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# Caries decline in the primary dentition of Belgian children over 15 years

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Abstract – *Objectives:* (1) To investigate changes in caries prevalence in the primary dentition of children resident in Brussels, Belgium between 1983 and 1998, (2) to analyse associations between changes in caries and children's socioeconomic and ethnic aspects. *Methods:* In the Brussels region, children in the first grade at the same schools were sampled in cohort 1983 ($n = 396$) and cohort 1998 ($n = 473$). Caries experience of Belgian and non-Belgian nationals was summarized in dmf scores. The socioeconomic status of the children was established based on their parents' education and profession. The children were categorized in eight subgroups in relation to their socioeconomic status, ethnic origin and cohort (SESEC subgroups). *Results:* The percentage of caries-free children increased significantly from 31.5% to 47.5%. A reduction was observed in the dmft scores from 3.9 to 2.3 ($P < 0.001$) and in the dmfs scores from 6.9 to 5.0 ($P < 0.001$). The odds ratio of being caries-free was 2.5 times higher for privileged children and 2.3 times higher for children belonging to cohort 1998. The ANCOVA analyses revealed that most of the SESEC subgroups showed significant reduction in dmft scores from 1983 to 1998 ($P < 0.003$). *Conclusions:* Children resident in Brussels showed caries decline in their primary dentition over 15 years. Diversity in caries decline was associated with children's socioeconomic status and ethnic origin.

Key words: dental caries; epidemiology; ethnic origin; primary dentition; socioeconomic status

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Very little is known about changes in caries prevalence in the primary dentition of Belgian children. Such information at national level has never been collected and, to date, only one study, carried out in the municipality of Liège, Belgium, has provided estimates (1). In this study, 7-year-old children showed reduction in caries prevalence of 42% between 1967 (dmft = 7.1) and 1983 (dmft = 4.1). Since that study, there has been no new data regarding changes in caries prevalence in the primary dentition of Belgian children.

In contrast, trends in caries experience in the primary dentition are well documented in other industrialized countries (2–7). Epidemiological surveys have shown that the prevalence of dental caries was higher in children from less favourable socioeconomic backgrounds and from ethnic minority groups than in the general population (8, 9). In addition, it has been speculated that, in the last decade, caries experience in the primary dentition has ceased to decline (2, 3, 8).

In Belgium, there is no public-funded preventive programme for children and they have access to private dental care only. There is a public subsidization of dental care, in the form of partial reimbursement of certain expenses (10). The supplied water has low levels of fluoride in most of the municipalities (11) and fluoridated toothpaste is regularly used (10).

According to the National Institute of Statistics, there has been significant migration to the Brussels region in recent decades with the result that, since the late 1980s, some 30% of the child population are non-Belgian nationals (12). The Brussels region consequently provides, for research purposes, one of the largest and ethnically most diverse

populations of children in Europe, with a wide range of socioeconomic backgrounds.

In a previous study we documented caries decline in Belgian 12-year-old children and its association with factors related to home-based and professional oral health care (10). Further investigation compared caries reduction in the same group of children according to their socioeconomic status. With the intention of gathering information about changes in caries prevalence in the primary dentition of children resident in Brussels, Belgium, the present survey compared children's caries experience in 1983 and 1998. Possible associations between changes in caries and children's socioeconomic and ethnic aspects were analysed.

## Materials and methods

### *Cohorts*

The study took place in the Brussels region, which is made up of 19 boroughs. A population of 11 400 children attended the first grade in 256 primary schools (12). The two cohorts were selected from children taking part in the obligatory medical check-up at the University School Health Centre in Brussels. This centre is responsible for carrying out medical check-ups on children from 48 primary schools from 11 boroughs. Children from 19 randomly selected schools, who came for the medical check-up in 1983, were examined for caries ($n = 396$). Children from the same schools were examined in 1998 ($n = 473$). Non-Belgian children represented 47% of the 6-year-old population in 1983 and 31% in 1998 in Brussels (12). The corresponding values for the cohorts were 37% and 30%, respectively.

### *Data collection*

Cohort 1983 was examined by one examiner (J.P.V.N.) and duplicate records for caries assessment were made in 10% of the sample. Two examiners (J.C.C. and J.P.V.N.) carried out the examination in cohort 1998. The examiners were calibrated and duplicate records were made of 10% of the sample with an interval of at least 4 h between the examinations. In cohort 1983, the intra-examiner reliability showed a kappa coefficient of agreement of 0.92 (13). In cohort 1998, the inter-examiner reliability showed a kappa of 0.93 and the corresponding values for intra-examiner were 0.94 (J.P.V.N.) and 0.96 (J.C.C.). The children had their teeth cleaned and dried with gauze compress in cohort 1983. The children's teeth were professionally brushed, flossed, and dried with gauze compress in cohort 1998. These procedures were carried out by the examiners before the clinical examination for caries.

Dental caries in the primary dentition was visually diagnosed using a plane mouth mirror. A dental probe was employed to identify whether cavitated lesions were soft or hard. Bitewing radiographs were not taken, following a recommendation by the ethical committee from the University of Louvain. Dental caries was assessed according to Møller and Poulsen (14) and summarized in dmft/dmfs index. Thus, a surface was classified as sound when it showed normal enamel translucency without any previous or present signs of caries. A surface was defined as carious when it showed: (i) a lesion with discontinuity in the enamel and loss of substance without dentine involvement, (ii) a lesion as a definite cavity with dentine involvement, (iii) a lesion with probable pulp complication. In the case of missing teeth/surfaces, only those due to caries were included. Such inclusion was based on the criterion that in young individuals the type of missing tooth indicates the reason for extraction. Dental caries treated by fillings was recorded as such when the presence of a permanent filling was identified on one or more surfaces without the presence of any caries (14). Additionally, in 1998, a surface showing an opaque area with a dull-whitish surface was recorded as a noncavitated active lesion (15). The results of the clinical examination were recorded by dental students in the child's file. The data were computerized from written record forms.

The socioeconomic status of the children was determined according to their parents' education and profession (16). When both parents were working, the socioeconomic status was based on the parent with the higher status. The parents' education and profession were described in the following categories: (i) without profession or with no established profession, (ii) unskilled manual workers, (iii) farm workers, (iv) shopkeepers and office employees, (v) middle or senior executives and managers, (vi) teaching staff and (vii) professionals. This classification was used in cohort 1983 (13) and it was observed that the children whose parents belonged to categories (i) to (iv) did not differ significantly in caries prevalence and they could be categorized as one group of 'nonprivileged children'. Similarly, the children whose parents belonged to categories (v) to (vii) did not

differ significantly in caries prevalence and could be grouped as 'privileged children'. The same criteria were applied in cohort 1998.

The children's ethnic origin was determined as follows: (i) Belgian children were born in Belgium and had at least one Belgian parent and (ii) non-Belgian children were children of immigrant parents mainly from Italy, Spain, Portugal, the Republic of Congo, Morocco, and Turkey.

The children were categorized in eight subgroups according to their SESEC. The SESEC subgroups were described as follows: (i) Belgian nonprivileged 1983 ($n = 67$), (ii) Belgian nonprivileged 1998 ($n = 168$), (iii) Belgian privileged 1983 ($n = 183$), (iv) Belgian privileged 1998 ($n = 163$), (v) non-Belgian nonprivileged 1983 ($n = 99$), (vi) non-Belgian nonprivileged 1998 ($n = 121$), (vii) non-Belgian privileged 1983 ($n = 47$), (viii) non-Belgian privileged 1998 ($n = 21$).

### *Statistical analysis*

The reproducibility of clinical scores for caries was assessed using Kappa coeffiecient. The Wilcoxon–Mann–Whitney test for two independent samples was used to examine the statistical significance of differences between means (17). Multiple logistic regression was used with binary response caries-free or carious and taking into account the following variables: age, gender, socioeconomic status, nationality and cohort. The level of statistical significance was set at 0.05. Subsequently, models of analyses of covariance (ANCOVA) tested the significance of differences in mean dmf scores in each SESEC subgroup adjusting for age and gender. As some of the subgroups had a limited number of subjects, the Bonferroni correction was made to adjust the multiple comparisons (18). For the ANCOVA analyses, only $P$-values $\leq 0.003$ were considered significant. The data were analysed using the statistical analysis system (SAS) software.

## Results

The initial analyses were made for the total sample. This analysis was followed by a more detailed analysis taking into account the SESEC subgroups.

### *Total sample*

In cohort 1983, the percentages of boys and girls were 43% and 57%, respectively ($P > 0.10$). The corresponding values in cohort 1998 were 48% and 52% ($P > 0.10$). No significant differences were observed between boys and girls in the mean dmf scores. Therefore, the data concerning boys and girls are presented together. In both cohorts, two-thirds of the children were aged 6 years and one-third 7 years. Nonprivileged children represented 42% of the sample in 1983, increasing to 61% in 1998. Non-Belgian nationals corresponded to 37% of the sample in cohort 1983 and 30% in cohort 1998.

The percentage of caries-free children resident in Brussels increased significantly from 31.5% in 1983 to 47.5% in 1998 ($P = 0.0001$). A reduction of the mean dmft from 3.93 to 2.39 and dmfs from 6.98 to 5.08 was recorded during the study period. The inclusion of noncavitated lesions in cohort 1998 enhanced the dmf scores considerably (Table 1).

The decayed component accounted for the majority of the recorded caries experience in 1983 (80%) and in 1998 (71%). The decrease in the mean number of the decayed surfaces was from 5.62 in cohort 1983 to 3.60 in cohort 1998 ($P < 0.0001$). The mean number of filled surfaces was 1.35 in cohort 1983 and 1.14 in cohort 1998 ($P = 0.30$). Caries experience in occlusal and proximal surfaces, in contrast to smooth surfaces, was reduced significantly during the study period (Table 1).

In both cohorts, a significantly higher percentage of privileged children were caries-free in their primary dentition when compared with their nonprivileged counterparts ($P = 0.001$). The same pat-

Table 1. Percentage distribution of caries-free children resident in Brussels in cohort 1983 and cohort 1998. Mean dmft and dmfs scores (SE) according to different surfaces

| | Cohort 1983 ($n = 396$) | Cohort 1998 ($n = 473$) | $P$-value | Cohort 1998[a] ($n = 473$) |
|---|---|---|---|---|
| Caries-free | 31.50% | 47.50% | 0.0010 | 34.80% |
| dmft (SE) | 3.93 (0.18) | 2.39 (0.14) | 0.0001 | 3.35 (0.16) |
| dmfs (SE) | 6.98 (0.43) | 5.08 (0.35) | 0.0007 | 6.40 (0.39) |
| Occlusal surface | 2.75 (0.13) | 1.74 (0.10) | 0.0001 | |
| Proximal surface | 2.71 (0.20) | 2.16 (0.15) | 0.0324 | |
| Smooth surface | 1.52 (0.14) | 1.18 (0.11) | 0.0670 | |

SE, standard error of the mean.
[a]Noncavitated active lesions are included.

Table 2. Percentage distribution of caries-free children resident in Brussels according to cohort, socioeconomic status and nationality

| | Privileged children | | | Nonprivileged children | | |
|---|---|---|---|---|---|---|
| | Cohort 1983 ($n$ = 230) | Cohort 1998 ($n$ = 184) | $P$-value (row) | Cohort 1983 ($n$ = 166) | Cohort 1998 ($n$ = 289) | $P$-value (row) |
| Belgian | 31.70% | 62.50% | 0.0001 | 13.20% | 25.20% | 0.0024 |
| Non-Belgian | 6.52% | 5.43% | 0.6445 | 8.43% | 8.99% | 0.8383 |
| $P$-value (column) | 0.3170 | 0.0350 | | 0.0040 | 0.0010 | |

tern was observed in relation to children's nationality; a higher percentage of Belgian caries-free children was found compared with non-Belgian children ($P = 0.0001$). Differences in dmft and dmfs scores between 1983 and 1998 were detected for both nonprivileged and privileged children ($P < 0.001$). Similar differences were seen in the dmft scores of non-Belgian ($P < 0.010$) and Belgian nationals ($P < 0.001$). However, significant difference in dmfs scores was only found for Belgian children ($P < 0.001$).

### *Subgroups of children according to socioeconomic status, ethnic origin and cohort*

The percentages of caries-free children within the SESEC subgroups (from (i) to (viii)) were compared. Non-Belgian children were less likely to be caries-free than Belgian children in both cohorts and groups of socioeconomic status ($P < 0.05$) (Table 2). In the subgroup of privileged children in cohort 1983, the percentage of caries-free Belgian children did not differ significantly from that of non-Belgian ($P = 0.317$). A significant increase in the percentage of caries-free children between 1983 and 1998 was observed only in Belgian children (Table 2).

Table 3 illustrates the results of the multiple logistic regression analysis. The cohort, the ethnic origin, the socioeconomic status and the gender were significantly associated with the condition of being caries-free ($P \leq 0.02$). Interactions between ethnic origin and socioeconomic status together with ethnic origin and cohort were not significant ($P > 0.50$). Privileged children were 2.5 times more likely to be caries-free in their primary dentition in comparison with nonprivileged children. Children belonging to cohort 1998 were 2.3 times as likely to be caries free than children in cohort 1983.

Table 4 shows caries experience within SESEC subgroups. Marked reduction in dmft scores between cohort 1983 and 1998 was observed for subgroups of privileged and nonprivileged children ($P \leq 0.003$), with the exception of non-Belgian privileged children. In both cohorts, no significant difference ($P \leq 0.003$) was recorded between the subgroups of privileged Belgian and non-Belgian children. When dmfs scores were analysed, significant decline in caries prevalence between cohort 1983 and cohort 1998 was only identified in the Belgian privileged subgroup ($P \leq 0.003$).

Table 3. Multiple logistic regression analysis for caries-free children resident in Brussels

| Variables | Odds ratio | 95% confidence intervals | $P$-value |
|---|---|---|---|
| Age (years) | | | |
| 7 | 0.75 | 0.53–1.04 | 0.0863 |
| 6 | 1.00 | | |
| Gender | | | |
| Boys | 1.00 | 1.04–1.87 | 0.0244 |
| Girls | 1.40 | | |
| Socioeconomic status | | | |
| Nonprivileged | 1.00 | 1.81–3.43 | 0.0001 |
| Privileged | 2.49 | | |
| Nationality | | | |
| Non-Belgian | 0.42 | 0.30–0.60 | 0.0001 |
| Belgian | 1.00 | | |
| Cohort | | | |
| 1983 | 1.00 | 1.69–3.16 | 0.0001 |
| 1998 | 2.30 | | |

−2 log likelihood for covariates = 117.90 ($P = 0.0001$; 5 d.f.).
−2 log likelihood no variable = 1170.01.

## Discussion

The analyses comparing the total sample in cohort 1983 and cohort 1998 revealed that there were improvements in dental health in the primary dentition of children resident in Brussels during the 15-year-period. This was demonstrated by an increase of 51% in the percentage of caries-free children, as well as a decrease of 39% in caries experience measured by teeth and 27% measured by tooth surfaces. A better improvement was registered in the permanent dentition of Belgian

Table 4. Analysis of covariance of mean dmf scores and standard error of the mean (SE) in relation to cohort, socioeconomic status and nationality

| | Privileged children | | | Nonprivileged children | | |
|---|---|---|---|---|---|---|
| | Cohort 1983 | Cohort 1998 | *P*-value (row) | Cohort 1983 | Cohort 1998 | *P*-value (row) |
| dmft (SE) | | | | | | |
| Belgian | 2. 87 (0.22) | 0.82 (0.13) | 0.0001 | 4.07 (0.47)$^{0.0081}$* | 2.63 (0.25)$^{0.0001}$* | 0.0021 |
| Non-Belgian | 4.02 (0.52) | 2.57 (0.85) | 0.0888 | 5.74 (0.38)$^{0.0026}$* | 4.15 (0.32)$^{0.0380}$* | 0.0003 |
| *P*-value (column) | 0.0273 | 0.0195 | | 0.0012 | 0.0001 | |
| dmfs (SE) | | | | | | |
| Belgian | 4.56 (0.46) | 1.47 (0.27) | 0.0003 | 7.56 (1.11)$^{0.0061}$* | 5.20 (0.55)$^{0.0001}$* | 0.0384 |
| Non-Belgian | 7.76 (1.18) | 5.90 (2.19) | 0.3656 | 10.67 (1.06)$^{0.0311}$* | 9.61 (0.86)$^{0.0414}$* | 0.3110 |
| Column *P*-value (column) | 0.0099 | 0.0123 | | 0.0100 | 0.0001 | |

*P*-value (row): comparison between cohort 1983 and cohort 1998.
*P*-value (column): comparison between Belgian and non-Belgian within cohort of the year in question.
*Difference between privileged and nonprivileged children within cohort of the year in question.

12-year-old during the same period (10) with 78% of reduction in caries prevalence. However, it is important to note that in the present study the percentage of caries-free children observed in cohort 1998 (47.5%) is much lower than that recorded in other developed countries in the mid-1980s (2, 3, 8, 19, 20). Such countries, with low caries prevalence, claimed a levelling out of children's caries experience in the primary dentition in the 1980s (2, 3, 8, 19, 20) in contrast with our data, which present a moderate caries prevalence in the late 1990s (dmft = 2.39). It has been suggested that caries prevalence in the primary dentition tends to stabilize with dmft scores 1.3–1.6 and 60% of caries-free children (5). However, further improvements in dental health have been reported in some countries (2, 3, 6, 8, 19, 20).

In cohort 1983 and cohort 1998 nonprivileged children as well as non-Belgian children were well represented. The influence of socioeconomic status in dental health has been broadly recognized in the literature (4, 8, 13, 19, 21–24) and recently it was documented in Belgian 12-year olds (11).

Some studies have also revealed differences in dental health among national and non-national parts of the population (13, 19, 21–22). Furthermore, a disproportionate amount of dental caries has been found in children from low-income households and ethnic minority groups (2, 9, 22–24). In our study, we addressed these issues by categorizing the children in subgroups according to their socioeconomic status and ethnic origin. This categorization allowed an analysis of changes in caries taking into consideration at the same time children's socioeconomic and ethnic aspects. As some of the subgroups had limited number of subjects, the Bonferroni correction was used to adjust the multiple comparisons (18). The limited number of subjects in some subgroups constitutes a limitation of the present study. A more detailed analysis of SESEC subgroups showed that any significant improvement in the percentage of caries-free children was associated with Belgian children, and that the contribution of Belgian nonprivileged children was much lower than that of their Belgian privileged peers (Table 2). The logistic regression revealed that privileged children were 2.5 times more likely to be caries-free in comparison with nonprivileged ones whose reference odds were 1.0. Non-Belgian nationals were found to influence the odds of a child being caries-free (Table 3).

Significant reduction in caries prevalence was observed between 1983 and 1998 in SESEC subgroups as measured as dmft scores. Yet, considerable variation in caries changes within SESEC subgroups was identified, ranging from moderate to high caries prevalence as illustrated in Table 4. Reduction in caries prevalence as measured by dmfs scores was only significant for Belgian privileged children. It should be borne in mind that the subgroups of privileged children were not only more likely to be caries-free than the subgroups of nonprivileged children, they also had lower dmfs scores.

In conclusion, children resident in Brussels showed caries decline in their primary dentition over 15 years. Diversity in caries decline was associated with children's socioeconomic status and ethnic origin. If further improvement in oral health of children resident in Brussels, Belgium is to be achieved the main question to address is the

provision of effective dental care in the framework of the private health care system in the country.

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