Evaluation of preventive programs in high caries active preschool children

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Abstract
Although caries prevalence in preschool children has dramatically decreased during the last decades it is still a large problem for a minor group of these children. Great efforts have been invested in finding effective preventive programs for the high caries active preschool children. However, few studies have evaluated and discussed which approach will give the best effect.

The aim of the present study was to compare the effect of a “standard” preventive program with a series of programs with more extensive measures during a two-year period.

At start one hundred and sixty high caries active preschool children (mean age 4 years) were included in the study. The children were randomly distributed to four groups. All groups were exposed to the basic program composed of dietary counselling, oral hygiene instructions and fluoride varnish application. Three groups were exposed to one additional preventive measure e.g. 1% chlorhexidine gel in trays, 0.2% NaF gel in trays or daily tooth brushing with 1% chlorhexidine gel. The programs were repeated seven times during the two-year study period and were executed by trained dental hygienists. Caries examination and saliva sampling for Streptococcus mutans measurements were performed at start of the study and after two years. The mean defs at start was between 10.8 and 12.6 for the four groups (NS).

After two years the caries increment was 1.9 ds in the basic preventive group and between 1.9 and 2.6 (NS) in the other groups. Numerically there were more children in the chlorhexidine groups that showed reduction of Streptococcus mutans counts compared to the other groups, but the differences were small.

The mean caries increment of about 1 ds per year in all groups indicate that all programs were effective taken into account that the children had about 11 defs at start. There were no differences in caries increment between the basic preventive group and the other groups. The conclusion was that addition of preventive measures on top of an effective basic program is a waste of resources. The effect on oral health of individual re-instruction and motivation, by a dental hygienist, seven times during the two-year study period should not be underestimated.

Key words
Caries active, prevention, children, preschool

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Jämförelse av kariesförebyggande program på högkariesaktiva förskolebarn

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Sammanfattning

Trots den dramatiska kariesminskningen bland förskolebarn under senare decennier finns det fortfarande en mindre grupp bland dessa barn som har en avvikande och hög kariesförekomst. Stora insatser har gjorts för att söka finna effektiva förebyggande program för denna utsatta barngrupp. Emellertid är det få studier som sökt jämföra effekt och praktikabilitet av olika program riktade mot förskolebarn med hög kariesaktivitet.

Syftet med föreliggande undersökning var att jämföra effekten av ett etablerat standardprogram för högkariesaktiva förskolebarn med ett antal profylaxprogram där olika förebyggande åtgärder lagts till utöver standardprogrammet. Studien planerades pågå i två år.

Etthundrasextio högkariesaktiva förskolebarn (medelålder 4 år) ingick i studien vid start. Barnen fördelades randomiserat på fyra grupper. Alla grupper tog del av basprogrammet som bestod av kostinformation, munhygieninstruktion och fluorlackning. Tre av grupperna erhöll dessutom tilläggsprofylax bestående av antingen.

1% klorhexidingel i skena, 0,2% NaF-gel i skena eller daglig tandborstning med 1% klorhexidingel. Programmen övervakades och genomfördes av tandhygienister och upprepades sju gånger under den två-åriga försöksperioden. Kariesundersökning och salivprovtagning för bedömning av förekomst av Streptococcus mutans utfördes vid försöks start och efter två år. Vid starten var defs mellan 10,8 och 12,6 för de fyra grupperna (NS).

Efter två år var kariesöningen 1,9 ds i basprogramgruppen och i de andra tre grupperna 1,9 - 2,6 (NS). Streptococcus mutans förekomst minskade numeriskt mest i klorhexidingrupperna men skillnaderna var små. En kariesutveckling av en ny kariesakt tändta per år bör kunna betraktas som låg ställt mot bakgrund att barnen i genomsnitt hade 11 defss redan vid fyra års ålder. Detta tyder på att alla program var i stort lika effektiva och att de ökade insatserna utöver basprogrammet inte gav någon tilläggs-effekt. Man kan inte bortse från den effekt på orala hälsan som de sju besöken hos tandhygienist, innebärande reinstruktioner och information, har haft under tvåårsperioden.
**Introduction**

Dental caries in children has dramatically decreased in most industrialized countries during the last decades (19, 22). However, it is still a significant problem for a minor group of children (9, 10). These high caries active children have great treatment needs often in combination with pain, which together have negative impact on their quality of life. They are also a heavy burden for dental health services and society as a whole. Furthermore, young children with caries in the primary dentition have been found to be at risk for further caries development in the primary and the permanent dentition (1, 2, 13, 17, 21). It has also been documented that present caries prevalence is the strongest predictor for further and future caries development (20). Factors contributing to high caries activity are extensive plaque accumulation on tooth surfaces in combination with frequent intake of sucrose containing products (7, 26) while improved oral hygiene supported by topical fluoride applications such as frequent applications of fluoride varnish (8, 12, 18) and the use of fluoride gels (6) are known to reduce caries activity (4, 24, 25). Some studies have reported that antimicrobial treatment with chlorhexidine (14, 27) often in combination with fluoride (5, 15) is successful in controlling caries development in children. In addition, since attitudes to oral health, oral hygiene habits, and dietary patterns are established in early childhood it is important to start caries preventive programs at an early age (3, 16, 23).

In Sweden, most of the basic preventive programs for high caries active preschool children are based on oral hygiene instructions, dietary counselling, application of fluoride varnish and a recommendation to use fluoride toothpaste. However, we do not know if this programme could be improved in effectiveness by adding more preventive measures.

The aim of this study was therefore to evaluate if the addition of further different measures to the basic preventive program could increase the caries preventive effect in high caries active preschool children. It was emphasized that such an evaluation should run for at least two years.

**Materials and methods**

**Participants**

One hundred and seventy-one preschool children (mean age 4 years; range 2-5 years) referred to the Departments of Paediatric Dentistry in Jönköping and Värnamo, Sweden, for high caries activity were invited to take part in a two-year-study on the effect of different preventive programmes. The inclusion criteria were for children younger than 3 years at least one caries lesion involving the dentin and for children aged 4-5 years two or more caries lesions involving the dentin. One hundred and sixty children/parents accepted to participate in the study.

**Caries examination**

All tooth surfaces were examined for caries by well-trained specialists in Paediatric Dentistry at start of the study and after two years. Clinical caries was defined as loss of tooth substance that had reached the stage of cavitation into the dentin on a tooth surface not previously restored. If the proximal tooth surfaces could not be clinically examined posterior bitewing radiographs were taken. A proximal caries lesion was, in the radiograph, defined as a lesion that clearly extended into the dentin (11). Restored tooth surfaces and teeth extracted due to caries were also recorded. Extracted incisors and canines were registered as four decayed tooth surfaces and extracted molars as five tooth surfaces. Caries data were presented as defs (decayed, extracted and filled tooth surfaces).

**Salivary sampling for mutans streptococci measurements**

Stimulated saliva was collected at start of the study and after two years.

**Restorative treatment**

Necessary restorative treatment and extractions were performed before start of the preventive programs. Twenty-five percent of the children had to be treated under general anaesthesia and 63 percent under nitrous oxide/oxygen sedation due to poor cooperation, fearfulness and extensive treatment needs. Prior to the restorative treatment the mean number of decayed tooth surfaces was 11.8 (SD 8.7). After treatment the mean number of tooth surfaces without caries and restorations (surfaces at risk) was 70 (SD 13.6). Caries prevalence and tooth surfaces at risk at start of the study are presented in the Table 1. If new caries lesions were detected during the study period they were treated with restorations or if indicated the tooth was extracted.

**Preventive programs**

The children were randomly distributed to one of four preventive programs which they followed for the next two years. Each programme was repeated every 2-4 month which means that each child was exposed to seven sessions of their respective program during the two-year-study period.
I  Basic preventive program (Positive Control): The children (and parents) received information about oral health, dietary counselling, oral hygiene instruction, fluoride varnish application and were recommended to daily use fluoride dentifrice (250 ppm F) at home. Before application of the fluoride varnish (Duraphat) the teeth were cleaned and dried with compressed air. After application the child was advised not to eat or drink for at least two hours. The total program was repeated seven times during the two-year-study period.

II  Basic preventive program and in addition the application of 1% chlorhexidine gel in individual trays (three applications for five minutes) at the dental clinic. The latter was repeated a second time within the following five days.

III  Basic preventive program and in addition application of 0.2% sodium fluoride gel (five drops) in individual trays, five minutes per day at home for one month.

IV  Basic preventive program and in addition tooth brushing with 1% chlorhexidine gel once a day at home throughout the two-year study period.

The preventive programs were introduced consecutively and were continuously supervised by specially trained dental hygienists and assistants. If a child wanted to leave the study he/she was sent back to its ordinary dental clinic and was then included in the clinic’s preventive program for high caries active children. This was also the case when the study was terminated after two years.

Statistics and sample size calculation

Unbalanced analysis of variance with Sheffé’s test and T-Test were used to test for differences between the groups (the SAS system). The sample size calculation was based on the assumption that a difference between the means of 2.5 or more decayed surfaces should be shown with a probability of 0.05 and a power of 80%. To meet these requirements about 35 individuals in each group is sufficient. P-values below 0.05 were considered statistically significant.

Results

Caries prevalence in the four groups at start of the study

Caries prevalence, before and after restorative treatment, and surfaces at risk at start are presented in Table 1 for the four groups. There were no statistically significant differences between the groups for any of the parameters.

Drop-outs

Forty-five children (I=0, II=10, III=9, IV=26) were lost during the study period or could not properly fulfill the respective program. The caries prevalence

| Table 1. Caries prevalence, mean and ± SD, at start of the study in the different groups |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                                 | I               | II              | III             | IV              | II+III+IV       | P               |
| n                               | 41              | 37              | 36              | 46              | 119             |                 |
| ds at first examination         | 10.7 ± 8.3      | 8.9 ± 6.5       | 10.2 ± 7.9      | 9.5 ± 7.9       | 9.5 ± 7.5       | NS              |
| defs after restorative treatment| 12.6 ± 9.2      | 10.8 ± 6.8      | 12.7 ± 9.4      | 11.4 ± 8.6      | 11.6 ± 8.3      | NS              |
| Surfaces at risk after treatment| 67.6 ± 17.2     | 72.4 ± 9.8      | 70.1 ± 12.5     | 70.4 ± 12.9     | 70.9 ± 11.8     | NS              |

I  Dietary counselling, oral hygiene instruction, fluoride varnish application
II  I+ 1% Chlorhexidine gel in trays
III  I+ 0.2% NaF gel in trays
IV  I+ Daily tooth brushing with chlorhexidine gel
Caries increment during the two-year-study period
Baseline caries prevalence for the four groups of children who completed the study ranged between 11.0 and 12.6 defs. The caries increment for the four groups varied between 1.9 and 2.6 new ds (Table 2).

Comparison between the caries increment in the Positive Control Group (I) and a combination of all the groups which were exposed to additional prevention (II, III, IV, n=74) revealed caries increments of 1.9 and 2.2 respectively (Table 2). There were no statistically difference between the groups concerning caries increment.

Twenty-seven percent of the children developed no new caries lesions. Nineteen percent of the children developed 1 new caries lesion, thirty-two percent 2-3 new ds, 18 percent 4-8 lesions and 1.8 percent of the children developed more than 9 lesion during the two-year-period.

Salivary mutans streptococci
At start of the study 80 percent of the children had more than 1 million Streptococcus mutans per ml saliva. After two years preventive activities the number of Streptococcus mutans had decreased in 45 percent of the children, was unchanged in 38 percent and had increased in 17 percent. The percentages of children who showed a reduction of the Streptococcus mutans were 38, 50, 46 and 52 in the groups I, II, III, and IV respectively.

Discussion
The results of the present study were somewhat unexpected. Although there were differences in intensity between the preventive programs the four groups showed a similar and low caries increment during the two-year study period. Clearly, the addition of further preventive measures to the basic program (Group I) did not increase the preventive outcome. It might be speculated if not the main cause for the caries control was the frequent and regular visits to the dental hygienists (and the dental clinic) where the preventive measures were reinforced and not the specific content of the programs.

It is remarkable that intensive fluoride programs such as daily fluoride gel treatment in trays for seven months or frequent exposure to chlorhexidin did not have any additional caries preventive effect on top of a good basic preventive program. Thus, on a group level, there seems to be an upper limit for the caries preventive effect of a preventive program.

For ethical reasons no true control group was used. All involved children were referred for high caries activity and thus needed prevention. The positive control group in this study was therefore exposed to the normal program for caries active children (Program I). Against this program the other programs with additional measures were evaluated concerning effect on caries increment.

The design of the present study was based on the assumption that high caries active preschool children will continue to develop a high number of caries lesions in the future. This is supported by a large number of studies (20). In our group of high caries active children the caries prevalence at approximately four years of age was almost 10 decayed tooth.
surfaces. This has to be accepted as a clear risk group for further caries development. In the present study it was possible to limit the caries development to an annual mean caries increment of one decayed tooth surface. This indicates that the programs used in the present study must be looked upon as effective on a group level.

One weakness of this study is the limited number of participants. To try to compensate for this the data from groups II, III, and IV (n=74) were combined and compared to group I (n=40). As can be seen from Table 3 there was no difference in caries increment between these two groups.

The drop-out rate was rather high. As the aim was to test the different programs effect on caries increment, only children who completed the respective program in an acceptable way were included in the evaluation. This might explain the great variance in drop-out rates in the groups. In Group I there was zero per cent and in group IV about 50 percent. It also shows that the more time consuming and complicated the programs were, the more demanding they were to be accepted by the children and parents.

The main conclusions and recommendations are that preventive programs for high cariesactive preschool children should be based on oral hygiene instructions, dietary counseling, fluoride varnish application and recommendation to use fluoride toothpaste at home. The programs should be repeated preferably every third month at a visit to the dental clinic to reinforce the message. There seems to be no need for additional preventive measures to enhance the outcome on a group level.

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