It's all about access. Dr. Emerich's article looking at dental caries in young Polish children reminds us that access is the challenge in all countries for health care, medical, dental, and other health professions.

Children in rural areas in Poland still suffer higher levels of dental disease. However, Poland has very competent dental professionals, with more than 24,000 dentists currently in practice—the majority of them in private practice. Poland's 10 dental schools graduate about 900 new dentists each year. According to a report from the Polish Chamber of Physicians and Dentists dated June 2005,¹ oral health care is free of charge for children up to age 18. The National Public Health Fund spends about 3% annually on oral health as a percentage of the total expenditure on health.¹

Polish dentists enjoy a very good reputation for their skills and competency. Popular articles and newspapers advertise Polish dentistry as part of the new medical tourism industry that has become popular in Eastern Europe.² Prices can be as little as one-third the cost as in a Western European country. Polish dentists are also moving into Western Europe and North America to practice.²

As fluoridated toothpaste use continues to increase and rural populations gain access, this disturbing trend will hopefully reverse. The competition from the private sector and the new medical tourism certainly puts pressure on accessibility for the rural poor in Poland and neighboring countries.

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1. Polish Chamber of Physicians and Dentists. Dental facts about Poland: statistical report. 2005 [cited 2007 Mar 14]. Available from: URL: http://www.fdiworldental.org/resources/assets/facts_and_figures/2004/Poland_2005.pdf
2. Private Healthcare UK. Polish dentists "have better skills and training." 2007 [cited 2007 Mar 14]. Available from: URL: <http://www.privatehealth.co.uk/private-dentistry/news/february-2007/dental-treatment-poland>

DENTAL CARIES AMONG 7-YEAR-OLD CHILDREN IN NORTHERN POLAND, 1987–2003

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Most epidemiological studies over the last 10 years have demonstrated a marked decline in the prevalence of dental caries in Western countries.^{1–5} However, in Poland, dental caries remain a serious sociomedical problem. The World Health Organization (WHO) goal of 50% of children being caries-free by the age of 5 by the year 2000⁶ had already been reached in most Western nations, but Polish children continue to experience very high rates of dental decay. Accurate data on caries prevalence in the Gdansk region had not been available until 1987. And while several small local studies had been performed, the methodology was poor and the sampling small.

The first nationwide epidemiological surveys conducted in 1987,^{7,8} 1995,^{9,10} and 2003 were limited to the Gdansk region. All surveys indicated a great

need for therapeutic measures and professional and self-care, and recommended that preventive and educational programs be instituted. The WHO strongly recommends that national epidemiological surveys should be conducted to monitor changes in oral health status.^{11,12} Epidemiology is also essential in the assessment of treatment needs; the planning, care, and further development of preventive and curative strategies; the determination of the cost-effectiveness of care; and the evaluation and adjustment of treatment methodologies.

From 1987 to 2003, the health-care system in Poland was in transition after enormous economic and political changes. Privatization and decentralization had an important impact on the delivery of health-care services, and this was one of the fundamental reasons for the changes in oral health.

This article reports the results of the 2003 survey and compares the findings with those of studies carried out in 1987 and 1995. It demonstrates the long-term trends in dental caries experiences of 7-year-olds in Poland, explores the possible reasons for the changes during recent years, and suggests some solutions that will bring improvement in the oral health of this population.

MATERIALS AND METHODS

Selection of children

In the 1987 survey, three different areas of urbanization were randomly selected following WHO recommendations. The data collection took place in one large city (Gdansk, population 450,000), a small regional town (Pruszcz Gdanski, population 23,000), and the rural areas around Pruszcz Gdanski (population 13,000). No water fluoridation existed in these areas and the fluoride level was low, varying from 0.01 to 0.2 mg/L throughout the study period.

Three elementary schools were randomly chosen in each location, and one class was selected in each school. In these classes, twenty 7-year-old children (10 boys and 10 girls, date of birth $\pm$ 6 months) were enrolled. A total of 30 boys and 30 girls were identified for examination at each site, thus the final survey consisted of 180 children in each year of the study. The sample size was determined in 1987 after a power analysis according to WHO recommendations, and the same methodology was used in subsequent surveys. The study was approved by the health authorities of the city of Gdansk and the Polish Ministry of Health. The localities in the 1995 and 2003 surveys were the same, but the schools, classes, and children were randomly selected.

Examiners

The observations were performed by four dentists in 1987, two dentists in 1995, and one dentist in 2003 (who was one of the examiners in all previous surveys). In each year, all examiners were trained and calibrated at a one-day course to follow exactly the same diagnostic procedures and standards. Only the examiners who obtained an intra- and inter-examiner reliability higher than 90% were allowed to examine the children. An intra- and inter-examiner reliability was obtained from reexamining 20 children on a different examination day and comparing their findings with those of the principal investigator. In each survey, 10% of children were reexamined by the same examiner at the end of the examination day to check intra-examination reliability. The reliability of caries score in 10% of the sample showed 91% agreement in 1987, 93% agreement in 1995, and 95% agreement in 2003.

Recording of caries

Dental examinations were performed according to WHO guidelines.¹¹ The examinations took place at the schools, usually in the classroom. The dental examinations were performed with the use of an artificial

light, a mirror, and a sharp explorer. None of the teeth were cleaned or dried prior to examination. The caries prevalence (percent caries-free) was recorded and caries experience in terms of decayed/missing/filled teeth—dmft value for primary dentition and DMFT value for permanent dentition—and its components (dt/DT = decayed teeth, mt/MT = missing teeth, ft/FT = filled teeth). Caries were diagnosed as cavitations, and all data were recorded in the WHO Oral Health Assessment Form.

STATISTICAL ANALYSIS

The total population of interest was divided into number of subpopulations created with respect to age, gender, and place of residence. The values of DT/dt, MT/mt, FT/ft, as well as DMFT/dmft were considered as discrete random variables.

Preliminary statistical data analysis revealed a large number of values with probability of occurrence equal to zero. For this reason, the primary dataset was converted into a secondary set of categorical data. Two hypotheses were put forward:

H_0 : The test population had their dentists in the same state.

H_1 : The test population had their dentists in a different state.

After conversion, data became of categorical type. Therefore, an appropriate method to test H_0 against H_1 was the contingency table. The significance level was assumed: $p=0.10$. This statistical inference procedure was computed in Microsoft® Excel¹³ that, in turn, calls several virtual basic application procedures to convert data and perform the necessary calculations.

RESULTS

Table 1 shows the mean DMFT values and their components (DT, MT, FT) in 1987, 1995, and 2003 in relation to location and gender of examined children. During the 16-year period covered by the surveys, the mean DMFT of 7-year-old children decreased from 0.73 to 0.31. In the large city, there was an insignificant rise in mean DMFT over the 16-year period, but the change was caused by a rise in the FT component. Between 1995 and 2003, there was a significant decrease in mean DT values in girls living in the small town. Children living in the small town and in the rural area had a higher caries experience in 1987 and 1995 compared with those living in the large city. However, in the 2003 survey, the situation changed and the children

Table 1. The mean caries experience (DMFT) and its components (DT, MT, FT) in permanent dentition of 7-year-old children in relation to urbanization and gender, by year of study

Location	Gender	Number of examined children in 1987, 1995, and 2003	Caries experience in permanent dentition								
			Mean DT (SD)			Mean MT (SD)			Mean FT (SD)		
			1987	1995	2003	1987	1995	2003	1987	1995	2003
Large city— Gdansk	Boys	30	0.23 (0.63)	0.30 (0.69)	0.27 (0.68)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.07 (0.37)	0.17 (0.45)	0.07 (0.36)
	Girls	30	0.40 (0.89)	0.37 (0.75)	0.23 (0.56)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.07 (0.37)	0.10 (0.40)	0.33 (0.83)
	Total	60	0.32 (0.77)	0.33 (0.72)	0.25 (0.62)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.07 (0.36)	0.13 (0.43)	0.20 (0.65)
Small town— Pruszcz Gdanski	Boys	30	0.97 (1.33)	0.70 (1.19)	0.27 (0.63)	0.00 (0.00)	0.00 (0.00)	0.07 (0.36)	0.27 (0.69)	0.17 (0.64)	0.03 (0.18)
	Girls	30	0.37 (0.76)	0.83 ^a (1.16)	0.17 ^a (0.45)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 ^b (0.00)	0.33 ^b (0.75)	0.00 (0.00)
	Total	60	0.67 (1.11)	0.77 (1.17)	0.22 (0.55)	0.00 (0.00)	0.00 (0.00)	0.03 (0.26)	0.13 (0.50)	0.25 (0.70)	0.02 (0.33)
Rural area— Pruszcz Gdanski	Boys	30	0.73 (1.01)	0.87 (1.06)	0.10 (0.30)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.03 (0.18)	0.10 (0.30)	0.07 (0.36)
	Girls	30	1.13 (1.41)	1.00 (1.10)	0.27 (0.51)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.07 (0.25)	0.03 (0.18)	0.00 (0.00)
	Total	60	0.93 (1.23)	0.93 (1.08)	0.18 (0.43)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.05 (0.22)	0.07 (0.25)	0.03 (0.26)
Whole Gdansk region	Boys	90	0.66 (1.06)	0.62 (1.03)	0.21 (0.57)	0.00 (0.00)	0.00 (0.00)	0.02 (0.21)	0.12 (0.47)	0.14 (0.48)	0.06 (0.31)
	Girls	90	0.63 (1.11)	0.73 (1.05)	0.22 (0.51)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.04 (0.26)	0.16 (0.51)	0.11 (0.50)
	Total	180	0.64 (1.08)	0.68 (1.04)	0.22 (0.54)	0.00 (0.00)	0.00 (0.00)	0.01 (0.15)	0.08 (0.38)	0.15 (0.50)	0.08 (0.42)

^aIndicates significant differences between 1995 and 2003

^bIndicates significant differences between 1987 and 1995

NOTE: Arrows indicate significant differences in relation to gender.

DT = decayed teeth

MT = missing teeth

FT = filled teeth

DMFT = decayed/missing/filled teeth

SD = standard deviation

from the large city had a higher mean DMFT value. Children living in the small town and in rural areas had very low mean FT levels. In all surveys, the MT values were very low.

The mean DMFT values are shown in Table 2. The data from the 1987 survey are quoted after Pellowska-Piontek.⁸ Caries experience in the primary dentition did not change during the 16-year period. An increase in the mean DMFT was observed in the large city, but there was a slight decrease in the rural area, and girls had a higher caries experience. In the 16-year period, we observed an appreciable rise in the number of treated teeth, which might be represented as a positive change. However, there were constantly high treatment needs in the primary dentition of this 7-year-old population.

Table 3 shows the percentages of caries-free children living in the three different environments. During the 16-year period, there was a statistically significant improvement in caries-free rates, from 10.56% in 1987 to 18.33% in 2003. The percentage of caries-free children during the 16-year period was the most stable in the large city, but the greatest change was seen in the rural area. The highest percentage of caries-free children (33.33%) was observed in boys from rural areas and the lowest (6.67%) was observed in boys living in the small town. In the whole Gdansk region, we found only 18.33% caries-free children in 2003; however, this percentage was an improvement over the rates observed in 1987 (10.56%) and in 1995 (13.33%). The male population showed the greatest improvement, with 20.00% of boys being caries-free in 2003 while only 16.67% of the girls had no caries at this time.

DISCUSSION

A random sample would have been preferable for obtaining an unbiased estimate of caries experience. Due to a lack of the necessary resources, however, a Pathfinder study was adopted, although in all surveys great care was taken to use the same methodology.

A well-organized public dental health service for children existed in Poland in 1987. While health care was free of charge for patients, there was an overall lack of modern equipment and dental materials. Most large primary schools in Poland had their own dental clinics located within the school. It was reported that there was a significantly lower caries experience for children when the dental clinic was located within the schools.¹⁴ By 1995, most of the dental health clinics in schools were using very old dental units and lacked basic instruments, resulting in poor caries treatment during those years.¹⁵ Due to the dramatic changes in

the political climate in Poland in 1999, the health-care system underwent a considerable transition and most dental services were then delivered privately, while almost all of the school dental services were discontinued. Subsequently, access to dental care for children has since dropped dramatically.

In general, oral health care is now based on demand for services rather than systematic national or regional preventive programs. We suspect that the reduced provision of dental services was the main reason for the lower ft/FT values observed in 1995. In Poland, the major source of health-care finance is a health insurance system in which only basic procedures and materials are refunded. Additionally, this system relies on the individual to seek care, and many parents do not ensure regular checkups for their children. The decayed component dt/DT was the major contribution to the total caries experience score and is the major demand for dental care of schoolchildren. Similar situations have been observed in other post-communist countries (i.e., Estonia).¹⁶

On the other hand, privatization of the Polish economy has raised the availability of consumer goods, resulting in better nutrition for the whole population, but also an increase in the availability of carbonated, sweetened beverages and high refined carbohydrate foods. Excessive consumption of sugar was also reported in Estonian children,¹⁶ but Walker and others (2000) found no significant association between the average daily consumption of sugar foods and dental caries experience.¹⁷ The recommendation to decrease the total national intake of sugar still appears in a WHO/Food and Agricultural Organization report.¹⁸ The economic change also improved the availability of fluoridated toothpastes and other oral hygiene products. In 2000 and 2004, for example, the sale of fluoride toothpastes doubled.¹⁹ Only 60% of 12-year-olds in Poland were using fluoride toothpaste on a regular basis in 1995, and 30% of children brushed their teeth less than once a day.¹⁵ These irregular patterns of poor oral hygiene were also characteristic for Estonian children.¹⁶

A fissure-sealing program of first permanent molars in 6- and 7-year-old children was started in 1993¹⁵ and lasted until 1999, when the Dental Health Service for children collapsed. However, in 1995, we observed a reduction by almost half of the mean DT values compared to DT values from 1987.

The largest change in caries prevalence and experience was found in children living in the rural area, who were primarily from low socioeconomic classes. The rural areas of Poland remain very poor, and there is limited availability and use of oral hygiene products.

Table 2. The mean caries experience (dmft) and its components (dt, mt, ft) in primary dentition of 7-year-old children in relation to urbanization and gender, by year of study

Location		Gender	Number of examined children in 1987, 1995, and 2003	Caries experience in permanent dentition											
				Mean dt (SD)			Mean mt (SD)			Mean ft (SD)					
				1987	1995	2003	1987	1995	2003	1987	1995	2003			
Large city— Gdansk	Boys	30	X	4.57 (3.00)	3.57 (3.44)		X	0.43 (1.31)	0.13 (0.43)	X	0.33 ^a (0.79)	1.33 ^a (2.02)	X	5.33 (3.52)	5.03 (3.52)
	Girls	30	X	4.27 (3.18)	3.97 (3.75)		X	0.10 (0.30)	0.03 (0.18)	X	0.63 (1.40)	2.27 (2.54)	X	5.00 (3.41)	6.27 (3.71)
	Total	60	3.17	4.42 (3.09)	3.77 (3.60)		0.00	0.27 (0.96)	0.08 (0.33)	0.57	0.48 (1.15)	1.80 (2.34)	3.73	5.17 (3.47)	5.65 (3.67)
Small town— Pruszcz Gdanski	Boys	30	X	3.87 (3.03)	3.63 (2.58)		X	0.67 ^a (1.16)	0.03 ^a (0.18)	X	0.10 ^a (0.40)	1.10 ^a (2.06)	X	4.63 (3.34)	4.77 (2.60)
	Girls	30	X	4.63 (3.27)	3.40 (2.43)		X	0.23 (0.56)	0.07 (0.25)	X	0.20 (0.75)	0.63 (1.45)	X	5.07 (3.40)	4.10 (2.75)
	Total	60	4.15	4.25 (3.18)	3.52 (2.51)		0.00	0.45 (0.94)	0.05 (0.22)	0.22	0.15 (0.60)	0.87 (1.79)	4.37	4.85 (3.38)	4.43 (2.70)
Rural area— Pruszcz Gdanski	Boys	30	X	4.47 ^a (2.86)	2.97 ^a (3.27)		X	0.33 (0.79)	0.17 (0.45)	X	0.00 (0.00)	0.33 (0.79)	X	4.80 ^a (2.95)	3.47 ^a (3.48)
	Girls	30	X	4.53 (2.78)	4.40 (2.95)		X	0.23 (0.56)	0.23 (0.56)	X	0.00 (0.00)	0.60 (1.33)	X	4.77 (3.00)	5.23 (2.97)
	Total	60	5.10	4.50 (2.82)	3.68 (3.20)		0.00	0.28 (0.69)	0.20 (0.51)	0.07	0.00 (0.00)	0.47 (1.10)	5.17	4.78 (2.97)	4.35 (3.36)
Whole Gdansk region	Boys	90	4.09	4.30 (2.98)	3.39 (3.13)		0.00	0.48 (1.12)	0.11 (0.38)	0.22	0.14 (0.53)	0.92 (1.78)	4.31	4.92 (3.29)	4.42 (3.30)
	Girls	90	4.18	4.48 (3.09)	3.92 (3.12)		0.00	0.19 (0.49)	0.11 (0.38)	0.34	0.28 (0.95)	0.17 (2.01)	4.52	4.94 (3.27)	5.20 (3.29)
	Total	180	4.13	4.39 (3.04)	3.66 (3.14)		0.00	0.33 (0.88)	0.11 (0.38)	0.28	0.21 (0.77)	1.04 (1.90)	4.42	4.93 (3.28)	4.81 (3.32)

^aIndicates significant differences between 1995 and 2003

NOTE: Arrows indicate significant differences in relation to gender.

dt = decayed teeth

mt = missing teeth

ft = filled teeth

dmft = decayed/missing/filled teeth

SD = standard deviation

X = lack of data

Table 3. Percentages of caries-free 7-year-old children in relation to urbanization and gender, by year of study

Location	Gender	Number of examined children in 1987, 1995, and 2003	Percentages of caries-free children					
			1987		1995		2003	
			Number of children	Percent	Number of children	Percent	Number of children	Percent
Large city— Gdansk	Boys	30	↑ 5	16.67	4	13.33	6	20.00
	Girls	30	5	16.67	↑ 7	23.33	6	20.00
	Total	60	↑ 10	16.67	↑ 11	18.33	12	20.00
Small town— Pruszcz Gdanski	Boys	30	5	16.67	4	13.33	2	6.67
	Girls	30	1 ^{a,b}	3.33	5 ^b	16.67	5 ^a	16.67
	Total	60	↓ 6	10.00	9	15.00	↑ 7	11.67
Rural area— Pruszcz Gdanski	Boys	30	0 ^a	0.00	↓ 2 ^b	6.67	10 ^{a,b}	33.33
	Girls	30	3	10.00	2	6.67	↓ 4	13.33
	Total	60	3 ^a	5.00	4 ^b	6.67	14 ^{a,b}	23.33
Whole Gdansk region	Boys	90	10 ^a	11.11	10 ^b	11.11	18 ^{a,b}	20.00
	Girls	90	9	10.00	14	15.56	15	16.67
	Total	180	19 ^a	10.56	24	13.33	33 ^a	↔ 18.33

^aIndicates significant differences between 1987 and 2003^bIndicates significant differences between 1987–1995 and 1995–2003

NOTE: Arrows indicate significant differences in relation to gender.

Dental knowledge is also dramatically poor and there is very limited access to regular dental care. It has been shown that children from low socioeconomic classes had lower standards of personal oral hygiene compared with children of medium and high socioeconomic classes.^{20,21}

During this period, the situation for low socioeconomic classes changed more than for those in the higher socioeconomic classes living in cities; the education level increased from 1988 to 2002. In towns, 4.3% more people had undertaken advanced education and this number had increased by 2.5% in rural areas. Secondary education increased in rural areas by more than 9% and in towns by 6.8%.²² Between 1995 and 2004, the income level in Poland rose more than 130% and consumption increased by more than 270%. The gross domestic product in the Gdansk region also doubled from 1995 to 2004.²² The economic change in Poland fostered a dramatic increase in dental health education delivered through mass-media advertisements of oral health products.

All these factors may have influenced caries prevalence and experience trends, but it should be emphasized that all these explanations are speculative because they were not analyzed with statistical data or based on ecological studies.²³ The reduction of caries observed in permanent dentition of 7-year-olds may be a consequence of the fissure-sealing program of first permanent molars, but may also be attributable

to the widespread use of fluoridated toothpastes and an improvement in the socioeconomic conditions of the Polish population.²⁴ On the other hand, the caries experience in primary dentition still remains very high, and we have failed to observe any positive change during the 16-year period. This may be due to the widespread belief of many parents that the treatment of the primary dentition is unnecessary. Although we observed a slight rise in mean ft and mt values, the untreated caries level (dt) in primary dentition remained very high.

While most western European countries have reported a mean dmft of about 2,²⁵ children in former Eastern Bloc countries have dmft values up to three times higher. Similarly, the caries prevalence of Polish 7-year-olds remains very high (18% caries-free) compared with similarly aged children from France (41%),²⁵ Germany (42%),²⁶ and Switzerland (48%).²⁷ On the other hand, developing European countries are demonstrating an improvement in caries experience. While up to 40% of this improvement has been attributed to the use of fluoride toothpastes and other fluoride therapeutics,²⁸ the impact of social factors,²⁹ changes in dental services,³⁰ the use of antibiotics,³¹ and a lower sugar consumption³² must also be considered.

The WHO goal set for the year 2000—for 50% of the children to be caries-free by the age of 5⁶—has not been achieved in Poland, although this article has demonstrated a trend toward this goal. In light of

the scarce public resources for oral health care and the current caries trends in Poland, a national health policy that emphasizes prevention rather than curative care must be introduced. The revitalization of a school dental service will meet the needs for therapeutic care of children but might also be an opportunity to initiate community-based oral health promotion programs.

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