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Caries increment in young children in Skaraborg, Sweden: Associations with parental sociodemography, health habits and attitudes

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Summary

Aim To explore parental sociodemography, oral health habits and attitudes in relation to dental caries increment in their children.

Design A longitudinal questionnaire and clinical study. The children were followed annually from age three years (n=271) to six years (n=243). Carious lesions of different depth were registered (initial and manifest) by four calibrated dentists. The parents filled out a questionnaire. Statistics included factor analyses, Cronbach's alpha together with bi- and multivariate logistic regression analyses.

Results Most of the parents exhibited positive health behaviour and attitudes. However, 'late start of tooth-brushing of child' was common (≥ 1 yr; 29%) and 'external locus of control' showed a high mean value (10,1; possible range 3-15). In a multivariate model, 'parent born abroad' (OR 3.26, 95% CI 1.85-5.76) and 'parental indulgence' (OR 3.20, 95% CI 1.37-7.51) were the most important for the development of carious lesions in the children.

Conclusions The present study identified 'parent born abroad' and 'parental indulgence' as significant risk factors for caries in the age period three to six years. Identifying parents with the greatest need should be emphasized, in order to target promotion and prevention activities.

Key words Attitude to health, dental caries, longitudinal study, parents, preschool child

Introduction

Dental caries remains a health problem worldwide¹. In Sweden, considerable improvements in dental health have been seen over the last decades². However, there are indications of stagnation of this positive trend among young children^{3,4}. This may lead to adverse consequences, as early experience of caries in life is a strong predictor of further disease development, both in the primary and the permanent dentition⁴⁻⁶.

A recent review by Schwendicke et al. (2015) concluded that dental caries lesions and/or experiences in children were related to low parental socioeconomic position, for instance, educational background⁷. Parents with a low educational level may not have the possibility/ability to acquire knowledge or to make use of available resources^{8,9}. It is noteworthy that the most influential socioeconomic factors may differ between demographic contexts¹⁰. The results by Schwendicke et al.⁷ also indicated that the associations could be stronger in highly developed countries than in less developed countries with greater inequality.

Parents influence the dental health of their children, both in terms of performed health behaviour activities like tooth-brushing, and as role models¹¹. A number of psychological models for health behaviour have been developed¹². Accordingly, the importance of parental health habits, attitudes, and lifestyle for the oral health of their children has been demonstrated¹³⁻¹⁵. Another factor is self-efficacy; that is, the parents' belief in their own capacity to care for the oral health of their children¹⁶.

As mentioned above, the influence of different factors may differ between countries and settings¹⁰. Whether or not this is the case, confirmative studies are needed in these diverse contexts. Thus, the current study hypothesized the importance of parental characteristics for the oral health of their children in an industrial country that is, a Swedish county. The aim was to examine the influence of parental sociodemography, oral health habits and attitudes at baseline in relation to dental caries increment in the children from three to six years of age.

Material and methods

Study participants/sample

The study was carried out in the county of Skaraborg, a mostly rural area with a few medium-sized towns in southern Sweden. The sample was recruited in three Public Dental Service clinics representing different socioeconomic profiles: one clinic in a mainly rural area with some manufacturing industries, one suburban clinic with a varied socioeconomic profile and one clinic in a small town dominated by administrative businesses.. The parents of one hundred children from each clinic (n=300) were asked in connection with their child's regular dental check-up at three years of age to participate in the study. At that time, when the children were three years old (baseline), the parents completed a questionnaire. The children were then followed longitudinally with annual dental examinations up to six years of age. The results from the clinical examinations of caries have been published earlier⁴.

Ethical approval

The study protocol was reviewed and approved by the Ethics Committee of Göteborg University (registration no. Ö199-02). All parents of the participating children provided written informed consent.

Variables

Questionnaire (independent variables)

A questionnaire on sociodemography, oral health habits and attitudes, developed and validated in an international study including 17 countries, was used¹³. The questionnaire had previously been used in Norway, a neighbouring Scandinavian country with a kindred language⁹. The items were translated from Norwegian into Swedish by a professional translator/language reviewer. A few additional questions were formulated for the Swedish context.

The sociodemographic variables were the following: parental educational level (dichotomized at compulsory level: >9 years/≤ 9 years), parental country of birth (both parents born in Sweden/one born abroad/both born abroad), family structure (child living with both parents/child living with one parent or another custodian). Oral health habits were mirrored by parental dental visiting habits (regular visits/only when experienced problems or not at all), own tooth-brushing habits and tooth-brushing of child (twice a day/less than twice a day), age when started tooth-brushing of child (<1 year of age/≥1 year of age), and intake of sugary food and/or drinks (less than daily/daily).

The attitudinal items (49 items) were all taken from the international study and were based on the following theoretical models for the explanation of health behaviour: the Theory of Planned Behaviour¹⁷, the Health Belief Model¹⁸, and the Health Locus of Control Model¹⁹. All attitudinal questions were constructed as statements with five possible choices in Likert scales. The choices were: “strongly disagree” (1), “disagree” (2), “neither agree nor disagree” (3), “agree” (4) and “strongly agree” (5).. Some statements were negatively formulated and these scores were reversed for the analyses. The validity and reliability have been tested in various contexts¹³.

Dental caries (dependent variables)

A five-grade caries diagnostic system was used²⁰, from the most superficial (Grade 1) to the most profound (Grade 5). Grade 1 and Grade 2 constituted enamel carious lesions (initial caries), and Grade 3 to Grade 5 were diagnosed when the carious lesions had reached the dentin (manifest caries). Initial and/or manifest carious lesions (Grade 1 to Grade 5) constituted “all carious lesions of different depth”. Teeth extracted due to caries were recorded. Teeth extracted due to trauma were excluded from the analyses⁴. For this study, dental caries decay was recorded at tooth level and dichotomized into “manifest carious lesions” (1) versus “no caries” (0), and “all carious lesions of different depth” (1) versus “no carious lesions” (0).

Data collection

The dental examinations were carried out by four experienced and calibrated dentists at baseline, and the follow-ups were performed in optimum clinical settings. Each child was examined by the same dentist for all occasions. The calibration programme comprised discussions based on clinical photos and radiographs, examinations of extracted teeth and lastly, clinical examinations of 10 children. Calibration sessions were held before the start of the study and in the middle of the data collection period. The weighted Cohen's kappa value for inter-examiner reliability was 0.64 at baseline⁴. The children were examined at 3, 4, 5 and 6 years of age (± 2 months) in dental clinics. The teeth were dried using air and examined with a mirror and a probe in the light of the dental unit. When indicated, and dependent of the child's cooperation, radiographs were taken; that is, when the approximal molar surfaces could not be visually inspected and/or due to the risk assessment based on known risk factors (such as dental hygiene, diet, earlier caries experience and socio-economic status).

The questionnaire was completed by the accompanying parent in connection with and before the dental examination. If something was unclear, the clinic staff offered help, and interpretation was provided for those who needed. Only a few carers needed linguistic help.

Data analysis

The SPSS (Statistical Package for the Social Sciences), version 22.0, was used for the data analyses. Descriptive statistics were used to describe the sample by sociodemography and parental oral health habits.

Factor analyses with Varimax rotation were used to identify the dimensions of parental oral health attitudes. Factors with Eigenvalues > 1 were examined. An equal number of items in each factor (the three with the highest loadings) were chosen to construct attitudinal composite variables. The procedure with a fixed number of items in the factors aimed to facilitate in-

between factor comparisons. The factors thus had a possible score range of 3-15, based on the Likert scale of 1-5 for possible answers to each of the three items. Two additional composite factors were created from the three-item factors with possible score ranges of 6-18 (“parental indulgence”, 6 items) and 9-45 (“parental attitude”, 9 items), respectively. Internal consistency was tested with Cronbach’s alpha. Dichotomizations of factors for multivariate analyses were performed with cut-offs at the median value *ad modum* Schwarzer²¹.

Bivariate logistic regression analyses explored associations between independent (sociodemographic, oral health habitual and attitudinal) variables and dependent caries variables. Only consistent statistically significant independent variables from the bivariate regressions were included in the multivariate logistic regression models. The independent variables were dichotomized as described above. However, the following variables were also tested as trichotomized variables: parental ethnicity (0/1/2 parent born abroad; that is, outside Sweden) and the child’s cohabitation status (living with 2/1/0 parents) in separate analyses. The dichotomous dependent variable in the logistic regression was caries increment from three to six years of age. Increment was defined in two ways: The first was a positive increment in manifest caries (d_{3-5}), and the second a positive increment in all caries (d_{1-5}) between two occasions (three years and six years).

Possible statistical dependence due to observation of the same subjects on two occasions (caries at baseline and follow-up) was controlled for by entering the average of d_{3-5} and d_{1-5} scores at three years and six years (Oldham’s method) to the multivariate models^{14,22}. The level of statistical significance was set to 5 %.

Results

At baseline, when the children were three years old (± 2 months) and the parents completed the questionnaire, 271 children were included in the study (90 % participation rate). At six years

of age, 243 children remained in the study (dropout rate, 10 % over three years). The characteristics of the sample at three years of age by parental sociodemography and oral health habits are given in **Table 1**. A higher proportion of fathers (16 %) than mothers (9 %) had a low educational level, and just under one fifth (17 %) of the children had at least one parent born abroad. Seven per cent of the children did not live with both parents. Having started tooth-brushing ≥ 1 year of age emerged as the most common adverse oral health behaviour (almost one third of the children).

One fifth (20.6 %) of the children had an increment in new manifest carious lesions from three to six years of age. Twice this proportion (39.9 %) had an increment considering all carious lesions of different depth (initial and manifest carious lesions) over the same period (not in tables).

The factor analysis of parental oral health attitudes resulted in 14 factors with Eigenvalues > 1 ; however, only the first eight factors displayed consistent patterns in loadings. These factors were assigned the following denominations: ‘attitude to hygiene’, ‘attitude to dental caries’, ‘attitude to diet’, ‘chance locus of control’ (the belief that one’s health is controlled by mere luck or fate), ‘internal locus of control’ (the belief that one’s health is controlled by one’s own abilities, efforts or behaviour), ‘external locus of control’ (the belief that one’s health is controlled by powerful others, such as health professionals), ‘parental indulgence regarding oral hygiene’ and ‘parental indulgence regarding diet’. The factors together with mean values and internal consistencies expressed as Cronbach’s α values are shown in **Table 2**. Low mean values revealed mostly positive attitudes, especially to oral hygiene with a mean value of 3.95 (possible range 3-15). The least favourable factor was “external locus of control” with a mean value of 10.1 (possible range 3-15). Calculation of the internal consistency of the locus of control subscales revealed Cronbach’s α values of 0.66, 0.65 and 0.49 for the “chance”, “internal” and “external” subscales, respectively. Calculation of the internal consistency for a composite

attitudinal factor (attitude to oral hygiene, dental caries and diet) produced a Cronbach's α of 0.79. A composite indulgence factor (hygiene and diet) gave a Cronbach's α of 0.61.

Table 3 shows bivariate associations between parental characteristics and the increment of carious lesions in their children from three to six years of age. The independent variables showing significant associations for increments in both manifest and all caries (manifest + initial) were parental country of birth, parental dental visiting habits, the child's age when starting tooth-brushing, parental attitudes, parental indulgence and chance locus of control. These variables were entered as independent variables in two separate multivariate models (**Table 4**). When using increment in manifest caries as the dependent variable, two significant independent variables were revealed: 'parent born abroad' (OR 3.26 (95 % CI 1.85-5.76)) and 'parental indulgence' (OR 3.20 (95 % CI 1.37-7.51)). When increment of all carious lesions of different depth (manifest and initial) was used as the dependent variable, only 'parent born abroad' showed statistical significance: OR 2.15 (95 % CI 1.27-3.65). When Oldham's method was taken into account, the associations were weakened but still significant.

Discussion

In this study, the parents of three-year-old children exhibited mostly positive oral health behaviours and attitudes. The most common less favourable health habit was late start of tooth-brushing of a child and the least favourable attitude was having a high external locus of control. The consistent statistically significant factors for increment of carious lesions from three to six years of age were parent born abroad, irregular parental dental visits, late start of tooth-brushing of child, chance locus of control, parental indulgence and negative attitudes. Of these factors, parent born abroad and parental indulgence appeared to be the most important for the dental health of their children.

The participation rate in the study was high. Initially, 90 % of the parents accepted their child's participation, and after three years, 90 % of these remained in the study. Longitudinal designs, as in the current study, are uncommon in dentistry, probably due to administrative and economic circumstances. A strength of the study was the good clinical conditions for the examinations, which were performed by only four calibrated dentists. The calibration process for the clinical examinations was careful, as previously reported⁴ However, no intra-examiner reliability tests were performed which might be seen as a limitation of the study. A randomized sample would have been desirable, as would the inclusion of more urban and metropolitan subjects. However, this was difficult to achieve for practical reasons. The used caries criteria were developed for young children and have been validated^{23,24}.

A self-reported questionnaire must be clear and comprehensible to the target group. The questionnaire used in the current study had been tested thoroughly in different countries and contexts²⁵. A weakness was that the items were only translated from Norwegian into Swedish and not retranslated back into Norwegian²⁶. However, an indicator of the intelligibility and legibility of the questionnaire was that only a few carers needed linguistic or interpretative help to answer the questions. Furthermore, there was low internal dropout on specific items. Whether the parents changed their attitudes—to better or worse attitudes—during the study period is unfortunately not known, as the questionnaires were only completed when the children were three years old.

The general pattern in the factor analyses was consistent and the loadings for most items included in the factors were high. A few items loaded lower than 0.5, although confirmatively for the three-item factors; that is, facilitating the interpretation and comparison between factors. Also, the Cronbach's alpha values were medium to high, especially for the combined attitudinal factors, indicating good reliability²⁷. It should be noted that the three subscales of locus of

control (internal, external, chance) represent diverting dimensions and cannot be combined and handled as one scale²⁸.

Dental health information is provided by Swedish Child Health Centres and at dental clinics; however, this does not guarantee an outcome of positive health behaviour. The adoption and performance of such habits are complicated and it is possible that not all parents are interested or able to follow the recommendations. For instance, the proportion of parents that started regular tooth-brushing of the child after the age of one year was as great as one third of the sample, which also showed a statistically significant relationship with the dental caries outcome; this despite the recommendation by the dental service to introduce the habit “when the first tooth has erupted”. There may, however, be some recall bias, and other studies also found diverging results. In a Belgian study, Declerck et al.⁸ could not verify any relationship between late start of tooth-brushing and caries development, while Scandinavian studies found such associations^{9,29}. Also, one fifth of the parents admitted to tooth-brushing of the child less than twice daily. This has been found in several studies to be a risk factor for carious lesions¹⁵, even if this could not be confirmed by our results. Possibly, some subgroups in the material were too small to reach statistical significance.

The cohabitation status did not appear to be a significant factor for the development of carious lesions in the children in our study. In the review by Hooley et al. (2012), single-parent status was found to be a risk factor for caries in young children¹⁵. In Sweden, shared custody between divorced parents is the most common arrangement, which may be a supporting factor, like the protective Swedish social security system. Likewise, only the mother’s educational background, but not the father’s, was related to the progression of caries in the children, which may indicate that mothers, more than fathers, engage in health promotion activities³⁰.

The parental attitudes were mostly favourable in the study, especially to dental hygiene. This is in line with earlier findings in Norway⁹. A striking result was the high mean value for “external locus of control”; that is, that many parents strongly believed that powerful others, i.e. dental staff, influenced whether their child got dental carious lesions or not²⁸. This is remarkable, considering that the dental service nowadays emphasizes the possibilities for individuals to control their own oral health. An indulgent attitude from the parent was a significant factor for the development of caries in both the bivariate and multivariate analyses. Many parents today experience a stressful everyday life, and this may lead to a more lenient attitude towards children having a more cariogenic diet and/or skipping tooth-brushing. This is consistent with the Norwegian study by Skeie et al. (2006)⁹.

An immigrant background (one or both parents born abroad) was a strong factor for the development of dental carious lesions in the children in our study. A cultural background with different dietary habits may influence health outcomes, for instance, with regard to dental caries^{3,9,15}. The social norms may differ between subgroups in societies³¹. Immigrant status *per se* has also been shown to entail greater vulnerability with greater social stress³². The results indicate the need for special preventive programs to be developed and directed to parents and children with an immigrant background.

To conclude, the present study identified ‘parent born abroad’ and ‘parental indulgence’ as most significant risk factors for caries during the age period three to six years. The most common risk factor for caries development was late start of tooth-brushing of child. Identifying parents with the greatest need should be emphasized, in order to target promotion and prevention activities.

Why this paper is important to paediatric dentists

- This study found that the strongest risk factors for caries in children 3-6 years were 'parent born abroad' and 'parental indulgence'.
- The parents of small children should be approached early to encourage healthy oral health habits and attitudes.
- Parents with the greatest need should be identified and targeted.

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Table 1. Description of the sample by gender, parental socio-demography and health habits when the children were 3 years old.

	n (%)
Boys	145 (54)
Girls	125 (46)
Mother's education ≤ 9 years	23 (9)
Father's education ≤ 9 years	42 (16)
Child not living with both parents	20 (7)
Both parents born abroad	27 (10)
One parent born abroad	18 (7)
Parental toothbrushing less than twice a day	24 (9)
Parent not regular dental visits	41 (16)
Toothbrushing on child less than twice a day	52 (19)
Age started toothbrushing ≥ 1 year	77 (29)
Sugary food and/or drink daily	36 (14)

Missing 0-10 cases

Table 2. Attitudinal composite variables according to factor analysis with Varimax rotation.

Factor	Variable/item	Item loading	Mean value for factor*	Cronbach's alpha for factor
Attitude to hygiene	As a family we intend brushing our child's teeth for him/her	0.643	3.95	0.80
	We intend brushing our child's teeth for him/her twice a day	0.825		
	The people in my family would feel it was important to help brush our child's teeth twice a day	0.799		
Attitude to dental caries	As a family we are confident to diminish the risks for our child to get tooth decay	0.668	4.70	0.68
	Dental caries is a severe problem for the milk teeth	0.658		
	It is our responsibility as parents to prevent our child gets tooth decay	0.641		
Attitude to diet	As a family, we try to control how often our child gets sweet food or drinks between meals	0.847	6.55	0.77
	As a family we think it is important to control how often our child gets sweet food or drinks between meals	0.845		
	We think we manage to give our child healthy alternatives to sweet drinks between meals	0.475		
Chance locus of control	It is only a matter of bad luck if our child gets tooth decay	0.751	5.40	0.66
	If our child gets tooth decay It is due to chance	0.648		
	It would not make any difference to our child getting tooth decay, if we helped her/him brush every day	0.654		
Internal locus of control	We can prevent tooth decay in our child by reducing sugary snacks and drinks between meals	0.698	4.65	0.65
	If we brush our child's teeth twice a day, we can prevent our child getting tooth decay	0.365		
	If our child uses fluoride toothpaste it will prevent tooth decay	0.367		
External locus of control	Regular dental visits will stop tooth decay in our child	0.591	10.1	0.49
	Regular dental visits are the best way to prevent tooth decay	0.812		
	The dentist is the best person to prevent our child getting tooth decay	0.410		
Parental indulgence: hygiene	If our child does not want to brush her/his teeth every day we don't feel we should make them	0.714	5.59	0.61
	We do not have time to help our child brush her/his teeth twice a day	0.465		
	We cannot make our child brush her/his teeth twice a day	0.562		
Parental indulgence: diet	We think it is difficult to make the child not have sugary food or drinks between meals	0.726	6.47	0.49
	It is worthwhile to give our child sweets/biscuits to behave well	0.678		
	It is often too stressful to say no to my child when she/he wants sweets	0.608		

*Mean values are based on Likert scale scores 1-5 for each item with 5 as the most negative response. Possible range for each factor: 3-15. Missing cases in composite variables 3-10%.

Table 3. Bivariate associations between parental characteristics and increment of caries (0/1) in children from 3 to 6 years of age. Statistical significant associations in bold. All caries: manifest plus initial.

INDEPENDENT	DEPENDENT	
	Increment in manifest caries OR (95% CI)	Increment in all caries OR (95% CI)
Mother's education ≤9 years	2.25 (0.79 – 6.41)	3.02 (1.08 – 8.49)
Father's education ≤9 years	0.90 (0.37 – 2.19)	0.82 (0.37 – 2.19)
Child not living with both parents	1.06 (0.28 – 3.94)	1.54 (0.52 – 4.55)
Two parents born abroad	14.63 (5.77 – 37.1)	6.37 (2.44 – 16.62)
One parent born abroad	3.25 (1.12 – 9.41)	1.91 (0.72 – 5.04)
Parent not regular dental visits	2.79 (1.29 – 6.05)	2.84 (1.37 – 5.88)
Parental toothbrushing less than twice a day	1.41 (0.49 – 4.15)	1.75 (0.69 – 4.48)
Toothbrushing on child less than twice a day	1.59 (0.75 – 3.37)	1.32 (0.68 – 2.55)
Age started toothbrushing ≥1 year	2.42 (1.26 – 4.66)	2.15 (1.20 -3.82)
Sugary food and/or drink daily	1.34 (0.56 – 3.20)	1.82 (0.86 – 3.85)
Parental negative attitudes*	1.14 (1.06 – 1.22)	1.12 (1.05 – 1.19)
Parental indulgence**	1.22 (1.11 – 1.34)	1.16 (1.07 – 1.25)
High chance locus of control	1.16 (1.02 – 1.32)	1.14 (1.01 – 1.27)
Low internal locus of control	1.15 (0.98 – 1.35)	1.42 (1.21 – 1.66)
High external locus of control	1.03 (0.89 – 1.18)	0.99 (0.89 – 1.11)

* attitude to hygiene, dental caries and diet

** indulgence regarding hygiene and diet

Table 4. Multivariate analyses of significant factors for incremental caries from 3 to 6 years of age. Independent variables based on consistent statistical significance in bivariate models. All independent variables dichotomous with the risk alternative presented in table, except “Parent born abroad” (three categories: 0/1/2 parents). Two models using dependent caries variables dichotomized in 0 (no increment) or 1 (increment). Oldham’s method: the average score of manifest caries at 3 and 6 years entered as covariate in the multivariate models.

Independent variables entered in both models	Dependent variable	Significant independent variables	OR (CI)	OR (CI) Oldham's method
Parent (0/1/2) born abroad	Model 1: Increment in manifest caries	Parent born abroad	3.26 (1.85 – 5.76)	2.54 (1.32 – 4.90)
Parent no regular dental visits		Parental indulgence	3.20 (1.37 – 7.51)	-
Start toothbrushing child ≥1 year of age	Model 2: Increment in all caries (manifest and initial)	Parent born abroad	2.15 (1.27 – 3.65)	1.78 (1.03 – 3.07)
High chance locus of control*				
Parental indulgence**				
Parental negative attitudes***				

* cut-off at median value = 5 (range 3-15)

** cut-off at median value = 12 (range 6-22)

*** cut-off at median value = 14 (range 9-37)