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# Zapobieganie próchnicy zębów u dzieci – możliwości i ograniczenia

**Streszczenie**

Zgodnie z wynikami badań epidemiologicznych prowadzonych przez „Monitoring Zdrowia Jamy Ustnej" Polska należy do krajów o utrzymującej się wysokiej częstości i intensywności choroby próchnicowej. Zmiany próchnicowe pojawiają się już we wczesnym dzieciństwie, występują u ponad 50% dzieci w wieku 3 lat i ponad 80% 12-latków. Ważna jest więc analiza podstawowych determinantów planowania działań profilaktycznych i proponowanych strategii zapobiegania chorobie próchnicowej u dzieci i młodzieży.

W pracy omówiono czynniki etiologiczne próchnicy zębów bezpośrednio i pośrednio związane z rozwojem procesu chorobowego. Zwrócono uwagę na zależność między występowaniem próchnicy wczesnego dzieciństwa a czasem kolonizacji jamy ustnej dziecka przez bakterie próchnicotwórcze oraz istnienie związku miedzy występowaniem próchnicy zębów stałych i mlecznych. Podkreślono konieczność wczesnego podjęcia działań profilaktycznych, już w okresie płodowym (pierwotnie pierwotna profilaktyka) i znaczenie długoterminowości zapobiegania. Omówiono strategie profilaktyczne: populacyjną i grupową opartą o ocenę wysokości ryzyka próchnicy zębów. Przedstawiono skuteczność profilaktyki dla grup wysokiego ryzyka choroby, zwracając uwagę na jej zalety i wady z punktu widzenia zdrowia publicznego. Przedstawiono dane epidemiologiczne wskazujące na konieczność łączenia zapobiegania w populacji z profilaktyką wysokiego ryzyka i indywidualną prowadzoną przez lekarza dentystę. Omówiono zasady zapobiegania indywidualnego oraz metody zalecane u pacjentów z ryzykiem ocenionym jako niskie, średnie i wysokie.

**Słowa kluczowe:** dzieci, próchnica zębów, profilaktyka próchnicy, strategie profilaktyczne, ryzyko próchnicy, profilaktyka indywidualna.

# Prevention of dental caries in children – opportunities and limitations`

**Abstract**

According to the results of epidemiological study – "Monitoring Zdrowia Jamy Ustnej" (Monitoring of Oral Health), Poland belongs to the countries of persistent high prevalence and intensity of caries disease. Caries lesions appear in early childhood and occur in over 50% of children of the age of 3 and in over 80% of children of 12. The analysis of basic determinants of planning prophylactic activity and strategy proposal of prevention against caries disease in children and adolescents is very important.

The paper discusses etiologic factors of caries disease directly and indirectly connected with the development of the disease process. The authors point to the relationship between the occurrence of early childhood caries and colonization time of oral cavity by cariogenic germs and present the relationship between caries in deciduous and permanent teeth. The authors emphasize the necessity of early prophylactic activity already in fetal period (primary primal prophylaxis) and the importance of long-term prophylaxis. Prophylactic strategies are discussed: population and corporate strategies based on the assessment of caries risk. Attention has been paid to the advantages and disadvantages of prophylactic strategies from Public Health point of view. Epidemiologic data are presented indicating the necessity of combining prevention in population with high prophylaxis and individual risk prophylaxis carried out by dentists. The principles of individual caries prophylaxis and methods of proceeding recommended for patients with risk assessed as low, moderate and high are discussed.

**Keywords:** children, dental caries, caries prophylaxis, prophylaxis strategies, caries risk, individual prophykaxis.

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## INTRODUCTION

Epidemiological studies ('Monitoring of Oral Health') conducted under the auspices of the Ministry of Health report a poor dental health in the Polish population, with only negligible slight improvement over the last 20 years. Between the years 1987 and 2010, the percentage of 12-year-old children with caries-free dentition increased by a mere 7.2%, and the disease severity, expressed as/by a mean value of the DMFT index, decreased by 1.22 (Figure1a and 1b). Unfortunately, the paediatric study population shows that the values of dental caries indices have been increasing with age. The dmft index values were as follows: 2.67 in three-year olds in 2009, 5.06 in six-year olds in 2008, and 5.62 in seven-year olds in 2011 (Figure 2). In accordance with the results of the 2011 study, the dmft score in five-year old children (5.07) approximated the figures reported for six-year old children in 2008. Additionally, 5-year olds are diagnosed with an average index of 0.03 in their carious permanent teeth (DT=0.03). In 2011, seven-year olds showed the DMFT score of 0.42, which, in 15-year olds, reached 2.67. Unfortunately, the percentage of 15-year-old subjects with at least one tooth lost due to dental caries exceeds 9% [1-3].

The epidemiological studies also focus on causes of the poor dental health in children and adolescents in Poland. Those include inadequate oral hygiene (approx. 10% of five – and seven-year-old children brush their teeth less frequently than once daily), dietary errors, and infrequent or no application of fluoride agents other than those contained in toothpastes. With regard to the permanent dentition, carious disease in the deciduous teeth should also be considered. The literature provides abundant evidence of correlation between caries in the deciduous and permanent teeth. According to Li and Wang, carious lesions in the deciduous dentition contribute to a three-fold risk of caries in the permanent dentition [4]. Skeie et al. reported that carious lesions in the deciduous second molars pose a particular risk. It has been proved that the presence of carious lesions in the teeth of five-year old children correlates with carious permanent teeth in those subjects at ten years of age [5]. In their study of a group of Japanese girls, Motohashi et al. showed that severity of dental caries expressed as a dmft index, is a significant prognostic risk indicator of dental caries in their permanent teeth [6]. Nevertheless, the correlation between carious lesions in the deciduous and permanent dentition shows the significance of adequate early intervention with effective prophylactic measures.

## AIM

The aim of the present study was to discuss basic determinants in planning prophylactic measures and proposed strategies in order to prevent dental caries in children and adolescents.

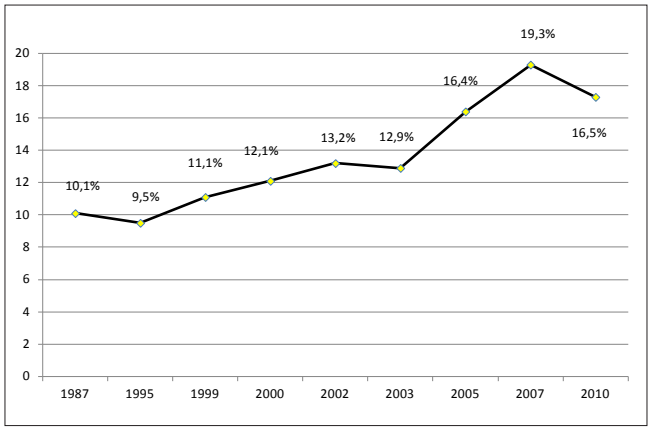


**FIGURE 1a. Change in dental health indices in 12-year-old children in Poland (1987-2010); percentage of children without dental caries.**

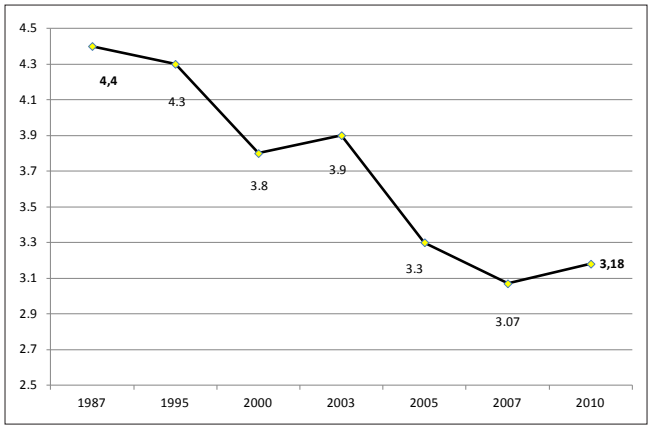


**FIGURE 1b. Change in dental health indices in 12-year-old children in Poland (1987-2010); intensity of caries expressed as the DMFT index..**

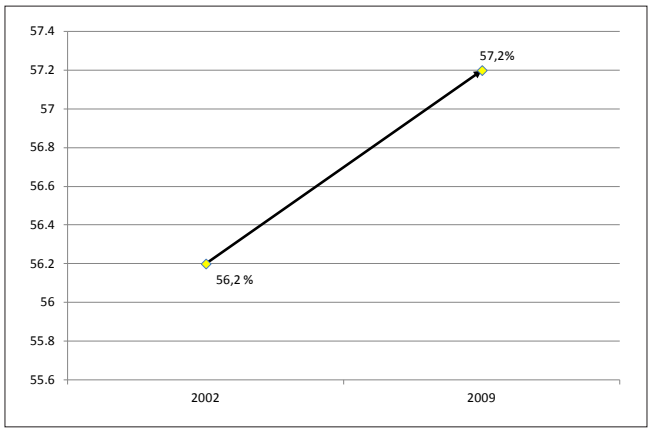


**FIGURE 2a. Change in dental health indices in three-year-old children in Poland (2002-2009); incidence of dental caries.**

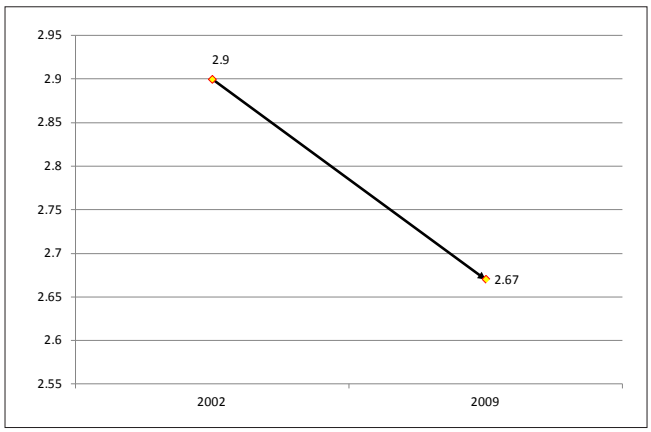


**FIGURE 2b. Change in dental health indices in three-year-old children in Poland (2002-2009); caries intensity expressed as the dmft index.**

## I. Aetiology of dental caries and its prevention

Dental caries is defined as a pathological process, which, essentially, means a loss of mineral elements, and proteolytic disintegration of hard dental tissues. Its aetiology has been well recognized. It is generally known that biological determinants of dental carious process include acidic and acidophilic cryogenic bacteria, a substrate for their metabolism (carbohydrates), local conditions in the oral cavity dependent on the saliva volume, composition, and its ability to buffer bacteria-produced acids, time for acid action upon dental tissues, and their susceptibility. The knowledge has also been increasing of the mechanism and structure of the bacterial biofilm residing on the dental surfaces, and its role in the development of dental caries. According to the present knowledge, the oral cavity is the site of continuous alternative processes of dental enamel demineralization, underneath the bacterial biofilm covering the enamel, due to a lowered pH, and repair processes, i.e. remineralization, in which mineral components from the saliva are incorporated into a decalcified tissue. Dental caries results from an imbalance between demineralization and remineralization. It is also a well known fact that cariogenic microorganisms resident in the child's oral cavity are most frequently transmitted by the mother, and, rarely, a third party. The sooner the bacterial transmission and the oral cavity colonization, the higher the risk of caries in the deciduous teeth [7].

Considering the factors directly associated with the carious process, prophylactic measures should:

- be started in the foetal life as the so-called primary primal prophylaxis;
- be provided for the patient's lifetime (primary and secondary prophylaxis);
- consist in elimination or restriction of cariogenic factors, and introduction of protective measures to support reconstructive processes [8].

Various multiple factors associated with the child itself, its family and the environment in which the child lives exert an intermediate effect upon the oral health, and resulting dental caries (Figure 3) [9]. Prevention of dental caries in a child therefore should include strategies directed also at the child's environment.

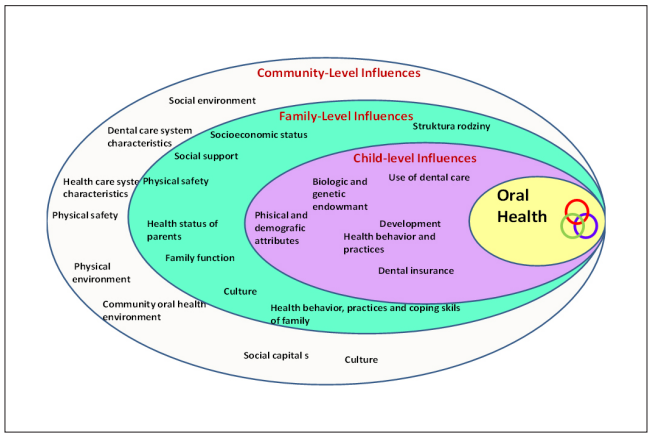


**FIGURE 3. Oral health determinants. (acc. to Fisher-Owens et al. [9]).**

## II. Prophylaxis vs. risk of dental caries

The results of the epidemiological studies, using the Significant Caries Index (SiC Index), revealed a phenomenon known as polarization of dental caries severity. The SiC Index is a DMFt/dmft median for 1/3 of the number of the study group with the highest DMFt/dmft values. In 2011, in seven-year-old children, the difference between the SiC Index values for the deciduous dentition, and a mean dmft values in the remaining 2/3 of the study individuals reached a high of 7.44 (SiC=10.48) [3]. Caries polarization in 12- and 15-year-old children was demonstrated using a graphic representation (Figure 4) [2,3].

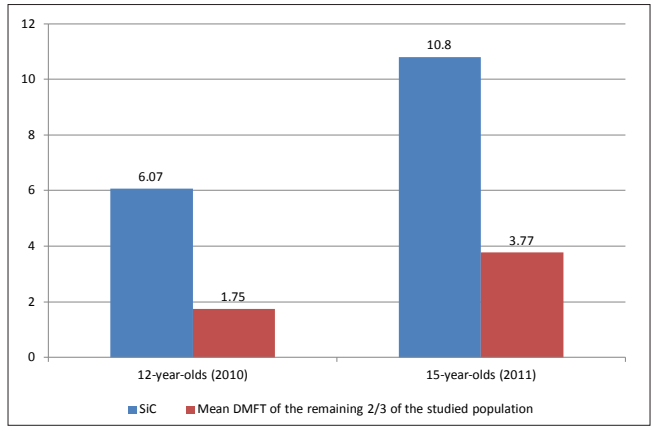


**FIGURE 4. The SIC index values in 12-year-olds and 15-year-olds children and the mean DMFT in the remaining 2/3 study groups.**

Caries severity in study populations is assessed in a group of subjects with very high DMFT indices. This shows a differentiated risk of the disease in a population and, consequently, measures to prevent it. According to Messer, "we need well directed prophylactic measures in dental caries for high risk patients/ individuals"[10].

According to Burt, dental caries prevention should be performed at three levels:

I. population – to reduce prevalence of dental caries in the society,
II. local – in geographic areas with a high prevalence of dental caries,
III. in the highest risk groups [11].

Prophylactic strategies based on the risk assessment levels assume selection of high risk caries groups (e.g. screening, epidemiological studies, socio-demographic data) and intensified preventive measures [12].

Group prophylactic programmes, based upon the high-risk caries strategy, have proved to be effective. There was for example, a 3-year programme implemented for over three years in pre-school children (commenced in three-year-olds, completed in five-year-olds). It compared the efficacy of routine prevention (the control group: parental education focussing on oral hygiene, the use of fluoride toothpastes, and children's sweet consumption) with increased prophylaxis depending on the risk level (in high risk: additional usage of chlorhexidine and fluoride varnish) [13]. Prophylaxis based upon high-risk caries assessment proved to be more effective in both deciduous and permanent dentition. A follow-up study performed seven years after the programme completion (in 12-year old children) showed a higher

**TABLE 1. Dental health and frequency of prophylactic and treatment appointments in 12-year-old children over seven years following the end of the assessment study of the efficacy of group prophylaxis.**

| Type of prophylactic measures (2 to 5 yrs) | | Dental status | | Dental appointments | | | |
|---|---|---|---|---|---|---|---|
| | | DMFT | Fissure sealant | Dental hygienist | Dental surgeon | | Total |
| | | | | Prophylaxis | | Treatment | |
| Risk-based (n=245) | Total | 0.2 | 2.6 | 8.2 | 3.9 | 2.0 | 14.1 |
| | High risk (at 12 yrs of age) | 0.4 | 3.4 | 11.6 | 3.9 | 2.7 | 18.2 |
| Routine (n=202) | Total | 0.4 | 1.6 | 7.2 | 5.7 | 3.4 | 16.3 |
| | High risk (at 12 yrs of age) | 0.9 | 2.2 | 8..9 | 6.3 | 7.1 | 22.3 |

severity of dental caries, more frequent dental appointments (Table 1), and higher dental care costs in the control group of children. What is, however, worth emphasizing is an increased number of prophylactic dental appointments in the group of children in whom caries prevention was based on the caries risk assessment [13].

In spite of the documented efficacy of the caries preventive programmes based on the risk levels related to groups of subjects at a particular risk, the programmes also show shortcomings – i.e. an imprecise methodology of risk assessment, and its variability over time. Additionally, on the population scale, the "burden" of the disease is an important aspect – i.e. the number of new carious foci in low risk subjects forming a larger group [11]. According to Hausen et al., the intensive prophylaxis aimed at high-risk subjects, used in 12-year-old children, in a population with a low caries incidence, does not provide any significantly higher health benefits than basic prophylactic measures provided at a lower financial cost. [14]. Similarly, in their analysis of the effects of various prophylactic programmes performed in 7-year-old children (the US data of National Preventive Dentistry Demonstration Program (NPDDP), Batchelor & Sheiham, questioned the benefits of the prophylactic high risk strategies from the point of view of public health. Nevertheless, they emphasized its value when used in the group programmes. The present approach to prevent dental caries in the aspect of public health assumes a combination of population prophylaxis based on a high risk strategy in different groups and subpopulations [10,11]. It is also crucial to identify children at a high caries risk, e.g. using prophylactic screening tests, and refer them to dental surgeons to implement an individually established prophylactic programme.

Apart from polarization of dental caries, epidemiological studies conducted within the Oral Health Monitoring programme showed that in 2011 the percentage of seven-year-old Polish children with dmft ≥4, reached a figure of 71%, whereas in those with DMFT=0, the percentage was only 10.2% [3]. The percentage of 12-year-old children with at least 4 teeth with carious lesions was 41.3% in 2010 [2]. Unfortunately, in 2011, 8.2% of 15-year-old adolescents showed DMFT =0; in 71.8% of the subjects, the index values were ≥4. Over 20% of five-year old children, and 7.7% of seven-year olds had never any dental appointment [3]. Dietary and hygienic errors were found in all the age groups. In a society in which subjects with a low caries risk are not a majority, it is crucial to introduce prophylactic programmes for children based on a high risk strategy. In Poland, pupils attending elementary schools are offered a group anti-caries prophylaxis using a technique of supervised tooth brushing with fluoride preparations. However, considering the prevalence and severity of dental caries in early childhood, it is obligatory to introduce group prophylactic programmes in younger age groups of children.

### III. Individual anticaries prophylaxis

Individual patient management in dental caries requires assessment of the caries risk level and aims at lowering it. The caries risk has been defined by the American Academy of Paediatric Dentistry as a probable development of new carious lesions over time, and progression of the present lesions (size, activity). The assessment requires a recognition of the present risk indices in the patient and evaluation of the equilibrium between those considered as protective, and negative. They include prognostically significant factors, which also encompass the presence of white carious spots, a low socio-economic status, and causative factors of the carious process, e.g. the presence of cariogenic bacteria or carbohydrates due to hygienic and dietary errors. The ground for assessment is the theory of the dynamic equilibrium between demineralization and remineralization, according to Featherstone [15].

Over the recent years numerous systems facilitating the caries risk assessment have been developed, e.g. CAT (Caries-Risk Assessment), Cariogram, CMS (Caries Management System), CAMBRA (Caries Management By Risk Assessment). In 2009, a 10-year programme "Caries Global Initiative" was initiated, which aims at changing the paradigm of the preventive management model in dental caries, including the development of effective, clinical diagnostic methods, risk assessment, prevention and treatment of dental caries [16] based on the contemporary knowledge and scientific evidence.

At present, the generally accepted rules in individual prevention, based on the level of risk assessment, are focused upon elimination of pathogenic factors found in the patient, application of prophylactic methods and means adapted to their age, as well as intensifying prophylaxis with an increasing risk level of the disease. When the risk is assessed as low, primary prophylaxis is approached. It includes daily hygienic measures, i.e. tooth brushing with fluoridated toothpaste, cleansing the contact surfaces with a dental floss, adequate nutrition including xylitol, or possible endogenic fluoride supplementation, fissure and anatomical groove sealing). A moderate or high risk requires the so-called intensive (reinforced) prophylactic measures. Individual cases may require modified dietary and hygienic habits, introduction

of additional methods and means, e.g. reducing the effect of cryogenic bacteria (e.g., professional dental cleansing, application of chemical agents) or/and supporting the reconstructive mechanisms (agents containing fluoride or/and calcium or phosphate ions indispensable for remineralization) [17].

Individual prophylaxis based on caries risk levels within the basic range, may be provided as guaranteed benefits financed from public resources. (Register of general dental care services for children and juveniles under the age of 18 years, and Register of Dental services for children from 6 months until 19 years of age). Similar care management standards and medical procedures in providing medical benefits for pregnant women, delivery time, postpartum period and newborn care (Minister of Health's bill dated 23rd September 2010) include prophylactic procedures/benefits and procedures provided by a doctor or a midwife. They also include procedures performed within the oral health promotion programme for pregnant mothers and infants, dental examination to assess the oral health in a pregnant woman and the child, dental examination to assess the oral health, establishing the prophylactic and medical requirements, and the treatment schedule for the expecting mother. According to the dental care benefits guaranteed to pregnant women and those in labour, they are entitled to extra benefits to guarantee receiving the quickest procedures available within the caries prophylactic programme.

However, planning and implementation of individual prophylactic programmes require significant engagement on behalf of the dental and medical personnel, active participation of the child and their carers in the course of dental management procedures, the sense of responsibility to maintain adequately own dental health (pro-health approach) and availability of dental care for children. It is crucial for the patients and their carers to follow doctors' recommendations and ably perform prophylactic procedures.

The determinant of the prophylactic efficacy is adequate motivation to make an effort on behalf of the oral health. It is, therefore, essential to promote pro-health approach, not only in children but also in their parents, and prospective parents, which will ensure their cooperation, and continuity of preventive measures.

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