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Oral health in children and adolescents with different socio-cultural and socio-economic backgrounds

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Abstract

Objectives. To describe the occurrence and severity of dental caries in children and adolescents and to relate these findings to the subject's socio-cultural and socio-economic backgrounds. ***Material and methods.*** A cross-sectional study in 12 706 children aged 5, 7, 12 and 15 years was conducted in 2006. Data on children's caries experience were collected from public oral health registers and pooled with socio-cultural and socio-economic data obtained from official statistics. The study population represented 76% of all registered inhabitants. ***Results.*** Among 5- and 7-year-old children with non-Danish mothers, the mean caries experience was three to four times higher than among children of Danish mothers, and a doubled rate was seen among the adolescents ($p < 0.001$). Significant differences in caries experience were found in various ethnic minorities. Multiple regression analysis showed that the level of caries was highest among children in families where mothers were not Danish, with low income, where mothers' educational levels were low, and in with a high number of children ($p < 0.001$). ***Conclusions.*** Although almost all children and adolescents attend the prevention-oriented, free public dental service, a social gradient still exists for dental health. In addition, in all age groups, major inequalities in dental health were found when families with Danish and non-Danish backgrounds were compared. The findings indicate a need for social action by policymakers. Furthermore, a change in the oral health preventive strategy is proposed to meet the needs of children in risk of caries, and appropriate oral health-promotion programmes should be organized in collaboration with leaders from different ethnic minorities.

Key Words: *Caries, Educational level, Family income, Immigrants*

Introduction

In spite of a global decline in childhood caries, inequalities in oral health exist between social classes and between certain ethnic minority groups [1,2]. In the UK, this has been observed primarily among preschool and school children [2–4], and the importance of carefully considering diversity among subpopulations with different ethnic backgrounds has been emphasized [5]. Also in Denmark, earlier studies demonstrated higher caries levels in non-Danish children compared to children with a Danish background [6,7]. These findings parallel results from similar studies in the other Scandinavian countries [8,9]. Results from a Dutch study on caries risk factors have demonstrated that, besides ethnicity, the child's gender and parental educational level seem to be associated with their caries level [10]. A similar influence from social factors has been documented in many countries [2,11].

In Copenhagen, the total number of inhabitants aged 0–17 years is ≈89 000, of whom 27% have a foreign background. For nearly one century, dental care has been provided through a public dental healthcare service, free of charge, to children and adolescents within the city. This dental care system became universal in 1972 [12] and, concomitant with its implementation, health authorities established a

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database in order to monitor oral health over time [13]. Consequently, national and local data on dental caries and caries experience have been collected and published from time to time and used for planning and evaluation [14]. However, the database does not include information on children's ethnic backgrounds, nor any social information on children and their parents. Consequently, the distribution of caries experience on a national level has been described solely in relation to age, gender and geographical area. These data are therefore considered insufficient to develop preventive programmes with the goal of reducing inequalities in oral health. The aim of the present investigation was, therefore, to link data from the dental record system to additional data from official statistics in order to (i) describe the occurrence and severity of dental caries in preschool and school children in Copenhagen and (ii) to relate these findings to the children's socio-cultural and socio-economic backgrounds.

Material and methods

Study design and study group

This register study had a cross-sectional design involving four age groups of a total child population. The Copenhagen Public Dental Care Service for children comprises 36 dental clinics, and provides treatment for children and adolescents on a regular basis. According to directives from health authorities, registration of data on oral health at 5, 7, 12 and 15 years of age is mandatory, so it was these age groups that were selected for the present study. A complete set of data was obtained from 12 706 children, representing 76% of the total number of children registered by the public dental healthcare system. The mean concentration of fluoride in drinking water in Copenhagen is generally low, varying between 0.3 and 0.49 ppm F. The project was approved by the Danish Data Protection Agency.

Methods

Epidemiological data on dental caries were collected from clinical dental examinations in 2006. The data were then transferred to national databases established and administered by the National Board of Health [13]. Calibration procedures are regularly carried out among dentists at each clinic in order to fulfil the criteria for reporting dental caries to Danish health authorities. The national recording system is based upon a relatively simple coding methodology. Standardized criteria for clinical registration provide information on decayed, missing and filled surfaces in primary and permanent teeth (dmfs and DMFS, respectively), at both regional and national levels. These criteria for caries agree with standards set by the WHO for the presence of initial and manifest caries. In the present study, caries occurrence was recorded at the cavity level. Caries prevalence was expressed as a percentage and caries experience was quantified by means of the dmfs/DMFS index.

Socio-economic and socio-cultural information on the children and their families, such as the mother's education level, family income, marital status, number of children, and ethnicity was obtained from "Statistics Denmark", a central government agency for national statistics. "Statistics Denmark" is a professional, independent, autonomous institution, run by a board of governors. Most of the data come from administrative registers of governmental agencies, and the data describe most aspects of the Danish society. All residents of Denmark have a civil registration number comprising 10 digits, which is entered as a variable in all population registers. This provides an opportunity for cross-disciplinary analyses. Educational levels were classified as "low", "medium" and "high" according to the International Standard Classification of Education (ISCED), which measures years of schooling and vocational training combined. Marital status was subdivided into two categories: "Married/cohabitants" and "living alone". Ethnicity was divided into three categories: (i) Danes; (ii) foreigners from Western countries, for example Nordic countries, countries within the European Union, the United States, Canada and Australia; and (iii) others. The third category was further subdivided into "immigrants", meaning children born outside Denmark and with both parents having foreign citizenship or having been born outside Denmark. The category "descendants" was assigned to children born in Denmark of parents who were both immigrants or descendants, and who had kept their foreign citizenship. Family income was also grouped into three categories according to total yearly income, expressed in Danish kroner and indicated in Table I. The distribution of the study population in relation to the various socio-demographic characteristics is shown in Table I.

Statistical procedures

All data from "Statistics Denmark" and from the national epidemiological database were matched, processed and analyzed by means of the Statistical Programme for the Social Sciences (SPSS, version 17.0; Chicago, IL). Data were described in bivariate tables. Student's *t*-test and one-way ANOVA were

Table I. Percentages of the study population (children and their mothers) in relation to various characteristics.

Characteristic	*n*	%
Age group (years)		
5	3772	30
7	3490	27
12	2995	24
15	2449	19
Gender		
Male	6465	51
Female	6241	49
No. of children in the family		
1	2956	24
2	5955	48
3	2426	19
4	812	6
≥5	324	3
Child's ethnic status		
Danish	9058	72
Immigrant	458	4
Descendant	3113	24
Mother's ethnic status		
Danish	8282	66
Immigrant	4034	32
Descendant	220	2
Mother's citizenship		
Danish	9962	79
Non-Danish, Western country	447	4
Non-Danish, non-Western country	2165	17
Mother's level of education (ISCED)		
Low (≤10 years)	2885	24
Medium (11–12 years)	4162	35
High (≥13 years)	4790	41
Mother's marital status		
Married or cohabitation	8662	69
Single/living alone	3912	31
Family income per year (Danish Kroner)		
Low (≤199 999)	2198	18
Medium (200 000–599 999)	6827	54
High (≥600 000)	3463	28

applied to evaluate differences in means, while χ^2 tests were used for comparing proportions. Univariate as well as multivariate linear regression analyses were applied to assess the relative effect of various variables on the level of caries experience. Logistic regression analyses (univariate and multivariate) were done to assess the relative effect of independent variables on the dichotomized variable: "caries experience" or "no caries experience".

Results

Caries prevalence was found to be 30%, 51%, 57% and 63% among the 5-, 7-, 12- and 15-year-olds, respectively. The average caries experience (dmfs+DMFS) was 2.0, 4.1, 3.0, and 3.4 in the corresponding age groups. Table II shows the level of caries experience and caries prevalence among children in each age group related to the mother's ethnic background. In all age groups, the percentage of children with caries experience was higher among children with foreign ethnic backgrounds. Among 5- and 7-year-old children with non-Danish mothers, mean caries experience was three to four times higher than among children of Danish mothers. Corresponding mean caries experience among children aged 12 and 15 years occurred at double the rate among those children with non-Danish mothers (Table II). The D/d component showed similar variations. In Table III, caries experience among children belonging to the most prevalent minority ethnic groups is presented. Compared to children of Danish origin and children who have a background in other Western countries, substantial variations in mean caries experience were seen. Children with a Somali background were the only ethnic group with lower mean caries experience (2.2 dmfs+DMFS among 12-year-olds) than Danish adolescents (2.4 dmfs+DMFS). All other minority groups showed a considerably higher caries level. For example, 7-year-old children from Pakistan and Iraq had more than 9 dmfs+DMFS on average (7-year-old Danish children had 2.7 dmfs+DMFS) (Table III).

Results of logistic regression analysis are shown in Table IV. The univariate model (caries experience as the dependent variable) showed significant association between caries experience and the mother's ethnic status. The odds ratio for children with caries was higher for mothers with immigrant status than for descendant mothers (born in Denmark) ($p < 0.001$). Furthermore, number of children, family income, the mother's level of education and the child's age had an influence on whether caries was present or not (Table IV) ($p < 0.001$). After control of other factors, the multivariate logistic regression model for caries experience revealed that few children in the family, a high family income, a highly educated mother or a Danish mother still seemed to have a positive influence on children's caries status (Table IV) ($p < 0.001$). Table V presents the results of the linear regression analyses of caries experience (dmfs+DMFS). The univariate regression model showed

Table II. Children's mean caries experience (dmfs+DMFS) in relation to age group and mother's ethnic status.

Age group (years)		*n*	ds+DS*	ms+MS	fs+FS*	dmfs+DMFS*	Caries prevalence proportion (%)*
5	Mother is Danish	2458	0.5	0.2	0.2	0.9	20
	Mother is not Danish	1274	2.1	0.7	1.0	3.8	49
7	Mother is Danish	2240	0.7	0.5	1.3	2.5	40
	Mother is not Danish	1208	2.1	1.6	3.4	7.1	70
12	Mother is Danish	1954	0.5	0.2	1.6	2.3	52
	Mother is not Danish	1002	0.9	0.6	2.7	4.2	65
15	Mother is Danish	1630	0.6	0	1.7	2.3	58
	Mother is not Danish	770	1.2	0.1	3.7	5.0	73

*$p < 0.001$.

Table III. Children's mean caries experience (dmfs+DMFS) in relation to minority ethnic group.

			dmfs+DMFS			
	n	%	5 years*	7 years*	12 years*	15 years*
Somalia	226	1.8	2.7	4.0	2.2	3.2
Morocco	293	2.3	3.0	6.7	4.7	4.9
Iraq	380	3.0	4.8	9.1	4.4	6.2
Lebanon	390	3.1	4.7	9.5	4.4	6.2
Pakistan	390	3.1	3.9	7.2	3.6	4.2
Turkey	457	3.6	5.1	8.4	5.5	6.3
Other non-Western countries**	1204	9.5				
Western countries	231	1.8	2.2	3.1	4.0	2.4
Danish	9058	71.2	1.1	2.7	2.4	2.3
No information	77	0.6				

*$p < 0.001$.
**71 countries, with very few children from each country.

that the level of caries experience was higher in children whose mothers were not Danish. Caries level was also higher if the mother was an immigrant, compared to children of mothers with descendant status (born in Denmark). The level of caries was highest among children in families with low incomes, where the mother's educational level was low and in families with a high number of children. Corresponding results were found in the multivariate model (Table V). Regarding the influence of the mother's education, her ethnic status and the family income, further analyses showed that no differences were found between boys and girls. At the same time, the influence of these social variables was greater for the younger age groups compared to 12- and 15-year-old children. Simple linear regression analyses were made to compare the caries levels (dmfs+DMFS) between children of mothers with Danish and non-Danish backgrounds in relation to three covariates: family income, mother's education and number of children (Table VI). Differences in caries level for each separate covariate are represented by the Beta values in the table. In families where mothers were highly educated and in one-child and high-income families, caries differences between children with Danish and non-Danish mothers were relatively small (Beta = –1.9, –1.8 and –1.1, respectively; $p < 0.001$). Table VII demonstrates that, irrespective of income level, differences in caries levels in children of Danish compared to non-Danish mothers were highest in families where the mother's education was low ($p < 0.01$).

Discussion

From the literature, it is evident that, from a socio-economic and socio-cultural point of view, oral health is unevenly distributed. An important first step in bridging these gaps is to thoroughly investigate and describe the occurrence of disease in children with different cultural and socio-economic backgrounds.

Table IV. Univariate and multivariate logistic regression models of odds ratio for caries experience.

	Univariate model		Multivariate model	
Variable	OR	95% CI	OR	95% CI
Mother's ethnic status				
Danish	–	–	–	–
Descendant	1.7	1.3–2.2	1.8	1.3–2.3
Immigrant	2.5	2.4–2.7	2.0	1.8–2.1
No. of children in the family				
1	–	–	–	–
2	0.9	0.8–1.0	0.9	0.9–1.1
3	1.4	1.2–1.5	1.2	1.1–1.4
4	2.3	1.9–2.7	1.4	1.2–1.7
≥5	3.1	2.5–4.1	1.6	1.2–2.1
Family income per year				
Low	2.4	2.2–2.7	1.7	1.5–1.9
Medium	1.8	1.7–2.0	1.4	1.3–1.6
High	–	–	–	–
Mother's level of education (ISCED)				
Low	2.4	2.2–2.7	1.8	1.6–1.9
Medium	1.6	1.4–1.7	1.4	1.3–1.5
High	–	–	–	–
Age group of children (years)				
5	–	–	–	–
7	2.4	2.2–2.6	2.5	2.3–2.8
12	3.1	2.8–3.4	3.3	3.0–3.7
15	3.9	3.5–4.3	4.3	3.9–4.8

The present study was the first attempt in Denmark to link social data with caries epidemiology among children and adolescents on a total population basis. The outcome firmly reinforced findings from other countries that caries prevalence was significantly related to the mother's ethnic background and level of education. This information will be used to form and implement a public health outreach programme tailored to the needs of major immigrant populations.

Study population

The eligible study population consisted of all children in four different age groups ($n = 16\,715$) registered as patients in the Copenhagen Public Dental Care Service. The public dental care service is a school-based system with a participation rate of nearly 100%. Dental recordings were available from 76% of the children, which was considered acceptable. Common reasons for missing data were either that the child was not scheduled for a dental examination that year or he/she did not show up for the given appointment. Another common reason was relocation, while very few cases were excluded due to an incomplete set of data. Although it was not possible to carry out a drop-out analysis, the study group was considered representative and to possess sufficient power for its purpose. Of the final study population, 28% had foreign backgrounds.

Reliability of registrations

Epidemiological data were collected from clinical examinations carried out by calibrated and experienced dentists, and there were no indications to suggest that caries was registered in a systematically biased way. The caries indices used in the present study have, however, some limitations. For example, the indices dmfs and DMFS are inadequate for measuring new decay in teeth or in surfaces which have already been restored. Even among experienced dentists, caries diagnoses are subjective [15], and the possibility of under-registration of occlusal dentine caries is likely to be higher than that of over-registrations. However, Hausen et al. [16] have suggested that data collected from public health records are not decisively inferior compared with data obtained from examinations by trained examiners. Consequently, the underlying data were considered to be of acceptable reliability. Socio-cultural and socio-economic information obtained from the national database are used for official statistics and were robust within the various categories.

Outcomes

Levels of caries occurrence in the present material from the city of Copenhagen were higher than the caries levels for corresponding age groups in a recent Danish study, which were 1.2, 2.6 and 2.8 dmfs+DMFS among 5-, 12- and 15-year-olds, respectively [17]. Such differences between Copenhagen and the rest of the country can likely be explained by the relatively large number of children in Copenhagen with foreign backgrounds. The main results of the present study clearly indicated that dental health was impaired among children with foreign ethnic backgrounds. This agrees with numerous previous studies worldwide, as well as with earlier observations in Denmark and a recent Swedish study [2,6,7,11,18]. However, previous studies from Denmark were based

Table V. Univariate and multivariate linear regression models for caries experience (dmfs+DMFS).

Variable	Univariate model Regression coefficient	*p*	Multivariate model. Regression coefficient unstandardized	*p*
Mother's ethnic status				
Danish	–	–	–	–
Descendant	1.7	<0.001	1.2	<0.001
Immigrant	3.1	<0.001	2.3	<0.001
No. of children in the family				
1	–	–	–	–
2	0.1	NS	0.1	NS
3	1.4	<0.001	0.7	<0.001
4	2.6	<0.001	0.9	<0.001
≥5	3.6	<0.001	1.4	<0.001
Family income per year				
Low	2.4	<0.001	0.8	<0.001
Medium	1.7	<0.001	0.6	<0.001
High	–	–	–	–
Mother's level of education (ISCED)				
Low	2.6	<0.001	1.7	<0.001
Medium	1.0	<0.001	0.7	<0.001
High	–	–	–	–
Age group of children (years)				
5	–	–	–	–
7	2.1	<0.001	2.2	<0.001
12	1.0	<0.001	1.0	<0.001
15	1.2	<0.001	1.2	<0.001

Table VI. Simple linear regression models for dmfs+DMFS of the children and mother's ethnic status (Danish or non-Danish), in relation to different covariates, family income, mother's educational level and number of children in the family. Alpha represents the mean level of caries in children of non-Danish mothers. Beta represents the difference in caries levels between children of non-Danish and Danish mothers.

				Standard error		
Variable	R^2	Alpha	Beta (unstandardized)	Alpha	Beta	*p*
Income level						
Low	0.03	5.2	–2.3	0.2	0.3	<0.001
Medium	0.07	5.2	–3.1	0.1	0.1	<0.001
High	0.01	2.6	–1.1	0.2	0.2	<0.001
Mother's educational level						
Low	0.04	6.1	–2.9	0.2	0.3	<0.001
Medium	0.05	4.8	–2.5	0.1	0.2	<0.001
High	0.03	3.3	–1.9	0.4	0.2	<0.001
No. of children in the family						
1	0.03	3.9	–1.8	0.2	0.2	<0.001
2	0.05	4.5	–2.7	0.1	0.1	<0.001
3	0.07	5.7	–3.5	0.2	0.3	<0.001
4	0.03	5.7	–3.0	0.3	0.6	<0.001
≥5	0.09	6.2	–2.8	0.4	1.6	NS

Table VII. Simple linear regression models for dmfs+DMFS of the children and mother's ethnic status (Danish or non-Danish), in relation to family income and mother's educational level. Alpha represents the mean level of caries in children of non-Danish mothers. Beta represents the difference in caries level between children of non-Danish and Danish mothers.

Variable	R^2	Alpha	Beta (unstandardized)	Standard error		p
				Alpha	Beta	
Low income						
Low education	0.02	5.9	–2.1	0.3	0.5	<0.001
Medium education	0.4	5.3	–2.7	0.3	0.5	<0.001
High education	0.04	3.7	–2.1	0.5	0.6	<0.001
Medium income						
Low education	0.04	6.1	–3.0	0.2	0.4	<0.001
Medium education	0.05	4.8	–2.5	0.2	0.2	<0.001
High education	0.04	3.6	–2.1	0.2	0.2	<0.001
High income						
Low education	0.06	5.6	–3.4	0.8	0.9	<0.01
Medium education	0	2.2	–0.3	0.4	0.4	NS
High education	0.002	1.7	–0.5	0.3	0.3	<0.05

on smaller subpopulations or convenience samples, with social and family data being collected by posted questionnaires. A striking finding in the present project was that the recorded inequalities were as evident in 15-year-olds as among preschool children, while studies in the Netherlands and the UK showed no association between caries experience and ethnicity in teenagers [19,20]. A reduction of disparities in caries occurrence could be expected over time through cultural assimilation, but the present data did not allow analysis of lengths of stay in Denmark. However, most of the children in the present study had descendant status, meaning that they were born in Denmark.

The present study had sufficient power to unveil significant differences in caries prevalence among children from different ethnic groups. The present findings were somewhat different from the previous study from Copenhagen [7]. These discrepancies illustrate the need to update epidemiological analyses of caries periodically, taking into account changing migration patterns. It must be pointed out, however, that further studies of socio-behavioural factors are needed to explain observed differences in caries occurrence. Whereas children with a Somali background appeared to have a level of caries similar to those children of Danish mothers, all other non-Danish minority groups displayed higher DMFS/dmfs values. These findings are in harmony with the WHO Oral Health Country/Area Profile Programme, which compiles updated national data on caries prevalence in 12-year-old children. This may suggest that some cultural determinants, such as dietary patterns and hygiene habits, may be transferred within families to their new homeland. On the other hand, data from the present study (Table IV) showed that children whose mothers had descendant status (born in Denmark) had less caries experience than children of mothers with immigrant status (born outside Denmark). This may indicate that, over time, integration into Danish culture could to some degree influence children's oral health in a positive direction. Associations between children's oral health, parent's education level and family income were recently demonstrated in a Danish study on preschool and school children [17]. In the present study, significant differences in caries experiences were found in relation to the same covariates, though the greatest differences were found in the younger age groups. Comparing caries level among children with a Danish and a non-Danish mother, a social gradient was found in both groups (Table VI). The gradient was steepest among children with foreign backgrounds.

In both groups, the mother's educational level seems to be the main determinant of the children's caries level. Low educational level often means lack of skills and social benefits [21]. Such lack of skills may include a lack of ability to process certain information and a lack of ability to interact with bureaucracy, institutions and health professionals. It can also mean a lack of ability to adopt to health promotion behaviour [21]. It is highly important to understand such mechanisms when planning and implementing oral health prevention programmes for children with high caries risk.

In general, it seems that most foreign ethnic groups need new approaches to oral health prevention and to oral health promotion programmes. In addition, it should be kept in mind that ethnic communities are not homogeneous groups. Consequently, there are differences in perceived barriers to oral health promotion and to preventive behaviour, as found earlier [22]. The co-varying factors of family income, mother's education and number of children are also essential factors that need to be addressed in tailored preventive programmes. These programmes should be organized at a local community level in close collaboration with key persons and/or leaders in ethnic minorities and/or in school groups or communities with high caries levels. Improved toothbrushing habits in children can be achieved through peer-performed education combined with increased maternal knowledge.

Conclusions

This cross-sectional study showed that even though almost all Danish children and adolescents attend the public dental service, a free service system based on preventive dentistry, a social gradient still exists for dental health. In addition, major inequalities in dental health among preschool children, school children and adolescents in Copenhagen were found when families with Danish and non-Danish backgrounds were compared. These findings of inequities in oral health support some of the overall conclusions of a recent WHO report on public health action for better health in children [23]. It was also concluded in the WHO report that, even in rich countries, people's health largely depends on the social conditions in which they live and work, the social determinants of health and "Interventions succeed in reducing disease and saving lives only when they take adequate account of the social determinants of health" [23]. According to the WHO report, this means recognizing health (and oral health) as social goals and as the responsibility of the whole society. This requires more social action by policymakers in order to reach these goals. At the current local operational level, the present findings point to the need to establish appropriate oral health-promotion programmes. These should be organized locally in collaboration with key persons from different ethnic minorities. Furthermore, in order to meet the needs of children regarding risk of caries, changing the oral health preventive strategy should be considered. These considerations must include the realities of the children's daily lives and the local environments in which they live.

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