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Trends in dental caries experience among children and adolescents in northern Poland between 1995 and 2003.

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Objective*:** To evaluate the oral health status of children and adolescents in the Gdansk region of Poland based on epidemiological examinations performed in 1995 and 2003. ***Basic research design: Sampling and examinations were performed according to WHO standards in children and adolescents aged 6, 7, 12 and 18. A sample of 180 children in each year and in each age group was selected. Their caries experience was recorded in terms of the mean dft/DMFT Index. ***Results*:** The mean dft/DMFT scores in some groups changed significantly in the period 1995 to 2003. The average DMFT score of all 12-year-olds declined from 4.32 in 1995 to 3.20 in 2003 and that of 18-year-olds from 7.74 to 6.66. ***Conclusions*:** The notable improvement in dental health may be due to oral health education and the increased availability of fluoride toothpaste.

Key words: Caries prevalence, dental epidemiology, DMFT.

Introduction

Dental caries in Poland remains a serious problem. Almost 25 years after the proposed goal of a DMFT score of three for 12-year-olds by the year 2000 and the 1979 WHO declaration of 'Health for All', Polish children still experience rates of dental caries that are almost double the targeted rates (Aggeryd, 1983). The WHO strongly recommends that national epidemiological surveys should be conducted in order to monitor changes in oral health status (WHO, 1987). During the years 1987 to 2003 healthcare systems in Poland were in transition after enormous economic and political changes. Privatisation and decentralisation had an impact on the delivery of healthcare services that accounted for some of the changes in oral health.

Therefore, the aim of the present publication is to report on the 2003 survey results and to compare the caries findings with those from studies carried out in 1995. This will allow us to highlight the long-term trends in the dental caries experience of children and adolescents, explore possible reasons for the changes that have taken place during recent years and suggest some solutions for improving the oral health of this population.

Methods

Examinations were performed in 1995 and 2003 on 1,440 children and adolescents aged 6, 7, 12 and 18, with 180 children being examined in each age group in each year. In the 1995 survey, three different areas of urbanisation were selected randomly according to WHO recommendations. The data collection took place in the city of Gdansk (population 450,000), a regional town, Pruszcz Gdanski (population 23,000), and the rural areas around Pruszcz Gdanski (population 13,000). There was no water fluoridation in these areas. Fluoride levels were low, varying from 0.01 to 0.2 mg/L, with no differences between any of the locations. Three kindergartens, three elementary schools and three high schools were randomly chosen at each location, and one class was selected from each. Twenty (ten boys and ten girls; date of birth ± 6 months) children and adolescents were enrolled from each class. A total of 30 boys and 30 girls from each age group were identified for examination at each site (60 subjects in the city, 60 subjects in the regional town, and 60 subjects from rural areas), so the final survey covered 180 children from different age groups in each year of study. The sample size in 1995 was agreed according to WHO recommendations and in the subsequent survey the same sampling procedure was followed. The localities for the 2003 survey were the same, but the schools, classes and children were randomly re-selected. The health authorities of the city of Gdansk and the Polish Ministry of Health approved both studies. The patients and/or parents signed an informed consent form after receiving pertinent explanations concerning the purpose of the studies.

The observations were performed by two dentists in 1995 and one dentist in 2003 who was one of the examiners in the previous survey. Four examiners were trained and calibrated in 1995 on a one-day course to follow diagnostic procedures and standards exactly. Only the two examiners who obtained an intra- and inter-examiner reliability of over 90% were allowed to examine the children. Intra- and inter-examiner reliability were determined by re-examination of 20 children on a different examination day and comparison of their findings with those of the principal investigator. In the surveys, 10% of children were re-examined by the same examiner at the end of the examination day to check for intra-examination reliability. The reliability of the caries score in 10% of the sample showed 93% agreement in 1995 and 95% in 2003.

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Dental examinations were performed according to WHO recommendations (WHO, 1987). The examinations took place at the schools, usually in the classroom. During all surveys the dental examination was performed with the use of artificial light (headlight), a mirror and an explorer. None of the teeth were cleaned or dried prior to the examination. The explorer was used with care to avoid damage to the enamel surface, and only applied when it was necessary to remove food debris. The caries experience was recorded in terms of the dft/DMFT value and its components. In our study, MT was determined when there was a clear history of tooth extraction due to caries. If the child was not able to tell us the reason for extraction, we did not score missing teeth as MT. If there was a sealed molar surface we did not score it in our study and the tooth was regarded as caries-free. Caries was diagnosed at the cavitation level according to WHO recommendations (WHO, 1987). All data were recorded on the WHO Oral Health Assessment Form 1986.

The intra- and inter-examiner reliability in the oral health assessment were tested using kappa statistics. The mean and standard deviation were used to describe the caries status in all age groups. Analysis of variance (ANOVA) was used to test the hypotheses. Significance was assumed at ≤ 0.05. This statistical inference procedure was computed in Excel (Microsoft Corporation, Redmont, USA), which, in turn, uses several VBA (Virtual Basic Application) procedures to convert data and perform the necessary calculations.

Results

Table 1 shows the mean dft values and components in the primary dentition (dt, ft) in 1995 and 2003 in relation to the age of the examined children. During the eight-year period covered by the surveys, the mean (SD) dft of 6-year-old children decreased from 5.45 (3.68) to 4.77 (4.10). Such children had significantly less caries in the primary dentition in 2003 compared with the mean dt values observed in 1995. There was also an appreciable rise in the mean values of treated primary teeth (ft) during the eight-year period. All changes observed in 6-year-olds between 1995 and 2003 were significant. In 7-year-old children the caries experience expressed by dft barely changed during the eight-year period. In 1995 we observed a mean (SD) dft value of 4.93 (3.28), which decreased in 2003 to 4.82 (3.32). Only the mean (SD) value of treated teeth (ft) increased significantly from 0.21 (0.77) to 1.04 (1.90).

Table 2 shows the mean caries experience in the permanent dentition of 7-, 12- and 18-year-olds. In each age group in 2003 the mean DMFT value was significantly lower than in 1995. The changes were greatest amongst 12-year-olds. The mean (SD) DT value dropped from 3.24 (2.52) to 1.34 (1.72) and the mean (SD) value of treated teeth (FT) increased significantly from 1.01 (1.42) in 1995 to 1.88 (2.22) in 2003. In 18-year-old adolescents, although the mean DMFT values decreased significantly, the changes in each component DT, MT and FT separately, were not significant. In both surveys the values of missing permanent teeth were very low and had also dropped after eight years.

We should stress that caries was diagnosed at the cavitation level according to WHO recommendations; all Polish epidemiological studies diagnose caries in this way, so our data are easily comparable with other studies performed according to WHO recommendations.

Discussion

In the 1980s, Poland had a well-organised public dental health service for children and adolescents. Most large elementary and high schools had their own dental clinics located within the school. By 1995 most of these clinics, however, had very old dental units and lacked basic instruments, which was the reason for the very poor caries treatment at that time. We suspect that the reduced provision of dental services was the main reason why we observed lower ft/FT values in those children who were treated in school clinics in 1995. We also suspect that those children who were able to obtain treatment in private practices had more restorations, because private dentists carried out more restorations in molar fissures as a preventive strategy. Owing to the dramatic changes in the political climate in Poland in 1999, the healthcare system underwent a considerable transition and most of the dental services were then delivered privately, almost all of the school dental services being discontinued (Petersen, 2003). Subsequently, access to dental care for children has declined dramatically. In 2000, 29% of children were treated in school dental clinics and 33% privately, and after the transition of the healthcare system in 2005 just 12% of children were treated in schools and 44% privately (Wierzbicka *et al*., 2002). Only one Eastern European country, Slovenia, has experienced a continued decline in dental caries prevalence and it was the only country where the school dental service did not collapse when the political situation changed (Vrbic, 2000). From other studies we know that political changes expressed as health and social policies are more important in reducing dental caries than the specific treatment and preventive measures used in dentistry (Peres *et al*., 20005).

On the other hand, privatisation of the Polish economy has increased the availability of consumer goods. This has resulted in better nutrition of the whole population, but has correspondingly resulted in an increase in the availability of carbonated, sweetened beverages and foods that are high in refined carbohydrates, such as chocolate bars etc., in school shops. Walker *et al*. (2000) did not find any significant association between the average daily consumption of sugary foods and dental caries experience. Declerck *et al*. (2008) found, however, that the consumption of sugar-containing drinks between main meals at the age of five is a significant predictor of caries experience. Caries development was especially associated with caries in children with poor oral hygiene as demonstrated by visible plaque accumulation and frequent consumption of foods and drinks sweetened with sugar. The most critical determinant of caries risk, however, is the timing of exposure to sugar and starch-containing foods (Marshall *et al*., 2005), although our study does not have any information about sugar consumption and other dietary habits. A WHO/FAO report (2003) clearly recommends decreasing sugar intake in the population. The Polish economic changes have also improved the availability of fluoride toothpaste and other oral hygiene goods. Between 2000 and 2004 the sale of fluoride toothpaste doubled (Zietek, 2005), whereas in 1995 only 60% of 12-year-olds in Poland were using fluoride

Table 1. The mean caries experience (dft) and it components (dt, ft) of 6- and 7-year-old children in polish Gdansk region by the year of study (standard deviation SD given in brackets).

Age / year of the study	*Number of examined children in each year*	*Caries experience in primary dentition*					
		mean dt (SD)	*p-value*	*mean ft (SD)*	*p-value*	*mean dft (SD)*	*p-value*
6-year-olds							
1995	180	5.01* (3.61)	p=0.002	0.31* (0.84)	p=0.007	5.45* (3.68)	p=0.002
2003		3.93* (3.85)		0.78* (1.54)		4.77* (4.10)	
7-year-olds							
1995	180	4.39 (3.04)	p=0.25	0.21* (0.77)	p<0.001	4.93 (3.28)	p=0.97
2003		3.66 (3.14)		1.04* (1.90)		4.82 (3.32)	

* significant differences (α=0.05) between 1995-2003 (ANOVA test)

Table 2. The mean caries experience (DMFT) and it components (DT, MT, FT) in children and adolescents in polish Gdansk region by the year of study (standard deviation SD given in brackets).

Age / year of the study	*Number of subjects examined in each year*	*Caries experience in permanent dentition*							
		mean DT (SD)	*p-value*	*mean MT (SD)*	*p-value*	*mean FT (SD)*	*p-value*	*mean DMFT (SD)*	*p-value*
7-year-olds									
1995	180	0.68* (1.04)	p<0.001	0		0.15 (0.50)	p=0.49	0.83* (1.18)	p<0.001
2003		0.21* (0.52)		0		0.08 (0.42)		0.29* (0.70)	
12-year-olds									
1995	180	3.24* (2.52)	p<0.001	0.08 (0.32)	p=0.13	1.01* (1.42)	p=0.003	4.32* (2.87)	p=0.017
2003		1.34* (1.72)		0.01 (0.07)		1.88* (2.22)		3.20* (2.63)	
18-year-olds									
1995	180	3.14 (3.25)	p=0.14	0.41 (0.98)	p=0.64	4.19 (3.71)	p=0.36	7.74* (4.66)	p=0.041
2003		2.54 (2.86)		0.24 (0.62)		3.88 (3.53)		6.66* (4.42)	

*significant differences (a=0.05) between 1995-2003 (ANOVA test)

toothpaste on a regular basis and 30% of children brushed their teeth less than once a day (Wierzbicka *et al*., 2002).

Since the early 1970s most primary schools have supervised tooth-brushing in groups and, additionally, in 1993 began a fissure sealing programme of first permanent molars in 6- and 7-year-old children (Janczuk, 1987). We did not score the use of sealants in our study and cannot present such data for children from the Gdansk region. In 1999 the dental health service for children collapsed. Most of the preventive and oral health education programmes for children were discontinued. Currently, the mass media provide the main source of oral health education knowledge through advertisements for toothpaste and toothbrushes (Petersen, 2003).

The largest change in caries prevalence and experience was noticed in children living in rural areas and small towns (Wierzbicka *et al*., 2002). These are largely children from low socio-economic classes. The rural areas of Poland remain very poor and there is limited availability and use of oral hygiene products. Dental knowledge is also extremely poor and there is very limited access to regular dental care. It has been shown that children from low socio-economic classes have lower standards of personal oral hygiene than those from medium and high socio-economic classes (Sogi and Bhaskar, 2002). During the period of our studies, the situation for low socio-economic classes changed, more than for those people living in cities in the higher socio-economic classes. The education level rose between 1988 and 2002. The percentage of people with advanced education increased by 4.3% in towns and by 2.5% in rural areas. Secondary education increased in rural areas by over 9% and in towns by 6.8% (Central Statistical Office). Between 1995 and 2004 the income level in Poland rose by over 130% and consumption by over 270%. The Gross Domestic Product in the Gdansk region doubled between 1995 and 2004 (Central Statistical Office). There was a large increase in dental health education delivered through mass media advertisements of oral health products.

All these factors may have influenced the trends in caries prevalence and experience. At present, the decrease in rates of caries in 6- and 7-year-old children may be due to their parents' better oral health knowledge. While the reduction in caries observed in 12-year-old children and 18-year-old adolescents may be a consequence of the fissure-sealing programme of first permanent molars, it may also be related to the widespread use of fluoride toothpastes and an improvement in the socio-economic conditions of the Polish population (Marthaler, 2004). We know that harmful social and biological factors accumulated in very early life influence dental caries levels in later life. For example, not attending a day care centre was the most important risk factor in the sixth year of life. Sugar consumption at least once a day and brushing

teeth less than once a day were also very important in the prediction of caries levels in children (Peres, 2005).

Caries experience in Polish children remains very high (Petersen, 2003; Wierzbicka *et al*. 2002). The mean DMFT values in 12-year-olds were 4.4 in 1987, 4.23 in 1995 and 3.3 in 2004 (Wierzbicka *et al*., 2002; Wierzbicka, 2004). The mean values from the Gdansk region were very similar to those obtained for the whole of Poland. In most western European countries, the mean DMFT values are around 1.0 (Petersen, 2003), but in former eastern bloc countries the DMFT values are higher. In 2001 12-year-old children in Lithuania had a mean DMFT of 3.6 (Aleksejuniene *et al*., 2004) and in Latvia it was 3.5 in 2002 (Yearbook, 2004). The fact that caries rates in developing countries are showing the same trends could indicate a common process, but the reason for this remains unknown. It is believed that 40% of caries reduction is due to the use of fluoride toothpaste and other fluoride strategies (Bratthal *et al*., 1996). It has been reported that the impact of social factors (Schou and Vitenbrock, 1995), changes in preventive and restorative dental services (Downer, 1996), the use of antibiotics (Birkeland *et al*., 2000) and lower sugar consumption (Downer, 1999) could be other reasons for decreasing caries trends.

Polish adolescents aged 18 also present very high rates of caries experience. The mean DMFT values were 9.2 in 1995, 7.3 in 2001 and 8.0 in 2004 (Wierzbicka, 2004). The mean DMFT values in 18-year-olds from the Gdansk region are lower than those obtained for the whole of Poland, but we do not have any data that could explain these differences. We can only speculate that because the Gdansk region is one of higher unemployment and lower income, a lot of children and adolescents from our region were unable to obtain frequent supplies of cariogenic carbonated, sweetened beverages and foods high in refined carbohydrate. In most European countries the mean DMFT values in 18-year-olds are around five, but in former eastern bloc countries the DMFT values are higher. In 1995 in the Czech Republic, for example, 18-year-old adolescents had a mean DMFT of 6.22 (Krejsa *et al*. 1996), while Slovenian adolescents in 1998 had a mean DMFT of 7.0 (Vrbic, 2000).

Conclusions

Children from the Gdansk region have yet to achieve the WHO goals, although there has been a decline in caries between 1987 and 2003. The present study documents that the achievements of oral health in children are threatened unless the health authorities in Poland take action to re-establish preventive services. The revitalisation of the school dental services would meet the need for curative care in children, and schools also provide an appropriate setting for systematic health promotion.

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