Longitudinal study of dental health behaviors and other caries predictors in early childhood


Abstract — This longitudinal study of 231 preschool children from a medium sized Norwegian town had three aims: firstly, to examine the children’s early dental behavior, secondly to study the variation of dental health behavior according to mother’s education, mother’s dental health, and her dental attendance pattern, and thirdly to identify any behavioral or social predictors of dental caries in 36-month-old children. Data were collected at health centers, using precoded questionnaires and examinations, when the children were 6, 18, and 36 months old. Data about the mothers were collected at the maternity ward. At 36 months of age, 80% of the children were caries free. Favorable dental behaviors were related to toothbrushing and use of fluorides. These behaviors were so well established and consistent at all ages that they can be regarded as norms for this community. The most unfavorable and inconsistent behavior was related to sugar consumption. Dental health education could be most usefully applied to this area, where the greatest potential for improvement in behavior exists. A relationship was found between the children’s caries experience and the number of missing teeth of the mother, her dental attendance pattern and her level of education. None of the social or behavioral variables tested had a strong enough association with caries experience to justify their use as caries predictors in this age group.

It is generally agreed among health educators that children are an important target group for dental health education. Behavior which is learnt during the child’s first years becomes deeply ingrained and resistant to change (1). Dental health education given to mothers, and aimed at children is more concerned with forming habits, rather than trying to change established routines. Intervention that requires behavioral change at a later stage is more difficult to implement and the chances of it benefitting dental health are less (2). If positive dental health routines are taught in early childhood, later health education intervention can be of a reinforcing nature (1).

There is a tendency that children who have little caries in the primary dentition are also likely to have little caries in the permanent dentition (3, 4). Assuming the very important role of primary socialization, health education activities directed towards young families will most likely benefit the children’s dental health in later life.

This study had three aims: the first aim was to examine early childhood dental health behavior over time. This was done in order to identify areas where dental health education could intervene most effectively, to change the dental health behavior of mothers and preschool children from unfavorable to favorable. The three types of behavior that can be considered as favorable behavior in order to avoid dental disease in early childhood are: regular toothbrushing, regular use of fluorides and consumption of no or little sugar. The second aim was to study the variation of dental health behavior among preschool children according to mother’s education, mother’s dental health, and her attendance pattern. The third aim was to assess the relative importance of behavioral and social predictors of dental caries in children at the age of 36 months.

Materials and methods

The sample included 231 children, the birth cohort of 1979-80 in a medium sized Norwegian town with a total population of 17000. During the study period, 30 families moved from the district and 16 families withdrew from the project. In addition, 14 individuals had not answered all questions in the questionnaires. Thus, data were missing on 60 individuals in the Multiple Classification Analysis (MCA).

Information about use of fluoride tablets and sweetened comforters was obtained by the health nurses at the maternal and child health center by use of a precoded questionnaire when the child was 6 months old. Additional data on toothbrushing, use of fluoride tablets, and sugar consumption were collected by dentists and dental hygienists in the community dental clinics when the children were 18 months and 36 months old.
Additive indices were constructed, and used to describe behavior patterns over time. The variables on use of fluorides at the ages of 6 months, 18 months, and 36 months were collapsed into an index composed of 3 categories: "no use of fluorides at all 3 ages", "irregular use of fluorides at all 3 ages", and "regular use of fluorides at all 3 ages". The index on brushing behavior was composed of the two variables on regularity of toothbrushing at 18 months and 36 months, and was divided into two categories: "irregular toothbrushing at one or both ages" and "daily toothbrushing at both ages". The variables on sugar consumption were: "Use of sweetened comforters" and "use of soft drinks at nighttime" at the age of 6 months, frequencies of "soft drinks consumption" and "candy consumption" at the age of 18 months and "request for candy" at the age of 36 months. These variables were collapsed into an additive index which was then divided into three categories in an ordinal scale: "Infrequent sugar consumption", "frequent sugar consumption", and "very frequent sugar consumption". Thus, these indices reflect both the regularity and the continuity of the behaviors.

Information about the mother's education and her dental attendance pattern was obtained by a health nurse at the maternity ward using an interview. Mother's education was used as an indicator of social background and family resources. Thus, those mothers who had no formal education above primary school and lower secondary school were classified into the category "low" on the educational level variable. Those who had an occupational training education above secondary school were classified into the category "middle" and those who had completed upper secondary school, college or university education were classified into the category "high".

Mother's dental health was registered in terms of caries experience of posterior teeth, using bitewing radiographs. Reliability testing was performed by estimating the consistency of the readings with a 1-week interval, from a random sample of 20 pairs of bitewings. By analyzing the data by Pearson's r, an r = 1.00 value was obtained.

At the age of 36 months the children were examined by dentist at the community dental clinics and caries prevalence was registered in terms of dmfs. A tooth surface or fissure was classified as decayed when it felt sticky to probing. The majority of teeth with caries experience were decayed, rather than filled or extracted. Eighty percent of the children were caries free at the age of 36 months. The dmfs variable was therefore divided into two categories: "0 dmfs" and "1 to 9 dmfs".

**Statistical analysis** - The caries predictive power of each of the independent variables was estimated in two different ways: a) The bivariate association between caries experience and the described independent variables was calculated using contingency tables. The independent variables' effect upon dmfs was expressed as percentages or percentage differences. The chi-square test was used to test statistical significance. The level of significance was set at P<0.05. b) The variables that showed the best caries predictive value on caries experience, were included in a MCA to provide the relative strengths of each independent variable upon dmfs. Basically, this program gives the effect of each explanatory variable after taking into account the effect of the other independent variables in the model (beta = b). Eta (e) is the effect of one variable before controlling for the others (5). Eta, calculated from MCA, is therefore equal to the percentage differences given by the independent variables in the contingency tables. Eta values in the models tested are slightly different from the eta values obtained from the contingency tables because the sample sizes are different. The MCA assumes an additive model where the explanatory variables are internally independent (5). A one-way analysis of variance was used to test whether the independent variables had a statistically significant effect upon the dependent variable (5). The level of statistical significance was set to P<0.05. The program package SPSSX (Statistical Package for the Social Sciences) was used.

**Results**

**Caries experience at 36 months** - At 36 months of age 20% of the children had experienced caries. Most of them had 1 or 2 decayed surfaces. Filled surfaces and extracted surfaces as a result of caries represented a minor part.

**Dental health behavior** - The habit of toothbrushing was widespread (Table 1). In a longitudinal perspective, 83% of the mothers brushed their children's teeth regularly, while 17% brushed irregularly at one or both ages. Compared to the habit of toothbrushing, the behavior with regard to use of fluoride tablets was not so well established (Table 1). In a longitudinal perspective, 55% used fluoride tablets regularly, while 29% used them irregularly at all 3 ages. Twenty-six percent of the children consumed sugar very frequently at 18 and 36 months of age, while 27% consumed sugar infrequently (Table 1).

Table 1 shows the bivariate association between the children’s behavior and the mother’s education, her number of mis-
Table 3. Percentage distribution of children with caries experience by different independent variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories</th>
<th>% with caries experience</th>
<th>Total no. of children</th>
<th>( \chi^2 )-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar consumption</td>
<td>Very frequent</td>
<td>33</td>
<td>42</td>
<td>0.018</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequent</td>
<td>14</td>
<td>72</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Infrequent</td>
<td>13</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toothbrushing</td>
<td>Regular</td>
<td>20</td>
<td>26</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Irregular</td>
<td>18</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluoride tablets</td>
<td>Regular use at all 3 ages</td>
<td>20</td>
<td>25</td>
<td>0.222</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Irregular use at all 3 ages</td>
<td>26</td>
<td>42</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No use at all 3 ages</td>
<td>14</td>
<td>81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother's missing teeth</td>
<td>No</td>
<td>14</td>
<td>102</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>38</td>
<td>42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother's dental attendance pattern</td>
<td>Once a year</td>
<td>17</td>
<td>150</td>
<td>0.039</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Less than once a year</td>
<td>42</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother's education</td>
<td>Low</td>
<td>32</td>
<td>44</td>
<td>0.024</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Middle</td>
<td>12</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>15</td>
<td>39</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discussion

Previous studies have shown that the dental health of children aged 36 months throughout Scandinavia is good (6, 7). The dental health of the children in this material does not differ from the general picture. This may be explained by the favorable dental health behavior among mothers, related to care of their children's teeth.

Toothbrushing behavior was favorable, as it was well established and consistent at all ages. Use of fluoride tablets was not such a well established behavior, but for those children who did use them, the behavior was consistent at all three ages. Toothbrushing behavior is so widespread and well accepted that it must be regarded as a norm for this community. The children become socialized into this behavior through the process of primary socialization. In later childhood and adult life, probably only some reinforcement will be necessary to maintain the established habit. The most unfavorable behavior was sugar consumption. Similar results are reported from a recent study in Sweden (8). In the community of Jönköping, candy-eating was the most unfavorable dental health behavior among children aged 36 months. Dietary habits are an area where there is potential for further improvement in behavior and where dental health education therefore can be useful.

Mothers who were regular dental attenders of dental care more often, and more regularly, complied with advice about fluoride tablets. Regular attendance can be regarded as an expression of a positive dental health attitude. Attendance and use of fluoride tablets are both causally related to attitude. Regular visits to the dentist may serve as an reinforcement of the positive attitude related to a wish to use fluoride tablets. The role of the dentist as a key person in health education is theoretically meaningful, though not always empirically strong. The lack of association between mother's education, her dental health, and the children's dental health behavior may be explained by the absence of reinforcement.

Fluoride was commonly used, either as tablets or in toothpaste. Thus it may be that the benefit of fluoride in terms of caries reduction, has almost reached its maximum. This may explain why it was not possible to demonstrate any correlation between use of fluoride tablets and caries experience. One could hypothesize that a further decrease in caries in this age group would be difficult to achieve by increased use of fluoride alone. This is in agreement with studies which have shown that it is only possible to reduce caries to a certain level in a population by using fluoride alone (9).

The relationship between frequency of sugar consumption at 6, 18, and 36 months of age and caries could be expected taking into consideration the important role of sugar in the etiology of caries (10–11).
A bivariate relationship was found between the children’s caries experience and the number of missing teeth of the mother, her dental attendance pattern, and her level of education. This is in agreement with findings from other studies (12–13). In a causal sense this is surprising since only attendance pattern was related to behavior. Mother’s attendance pattern, her dental status or her education could not be understood as having a direct effect upon caries of a 3-yr-old. We would therefore have expected these variables to be directly related to dental health behavior, as is dental attendance. However, there are reasons to believe that the results were affected by both the difficulties of measuring behaviors reliably, and by the low level of dental caries in the age group. The latter reduces the statistical variation and hence the potential of the independent variables. Any measurement error will attenuate a statistical relationship. In summary, the low proportion of the variance in dental caries explained by the model indicates that none of the social or behavioral variables are strongly enough associated with dental caries at the age of 3 to be pointed out as good caries predictors.

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References