Carious lesions and caries risk predictors in a group of Swedish children 2 to 3 years of age. One year observation

ABSTRACT

Aim Identification of potential carious risk criteria, retrospectively at 2 years of age, for developing carious lesions at 3 years of age. Study design Longitudinal observations from 2 until 3 years of age. Cross-sectional observations of two cohorts of 3-year-olds with different approaches.

Materials and methods The study group consisted of 78 three-year-olds from a previous study at age 2 years. Clinical examination, diet history, questions regarding breastfeeding and salivary sampling for mutans streptococci (MS) were performed at both ages. The previous study on 124 three-year-olds was used as a control group for comparison of the 3-year-olds in the longitudinal study group.

Results The examinations suggested the following risk predictors: carious lesions, frequent intake of selected sugar-containing products, breastfeeding at night and MS, which covered all children with lesions at 3 years of age, resulting in a positive predictive value of 32% and a negative predictive value of 100%. The only statistically significant difference between the two groups of 3-year-olds was the reported intake of sugar-containing items. Statistics Student’s t-test and χ² test, completed by Fischer’s exact test.

Conclusion The combination of the suggested risk criteria was predictive of carious lesions. In spite of individual parental information, new lesions developed after one year. Based on observations, a more structured and monitored preventive approach is suggested.

Keywords: Cross-sectional and longitudinal observations; Breastfeeding; Dietary factors; ECC; Mutans streptococci; Caries risk predictors.

Introduction

A decline in carious lesion prevalence has been observed for a long period of time in the majority of highly industrialized countries [Marthaler, 2004]. The decline started when fluoride brushing was introduced [Fehr, 1997]. However, among preschool children, the lesion prevalence seems to have leveled out [Poulsen, 2002] or even increased slightly [Haugejorden and Birkeland, 2002; Stecksen-Blicks et al., 2008].

Many young child populations show a polarised distribution of carious lesions with many caries-free children and few children for whom lesions remain a problem [Stecksen-Blicks and Holm, 2008; Vehkalahdi et al., 1997; Wendt et al., 1999]. Children of low socioeconomic status and immigrants from outside Western Europe generally have higher disease levels which might result in increased caries prevalence [Marthaler; 2004]. In order to influence this polarisation, there is a need to recognise risk predictors and develop strict schemes for individual preventive measures from a young age.

Lesion prevalence and a number of criteria associated with the development of early childhood caries (ECC), in a group of 2 and 3-year-old children, were reported in a previous study [Bankel et al., 2006]. The 2-year-olds were recalled for a follow-up after one year.

The aim was to identify potential risk factors at 2 years of age as probable predictors regarding development of lesions until the age of 3 years.

Methods

Subjects

• Study group. In 2001, all 2-year-olds living in the district of Majorna in Gothenburg were called for a dental examination and an extended history at the Public Dental Clinic [Bankel et al., 2006]. Ninety-seven of them accepted. All parents were informed regarding the results of the examination, salivary sampling, diet history and possible consequences for dental health.

• Control group. In 2001, 124 three-year-olds in the district of Majorna had their first dental examination. The study was approved by the Ethical Committee at the University of Gothenburg.

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The
efficacy, one year after the earlier extended examination and individual information, given at 2 years of age in the study group, was estimated by comparing this group at 3 years of age with the 3-year-olds examined in 2001 (control group).

**Standardised questionnaire**
The same standardised frequency questionnaire, as in the previous study, was used concerning consumption of a selected number of snacks and other sugar-containing foods and beverages considered as cariogenic [Bankel et al., 2006]. More than 27 intakes per week were considered high. Questions were asked about oral hygiene routines, breastfeeding and other consumption during the night. The fluoride content in the drinking water in the area is <0.1mg/l.

**Clinical examination**
The examination was made as reported in the previous study [Bankel et al., 2006]. Manifest lesions were registered according to the criteria stated by Koch [Koch, 1967]. Extracted or restored teeth due to caries were registered and defs plus di were calculated (d = decayed with manifest caries, e = extracted, f = filled surfaces and di = initial caries). Extracted molars were equivalent to five decayed surfaces, and incisors and canines to four decayed surfaces.

**Saliva sampling**
Dentocult SM Strip Mutans® (Orion, Finland) were used for detection of salivary mutans streptococci (MS). The sampling was performed according to the manufacturer's instruction. The presence of MS was given a score from 0 to 3 according to the manufacturer. Score 0 = none or only a few colony-forming units (cfu) per ml saliva; score 1 = <105 cfu per ml saliva; score 2 = 105-106 cfu per ml saliva; score 3 = >106 cfu per ml saliva.

The samples were also examined in a microscope in cooperation with the Department of Cariology, Institute of Odontology, Gothenburg.

**Risk assessment of the study group**
The 3-year-olds in the study group were retrospectively divided into two groups, a non-risk and a risk group, according to the risk criteria identified at 2 years of age. The criteria were as follows: carious lesions, high intake of sugar-containing risk products, breastfeeding during night and presence of MS in the saliva. The children in the "risk group" had experienced carious lesions, had >27 intakes per week of the selected sugar-containing products, were breastfed at night or carried MS at 2 years of age. A caries risk prediction model was created by evaluating the risk indicators retrospectively when the children were 3 years old.

**Statistical analysis**
For statistical analysis, the Student's t-test and the χ² test, completed by Fisher's exact test were used. The level of statistical significance was set at 5%.

**Results**

**Study group**
Seventy-eight children (80%) accepted the invitation and were examined at 3 years of age; 19 children were not available (dropouts). All children brushed their teeth once a day or more. Toothpaste with fluoride was used by all but one child.

**Control group**
The control group consisted of the 124 three-year-olds from the study in 2001 [Bankel et al., 2006]. All but one 3-year-old brushed their teeth. Fluoride toothpaste was used by 98% of the children.

<p>| TABLE 1 - Selected risk-predictors at 2 years of age and the outcome at 3 years. |
|---|---|---|---|</p>
<table>
<thead>
<tr>
<th>ID</th>
<th>Caries defs plus di</th>
<th>Sucrosecontaining MS in saliva</th>
<th>Breastfeeding at night</th>
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a) di = initial caries, b) <14, 2=14-21, 3=22-27, 4>27 sucrosecontaining items/wk; c) 1=none, 2=breastfeeding; d) Score 0 = none or few cfu per ml saliva, score 1 = <105 cfu per ml saliva saliva, score 2 = 105-106 cfu per ml saliva and score 3 = >106 cfu per ml saliva
Longitudinal observations of risk predictors – study group at 2 and 3 years of age

Table 1 includes all the suggested risk predictors at 2 years and the outcome at 3 years of age. Taking all risk predictors into consideration, 25 two-year-olds in the study group (32%) were assessed as caries risk children.

Table 1 shows that 8 three-year-olds (10%) had lesions. The lesions were diagnosed in five of the children (6%) at 2 years of age. All children with lesions at 3 years of age were found within the suggested “predicted risk group”. However, the following risk predictors lesions, frequent intake of sugar-containing products and breastfeeding at night, covered seven of the eight children with lesions at 3 years of age resulting in a positive predictive value of 32% (Table 2). By excluding MS as a criterion, the size of the “risk group” was reduced to 22 instead of 25 children.

Four of the five children with lesions at 2 years of age had developed new lesions at the age of 3 years. Two of the 3 children, who were free of lesions at 2 years of age and developed lesions at 3 years of age, had a high consumption of sugar-containing products at the age of 2 years. The third child had presence of MS at the age of 2 years. Five children in the study group reported a high sugar intake at the follow-up. Four of them were found in the group of “risk predicted children” and two of them developed lesions.

Four of the eight children with lesions at 3 years of age were breastfed at night as 2-year-olds and three children had other night meals (not shown in Table 1), and one child did neither.

The presence of MS at the age of 2 years was found in four of the eight children with lesions at 3 years of age. Two children, who developed lesions from 2 to 3 years of age, had reported low sugar consumption at 2 years of age. However, both of them had the presence of MS at the age of 2 years and one of them was breastfed at night, covered seven of the eight children with lesions at 3 years of age resulting in a positive predictive value of 32%.

Dropouts

Nine of the dropouts had moved from the area (M) and ten children did not respond to the invitation (NR).

Two of the dropouts had lesions at 2 years of age and carried high levels of MS. A total of five were MS positive (26%) compared to nine of the 2-year-olds in the present study group (12%).

Cross-sectional observations

Study and control group at 3 years of age

• Carious lesions. Of the subjects examined, 82% of the children of the control group and 90% of the children of the study group showed no lesions. The difference was not statistically different (Table 3) (χ2 test: p=0.161). Table 3 also shows the caries prevalence for the two groups of 3-year-olds.

Discussion

The present study suggested that caries risk predictors are useful in the management of caries in preschool children, in a medium-high socioeconomic district in Sweden, with low caries prevalence.

The appearance of the first carious lesion in infants must be considered a health problem, as it starts the initiation of treatment that might end up in more and more complicated restorations and new lesions, unless a structured individualised preventive programme is put in place and monitored (Edelstein, 1995). Many children perceive early restorative treatment as stressful, which may result in future uncooperative behaviour and fear reactions.

<table>
<thead>
<tr>
<th>Study group 1 (n=78)</th>
<th>Control group (n=324)</th>
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<tbody>
<tr>
<td>2 yrs</td>
<td>3 yrs</td>
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<tr>
<td>Caries-free (%)</td>
<td>94</td>
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<tr>
<td>Caries mean defs+di*</td>
<td>0.3±2.08</td>
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<td>Range of di</td>
<td>0–18</td>
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</table>

* di = initial caries

TABLE 2 - Predicted risk for caries at 3 yrs of age in 78 2 years old children. Risk indicators: caries, sucrose intake, breastfeeding at night and MS in saliva.

TABLE 3 - Caries prevalence at baseline in the 2 and 3 year-olds and follow-up at 3 years of age.
Lesion prevalence increases with age according to a number of studies [Grindel, 1995; Holbrook, 1993; Wendt et al., 1992], which is in agreement with these observations. The present child population also showed a skewed distribution of lesions, with a smaller group of children developing ECC than those from a low socioeconomic district. This is a tendency shared by many countries [Wennhall et al., 2002; Marthaler, 2004] and suggests a high-risk preventive approach rather than a population-based preventive programme. The most important challenge in the dental profession is, thus, to identify and manage children with a high-risk profile and focus on them.

The intention of this study was to test, retrospectively, if it was possible to screen the 2-year-olds for caries predictors in this low-caries prevalence area. Seven of the eight children with lesions at 3 years of age could have been identified at the age of 2 years by either of the suggested criteria. These observations support other studies showing that the probability of identifying true high-risk children is lower than correctly identifying subjects with a low-risk of developing lesions [Graves et al., 1992].

In agreement with other studies [Stecksén-Blicks et al., 2007; Vanobbergen et al., 2001], these results suggest to focus on collecting an appropriate diet history of the child regarding exposure to sugar-containing items for subsequent diet counseling. A prerequisite to obtaining behavioral changes is early identification of a child at risk. In a low-prevalence area, these children are few. The scarce resources available should focus on these children with the greatest needs and in encouraging their parents to establish healthy dietary habits. It has been shown that professional prophylaxis along with strong motivational activities resulted in more or less complete caries control in children, whereas less enthusiasm or motivation did not give the same results [Axelson, 1978; Hamp et al., 1978]. Lencová et al. [2008] demonstrated the importance of parental involvement (high parental focus) for successful caries prevention in preschool children.

The control children had their first dental examination at the age of 3 years, and the number of these children displaying lesions was higher than in the study group examined at 2 years of age. However, the difference did not reach significance. Thus, the individual information on caries risk factors at 2 years of age was not motivational enough to prevent further development of lesions, but resulted in reported decreased sugar intake compared to the control group. This information is based on standardised frequency questionnaires concerning the weekly consumption of sugar-containing items. Unfortunately, the study does not show whether the parents had the knowledge and changed their behaviour or just had the knowledge. These observations stress the importance of monitoring the effect of preventive measures with short individualised intervals for support and encouragement. The results also indicated the importance of early contact with the dental team for identifying risk behavior from one year of age.

Prolonged breastfeeding may contribute to establish a dietary pattern, which might affect future caries risk [Hallonsten et al., 1995; Yonezu et al., 2006]. In this study, one child continued to be breastfed at night, and it developed new lesions at 3 years. Dietary factors related to sugar consumption predisposes to early MS Colonisation and by being part of the causal chain, makes the child more susceptible to lesion development. Early MS colonisation has been shown to be associated with the development of lesions [Alaluusua and Renkonen, 1983; Köhler et al., 1988].

In this study, the presence of MS at the age of 2 years was found in four of the eight children with lesions at 3 years of age. By including MS positive as a criterion in this study, all children with carious lesions had been identified in this area. The systematic review by Thenisch et al. [2006] suggests that the detection of MS in 2 to 5-year-olds is associated with increased caries development, but they also point out several limitations and the need for further studies. In this study, to identify further one child with lesions, after one year, would mean the collection of MS samples from 78 children. Thus, it might not be motivated to monitor all children for MS in a low caries population. Although, when a child at risk is identified, the sample is an excellent simple paedagogic tool in the process of motivating the parents and to monitor the effect of dietary measures.

The dropout NR group did not differ much from the study group regarding lesion prevalence. Thus, it was not possible in this medium-high socioeconomic area to confirm the common notion of dropouts as being more compromised than those participating.

In summary, the retrospective risk assessment suggested a number of risk predictors. A combination of these criteria was predictive of lesions one year later. The parents at that time were informed about these factors and possible consequences, but still new lesions were diagnosed at 3 years of age. Based on these observations, a structured and systematic approach to dental care is suggested for these children in most need, followed by a plan to monitor the effect and the need of parental and/or clinical support. Early oral health promotion with strong parental involvement is a prerequisite to reach these children in order to obtain good oral health on a long-term basis, which also should be in the interest of the community dental health authority.

Acknowledgement

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