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## Dental caries in primary teeth during early childhood in the Warsaw agglomeration

Próchnica zębów mlecznych w okresie wczesnego dzieciństwa w aglomeracji warszawskiej

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### KEYWORDS

severe early childhood caries, toddler age, caries incidence, caries level

### SUMMARY

**Introduction.** The high incidence and level of Early Childhood Caries (ECC) in children aged 3 in Poland indicate a high risk of developing this disease in younger children. There are no data describing the scale of the problem in Poland.

**Aim.** Determining the prevalence and level of severe early childhood caries (S-ECC), the needs of conservative treatment in children in the second and third year of life from the Warsaw agglomeration.

**Material and methods.** A cross-sectional study of children aged 12-36 months was carried out after obtaining the consent of the Bioethics Committee of the Medical University of Warsaw. The presence of non-cavitated ( $d_1$ ) and cavitated caries ( $d_2$ ), fillings (f), and missing teeth (t) and surfaces (s) caused by caries (m), periodontal abscesses and fistulas was assessed. The frequency of ECC and its intensity ( $d_1d_2mft$  and  $d_1d_2mfs$ ), conservative treatment index ( $f/f + d$ ) were determined. In the statistical analysis, the chi-square test was used to compare the fractions.

**Results.** 496 children were examined, including 262 (52.8%) boys. S-ECC was recorded in 44.8% of the respondents,  $d_1d_2mft$  and  $d_1d_2mfs$  reached the values of  $2.62 \pm 3.88$  and  $4.46 \pm 8.42$ . The incidence and level of S-ECC increased with age. The greatest increase was seen in the subgroup > 18 to 24 months. The main components of  $d_1d_2mft$  were the teeth with caries (d). Abscesses and fistulas were diagnosed in 15 (3%) patients. The treatment indexes increased from 0 in the youngest to 0.08 in the oldest age group.

**Conclusions.** Caries of primary teeth in the early childhood period is characterized by a rapid transformation of non-cavitated lesions into cavitated ones and subsequent eruption of teeth. With medical negligence, complications result in tooth loss. The greatest increase in the frequency and level of caries is observed in the second half of the second year of life, therefore, early home and professional prevention is essential.

## SŁOWA KLUCZOWE

ciężka postać próchnicy wczesnego dzieciństwa, wiek poniemowlęcy, częstość występowania, poziom próchnicy

## STRESZCZENIE

**Wstęp.** Wysoka częstość występowania i poziom próchnicy wczesnego dzieciństwa u dzieci w wieku 3 lat w Polsce wskazują na wysokie ryzyko zachorowania na tę chorobę dzieci młodszych. Brak jest danych opisujących skalę problemu w Polsce.

**Cel pracy.** Określenie częstości występowania i poziomu ciężkiej postaci próchnicy wczesnego dzieciństwa (S-ECC), zaspokojenia potrzeb leczenia zachowawczego u dzieci w 2. i 3. roku życia z aglomeracji warszawskiej.

**Materiał i metody.** Badanie przekrojowe dzieci w wieku 12-36 miesięcy przeprowadzono po uzyskaniu zgody Komisji Bioetycznej WUM. Oceniono obecność próchnicowych zmian nieubytkowych (d), ubytkowych (p), wypełnień (w), braków zębowych spowodowanych próchnicą (u), ropni i przetok okołozębowych. Określono częstość S-ECC, jej nasilenie (dpuwz i dpuwp) i poziom zaspokojenia potrzeb w zakresie leczenia zachowawczego (wz/wz + pz). W analizie statystycznej zastosowano test chi-kwadrat do porównania frakcji.

**Wyniki.** Zbadano 496 dzieci, w tym 262 (52,8%) chłopców. S-ECC odnotowano u 44,8% badanych, dpuwz i dpuwp osiągnęły wartości  $2,62 \pm 3,88$  i  $4,46 \pm 8,42$ . Częstość i poziom S-ECC wzrastały z wiekiem. Największy wzrost obserwowano w podgrupie > 18 do 24 miesięcy. Głównymi składowymi dpuwz były liczby zębów z próchnicą (pz). Ropnie i przetoki zdiagnozowano u 15 (3%) pacjentów. Wartości wskaźników leczenia wzrastały od 0 w najmłodszej do 0,08 w najstarszej grupie wiekowej.

**Wnioski.** Próchnicę zębów mlecznych w okresie wczesnodziecięcym charakteryzuje szybkie przechodzenie zmian nieubytkowych w ubytkowe i obejmowanie kolejno wyrzynających się zębów. Przy zaniedbaniach leczniczych dochodzi do powikłań skutkujących utratą zęba. Największy wzrost częstości i poziomu próchnicy obserwuje się w drugim półroczu 2. roku życia, dlatego niezbędne jest wczesne zapobieganie domowe i profesjonalne.

## INTRODUCTION

Historically, caries that develops shortly after tooth eruption was most often referred to as caries praecox, nursing caries, labial caries, baby bottle tooth decay or comforter caries (1). These terms did not precisely define the disease, but rather indicated the location of lesions, the causative factor, or emphasised their onset in early childhood. The term Early Childhood Caries (ECC) was proposed at a workshop held by the National Institute for Dental and Craniofacial Research in 1999 to describe a disease that occurs in the first 5 years of a child's life without suggesting the causal factor. The American Dental Association (ADA) and the American Academy of Pediatric Dentistry (AAPD) define early childhood caries as the presence of one or more decayed, missing or filled teeth (due to caries) in a child 72 of months age (5 years and 11 months) or younger, i.e. children before the age of 6 years (2). At the same time, Severe Early Childhood Caries (S-ECC) was defined to refer to "atypical", "rapidly progressive", "acute", or "rampant" pattern of dental caries.

This form is diagnosed for:

- any sign of smooth surface caries in < 3-year-olds,
- carious lesions on at least 4 surfaces in 3-year-olds,
- carious lesions on 5 surfaces in 4-year-olds,
- and carious lesions on at least 6 surfaces in 5-year-olds (2-5).

Defining the presence of any carious lesion in children in the first three years of life as S-ECC emphasizes the high

dynamics of the disease process in freshly erupted teeth, which may lead to the rapid destruction of dentition (6-8).

The scale of the problem of early childhood caries in the group of the youngest children is not fully known as most of the epidemiological studies in various countries were conducted in older children. Studies in a group of 3-year-olds, showing the frequency and the level of caries in primary teeth, as well as the treatment needs associated with this disease and its complications, indicate that younger children are also affected. In Poland, epidemiological research was conducted among 3-year-old children in 2002, 2009, 2015 and 2017 as part of a Ministry of Health programme "Monitoring of Oral Health in Polish Population". The incidence of caries was estimated at 41.1% in 2017 and was only 15% lower than in 2002. Severe early childhood caries, defined as  $d_2mft > 4$ , was reported in 1 in 5 children. Over the past 15 years, the  $d_2mft$  has also slightly decreased, from 2.9 in 2002 to 1.85 in 2017 (9). The prevalence of ECC in this age group varies from country to country. It is lower in most European countries compared to Poland. Higher rates were recorded only in Lithuania (50.6% in 2010) (10). The same rates were 11.7% in 2013 in England, 8.7% in 2013 in Italy, and 14% in 2015 in Germany (11-13).

The epidemiological studies conducted in a group of 3-year-olds in Poland also revealed major negligence in the prevention and treatment of dental caries. The needs for conservative treatment of cavitated lesions were covered only in 7% of children at this age (9). The need for rapid treatment was found in 7.3% of children and immediate

treatment due to pain or infection was needed in 3% of 3-year-olds. No current data to estimate the scale of the problem of primary teeth caries in children in early childhood are available in Poland. The prevalence of caries in children in the first three years of life was estimated in 2003 and 2006 at 35.3-55.6%, respectively (14).

## AIM

The aim of the study was to assess the prevalence and the level of severe early childhood caries (S-ECC), the level of satisfaction of the needs in the treatment of caries in 2-3-year-olds from the Warsaw agglomeration, as well as the dynamics of the carious process.

## MATERIAL AND METHODS

The study involved a clinical dental examination of children invited to participate in the programme to assess oral health and the course of teething at the Department of Pediatric Dentistry at the Medical University of Warsaw in 2011-2017. The obtained results were analysed statistically. The study was approved by the Bioethics Committee of the Medical University of Warsaw (KB/221/2009).

Children aged 12-36 months and their parents/legal guardians from Warsaw and areas located no more than 20 km away from Warsaw were included in the study.

The inclusion criteria included a written consent for child's participation in the clinical evaluation and parental completion of a questionnaire, as well as child's cooperation enabling clinical examination.

Children aged less than 12 months and over 36 months, those with intellectual disability, chronic diseases, pharmacotherapy likely to affect dental health, those whose parents/legal guardians failed to complete the questionnaire, and children residing outside the study region were excluded from the study.

The children were classified into four age subgroups:

- I. > 12-18 months
- II. > 18-24 months
- III. > 24-30 months
- IV. > 30-36 months.

The clinical examination of oral health was performed in a dentist's office equipped with a shadowless lamp, using a mirror and a WHO-621 periodontal probe. The number of erupted teeth, the presence of carious lesions, filled and missing teeth, fistulas and abscesses was assessed. All tooth surfaces were evaluated in subsequent quadrants. Carious lesions were assessed according to the criteria of the modified International Caries Detection and Assessment System (ICDAS II) (15).

International Caries Detection and Assessment System (ICDAS II):

0. – no evidence of any change in enamel transparency after 5 sec air drying,
1. – white opacity hardly visible on wet surface, clearly visible after drying,

- 1a.– dark opacity hardly visible on wet surface, clearly visible after drying,
2. – white opacity clearly visible when dry,
- 2a.– dark opacity clearly visible on wet surface,
3. – localized enamel breakdown (without clinical visual signs of dentinal involvement) within opaque or discoloured enamel,
4. – underlying dark shadow from dentine with or without enamel loss,
5. – distinct cavity with visible dentine,
6. – extensive cavity with visible dentine.

Lesions coded 1 and 2 were diagnosed as carious if located in the gingival (plaque retention site) or chewing area and were described as "d<sub>1</sub>". Lesions coded at least 3 were classified as cavitated caries and described as "d<sub>2</sub>". The following parameters were assessed:

- mean number of teeth present in the oral cavity,
- frequency of S-ECC, i.e., percentage of children with  $d1d_2mft > 0$ ,
- $d_2mft$ ,  $d_2mfs$ ,  $d_1d_2mft$ ,  $d_1d_2mfs$  and their components, where  $d_1t/d_1s$  denotes teeth/tooth surfaces with non-cavitated lesions (ICDAS II code 1 and 2),  $d_2t/d_2s$  denotes cavitated caries,  $mt/ms$  – missing due to caries, and  $ft/fs$  – filled (3, 5).

Oral health was assessed by three specialists in pediatric dentistry, who were appropriately trained and calibrated. During calibration, each specialist examined the same group of 10 children independently. Cohen's kappa coefficients ranging from 0.89 to 0.95 were obtained.

During the research, dietary and hygienic recommendations were provided, preventive procedures were performed (application of fluoride varnish 0.5% NaF) or children were qualified for and offered dental treatment.

In the statistical analysis, the chi-square test was used to compare the fractions (percentages, e.g., of carious teeth) between the two groups. Statistica 13 was used for statistical analyses. The level of significance was < 0.05 for all analyses. The level of significance was < 0.05 for all analyses.

## RESULTS

A total of 496 children, including 262 (52.8%) boys, participated in the study. The size of the age subgroups ranged from 105 in the youngest group to 133 in the age subgroup > 24-30 months (tab. 1).

The prevalence of severe early childhood caries was estimated at 44.8% throughout the study group. The prevalence of S-ECC increased with age. The disease was present in one in five children in the youngest age group and in over half of the oldest children (tab. 2). Similarly, the level of caries, expressed by  $d_1d_2mft$  and  $d_1d_2mfs$ , increased.

Regardless of the age of the children, the main component of the  $d_1d_2mft$  index was the number of teeth with carious lesions, which accounted for 100% of the index value at the age > 12-18 months, and 90.5% at the age > 30-36

months (fig. 1). Children aged > 18-24 months have already had filled and missing teeth due to caries.

Considering the number of teeth present in the oral cavity in children in subsequent age groups, it was reasonable to evaluate the ratio of  $d_1d_2$ mft to the mean number

of teeth present in these groups. It indicates the largest (two-fold) increase in the level of caries in the second half of the second year of life, despite the 1.5-fold increase in the number of teeth (fig. 2).

The analysis of  $d_1d_2$ mfs/ $d_1d_2$ mft ratios showed that children in the youngest age group already presented with more than one carious surface (fig. 3).

The analysis for the total study group did not show any significance of the sex for any of the analysed caries indicators (tab. 3).

**Tab. 1.** Age structure of children aged 12-36 months included in the study

Age (months)	Number n/%	Mean age ± SD (months)
> 12-18	105 (27.2%)	15.52 ± 2.06
> 18-24	129 (25.8%)	21.76 ± 1.83
> 24-30	133 (26.0%)	21.76 ± 1.83
> 30-36	129 (20.1%)	33.75 ± 1.55
Total	496 (100%)	24.16 ± 6.93

## DISCUSSION

The frequency of severe early childhood caries was estimated at 44.8% in the total group of children aged > 12-36 months. The same frequency was 55.6% in a similar study in 153 children > 18 to 36 months of age, attending three randomly selected nurseries in Wrocław. This may result, among other things, from the difference in the age of the study groups and the number of erupted teeth (8). In the group of children from the Warsaw agglomeration, the average

**Tab. 2.** S-ECC frequency and level as well as  $d_1d_2$ mft and  $d_1d_2$ mfs components throughout the study group and depending on age

Parameters	Total	Age groups (months)			
		> 12-18	> 18-24	> 24-30	> 30-36
N (%)					
Number of subjects with	496	105	129	133	129
$d_1d_2$ mft > 0	222 (44.8%)	20 (19.0%)	55 (42.6%)	71 (53.4%)	76 (58.9%)
Fistulas, abscesses	15 (3.0%)	2 (1.9%)	2 (1.6%)	4 (3.0%)	7 (5.4%)
Mean ± SD					
Number of teeth	15.40 ± 4.60	9.21 ± 3.67	14.27 ± 2.83	17.48 ± 2.73	19.40 ± 1.28
$d_1d_2$ mft	2.62 ± 3.88	0.71 ± 1.67	2.05 ± 2.91	3.32 ± 4.28	4.02 ± 4.77
$d_1t$	0.32 ± 1.06	0.17 ± 0.83	0.32 ± 0.95	0.43 ± 1.36	0.35 ± 0.99
$d_2t$	2.04 ± 3.46	0.54 ± 1.52	1.49 ± 2.48	2.54 ± 3.98	3.29 ± 4.22
mt	0.10 ± 0.66	0.00 ± 0.00	0.12 ± 0.63	0.18 ± 0.91	0.09 ± 0.63
ft	0.15 ± 0.71	0.00 ± 0.00	0.12 ± 0.79	0.17 ± 0.68	0.29 ± 0.91
$d_2$ mft	2.29 ± 3.73	0.54 ± 1.52	1.73 ± 2.75	2.89 ± 4.25	3.67 ± 4.55
$d_1d_2$ mfs	4.46 ± 8.42	1.09 ± 3.07	3.80 ± 6.61	5.02 ± 7.72	7.27 ± 11.98
$d_1s$	0.40 ± 1.33	0.17 ± 0.83	0.40 ± 1.11	0.44 ± 1.42	0.56 ± 1.70
$d_2s$	3.43 ± 7.47	0.90 ± 2.98	2.81 ± 5.88	3.63 ± 6.43	5.90 ± 10.94
ms	0.43 ± 2.76	0.00 ± 0.00	0.47 ± 2.53	0.75 ± 3.91	0.40 ± 2.66
fs	0.20 ± 0.91	0.02 ± 0.20	0.13 ± 0.79	0.20 ± 0.75	0.42 ± 1.38
$d_1$ mfs	4.05 ± 8.24	0.91 ± 3.01	3.40 ± 6.48	4.58 ± 7.78	6.71 ± 11.62
Conservative treatment index ft/ft + fs	0.07 ± 0.20	0.0 ± 0.0	0.07 ± 0.19	0.06 ± 0.19	0.08 ± 0.23

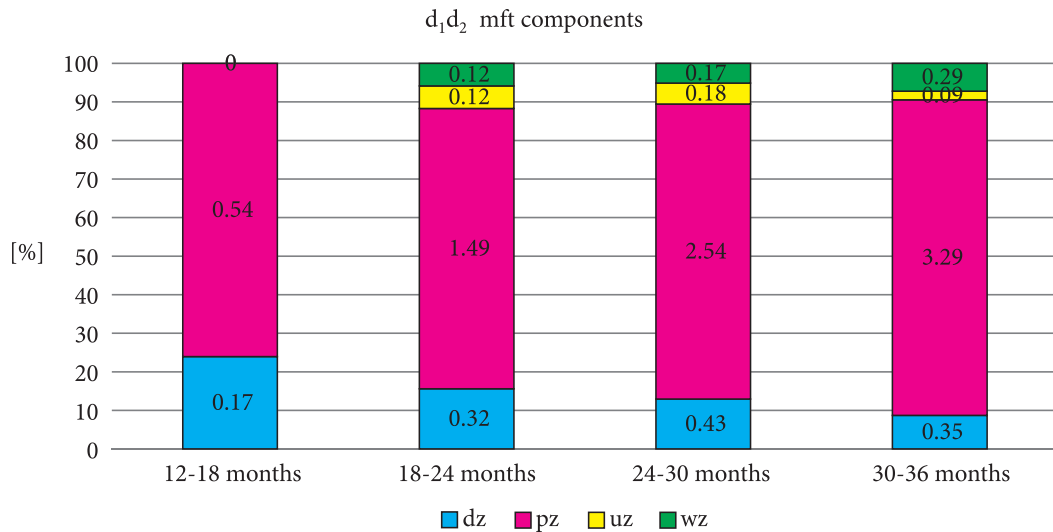


Fig. 1. The structure of the components of the  $d_1d_2$ mft in individual age subgroups

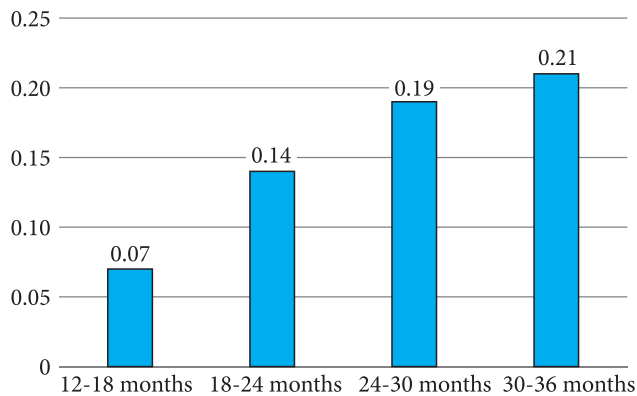


Fig. 2. The ratios of  $d_1d_2$ mft to the mean numbers of teeth in individual age subgroups of children

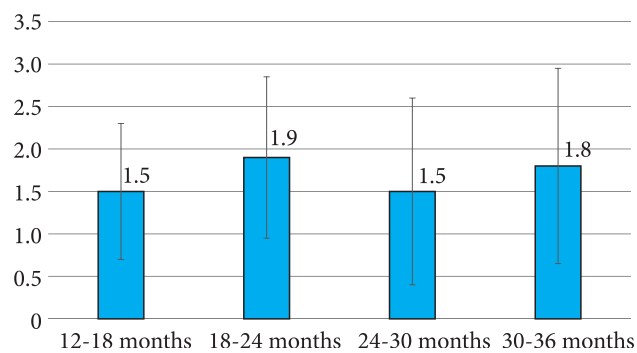


Fig. 3. Mean  $d_1d_2$ mfs/ $d_1d_2$ mft ratios in individual age subgroups

Tab. 3. Comparison of dental health between girls and boys in the total group of children in the early childhood period

	Girls (n = 234)	Boys (n = 262)	P
N (%)			
$d_1d_2$ mft > 0	100 (42.7%)	122 (46.6%)	0.392
Fistulas, abscesses	9 (3.8%)	6 (2.3%)	0.312
Mean ± SD			
Number of teeth	15.45 ± 4.64	15.34 ± 4.56	0.791
$d_1d_2$ mft	2.52 ± 3.75	2.71 ± 4.00	0.581
$d_1$ t	0.30 ± 0.97	0.34 ± 1.14	0.676
$d_2$ t	1.93 ± 3.32	2.14 ± 3.58	0.509
mt	0.09 ± 0.53	0.12 ± 0.76	0.579
ft	0.20 ± 0.86	0.11 ± 0.55	0.181
$d_2$ mft	2.21 ± 3.62	2.37 ± 3.84	0.650
$d_1d_2$ mfs	3.98 ± 7.19	4.88 ± 9.39	0.238
$d_1$ s	0.35 ± 1.10	0.45 ± 1.50	0.402
$d_2$ s	3.03 ± 6.22	3.79 ± 8.44	0.258
ms	0.34 ± 2.10	0.50 ± 3.24	0.525
fs	0.26 ± 1.15	0.14 ± 0.62	0.132
$d_2$ mfs	3.63 ± 7.00	4.43 ± 9.21	0.284

\*statistically significant  $p < 0.05$

number of teeth in the study group was  $15.40 \pm 4.60$  and ranged from  $9.21 \pm 3.67$  in the group > 12-24-month-olds to  $19.40 \pm 1.28$  in the group of children aged > 30 to 36 months. A higher frequency of caries was also observed by researchers in the Łódź region among children aged 1-4 years (78.57%) (6). In a similar study in a group of children up to 3 years of age, the incidence of caries was estimated at 34.3% (14).

Data on primary teeth caries in children up to 3 years of age in other countries also vary significantly. These differences certainly reflect the impact of socio-demographic and cultural factors specific to different world regions, as well as the diversity of study groups and methodologies used. A national study in Japan in 2007 showed that the estimated caries incidence was only 2.8% among children aged 18 months and 25.9% among 3-year-olds (16).

A similar frequency (25%) was found by Douglass et al. in children up to 34-36 months of age from Arizona (17). Milgrom et al. (18) reported higher rates of caries among US children aged 6-36 months. Incipient carious lesions and cavities were found in 46.8% and 39.1% of children, respectively.

According to literature, the highest increase in the incidence of caries in children is observed between the ages of 2 and 3 years (35%), followed by 3 and 4 years (36%) (19). Studies conducted at the turn of 1992 and 1993 showed caries in 5.42% of 1-2-year-olds and 36.9% of 2-3-year-olds.  $D_2$ mft values were 0.2 and 1.36, respectively (19). Similar results were obtained by the authors who assessed children from the Łódź region. They estimated caries incidence at 15.1% in 2-year-olds and 45.4% in 3-year-olds (14). The findings in children from the Warsaw agglomeration allowed for more detailed observations. The incidence of dental caries increased by 23.6% in the second half of the second year of life (> 18 to 24 months) compared to 19% in the first six months. It increased only by 10.8% and 5.5% in subsequent age subgroups. Similarly, the highest increase in the level of caries is observed in the second half of the second year of life. A study conducted in a group of 504 Tehranian children aged 12-36 months also showed an increasing incidence of caries with age (3% at the age of 12-15 months, 9% at 16-19 months, 14% at 20-25 months, and 33% at 26-36 months). However, the greatest increase was observed in the second half of the third year of life (20).

The increase in the incidence and level of caries in 2-year-olds in Poland may be related to dietary and hygiene behaviour. Epidemiological studies conducted among Polish children aged 3 years as part of the programme entitled "Monitoring the oral health of the Polish population in 2016-2020" showed that 86.7% of children had sugar added to food or beverages in the first two years of life. A total of 17% of children > 12 months of age consumed beverages sweetened with sugar or honey at bedtime/night. Nearly half of the children did not have their teeth cleaned with fluoride toothpaste twice a day. Only 34.5% of children had their teeth cleaned by an adult despite the known fact that

the manual skills of a child at the age of 3 years make it impossible to perform this activity effectively (9).

Teeth cleaning is rarely initiated immediately after eruption. The lack of child's cooperation is a common barrier. Parents reported the following reasons for hygienic negligence: resistant behaviour, tantrums, painful teething, and even the child's fatigue (21). A study among mothers of children under 4 years of age demonstrated that oral hygiene in the child was often limited to brushing their teeth and that they resigned from toothbrushing when the child was ill or tired (22). It should be also noted that the treatment of carious lesions is usually delayed, as evidenced by the conservative treatment index ranging from 0 in the youngest age group to 0.08 in the oldest age group, missing teeth due to caries and the presence of fistulas or abscesses.

The presented study has also shown significant progression of carious lesions. In the children from Warsaw, the average number of teeth with non-cavitated caries accounted for only 12% and the average number of carious surfaces for 9% of the  $d_1d_2$ mft value. It is worth emphasising that the percentage of the  $d_1t$  component decreased with age. It was 23% in the age subgroup > 12-18 months, followed by 15.6, 12.9 and 8.7% in subsequent groups. At the same time, there was an increase in  $d_2t$  with only slight changes in ft. This indicates rapid progression of a non-cavitated lesion into a cavitated one in the primary dentition in the case of medical negligence. A study in children from Wrocław assessed dental health according to the criteria of Yagot et al. modified by the authors themselves, which take into account the presence of non-cavitated carious lesions (code 1 – incipient caries: white opaque demineralisation spot located pericervically or tangentially), missing (code 2 to 4) and inactive lesions (code 5). The researchers also noticed that cavitated caries was the most common lesion in the study group of children (43.5%). Non-cavitated lesions were almost four times less common (11.8% of children) (8). Similarly, American researchers reported smaller numbers of tooth surfaces with non-cavitated lesions (1.2 at the age of 13-24 months, 2.3 at the age of 25-36 months) than cavitated ones (3.7 and 9.3, respectively) (18).

The incidence of caries was 55.6% and was slightly higher in boys (62.6%) than in girls (47.1%) throughout the group of children in Wrocław. The severity of caries was also higher in boys ( $d_2$ mft  $2.7 \pm 3.2$  and  $2.2 \pm 3.3$ , respectively). However, these differences were not statistically significant (8). Similarly, no relationship between caries and the gender of children up to 3 years of age was reported by other researchers (18, 20, 23).

## CONCLUSIONS

Primary teeth caries in early childhood children from the Warsaw agglomeration develops shortly after tooth eruption. The carious process is highly dynamic, as evidenced by the rapid progression of non-cavitated into cavitated lesions, including subsequent tooth surfaces and teeth



erupting in the oral cavity. At the same time, neglected conservative treatment of carious lesions leads to complications resulting in tooth loss.

The greatest increase in the frequency and the level of caries in primary teeth at the post-toddler age is observed

in the second half of the second year of life. Therefore, it is necessary to implement at-home caries prevention not later than from the moment the first tooth appears, and report the child for a dental appointment to receive professional prophylaxis.

#### CONFLICT OF INTEREST KONFLIKT INTERESÓW

None

Brak konfliktu interesów

#### CORRESPONDENCE ADRES DO KORESPONDENCJI

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