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Parental risk attitudes and caries-related behaviours among immigrant and western native children in Oslo

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Abstract – *Objectives:* Immigrant children make up a large proportion of the school populations in many western cities. It is likely that their parents have different attitudes and knowledge of dental health than resident populations, and thus provide a challenge to public dental services. This study sought to map existing disparities in oral health among immigrant and western native children in Oslo and to identify differences in parental, cultural and ethnic beliefs and attitudes towards oral health and caries-related behaviours. *Methods:* Caries was recorded of 735 children (3- and 5-year olds), supplemented with radiographs among 5-year olds. Their parents responded to a questionnaire. *Results:* Immigrant background, consumption of sweet drinks at bed and social status were the dominant caries risk indicators among the 3-year olds. Among the 5-year olds, the caries risk indicators were immigrant background, parental indulgence, attitude to diet, attitude to oral hygiene, social status and age starting toothbrushing. Being an immigrant was closely associated with higher caries prevalence and experience. Parental attitudes to oral hygiene, diet and indulgence, and caries-related behaviours distinguished immigrants from western natives. *Conclusions:* The results suggest that immigrant groups in western societies require different information packages, modified strategies for forming oral hygiene habits and attitudes related to dental care of children, and encouragement to exercise discipline on factors known to be risks for oral health. These strategies must recognize that immigrants and western natives attach different levels of importance to oral health and dental parameters. It should be paid extra attention to some caries high-risk subgroups.

Key words: child; immigrants; dental health; caries risk indicators; attitudes

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Like most other European capitals, Oslo has had an influx of migrants from the non-western world in the last two decades (1). Immigrant children and adolescents constitute 27% of children (0–17 years); of these, 94% are of non-western origin (1). Immigration from non-western countries increased by 83% during the period 1993–2003, and in 2003 16.8% of Oslo's population was made up of immigrants (2). Many live clustered in inner-city neighbourhoods (3), have an unemployment rate three to four times the Norwegian average of 4.6% (4), and thus are more often dependent on social security funds than the established population. They consumed 36% of social security expenditure in Oslo in 1998 (5). This association between socioeconomic difficulties and immigrant status is well known (6). General and oral health disparities exist between immigrant groups and the established population (6), particularly between children with immigrant and native backgrounds (7).

The Public Dental Health Service in Oslo has reported such dental health disparities in an Oslo suburb, where 3-year-old immigrant children had four times as many teeth with caries experience than other children (8).

It is well known that beliefs and attitudes towards dental health impact on how parents care for the dental health of their children (9, 10), and these mediating factors differ according to family, cultural and ethnic backgrounds (10). Additionally, parents' own dental behaviour, lifestyle, habits and routines influence the way they assist their children (11, 12). Self-efficacy, the parents' belief that they can effectively implement the guidelines of good dental care for their children, is another relevant factor that determines whether positive dental behaviours occur or not (13).

The aims of the present study were: (i) to report on the oral health status of a group of 3- and 5-year-old children of Oslo and (ii) with the help of a self-administrated questionnaire, to describe parental beliefs, attitudes and behaviours towards their children's oral health, indicating different risks for dental disease among western native and immigrant children.

The null hypotheses tested were that: (i) there was no association between immigrant status and caries experience of the children; (ii) there was no association between parental attitudes or behaviours towards children's dental care and the caries experience of the children; and (iii) the responses concerning caries predictors (parental risk attitudes and caries-related behaviours) were equally distributed between immigrant and western native children.

Material and methods

Participants

In Norway, free dental care is offered to children from birth to 18 years of age. The target group consisted of 3- and 5-year-old children, drawn from seven different clinics. The selection criteria were: (i) clinics with high proportion of immigrant children in their catchment area or (ii) clinics with substantial spread concerning socioeconomic location. The local dental health profile and availability of clinics and dental hygienists were also taken into consideration. In two cases of twins, only one child was chosen. At each clinic, the children were randomly selected. A sample size calculation for comparing mean values was performed under the assumption that type I (alpha) and type II (beta) errors were 0.05 and 0.2 respectively. Standard deviations used in sample-size calculations were based on an adjustment between the values found in children with and without immigrant background. The sample size was estimated to 700 in the two age groups together, but was increased to 900, because of defection and inequality in the size of subgroups to be compared. An informative letter about the study was sent to the parents together with a request to fill out a self-administered structured questionnaire. The letter also contained information on the purpose of the study, confidentiality and a promise of a gift for the children if they participated. The parents were asked to return the questionnaire when the child had the clinical appointment. Interpreter assistance was offered at the clinics. The non-respondents were first given reminders by mail, and then by telephone.

Clinical examinations

Caries examinations were conducted in 2002 by calibrated dental hygienists ($n = 7$). Details of the calibration process and the Cohen's kappa scores, have been described previously (14). Calibration courses and training sessions were performed before and during the study, based on extracted teeth, radiographs, clinical pictures, a specially designed computer program (15) and clinical training. The reliability test prior to the start of the study was based on eight 10-year-old children. The calibration test during the middle of the study was conducted on two to five patients in the respective clinics.

Carious lesions were graded on a five-point scale based on written descriptions and photographs as described by Amarante et al. (16). In this study, caries is denoted d_{1-5} and d_{3-5} where the subscripts indicate the caries grades. Radiographs (BW) were taken of the 5-year-old children whenever the approximal surfaces could not be inspected clinically. A total of 735 children with completed questionnaires constituted the study group.

A child was assigned to the immigrant group (IM group) if the mother was of non-western origin and to the western native group (WN group) if the mother had a western background. Non-western background meant origin from Eastern Europe, Asia, Africa, Turkey, South and Central America while Nordic countries, Western Europe, North America, Australia and New Zealand were considered to be western (1). This definition assumed that the mothers were first-generation immigrants.

Questionnaire construction and development

The questionnaire contained 104 main items from a collaborative international study (10) and 23 main items tailored to Norwegian conditions. The belief and attitudinal items from the international study were based on theoretical models regarding the psychology of health behaviour (17–19), and the explanatory working model was influenced by the hypothesis of Conner and Norman (9), that beliefs and attitudes about particular behaviours might predict those behaviours. Based on a recent review of risk factors (20), tooth-brushing and sugar-snacking represented the dental behaviours in the models. Responses to the belief and attitudinal items were registered on a five-point Likert scale (from strongly disagree to strongly agree). The direction of the scale was determined before analyses were performed, and for the regression analyses the midpoint of 'neither degree nor disagree' was excluded. The questionnaire also contained items that measured present and past dietary and toothbrushing habits, parental dental attendance, use of fluoride, family structure and other demographic conditions. Further background details about the reliability and validity of the mutual international questionnaire have previously been published (21). The international items were translated to Norwegian and reverse translated by a bilingual person to ensure comparability with the original form. Semantic and conceptual balance was sought in the selection of appropriate words concerning Norwegian conditions.

Constructed variables

Several groups of variables were closely related; parental attitudinal variables concerning oral hygiene, dietary habits and parental indulgence were consolidated by assigning a positive score to responses that were favourable to oral health, and a negative score to those that were unfavourable. The sum of these scores then formed a quantitative expression of parents' attitudes to these factors. The parents with the most favourable attitudes had thus the highest sum. The composite variables were given titles based on the content of the included statements. For example, the indulgence composite variable included items which showed permissiveness. Not all questionnaires were completed for every item; analyses and results presented are based on a varying number of completed questions. Composite variables are presented in Table 1.

Table 1. An overview of the different items in each composite variable

Composite variable: Attitude to Hygiene – Cronbach's alpha: 0.77
As a family we intend brushing our child's teeth for him/her
We intend brushing our child's teeth for him/her twice a day
The people in my family would feel it was important to help brush our child's teeth twice a day
The people we know well would feel it was important to brush our child's teeth twice a day
We feel able to brush our child's teeth for him/her
I don't know how to brush my child's teeth properly
If we brush our child's teeth twice a day, we can prevent our child getting tooth decay in the future
If our child uses a fluoride toothpaste, it will prevent tooth decay
We can prevent tooth decay in our child by helping with brushing once a day
It would not make any difference to our child getting tooth decay, if we helped him/her brush every day
We feel it is important to check if our child has brushed his/her teeth
We don't have time to help brush our child's teeth twice a day
We cannot make our child brush his/her teeth twice a day
My child's teeth are brushed as part of my child's daily washing routine (washing hands and face)
Composite variable: Attitude to Diet – Cronbach's alpha: 0.75
As a family, we intend controlling how often our child has sugary foods or drinks between meals
The people in my family would feel it was important to control how often our child has sugary foods and drinks between meals
We feel able to give our child healthy alternatives to sugary drinks between meals (e.g. like water instead of a fizzy drink)
We feel able to give our child healthy alternatives to sugary foods between meals (e.g. like apples instead of sweets)
Composite variable: Parental Indulgence – Cronbach's alpha: 0.63
If our child does not want to brush his/her teeth every day we don't feel we should make them
It is worthwhile to give our child sweets/biscuits to behave well
In our family, it would be unfair not to give sweets to our child every day
It is often too stressful to say no to my child when he/she wants sweets
It is not worth it to battle with our child to brush his/her teeth twice a day

'Social Status' was an expression of the combined educational level of both parents, and used as a proxy for socioeconomic status. High 'Social Status' was defined as both parents having educational background up to the university level. Middle 'Social Status' was the category when either one of the parents had university-level education or when both the parents had reached the high school level. Remaining responding parents were classified to be of low 'Social Status'. The variable 'Frequent Sugar' classified high degree of sugar-related intake (eating/drinking) every day as a negative dietary behaviour, and other responses were classified as positive dietary behaviour. 'Parental Dental Attendance' differentiated between regular attendance or sporadic visit. A question about the appropriate amount of toothpaste for children might be seen upon as a proxy for verifying whether dental care directives given were appropriately communicated and understood by recipients. In spite of its limitations, the marker 'Acquired Dental Knowledge' was positive if the guideline was followed and negative if not. The variable 'Religion' was based on the main official religion of the country of origin. It was constructed because of the close association of Islam with a strict hygiene regime on the one hand (22), and the discussed link between caries and religious background on the other (23, 24). The variable was dichotomized according to 'Muslim' or 'non-Muslim'.

Ethical approval

The study was approved by the Regional Committee for Medical Research Ethics and the Norwegian Data Inspectorate. Written informed consent was obtained from the parents before clinical examination of their children.

Statistical methods

Data management and analyses were undertaken using SPPS version 11.0 (SPSS Inc, Chicago, IL, USA). Cronbach's α was used to test internal consistency of belief and attitudinal items. If the correlation of an individual item score on the belief and attitude part of the questionnaire was negative, it was removed from the analyses.

Logistic regression, bivariate and multiple forward stepwise analyses were carried out. Only statistically significant predictors were allowed to enter the multivariate models. The dependent variable was the presence of caries experience (d_{1-5}mfs index >0 or d_{3-5}mfs index >0). Odds ratios (OR) with 95% confidence intervals (CIs) were the outcome measurements. Relative risk (RR), *t*-tests and Kruskal–Wallis test were used to measure differences between groups, and both parametric and non-parametric correlation tests were conducted for measuring associations between caries and responses of items in the questionnaire (Pearson's correlation coefficient and Spearman's rank correlation coefficient). The level of statistical significance was set at 5%.

Results

Study participants

Altogether, 900 children were invited to the clinical examination – 770 western natives and 130 immigrants. Of these, 654 (response rate: 84.9%) and 81 (response rate: 62.3%) respectively attended for examination and provided a completed questionnaire ($\chi^2 = 38.03$, d.f. = 1, $P < 0.001$). The mothers in the WN group alone answered the questionnaire more often (87.3%) than in the IM group (74.3%).

Three-year olds (mean age = 3.0 years) made up 353 (40 immigrants), and 5-year olds (mean age = 4.8 years) 382 (41 immigrants) of these children. As shown from Table 2, the demographic profile differed between the WN and IM group. Among the 3-year olds, there were 156 girls and 197 boys.

Table 2. Demographic profile based on the questionnaire respondents and presented as proportions within the respective groups

	WN % (n = 654)	IM % (n = 81)
Social Status		
High	53.9	15.2
Middle	36.6	41.8
Low	9.5	43.0
Mean age of mothers <30 years	12.1	24.4
Full-time job		
Mothers	55.6	31.2
Fathers	92.7	79.2
In kindergarden	81.8	43.2
Living with only one parent	12.1	15.6
Boys	53.7	51.9

The mean age in months was the same in the two groups at each age level. Exclusive the two lower rows, the frequency percentage differed statistically significantly between the groups. Not all the participants answered all the items.
WN, western native; IM, immigrants.

The questionnaire

One belief and attitudinal item for the sample showed negative correlation score against total item score and was removed from the analyses. Cronbach's α then became 0.86. Among the consolidated variables, the Cronbach's α varied from 0.63 to 0.77.

In a bivariate logistic regression model, the 'Attitude to Hygiene' was statistically significantly associated with the dependent variable 'Supervised Brushing', twice daily or not, showing an OR (unadjusted) of 5.5 (95% CI 3.5–8.6) and 'Attitude to Diet' showed similar significance according to the dependent variable 'Frequent Sugar' OR (unadjusted) = 4.0 (95% CI 2.5–6.4).

Caries and caries-risk predictors

Univariate

The prevalence of caries at age 3 and 5 years are presented in Table 3 with two different caries threshold levels (d_{1-5} and d_{3-5}). A high prevalence at d_{3-5} level was found on incisors and canines in the 3-year olds in the IM group. The respective d_{1-5}mfs and d_{1-5}mft values were 0.99 (SD 3.5) and 0.73 (SD 2.1) among the 3-year olds whereas the 5-year olds had 2.73 (SD 4.7) and 2.14 (SD 3.2). Immigrants consistently had higher caries prevalence than the western native children. Within the IM group, however, there were no statistically significant differences in caries prevalence between children with or without Muslim background (Table 3).

Bivariate

Among the 3-year olds, boys had a statistically significantly higher level of caries experience (d_{1-5}mfs) ($t = 2.31$, d.f. = 340, $P = 0.021$) than girls. Three-year olds in the IM group were three times more likely (RR = 3.0), and 5-year olds nearly twice as likely (RR = 1.9), to have caries experience compared with those in the WN groups.

Caries prevalence was also related to which parent responded to the questionnaire, and to whether the parents were immigrant or western natives. When fathers of WN group were involved in answering the questionnaire (12.9% of the group), the d_{1-5}mfs index was statistically significantly lower than when mothers alone responded (among 3-year olds: $t = 2.33$, d.f. = 279, $P = 0.021$; among 5-year olds: $t = 2.32$, d.f. = 108, $P = 0.022$). The opposite outcome was noted when immigrant fathers responded, but this difference was not statistically significant. Caries experience (d_{1-5}mfs) was inversely related to the parents' educational level for 3-year olds ($r = -0.20$ for mothers and $r = -0.20$ for fathers). Among the 5-year-old children, these correlations were $r = -0.25$ for mothers and $r = -0.19$ for fathers.

Caries-risk indicators indicated by bivariate analysis are presented in Table 4 where statistically significant differences were found between caries status and various caries-risk indicators. Their impact on caries status varied according to age. The distributions of all variables in Table 4 were analysed separately for immigrants and western natives. Except from the item 'Living with only one parent', the responses were statistically significantly different.

The questionnaire item 'It is often too stressful to say ''no'' to my child when he/she wants sweets' was strongly correlated with d_{1-5}mft ($r = 0.52$) in the 5-year-old IM group ($n = 37$). The parents in the IM group more often responded to be indulgent than those in the WN group (IM group: 45.1% vs. WN group: 7.8%). The proportion of indulgent parents among Muslims was 55.6% (20/36 Muslim

Table 3. Caries prevalence (%) in 3- and 5-year-old children

Diagnostic level	3 years ($n = 353$)	5 years ($n = 382$)	WN: 3 years ($n = 313$)	IM: 3 years ($n = 40$)	WN: 5 years ($n = 271$)	IM: 5 years ($n = 41$)	Muslim 3 years ($n = 20$)	Muslim 5 years ($n = 24$)
All teeth								
d_{1-5}mf	19.3	51.6	15.7	47.5*	47.2	87.8*	60.0	91.7
d_{3-5}mf	6.5	25.7	3.5	30.0*	20.5	68.3*	30.0	79.2
Incisors and canines only								
d_{1-5}f	10.5	16.0	7.7	32.5*	12.0	48.8*	40.0	54.2
d_{3-5}f	6.2	9.9	3.5	27.5*	6.7	36.6*	30.0	45.8

WN, western native; IM, immigrants (muslims included). Religion is assumed from the major religion of the immigrants' native land.

*Statistically significant differences between WN and IM groups ($P < 0.001$).

Table 4. Bivariate analysis: risk indicators and mean d_{1-5}mfs ($n = 735$)

	3 years			5 years		
	n	d_{1-5}mfs (SD)	*t*, *F*, d.f., *P*-values	n	d_{1-5}mfs (SD)	*t*, *F*, d.f., *P*-values
Immigrant Status						
Western	313	0.7 (2.8)	$t = -2.89$, d.f. $= 41$, $P = 0.006$	341	2.2 (4.0)	$t = -4.48$, d.f. $= 43$, $P = 0.001$
Non-western	40	3.7 (6.5)		41	7.3 (7.2)	
Parental Indulgence						
Low	305	0.7 (2.8)	$t = -2.20$, d.f. $= 44$, $P = 0.033$	336	2.2 (4.0)	$t = -3.85$, d.f. $= 42$, $P < 0.001$
High	43	2.9 (6.3)		40	6.8 (7.5)	
Attitude to Hygiene						
Good	297	0.8 (3.3)	$t = -1.95$, d.f. $= 60$, $P = 0.056$	327	2.2 (4.1)	$t = -4.03$, d.f. $= 55$, $P < 0.001$
Poor	52	2.1 (4.6)		50	6.0 (6.6)	
Attitude to Diet						
Good	288	0.8 (2.8)	$t = -1.86$, d.f. $= 58$, $P = 0.068$	322	2.3 (4.2)	$t = -2.84$, d.f. $= 54$, $P = 0.006$
Poor	54	2.3 (5.9)		50	5.2 (7.0)	
Social Status						
High	180	0.3 (1.0)	$\chi^2 = 21.59$, d.f. $= 2$, $P < 0.001$	183	1.7 (2.7)	$\chi^2 = 26.69$, d.f. $= 2$, $P < 0.001$
Middle	125	1.1 (3.2)		146	2.7 (4.1)	
Low	44	3.4 (7.7)		52	6.6 (7.5)	
Age started Brushing						
<1 year	263	0.7 (2.8)	$t = -2.41$, d.f. $= 106$, $P = 0.018$	269	2.2 (4.3)	$t = -3.23$, d.f. $= 171$, $P = 0.001$
≥1 year	88	2.0 (5.0)		110	4.0 (5.3)	
Acquired Dental Knowledge						
High	244	0.8 (3.0)	$t = -1.60$, d.f. $= 150$, $P = 0.111$	184	2.2 (3.8)	$t = -2.30$, d.f. $= 347$, $P = 0.022$
Low	107	1.5 (4.4)		196	3.3 (5.4)	
Frequent Sugar						
Low	284	0.9 (3.4)	$t = -1.13$, d.f. $= 345$, $P = 0.260$	330	2.5 (4.3)	$t = -2.12$, d.f. $= 56$, $P = 0.038$
High	63	1.5 (4.3)		51	4.6 (6.9)	
Sugary Drink to Bed						
No	299	0.7 (3.0)	$t = -2.65$, d.f. $= 59$, $P = 0.010$	350	2.5 (4.4)	$t = -2.92$, d.f. $= 34$, $P = 0.006$
Yes	54	2.7 (5.4)		32	5.9 (6.5)	
Parental Dental Attendance						
Regular	294	0.7 (2.8)	$t = -2.22$, d.f. $= 57$, $P = 0.030$	328	2.6 (4.6)	$t = -1,53$ d.f. $= 375$, $P = 0.127$
Sporadic/not	53	2.4 (5.4)		49	3.7 (5.2)	
Living with only one parent						
No	310	0.8 (2.9)	$t = -1.52$, d.f. $= 41$, $P = 0.135$	328	2.4 (4.0)	$t = -1.84$, d.f. $= 55$, $P = 0.071$
Yes	40	2.4 (6.6)		51	4.4 (7.6)	

responders), which was slightly higher than that of the rest of the IM group, but not statistically significantly so ($\chi^2 = 3.24$, d.f. $= 1$, $P = 0.072$).

For the composite variable 'Attitude to Hygiene', 12.4% of the western native parents had caries-promoting attitude to oral hygiene compared with 28.8% of the immigrants. Within the immigrant group, 47.4% (18/38 responders) of Muslims had this negative attitude against 8.6% of the parents without Muslim background (3/35 responders), a difference which was found to be statistically significant ($\chi^2 = 13.38$, d.f. $= 1$, $P < 0.001$).

The composite variable 'Attitude to Diet' was unfavourable among 13.5% of western natives and among 23.9% of immigrants. The percentage of Muslims with this attitude was statistically significantly higher than that among the rest of the immigrants (38.9% = 14/36 responders) vs. (8.6% = 3/35 responders; $\chi^2 = 8.96$, d.f. $= 1$, $P = 0.003$). The educational level of mothers was statistically significantly lower in the Muslim group than that in the remaining IM group ($\chi^2 = 7.17$, d.f. $= 1$, $P = 0.028$), but among immigrant children caries experience was not correlated significantly with the educational level of the mother.

When compared with those parents showing favourable 'Attitudes to Hygiene and to Diet' ($n = 547$, mean age = 3.9 years), parents with both unfavourable attitudes had children with almost five times higher caries experience (d_{1-5}mfs) ($n = 32$, mean age = 4.0 years).

Table 5 shows the variation found in dental habits and behaviours between the two groups and it is notable that western natives started tooth-brushing for their children at a much younger age.

Multivariate

Different multivariable logistic regression analyses were carried out to test the robustness of the predictor variables. First, the analyses were carried out with the dichotomous variable 'Presence of dentin caries experience' (d_{3-5}mfs > 0) as the dependent variable, and then with the dichotomous

Table 5. Distribution of responses (%) to some behavioural items in the western native group, and the immigrant group (muslims included)

Dental habits and behaviours	WN group (n = 654)	IM group (n = 81)	
		Total group (n = 81)	Muslim (n = 44)
Supervised brushing ≥ twice daily	68.9	68.8	58.1
Age started brushing <1 year	77.0	39.2	28.6
Frequent sugar, high degree	13.9	28.4	28.6
Regular use of fluoride tablets	63.5	41.8	37.2
Lemonade/milk in bottle after 1 year of age	52.4	76.5	78.6
Sugary drink to bed	8.6	37.0	40.9

Not all the participants answered all the items.

'Presence of total caries experience' (d_{1-5}mfs > 0). As shown in Table 6, for 3-year olds the persistent variables were 'Immigrant Status', 'Sugary Drink to Bed' and 'Social Status'. The persistent variables at 5 years of age were 'Immigrant Status', 'Parental Indulgence', 'Attitude to Diet', 'Attitude to Hygiene', 'Social Status' and 'Age Started Brushing' (Table 6).

In order to identify separately the impact of the various caries-risk indicators on the IM group, the regression model was run exclusively on immigrants (dependent variable = d_{3-5}mfs > 0). The persistent variables were 'Attitude to Hygiene' and 'Parental Indulgence' when the analyses were run together on both age groups in the IM group (n = 65) (OR = 4.0, 95% CI 1.1–15.0 and OR = 3.4, 95% CI 1.2–10.0). When only the 5-year olds (n = 34) were included, the variables 'Age Started Brushing' and 'Parental Indulgence' were the most important (OR = 14.3, 95% CI 1.4–150.1 and OR = 12.0, 95% CI 1.1–127.9).

Table 6. Results of multiple logistic regression: major predictor variables for presence of any caries experience at 3- and 5-years of age when caries level was defined as either d_{3-5} or d_{1-5}

	d_{3-5}mfs > 0		d_{1-5}mfs > 0	
	OR	95% CI	OR	95% CI
3-year-old children				
Immigrant Status	4.2	1.4–12.9	*	
Sugary Drink to Bed	3.9	1.3–11.1	3.7	1.9–7.3
Social Status	2.3	1.2–4.7	1.7	1.1–2.6
5-year-old children				
Immigrant Status	4.3	1.7–10.6	6.0	2.0–18.0
Parental Indulgence	4.0	1.6–9.7	2.6	1.1–6.6
Attitude to Diet	2.8	1.3–6.0	*	
Attitude to Hygiene	2.2	1.0–4.9	2.4	1.2–4.9
Social Status	2.1	1.4–3.1	*	
Age started Brushing	1.8	1.0–3.3	*	

*Variables excluded from the model when d_{1-5}mfs > 0 was the chosen dependent variable.
Most of the predictors in Table 4 were analysed.

When the regression model was run for only the WN group (dependent variable = d_{3-5}mfs > 0), the dominant caries risk indicators were 'Parental Dental Attendance' and 'Social Status' (OR = 5.3, 95% CI 1.4–19.9 and OR = 4.7, 95% CI 1.9–11.8) for the 3-year olds and for the 5-year olds, 'Parental Indulgence', 'Attitude to Diet' and 'Social Status' (OR = 3.9, 95% CI 1.5–10.3; OR = 3.0, 95% CI 1.4–6.2 and OR = 2.3, 95% CI 1.5–3.5 respectively).

The IM group

Immigrants (39 girls, 42 boys) made up 11.0% of the participants and came from about 28 countries. Immigrants from Pakistan made up the largest group (n = 20). On average, the mothers had lived in Norway for 10 years, and 78.5% of them had lived in Norway for more than 5 years. Their educational level was statistically significantly lower than that of mothers in the WN group (t = 8.83, d.f. = 87, P < 0.001). The caries experience of the children of mothers who had lived in Norway for more than 5 years (n = 51, mean age = 4.0 years) was 2.3 times as high as that of children of more recent arrivals (n = 14, mean age = 3.5 years). The difference in caries experience was found to be statistically significant (t = −2.77, d.f. = 55, P = 0.008). Religious background within the IM group was most often Muslim (54.3%).

Discussion

It is known that immigrant parents are less likely to bring their children to the dentist even when there is no cost or charge (25). All participant children were offered an appointment for a free dental check-up, and the participation rates for the IM and WN groups are consistent with this finding.

Because of the small number of responders in each national group, detailed analyses were not possible by nationality. It is reasonable to expect oral health disparities within the IM group, as pointed out by many authors (7, 24).

In the questionnaire, we enquired about people's habits and behaviours concerning oral health. Such questions are vulnerable to respondents giving the answers they think are most desirable (26), and the responses were not validated in the present study. Interpreter assistance, however, was offered, but most of immigrants had been in Norway for more than 5 years, and no request was received.

Oral health status

The dominant caries risk indicators in this study for 3-year olds, immigrant background, consumption of sweet drinks in bed at night and social status, are in line with previously published epidemiologic studies (27, 28). It was interesting to note that the variables as 'Supervised Brushing', twice daily or not, and the constructed variable 'Frequent Sugar', did not at any age group belong to the dominant caries risk indicators. The high caries prevalence in front teeth for 3-year-old immigrants (Table 3) underlines previous findings that immigrants are vulnerable to early childhood caries (29). For 5-year olds, caries (d_{3-5}mf) prevalence was 25.7% in the present study, whereas the reported data of 2003 from Public Dental Health Service, Oslo, was 42% (30). Prevalence of caries (d_{3-5}mf) among immigrants in this study was 68.3%. It is difficult to compare the present caries data with those from Public Dental Health Service, Oslo, or nationally. The data from Public Dental Health Service probably report on worse than average oral status, because of their system of extended intervals and selective recall of children. On the contrary, the mean age of the children in the present study was relatively low (4.8 years) and might thus have influenced the caries prevalence. Western native participants in the present study had thus better dental health (d_{3-5}mf) while our immigrant group, in contrast, had considerably worse oral health.

The variable 'Social Status' was based on the educational level of each child's parents. There was an association between the father having accompanied the child to the clinical examination and lower caries levels in the child. Greater participation by fathers in the child's daily care is associated with higher educational status (31) which may explain this association. There are studies which have shown that ethnic differences in caries experience may decrease or disappear when adjustment is made for socioeconomic variables (6, 32). The present study suggests that immigrant status has an independent effect on caries experience.

The various independent caries risk indicators of socioeconomic backgrounds differed between immigrants and western native children (Table 2). There were also group differences in the way parents cared for the dental care of their children (Table 5). The responses indicating inappropriate oral hygiene and diet regimes performed by the IM group are inconsistent with regard to appropriate use of fluoride, and some literature reports that minority ethnic communities may use fluoride-containing toothpastes less frequently (24). It is noteworthy that reported parental attitudes to dental health were more closely correlated with caries experience than the dental behaviours the parents stated they performed, such as 'Supervised Brushing'. This is in line with the findings of a previous study (10). Social desirability is documented to take place when parents respond to behavioural items, of which the acceptable answers are well known (26). Concerning the many attitudinal items towards the same behaviours, the responses might not be equally predictable, thus reducing this source of response bias. Attitudinal items might also easier reveal the parents with poor knowledge about dental health problems, or those with low priority on oral health matters.

Children of immigrant mothers who had lived >5 years in Norway had worse dental health than the newcomers. One explanation for this may be that having lived >5 years in Norway implies greater family income and the ability to buy more soft drinks, sweets and sticky products than do recent arrivals (24). Such adaptation is common among immigrants, and may be part of the acculturation process (33, 34). Simultaneously, the parents most likely have little knowledge on dental health-related matters and do not work against their children's increased demands for sweets (6). This finding should however be interpreted with caution, because of the small sample sizes.

Religious background has been shown to be an indicator of caries risk in immigrant children (23, 24). This questionnaire did not contain items on religion, but a Muslim background was assumed for parents from countries that are predominately Muslim. This was of interest because this religion regards personal hygiene as having great import-

ance, and anecdotal reports suggested that many Muslim parents, like other minority groups (35), are indulgent towards their children. Our results confirmed this. However, our results did not find religion to be associated with a better attitude to oral hygiene. Bedi and Elton (36) reported poor oral cleanliness to be more strongly associated with persons with Muslim than those with non-Muslim immigrant background. In the present study, religion was treated as an ecological variable which is imprecise. Nevertheless, such an approach warrants trial as a motivational strategy. Regarding unfavourable 'Attitude to Diet' it was more frequently associated to Muslim parents. High-sugar diet is reported to be associated with children of Muslim background (37, 38).

It is apparent from these analyses that there are differences in 'Parental Indulgence', 'Attitude to Hygiene' and 'Attitude to Diet' between immigrants and western native parents. These differences, almost certainly at least partial explanations for differences in oral health status, suggest that to improve immigrants' oral health, parents must operate stricter regimes of diet and toothbrushing and ensure an appropriate use of fluoride. Fluoride daily supplements or fluoridated toothpaste have also been shown to be effective in a recent study of children, living in a high-caries-risk multicultural area (39). Dental health information should be tailored to the immigrants' needs and given in a culturally sensitive way (24); and the preventive programmes should be culturally appropriate (6). If possible, collaboration with the targeted minority ethnic communities in programme design should be encouraged (7).

Immigrants distinguished themselves by having many attitudes and behaviours that are associated with poorer health outcomes, and detailed examination of the responses to questionnaire items confirmed links to poor oral health. Immigrant parents were less likely to be regular dental attenders and less likely to think that loss of a deciduous tooth was important. They often had the view that caries occurred independent of the care they gave the child, they felt that caries occurrence was a result of luck and they had less confidence in their ability to assist the child's toothbrushing (6).

Although the oral health picture provided by immigrants in this study could be interpreted as being negative, many of the attitudes and habits they display are not unlike attitudes and behaviours that were prevalent in industrialized countries several generations ago. If that is the case, it would be natural to believe that the recent improvements in oral health displayed among children in most industrialized countries would similarly take place within the immigrant population. However, it is increasingly being accepted that the social and cultural context in which people live is a strong determinant of oral and general health (40). Immigrants are influenced by socially acceptable norms and expectations in their societies or subgroups (41), implying that dental health behaviours (lifestyle behaviour) are not solely based on the individual's free choice (40). Even highly acculturated immigrants retain facets of their own culture (34), partly confirmed by studies reporting that children of second-generation immigrant mothers have more caries than those of the first generation (42). Among those less acculturated, surrounding stress factors and more immediate problems of resettlement might overshadow tooth care (43).

Based on the information gained in the study, the results did not support the three null hypotheses to be tested. (i) A statistically significant association between immigrant status and caries experience of the children was found. (ii) A statistically significant association between both parental attitudes and behaviours towards children's dental care and caries experience of the children was found. (iii) The responses concerning caries predictors (parental risk attitudes and caries-related behaviours) were not equally distributed between immigrant and western native children.

Conclusively, immigrant status has shown to have a marked independent relationship to dental caries status among preschool children, living in Oslo. Additionally, as unfavourable parental attitudes and behaviours towards children's dental care were more frequent within the IM group, these caries risk indicators may also to some extent be seen as proxies for immigrant status. However, it has to be accepted that to date not all pathways, linking the immigrants status to poor dental health outcome, are revealed. Therefore, the work of improving the oral health in the immigrant children becomes a challenge for established health services, especially in such a traditionally monocultural country as Norway.

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