-based program.

Materials and Methods: All 2-year-old children from a small town in northern Sweden were invited and 87% (n = 125) accepted to participate. Data was collected with a questionnaire concerning the child's normal diet and sugar consumption. Special care was taken to note the intake of sweet drinks and sugary between-meal products. Questions on general health and medication, toothbrushing frequency with parental help and use of fluorides were also included. The caries prevalence was recorded with mirror and probe and the level of oral mutans streptococci was enumerated with a chair-side technique. The obtained data were computerised in a risk assessment program (Cariogram) and a graphical profile of each child was constructed.

Results: The caries prevalence was 6%, and 18% had detectable levels of oral mutans streptococci. The sugar consumption was strikingly high with 82% and 97% having ice cream and sweets once a week or more often. In 22% of the families, toothbrushing with parental help was not a daily routine. Of the children, 51% displayed a low chance (0–20%) of avoiding caries in the future. The frequency of sugar consumption was the most pertinent factor in the children's caries risk profiles.

Conclusions: Half of the subjects exhibited a low chance of avoiding caries in the near future and the strongest single factor was frequent sugar consumption. Thus efforts to limit and reduce the sugar intake in young children are important measures for primary caries prevention.

Key words: caries risk, children, mutans streptococci, oral hygiene, sugar

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It has previously been shown that preschool children from immigrant groups and low socio-economic communities may display a high caries prevalence compared with the majority of the population (Grindefjord et al, 1995; Wennhall et al, 2002). An increasing caries prevalence can also, however, be seen in other subgroups of preschool children in Sweden, as recently highlighted by Stecksén-Blicks et al (2006). It is well documented that the main risk factors for caries development in the primary dentition are frequency of sugar consumption, improper oral hygiene habits, shortage of fluoride and early colonisation of mutans streptococci (Grindefjord et al, 1996; Tinanoff and Palmer, 2000; Vanobbergen et al, 2001; Mariri et al, 2003; Pienihäkkinen et al, 2004). Some of these factors may, however, interact with each other. For example, children with frequent sugar consumption early in life have a higher risk of colonisation with mutans streptococci (Mohan et al, 1998; Habibian et al, 2002) and a low brushing frequency may be associated with colonisation of mutans streptococci (Habibian et al, 2002). Presence of mutans streptococci, consumption of sweets and caries lesions have been shown to have caries-predictive power sufficient for clinical implications (Pienihäkkinen et al, 2004). Sweet drinks

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between meals have also been stressed as an important risk factor for caries in young children (Grindefjord et al, 1996; Borssén and Stecksén-Blicks, 1998; Vanobbergen et al, 2001; Levy et al, 2003; Mariri et al, 2003) and the consumption has increased in these age groups (Stecksén-Blicks and Borssén, 1999).

In order to elucidate the relative importance of various factors associated with caries, the aim of this study was to investigate the existing prevalence in 2-year-old children and to illustrate their caries risk profiles graphically with aid of a computer-based program.

MATERIALS AND METHODS

The present study had a cross-sectional design and was approved by the local ethical committee at Umeå University. All 2-year-old children, born between January 2000 and March 2001, attending the Public Dental Clinic in Lycksele, a town in northern Sweden with around 13,000 inhabitants, were invited to participate in the study (n = 146). Children with severe disabilities and children that did not cooperate for an oral inspection were not included. Of all children in the area, 87% (n = 125) fulfilled the criteria for inclusion and their parents gave consent after verbal and written information. The dental care system in the region offers dental health information to parents of 1-year-old children and a check-up with an oral examination at 2 years of age. The fluoride content in the piped drinking water was low (<0.2 mg/l).

Clinical procedures and questionnaire

Two calibrated examiners performed the clinical procedures. At the regular check-up at 2 years of age, the accompanying parent was asked to fill in a validated questionnaire concerning the child's normal diet and sugar consumption. Special care was taken to note the intake of sweet drinks between meals as well as the frequency of sugary snacks. The following scores were used; 0 = never, 1 = once per month, 2 = 2–3 times per month, 3 = once per week, 4 = 2–3 times per week, 5 = daily, 6 = 2–3 times/day or more. The questionnaire had also questions on general health and medication, toothbrushing frequency with parental help and use of fluorides. An oral examination using mirror and probe was performed and caries were recorded according to the guidelines of the Public Dental Service in accordance with the WHO criteria (World Health Organization, 1987) modified for the primary dentition. No bitewing radiographs were exposed.

Microbial procedures

The enumeration of oral mutans streptococci was carried out with the Strip mutans chair-side technique (Orion Diagnostica, Helsinki, Finland) as described by Jensen and Bratthall (1989). The oral sampling was modified according to Twetman and Grindefjord (1999). In brief, a wooden saline-wetted cotton-pin was streaked along the upper incisors of the child and then rolled along the specially prepared plastic strip. The strips were placed in the selective MSB-broth and cultivated at 37°C for 48 hours. The mutans streptococci were identified based on morphology, and the colony forming units (CFU) were counted in a stereomicroscope with 12–25x magnification.

Calculating the caries risk profiles

The caries risk profiles of the individuals were graphically illustrated with a computer-based program (Cariogram; Bratthall, 1996), expressing to what extent different aetiological factors contribute to the caries risk. In the original Cariogram, ten different parameters are scored and entered into the computer but only seven parameters were included in the present study: caries experience, mutans streptococci levels, answers from the questionnaire including relevant diseases or medication, frequency of sugar consumption, oral hygiene, use of fluorides and clinical judgement. The variables were scored and categorised according to Table 1. The parameter 'sugar frequency' was formed by summarising the scored consumption of ice cream, soft drinks and sweets for each child. A summarised score above the mean value was regarded as a frequent intake (score 3), the mean value as a moderate intake (score 2), and a value below the mean value was scored as a low intake (score 1 or 0). A clinical judgement was made based on the clinical impression at the examination. The caries risk profile was calculated for each child and presented in a pie-diagram with five different sectors expressed as percentages: i) diet, based on the frequency of sugar intake; ii) bacteria based on a combination of oral hygiene and number of mutans streptococci; iii) susceptibility based on fluoride programme; iv) circumstances based on past caries experience and general diseases; and (v) represented the chance of avoiding caries and was scored in five groups (0–20% = low chance, 21–40% = fairly low chance, 41–60% = moderate chance, 61–80% = fairly high chance, 81–100% = high chance).

Table 1 Caries risk factors entered into the Cariogram and percentage distribution of the scores in 2-year old children (n = 125)

Factor	Data	Cariogram scores	%
Caries experience	Clinical examination	2: No caries (normal for the age group)	94
		3: Caries (above the average for the age group)	6
Related diseases	As recorded in questionnaire	0: Healthy	95
		1: Caries related diseases or medication	5
Diet, frequency	Sum of scores for intake of sweets, sweet drinks and ice-cream	0: ≤ 8	5
		1: 9	13
		2: 10	37
		3: ≥ 11	45
Oral hygiene	As recorded in questionnaire	1: 1–2 times/day with parental help	78
		2: Almost every day with parental help	17
		3: Irregularly	5
Mutans streptococci	Enumeration using the Strip mutans test	0: No detectable CFU	82
		1: 1–10 CFU	5
		2: 11–100 CFU	4
		3: ≥ 101 CFU	9
Fluorides	Data from questionnaire	0: Fluoride toothpaste and extra fluorides regularly	0
		1: Fluoride toothpaste and extra fluorides irregularly	0
		2: Fluoride toothpaste only	98
		3: Not fluoride toothpaste	2
Clinical judgement	Clinical impression	0: More positive than the result of the Cariogram	3
		1: Normal	38
		2: Worse than the result of the Cariogram	21
		3: Convinced that caries will occur	38

Statistical methods

All individual data obtained from the questionnaire and from the Cariograms were processed by the SPSS software (12.0, SPSS, Chicago, IL, USA). The average contribution of the risk factors and the distribution of data from the questionnaire were calculated and presented descriptively.

RESULTS

In Table 1, the prevalence and distribution of the risk factors used in the Cariogram are presented. The intake of sugary products is given in Table 2 and Fig 1. Ice cream was given to 82% and sweets to 97% once per week or more often; 1% of the children were never given sweets. Sweet drinks were given to 20% and buns and cakes to 24% of the children once per day or more. To the question 'what do you give your child when he/she is thirsty between meals', 38% of the mothers stated that they gave sugar-containing drinks. The average contribution of the individual factors to the total caries risk in 2-year-olds is illustrated in Table 3. The sugar consumption was the most important risk factor. The distribution of the calculated caries risk profiles is shown in Table 4 and Fig 2. Fifty-one per cent of the children displayed a 0–20% chance of avoiding caries while only 2% had a fairly high chance of avoiding caries in the near future.

DISCUSSION

The present study was performed in order to increase the knowledge of current caries risk profiles of very young children. This was motivated by the fact that increasing caries prevalence has recently been demonstrated in 4-year-old children (Stecksén-Blicks et al, 2006). Known risk factors for the development of

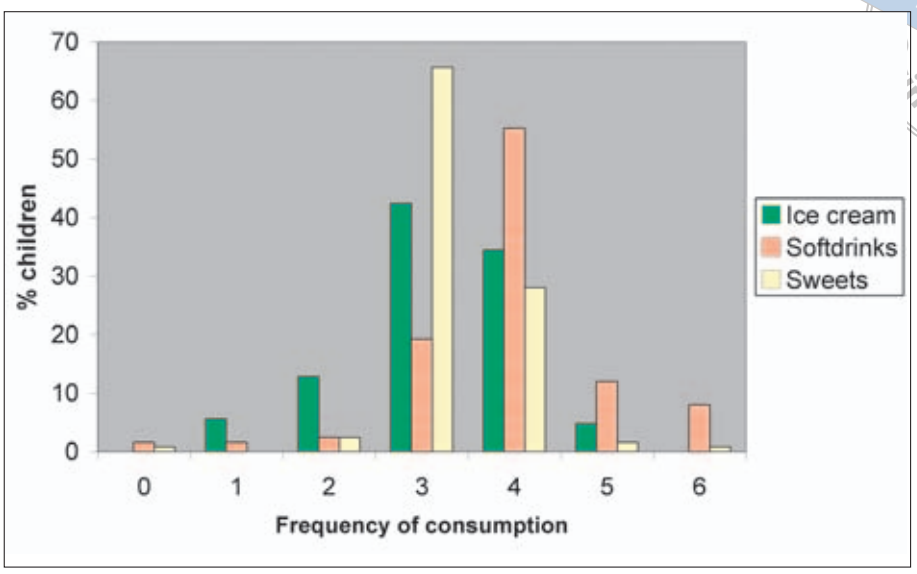

Fig 1 Frequency of consumption of ice cream, sweets and sweet drinks in 2-year-old children. 0, never; 1, once per month; 2, 2–3 times per month; 3, once per week; 4, 2–3 times per week; 5, once per day; 6, 2–3 times per day or more often (n = 125).

Table 2 Percentage distribution of intakes sugary products in 2-year-old children (n = 125)

Products	Percentage distribution			
	Never	Monthly	Weekly	Daily
		1–3 x/m	1–3 x/w	1–3 x/d
Pure sucrose	35	21	31	13
Buns and cakes	-	6	70	24
Ice cream	-	18	77	5
Sweet breakfast cereals	38	19	38	5
Marmalades	17	26	49	7
Sweet drinks	2	4	74	20
Sweets	1	2	94	3
Sweet soups	16	36	37	11
Fruits	-	-	20	80
Dried fruits	31	37	30	2

Table 3 Average contribution of the different factors to the total caries risk in 2-year-old children (n = 125)

Cariogram sector	Mean ± SD
Chance of avoiding caries	25.3 ± 23.9
Sugar	28.3 ± 10.5
Bacteria	11.3 ± 8.5
Susceptibility	26.1 ± 6.9
Circumstances	8.9 ± 3.0

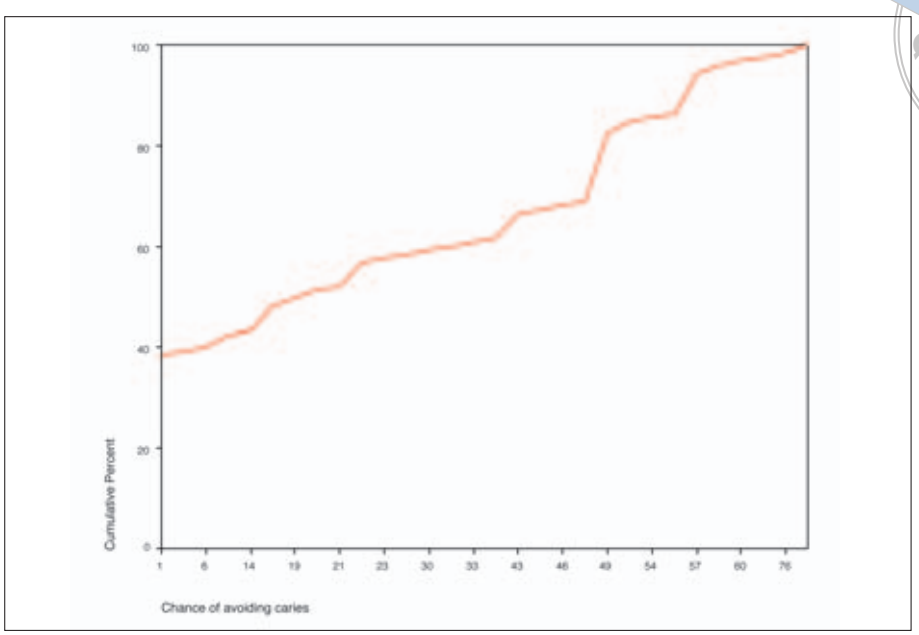

Fig 2 The cumulative distribution frequency of the chance of avoiding caries in 2-year-old children (n = 125).

Table 4 Caries risk expressed as chance of avoiding caries (%) according to the Cariogram

	0–20%	21–40%	41–60%	61–80%
Chance of avoiding caries	51.2	10.4	35.2	2.4

caries in the primary dentition were entered in the Cariogram model, weighted against each other and compiled to a final risk profile. The underlying thinking for such risk profiles was that they could be helpful in revealing how the preventive measures should be targeted. The material consisted of an almost complete age group, adequately reflecting a small town population, but it may not necessarily be representative for young preschool children from an urban area.

The weights of each factor entered into the Cariogram are based on the interpretation of data from numerous clinical studies (Bratthall, 1996) but it must be stressed that the Cariogram model was not developed for 2-year-olds. It is common knowledge that the susceptibility to caries of infants with newly erupted primary teeth differs from older children, adults and the elderly. This different susceptibility may depend more on resistance factors than challenging factors but this has not been expressed in quantitative terms. The prevalence of some risk factors used in the Cariogram may be dependant on age. Initially, children do not harbour mutans streptococci, but the prevalence increases with age (Carlsson et al, 1975). The prevalence of mutans streptococci in the present group was lower compared with previous findings in comparable age groups (Twetman et al, 1994, 1996) and might partly depend on the socio-economic level of the studied subjects (Grindefjord et al, 1995). It must also be highlighted that the microbiological variables were oral samples that cannot directly be compared with samples from pure saliva or plaque. A second age related risk factor used in the Cariogram model is caries experience, and 6% of the children in the present study had signs of caries. It was thus normal for 2-year-olds to be caries-free. All caries-free children were therefore given score 2, and all children with caries scored 3 for caries experience.

There is no general consensus on a 'safe' amount of cariogenic intake (van Loveren and Duggal, 2004). In the original Cariogram model, it is suggested that individuals with more than 7 daily sugar-containing intakes should be given the highest score (3), whereas 7 intakes scores 2, 5 intakes scores 1, etc. As parents of 2-year-old children are advised to give their child 5–6 regular meals per day according to current dietary recommendations (Nordic Council, 2004), the original scoring system could not be used. The frequency of sugary intakes in our sample was estimated after summarising the frequency of ice cream, sweets and sugary drinks as registered in the questionnaire. Subjects with a total of 11 or more were given the highest score in the Cariogram; for example, this could be a child who consumed two of these products at least once every day or more frequently. The possibility of entering a clinical judgement in the Cariogram was used when there were factors of the clinical examination that not were fully taken into account in the program. For example, in a case with a carer who stated at the clinical examination that the child was given sugared drinks between meals daily or at night, but in the questionnaire had given a low frequency of intakes, the clinical judgement was changed from normal (1) to 2 or 3.

The most striking observation in the study group was the high frequency of unfavourable risk profiles, as 51% had a low chance of avoiding caries in the near future. Less marked risks profiles have recently been displayed in groups of 10–11-year-old children as well as in the elderly (Hänsel-Petersson et al, 2004). However, it should be noted that as many as 46% of the 4-year-olds in Umeå, a larger city in the same area, displayed caries (Stecksén-Blicks et al, 2004). This indicates that the present Cariogram profiles may be relevant, in spite of its rather rough estimation and simplification of a complex situation.

The sugar consumption was high and constituted the main part of the risk profiles. Sweet drinks between meals were common, and frequent early intake of sugar-containing drinks has been associated with colonisation of mutans streptococci (Grindefjord et al, 1996; Mohan et al, 1998, Habibian et al, 2002). Such consumption early in life has also been linked to an increased risk for caries (Levy et al, 2003; Marshall et al, 2005). The frequent consumption of ice cream, sweets and sugary drinks in young children reported here is alarming for both dental and general health. Similar findings have been shown in an extensive survey of children's nutrient intake at preschool and at home (Sepp et al, 2001) and in a national survey on children's diet and nutrient intake (Swedish National Food Administration, 2006). The habit of a diet with high sugar content is often established early in life and has a tendency to remain (Rossow et al, 1990; Routtinen et al, 2004). The observation that only a minority (3%) of the 2-year-old children were given sweets less than once per week is definitely a cause of concern. The overall high sugar consumption in children, together with low physical activity, have been considered as main reasons for the increasing prevalence of overweight 4-year-old children in the same area (Petersén el al, 2003) and in other areas (Philippas and Lo, 2005). A primary intervention aiming to reduce the sugar intake in young children is therefore a challenge of common interest to both dentists and physicians (World Health Organization, 2003; Vann et al, 2005). Children should be helped to develop healthy nutrition and exercise habits early, since interventions are expected to be more effective when behaviours are still being formed. The Swedish Dental Association has advocated limited access to soft drinks and other sugary products for schoolchildren and the result of the present study suggests that such efforts should also include the youngest age groups. Carers should be encouraged to avoid frequent consumption of sugar-containing drinks and to promote non-cariogenic foods for snacks. Access to slowly eaten sugar-containing products such as sweets, lozenges or lollipops should be limited.

As none of the children in this study received additional fluorides except toothpaste, the susceptibility sector of the Cariogram resulted in higher values than for schoolchildren and the elderly (Hänsel-Petersson et al, 2004). Therefore susceptibility was ranked as the second strongest caries risk factor. Oral hygiene habits were satisfactory in the majority of the children, but it was not daily routine for 22%. Toothbrushing brings fluoride into the mouth and the beneficial effects could probably be achieved by improving this habit in children (Stecksén-Blicks et al, 2004), although the specific contribution of tooth-cleaning to the brushing procedure remains unclear (Tinanoff and Douglass, 2001).

In conclusion, the present study showed that frequent sugar intakes constituted the main part of the caries risk profiles of 2-year-old children. Therefore efforts to inform and encourage carers to reduce this intake are important tasks for primary caries intervention.

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