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ORIGINAL ARTICLE

Caries-preventive effect of an oral health program for preschool children in a low socio-economic, multicultural area in Sweden: Results after one year

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Abstract

The aim of this study was to evaluate the caries-preventive effect of an oral health program for preschool children living in a multicultural, low socio-economic area. In total, 804 2-year-old children were invited and recalled every 3rd month to an outreach facility for parent education and toothbrushing instruction. In addition, fluoride tablets (0.25 mg/day) were provided free of charge. A clinical examination and questionnaire were completed at baseline and at age 3 years. The results of the intervention were compared with a non-intervention Reference group of 3-year-old children ($n = 217$) from the same area. In the Intervention group, the 1-year attrition rate was 8.2%, and more than 90% of the children attended at least 4 of their scheduled appointments. The parents' daily assistance with toothbrushing and the use of fluoride toothpaste and tablets improved significantly during the intervention. Compared with the Reference group when the children were 3 years old, the number of children in the Intervention group who consumed frequent in-between meals and sweet drinks at night was significantly lower. Caries prevalence at age 3 was significantly lower in the Intervention group than in the Reference group (3.0 deft versus 4.4 deft; $p < 0.01$). The number of caries-free children after the 1-year intervention was 37% in the Intervention group compared with 15% in the Reference group. The relative risk (RR) was calculated to be 2.5 (95% CI 1.8–3.4) and the number needed to treat (NNT) 4.6. In conclusion, this study demonstrated that the oral health program significantly affected the prevalence of caries and various risk factors for caries development.

Key Words: *Caries, immigrants, preschool children, prevention*

Introduction

It is generally understood that growing inequalities in oral health exist between social classes and ethnic groups in preschool children [1]. Several studies have demonstrated that immigrant children and children in socially deprived communities have significantly more caries than the average child [2–4]. A systematic review has concluded that significant improvements in social conditions and the physical environment are needed to reduce the gap, but also that outreach interventions by the local health service can actively reduce disparities in health [5].

We recently described a multicultural, low socio-economic urban area in which early childhood caries is a public health problem [6]. With the aim of combating the high caries situation, a community-based oral health project for 2-year-olds was implemented and launched in 2000 in the Malmö–Rosengård area. The cornerstone of the intervention was parent education, which included information on dietary habits, toothbrushing, and the daily use of fluoride. This was justified by observations that the mother's level of education and the presence of visible dental plaque were strongly related to the development of caries [7,8] and by the well-established effect of fluoride in controlling caries by reducing enamel demineralization and enhancing remineralization [9].

The aim of this communication is to report the 1-year results of an oral health program for preschool

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children living in a multicultural, low socio-economic area.

Materials and methods

Study groups

All children born during the 24-month period between July 1998 and June 2000 and living in the suburban area of Rosengård in Malmö, Sweden, were invited to participate in this project, which was approved by the local ethics committee at Lund University. After verbal and written information was given and parental consent obtained, a total of 804 children (407 boys and 397 girls) entered the study and formed the Intervention group. The vast majority of the families were of immigrant origin and a language other than Swedish was spoken at home in 94% of the families. Arabic was the most common language (52%). One percent of the children at baseline were disabled and another 5% were medically compromised. The fluoride content in the piped water supply was 0.22 ppm. At the age of 3 years, 738 children were re-examined and 66 (8.2%) dropped out due to relocation outside and within the country.

All children from the same area and born during the 6-month period between July and December 1997 ($n=217$) served as a historic non-intervention Reference group [6] and were included from 3 years of age. The parents of these children had been invited to visit at the local Child Health Center for dental health information at the age of about 18 months, as had the parents of the children in the Intervention group. Of the children in the Reference group, 1% were disabled and 7% medically compromised; 96% were of immigrant origin and a language other than Swedish was spoken in 93% of the families.

Intervention program

The intervention program was carried out on 5 occasions: at 24 months of age (baseline); at 27, 30, and 33 months of age; and at 36 months of age (final examination). The participants were thus successively introduced to the program from July 2000 to June 2002. The core of the program is given in Table I. At each visit, the accompanying guardian was given practical instruction on how to brush the child's teeth. After this demonstration, the child was given a toothbrush and offered a discounted fluoridated toothpaste containing 1,000–1,100 ppm NaF. The parent was also provided with free fluoride tablets for the next 3 months and encouraged to give the child one fluoride tablet each day (0.25 mg NaF) in the evening after toothbrushing. Brushing instructions and training were reinforced at each visit. Based on the interview, dietary recommendations were given, with a focus on avoiding nocturnal meals and sugar-containing snacks. Assistance from professional translators was arranged on demand and used at 3% of the visits. The program was carried out by two specially trained dental assistants (EM and IS) throughout the study period. Performance assessments were undertaken regularly during the intervention period to secure compliance with the study protocol. The children were individually recalled for each visit to an outreach facility located in the area center, close to shops and social services. The setting was specially designed for counseling and did not serve as a dental office.

Table I. Core of the oral health program

Age	Measure
Data collection questionnaire	
24 months (baseline)	Toothbrushing instruction F-toothpaste discount offer F-tablets provided (0.25 mg/day) Diet recommendations
27 months	Reinforced toothbrushing instruction F-toothpaste discount offer F-tablets provided (0.25 mg/day) Oral hygiene and diet problem-solving
30 months	Reinforced toothbrushing instruction F-toothpaste discount offer F-tablets provided (0.25 mg/day) Feedback and problem-solving
33 months	Toothbrushing reinforcement F-toothpaste discount offer F-tablets provided (0.25 mg/day) Feedback and problem-solving
Clinical examination questionnaire	
36 months	Toothbrushing reinforcement F-toothpaste discount offer F-tablets provided (2×0.25 mg/day) Feedback and problem-solving

Clinical examination and interview

At 2 years of age (baseline) and at 3 years of age (after 1-year prevention program) in the Intervention group and at 3 years of age in the Reference group, the accompanying guardian was interviewed. A clinical examination was carried out at 3 years of age. The design of the study did not permit a blinded examination procedure.

The clinical examinations were carried out in a dental office by one experienced dentist (I.W.) after the teeth had been carefully dried. Lighting was optimal, and a mirror and a blunt explorer were used. The children were examined either lying in the dental chair or with their heads in the lap of the dentist. No bitewing radiographs were exposed. The presence of visible plaque on the labial surfaces of the upper incisors was scored according to the visible plaque index [10], and gingival health was scored as "bleeding" or "non-bleeding" after toothbrushing. Caries was recorded as manifest (cavitated) or initial (non-cavitated) decay, extracted or filled teeth (deft) according to the criteria described by Wendt et al. [11]. A child was scored as caries-free when neither manifest nor initial enamel

Table II. Selected data from the questionnaire at baseline (2 years of age) and after 1 year (3 years of age) in the Intervention group and in the Reference group (3 years of age)

	Intervention group (I)			Reference group (R)	
Variable	Baseline 2 yrs ($n=804$)	After 1 yr 3 yrs ($n=738$)	Diff.*	3 yrs ($n=217$)	Diff.* I – R (3 yrs)
Frequent small eating (>5/day)	28.1%	22.4%	$p<0.05$	46.2%	$p<0.001$
Sweet drinks at night	13.2%	14.8%	NS	23.8%	$p<0.01$
No parent-performed daily toothbrushing	13.2%	5.6%	$p<0.001$	21.1%	$p<0.01$
No fluoride toothpaste	7.5%	2.1%	$p<0.001$	1.8%	NS
No fluoride tablets	94.2%	8.6%	$p<0.001$	88.8%	$p<0.001$

*Comparison of proportions was subjected to the chi-square test. NS = not significant.

lesions were registered. Intra-examiner reproducibility was tested by a re-examination of 30 patients after 2 months, and the deft agreement was 83%.

The guardians were interviewed with the aid of a structured questionnaire concerning ethnic background, medical history, diet, toothbrushing assistance, and use of fluorides. The questionnaire was accompanied by a booklet with illustrations and pictures (toothbrush, baby bottle, etc.), to aid understanding.

Statistical methods

All data were transferred by optical reading to the SPSS software program (Chicago, Ill., USA). Comparisons of caries prevalence between the Intervention group and the Reference group at the age of 3 years were made using the Mann-Whitney U-test. In all other comparisons, the Mantel-Haenzel chi-square test was applied. For relative risk (RR) calculations, the participants were dichotomized as having "caries" or being "caries-free". Differences at the 5% level of probability were considered statistically significant.

Results

Compliance with the intervention program was as follows: 75.5% of the children attended on all 5 occasions, 16.2% showed up 4 times, and 8.3% less than 4 times. Data from the questionnaires, collected at the ages of 2 and 3 in the Intervention group and at the age of 3 in the Reference group, are given in Table II. In the Intervention group, the proportion of children with frequent in-between meals decreased to some extent, while the unfavorable intake of sweet drinks at night remained unchanged after 1 year of intervention. Comparison with the Reference group at the age of 3 revealed that the proportion of children in the Intervention group with frequent in-between meals and unfavorable intake of sweet drinks at night was significantly lower. The parents' daily assistance with toothbrushing improved significantly during the intervention period, and at the age of 3 the number of children with no toothbrushing assistance from a parent was 4 times as high in the Reference group as in the Intervention group.

The use of fluoride toothpaste and tablets was significantly improved in the Intervention group. No significant difference in the use of fluoride toothpaste were seen between the Intervention group and the Reference group at the age of 3, but a significantly more frequent use of fluoride tablets was noted in the Intervention group.

The proportions of caries-free children in the intervention and Reference groups are presented in Table III. The percentage of caries-free children at the age of 3 was 37% in the Intervention group compared with 15% in the Reference group ($p<0.001$). There was no significant difference between the groups regarding the number of children with initial lesions, while a significantly lower number of children with manifest lesions was noted in the group.

The mean caries prevalence (deft) in the Intervention group at the age of 3 was 3.0 compared with 4.4 in the Reference group. The difference was statistically significant ($p<0.01$).

The distribution of caries for the Intervention and Reference groups is shown in Figure 1. A significant drift towards the left was demonstrated, with more children being caries-free and fewer exhibiting severe decay.

The distribution of caries-free and non-caries-free children in the Intervention and Reference groups is summarized in Table IV. The relative risk (RR) was calculated to be 2.5 (95% CI 1.8–3.4) and the number needed to treat (NNT) 4.6.

Comparisons at 3 years of age revealed no significant differences in presence of visible plaque between the Intervention group and the Reference group. Still, in the Intervention group 39.1% of the children showed

Table III. Proportion of caries-free children and children with initial and cavitated lesions in the Intervention group and in the Reference group at the age of 3 years

	Intervention group 3 yrs ($n=738$)	Reference group 3 yrs ($n=217$)	Diff.*
Caries-free	37%	15%	$p<0.001$
Initial lesions	52%	45%	NS
Cavitated lesions	29%	55%	$p<0.001$

*Comparison of proportions was subjected to the chi-square test. NS = not significant.

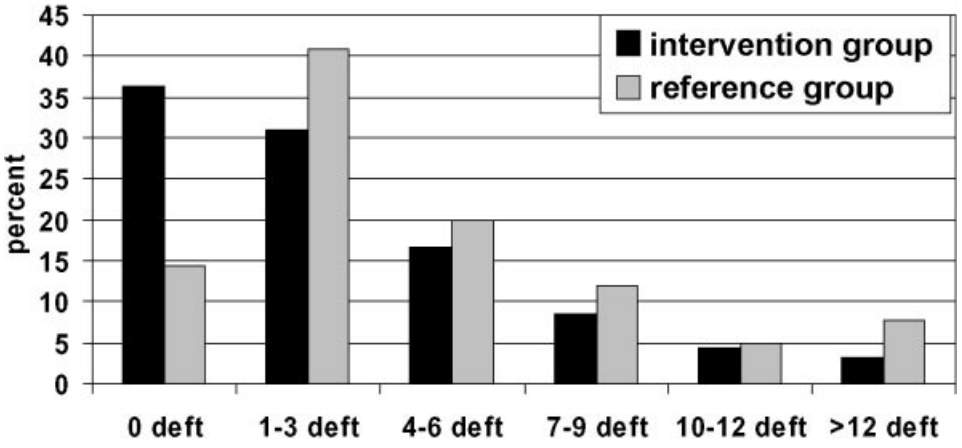

Figure 1. Distribution of caries in the Intervention ($n=738$) and Reference ($n=217$) groups at the age of 3 years. The difference in distribution was statistically significant ($p<0.05$, chi-square test).

bleeding after brushing, compared to 49.3% of the children in the Reference group ($p<0.01$).

Discussion

This report describes the 1-year results of a community trial with the aim of reducing an identified inequality in oral health in a highly multicultural urban area with low socio-economic conditions. All Swedish children have access to free dental care from the age of 3 years, and the preventive measures normally offered by the Public Dental Clinic in the Malmö–Rosengård area are based on a risk strategy after assessments of individual risk. In addition, the parents are invited to dental health information when the child is 18 months old, but this opportunity has been taken only to a limited extent in this multicultural community. The present oral health program expanded the preventive efforts in a community approach to include parent education, toothbrushing training, and fluoride tablets free of charge from the age of 2 years. To secure a high level of participation, all information took place at an outreach facility located close to the shops and social services in the area. Since recent randomized controlled trials have firmly established the caries-preventive effect of fluoride in preschool children [12–15], it was considered less appropriate not to include all children of the actual age group in the area. Therefore, instead of creating a true control group, a cohort from the same area but slightly older than the Intervention group served as a historical Reference group [6]. This may have introduced a bias in the comparisons between the groups. However, no obvious changes in the population or any other changes that might have an input on the oral health in the young children took place in the area during the period. Still, this fact, and the fact that baseline caries data at the age of 2 years was not available, implies that conclusions from this field project must be drawn with caution.

Table IV. Two-by-two table showing the distribution of caries free and non-caries free children in the Intervention and Reference groups

	n	Caries-free	Caries
Intervention group	738	268	470
Reference group	217	32	185

RR = 2.5 (95% CI 1.8–3.4). Number needed to treat (NNT) = 4.6.

The good compliance with the program, including the use of fluoride tablets and the relatively low drop-out rate, was encouraging and better than expected, considering the social and multicultural background of the children in the area. However, the good compliance is likely a result of the efforts of the dental assistants who encouraged the families to take part in the program. Another factor of possible importance for the performance of the program was the non-clinic outreach facility, which enabled easy access and a socially open atmosphere that encouraged communication and contact between different ethnic groups.

The main finding of this trial was that the oral health program did reduce caries significantly, which is in concurrence with previous findings [13,16,17]. However, not only were fewer caries lesions found in the Intervention group compared to the Reference group, those that were found were less severe. This was illustrated by the significant decrease in cavitated lesions found among the children after the intervention program, while the prevalence of non-cavitated lesions was unchanged and comparably high.

The overall aim of the study was to evaluate a comprehensive oral health program made up of different preventive components. Comparison with the Reference group revealed that oral hygiene habits (parent performed toothbrushing) as well as exposure to fluoride were influenced by the program. In addition, the significant difference in dietary habits indicates that the development of bad dietary habits was held back. The study design did not allow any conclusions to be drawn on the relative impact of the various components. Still, one might speculate that the

dramatic difference in the use of fluoride tablets may have played a major role in the improvement of health obtained in the Intervention group. The self-reported good compliance with the fluoride tablets in this group was notable compared with the Reference group, whose compliance was similar to that previously reported from the region [18]. The use of fluoride tablets was a fundamental part of the parent education, and it may very well be that this form of fluoride administration was considered convenient in the multicultural group.

It is important to keep in mind that the caries prevalence was still high in the study population after 1 year of intervention. It was interesting to compare the present findings with a series of cross-sectional data from 4-year-old children in northern Sweden [19]. In 1967, before the introduction of preschool preventive dental care in this part of Sweden, 83% of the children had caries, a figure in good agreement with that in the present Reference group. After the introduction of dental health information at Maternal and Child Health Centers for children 6 and 18 months of age, the proportion of children with caries dropped to 64% in 1976, a reduction similar to that in the present Intervention group, achieved in only 1 year. Although in the present study a rather dramatic decline in caries was seen, it is obvious that the risk factors must be further reduced to bring the caries prevalence down to an acceptable level. The high caries prevalence at the age of 2 years is a sign of the need for early prophylactic intervention. Early intervention has proved successful in a recent study by Kowash et al. [20].

In conclusion, this study clearly indicates that a comprehensive oral health program, based on repeated parent education, which included dietary guidance, toothbrushing instruction, and guidelines for the regular use of fluoride toothpaste and tablets, is an effective approach to preventing caries in young children living in a multicultural, low socio-economic urban area. The long-term effects of the program as well as its cost-effectiveness will be evaluated at the completion of the study when the children are 5 years of age.

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