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Original article

Caries prevalence in 11- to 14-year old migrant children in Germany

Abdul-Razak Bissar[1], Andreas Gerhard Schulte[1], Ghada Muhjazi[2], Martin Jean Koch[1]

[1] *Department of Conservative Dentistry, Faculty of Medicine, University of Heidelberg, Germany*
[2] *Department of Tropical Hygiene and Public Health, University of Heidelberg, Germany*

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Summary

Objectives: To assess whether immigration stage is associated with higher prevalence of dental caries among schoolchildren in Heidelberg, Germany.
Methods: A cross-sectional dental examination on 570 schoolchildren, aged 11 to 14 years, in schools with high proportions of immigrant pupils (49.5%) was performed. Carious, missing and filled permanent teeth were recorded for each child, so that mean DMFT values could be calculated. The pupils were classified into three groups: M0 (children and their parents were born in Germany), M1 (children who were born in Germany but whose parents were born outside of Germany), and M2 (children and their parents were born outside of Germany).
Results: The mean DMFT values in M1 and M2 were close, and both were significantly higher than the corresponding values in M0. The proportions of caries-free children in M0, M1 and M2 were 63.7%, 40.3% and 42.3%, respectively.
Conclusion: In Germany, migrant children have a poorer dental health status than native children coming from the same low socio-economic classes. Risk-oriented public health policies with appropriate prevention programs must be developed for these children.

Keywords: Caries epidemiology – Migrant children – Caries-risk groups – Dental health – Preventive dental care.

Immigration to Germany increased about fifty years ago as hundreds of thousands of workers, especially from Southern Europe and later from Turkey came to Germany, most of them subsequently being joined by their families. Also, more recently, many refugees fleeing wars and conflicts in their countries especially from Iran, the former Yugoslav republics, and Iraq came to Germany. In addition, since the end of the eighties, about two million immigrants from Eastern Europe came to Germany, taking advantage of a new German law offering the German citizenship for individuals with German ancestors. Officially, nowadays, 7.3 million foreigners live in the Federal Republic of Germany and they represent about 9% of the population (Statistisches Bundesamt 2004). These figures demonstrate that Germany is the country that hosts the largest number of foreigners in Europe: about one third of all foreigners of the Western European countries. Furthermore, several million persons have already received the German citizenship and are therefore no longer revealed in the statistics as foreigners. Ninety-eight percent of all these immigrants live in the western part of Germany and in the capital Berlin, and most of them have a low socio-economic status.

Conversely, it has been shown since the beginning of the eighties that caries prevalence in children in industrialized countries has gradually decreased (Marthaler et al. 1996; Pitts et al. 1998; Pieper & Schulte 2004; Schulte et al. 2006). Unfortunately, not all children living in these countries have equally demonstrated this trend. In fact, earlier studies carried out in other western countries have reported a poorer oral health status in children and adolescents of ethnic minorities and immigrants living in these industrialized countries compared to the oral health of the national population. Many of these studies were performed in Sweden (Ekman 1990; Wendt & Jonsell 1996; Källestål & Wall 2002), in Denmark (Petersen 1996; Sundby & Petersen 2003), in Great Britain (Laher 1990; Bedi 1991; Todd & Gelbier 1991), in the USA (Ismail & Szpunar 1990; Nurko et al. 1998; Cruz et al. 2004) and in Australia (Durward & Wright 1989; Marino et al. 2001).

In Germany, in spite of the large number of immigrants and the dissimilarity in their origins compared with the other host countries, the oral health of migrant and foreign children has

not been evaluated adequately. Respective reports are rare, and unfortunately, none of them was published in English. However, these publications reported that children of immigrants and foreigners have a much poorer oral health compared to the native German children (Geiger & Künzel 1995; Van Steenkiste 2002; Kühnisch et al. 2003). These findings are remarkable because since 1989, the social security system in Germany has been paying the costs for caries preventive measures for native as well as for immigrant children. Furthermore, in Germany the schoolchildren are obliged to have an annual dental examination by public health dental officers (Schulte et al. 2001).
Besides, a correlation between socio-economic status and oral health has been reported in several studies (Declerck et al. 1992; Locker 2000; Klemme et al. 2004). To date, this aspect was neglected in the German reports on dental health of immigrants. In addition, no recent information is available whether differences in dental health exist between immigrant children born in Germany and those born outside of Germany. Therefore, the present study aimed to compare the dental health of immigrant children with that of German children with low social economic status. Another goal of this study was to find out if there are differences in caries prevalence between migrant children born in Germany and those born outside of Germany.

Materials and methods

Population sample
The study was conducted in May and June 2004 in Heidelberg, a city located in south-west Germany and counting 140000 inhabitants, 14% of them being foreigners. With the help of the Heidelberg Regional Health Authority, the secondary schools that have a high proportion of enrolled children with an immigration background were selected. Five schools were identified in Heidelberg, and all of them were located in low income areas of the city. Aiming to examine the permanent dentition of young adolescents, it was decided to include the pupils of the 5th, 6th and 7th grades of these schools in the study. All migrant children and all German children who were attending these grades and were 11 to 14 years old on the day of the examination formed the study group. It should be noted that these German children, who were living principally in these same socially disadvantaged areas of the city, were included in the study in order to have relevant comparison groups of corresponding ages.
Several days prior to the dental examination, a letter was sent to the parents in which they were informed about the aim of the study and asked for consent to have their children's teeth examined. They were also asked to answer some questions concerning the age of their child, the country of the child's birth, the year of arrival in Germany (in case the child was born outside Germany) and the country of birth of each of the parents. Only children who returned these papers completed and signed by a parent were included in this study.

Data collection
The clinical examination took place in the schools and was performed by a dentist (A.B.) who had been calibrated by a dentist with extensive experience in oral epidemiology (A.S.). The caries diagnosis was based on visual-tactile criteria. A plane mouth mirror, a blunt dental probe, and a halogen lamp were used. Probes were only used to remove oral debris obscuring tooth surfaces or to confirm suspicious lesions. No radiographs were taken. The WHO method and criteria were followed for the collection and recording of data (WHO 1997). Carious, missing, and filled permanent teeth were recorded. Only teeth with dentinal caries lesions were considered carious. Missing and filled teeth were only counted when this was due to caries. The children did not know the day of the examination in advance.
Using the information provided by the parents in the questionnaire, the pupils were classified in three groups: M0 comprised children who, as well as both of their parents, were born in Germany; M1 consisted of children born in Germany but whose parents, one or both, were born outside of Germany; and M2 comprised children who, as well as their parents, were born outside of Germany. Thus, children of M0 were without immigration experience, those of M1 had an indirect immigration experience and those of M2 a direct immigration experience. In each group, the children were divided in four subgroups according to their age.

Statistical analyses
DMFT values and scores of the different components of this index were calculated. The letters DMFT stand for D = decayed (carious), M = missing, F = filled, T = tooth/teeth. Mean values, standard deviation, and frequency distribution were computed. Epi Info 2002 program was used (Källestål & Wall 2002). Comparisons between groups were made using the p-value obtained from the Mann-Whitney U Test or from the Chi-Square Test. Differences were considered significant for $p < 0.05$.

Results

In the targeted 38 classes of the selected five schools, 948 pupils were registered. Forty-two of them were missing school on the day of the examination or had a non-compatible age for the study. Another 336 were excluded from the study due to the non-agreement of the parents and/or the child, or because

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Table 1 Study population distributed according to group and age (M0 denotes the children without immigration experience, M1 denotes the children born in Germany but where at least a parent was born outside Germany, and M2 denotes the children born outside of Germany).

Age\Group	Group M0	Group M1	Group M2	All
11	76	59	16	151
12	99	58	30	187
13	86	50	28	164
14	27	24	17	68
All ages	288	191	91	570
Proportion	50.5%	33.5%	16%	100%

the questionnaire had not been returned, not properly filled out or not signed. There was no distinct difference between the proportions of the excluded children among the three groups. Proportions of excluded children varied from class to class, i.e. in three classes all children were examined, and in one class no child returned the questionnaire.

Data of 570 pupils were analyzed in this study, and 49.5% of them had immigration background (Tab. 1). The average age of the 570 studied children was 12.3 years. The average age (in years) per group was 12.2, 12.2 and 12.5 for M0, M1, and M2 respectively.

With regard to ethnicity, the majority of the children from M1 had parents coming from Turkey (31.4%) or from Poland (15.2%), while for M2, most of the children were born in the former states of the USSR (33%) or in the former Yugoslav republics (17.5%).

The boy to girl ratio was 49.1% versus 50.9%. For the different groups this was: 50% vs. 50% in M0, 47.1% vs. 52.9% in M1 and 50.5% vs. 49.5% in M2.

Table 2 presents the values of the mean number of decayed, missing and filled permanent teeth of the different groups. There was no significant difference between the mean DMFT values for the same age categories of the children of M1 and M2, ($p > 0.05$ for the 11–12-year-olds as well as for the 13–14-year-olds). On the other hand, the children of M2 as well as those of M1, had significantly more caries experience compared to the children of M0 ($p < 0.05$). These differences seemed, however, to diminish with increasing age.

Table 3 shows differences in caries prevalence by gender. In most subgroups, girls had slightly higher mean DMFT values. This difference seemed to increase quite with increasing age.

Most dental caries had been treated because the DMFT index was mainly determined by filled teeth. However, children with untreated caries were found in all groups. The highest mean D-T values for permanent teeth were seen in M1. With all ages grouped together, the difference in D-T was not significant between M1 and M2 ($p > 0.05$), but significant between M2 and M0 ($p < 0.05$) and between M1 and M0 ($p < 0.05$).

At least one permanent tooth missing due to caries was observed in 6.6% of M2, in 3.1% of M1, and in 1% of M0. Because of the very low number of children with missing teeth, M-T rates were not statistically compared.

Figure 1 shows the percentage of children with a caries-free permanent dentition in each group, classified by age. The difference was not significant between M1 and M2 ($p > 0.05$), but significant between M0 and M1 ($p < 0.01$), as well as between M0 and M2 ($p < 0.01$). However, in all groups the proportion of caries-free children was decreasing with age. Interestingly, in all age categories the German children had a higher proportion of caries-free individuals compared to the other groups. Immigrant children born in Germany had generally the lowest proportion, especially the 14-year-old group, where only 16.7% of them were caries-free.

Table 2 Mean and standard deviation (SD) of D, M, F, DMFT, and maximum-DMFT scores in various subgroups (M0 denotes the children without immigration experience, M1 denotes the children born in Germany but where at least a parent was born outside of Germany, and M2 denotes the children born outside of Germany).

Group	Age	11	12	13	14	11–14
	DMFT (SD)	0.50 (1.00)	0.87 (1.41)	1.00 (1.90)	1.74 (2.12)	0.89 (1.59)
	D-T (SD)	0.08 (0.42)	0.11 (0.43)	0.12 (0.52)	0.44 (0.75)	0.14 (0.50)
M0	**M-T (SD)**	0.00 (0.00)	0.05 (0.41)	0.01 (0.11)	0.00 (0.00)	0.02 (0.25)
	F-T (SD)	0.42 (0.88)	0.71 (1.23)	0.87 (1.86)	1.30 (1.71)	0.74 (1.44)
	DMFT-Max.	4	6	10	8	10
	DMFT (SD)	1.32 (1.76)	1.21 (1.62)	2.14 (2.38)	2.46 (2.02)	1.64 (1.98)
	D-T (SD)	0.22 (0.74)	0.40 (1.08)	0.30 (0.95)	0.25 (0.53)	0.30 (0.89)
M1	**M-T (SD)**	0.02 (0.13)	0.00 (0.00)	0.20 (0.81)	0.04 (0.20)	0.06 (0.43)
	F-T (SD)	1.08 (1.52)	0.81 (1.23)	1.60 (1.88)	2.17 (1.79)	1.27 (1.63)
	DMFT-Max.	7	6	10	6	10
	DMFT (SD)	1.12 (1.54)	1.40 (1.83)	1.57 (2.04)	2.29 (2.20)	1.57 (1.93)
	D-T (SD)	0.12 (0,34)	0.30 (0.53)	0.11 (0.31)	0.47 (0.87)	0.24 (0.54)
M2	**M-T (SD)**	0.06 (0.25)	0.03 (0.18)	0.04 (0.19)	0.18 (0.39)	0.07 (0.25)
	F-T (SD)	0.94 (1.29)	1.07 (1.76)	1.43 (1.99)	1.65 (1.77)	1.26 (1.76)
	DMFT-Max.	4	7	8	7	8

Table 3 Mean and standard deviation (SD) of the DMFT in boys and girls (M0 denotes the children without immigration experience, M1 denotes the children born in Germany but where at least a parent was born outside of Germany, and M2 denotes the children born outside of Germany).

	Age	11	12	13	14	11–14
M0	DMFT boys(SD)	0.47 (0.94)	0.94 (1.35)	0.78 (1.56)	1.58 (1.62)	0.83 (1.38)
	DMFT girls (SD)	0.52 (1.06)	0.80 (1.49)	1.25 (2.23)	1.87 (2.50)	0.96 (1.79)
M1	DMFT boys(SD)	1.5 (1.84)	1.05 (1.73)	2.17 (2.35)	2.27 (1.87)	1.74 (2.03)
	DMFT girls (SD)	1.18 (1.70)	1.29 (1.58)	2.09 (2.47)	2.78 (2.33)	1.55 (1.94)
M2	DMFT boys(SD)	0.62 (1.06)	1.47 (2.15)	0.86 (1.41)	1.43 (2.23)	1.13 (1.78)
	DMFT girls (SD)	1.62 (1.85)	1.31 (1.38)	2.29 (2.37)	2.90 (2.08)	2.02 (1.99)

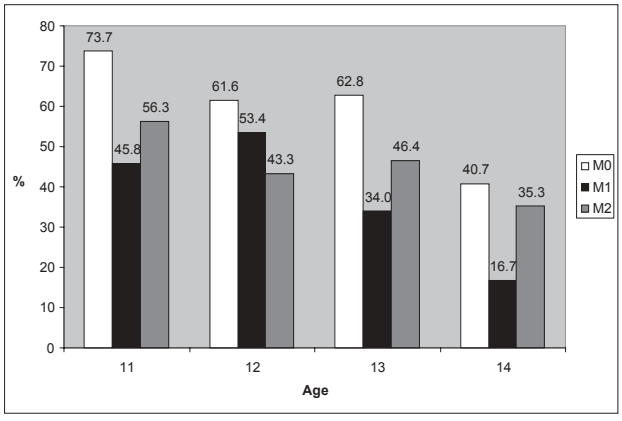

Figure 1 Distribution of the proportion of caries-free children in each group and age category (M0 denotes the children without immigration experience, M1 denotes the children born in Germany but where at least a parent was born outside Germany, and M2 denotes the children born outside Germany).

Discussion

Evaluating the results of the present study, the effect of non-participation, which occured in nearly all similar studies, should certainly be taken into account. There are good reasons to assume that oral health of non-participating children is often less favourable than that of the whole group. Since the proportions of non-participation in the three groups in our study seemed to be similar, we assume that differences in the results between the groups would have been close to those obtained in the study.

Our results show that immigration experience of children is associated with dental health. In fact, caries prevalence in immigrant children was higher compared to the German children living in the same underprivileged areas of Heidelberg, and this applies to all examined age categories (11 to 14 years). Those findings are in agreement with those of other respective studies performed in Germany (Önal 1992; Geiger & Künzel 1995; Van Steenkiste 2002; Kühnisch et al. 2003). Nevertheless, these differences in caries prevalence would have been even higher if caries prevalence of the immigrant children were compared to that of German children coming from all social classes.

Poorer oral health in immigrant children was also observed in other western countries, (Todd & Gelbier 1991; Kalsbeek et al. 1996; Sundby & Petersen 2003). However, some few studies reported that children of some specific immigrant ethnic groups had a lower caries experience compared to native children (Bedi 1991; Declerck et al. 1992).

The present study shows that the differences in caries prevalence between German and immigrant children decreased with increasing age. In the oldest children, the 14-year-olds, the DMFT scores and the percentage of caries-free individuals between natives and immigrants were much closer. In fact, most studies reported similar findings. Some authors from other countries even observed that older immigrant children had sometimes better dental status compared to that of the native children (Heidmann & Christensen 1985; Laher 1990; Kalsbeek et al. 1996; Wang 1996; Sundby & Petersen 2003). It can be hypothesized that the older children are more mature and generally more familiarised with the new language and therefore adopt easier the dental health habits of the German population. In contrast to the younger children, their dental health is distinctly less related to the health habits of the parents, who generally still have language problems, and are generally still living a more traditional life. Also the less cariogenic food consumed in the countries of origin and still frequently used by the immigrant families can beget that, with adequate oral health hygiene, these individuals can have a better oral health status compared to that of the native population of the host industrial country.

In fact, Önal (1992) found that Turkish children with low socio-economic status living in Turkey had much lower DMFT values compared to Turkish children living in Germany or to German children. The deterioration in oral health after immigration was the result of the shift to the western meals and dietary habits but without improving the oral hygiene.

The differences between the oral health of immigrant children born in Germany and those born outside of this country were not significant although, the latter had slightly less caries. An

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explanation for this was presented by Marino et al. (2001) who studied the impact of acculturation on the dental health of Vietnamese immigrants living in Australia. The authors observed that immigrants with a lower acculturation level tend to have a less favourable oral health compared to those with a higher acculturation level. Ismail and Szpunar (1990), as well as Cruz et al. (2004), found similar results when studying the impact of acculturation on the oral health of Mexican and Haitian immigrants in the USA. In our present case, we can assume that Turkish families (mainly represented in Group M1) have generally a lower acculturation level compared to Russian families (mainly represented in Group M2) who have generally an initial life style similar to that of the Germans. Acculturation level, dietary habits, oral hygiene and oral health status in the country of origin have certainly an important impact on caries prevalence rates in the host country. In fact, differences in caries prevalence by different ethnic groups of immigrants have been reported by many authors in several countries (Durward & Wright 1989; Todd & Gelbier 1991; Angelillo et al. 1996; Sundby & Petersen 2003).

The higher rate of children with extracted teeth found in immigrant children born outside of Germany (Group M2) may be the result of financial problems, ignorance of dental health, irregular dental check-up visits, lower qualification of dentists, and lack of pedodontists in the native countries which may force parents and dentists to opt more often for an extraction.

The present study also supports findings that, in general, girls exhibit less favourable oral health compared to boys of the same age. This could be related to the earlier teeth exchange by girls. Nevertheless, the fact that these differences are so distinct in Group M2, especially in the 13- and 14-year-old girls, is difficult to explain. Anyway, Källestål and Wall (2002) observed also such big differences in caries prevalence between genders among immigrant children in Sweden.

We can conclude from the study results that immigration background still has a negative impact on oral health of children in Germany. Thus, there is a need to develop effective and appropriate public health policies and community-based oral health care programmes focusing to improve the oral health behaviour and attitudes of immigrant parents and children. Close collaboration with key persons in societies of ethnic minority, organisation of dental health education meetings, and distribution of educational materials offered in the languages of these minorities are therefore very important basic steps. Preventive concrete programmes comprising i.e. the application of fluorides, the widespread use of fissure sealants must be also offered in parallel for these children. To date, such programmes have only been established in few European places (Ekman & Persson 1990; Petersen 1996; Van Steenkiste & Brestel-von Haussen 1999). Such essential programmes must be developed and expanded to include all ethnic minorities, and must be applied in all socially disadvantaged regions and areas holding an important number of immigrants.

Prospective studies with a longitudinal design, e.g. that performed in the Netherlands (Kalsbeek et al. 1996) must also be planned in Germany to follow the changes in caries prevalence in immigrant children, and to evaluate and improve the existing oral health preventive programmes.

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Address for correspondance

Dr. Abdul-Razak Bissar
Poliklinik für Zahnerhaltungskunde am Universitätsklinikum Heidelberg
Im Neuenheimer Feld 400
D-69120 Heidelberg
Germany
Tel.: +49 6221 56 36008
Fax: +49 6221 56 5074
e-mail: abissar@hotmail.com