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Mutans streptococci colonization associates with the occupation of caretaker, a practise-based study

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Background. The early mutans streptococci (MS) bacteria colonization is connected to early childhood caries. The aim of this study is to examine associations between the MS-colonization and background factors in young children, in order to enhance the oral health program in a low caries prevalence community.

Subjects and Design. An age cohort of 512 children was screened for MS in the oral biofilm at the age of 18 months. The caretakers were, using a structured form, interviewed of demographical factors and habits connected to oral health: antibiotic treatments, child's appetite, frequency of night feeding, use of sugary products or drinks, and maternal xylitol use. The associations were evaluated with logistic regression analysis.

Results. Mutans streptococci colonization was significantly associated with both the occupation of the caretaker and the non-Finnish background.

Conclusion. The early MS-colonization, in preschool children, strongly associates with the socioeconomic status of the family.

Introduction

The mouth of an infant colonizes little by little depending on the microbiota available in the immediate surroundings, their virulence and the frequency of the exposure, combined with the presence of dietary carbohydrates. The colonization of mutans streptococci (MS) bacteria has been connected to salivary contacts mostly with mothers[1]. The early MS-colonization and early plaque accumulation are known to indicate an elevated risk for early childhood caries (ECC)[2–5]. As to be expected, several family-related factors reflect in the caring and thus, well-being of the child[6]. Accordingly, the child's socioeconomic background has been connected to poor oral health[3].

Finding out the key factors associating with the acquisition of the oral microflora, could help in perceiving and thus, preventing or delaying the complex process leading to dental caries. Hence, the caries-associated microflora and their acquisition and associations have been studied in many countries[1,7–12]. Multiple interactions among the key factors connected to the colonization have been suggested[13]. In Scotland, the child's salivary MS counts in 2-year olds and >2-year old, was found to be associated with the degree of the social deprivation, and with caries in the 3- and 4-year olds[14].

The bacteria once harbouring the dentition seem to persist or easily to recolonize. In addition, the decolonization of the MS has been found only partial or temporary in adults, teenagers, and preschool children[15–17]. In other words, to be able to prevent or delay the MS-colonization, both in low and high caries prevalence communities, the associated factors, should be recognized and controlled before the colonization occurs.

Aim

The aim of this study is to explore associations of the child's early MS-colonization with socioeconomic factors and oral health-related habits.

Hypothesis

Family-related factors can affect MS-colonization in toddlers.

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Ethical aspects of the study

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

Material and methods

Power analysis

Based on a pilot study, 25–30% of children were estimated to be MS-colonized in early childhood. To reach a fair sample size of around 100 MS-colonized children, around 400–500 children should be enrolled in the study.

Study population

In the city of Turku, Finland, the entire cohort born between 1 January, 1998 and 30 June, 1999, all 545 children in one of four health care areas, was invited to a screening test for MS and their caretakers interviewed about background factors. The study subjects, formed the control group in our oral health program (OHP) study[18].

The inclusion criteria for this study were the performed screening test, the interview and the information about the child's gender. Five hundred and twelve children (mean age 19.1 months; SD 1.7; range 16) met with the inclusion criteria (Fig. 1). The description of the study subjects is presented in Table 1.

Dropouts

Of the enrolled 545 children, 512 were both screened for MS and their caretakers interviewed. Of the 33 excluded, in 15 cases the children were not screened for MS. They were either sick or treated by antibiotics at the time, had moved from the area, or for other reasons did not visit the dental hygienist. In one case, the screening test was unavailable, and in 17 cases, the interview was incomplete (Fig. 1).

Oral health consultation

The expecting mothers met their *maternal* health nurse for individual, programmed controls and advice. Within the first year of life, the infant and the caretakers visited the public paediatric health nurse 10 times. An overall health program was carried out. The oral health aspects were discussed by the public paediatric health nurse and by the dental personnel at the age of 6–8 months in the child health clinics.

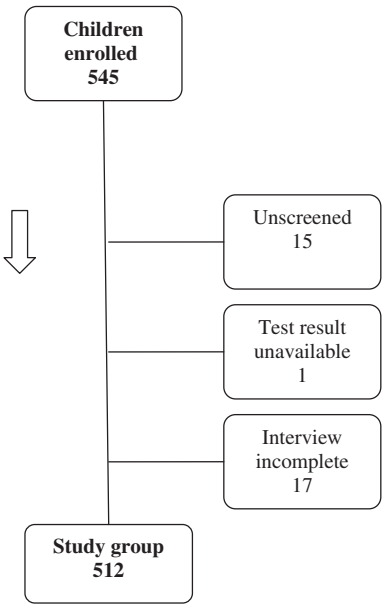

Fig. 1. The flow chart of the enrolled and completed study groups and dropouts.

Table 1. Demographical and clinical profiles of the enrolled, screened, and dropout children based on available information.

	Enrolled Finnish	Analysed Finnish	Enrolled non-Finn	Analysed non-Finn
Number of subjects	526	495	19	17
Occupation of caretaker: blue-collar	237 (45)	222 (46)	13 (68)	12 (70)
Gender: boys	248 (47)	233 (46)	11 (58)	11 (61)
Caries dmft > 0		(0.2)		0
Incipient lesions idmft > 0		(0.6)		0
Dropouts	31		2	
Occupation of caretaker: blue-collar	15 (48)		1	
Gender: boys	15 (48)		0	

Values within parenthesis are expressed as percentage. Key: no significant differences in relation to the occupation of caretaker nor gender were found between the analysed and the dropouts.

Training and calibration of personnel

One dental hygienist and four dentists carried out the child health clinic visits and the screening test. Sample collection was demonstrated by one of the writers (PM) and rehearsed in a group session with the hygienists and dentists involved in the study.

Outside the collector team, two dental hygienists, separately evaluated all test strips. They were specially trained, in five sessions, by two of the writers (KP and PM) for the screening procedure and the interpretation of the strips. The evaluating was rehearsed until a consensus of the rules was achieved.

Dental biofilm samples, screening for MS

As described in our previous OHP study[18], the dentists or the hygienists screened all children for MS unless the child was sick or treated by antibiotics. The sick children's parents 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 the proximal spaces of the maxillary incisors, using dental floss (Oral-B Flossette®; Oral-B Laboratories, Belmont, USA, or Hager® floss; Hager & Werken, Taipei, Taiwan). The strip of the Dentocult-SM strip mutans test® (Orion Espoo, Espoo, Finland) kit was immediately inoculated by the biofilm and incubated in 35–36 °C for 3 days. After the incubation, the strips were dried in room temperature and then 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 density values in the chart. Possible other stained spots or lines on the strip were considered negative, i.e., zero.

Clinical examination and data collection

Dentists or dental hygienists examined the 18-month-old children's oral health at the child health clinics. The visual inspection was done in a well lit room the child sitting in the caretaker's lap. Table lamp was used if more light was needed. For this study, the dmft- and idmft-indices were used. The lesion was recorded carious if cavitation was seen and incipient (i.e., superficial) if the surface showed coloured or white spot lesions but no cavitation. The letter d represented dentinal or pulpal decay, incipient enamel lesion (i, active or arrested), extracted (m), filled (f) and tooth (t). The examiner filled a structured form to obtain the background information.

Data handling

The results of the screening test were dichotomized as 0 or MS− for no growth of MS bacteria and 1 or MS+ 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 parent responsible of the maintenance of the family, mostly father, was regarded as the primary caretaker. The occupation of the primary caretaker was categorized according to the Finnish official statistical classification and further dichotomized in 1 for white-collar occupations and 2 for blue-collar occupations[19]. The classification and further the dichotomization, were based on the required education, and the degree of independence (e.g., decision making) of the different types of occupations. For instance entrepreneurs, occupations within upper and lower clerical staff belonged to the white-collar occupations. Workers in industry, construction or the service sector, students, unemployed, or unknown occupations were in the blue-collar group. The ethnic background, based on the mother tongue of the child, was reported as Finnish or non-Finnish. The Finnish children had either of the two official languages, Finnish or Swedish, as their mother tongue. All other languages were reported as non-Finnish. From the reported information, the child's number of antibiotic treatments was dichotomized as 0 for not more than one treatment and 1 for two treatments or more than two. The child's reported appetite was dichotomized as 0 representing good or usually

good appetite and 1 for moderate or poor appetite. The reported night feeding of the child was dichotomized as 0 for never or seldom feeding at night, and 1 representing one or several feedings per night. The child's reported use of thirst-quencher (drink), other than water, between meals was dichotomized as 0 for consuming never or seldom and 1 for daily consumption. The reported information on added sugar on the child's meal was dichotomized as 0 for never or seldom, and 1 for adding sugar daily. The reported consumption of sweets, cookies, raisins, etc. by the child, was dichotomized as 0 for consuming never or seldom and 1 for daily consumption. The reported use of xylitol products by the mother was dichotomized as 0 for daily use and 1 for no use or occasional use. The selection of the cutoff points was based on the highest sum of sensitivity and specificity combined with a clinically relevant category size of at least 5% of cases.

Statistical analyses

The dependent variable was the proportion of colonized (MS+) children at the age of 18 months. A univariate logistic regression model was used to estimate the effect of the occupation of the caretaker, the child's gender and the oral health-related habits on the MS-colonization. The variables were further included in a multifactorial, stepwise logistic regression model. The demographical differences in the distribution of the reported background categories were analysed using the two-sided 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

The prevalence of MS-colonization in the present group was 23% (Table 2). The occupation of the primary caretaker was the strongest factor significantly associated with the MS-colonization (Tables 2–4). In the blue-collar families, the colonization rates were higher than in the white-collar families. In univariate analyses, also the non-Finnish background associated significantly, with the MS-colonization (Tables 3–4). Furthermore, in the multivariate analysis, this effect was found additive to the effect of the occupation of the caretaker. The associations of other studied factors with MS-colonization, were not significant.

Table 2. MS-colonization in relation to the occupation of caretaker and gender.

Occupation of caretaker	Gender	*n*	MS+	%
White-collar	Girls	147	25	17
	Boys	131	26	20
Blue-collar	Girls	121	35	30
	Boys	113	34	30
		512	120	23

Table 3. Reported background factors and their associations with MS-colonization, univariate analyses.

Background information	*n*	MS+ *n*	MS+ %	Log reg OR (95% CI)	*P*-value
Gender					
Girls	268	62	22.5	1.1 (0.8–1.7)	0.557
Boys	244	63	25.0		
Occupation of caretaker					
White-collar	278	51	18.3	1.9 (1.2–2.8)	0.003
Blue-collar	234	69	29.5		
Finnish	495	111	22.4	3.9 (1.5–10.3)	0.006
Non-Finnish	17	9	50.0		
Antibiotic treatment					
≤1	254	57	22	0.896 (0.6–1.3)	0.597
≥2	258	63	24		
Appetite					
Good/usually good	444	104	23	0.994 (0.5–1.8)	0.985
Poor/medium	68	16	24		
Night feeding					
Never/seldom	473	109	23	0.762 (0.4–1.6)	0.466
Nightly	39	11	28		
Sugar added					
Never/seldom	479	110	23	0.686 (0.3–1.5)	0.338
Daily	33	10	30		
Sweet snacks					
Never/seldom	458	106	23	0.860 (0.5–1.6)	0.648
Daily	54	14	26		
Drink other than water					
Never/seldom	399	86	22	0.638 (0.4–1.0)	0.060
Daily	113	34	30		
Maternal xylitol use					
Never/seldom	304	66	22	1.264 (0.8–1.9)	0.265
Daily	208	54	26		

Key: dichotomized MS-colonization as dependent variable and dichotomized background factors as independent variables; logistic regression, univariate analyses.

Table 4. Multivariate analysis of the background factors.

Background information	*n*	MS+		Log reg	
		n	%	OR (95% CI)	*P*-value
Occupation of caretaker					
White-collar	278	51	18.3	1.8 (1.2–2.7)	0.007
Blue-collar	234	69	29.5		
Finnish	495	111	22.4	3.4 (1.3–9.2)	0.014
Non-Finnish	17	9	50.0		

Key: dichotomized MS-colonization as dependent variable and dichotomized background factors as independent variables; a multivariate, stepwise, logistic regression model.

Discussion

In this study, the toddlers in blue-collar families showed higher MS-colonization rates than those in the white-collar families. Many aspects within the modern lifestyle are both related and interrelated with the well-being, general health, and the health habits of the families. The occupation of the primary caretaker represents the socioeconomic status of the family. The health habits and attitudes reflect the socioeconomic status and the educational background of the caretaker. The official Finnish classification of the occupations in this study, was based on the education needed and the degree of independence in the occupation. Therefore, the classification takes both the educational background and the socioeconomic status into account. MS-colonization was found significantly associated both with the low socioeconomic status and the non-Finnish background (Table 4). The latter finding, actually an additive effect, is in line with earlier findings in 1-year-old Swedish children where ethnicity and the education level of mother strongly associated with the MS-colonization. However, in the Swedish study, in contrast, the low social group itself did not seem to correlate with the higher colonization rate[20,21]. Furthermore, in an international, multi-country study, the microbiota of the young children's biofilm were investigated and higher levels of caries-associated microflora were found in children from deprived backgrounds[7].

Surprisingly, the interviewed oral health-related habits did not seem to associate with the MS-colonization. The studied habits have traditionally been connected to ECC and hence, it was assumed that they also would associate with the MS-colonization. Possible other explanations for the colonization process could be connected, for instance, to the immunological or other age-related factors. In toddlers, after all, some of the habits or other factors may have been in use only for too short a time. The environment of an infant or a toddler, undoubtedly, vary considerably in many aspects between subjects and in the course of time.

Naturally, the data, collected by interviews with the caretakers, must be considered with some reservations about the accuracy. People tend to embellish their answers, and the actual interview situations may sometimes be embarrassing – especially if the optimal behaviour (good health habits) has not been achieved. The screening test, on the other hand, can be regarded more objective. The sample collecting and culturing were rehearsed and can be considered simple and suitable for outreach health programs. The blinded observation and the interpretation of the test strips were done by two well-trained hygienists. The sample size, and thus, the amount of observations, is large enough to enable conclusions. The study group was the entire cohort born in the respective health care area, a fourth of the city. Thus, it well represented the population. Furthermore, a single testing of MS-colonization also has its limitations. It is known that especially the level of salivary streptococci vary at times. From the biofilm of toddlers, however, the results are more feasible than from the saliva[4]. Samples from the biofilm are found more reliable in the caries risk-assessment[22]. In validity testing the agreement between the present method of salivary and biofilm/plaque tests and the laboratory salivary assay was found good and the biofilm test surpassed the salivary test in sensitivity, accuracy, and kappa values[23].

The frequency of xylitol use within the family is known to be congruent[24]. Of mothers, 41% reported the daily use of xylitol products. This, in Finland, is not very surprising since the use of xylitol products has become quite frequent, a well-adopted habit,

among young adults and children. About half of the teenagers have been reported to use xylitol products daily[25]. The caretakers were interviewed of the frequency of xylitol consumption, wheras the amount of xylitol, was ungraded and therefore, it is likely to assume it to be varying and fairly small. This may explain why the mothers' xylitol use did not correlate negatively with MS-colonization, in contrast with earlier observations[26,27].

Several other risk factors for dental caries, besides the MS-colonization, have been connected to the child's environment. In this study, the occurrence of caries was very low (dmft 0.2% and idmft 0.6%, Table 1). Family-related factors, in earlier Finnish studies as well, have been connected with dental caries in children[6]. Newly published studies from Belgium indicate that there are significant associations between dental caries experience and socioeconomic factors, visible plaque, use of sugary products and sugary drinks between meals and at night in 3-year olds[28]. The process of MS-colonization needs to be further studied.

Conclusion

The early MS-colonization, in preschool children, strongly associates with the socioeconomic status of the family.

What this paper adds

- The effect of the socioeconomic factors seem to exceed those of a number of other background factors in the MS-colonization of toddlers.

Why this paper is important to paediatric dentists

- Dentists should pay attention to the socioeconomic background, when planning the treatment or individual recall intervals of paediatric patients.

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