Dental caries severity and oral hygiene in Warsaw preschool children at high risk for caries

Intensywność próchnicy i stan higieny jamy ustnej warszawskich dzieci w wieku przedszkolnym obciążonych dużym ryzykiem wystąpienia próchnicy

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Abstract

Background. Fast progression of caries in primary teeth may lead to pulpitis or even to premature tooth loss. Poor oral hygiene is a risk factor for caries, although it is not considered to be an important one.

Objectives. The objective of this study was to assess the correlation between dental caries and oral hygiene in Warsaw preschool children at high risk for caries.

Material and methods. One hundred and eighty preschool children (average age 50.27 ± 11.27 months) at risk for caries were eligible to participate in the study. Oral hygiene, carious lesions, fillings and missing teeth were evaluated. White spot lesions, dmft, dmfs, d1-2dmft, d1-2dmfs, and their components were calculated. The study was conducted by 3 calibrated examiners.

Results. Dmft was 7.20 ± 5.33, dmfs 15.65 ± 15.82, d1-2dmft 10.81 ± 5.63, d1-2dmfs 20.84 ± 16.56, including d1-2t and d1-2s dp – 3.59 ± 2.86 and 5.14 ± 4.51 respectively for 19.04 ± 1.99 examined primary teeth. The main component of the indicators was the average number of teeth/tooth surfaces with caries (4.71 ± 4.54/8.72 ± 10.77 respectively). The average number of teeth/surface fillings amounted to 1.73 ± 1.99 and 3.58 ± 5.01; those lost due to the caries of 0.79 ± 1.74 and 3.39 ± 7.56. Treatment index amounted to 0.27 and DI-S to 1.1 ± 0.57. There was a statistically significant positive correlation between dmft and dmfs, dt and ds, and the DI-S.

Conclusions. Poor oral hygiene caused severe caries. Massive accumulation of dental plaque was accompanied by a greater number of teeth and tooth surfaces with caries.

Key words: children, oral hygiene, the intensity of caries, high risk of caries

Słowa kluczowe: dzieci, higiena jamy ustnej, intensywność próchnicy, wysokie ryzyko próchnicy

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Dental caries remain a challenge and are severe in Polish children. According to an oral health survey, 53.8% of 3-year-olds in 2015 and 79.9% of 5-year-olds in 2011 had dental caries.^{1,2} Caries in children may appear very early and their prevalence and severity increase with age.

Carious lesions in primary teeth are the best predictor of the risk for caries in children. According to numerous studies, children under the age of 3 diagnosed with caries are at a high risk for caries development in permanent teeth.^{3,4} Children with caries in primary teeth have three times greater higher risk of developing caries in their permanent teeth than children without carious lesions.

The dental examinations of primary teeth are too scarce and preventive treatments too rare in preschool children.^{1,2,4} According to surveys, over 60% of mothers of 3-year-olds had never taken their children to the dentist.⁴ Oral health surveys established that 56.3% of mothers were not interested in the dental health of their children, whereas 74% took their children to a paediatric consult once a year.^{1,2}

The objectives of the 11th National Health Plan for 2007–2015 were to decrease caries prevalence and severity in primary teeth and to increase the percentage of children taking part in awareness programs.⁴ The WHO, the Polish Dental Association (PTS), the FDI World Dental Federation, the International Association of Paediatric Dentistry (IAPD), the International Association for Dental Research (IADR), the Polish Association of Paediatric Dentistry (PTSD), and the Polish Alliance for a Cavity Free Future (ACFF) advocating for oral health, defined strategic oral health goals, meant to prevent caries, which should be reached by 2020. Among other goals, children aged 3–6 years without caries will undergo close monitoring.

The study was to assess the correlation between the severity of caries and oral hygiene in Warsaw preschool children at high risk for caries.

Material and methods

Children who reported to the Department of Paediatric Dentistry, WUM, and were attending nurseries and preschools in Warsaw were eligible to take part in the study. The study was approved by the WUM Commission for bioethics (decision 156/2013).

The inclusion criteria were age between 18 months to 5 years and 11 months and a written consent of the parents/legal guardians for participation in the study. Children older than 6, non-cooperative, or unwilling to undergo a dental examination were excluded. The clinical study was conducted by 3 examiners (the co-authors of the present paper) after prior calibration using kappa statistics. Children were seated in dental chairs and examined using a shadowless lamp, a mouth mirror, a dental air syringe and a WHO-recommended 621 periodontal probe.⁵ The study data was recorded in patient charts designed in accordance

with WHO guidelines. Teeth with carious lesions (d), teeth with fillings (f), and teeth removed because of caries (m) were counted and the oral hygiene index was calculated.

Carious lesions were assessed according to the International Caries Detection and Assessment System (ICDAS-II), where 0 represented sound enamel, 1 and 2 early stage decay limited to enamel (d), and 3–6 carious lesions (p).⁶

Oral hygiene was assessed before teeth cleaning but after dental debris was disclosed with 3% erythrosine aqueous solution. Green and Vermillion's oral hygiene index simplified (DI-S of OHI-S), 1964⁷ and WHO's 2013 were used.⁵ Oral Debris Index Simplified was used as young children rarely had dental calculus. The prevalence of soft debris on the buccal surfaces of teeth 55, 51, 65, and 71 and on lingual surfaces of teeth 75 and 85 was assessed; so was the degree of tooth coverage on a scale of 0 to 3, with 0 – no debris or stains present; 1 – soft debris covering not more than 1/3 of the tooth surface; 2 – soft debris covering more than 1/3, but not more than 2/3 of the exposed tooth surface; and 3 – soft debris covering more than 2/3 of the exposed tooth surface. The index equaled the mean values for all surfaces. Value DI-S ($0 < \text{DI-S} < 0.6$) indicated good oral hygiene; ($0.7 < \text{DI} < 1.8$) – sufficient; ($1.9 < \text{OHI} < 3.0$) – poor.

All children and parents received instructions on how to brush their teeth and healthy eating and hygiene tips. Dmft and dmfs, d1-2dmft, d1-2dmfs, their components, and the DI-S were calculated based on the study results, which were statistically analyzed using the χ^2 test, the Wilcoxon signed-rank test, and STATISTICA 10 (StatSoft); significance was set at 0.05.

Results

After calibration kappa equaled 0.88, 180 children, both sexes, aged 21 to 72 months (mean age 50.27 ± 11.27) were examined (Table 1).

Eighty one percent had caries. Most cases were severe. Dmft and dmfs equalled 7.20 ± 5.33 and 15.65 ± 15.82 for an average of 19.04 ± 1.99 tested teeth; d1-2dmft 10.81 ± 5.63 and d1-2dmfs 20.84 ± 16.56 .

The main components of d1-2dmft/d1-2dmfs were carious teeth and surfaces (4.71 ± 4.54 and 8.72 ± 10.77 respectively). The mean numbers of teeth and surfaces with white spot lesions (ICDAS II 1 and 2) equaled 3.59 ± 2.86 and 5.14 ± 4.51 respectively; teeth with fillings – 1.73 ± 1.99 and 3.58 ± 5.01 . Teeth and tooth surfaces lost to caries equaled 0.79 ± 1.74 and 3.39 ± 7.56 (Fig. 1).

Mean dmft/dmfs, d1-2dmft/d1-2dmfs and their components were calculated for boys and girls (Table 2). The differences between both sexes were statistically significantly different for dt ($p < 0.05$).

The treatment index equaled only 0.27; 0.312 in girls and 0.278 in boys. There was no statistical difference between the sexes and treatment indexes using the Mann-Whitney U test.

Table 1. Test group specifics

Main characteristic of data	Boys	Girls	Total	p
Mean age (in months) ($\pm$ SD)	50.07 $\pm$ 10.44	51.09 $\pm$ 12.10	50.27 $\pm$ 11.27	0.547
Number of examined patients	88	92	180	0.673
Number of examined teeth	1672	1793	3465	
Mean number of examined teeth ($\pm$ SD)	19.00 $\pm$ 2.12	19.08 $\pm$ 1.87	19.04 $\pm$ 1.99	0.798
Number of examined surfaces	7384	8011	15395	0.683
Mean number of examined surfaces ($\pm$ SD)	83.91 $\pm$ 8.56	85.22 $\pm$ 6.44	84.59 $\pm$ 7.55	0.690

Fig. 1. Mean d1-2dmft/d1-2dmfs, and their components

Table 2. Comparison of mean dmft/dmfs and d1-2dmft/d1-2dmfs of their components in boys and girls

dmft, dtms and their components	Boys	Girls	Total	p
d1-2t	3.80 $\pm$ 2.94	3.39 $\pm$ 2.78	3.59 $\pm$ 2.86	0.374
dt	5.35 $\pm$ 4.86	4.09 $\pm$ 4.14	4.71 $\pm$ 4.54	0.035*
mt	0.92 $\pm$ 1.94	0.66 $\pm$ 1.53	0.79 $\pm$ 1.74	0.690
ft	1.76 $\pm$ 2.03	1.70 $\pm$ 1.96	1.73 $\pm$ 1.99	0.866
dmft	8.05 $\pm$ 5.83	6.41 $\pm$ 4.70	7.20 $\pm$ 5.33	0.039*
d1-2dmft	11.83 $\pm$ 6.21	9.84 $\pm$ 4.85	10.814 $\pm$ 5.63	0.017
d1-2s	5.27 $\pm$ 4.79	5.01 $\pm$ 4.25	5.14 $\pm$ 4.51	0.953
ds	9.41 $\pm$ 10.06	8.07 $\pm$ 11.42	8.72 $\pm$ 10.77	0.064
ms	4.05 $\pm$ 8.60	2.77 $\pm$ 6.39	3.39 $\pm$ 7.56	0.679
fs	4.31 $\pm$ 6.12	2.89 $\pm$ 3.55	3.58 $\pm$ 5.01	0.310

* statistical significance ($p < 0.05$).

The mean DI-S equaled 1.1 ± 0.57 ; 1.21 ± 0.58 in boys and 0.97 ± 0.53 in girls. This difference was statistically significant ($p = 0.005$). The smallest accumulation of dental plaque was observed on tooth 51 and the biggest on tooth 85. The amount of dental plaque that was statistically sig-

Fig. 2. Mean DI-S and its components in both sexes

Table 3. Spearman's rank correlation coefficient measures the correlations between mean dmft, dmfs, d1-dmft, d1-dmfs, their components, age and the DI-S

dmft, dtms and their components	AGE (months)			DI-S		
	Total	Girls	Boys	Total	Girls	Boys
d1-2t	0.107	0.034	0.127	0.003	-0.026	0.118
dt	0.047	0.047	-0.002	0.304*	0.289*	0.247*
mt	0.180*	0.179	0.190	-0.013	0.061	-0.107
ft	0.293*	0.336*	0.279*	-0.021	-0.042	-0.165
dmft	0.245*	0.292*	0.202	0.245*	0.269*	0.149
d1-2dmft	0.259*	0.297*	0.271*	0.221*	0.198	0.164
d1-2s	0.121	0.038	0.119	0.070	0.120	0.169
ds	0.046	0.034	0.015	0.295*	0.302*	0.244*
ms	0.190*	0.185	0.197	-0.016	0.057	-0.108
fs	0.258*	0.363*	0.280*	0.078	0.025	-0.087
dmfs	0.235*	0.255*	0.220*	0.243*	0.271*	0.144
d1-2dmfs	0.227*	0.226*	0.256*	0.227*	0.243*	0.189

* statistical significance ($p < 0.05$).

nificantly different between both groups was observed on teeth 55 and 65. Boys had poorer hygiene habits (Fig. 2).

The assessment of the Spearman's rank correlation coefficient confirmed a statistically significant positive correlation between d1-2dmft, d1-2dmfs, dt, ds and the DI-S, as well as between patient's age and dmft, dmfs and mt/ms, and ft/fs (Tab. 3). There was no statistically significant correlation between the age and the DI-S in the test group.

Discussion

The present study illustrated that teeth in children below the age of 6 were in very poor condition, which was also confirmed by other studies.^{1,2,8–19} Caries occurred in 81% of the children. According to national studies, 53.8% of 3-year-olds and 87% of 6-year-olds had caries.^{1,2} Bagińska et al.²⁰ (81.6%), Szczepańska et al.²¹ (77.98%), Olczak-Kowalczyk¹⁸ (74.58%), and Kaczmarek and Grzesiak²² (70.0%) reached similar conclusions for children below the age of 3; lower percentages were confirmed by Proc et al.²³ (46.5%) and Szmidi et al.¹³ (47.1%).

The occurrence of caries in 3-year-olds in the West Pomerania province currently equaled 47.10% and, therefore, had decreased since 2003 when it equaled 72.9%.¹³ Between 51–87.97% of 4-year-olds and 62.09–85% of 5-year-olds had caries.^{11,12,16,18,20,23}

A comparison of the results of the various regions revealed geographical differences in the percentage of caries either higher or lower than the national median.¹³ There were 20.1% 5-year-olds without caries at the national level, from 29.7% in the Kuyavian-Pomeranian province, 29.5% in Silesia and 13.5% in the Podkarpackie province to 13.2% in the West Pomeranian province.² There were 18.8% of such children in Mazovia, similarly to the present study (19%). Banaszek, on the contrary, noted a high percentage of 2–4 and 4–5 year-olds (75% and 50% respectively).¹⁹ Proc et al. established 46.6% children below the age of 5 in Łódź had caries, including 34.3% of 3-year-olds.²³

However, this was considerably different from the situation in other countries. The percentage was significantly lower in Finnish (7.3%) and Dutch (8%) children.²⁴ Only 6.6% of Norwegian 3-year-olds and 19.1% of 5-year-olds had caries²⁵ and 84% of British and Italian preschool children did not have caries,^{24,26} similarly to Latvian, Swedish, and American children.^{3,27,28} Within the last 45 years, the percentage of 4-year-olds with caries decreased by 67% in Sweden. It was at 83% in the 70s and it is at 16% today.³ The tendency in the other aforementioned countries was similar; therefore, it was possible to significantly decrease the level of caries in deciduous teeth after implementing long-term awareness and prevention programs.

The present study and other Polish studies reported an alarmingly high percentage of carious deciduous teeth and poor hygiene habits in children under the age of 6. The present study established, comparably to the percentage of deciduous teeth with caries, severe caries illustrated by a mean dmft of 7.20, which was similar to the mean dmf from epidemiological studies. In Poland over half of 3-year-olds had carious lesions in at least 3 teeth, and 5-year-olds in at least 5 teeth.⁴ According to oral health surveys, dmft in 5-year-olds equalled 5.07; from 7.18 in the Warmian-Masurian region and 6.02 in Mazovia to 3.55 in Silesia.² The dmft of Białystok children's between the age of 3 and 7 equaled 6.11.¹⁴ Szafrńska and Waszkiel¹⁴ established a lower caries severity, with dmft in 3-and-a-half-year-olds equalling 0.77 and in 5-and-a-half-year-olds 3.74. For Proc et al.²³ the mean dmft in preschool children with caries equaled 2.4 and for Leda et al.¹⁶ 2.74, including 2.26 in 4 and 3.09 in 5-year-olds. Banaszek¹⁹ and Schmidt et al.¹³ (1.79 in 3-year-olds) confirmed a similar severity of caries in 2–4-year-olds and 4–5-year-olds (1.09 and 1.64 respectively for Banaszek).¹⁹ The dmft in Italian preschool children equaled 0.94 (including 0.43 in 4-year-olds and 1.94 in 4 to 5 year-olds) and 0.98 and 1.88 in Swedish three and 5-year-olds.³

The severity of caries in the present study illustrated the high incidence of dental caries. However dmft was

higher because caries were diagnosed differently. On top of WHO criteria, the local loss of the continuity of the enamel surface within the opaque or discolored carious enamel with no visible dentine or with translucent dentine with/without local enamel loss, according to ICDAS II, was also taken into account.

Caries were not always treated in deciduous teeth. The mean number of deciduous teeth with fillings was $w = 1.73$. The present treatment index equaled only 0.27; however, it was much higher for Kaczmarek et al.²⁹ at 0.085 in 4–5 year-olds and for Hilt et al.¹¹ at 0.09 in 5-year-olds. The index equaled 0.14 in 5-year-olds in Łódź¹⁰ and 0.13 in three to 7-year-olds in Warsaw).¹⁸ Szafrńska and Waszkiel confirmed an identically low treatment index equaling from 0.01 to 0.25.¹⁴ A higher treatment index equaling 0.56 was reported in Poznań preschool children.¹⁶ Only 15% of teeth in preschool children were successfully treated vs 80% in numerous countries.¹⁵

Poor caries treatment indexes, in the present study and in other studies, confirmed that preschool children most often did not regularly go to the dentist. Parents, unaware of healthy habits, could be often to blame. They often came to the first dental examination too late to prevent caries when their children were even 5-year-old.

High oral hygiene indexes reflected a risk for caries in children.^{17,18,30} According to Szczepańska the risk for caries in children with poor oral hygiene was 11 times higher than in children with OHI = 0.³⁰ She assessed different parameters (frequency of brushing, who brushed the child's teeth, time elapsed since the beginning of teething until the beginning of tooth brushing, and OHI) and their impact on the caries severity in children and concluded that dental plaque had the biggest impact on the occurrence of caries.^{21,30} Oral hygiene levels were assessed using appropriate indexes and, therefore, credible to assess the risk for caries.

Numerous studies suggested oral hygiene was very poor in the youngest children. According to Olczak-Kowalczyk only one in every three Warsaw children aged three to seven had healthy oral habits, whereas 60% were borderline and almost one in ten children had very unhealthy habits.¹⁸ The mean DI-S in the present treatment group equaled 1.1 ± 0.57 . The mean DI/OHI in preschool children in Wrocław aged 1.5–3 years equaled 0.69, and that in three-year-olds from Łódź 0.30.^{17,21}

According to Banaszek oral hygiene was optimal in 2–4 year-olds and good in 4–5 year-olds (using the index of dental plaque – API – 15 and 32% respectively).¹⁹

Conclusions

The caries epidemiological indexes in Warsaw preschool children at high risk for caries indicated caries was frequent and the demand for treatment high. Poor oral hygiene promoted caries. Massive accumulation of dental plaque meant more carious surfaces on the teeth.

Child health care providers should receive appropriate training and continuing education in oral health, with emphasis laid on early childhood caries risk assessment. Programs including such components: oral health screening during medical visits (well-child visits), dental caries risk assessment, anticipatory guidance (education), fluoride application, referral to a dentist, should be initiated and improved to prevent dental caries in children.

A multidisciplinary approach to pediatric oral health care should be developed, involving physicians, dentists, hygienists, nurses and preschools.

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