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Oral health programme for preschool children: a prospective, controlled study

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Background. New perspectives are needed for oral health programmes (OHPs). The aim was to evaluate the preventive effect of a risk-based OHP in comparison with a traditional programme.

Design. An age cohort of 794 Finnish children, 446 in the intervention group and 348 in the control group, was followed from 18 months to 5 years of age. The children were screened for mutans streptococci (MS) in the dental biofilm. The main outcome measure was the proportion of children with dental caries (decayed, missing, or filled primary teeth > 0) at the age of 5 years. The intervention, targeted to MS-positive subjects in the intervention group only, was based on repeated health education to the caretakers and xylitol lozenges for the child. Dental hygienists carried out the programme.

Results. OHP was effective in white-collar families [numbers needed to treat (NNT) = 3, 95% CI 2–11]. Factors significantly associated with caries at 5 years were MS colonization at 18 months, occupation of caretaker, but also gender when incipient carious lesions were included in the index.

Conclusion. Early risk-based OHP, targeted to the families of MS-positive children, can reduce the risk for caries in white-collar families. For blue-collar families, different kinds of methods in caries prevention and support are needed.

Introduction

In young children, dental caries causes pain, discomfort, and need for demanding and costly treatment procedures and repeated interventions. The early colonization of mutans streptococci (MS) has been reported to best indicate a high risk for dental caries in young children[1–3]. Several other indicators have also been connected with elevated risk for dental caries. Early access and frequent use of fermentable carbohydrates, prolonged breastfeeding, nocturnal feeding (baby bottle), and early plaque accumulation are known risk indicators for caries[4,5]. Health habits and nutritional patterns develop early in life and reflect those of the caretakers and their socioeconomic status. Accordingly, family-related factors (e.g. dental health habits, age, and cohabitation of caretakers) have been found to associate strongly with oral health status of children at the age of 5 years[6,7]. Various types of preventive strategies have been studied in the early prevention of the multicausal disease[8]. In socially deprived suburbs with high caries prevalence, early oral health education has successfully prevented dental caries in preschool children[6,9,10]. Also in low-caries-prevalence communities, targeted early caries prevention has been cost-effective when intensive clinical measures and health education were used[11]. In the 21st century, maternal, regular use of xylitol gum, on the other hand, reduced the transmission of MS from mother to child and subsequently the occurrence of caries in their children[12–15]. As a part of oral health programmes (OHPs) for preschool children, however, the use of xylitol for newly colonized young children has not been reported.

At preschool age, the occurrence of dental caries can be diminished by means of a risk-based, targeted OHP at health clinics. The intention is to create good oral health habits from birth on, and later focusing to MS-colonized children by education and motivation of caretakers.

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The aim of the study was to evaluate the preventive effect of a risk-based OHP versus a traditional programme on the occurrence of dental caries at preschool age. The OHP for the MS-colonized children was based on repeated motivation and oral health education, and included the use of xylitol lozenges at home.

The local ethics committee approved the study plan of this study (ethics committee, City of Turku, Health Office, 16 November 1997).

Materials and methods

The study was carried out in two of four public health care areas of Turku, Finland. The infants of the entire population of the respective health care areas were enrolled in the study. The screening was started in June 1999 and the last examinations took place in December 2004.

Families, almost without exception, use the free public dental services, as well as the free services of the child health clinics: during the first year of life, the caretakers and their infants attend the public paediatric health nurse for up to ten regular visits for advice, inspections, and vaccinations. At these visits, the nurse routinely discusses aspects affecting oral health, along with other general health issues. In addition, dentists and dental hygienists have been part of the child health team, promoting oral health in child health clinics since the 1970s. Of the 5-year-olds, 68–75% have been caries free (dmf = 0) from 1994 to 2003. The fluoride content of the tap water is low (0.3 mg/L).

On the grounds of the results of a short pilot study, around 25–30% of children were estimated to be MS colonized in early childhood. Of the MS-colonized Finnish children, 37% were estimated to develop dental caries up to the age of 5 years[11]. To obtain an absolute risk reduction (ARR) of 10%, which was considered clinically significant, around 1000 children should be enrolled in the study.

Study population

Based on the study plan, the health authorities in Turku Health Centre pointed out two suburban areas for this study. They estimated the socio-economic profiles and sizes to be comparable and suitable for a prevention programme. The areas were not randomly assigned to study groups. For practical reasons, the more populated area, with two employed hygienists was selected for the intervention. Only one hygienist was stationed in the other area which then formed the control group. The entire cohort of 1275 children, born between 1 January 1998 and 30 June 1999, and living in either of the study areas, was enrolled in the study and screened for MS. The inclusion criteria for this study were Finnish background, information of gender, performed screening test at 18 months, and a clinical examination at the age of 5 years ± 6 months. A total of 794 children met with the inclusion criteria, 446 in the intervention group and 348 in the control group (Fig. 1).

Drop-outs

Altogether, 1128 of the 1186 Finnish children were screened for MS. Of the 58 unscreened, 20 children were sick or treated by antibiotics at the time, 36 either had moved from the area, or for other reasons did not visit the hygienist. During the follow-up period, if the family

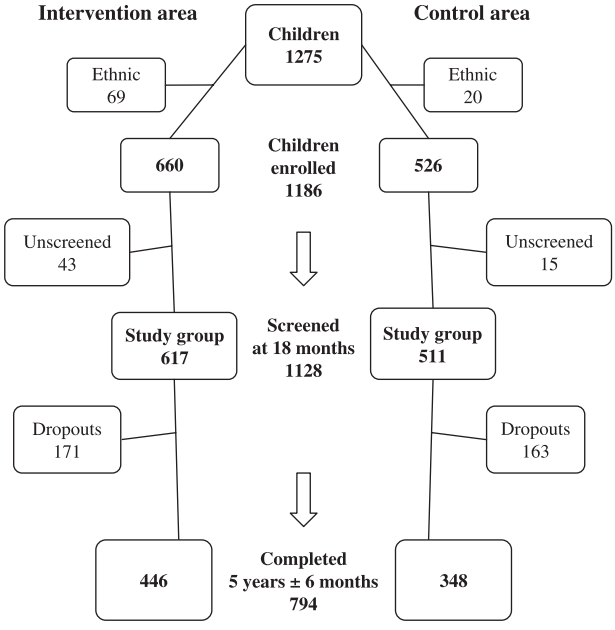

Fig. 1. The flow chart of the enrolled and completed study groups and drop-outs in the intervention and control areas. The numbers in the boxes and under the headings relate to the number of children.

Table 1. Demographic and clinical profiles, and the numbers of the subjects in the study groups and drop-outs.

	Enrolled *n* = 1186	Completed[a] *n* = 794	Drop-outs[a] *n* = 334
	%	%	%
Intervention group			
Boys	53.9	53.1	55.0
Occupation of caretaker blue-collar	62.1	62.6[b]	51.5
MS-colonized 18 months	18.0	20.0[c]	17.5
Dental caries 18 months	0.3	0.2	0.6
Incipient lesions 18 months	1.2	1.3	1.2
Control group			
Boys	47.1	46.3	47.9
Occupation of caretaker blue-collar	45.1	45.1[b]	39.9
MS-colonized 18 months	22.1	25.3[c]	17.2
Dental caries 18 months	0.2	0.3	0.0
Incipient lesions 18 months	0.6	0.8	0.0

[a]No significant differences between drop-outs and completed were found in any analysed variable.
[b]Between the study groups, a significant difference was found in the proportion of blue-collar families $P < 0.001$ (chi-squared).
[c]Between the study groups, a significant difference was found in the proportion of MS-colonized children $P = 0.044$ (chi-squared).
MS, mutans streptococci.

moved to another area within the city, the children were examined by the dentist in the respective area and they remained as study participants. Altogether, 334 children dropped out because the family had either moved out of the city (256 cases) or they were excluded if the 5-year dental examination did not come about within the time limit. Reasons mentioned for absence/delay (51 cases) were temporary visit abroad, logistic problems, illnesses, family causes such as a newborn baby at home, unsuitable working hours, ongoing dental treatment, and sickness leave of the dentist. The reason for absence remained unnoticed in 27 patient records. Of the drop-outs, the demographic factors, gender, carious lesions at baseline, and proportion of risk subjects were analysed based on available information. No significant differences between the drop-outs and the analysed were found in either study group (Table 1).

OHP for all families in the intervention and control groups

The public maternity health nurses mentioned the importance of good oral health and oral health habits during pregnancy and after the birth of the child. The caretakers of an infant received information and advice on well-being of the child and family orally and in writing during the programmed visits at the child health clinics. Feeding and choosing of both food and drink for the infant were issues touched by the public paediatric health nurses during most contacts. To avoid transmission of the cariogenic bacteria, the caretakers were recommended to refrain from salivary contacts with the infant (sharing spoon or giving the infant any object that had contacted the mouth of another person). The oral health aspects were emphasized by the public paediatric health nurse and by the dental personnel at the ages of 6–8 months, and later at 18 months. At these OHP visits, the main topics were dental health; oral bacteria and transmission pathways; planned regular meals; avoiding sugar; choosing healthy non-cariogenic food, drink, and snacks; oral hygiene; adequate use of fluorides; the development of teeth; and sucking habits. Caretakers received a toothbrush for the child. During the 18-month visit, a biofilm sample was taken from all children. No obligation due to the test was proposed. The test result and confirmation of the earlier explained health aspects were given upon call. At the age of 3 years, a dentist invited the child to a dental clinic for examination. Thereafter, the invitations were sent individually approximately every 18 months or more frequently if the risk for caries was considered high (Table 2).

Table 2. Planned events for the study groups.

Group	18 Months	21 Months	27 Months	3 Years	3.5 Years	4 Years	4.5 Years	5 Years
Interv. MS+	Screening	OHP	OHP	Exam	OHP	OHP	OHP	Exam
Interv. MS–	Screening			Exam				Exam
Control MS+ MS–	Screening			Exam				Exam

Exam, clinical examination; Interv., intervention group; MS+, mutans streptococci colonized; MS–, no detected mutans streptococci bacteria in the dental biofilm; OHP, oral health promotion visit to the hygienist.

Additional intervention for families in the intervention group

The public maternity health nurses were advised to mention that habitual use of xylitol products could be continued also during pregnancy and after birth. The caretakers were, during their programmed visit, individually informed about the study and the screening test to be performed at the child health clinics.

Soon after the result of the screening test was found positive, the first invitation to the hygienist's office was sent to the child with its caretakers (Table 2). During this visit, the result of the screening test was discussed and explained. Healthy oral habits and dietary aspects were stressed anew using other terms. The caretakers were motivated to ensure the adequate use of fluorides and good oral hygiene of the child. Toothbrushing was demonstrated, if necessary. Additionally, free xylitol lozenges were offered to the MS-positive children. The specially made xylitol/maltitol lozenges (Leaf, Turku Finland), consisting of 0.25 mg xylitol, were available until the third birthday. The recommended use was two lozenges three times daily which equals 1.5 g xylitol. For new users of xylitol, the recommendation was to start with one lozenge in order to habituate to xylitol and thus avoid its possible laxative effect. Instructions were given orally and in writing. The caretakers were informed that they could cancel the participation in the study at any time. Their informed consent or opinion was recorded in the file.

For the MS-positive subjects, the second invitation to the hygienist's office was due after 3 months and thereafter every 6 months until the age of 5 years (Table 2). At the following visits, the caretakers received repeated information on healthy habits, brushing, fluorides, meals, snacks, and drinks. The hygienists were encouraged and advised to create a supportive, relaxed atmosphere during the OHP visits.

Personnel

The study was performed as a part of the public health care. The staff, including 54 dentists, acted in their positions and carried out all examinations and operative procedures which were part of their routine duties. Of the dentists, 36 examined more than four (≥ 5) 5-year-old children, and 39 dentists examined children of both intervention and control groups. The dentists were not blinded to the grouping.

In the intervention group, two specially trained dental hygienists carried out the screening, child health clinic visits, and the OHP throughout the study. They evaluated all test samples, including those from the control group. In the control group, one dental hygienist and four dentists carried out the screening and the child health clinic visits.

Calibrations

A letter concerning this study and recommendations for oral health habits was sent to all public maternity health nurses in the intervention and control clinics. In the intervention area, all public maternity and paediatric health nurses were invited to join an information and motivation session concerning this study and oral health themes, including the use of xylitol products in the expecting family.

Two responsible dental hygienists were trained in five sessions. Biofilm sample collecting and culturing were demonstrated, discussed, and rehearsed until a consensus of the rules of interpretation was achieved. All dentists attended a 1-day supplemental educational session relating

to caries detection and prevention. Instructions about how to record the oral health status and to collect background information, for study purposes, were given on two separate occasions orally, and in writing. In addition, 20 children were examined by two dentists – both by one of the authors (PM) and one of nine other dentists. In relation to the decayed, missing, or filled primary teeth (dmft) index, the inter-examiner agreement percentage was 90 on the subject level, whereas the kappa value on the tooth level (405 teeth) was 0.961.

Dental biofilm samples, screening for MS

At the age of 18 months, all children were screened for MS unless they were sick or treated by antibiotics. The caretakers of sick children were encouraged to make another appointment when the child would be well, and a minimum of 2 weeks had passed since the antibiotic treatment. Dental biofilm samples were taken from proximal spaces of the maxillary incisors, using dental floss (Oral-B Flossette, Oral-B Laboratories, Belmont, CA, USA, or Hager floss, Hager & Werken, Taiwan). The strip of the Dentocult-SM strip mutans test (Orion, Espoo, Finland) kit was immediately inoculated by the biofilm and incubated in 35–36 °C for 3 days. The strips were then dried in room temperature and observed with the naked eye by either of the two specially trained dental hygienists. The classification of the strips was done according to the classification chart of the manufacturer. If any round, spherical, typical MS colonies were noticed, the strip was considered to be positive and of value 1. Values 2 and 3 corresponded to the values in the chart. Possible other stained spots or lines on the strip were considered negative (i.e. 0). The information of the test result was noted in the patient record, and thus, was available for all dentists and hygienists participating in the health care processes.

Clinical examinations and data collecting

At the age of 18 months, a dental examination was performed at child health clinics by dental hygienists or dentists. At the age of 5 years ± 6 months, dentists performed the final examination at public dental clinics. The dentists had been requested to examine the study cohort as near to the 5-year birthday as possible. They recorded the dental status at all dried surfaces. For the study, the dmft and idmft indices were used. The letter *d* represented dentinal or pulpal decay, *m* missing (i.e. extracted for cariologic reasons), *f* for filled (i.e. restored), *i* for incipient (superficial) enamel lesion, and *t* for tooth. For the analyses, all active and arrested enamel lesions were recorded as *i*. Background information was collected at the ages of 18 months and 3 years. Structured forms were designed and filled as a part of the study. The additional option of the questionnaires was to steer the conversation to various health aspects. The oral health care data, as well as the duration and intensity of the use of the xylitol lentils in the programme, were retained from the patient records or caretaker interview forms.

Data handling

The results of the screening test were dichotomized as 0 for no growth of MS bacteria, and 1 representing all other values. The caries indices were dichotomized as 0 for idmft/dmft value equal to 0, and 1 representing all other values. The occupation of the primary caretaker in the family was categorized according to the Finnish official statistical classification[16], and further dichotomized in white-collar occupations and blue-collar occupations. The classification and further dichotomization were based on the need of education and the degree of independence (e.g. decision making) of the different types of occupations. The categories for the use of xylitol lozenges were as follows: 0 for no offered lozenges, 1 for use three times daily, 2 for fairly good adherence, 3 for reported irregular use, 4 for stopped use, 5 for early stopped use, and 6 for no use. Categories 1 and 2 represented regular use, and all other values irregular/no use.

Statistical analyses

The main outcome measure was the proportion of diseased (dmft > 0 and idmft > 0) children at the age of 5 years. The preventive effect of

Table 3. Distribution of MS-colonized subjects in the study groups, *n* = 794.

				MS colonized	
Occupation of caretaker		**Gender**	***n***	***n***	**%**
Intervention group	White collar	Girls	79	11	13.9
		Boys	88	18	20.5
	Blue collar	Girls	130	22	16.9
		Boys	149	38	25.5
			446	89	20.0
Control group	White collar	Girls	106	18	17.0
		Boys	85	19	22.4
	Blue collar	Girls	81	29	35.8
		Boys	76	22	28.9
			348	88	25.3

In the logistic regression analysis with mutans streptococci = MS colonization at 18 months as dependent variable and occupation of caretaker, study group, and gender as independent variables: occupation of caretaker $P = 0.007$, OR 0.6, 95% CI 0.4–0.9; study group $P = 0.025$, OR 0.7, 95% CI 0.5–1.0; gender $P = 0.204$, OR 1.6.
MS, mutans streptococci.

the OHP was analysed in MS-positive children. The ARR and numbers needed to treat (NNT) were counted with the method by Sackett *et al.* from the proportion of the diseased (dmft > 0)[17]. A multivariate logistic regression model with a step-wise forward principle was used to estimate the effect of the child´s gender, group, MS colonization, and the occupation of caretaker, on caries at the age of 5 years. All main effects and two-factor interaction terms were included one pair after another in the analyses, inclusion criterion being $P < 0.05$ and exclusion criterion being $P < 0.1$. Similarly, the multivariate logistic regression model was used to estimate the effect of the child's gender, group, and occupation of caretaker on MS colonization rate at 18 months. The baseline demographic differences and differences in the distribution of colonized subjects in the study groups were analysed using the chi-squared test, statistical significance level being $P < 0.05$. The program SPSS 13.0 (Chicago, IL, USA) for Windows was used in the analyses.

Results

MS colonization

At the age of 18 months, in the intervention group, 20% of all screened children were MS-positive, whereas in the control group, the corresponding percentage was 25. The group difference was significant (Table 1). There was additionally a significant difference in the distribution of occupations between the study groups. In the intervention group, 63% of children were from blue-collar families, whereas in the control group the corresponding figure was 45 (Tables 1 and 3).

Dental caries

At the age of 5 years ± 6 months, the prevalence of caries in the intervention group was 20.2%, whereas in the control group the prevalence was 20.4% ($P = 0.58$, Table 4). The preventive effect of the OHP was evaluated among the MS-positive children to whom the additional measures were targeted (Table 5). A significantly lower caries prevalence was found only in the white-collar background children in the intervention group (ARR 0.29, 95% CI 0.1–0.5, NNT 3, 95% CI 2–11 (Table 4): in girls, the prevalence of caries (dmft > 0) was 18% in the intervention group, and 44% in the control group. The corresponding figures were 11% and 42% in boys (Table 4). In blue-collar background children, no differences between the groups were found. The same phenomena were seen in the mean dmft values (Table 4).

Early MS colonization (18 months) and occupation of caretaker were the strongest factors associated with caries at the age of 5 years. The blue-collar background, MS-colonized children had a higher prevalence of caries, than the white-collar background, MS-negative children, in both study groups (Table 4).

Table 4. Prevalence of dental caries (dmft > 0 at 5 years) and means of the dmft in relation to MS colonization at 18 months, gender, occupation of caretaker, and study group.

				Dental caries			
				dmft > 0			
Group	Occupation of caretaker	Gender and MS	*n*	*n*	%	dmft Mean	SEM
Intervention group	White collar	Girls +	11	2	18.2	1.27	0.85
		Girls –	68	6	8.8	0.16	0.08
		Boys +	18	2	11.1	0.22	0.17
		Boys –	70	9	12.9	0.33	0.13
			167	**19**	**11.4**	**0.31**	**0.09**
	Blue collar	Girls +	22	7	31.8	2.14	0.10
		Girls –	108	17	15.7	0.40	0.80
		Boys +	38	18	47.4	2.24	0.50
		Boys –	111	29	26.2	0.93	0.20
			279	**71**	**25.4**	**1.00**	**0.13**
Control group	White collar	Girls +	18	8	44.4	2.17	0.77
		Girls –	88	8	9.1	0.17	0.07
		Boys +	19	8	42.1	1.79	0.67
		Boys –	66	4	6.1	0.24	0.13
			191	**28**	**14.7**	**0.54**	**0.12**
	Blue collar	Girls +	29	10	34.5	1.14	0.37
		Girls –	52	10	19.2	0.73	0.27
		Boys +	22	9	40.9	1.09	0.34
		Boys –	54	14	25.9	0.74	0.21
			157	**43**	**27.4**	**0.86**	**0.14**

dmft, decayed, missing, or filled primary teeth; Girls+, MS-colonized girls; Girls–, no detected MS bacteria in dental biofilm; boys correspondingly; MS, mutans streptococci; SEM, standard error of mean. Logistic regression analysis with caries (dmft > 0 at 5 years) as dependent variable and MS colonization, gender, occupation of caretaker, and study group as independent variables: MS colonization at 18 months $P < 0.001$, OR 2.8, 95% CI 1.9–4.2; occupation of caretaker $P < 0.001$, OR 2.2, 95% CI 1.5–3.3; group $P = 0.58$; OR 1.1 and gender $P = 0.06$, OR 1.

Table 5. The proportion of children with caries (dmft > 0 at 5 years) in relation to occupation of caretaker and group.

	Intervention group 5 years			Control group 5 years		
		dmft > 0			dmft > 0	
MS and occupation of caretaker	*n*	*n*	%	*n*	*n*	%
MS+ white collar	29	4	13.8	37	16	43.2
MS+ blue collar	60	25	41.7	51	19	37.3

The absolute risk reduction (ARR) and the number needed to treat (NNT) values as a measure of the preventive effect of the oral health programme targeted to MS-colonized children in the intervention group.
White-collar families: ARR 0.29, 95% CI 0.1–0.5, NNT 3, 95% CI 2–11; blue-collar families: ARR –0.04, 95% CI –0.23–0.14.
dmft, decayed, missing, or filled primary teeth; MS, mutans streptococci.

When early signs of caries (i.e. incipient carious lesions) were included in the analyses, caries (idmft > 0) was significantly associated with the child´s gender and in addition, to the child's MS colonization and the occupation of caretaker (Table 6).

In the intervention group, 52% of the MS-positive white-collar children, and 50% of the blue-collar children regularly used the specially manufactured xylitol lozenges, whereas the other half either used the lozenges irregularly or had stopped using. Three mothers reported laxative effects as adverse effects and as the reason for discontinued use of lozenges, and one mother reported preferring to give only half a dose of lozenges. In the intervention

Table 6. Prevalence of carious lesions (idmft > 0 at 5 years) in relation to MS colonization at 18 months, gender, occupation of caretaker, and study group.

Group	Occupation of caretaker	Gender and MS	*n*	idmft > 0	
				n	%
Intervention group	White collar	Girls +	11	4	36.4
		Girls –	68	14	20.6
		Boys +	18	8	44.4
		Boys –	70	23	32.9
			167	**49**	**29.3**
	Blue collar	Girls +	22	13	59.1
		Girls –	108	29	26.9
		Boys +	38	24	63.2
		Boys –	111	48	43.2
			279	**114**	**40.9**
Control group	White collar	Girls +	18	11	61.1
		Girls –	88	21	23.9
		Boys +	19	11	57.9
		Boys –	66	14	21.2
			191	**57**	**29.8**
	Blue collar	Girls +	29	13	44.8
		Girls –	52	19	36.5
		Boys +	22	13	59.1
		Boys –	54	23	42.6
			157	**68**	**43.3**

dmft, decayed, missing, or filled primary teeth; Girls+, MS-colonized girls; Girls–, no detected MS bacteria in dental biofilm; boys correspondingly; MS, mutans streptococci.

Logistic regression analysis with carious lesions (idmft > 0 at 5 years) as dependent variable, and MS colonization at 18 months, gender, occupation of caretaker, and study group as independent variables: MS colonization $P < 0.001$, OR 2.6, 95% CI 1.8–3.6; gender $P = 0.009$, OR 1.5, 95% CI 1.1–2.0; occupation of caretaker $P = 0.002$, OR 1.6, 95% CI 1.2–2.2; group $P = 0.87$, OR 1.0.

group, among the MS-positive children, no significant differences between regular users versus irregular users of the xylitol lozenges were found in relation to caries.

Discussion

The present practise-based, controlled study compared the caries preventive effect of two OHPs in preschool children. The entire population of both study areas was enrolled in the study. The families, despite their socioeconomic background, use the services of the health care system, and thus, comprehensively can be reached. The control group received standard care as outlined previously. The intervention OHP included the standard care and additionally, a risk-based programme for the MS-colonized children from 18 months to 5 years of age.

At baseline, there were differences between the groups, in relation to the occupation of caretakers, child´s gender, and MS colonization. Therefore, these confounding factors had to be controlled in the statistical analyses. This increased the validity of the study and improved the possibilities to interprete the outcomes. In white-collar families, the prevented fraction was substantial, about 67%, and the NNT value low, indicating a good caries preventive effect. In blue-collar families, the reduction in caries occurrence actually did not come about. The finding suggests that the white-collar families benefit from the studied OHP. From the ethical point of view, levelling down differences would have been more desirable.

The occupation of the primary caretaker in the family was selected as a measure of the socioeconomic background, because it was believed to be a reliable measure, and both easy and neutral to find out. The cut-point between the white-collar and blue-collar occupations was based on the competence classification of the job and the distribution of the occupations. Of the studied factors connected to dental caries, the socioeconomic status was found to be significantly associated with early MS colonization

at the age of 18 months. Furthermore, both the socioeconomic status and the early MS colonization were significantly associated with caries at the age of 5 years. This interrelation is in line with earlier findings. In the highest social class in Finland, especially girls have been at lower risk for dental caries compared with the two lower social classes and boys[18]. In recent studies as well, family-related risk factors have been connected with dental caries[7,19].

Screening toddlers for MS was an easily implemented, good measure for risk evaluation. The samples were taken from dental biofilm and thus, a good positive predictive value was to be expected[20]. Carrying out a health programme study in a city, in a complex organization, demands co-operation of a large group of professionals. All involved were informed and trained for the needed study procedures. The clinical examinations were similarly carried out in all areas of the city. The high kappa value of the interexaminer agreement was achieved partly because of the low caries prevalence, but also because of the young age of the children. A 5-year-old child is usually cooperative, and the jaws have grown to make the inspection of the proximal spaces relatively easy. Hence, caries at this age can rather reliably be detected by experienced dentists. In adolescents and adults, the level of the agreement is usually lower, but even so, data collected from public health records have not been found decisively inferior to data collected by calibrated examiners[21]. What is more, there is no reason to suggest that there would be a group-related difference between the examiners. In fact, most of the dentists examined children from both groups. Of the 54 dentists, only six performed no examinations of intervention group children, and nine performed no examinations of control group children. The 5-year examination was performed in any health care area, if the family moved, during the follow-up period, within the city. The moving of the family, to other health care areas, also increased the number of examining dentists. Thus, the large number of examiners reduces the likelihood of systematic error.

An OHP, which is mainly based on the activity at home and compliance of the family, seems to increase the polarization (i.e. skewed distribution) of dental caries. The age of the children, on the other hand, would have been optimal for primary prevention of caries. Clinical and economic effectiveness in early prevention of caries has been achieved, for instance in Vanha Korpilahti, in a targeted OHP for preschool children[11]. In Vanha Korpilahti, the main elements were health education for the caretakers, intensified home care, and clinical caries preventive and controlling measures for the child. Clinical preventive measures combined with health programmes presumably enhance the preventive effect of the programmes. In terms of cost, clinical measures demand more resources, whereas education and motivation sessions can be organized outside dental offices at child health clinics, at home, or elsewhere, and they emphasize self-care, which is considered more economical in the long run. In the Nordic countries, practically all children regardless of background, including those from socially deprived families, are brought to the child health clinics. Hence, the coverage of the programmes commonly is very high. Therefore, the skewness in distribution of caries is not necessarily increased if effective clinical measures are used. The present result may indicate that the OHP for preschool-aged children should be more based on clinical measures.

The present programme can only be evaluated *en bloc*. None of the elements can be extracted for independent evaluation. Repeated contacts with health professionals were meant to create good oral health habits by educating, motivating, and supporting the caretakers.

The number of drop-outs (334 children) was larger than expected. Their profiles, however, did not differ from that of either of the completed groups. Of the drop-outs, 77% had moved out of town. All other drop-out children were examined outside the time limit of the study. The examination interval was, as a rule, individually determined. The dentists were requested though, to examine the study cohort as near to the fifth birthday as possible. The request was not easy to fill among all other tasks and patients. Neither of the drop-out reasons was connected to or caused by this study. Hence, the number of drop-outs was not likely to cause a systematic error in the study.

All health programmes have social and practical limitations. The effects of the socioe-

conomic status are not easily overcome in a simple community programme. An OHP was not expected to solve inequalities in the society, and many of the background factors were not touched. Interventions can be fruitful, but in the end, different kinds of structural approaches to oral health promotion are additionally needed. Amending health-supporting legislation or environmental conditions could be efficient, especially if all health authorities support the actions. Nevertheless, all new generations need to be educated to become aware of the basic health issues. Reminding and motivating to good health habits should be self-evident to all professionals. The Nordic health care system and health clinics have proven their good covering and acceptability, and because of this, have potential to develop their services and networks further to meet the needs of all families, including the socially deprived families.

Conclusion

In the present population, with relatively low caries prevalence, the MS colonization in the dental plaque (biofilm) and the occupation of caretaker are strongly related to dental caries at the age of 5 years. The present programme seems to have a better preventive effect on dental caries in white-collar families than in blue-collar families. For blue-collar families, different kinds of methods for oral health promotion and support are additionally needed.

What this paper adds
- The paper emphasizes the importance of the socioeconomic background and the early MS colonization on caries.

Why this paper is important to paediatric dentists
- The paper helps in the determination of the individual examination intervals and planning of OHPs.

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