Early Childhood Caries – literature review on risk factors, prevalence and prevention

Próchnica wczesnego dzieciństwa – przegląd literatury pod kątem czynników ryzyka, występowania i zapobiegania

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Abstract
Introduction. Early Childhood Caries (ECC), one of the most prevalent chronic diseases among children, is still a severe problem worldwide. It is an infectious disease of mineralized tooth tissue that can affect general health.

Objective. The aim of this study is to summarize evidence-based knowledge on the etiology, prevalence, clinical manifestation and management of ECC, as well as its consequences for proper development.

Materials and method. The research included the PubMed and Google Scholar databases. Only articles published in 2013 and later were reviewed.

Brief description of the state of knowledge. The prevalence of ECC among countries is highly inhomogeneous. It is reported that in some countries more than a half of children suffer from ECC. Furthermore, ECC can vary in severity and is classified into 3 types: type 1 (mild to moderate), type 2 (moderate to severe), type 3 (severe). The most common risk factors include beverages containing sugar, large amounts and high frequency of sugar consumption along with the lack of proper oral hygiene. Studies have shown that social background can also strongly affect the probability of ECC occurrence. Depending on severity, ECC can lead to various consequences that have been divided into short- and long-term. ECC can even cause developmental problems.

Summary. ECC is an entirely preventable disease. It appears that the awareness of gynaecologists and paediatricians may be one of the crucial factors. These specialists are the first doctors that have contact with the mother and her infant, thanks to which they can convey knowledge about ECC before the disease appears. On the other hand, the final effect depends on parent’s behaviour and willingness to apply the guidelines.

Key words
oral health, early childhood caries, dental care, paediatric dentistry

Streszczenie
Wprowadzenie i cel pracy. Próchnica wczesnego dzieciństwa (ECC), jako będąca jedną z najczęściej występujących chorób przewlekłych wieku dziecięcego, jest nadal znaczącym problemem na świecie. Jest to choroba infekcyjno-zmineralizowanych tkanków zębów, która może wpływać na ogólny stan zdrowia.

Cel pracy. Celem pracy było podsumowanie informacji na temat etiologii, występowania, objawów klinicznych i leczenia ECC, jak również konsekwencji tej choroby dla prawidłowego rozwoju.

Metody przeglądu. Przegląd piśmiennictwa obejmował bazy PubMed oraz Google Scholar. Uwzględniono jedynie artykuły opublikowane w roku 2013 lub później.

Opis stanu wiedzy. Zachorowalność pośród w populacji różnych krajów nie jest jednolita. W niektórych krajach na ECC choruje powyżej 50% dzieci. Ponadto ECC może cechować się różną intensywnością przebiegu. Rozróżnia się 3 typy ECC: typ 1 (przebieg lekki do umiarkowanego), typ 2 (przebieg umiarkowany do ciężkiego), typ 3 (przebieg ciężki). Do najczęstszych czynników ryzyka należą słodzone napoje, często spożywanie dużych ilości cukrów prostych oraz brak odpowiedniej higieny jamy ustnej. Badania wskazują, że pozycja społeczna również wpływa na prawdopodobieństwo rozwoju ECC. W zależności od ciężkości przebiegu, ECC może powodować zróżnicowane konsekwencje, które zostały pozielone na krótkoterminowe i długoterminowe. ECC może skutkować zaburzeniami w prawidłowym rozwoju.

Podsumowanie. Odpowiednia prewencja umożliwia ograniczenie występowania ECC. Lekarze ginekologiczni i pediatrzy są pierwszymi specjalistami, którzy mają kontakt z matką i noworodkiem, dzięki czemu mogą przekazać informacje o prewencji ECC, zanim choroba wystąpi. Ostatecznie, skuteczność prewencji jest zależna od postępowania rodziców i ich chęci do przestrzegania wychowawczych.

Słowa kluczowe
próchnica wczesnego dzieciństwa, higiena jamy ustnej, zdrowie jamy ustnej, stomatologia dziecięca
INTRODUCTION

Early Childhood Caries (ECC) is still believed to be one of the most prevalent chronic diseases in children worldwide [1]. As consequences might be short-term, long-term or even life-threatening [2], the need for education about proper oral hygiene measures, especially among parents and/or medical specialties other than dentists, is still high [3].

Dental caries is an infectious disease of the mineralized tissues of the teeth, including enamel and dentine, as well as cementum [4]. Four factors are required for caries to develop: cariogenic bacteria, susceptible host (erupted teeth), fermentable carbohydrate substrate along with time for the previous factors to interact [5].

The American Academy of Pediatric Dentistry (AAPD) defines Early Childhood Caries as ‘…as the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child under the age of six’ [5]. This chronic childhood disease is considered to be a global problem, affecting children in developing as well as industrialized countries [4, 5].

The aim of this study was to conduct a literature review on Early Childhood Caries in order to present updated knowledge about its prevalence, etiology, clinical manifestation and management, as well as consequences.

A thorough search was carried out for articles describing the topic of ECC which included the PubMed and Google Scholar databases. The search focused on literature published in 2013 and later, in order that the summarized knowledge could refer to the most up-to-date understanding of the disease. The final review cited only one article published prior to 2013.

Prevalence. The reported prevalence of ECC differs strongly from study to study and also between continents. Eldrissi et al. described a prevalence of 56.1% for ECC in Sudan (Africa) [6], and according to Chen et al., the prevalence in Asia ranged between 22.9% – 90% [5]; European studies reported ECC prevalence at 26.2% in Germany [7], from 27.9% (England) to 41% (Wales) in the United Kingdom [8], from 29.8% [9] to 43.4% [10] in Italy and 64.2% in North-eastern Greece [11]. The prevalence of ECC according to studies from the Middle East was 75% in Saudi Arabia [12] and 66.9% in Turkey [13]. In Brazil, the ECC prevalence ranged from 41.6% – 67.8% [14].

Due to the widespread prevalence and inhomogeneous reports, it is rather difficult to identify certain risk groups for ECC. However, some authors describe the highest prevalence of ECC among the 3–4-year-old age group. Also, boys seem to be more affected than girls during the age interval of 8 months to 7 years. ECC is reported to be randomly spread in the population, excluding socially disadvantaged groups, where the prevalence is said to be significantly higher [15]. Seow et al. present a similar statement, describing deprived, poor or minority families as risk groups for ECC [16].

Etiology. Although the etiology of caries itself is well recognized, the process of developing ECC differs from individual to individual, depending strongly on their genetics, environment, along with family and community factors [17]. Parents play a paramount role in the etiology of ECC since, as primary care givers, they provide nourishment, control the child’s environment and oral hygiene [18]. The age at which sugar is actively introduced into the diet [19], as well as the frequency, amount and timing of sugar consumption, are the main dietary factors influencing the development of ECC [1]. The excessive use of nursing bottles filled with cariogenic fluids also contributes to ECC, especially among infants and toddlers. Products recognized as being often used in bottles and potentially damaging to teeth are juice, sweetened tea, soft-drinks or flavoured water (containing sugar). The use of nursing bottles containing sweetened fluids as a calming agent or sleeping aid during the night leads to continuous delivery of simple carbohydrates to the oral cavity. In consequence, the oral microorganisms have enough substrate for constant acid production, resulting in increased tooth demineralization [18].

The social background of the parents was also identified as an etiology factor in childhood caries; therefore, children from a low socio-economic background are twice as likely to develop ECC compared to children from high income families [15]. Moreover, the oral hygiene of the parents plays an important role, as children of mothers suffering from dental caries are at greater risk of developing caries themselves [17]. Some studies also identified breastfeeding over the age of 12 months as a risk factor for ECC [20] [21]; however, a systematic review by Moynihan et al. contradicts those findings, stating that breastfeeding up to 24 months of age does not increase the risk of ECC [22].

Clinical manifestation. Early Childhood Caries can be classified according to Wyne [23] into three types:

• Type I (mild to moderate) ECC – isolated carious lesion(s) can be observed on molars and/or incisors, usually among children 2 – 5-years-old.
• Type II (moderate to severe) ECC – carious lesions on the labio-oral surfaces of maxillary incisor can be observed. Depending on the patients age, molars may or may not be affected. Mandibular incisors are unaffected. Occurs soon after teeth erupt. Unless controlled, may lead to Type III ECC.
• Type III (severe) ECC – carious lesions affect almost all or all teeth, mandibular incisors are affected. Can usually be observed between the age of 3–5 years.

According to Wyne, the cause for each type The cause for each type, lies mostly in a combination of cariogenic food and poor oral hygiene [23].

The upper incisors are primarily inflicted due to the proximity of the bottle teat and constant contact with sugar-containing beverages. The localization of salivatory gland ducts openings also influences the order in which certain teeth are affected by demineralization. The lower incisors, for example, are protected and regularly remineralized by the saliva from the submandibular and sublingual glands. The protection of maxillary incisors, on the other hand, is weaker, resulting in earlier cavities [18].

Consequences. Early Childhood Caries, depending on its severity, can be asymptomatic, it can also lead to acute inflammation symptoms, such as swelling, pain or fever. In some cases, treatment is sought quite late, resulting in potentially life-threatening infections and abscesses [2]. The treatment of patients at such a young age often requires sedation or general anaesthesia, since the children are pre-cooperative [24]. Such procedures are directly related to higher risks for the children, greater efforts for the families, together with
Up to full length of
Size 1,000*
0.25 1,000
Grain of rice 0.5–1.0
Amount 0.125
Twice daily Twice daily
Primary prevention, beginning be
Frequency
246
Table 1 shows the recommended use of fluoride in toothpaste.
European Academy of Paediatric Dentistry (EAPD) released
also of great importance in caries prevention. In 2019, the
children while brushing, are also important preventive fac
informing the parents that they should always help their
brushing technique and, especially in case of older children,
has proved to be effective [28]. Parents should be educated
the prevalence of ECC [19]. Educating parents or guardians
fore the diseases development, has the potential to reduce
Clinical management. Primary prevention, beginning be
before the diseases development, has the potential to reduce
the prevalence of ECC [19]. Educating parents or guardians
about oral health methods along with preventive therapies
has proved to be effective [28]. Parents should be educated
that teeth brushing is supposed to begin with the eruption
of the first primary tooth. Instruction in the proper teeth
brushing technique and, especially in case of older children,
informing the parents that they should always help their
children while brushing, are also important preventive fac-
tors [29]. The use of toothpaste with an adequate dosage is
also of great importance in caries prevention. In 2019, the
European Academy of Paediatric Dentistry (EAPD) released
new guidelines concerning the use of fluoride in children [30].
Table 1 shows the recommended use of fluoride in toothpaste.

| Age (years) | (ppm F) | Frequency | Amount | Size |
|------------|---------|-----------|--------|------|
| First tooth – up to 2 years | 1,000 | Twice daily | 0.125 | Grain of rice |
| 2–6 years | 1,000* | Twice daily | 0.25 | Pea |
| Over 6 years | 1,450 | Twice daily | 0.5–1.0 | Up to full length of brush |

* Toothpaste with dosage >1,000 ppm F could be indicated in cases with high caries risk.

Furthermore, dietary preventive messages ought to include the
limitation of free sugar in drinks and food along with the
exclusion of night-time nursing with milk or fluids contain-
ting sugar [19]. Secondary prevention of ECC includes pro-
gression prevention and remineralisation of teeth. Ef-
ective measures are application of fluoride varnish (up to
to four times per year) or sealing of pits fissures by the dentist
[31]. Tertiary prevention stops cavitated teeth from breaking
down further and includes carries removal with subsequent
restoration. Endodontic treatment may also be required,
dependng on the individual’s age [32].

If tooth extraction is necessary, the importance of space
holding devices should be stressed. In cases of multiple ex-
tractions, prosthetic appliances can ameliorate the patient’s
life quality by improving function (mastication, speech) as
well as aesthetics [33].

Awareness. Some studies reported that paediatricians have
limited knowledge about caries prevention [34]. Such
knowledge, however, can be of primary importance since new
parents seek help from paediatricians much sooner during
their child’s life than from dentists [15]. Also gynaecologists
have a great opportunity to educate future mothers in their
care about oral health [3].

Awareness concerning children’s dental health has been eval-
uated in several studies which show a limited knowledge of
caries preventive measures among parents [3, 35–38].
According to El Karmi et al., only 16% of expectant mothers
taking part in the survey thought that primary teeth need
brushing [38]. Another study reported 48% of mothers thought
that tooth brushing should start from the age of three
[36]. Dagon et al. state that 72% of mothers did not know the
right fluoride concentration adequate to their child’s age [37].
Furthermore, Suprabha et al. presented reports of parents
being challenged by the choice of proper dental hygiene
instruments (toothbrush, toothpaste) [39].

SUMMARY

The evidence on Early Childhood Caries concerning preva-
ence, risk factors, clinical management and prevention is vast.
Since it is an entirely preventable disease, the efforts of
medical personal should concentrate on limiting ECC
through parent education on oral hygiene and appropriate
diet for children. By preventing ECC, potentially considerable
damage to a child’s health can be avoided.

REFERENCES

1. Kirthiga M, Murugan M, Saikia A, Kirubakaran R. Risk Factors for
Early Childhood Caries: A Systematic Review and Meta-Analysis of
Case Control and Cohort Studies. Pediatr Dent. 2019; 41(2): 95–112.
2. Alazmah A. Early Childhood Caries: A Review. J Contemp Dent Pract.
2017; 18(8): 732–737.
3. Dhull KS, Dutta B, Devraj IM, Samir PV. Knowledge, Attitude, and
Practice of Mothers towards Infant Oral Healthcare. Int J Clin Pediatr
Dent. 2018; 11(5): 435–439.
4. Iaved F, Feng C, Kopycka-Kedzierska DT. Incidence of early child-
hood caries: A systematic review and meta-analysis. J Invest Clin Dent.
2017; 8(4).
5. Chen KJ, Gao SS, Duangthip L, Lo ECM, Chu CH. Prevalence of early
childhood caries among 5-year-old children: A systematic review. J
Invest Clin Dent. 2019; 10(1): e12376.
6. Elidrissi SM, Naidoo S. Prevalence of dental caries and toothbrushing
habits among preschool children in Khartoum State, Sudan. Int Dent J.
2016; 66(4): 215–220.
7. Grund K, Goddon I, Schüter JM, Lehmann T, Heinrich-Weltzien R.
Clinical consequences of untreated dental caries in German 5- and
8-year-olds. BMC Oral Health. 2015; 15(1): 140.
8. Monaghan N, Davies GM, Jones CM, Neville JS, Pitts NB. The caries
experience of 5-year-old children in Scotland, Wales and England in
2011–2012: reports of cross-sectional surveys using BASCD criteria.
Community Dent Health. 2014; 31(2): 105–110.
9. Nobile CGA, Fortunato L, Bianco A, Pileggi C, Pavia M. Pattern and
severity of early childhood caries in Southern Italy: a preschool-based
cross-sectional study. BMC Public Health. 2014; 14: 206.
10. Ferrazzano GF, Sangianantoni G, Cantile T, Ingenti A. Relationship
Between Social and Behavioural Factors and Caries Experience in
Schoolchildren in Italy. Oral Health Prev. Dent. 2016; 14(1): 55–61.
11. Tsinidou E, et al. Caries prevalence and manganese and iron levels of
drinking water in school children living in a rural/semi-urban region of
North-Eastern Greece. Environ Health Prev Med. 2015; 20(6): 404–409.
12. Al-Meedani LA, Al-Diaqan YH. Prevalence of dental caries and asso-
ciated social risk factors among preschool children in Riyadh, Saudi
Arabia. Pak J Med Sci. 2016; 32(2): 452–456.
13. Abbasoglu Z, et al. Early childhood caries is associated with genetic
variants in enamel formation and immune response genes. Caries Res.
2015; 49(1): 70–77.
14. Lourenco CB, de L. Saintrain MV, Vieira APGF. Child, neglect and oral
health. BMC Pediatr. 2013; 13: 188.
15. Anil S, Anand PS. Early Childhood Caries: Prevalence, Risk Factors,
and Prevention. Front Pediatr. 2017; 5: 157.
16. Seow WK. Early Childhood Caries. Pediatr Clin North Am. 2018;
65(3): 941–954.
17. Riggs E, et al. Interventions with pregnant women, new mothers and other primary caregivers for preventing early childhood caries. Cochrane Database Syst Rev. 2019; 2019(11): CD012155.
18. Tinanoff N, et al. Early childhood caries epidemiology, aetiology, risk assessment, societal burden, management, education, and policy: Global perspective. Int J Paediatr Dent. 2019; 29(3): 238–248.
19. Kato T. Association of breast feeding with early childhood dental caries: Japanese population-based study. BMJ Open. 2015; 5(3): 69–82.
20. Tham R, et al. Breastfeeding and the risk of dental caries: a systematic review and meta-analysis. Acta Paediatr. 2015; 104(467): 62–84.
21. Moynihan P, et al. Systematic Review of Evidence Pertaining to Factors That Modify Risk of Early Childhood Caries. JDR Clin Transl Res. 2019; 4(3): 202–216.
22. Wyne AH. Early childhood caries: nomenclature and case definition. Community Dent Oral Epidemiol. 1999; 27(5): 313–315.
23. Schmoeckel J, Gorseta K, Splieth CH, Juric H. How to Intervene in the Caries Process: Early Childhood Caries – A Systematic Review. Caries Res. 2020; 54(2): 102–112.
24. Thomson WM. Public Health Aspects of Paediatric Dental Treatment under General Anaesthetic. Dent J. 2016; 4(2): 20.
25. Llena C, Calabuig E. Risk factors associated with new caries lesions in permanent first molars in children: a 5-year historical cohort follow-up study. Clin Oral Investig. 2018; 22(3): 1579–1586.
26. Jordan A R, Becker N, Jöhren H P, Zimmer S. Early Childhood Caries and Caries Experience in Permanent Dentition: A 15-year Cohort Study. Swiss Dent J. 2016; 126(2): 114–119.
27. Albino J, Tiwari T. Preventing Childhood Caries: A Review of Recent Behavioral Research. J Dent Res. 2016; 95(1): 35–42.
28. Sun HB, Zhang W, Zhou XB. Risk Factors associated with Early Childhood Caries. Chin J Dent Res. 2017; 20(2): 97–104.
29. Toumba KJ, Tweetman S, Spleth C, Parnell C, van Loveren C, Lygidakis NA. Guidelines on the use of fluoride for caries prevention in children: an updated EAPD policy document. Eur Arch Paediatr Dent. 2019; 20(6): 507–516.
30. Urquhart O, et al. Nonrestorative Treatments for Caries: Systematic Review and Network Meta-analysis. J Dent Res. 2019; 98(1): 14–26.
31. Schwendicke F, et al. Managing Carious Lesions: Consensus Recommendations on Carious Tissue Removal. Adv Dent Res. 2016; 28(2): 58–67.
32. Prathima GS, Kavitha M, Kalyavizhi G, Suganda A, Suganya M, Arumugam S. Awareness, attitude, and practice of pediatricians regarding early childhood caries and infant oral healthcare of children in Puducherry. A cross-sectional survey. Indian J Dent Res. 2020; 31(3): 439–443.
33. Banihani A, Tahmassebi J, Zawaideh F. Maternal knowledge on early childhood caries and barriers to seek dental treatment in Jordan. Eur Arch Paediatr Dent. 2020. doi: 10.1007/s40368-020-00576-0. Online ahead of print.
34. Alkhtib A, Morawala A. Knowledge, Attitudes, and Practices of Mothers of Preschool Children About Oral Health in Qatar: A Cross-Sectional Survey. Dent J. 2018; 6(4): 51.
35. Dagon N, Ratson T, Perez B, Blumer S. Maternal Knowledge of Oral Health of Children Aged 1–4 Years. J Clin Pediatr Dent. 2019; 43(2): 116–120.
36. ElKarmi R, Aljafari A, Eldali H, Hosey MT. Do expectant mothers know how early childhood caries can be prevented? A cross-sectional study. Eur Arch Paediatr Dent. 2019; 20(6): 595–601.
37. Suprabha BS, D’Souza V, Shenoy R, Karuna YM, Nayak AP, Rao A. Early childhood caries and parents’ challenges in implementing oral hygiene practices: a qualitative study. Int J Paediatr Dent. 2021; 31(1): 106–114.