Caries pattern in three-year old preschool children

Wzorzec próchnicy u dzieci przedszkolnych w wieku 3 lat

Dorota Olczak-Kowalczyk[1,A–F], Anna Turska-Szybka[1,A,D–F], Izabela Strużycka[2,A,F], Dariusz Gozdowski[3,C,E,F], Teresa Bachanek[4,A,C,F], Urszula Kaczmarek[5,A,C,E,F]

[1] Department of Pediatric Dentistry, Medical University of Warsaw, Warsaw, Poland
[2] Department of Comprehensive Dentistry, Medical University of Warsaw, Warsaw, Poland
[3] Department of Experimental Design and Bioinformatics, Department of Agriculture and Biology, Warsaw University of Life Sciences, Warsaw, Poland
[4] Department of Conservative Dentistry with Endodontics, Medical University of Lublin, Lublin, Poland
[5] Department of Conservative and Pedodontics, Medical University of Wroclaw, Wrocław, Poland

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;
D – writing the article; E – critical revision of the article; F – final approval of article

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Address for correspondence
Anna Turska-Szybka
E-mail: aturskaszybka@orange.pl

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Abstract

Background. Analysis of the results of epidemiological studies of Polish children showed that caries in children can occur very early, and their incidence and intensity increase with age. According to an epidemiological study, 53.8% children at the age of 3 reported an average of 2.4 tooth decay. There is insufficient information about the intensity of decay, the pattern of caries in primary dentition and the treatment undertaken in the group of 3-years-old children with tooth decay.

Objectives. The aim of this study was to evaluate the intensity of caries and their pattern in primary dentition in 3 year-old children with early childhood caries.

Material and methods. The study enrolled children at the age of 3 with early childhood caries included in the program "The monitoring of oral health and its determinants among Polish population in 2015". The presence of caries, fillings and extractions was assessed in teeth and their surfaces.

Results. In 353 3-year-old children with active caries, dmft reached 4.45 ±3.63, dmfs 6.84 ±8.78. In maxilla, 13.4% of the teeth was decayed (dmft = 2.67 ±2.5), in the mandible 8.9% (dmft = 1.78 ±1.67) ($p < 0.001$). Mandibular molars were the most frequently affected by caries, then the maxillary central incisors and the maxillary molars. Of the surfaces affected by caries, 31.9% were proximal, 29.3% smooth and 38.3% occlusal surfaces. Fillings were stated in 6.4% of primary teeth. Due to caries, 1.2% of the teeth were extracted.

Conclusions. Caries lesions in 3-year-old children, appearing symmetrically on both sides of the dental arches, more often affect maxillary than mandibular teeth. Their appearance on the smooth and proximal surfaces of the teeth, involving more than one tooth surface, few fillings and premature incisors loss indicate significant prophylactic and therapeutic negligence.

Key words: epidemiological studies, primary dentition, distribution of caries, preschool children, treatment needs

Słowa kluczowe: badania epidemiologiczne, uzębienie mleczne, rozkład próchnicy, dzieci w wieku przedszkolnym, potrzeby w zakresie leczenia

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Early childhood caries (ECC) remains a significant problem because of its implications for the health status of the oral cavity and the whole body. Its prevalence varies considerably in different populations from 4% in Sweden by 11.7% in England, 50.5% in Lithuania to above 80% in Native Americans or Kosovo.[1–4]

The incidence of tooth decay in children at this age ranges from 0.4 to 3.86.[1–4] In Poland in 2015, 53.8% of children at the age of 3 were affected by caries, and 2.4 teeth were involved in the carious process.[5] A slight decrease in these values was noted (3.4 and 0.5% teeth respectively) in the previous monitoring study.[6]

In ECC prevention, it is crucial to understand not only the importance of its risk factors but also the distribution of caries in dentition. Studies demonstrated that molars, as well as upper incisors, are susceptible to caries.[7-9]

Caries most often develop in the pits and fissures of primary molars, and then on the mesial surface of second molar and the distal surface of the first molar.[9,10] The pattern of caries in primary dentition changes with age, as in 3-year-old children the upper incisors are the most frequently affected by caries, while in older children the lower molar teeth, which may suggest a connection with the timing of tooth eruption and their time of being in the oral cavity.[11,12]

The aim of the study was to evaluate the pattern of early childhood caries in children at the age of 3.

Material and methods

A total of 353 children at the age of 3 with diagnosed ECC were clinically examined as part of a program financed by the Ministry of Health "The monitoring of oral health and its determinants among the Polish population in 2015" (contract no. 11/1/2015/1210/421 dated 18.08.2015). Children with ECC were selected among 656 children examined during nationwide monitoring from 3 voivodships: Lower Silesian, Mazowieckie and Lubelskie. Population samples were selected in a multilayered draw. In each of the voivodships 3 counties and communes were drawn, then kindergartens in respective towns and villages. The inclusion criteria of participation were: the child's cooperation with the dentist, recognized ECC and the written consent of the parents/guardians of the children to participate in the study. Exclusion criteria were: age above or below 3 years, caries-free children and lack of parental/guardian consent for participation in the study.

A clinical examination was conducted by the dentist after training and calibration (Cohen's kappa > 0.655) in standardized conditions, with artificial lighting, using the dental mirror and the WHO 621 periodontal probe. The presence of carious lesions/fillings and teeth lost due to caries was assessed by the World Health Organization (WHO) diagnostic criteria for dental caries detection.[13]

The dmft and dmfs scores, as well as the percentage and proportion of the number of teeth and tooth surfaces affected by caries, were determined.

Prior to the examination, the consent of the Bioethics Committee of Warsaw Medical University (No. KB/216/2015) was obtained.

The results were presented as means and standard deviations as well as the number of patients and percentage shares of them. Statistical analysis was performed using a χ^2 test to compare fractions with STATISTICA v. 12. P-value of 0.05 was considered as statistically significant.

Results

The mean dmft of the sample was 4.45 ±3.63 (dt = 4.11 ±3.44; mt = 0.05 ±0.44; ft = 0.29 ±0.88), dmfs – 6.84 ±8.78 (ds = 6.19 ±7.93; ms = 0.22 ±1.80; fs = 0.42 ±1.66). In children with ECC caries affected 1.54 tooth surfaces on average.

Out of 7,017 evaluated teeth, caries affected 1,572 teeth (22.3%), 943 (13.4%) in the maxilla and 629 (8.9%) in the mandible. The mean dmft in the upper jaw (2.67 ±2.5) was higher than in the lower jaw (1.78 ±1.67). Analysis revealed that the differences in the incidence and intensity of ECC between maxilla and mandible were statistically significant ($p < 0.001$, χ^2 test). Caries were present in 1,452 teeth (92.4%); 91 teeth (6.4%) were filled and 19 (1.2%) were extracted due to caries. The symmetrical distribution of caries is shown in Fig. 1.

Most of the teeth affected by carriers were mandibular molars, then central maxillary incisors and maxillary molars (Fig. 2). Analyzing the frequency of fillings, it was found that the fillings in the mandibular molar teeth were more frequent than in maxillary molars. In the mandible, fillings were present in 10.44% of all first carious molars (31/297) and 10.67% of second molars (20/281). In the maxilla, the percentage was lower and amounted to 5.37% in the first molars (11/205) and 8.47% in the second molars (20/236), respectively. The percentage of filled maxillary incisors was significantly lower. Fillings were in 1.38% (4/288) of central incisors and 1.91% (3/157) lateral incisors.

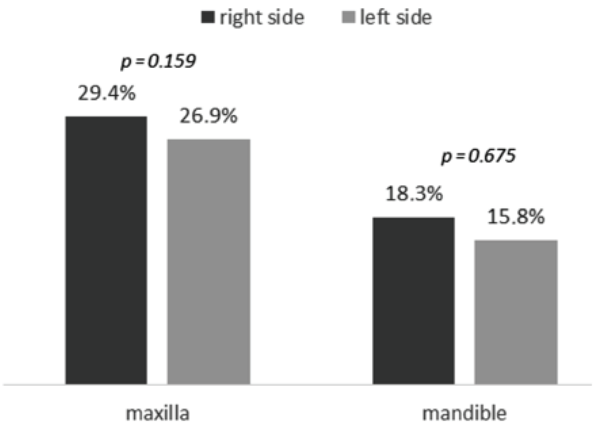

Fig. 1. The symmetry of distribution of caries in the dentition quadrants

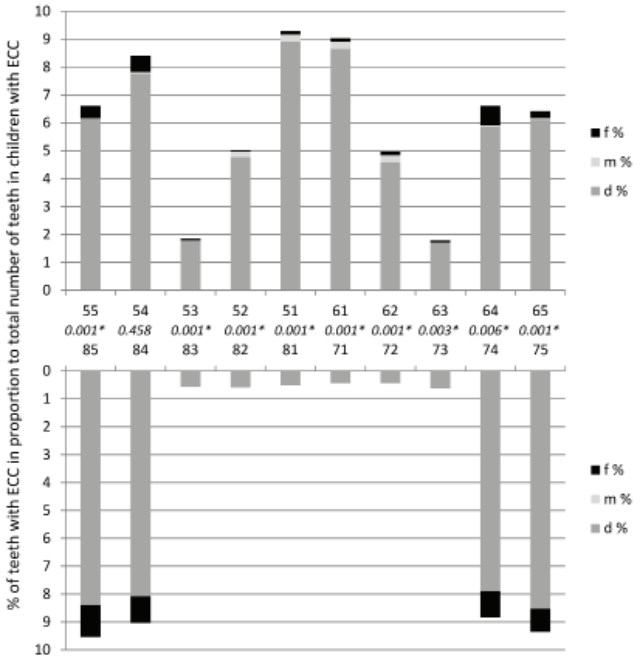

Fig. 2. The distribution of decayed teeth (d), missed due to caries (m) and filled (f) in the dentition of children with ECC

Maxillary incisors were the most often extracted teeth as a result of caries, 2.78% (8/288) of central incisors and 4.46% (7/157) of lateral incisors. None of the mandibular molars were extracted. In the maxilla, 2 of 236 first molars (0.8%) and 1 out of 288 second molars (0.3%) were extracted.

Carious lesions involved 2,416 tooth surfaces (a mean of 6.84 ±8.77 tooth surfaces in a child with carious lesions). The percentage of surfaces decayed (ds), missed due to caries (ms) or filled (fs) in the dentition of children with ECC compared to the number of all decayed surfaces is shown in Fig. 3.

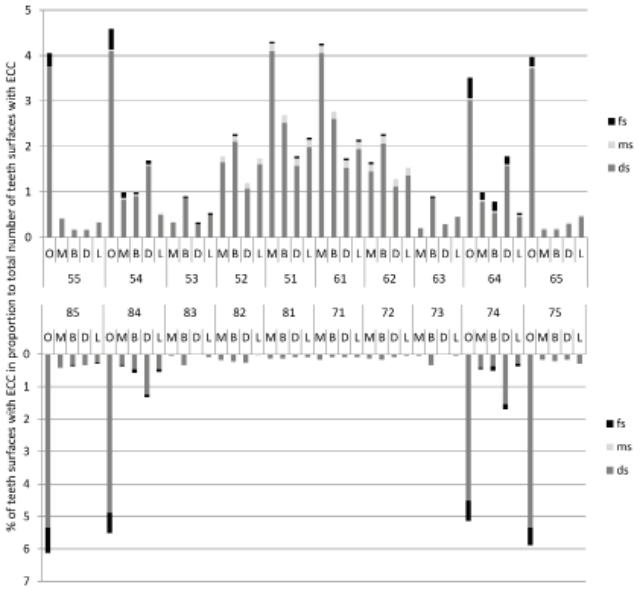

Fig. 3. The percentage of particular teeth surfaces with active caries (ds), missed due to caries (ms) or filled (fs) in the dentition of children with ECC according to a total number of teeth surfaces with ECC

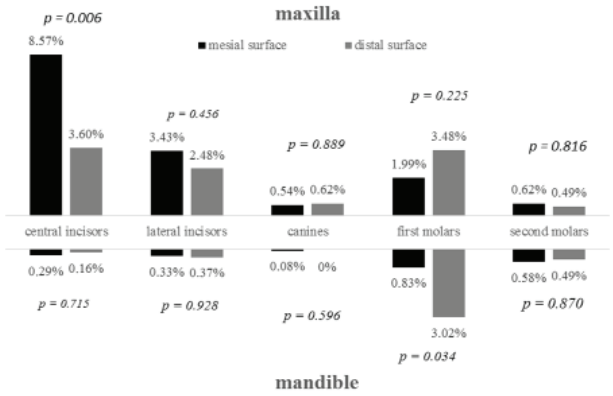

Fig. 4. The percentage of proximal surfaces of teeth with caries to a total number of surfaces with ECC in all children

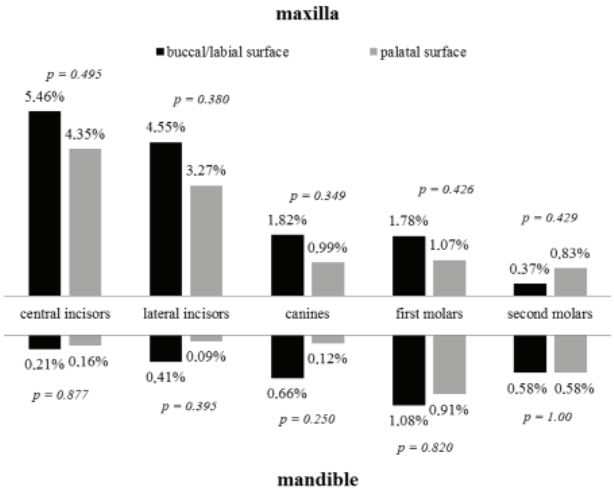

Fig. 5. The percentage of labial/buccal and lingual surfaces of teeth with caries to a total number of surfaces with ECC in all children

Among the 2,416 surfaces of caries, 771 (31.9%) were proximal, 708 (29.3%) smooth, and 937 (38.3%) occlusal surfaces. The percentage distribution of carious teeth surfaces is shown in Fig. 4-6.

Figure 7 provides information on the measurement of inequality in the distribution of dental disease, by displaying the Lorenz curve for the observed sample and average dmft. Half of the 3-year-old population has no caries (about 1.6% of the teeth with dmft according to the number of all teeth with caries). The Gini coefficient was 0.856.

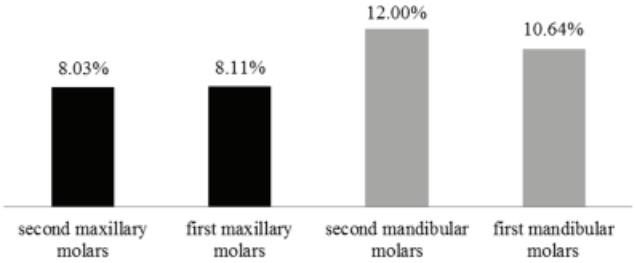

Fig. 6. The percentage of occlusal surfaces of molars with caries to the total number of surfaces with ECC in all children

Discussion

The developed patterns of caries define surfaces involved in caries: labial surfaces of maxillary teeth, pits and fissures of occlusal surfaces, proximal surfaces of molars and also other smooth surfaces of lateral teeth.[14,15] The caries distribution pattern should contribute to reduce the misclassification of caries and thereby increase the ability of the analysis to identify significant correlations between risk factors and ECC.

Among the examined children, more carious teeth were recorded in mandibular molars, followed by maxillary central incisors and molars. This finding is in accordance with the literature. A similar distribution of caries was observed by Agarwal et al.[16], Al-Malik et al.[17], Gizani et al.[9], Du et al.[8] According to the results obtained by Agarwal et al.[16] ECC involved 39.42% of mandibular molars, 32.64% of maxillary molars, 26.07% of maxillary front teeth and 1.84% of mandibular incisors in children 3–6 years old. In the group of children aged 36–48 months (mean age 43 months) from the Podlasie region, more caries were found in mandibular second molars (40.8%) and central upper incisors (35.7%).[18] Similar results were obtained by Cadavid et al. based on the examination of 447 children (mean age of 2.8 ±0.48 years).[19] According to Al-Malik et al., 26% of children had tooth decay restricted to the posterior teeth, 6% in the anterior teeth only, and 39% in both groups.[17] In the study of Chinese children aged 3–5, it was found that dental caries are more common in mandibular molars than in maxillary molars and in anterior maxillary teeth (23%) than anterior mandibular teeth (2% only).[20] This finding is consistent with the study by Gizani et al., where it was found that most carious teeth were first and second mandibular molars, while decayed incisors occur very seldom.[9]

When analyzing the distribution, caries are more prevalent in the posterior than in the anterior part of the jaw. It should be noted that the pattern of caries is related to the age of the child. Certainly, the morphology of the molars is very important.[16,20] However, it is important to remember that the rarer appearance of caries in the anterior segment is associated with the less frequent incidence of caries in the anterior part of the mandible. Mandibular teeth are less subjected to dryness due to the protective mechanism of saliva and are covered by the tongue during sucking, which reduces their exposure to cariogenic factors. The incidence of carious lesions in the primary maxillary incisors in young children is primarily related to the child consuming cariogenic products directly before bedtime or at night and to reduced saliva secretion during sleep.[14] This pattern of dental caries is also related to the chronology of tooth eruption and acquisition of cariogenic bacteria. As the incisor teeth are first to erupt, they are more susceptible to adverse bottle-feeding habits, especially during bedtime, and become decayed at an earlier age.

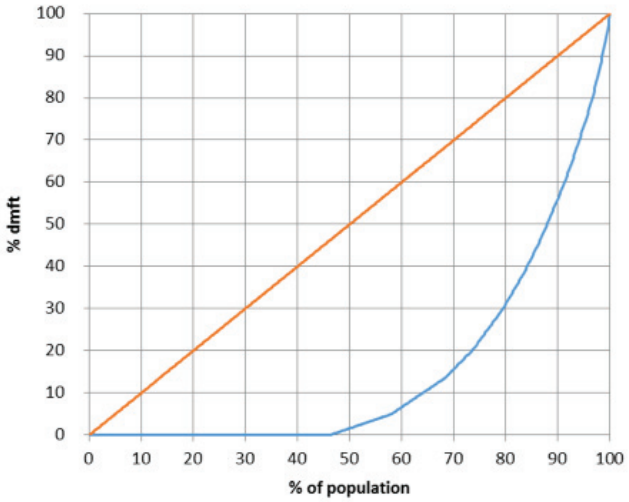

Fig. 7. Lorenz curve for dmft

In the youngest children, caries mainly involves anterior teeth.[14,18,21–28] In the examination of 3,171 Turkish children aged 8–60 months (mean age 25.8 ±10.11 months) caries were mainly observed in the central incisors in the maxilla.[21] Similarly, among children in Łódź, maxillary central incisors were most often affected by dental caries.[23] Among 2,428 children from Arizona, aged 6–36 months, in the group of 3-years-old, 25% had diagnosed caries – 16% in maxillary incisors, more often on interproximal surfaces than on smooth surfaces.[14] Also in a Danish 3-year-old child, caries was found mainly in the maxillary anterior teeth, on the mesial surfaces.[29] Among 353 children in Macao aged 2.8 ±0.6 years, 7% had dental caries only in the anterior teeth and 8% in the teeth other than the maxillary anterior. In the study by Wulaerhan et al., maxillary incisors had a higher incidence of caries than mandibular incisors (23 vs 2%).[20] In Brazilian children up to 3 years old, up to 87.5% of upper incisors and canines had caries, compared to 9.4% in lower incisors and canines.[22] Among children in Wrocław, aged 30 ±5.7 months, upper incisors were most often affected by caries (central 34%, lateral 22.4%), palatal and labial surfaces similarly, followed by second and first lower molars (7%), and rarely frontal lower teeth (less than 1%).[24] Similar observations were reported by Bagińska and Stokowska[18], where cavities in central incisors dominated in the maxilla followed by cavities in molars, because tooth decay often develops according to the sequence of teeth eruption, successively affecting teeth appearing in the oral cavity.[14] Similarly, Kerosuo and Honkala observed more frequent appearance of caries in incisors and molars, while the lowest in canines and mandibular incisors.[7] The authors pointed to 3 times higher incidence of caries in Tanzanian children compared with Finnish.

Among the 3-year-old children examined during this study, caries occurred more often in the maxilla, in the first molars, whereas in the mandible caries occured in second molars. Similarly, in the study by Bagińska and

Stokowska, caries was observed in the second mandibular molars more often than in the first mandibular molars.[18] In Hindu children aged 3–6 years, dental caries were the most common in the second molars of maxilla and mandible. Proc and Filipinska-Skąpska[23], Bagińska and Stokowska[18] and Dimitrova et al.[25] have stated that the second molars are the most prone to caries. Analyzing the appearance of caries in molar teeth in children aged 8–60 months, Doğan et al. noticed their more frequent appearance in the first molars followed by the second ones, in the maxilla and in the mandible, although in the mandible the numbers differed only slightly.[21]

There are various reasons for the differing susceptibilities to caries, such as tooth surface morphology or posteruptive enamel maturation. The caries susceptibility of a tooth surface also varies over time and rises rapidly approximately 2–3 years after eruption. The occlusal surfaces are the most susceptible, because of complex surface morphology and difficult access for effective oral hygiene. The pit and fissures serve as retentive areas for food making them more prone to carious attacks. The results of the present study confirm this. Carious lesions involved 38.3% of the occlusal surfaces, followed by 31.9% of the interproximal surfaces and 29.3% of the smooth surfaces. In the examination of Indian children, caries more often involved occlusal surfaces (46%) as well.[16] However, the researchers noted a greater difference in the incidence of lesions on proximal surfaces (37%) compared to smooth surfaces (16%), which was probably related to the age difference of the examined children.[16] For that matter, according to Warren et al., caries on occlusal surfaces were the most common (56%), especially in the second molar, while 58% appeared on smooth surfaces.[3] Similarly, a study by King et al.[27], Kerosuo and Honkala[7], Nørrisgaard et al.[29], Gizani et al.[9], Leroy et al.[12] demonstrated that the occlusal surfaces of the molar teeth are most often affected by caries, especially the second molar.[12]

In accordance with previous findings it was found that tooth decay in young children mainly occurs on occlusal surfaces.[12,14,18,23,25,29] In these children, a small number of proximal surfaces are affected by caries, and if the disease develops, it begins after reaching complete contact between the first and second molar, at the age of 3.5 years. There are no differences in the incidence of caries on the mesial and distal surfaces of the first and second molar.[14,21]

In the present study, the incidence of dental caries on the proximal surfaces of the molars was higher. In the maxilla and mandible, caries mostly involved distal surfaces of the first molars than mesial surfaces. First primary molars had significantly more caries lesions on the proximal surface compared to second primary molars. That can be explained by the fact that at the age of 3, the second primary molars had barely erupted and had surface contact with the first primary molars, creating a susceptible place for the development of proximal caries. In the Kerosuo and Honkala study, caries mostly involved the second molar occlusal surface, followed by the first molar occlusal surface and the distal one.[7] However, according to Ginzani et al., interproximal surfaces between the first and second molar were involved in caries in the maxilla, whereas in the mandible – more often the distal than the mesial surface of the first molar.[9] Similarly, Leroy et al. reported more frequent appearance of caries on the distal surface of the first molar.[12]

Changes in the distribution of caries with age are confirmed by the examination of younger children whose occlusal and buccal surfaces were most affected by caries.[21] In a study by Doğan et al., an analysis of the distribution of caries on the surfaces of the particular teeth was performed.[21] In maxillary incisors caries involved mostly labial surfaces, then mesial ones.In the present study, caries occurred mostly on the mesial surface of the central incisors (significantly more often than distal surface), followed by the labial surface. In the posterior maxillary teeth, the majority of carious lesions were located on the labial surfaces, slightly less often on proximal surfaces.

Grzesiak and Kaczmarek found decay in maxilla in the descending order: palatal, mesial, buccal, occlusal, distal, in mandible: 17.6% occlusal surfaces in molars, and rarely distal surfaces in all groups of teeth.[24] According to Kerosuo and Honkala, in the anterior maxillary teeth, dental caries were present on the mesial surfaces of the central incisors, followed by distal and mesial surfaces of the lateral incisors.[7]

Similarly to Wulaerhan et al.[20], Gizani et al.[9], in the present study carious lesions were symmetrically distributed on the right and left side of the dental arch. Comparison of ECC in upper and lower jaw revealed that maxillary teeth were more frequently affected by caries (13.4%) than mandibular teeth (8.9%). Also, the mean dmft in the upper dental arch (2.67 ±2.5) was higher than in the lower dental arch (1.78 ±1.67). Similar results were obtained by other authors.[9,16,21–23] An analysis of caries distribution in the study by Argawal et al. showed that 30% concerned maxilla, 26% mandible, and the mean dmft was 2.81 ±2.16 and 2.27 ±1.21 respectively ($p < 0.001$).[16] The differences observed in Indian children aged 3 to 6 years were smaller, which may be related to the age of children involved in the study.[16] In the dentition of 3-year-old children from Łódź, the intensity of caries was also statistically significantly higher in the maxilla (2.6 ±5.8) than in the mandible (0.9 ±2.5).[23]

It should be emphasized that in agreement with our results, studies conducted by other authors confirm a higher incidence of caries in the upper anterior teeth than the lower teeth.[16,18,19,21,24] It is believed that the incidence of caries in the upper arch is associated with lower flow and protection of saliva of the maxillary teeth.[16]

The present study found that the predominant proportion of dmft values was caused by untreated carious lesions. Although preventive and therapeutic procedures in children are completely refunded by public dental care, children do not benefit from it. 48% of children had not

visited a dentist yet. In the case of 4.6% of children, more than 1 year has elapsed since their last visit to the dental office, and only 35.1% of children had visited a dentist during the last 6 months.[5] Therefore, other factors than the financial barrier keep children from taking advantage of free dental care.

In the present study, the caries were diagnosed at the level d3, thus less advanced carious lesions were omitted. It can be speculated that the intensity of caries would be much higher when including pre-cavity lesion (d1, d2). However, the use of this diagnostic criterion requires drying the smooth surfaces and taking a bitewing X-ray, which reduces the child's cooperation. Studies have documented that using X-ray as a diagnostic tool for caries detection increases the frequency of identified proximal carious lesions significantly, particularly in the primary dentition.

Information on surface-specific dental caries patterns is a useful source of reference about preventive strategies. The presence of caries in the primary dentition is the predictor of caries in permanent dentition.

Conclusions

The appearance of caries in 3-year-old children showed a symmetrical distribution localized more often on primary mandibular molars, followed by maxillary central incisors and maxillary molars. Caries, mostly untreated, appear on occlusal surfaces as well as smooth and proximal teeth surfaces, often involving more than one tooth surface. The small percentage of treated teeth and the premature loss of incisors are evidence of major preventive and therapeutic negligence in the youngest patients.

A high caries prevalence and dmft scores indicate the necessity of preventive programs in preschool children including fluoride varnish applications, dietary and oral hygiene maintenance, and fissure sealants. Primary molars and maxillary incisors will need special attention during preventive efforts.

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