Change in Caries Prevalence after Implementation of a Fluoride Varnish Program

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Abstract

Objective: *In 1996 the caries prevalence of schoolchildren living in Neukölln, a district of Berlin, Germany, was higher than the mean of total Berlin. Hence, a special preventive program including the application of fluoride varnish was initiated. All 49 primary schools of the district joined the project. The aim of the present study was to evaluate in a cross-sectional study whether the preventive program resulted in a reduced caries prevalence.* ***Methods:*** *The complete program included oral health education as well as the application of a highly concentrated fluoride varnish (Duraphat®). All children whose parents' consent was given could receive fluoride varnish twice a year. All children were examined once a year by four calibrated dentists. The baseline examination was conducted in 1995–96, the final examination in 1999–2000 (1995–96:* n=*7,748; 1996–97:* n=*15,673; 1997–98:* n=*19,362; 1998–99:* n=*19,822; 1999–2000:* n=*17,984).* ***Results:*** *A total of 80,589 dental records were used for data analysis. A decline of DMFT-values was observed in all age groups and school years. The major improvement was found in school year 1999–2000, when the program had been established for four years.* ***Conclusion:*** *The described program may be an effective public health measure for 6- to 12-year-old children with high caries prevalence. [J Public Health Dent 2004;64(2):96-100]*

Key Words: dental caries, prevention, fluoride varnishes, underprivileged groups, migrants.

Since 1990, a group prevention program has covered all districts of the city of Berlin (1). This program is based on legislation and consists of periodic group examinations, toothbrushing training, as well as oral health education for all children from the kindergarten level up to the end of primary school. In Berlin, the primary school includes the preschool as well as grades 1 to 6.

When compared to the average of the entire city of Berlin, the children in Berlin's Neukölln district showed a higher caries level. In the school year 1994–95 the mean DMFT for 12-year-old-children in Berlin was 2.6 (2), while it was 2.82 in Berlin-Neukölln. Since it was shown to be very difficult to move high caries risk children to special individualized prevention services in a dental office, it became necessary to establish a special program for those children within the framework of group prevention in schools (3).

To reach the regional WHO goals (4) for the year 2000 (DMFT≤2), the oral health situation of the district should be improved very quickly with efficient and practicable methods for the use in schools. It is well known that dental health is strongly associated with socioeconomic status (5,6). Therefore, the preventive method should deal with all aspects of the multicultural and underprivileged situation of the area. Beyond this, the results of a questionnaire (7) showed that the schools would not spare any more time for caries prevention.

As the beneficial effects of topical fluoride application are well documented (8-15), the decision to expand the existing program of health education by the use of the fluoride varnish Duraphat®, containing 22,600 ppm as sodium fluoride, was taken. The application of fluoride varnish twice a year was planned to be offered to all children supplementary to the existing group prevention. The goal of this study was to show the effects of group prevention expanded to include two annual applications of Duraphat® during four years.

Methods

In 1996, Berlin-Neukölln had a population of nearly 314,000 (16). At that time, the proportion of migrant people was 19 percent, increasing to 21 percent in 1998. Of the population of Berlin-Neukölln, 13.5 percent were living on social welfare.

Since 1990, all children of the primary schools have undergone an annual examination. Additionally, oral health education—including toothbrushing training and nutritional advice—took place three to four times per year. The DMFT scores were recorded by four dentists mostly in classrooms in the schools, but also in dental chairs in the consulting rooms of the Public Dental Health Services, using bright natural light, surface-coated dental mirrors (No. 5, Hu Friedy, Leimen, Germany) and probes (Aesculap DA 402, Aesculap, Tuttlingen, Germany). Besides the DMFT, the presence of fissure sealants was recorded. Since 1994, personal computers have been used to record the data from the annual group examinations. In the school year 1996–97, the preventive program was expanded to include the application of fluoride varnish.

All involved examiners were calibrated according to the guidelines for epidemiologic studies in Germany. The examiners took part in a training course that not only included instruction in theory, but also practical tests

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of the reproducibility of their diagnoses (2,17-19).

In autumn 1996, the already existing preventive program was expanded to include biannual applications of fluoride varnish (Duraphat®, Colgate Hamburg, Germany). Initially, the project started with the preschool children and grades 1 to 3. In autumn 1997, the project was expanded to include grades 4 to 6. All 49 primary schools in the district—a total of 18,600 children—participated.

The fluoride varnish was applied using wooden spatulas wrapped with cotton to dry the oral cavity. Syringes with blunt needles were used for the fluoride varnish applications. The fluoride was always applied after the health education lectures and toothbrushing training. The complete program took one hour.

One of the main goals was to reach all children equally. The objectives of the program were presented to all principals and teachers, as well as to the parents' councils of the schools before any steps were taken. Although Berlin law does not require parental consent for examinations of schoolchildren, it is absolutely necessary for fluoride applications. Therefore, declarations of consent as well as leaflets were used, including Turkish, Polish, and Arabic versions to accommodate non-German-speaking parents.

DMFT scores were recorded each school year. The examinations were performed by four calibrated dentists (2,17-19). Data recording and calculation were done by electronic data processing with the German Software JZP (G.A.U.S.S. GmbH, Göttingen) (19,20).

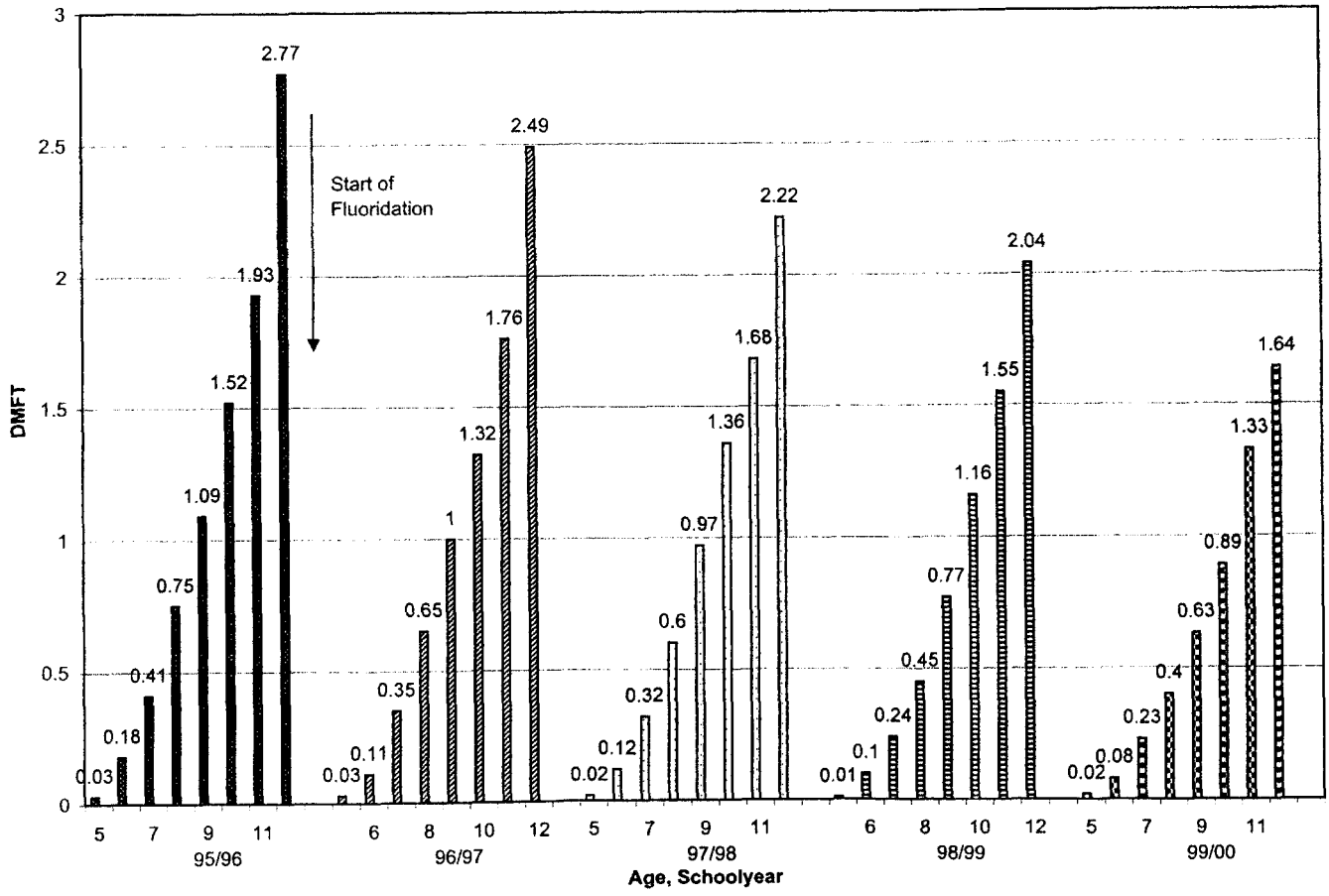
A postal questionnaire (21) was designed and given to the principals of the 49 schools. The baseline examinations took place in the school year 1995–96 and the final examination was conducted in 1999–2000. Three additional recordings were performed between baseline and final examination on a yearly basis.

Results

A total of 80,589 examinations were performed during a four-year period (1995–96: n=7,748; 1996–97: n=15,673; 1997–98: n=19,362; 1998–99: n=19,822; 1999–2000: n=17,984). Acceptance of the fluoride program as measured by parental consent was 80 percent. The mean value in the downtown area with the highest caries prevalence reached 90 percent, while the acceptance in the rest of the district was 65–70 percent; 97–100 percent of the children participated in the basic group prevention, while 64–83 percent attended the fluoride part of the project. In the 1998–99 questionnaire, 93 percent of the principals stated that they valued the project and 90 percent of them stated they would promote further steps and developments.

An overview of all data of all age groups who participated in the program is given in Figure 1. The most remarkable improvement can be seen in the data for the school year

FIGURE 1
DMFT of 5-, 6-, 7-, 8-, 9-, 10-, 11-, and 12-year-olds During School Years 1995–96 to 1999–2000 (1995–96: n=7,748; 1996–97: n=15,673; 1997–98: n=19,362; 1998–99: n=19,822; 1999–2000: n=17,984)



1999–2000. The mean DMFT of the 12-year-olds decreased continuously from 2.77 to 1.64. The total caries inhibition was 40.7 percent. The decrease of the mean DMFT of the 9-year-olds was 42 percent (from 1.09 in 1995–96 to 0.63 in 1999–2000).

The decrease of the mean DMFT values can be seen in all school years and in all age groups, as well as in all cultural backgrounds. As an example, Table 1 shows the decrease among 7-year-olds with different cultural backgrounds. The decrease was lower in the Polish children than in children of other nationalities.

The caries decline can also be seen in 12-year-olds (Table 2) in all cultural groups. The percentage of 12-year-olds with DMFT=0 increased from 23 percent to 46 percent (Table 3). Furthermore, a decline in the proportion of children with high caries prevalence was found: for example, in 7-year-olds (dmft/DMFT>5 or DT>0) from 38 percent to 26 percent and in the 9-year-olds (dmft/DMFT>7 or DT>2 from 18 percent to 8 percent.

To give an impression of other prevention programs in the district that might have had an influence on the success of the project, we counted the number of children with at least one fissure sealant. In school year 1999–2000, the percentage of 12-year-old children (n=1,804) with at least one sealant was below 9 percent.

At the time of this study, the city of Berlin consisted of 23 districts. While these are not homogeneous with regard to social structure, the system of oral health education is the same in all Berlin districts. For each district, social indexes are calculated routinely (22). Schöneberg and Neukölln are nearly at the same level. Therefore, Schöneberg can be regarded as a negative control to Neukölln when discussing the effects of fluoride varnish applications. The proportion of children who were caries free in Neukölln was higher than in Schöneberg (Figure 2). The data were taken from a social report for Berlin and represent all schoolchildren (23). Unfortunately, this report gives no DMFT data.

TABLE 1
Mean DMFT of 7-year-olds in Berlin/Neukölln in 3 School Years, by Nationality

	1997–98		1998–99		1999–2000	
Nationality	n	DMFT	n	DMFT	n	DMFT
German	1,441	0.20	1,468	0.17	1,516	0.14
Turkish	385	0.43	405	0.37	399	0.35
Arabic	56	0.46	66	0.44	50	0.16
Polish	83	0.61	91	0.45	78	0.42
Others	61	0.46	76	0.36	86	0.24
Total Neukölln	2,716	0.32	2,672	0.24	2,455	0.23

TABLE 2
Mean DMFT of 12-year-olds in Berlin-Neukölln in 3 School Years, by Nationality

	1997–98		1998–99		1999–2000	
Nationality	n	DMFT	n	DMFT	n	DMFT
German	379	2.24	557	1.95	1,143	1.26
Turkish	215	3.03	244	2.81	309	2.23
Arabic	34	3.38	19	2.58	53	3.02
Polish	53	3.25	58	3.34	66	2.83
Others	35	2.97	35	2.71	37	2.62
Total Neukölln	2,060	2.22	1,804	2.04	1,804	1.64

Discussion

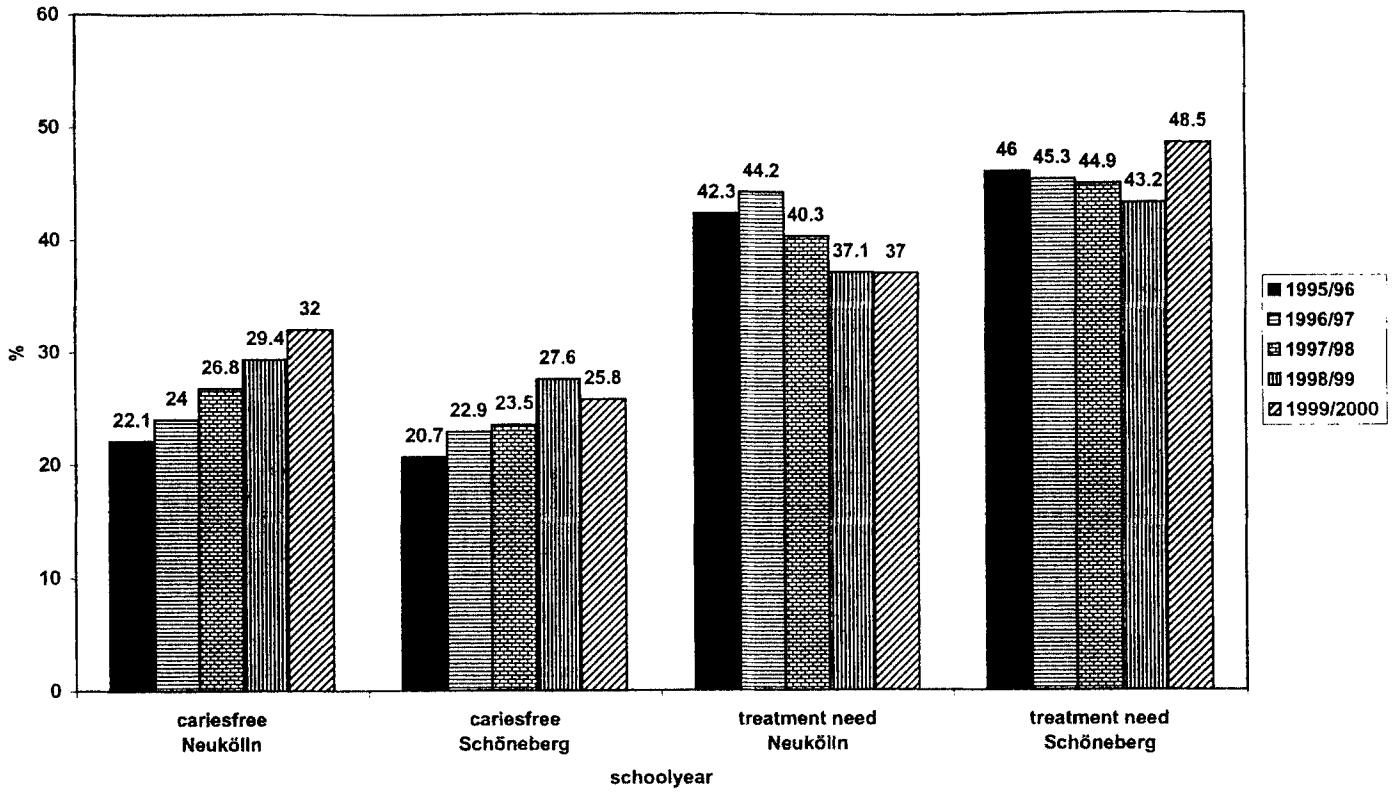
In the present study, the DMFT of all age groups decreased continuously by more than 40 percent within four years after starting the project. In sum, the evaluated preventive program may be considered successful. The computer program used for data calculation in the dental public health service can only provide a descriptive statistical analysis. Therefore, standard deviations and confidence intervals are not available, nor was it possible to perform statistical testing. However, considering the large number of subjects examined, prevalence differences shown in Figure 1 probably are statistically significant.

Another goal of the project was to reach all children and thus to avoid social inequities. For this reason a test group was not established at the start of the project. The software used in the German public health services is not designed to produce longitudinal data, only cross-sectional data. Therefore, it was possible only to determine the cohort of children who received fluoride varnish in the respective year. It could not be ascertained whether the individuals of this cohort underwent the fluoride application in the year before or after. Thus, children who never received fluoride varnish could not be distinguished from those who received it consistently from the start

TABLE 3
Percent Distributions of DMFT of 12-year-olds in 1995–96 and 1999–2000

Score	% in 1995–96	% in 1999–2000
0	23.30	46.40
1	10.24	13.64
2	15.02	11.59
3	12.46	10.03
4	19.62	8.98
5	6.66	3.27
6	3.58	2.49
7	1.71	1.44
8	1.88	1.27
9	1.54	0.28
10	0.85	0.33
11	0.17	0.06
12	0.34	0
13	0	0.06
14	0.17	0.06
15	0.34	0.06
16	0	0
17	0	0.06
18	0.17	0

FIGURE 2
Comparison Between Two Districts of Berlin (Average of All Schoolchildren)



until 1999–2000. Possibly this fact led to some underestimation of the fluoride effect.

On the other hand, the caries decline found in this study cannot be ascribed to the fluoride varnish program alone. In the early 1990s, the health insurance companies introduced several individualized preventive measures, such as fluoride application, motivation in proper oral hygiene, and fissure sealants. These measures, which are offered in dental offices, may have contributed to the caries decline found in this study. Since a control group was lacking in the present study, it is not possible to determine how much of the caries decline was caused by the fluoride program. Unfortunately, no data are available that could serve as a reference for the present data. National German surveys show a caries decline comparable to the one found in the present study. This is due to the fact that intensified preventive measures were implemented in the whole country during the last decade.

On a local scale, the district of Berlin-Schöneberg could serve as a reference. This borough has a social structure comparable to Berlin-Neukölln (22). The percentages of caries-free schoolchildren in Schöneberg were 20.7 in 1995–96 and 25.8 in 1999–2000. In contrast, the corresponding values were 22.1 (1995–96) and 32.0 (1999–2000) in Neukölln (23). A corresponding development can also be seen in the values of treatment need for both districts (Figure 2). In Schöneberg, no preventive program existed during the respective period. Therefore, the comparison of these data may be interpreted as success for the fluoride program in Neukölln.

While nearly 100 percent of the children attended the traditional group prevention, differences were found in the participation of the various ethnic groups. Group preventive projects in schools are highly dependent on the support of the teachers. It may be that their motivation with respect to foreign children and their parents was stronger than with the German ones. On the other hand, it is also possible that other cultural influences encourage a greater acceptance of the use of fluorides or of group prevention programs. But because the children were always informed ahead of time concerning the dental staff's visit, it is possible that they purposely missed school on that day. This phenomenon was found in another fluoride varnish study (9). The lowest acceptance rates were found in the German and Polish children.

Parents are responsible for arranging appointments with dental practitioners for treatment or individual prophylaxes. To reflect other influences on the caries level of the district's children, it is necessary to examine the acceptance of dental practitioners' offers with regard to individual prevention. The small amount of fissure sealants (not more than 9%) demonstrates that the reliance on dental practices by the children of Berlin-Neukölln is low.

In their meta-analysis, Helfenstein and Steiner (13) found a caries inhibition of 38 percent when Duraphat® was applied biannually in 9–15-year-old children. The data of the present study are in good accordance with this meta-analysis. A study of children with high caries risk from Zimmer et al. showed similar results (9). As most of these studies were performed in Germany, Switzerland, or Scandinavia, it can be assumed that most of the

participants used fluoridated dentifrice (15). In the present study, fluoridated dentrifice was in use even for the toothbrushing part of the group prevention, which was conducted four times per year.

In the present study, the educational group prevention expanded to include biannual application of fluoride varnish resulted in a caries inhibition of 40.7 percent in the 12-year-olds and 42 percent in the 9-year-olds. The slightly better results of the 9-year-olds can be explained by the fact that most of these children received Duraphat® applications from the beginning of their permanent dentition, while the 12-year-olds began receiving the applications when they were already 8 years old.

From the results of the present study, it can be concluded that the described program may be an effective public health measure for 6- to 12-year-old children with high caries levels.

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