International Journal of Community Medicine and Public Health
*Amer AI et al. Int J Community Med Public Health. 2022 Feb;9(2):1045-1050*
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20220049

**Review Article**

# Stages, risk factors and prevention of early childhood caries

**Ameera Ibrahim Amer[1]*, Kholoud Saeed Almohammadi[2], Omar Sami Al-Majed[3], Sultan Hasan Al Harbi[4], Rahmah Mutlaq Aljohani[5], Leena Mustafa Sabri[6], Anas Ziyad Rambo[7], Emtenan Abobakr Barnawi[8], Fatemah Aadel Madani[9], Amal Saad Alahmri[10], Laila Khalid Halawani[11]**

[1]Department of Pediatric Dentistry, East Jeddah Hospital, Jeddah, Saudi Arabia
[2]Ministry of Health, AlBaha, Saudi Arabia
[3]College of Dentistry, King Faisal University, Hofuf, Saudi Arabia
[4]Buraidah Central Hospital, Buraidah, Saudi Arabia
[5]College of Dentistry, Jordan University of Science and Technology, Irbid, Jordan
[6]College of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia
[7]Almeswak Dental Clinics, Jeddah, Saudi Arabia
[8]College of Dentistry, Taibah University, Medina, Saudi Arabia
[9]Ministry of Health, Medina, Saudi Arabia
[10]Dental Department, Prince Sultan Military Medical City, Riyadh, Saudi Arabia
[11]College of Dentistry, Ibn Sina National College, Jeddah, Saudi Arabia

**Received:** 22 December 2021
**Accepted:** 06 January 2022

***Correspondence:**
Dr. Ameera Ibrahim Amer,
E-mail: ameera-dent@hotmail.com



## ABSTRACT

Early childhood caries is a common condition that affects children and young infants. In addition to the effect of the condition on the child's oral health, it has been furtherly shown that many systemic consequences are usually associated. Therefore, it has been reported that these conditions can significantly impair the quality of life of corresponding families based on economic and health-related burdens. Affected children usually present with variable degrees of the condition, and some complications might be associated. Many risk factors have been reported in the literature for developing the condition in children. These include the presence of certain bacterial pathogens (especially through vertical transmission), dietary habits, and poor oral hygiene. Evidence indicates that these risk factors significantly contribute to the development of early childhood caries and the importance of the child's socioeconomic status and his caregivers. Targeting these factors would significantly reduce the risk of developing the condition, in addition to fluoridation as suggested by various relevant investigations.

**Keywords:** Early childhood caries, Classification, Stages, Management, Prevention, Risk factors, Epidemiology

## INTRODUCTION

Global studies show that early childhood caries is among the most common diseases in children. In addition to the effect of the condition on the child's oral health, it has been furtherly shown that many systemic consequences are usually associated.[1,2] Therefore, different complications might be associated with early childhood caries. These include the development of caries in permanent dentition, associated problems with speaking and eating, enamel defects, orthodontic problems, and oral pain.[3]

In addition, adult-related orthodontic problems might also develop secondary to the premature loss of primary dentition.[4] Besides, evidence indicates that caregivers and parents of affected children with early childhood caries

are usually impacted.[3,4] It has been further shown that in 2015 in Australia, early childhood caries was the leading cause of hospitalization in children.[5] Therefore, it has been reported that these conditions can significantly impair the quality of life of corresponding families based on economic and health-related burdens.[6,7] Furthermore, many risk factors and prevention approaches have been reported in the literature to facilitate the management of these disorders. Thus, we aim to discuss the stages, risk factors, and prevention of early childhood caries from relevant studies.

## LITERATURE REVIEW

This literature review is based on an extensive literature search in Medline, Cochrane, and EMBASE databases on which was performed 3rd December 2021 using the medical subject headings (MeSH) or a combination of all possible related terms, according to the database. To avoid missing poetential studies, a further manual search for papers was done through Google Scholar, while the reference lists of the initially included papers. Studies discussing stages, risk factors and prevention of early childhood caries wires were screened for useful information, with no limitations posed on date, language, age of participants, or publication type.

## DISCUSSION

### *Stages*

Various studies in the literature have tried to classify early childhood caries based on different parameters. For instance, the previous study by Wyne et al classified early childhood caries based on their etiology and severity into three types, including type I (mild to moderate), type II (moderate to severe), and type III (severe). A detailed description of the three types is presented in Figure 1. Another study by Johnston and Messer developed a classification system based on the patterns of presentation of children with early childhood caries. These include type I (the affected children usually suffer from developmental defects, including hypoplasia and fissure and pit defects), type II (the affected children usually present with smooth surface lesions, including approximal molar lesions and labial-lingual lesions), and type III (the affected children usually present with rampant caries, in which 14 of 20 primary teeth are affected with one or more mandibular incisors included).[8,9] Another classification system was also reported in the literature, which classified early childhood caries and severe early childhood caries based on the age of children and corresponding lesions. This classification pattern has been summarized in Figure 2. Finally, another study by Veerkamp and Weerheijm proposed another classification system based on the severity of dental caries (cavitated and initial) and stage of dentition development. According to this classification system, the authors proposed that the development of caries usually occurs in consecutive stages. However, it has been reported that they begin late (at ten months of age) and end within four years of life (48 months). Accordingly, four stages were reported by the authors for early childhood caries, including initial, damaged, deep, and traumatic lesions. Besides, it has been shown that the involved teeth in each stage are not the same. The lesions can also vary from cavitation (including enamel and dentin) and enamel demineralization (opaque white).[10]

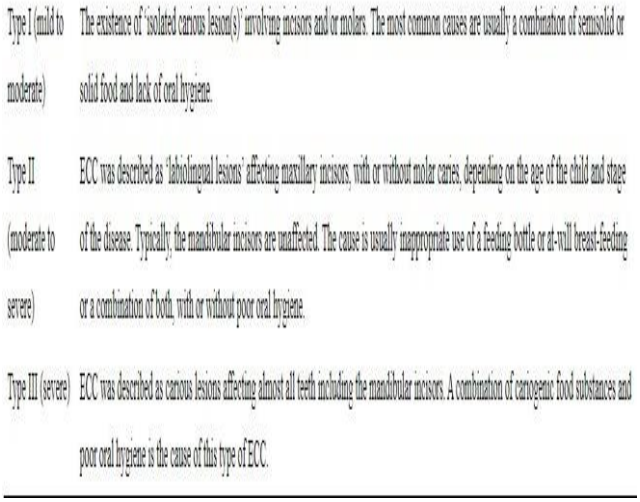


**Figure 1: Classification and staging of early childhood caries based on etiology and severity.[48]**

| Age (months) | Early childhood caries | Severe early childhood caries |
|---|---|---|
| <12 | 1 or more dmfs surfaces | 1 or more smooth dmf surfaces. |
| 12–23 | 1 or more dmfs surfaces | 1 or more smooth dmf surfaces. |
| 24–35 | 1 or more dmfs surfaces | 1 or more smooth dmf surfaces. |
| 36–47 | 1 or more dmfs surfaces | 1 or more cavitated, filled, or missing (due to caries) smooth surfaces in primary maxillary anterior teeth or dmfs score >4. |
| 48–59 | 1 or more dmfs surfaces | 1 or more cavitated, filled, or missing (due to caries) smooth surfaces in primary maxillary anterior teeth or dmfs score >5. |

**Figure 2: Classification of early childhood caries and severe early childhood caries and stratification based on age groups.[49,50]**

### *Risk factors*

Evidence in the literature indicates the involvement of various risk factors. These generally include bad oral health habits and poor diet.[11,12] Besides, evidence indicates the importance of certain risk factors, including microbiological, dietary, and socioeconomic risk factors. For instance, some studies reported that certain

microorganisms are usually associated with the development of early childhood caries, including *Streptococcus sobrinus* and *S. mutans*.[13,14] These microorganisms usually inhabit the mouth of all children. However, the damage is caused by interacting with fermentable carbohydrates (like glucose, fructose, and sucrose) to dissolve different teeth-related structures.[15,16] Previous studies reported that the *S. mutans* usually exceeds 30% of the naturally occurring microflora in children confirmed with early childhood caries. It has been shown that these organisms are usually correlated with white spot lesions, carious lesions, and healthy tooth surfaces close to the lesion.[17,18] Other studies also demonstrated that a very low risk of developing caries is usually associated with the window of infectivity, which is usually associated with reduced levels of infections, based on long-term investigations.[19] This might be attributed to the significant competition between oral bacteria.[20] Vertical transmission has been reported to be a direct cause of mutans *Streptococci* transmission from a mother to a child. This has been indicated in previous bacteriocin studies, which found typical patterns between bacteria derived from mothers and their children.[21] Previous investigations have further supported the evidence of vertical transmission that strengthened their evidence by chromosomal DNA patterns.[22]

Considering socioeconomic factors is also essential when evaluating early childhood caries because of the documented association between them among various studies in the literature. Many studies reported that early childhood caries is more significantly associated with children with reduced educational levels (particularly when born to illiterate mothers), single mothers, children with racial and ethnic minorities, and children with poor socioeconomic status.[23-27] Evidence indicates that these circumstances suggest reduced fluoride exposure, increased risk of enamel hypoplasia, and increased administration of sugary foods.[27,28] The role of sugar in the diet and dietary habits might also explain the impact of socioeconomic status on the pathogenesis of early childhood caries.[29] This can be indicated by the prevalence of early childhood caries in developing and developed countries. Weinstein et al estimated that the prevalence of the condition was 70% in developing countries and only 1-12% in developed ones, indicating the impact of socioeconomic status.[30] It has been furtherly demonstrated that the mean scores of filled, missing, and decayed teeth were four times higher among children to parents with the lowest income than children to parents with the highest income in the study population groups.[31,32]

Feeding practices might also represent significant risk factors for developing early childhood caries. For instance, it has been reported that the pathology and severity of early childhood caries are significantly associated with the improper use of feeding bottles.[33] This has been attributed to the prolonged use of these bottles and increased amounts of sugar administration. In addition, sleeping with a bottle and bottle feeding were two factors that were significantly correlated with developing early childhood caries among different studies. On the other hand, studies reported that the risk is significantly reduced with breastfeeding, which provides further interventional roles for infants by reducing the incidence of respiratory and gastrointestinal complications.[34] However, it has been shown that softening of enamel secondary to the development of acidogenic contents in the baby's mouth might occur secondary to the prolonged contact with human milk and enamel. Accordingly, this might interfere with the balance between the physiological mineralization process from breastfeeding practices.[35] In this context, evidence shows that the development of early childhood caries is significantly associated with nocturnal and prolonged breastfeeding habits.

Although evidence indicates that the primary cause and risk factors for developing early childhood caries are microbial factors, it has been shown that diet contents also have an important secondary role in developing the condition. Many studies with variable designs and settings have reported early childhood caries and dietary features.[36] For instance, some studies indicated that fermentable carbohydrates usually have a significant role by inducing demineralization secondary to the acidic action of the existing bacterial pathogens. Previous investigations have indicated this, which concluded that early childhood caries is significantly associated with sugar intake. However, it has been reported that these studies also showed that poor oral hygiene and minimal fluoridation were also significantly present as potentially associated factors in this correlation. In addition, the duration of exposure is the most important factor in this correlation, as reported by previous studies.[37] The association between dental caries and sugar consumption was also indicated in other studies that showed the low prevalence of the condition among countries with a mean reduced daily consumption of sugars.[38] It should be noted that milk sugars are not significantly associated with caries development. On the other hand, non-milk extrinsic sugars are significantly correlated. However, it should be noted that the recent widespread of fluoride use has remarkably reduced interest in the association between dental caries and dietary habits.[39]

***Prevention***

Many approaches have been proposed in the literature as potentially validated strategies to minimize dental caries in children. For instance, many previous studies and reviews have evaluated the efficacy of varnish fluoride on permanent teeth in school-aged children. In this context, it has been reported that the efficacy of fluoride for children with moderate-to-severe dental caries is greater than the evaluated benefits for children with healthy tooth surfaces. Moreover, evidence from worldwide investigations shows the positive association between using fluoride-based toothpaste and children's oral health.

Besides, tooth brushing is an accepted modality for many cultures across the globe, and fluoride is a widely available substance.[40]

However, it should be noted that the amount of toothpaste should be limited to the necessary amount only because most children usually ingest around 30% of the toothpaste. In addition, many studies have reported that the rate of early childhood caries has significantly decreased by up to 70% when using dental office topicals, mouth rinse, and toothpaste that contain fluoride. It has been furtherly shown that the severity of systemic fluoridation is an efficacious approach to reducing the incidence of tooth decay in the general population. Many previous investigations have indicated that the prevalence of early childhood caries has significantly decreased secondary to water fluoridation and the administration of different fluoride resources. Accordingly, establishing these approaches in high-risk groups is recommended as a favorable interventional approach against the development of dental caries.[41,42]

There are also other prevention approaches that were described in the literature. For instance, reducing the risk of caries can be achieved by minimizing the practice of harmful feeding behaviors. For instance, infants should not be put to bed with feeding bottles. Instead, they should be encouraged to drink from a cup by 12 months old. In addition, increased consumption of products containing fermentable carbohydrates (including between-meal snacks, juice, and others) should be avoided. Educating parents about the oral health practices of their children was also previously suggested as an efficacious approach to minimizing the risk of developing early childhood caries. Such education programs encourage routine dental visits, regular tooth brushing, and enhanced feeding habits.[43,44]

Another approach would be to minimize the risk of vertical transmission of bacteria, which is considered a major risk factor for developing early childhood caries, as previously discussed. These approaches are usually termed primary-primary interventions among the different studies. The approach is broadly divided into two main concepts, including strategies to minimize the frequency of bacteria in primary caregivers' and mothers' mouths and minimize activities by which mothers and infants share their saliva. The latter can be achieved by avoiding sharing toothbrushes, foods, drinks, utensils and training the child to avoid putting his fingers in his mother's mouth. Subsequently, the risk of transmitting bacteria-causing early childhood caries can be significantly decreased. Accordingly, it has been suggested that suppressing the frequency of S. mutans from mothers' mouths can significantly enhance children's oral hygiene by decreasing the risk of transmitting this infection to infants. Previous studies suggested that reducing oral microorganisms can be significantly achieved by using chlorhexidine gluconate in the form of dentifrices, mouth gels, and rinses.[44-47]

## CONCLUSION

Early childhood caries is a common condition that affects children and young infants. Affected children usually present with variable degrees of the condition, and some complications might be associated. Many risk factors have been reported in the literature for developing the condition in children. These include the presence of certain bacterial pathogens (especially through vertical transmission), dietary habits, and poor oral hygiene. Evidence indicates that these risk factors significantly contribute to the development of early childhood caries and the importance of the child's socioeconomic status and his caregivers. Targeting these factors would significantly reduce the risk of developing the condition, in addition to fluoridation as suggested by various relevant investigations.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: Not required*

## REFERENCES

1. Naidu R, Nunn J, Donnelly-Swift E. Oral health-related quality of life and early childhood caries among preschool children in Trinidad. BMC Oral Health. 2016;16(1):1-9.
2. Filstrup SL, Briskie D, da Fonseca M, Lawrence L, Wandera A, Inglehart MR. Early childhood caries and quality of life: child and parent perspectives. Pediatric Dentistry. 2003;25(5):431-40.
3. Abanto J, Carvalho TS, Mendes FM, Wanderley MT, Bönecker M, Raggio DP. Impact of oral diseases and disorders on oral health-related quality of life of preschool children. Community Dentistry Oral Epidemiol. 2011;39(2):105-14.
4. Casamassimo PS, Thikkurissy S, Edelstein BL, Maiorini E. Beyond the dmft: the human and economic cost of early childhood caries. J Am Dental Asso. 2009;140(6):650-7.
5. Chrisopoulos S, Harford J, Ellershaw A. Oral health and dental care in Australia: key facts and figures 2015. 2016.
6. BaniHani A, Deery C, Toumba J, Munyombwe T, Duggal M. The impact of dental caries and its treatment by conventional or biological approaches on the oral health-related quality of life of children and carers. Int J Paediatr Dentistry. 2018;28(2):266-76.
7. Righolt A, Jevdjevic M, Marcenes W, Listl S. Global-, regional-, and country-level economic impacts of dental diseases in 2015. J Dental Res. 2018;97(5):501-7.
8. Johnston T, Messer LB. Nursing caries: literature review and report of a case managed under local anaesthesia. Aus Dental J. 1994;39(6):373-81.
9. Nguyen TM, Huan VT, Reda A. Clinical features and outcomes of neonatal dengue at the Children's

Hospital 1, Ho Chi Minh, Vietnam. J Clin Virol. 2021;138:104758.
10. Veerkamp JS, Weerheijm KL. Nursing-bottle caries: the importance of a development perspective. ASDC J Dentistry Children. 1995;62(6):381-6.
11. Berkowitz RJ. Causes, treatment and prevention of early childhood caries: a microbiologic perspective. J Can Dental Asso. 2003;69(5):304-7.
12. Davies GN. Early childhood caries--a synopsis. Community Dentistry Oral Epidemiol. 1998;26(1):106-16.
13. Nurelhuda NM, Al-Haroni M, Trovik TA, Bakken V. Caries experience and quantification of *Streptococcus mutans* and *Streptococcus sobrinus* in saliva of Sudanese school children. Caries research. 2010;44(4):402-407.
14. Tanzer JM, Livingston J, Thompson AM. The microbiology of primary dental caries in humans. J Dental Education. 2001;65(10):1028-1037.
15. Caufield PW, Griffen AL. Dental caries. An infectious and transmissible disease. Pediatr Clin N Am. 2000;47(5):1001-19.
16. Schafer TE, Adair SM. Prevention of dental disease. The role of the pediatrician. Pediatr Clin N Am. 2000;47(5):1021-42.
17. Milnes AR, Bowden GH. The microflora associated with developing lesions of nursing caries. Caries Res. 1985;19(4):289-97.
18. Berkowitz RJ, Turner J, Hughes C. Microbial characteristics of the human dental caries associated with prolonged bottle-feeding. Arch Oral Biol. 1984;29(11):949-51.
19. Caufield PW, Cutter GR, Dasanayake AP. Initial acquisition of mutans *Streptococci* by infants: evidence for a discrete window of infectivity. J Dental Res. 1993;72(1):37-45.
20. Türksel Dülgergil C, Satici O, Yildirim I, Yavuz I. Prevention of caries in children by preventive and operative dental care for mothers in rural Anatolia, Turkey. Acta Odontol Scand. 2004;62(5):251-257.
21. Berkowitz RJ, Jones P. Mouth-to-mouth transmission of the bacterium *Streptococcus mutans* between mother and child. Archives Oral Biol. 1985;30(4):377-9.
22. Caufield PW, Childers NK, Allen DN, Hansen JB. Distinct bacteriocin groups correlate with different groups of Streptococcus mutans plasmids. Infection Immunity. 1985;48(1):51-6.
23. Weerheijm KL, Uyttendaele-Speybrouck BF, Euwe HC, Groen HJ. Prolonged demand breast-feeding and nursing caries. Caries Res. 1998;32(1):46-50.
24. Slavkin HC. S*treptococcus mutans*, early childhood caries and new opportunities. J Am Dental Asso. 1999;130(12):1787-92.
25. Wendt LK, Hallonsten AL, Koch G, Birkhed D. Analysis of caries-related factors in infants and toddlers living in Sweden. Acta Odontol Scand. 1996;54(2):131-7.
26. Quiñonez RB, Keels MA, Vann WF Jr., McIver FT, Heller K, Whitt JK. Early childhood caries: analysis of psychosocial and biological factors in a high-risk population. Caries Res. 2001;35(5):376-83.
27. Ramos-Gomez FJ, Tomar SL, Ellison J, Artiga N, Sintes J, Vicuna G. Assessment of early childhood caries and dietary habits in a population of migrant Hispanic children in Stockton, California. ASDC J Dentistry For Children. 1999;66(6):395-403.
28. Ruottinen S, Karjalainen S, Pienihäkkinen K. Sucrose intake since infancy and dental health in 10-year-old children. Caries Res. 2004;38(2):142-8.
29. Ismail AI, Tanzer JM, Dingle JL. Current trends of sugar consumption in developing societies. Community Dentistry Oral Epidemiol. 1997;25(6):438-43.
30. Weinstein P, Domoto P, Koday M, Leroux B. Results of a promising open trial to prevent baby bottle tooth decay: a fluoride varnish study. ASDC J Dentistry For Children. 1994;61(5-6):338-41.
31. Tang JM, Altman DS, Robertson DC, O'Sullivan DM, Douglass JM, Tinanoff N. Dental caries prevalence and treatment levels in Arizona preschool children. Public Health Rep. 1997;112(4):319-29.
32. AlMarshad LK, Wyne AH, AlJobair AM. Early childhood caries prevalence and associated risk factors among Saudi preschool children in Riyadh. Saudi Dental J. 2021.
33. Oulis CJ, Berdouses ED, Vadiakas G, Lygidakis NA. Feeding practices of Greek children with and without nursing caries. Pediatric Dentistry. 1999;21(7):409-16.
34. Kramer MS, Kakuma R. Optimal duration of exclusive breastfeeding. The Cochrane Database Systematic Rev. 2002(1):Cd003517.
35. Ramos-Gomez F, Crystal YO, Ng MW, Tinanoff N, Featherstone JD. Caries risk assessment, prevention, and management in pediatric dental care. General Dentistry. 2010;58(6):505-17.
36. Naylor MN. Diet and the prevention of dental caries. J Royal Society Med. 1986;79(14):11-4.
37. Sanders TA. Diet and general health: dietary counselling. Caries Res. 2004;38(1):3-8.
38. Misra S, Tahmassebi JF, Brosnan M. Early childhood caries--a review. Dental update. 2007;34(9):556-558, 561-552, 564.
39. Moynihan PJ. Update on the nomenclature of carbohydrates and their dental effects. J Dentistry. 1998;26(3):209-18.
40. Bratthall D, Hänsel-Petersson G, Sundberg H. Reasons for the caries decline: what do the experts believe? Eur J Oral Sci. 1996;104(4 ( Pt 2)):416-422; discussion 423-415, 430-412.
41. Jenkins GN. Recent changes in dental caries. Bri Med J. 1985;291(6505):1297-8.
42. Featherstone JD. The continuum of dental caries--evidence for a dynamic disease process. J Dental Res. 2004;83C:C39-42.
43. Adair P, Ashcroft A, Pine C, Harris R. Community Oral Health. 2007.

44. Dülgergil CT, Colak H. Rural dentistry: Is it an imagination or obligation in community dental health education? Nigerian Med J. 2012;53(1):1-8.
45. Ercan E, Dülgergil CT, Yildirim I, Dalli M. Prevention of maternal bacterial transmission on children's dental-caries-development: 4-year results of a pilot study in a rural-child population. Arch Oral Biol. 2007;52(8):748-52.
46. Kishi M, Abe A, Kishi K, Ohara-Nemoto Y, Kimura S, Yonemitsu M. Relationship of quantitative salivary levels of *Streptococcus mutans* and *S. sobrinus* in mothers to caries status and colonization of mutans *Streptococci* in plaque in their 2.5-year-old children. Community Dentistry Oral Epidemiol. 2009;37(3):241-9.
47. King NM, Anthonappa RP, Itthagarun A. The importance of the primary dentition to children-Part 1: consequences of not treating carious teeth. Hong Kong Practitioner. 2007;29(2):52.
48. Amjad HW. Prevalence and risk factors of nursing caries in Adelaide, South Australia. Pediatric Dental J. 1999;9(1):31-6.
49. Drury TF, Horowitz AM, Ismail AI, Maertens MP, Rozier RG, Selwitz RH. Diagnosing and reporting early childhood caries for research purposes. A report of a workshop sponsored by the National Institute of Dental and Craniofacial Research, the Health Resources and Services Administration, and the Health Care Financing Administration. J Public Health Dentistry. 1999;59(3):192-7.
50. De Grauwe A, Aps JK, Martens LC. Early Childhood Caries (ECC): what's in a name? Eur J Paediatr Dentistry. 2004;5(2):62-70.

**Cite this article as:** Amer AI, Almohammadi KS, Al-Majed OS, Al Harbi SH, Aljohani RM, Sabri RM et al. Stages, risk factors and prevention of early childhood caries. Int J Community Med Public Health 2022;9:1045-50.