

## Systematic Review

**\*Corresponding author**  
**Nighat Nisar, MD**

Professor  
Department of Community Medicine  
Dow University of Health Sciences  
Suparco Road, Off Mail University Road  
Gulzar-e-Hijri, Scheme 33  
Karachi, Pakistan  
Tel. 03002382639  
E-mail: [nisarnighat@hotmail.com](mailto:nisarnighat@hotmail.com)

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## Early Childhood Caries: A Preventable Disease

Shahbano Syed<sup>1</sup>, Nighat Nisar<sup>2\*</sup> and Nida Mubeen<sup>3</sup>

<sup>1</sup>MDS Trainee, Department of Community Dentistry, Dow University of Health Sciences, Karachi, Pakistan

<sup>2</sup>Professor, Department of Community Medicine, Dow University of Health Sciences, Karachi, Pakistan

<sup>3</sup>MPH Trainee, Dow University of Health Sciences, Karachi, Pakistan

### ABSTRACT

Early Childhood Caries (ECC) is a preventable chronic disease which affects infants and children worldwide. The early detection of ECC can reduce pain, life threatening conditions and helps in the growth and the overall development of the child. The risk factors of ECC include: Mutant Streptococci (MS), dietary and feeding habits, socioeconomic and environmental factors, systemic diseases and certain medications.

The aim of this paper is to systematically review the global burden of ECC, contributing risk factors, preventive and treatment strategies. The literature search was based on published systematic reviews which were focused on diseases burden; heterogeneity of research studies on this subject did not allow a meta-analysis.

**KEYWORDS:** ECC; Epidemiology; Risk factor; Prevention.

**ABBREVIATIONS:** ECC: Early Childhood Caries; MS: Mutant Streptococci; WHO: World Health Organization; ART: Atraumatic Restorative Treatment; CDC: Centre for Disease Control and Prevention; AAPD: American Association of Pediatric Dentistry.

### INTRODUCTION

Early childhood caries (ECC) is considered to be a big public health challenge for dental professionals' through-out the world.<sup>1,2</sup> Early childhood caries is defined as the presence of one or more decayed, missing or filled tooth surfaces in any primary tooth of child age 71 months or younger.<sup>3</sup> The smooth surfaces of maxillary incisors are commonly involved in initial stage of ECC. There are different terms used for early childhood caries which includes: feeding bottle tooth decay, feeding bottle syndrome, nursing caries, and nursing bottle mouth.<sup>4</sup> The dangers of excessive bottle feeding, sweetened liquids and prolonged on-demand breastfeeding are highlighted as risk factors for ECC in the literature.<sup>4</sup> An in-depth understanding and awareness about the natural history of ECC is required so that preventive strategies can be applied in inhibiting and/or reducing dental caries in very young children.<sup>5,6</sup>

The World Health Organization (WHO) recommends that children should be breastfed up to 24 months of age. Whilst, healthcare professionals and paediatricians recommend that breastfeeding should be continued from birth of the child to one year and beyond. Mothers' desire to breastfeed on child's demand should also be considered.<sup>7</sup> The prolonged and unrestricted nocturnal breastfeeding is reported to be a potential risk factor for the development of ECC.<sup>8-11</sup> The aim of this paper is to systematically review the literature on global burden of ECC, contributing risk factors, preventive and treatment strategies.

**PREVALENCE**

A comprehensive review of literature showed that the prevalence of ECC varies across the world, with it being between 1-12% in developed countries and up to 70% in developing countries.<sup>12</sup> The highest prevalence of caries found in Africa and South East Asia.<sup>13</sup> Whilst in European countries (England, Sweden and Finland) the prevalence is estimated from 1% to 32%<sup>14,15</sup> and in Eastern Europe it is reported up to 56%.<sup>16</sup> The prevalence of ECC in Canadian general population is less than 5% and in high risk group 50% to 80%.<sup>17-19</sup> The reports from developed countries showed that prevalence of caries is found high among preschooler and severity of the disease is reported more in certain ethnic and immigrant groups, which is a serious concern.<sup>20,21</sup> In developing world the prevalence of ECC is reported very high. In Far East Asian region, ECC prevalence is reported from 36% to 85%.<sup>22-24</sup> In India, it is reported 44% among 8 to 48 months old children.<sup>25</sup> The prevalence of dental caries in India among 3 years old children is reported 54.1%, 4 years 42.6% and 5 years 50.7%. About 60.9% of children reported to have one or more carious lesions.<sup>26</sup> In Middle East, high prevalence of caries is reported from 22% to 61% among 3 years old children<sup>27-29</sup> depending up on the severity of the disease.<sup>30,31</sup> The extent of disease is found different in various socio-economic groups, gender and age of individuals.<sup>32</sup> The prevalence of ECC is continuously increasing in low socioeconomic groups due to lack of early preventive measures and availability of adequate treatment facilities.<sup>33,34</sup> In United States, ECC is the most prevalent chronic disease and unmet health need among children. Ramos and co-workers reported that in predominant Mexican-American population of San Francis co-primary teeth caries is reported 43% in under 5 years old children. In Native American children, the prevalence of ECC is reported from 40% to 72%.<sup>34</sup>

**RISK FACTORS**

ECC is a multi-factorial disease. An early infection with *Streptococcus-mutans* group organisms is reported to be a major risk factor for the development of dental caries.<sup>35</sup> The determinants of ECC are identified as biological, social, and behavioural; they are reported to cause detrimental effects on dental health and quality of life of children. The high cost of treating ECC is considered to be a significant economic burden on families and health care system in developing countries which can be avoided by adopting appropriate preventive measures and prompt treatment.<sup>27-33</sup> A report from CDC (Centre for Disease Control and Prevention) showed that 40% of five years old children are reported to suffer from dental caries and 8% of two years old children are reported to suffer from decayed or previous restoration of teeth.<sup>36,37</sup>

The risk factors including; age of the child, educational and occupational status of mothers, number of siblings, time of cessation of breastfeeding, high intake of carbohydrate snacks and biscuits are found to be associated with child's oral health. These risk factors lead to development of ECC among preschool

children.

The classic aetiology of ECC involved bacterial, dietary, and host determinants with interplay of multiple sociological and environmental factors.<sup>38,39</sup> *Streptococcus mutans* and *Streptococcus sobrinus*, are the most common identified causative agents of ECC,<sup>40-42</sup> acid-producing pathogens caused damage by dissolving tooth structures in presence of fermentable carbohydrates such as sucrose, fructose, and glucose.<sup>43,44</sup> Vertical transmission i.e. mother-to-child transmission of cariogenic bacteria and repeated supply of substrate (sucrose) leads to plaque development and early childhood caries.

The formation of plaque and consumption of sugar at bedtime (night) without proper brushing of teeth leads to rapid progression of caries. The feeding on demand with or without cariogenic food and liquid is considered to be a co-factor for early childhood caries development.<sup>8</sup>

The use of baby bottle contributes a central role in aetiology and severity of ECC because of prolonged bottle feeding with sweetened lactose. Most of the studies showed significant correlation between ECC and bottle-feeding during night sleeping with a bottle in mouth.<sup>8,45,46</sup> It is reported in several studies that most of the mothers preferred to breastfeed their children as compared to bottle feed and only few mothers preferred to use both. Many studies reported that one of the greatest advantages of proper breastfeeding is caries free healthy children.<sup>8,16,45-50</sup> The exact duration and frequency of breastfeeding and human milk carcinogenicity is still debatable.

Numerous reviews are found to support the notion of frequent and prolonged breastfeeding as a causative factor for ECC, while only a few workers have reported that frequency and prolong breast feeding is a risk factor for caries in general.<sup>38-43,46,47,51,52</sup> The literature explicitly reports that infant breastfeeding and its duration did not provide any association with increased risk of ECC or S-ECC and the benefits of breast feeding are numerous and cannot be ignored.<sup>33,53-55</sup> Contrarily, few studies reported that children who never breast fed and children who fed longer than 24 months are more prone to develop ECC. This showed that children who never breastfed are found at risk to suffer from oral diseases and other systemic diseases like GI infections, asthma, atopic disease and diabetes mellitus.<sup>32,56,57</sup>

The WHO7 recommendations stated that a child should be breastfed up to the age of 24 months. The prolonged nocturnal breast feeding or bottle feeding is found to be a risk factor for early childhood caries (ECC).<sup>8,10,11,51,58</sup> The study conducted on animals found human milk more cariogenic than bovine milk.<sup>59</sup>

The socio-demographic factors are reported as important risk factors for caries development and progression. Literature documented an inverse relationship between socioeconomic status and incidence and prevalence of diseases.<sup>60</sup> Among the risk indicators/factors universally identified for early childhood

caries is low socioeconomic status. The total household income is reported as a factor affecting utilization of preventive dental health care services. The high income group utilized more dental services available as compared to low income group.<sup>38,61-70</sup> The children from low socioeconomic group are reported to consume more sugary edibles and in appropriate dental health practices; using tooth brush, tooth paste, and making routine dental visits. ECC is found more in children who belong to certain ethnic group and racial minorities.<sup>71</sup> As far as gender difference are concerned the decayed, missing and filled teeth (DMFT) score is found similar in most of the studies worldwide.<sup>72-75</sup> The most probable reported reason is dietary and oral hygiene measures which are under the control of parents or care giver.<sup>76</sup> This increase in severity of dental caries among children is mainly due to mothers behaviour and teaching healthier lifestyles to children from birth.<sup>76</sup>

#### PREVENTIVE STRATEGIES OF ECC

Dental caries is an infectious disease transferred from mother to child. The understanding of the risk factors such as cariogenic microbes was found helpful in improving the preventive strategies.<sup>77</sup> The *Streptococcus mutans* transmits vertically from mother or caregiver to child through salivary contact, it is important to examine mothers or care givers teeth so that further transmission of infection to the child can be prevented. A study reported that mothers who had untreated dental decay are found at greater risk of transmitting *Streptococcus mutans* to the newborn.<sup>78</sup> The preventive interventions for mothers should be designed to reduce the translocation of bacteria from the mother to children and for better oral health of children.<sup>79</sup>

It is a well documented fact that early initiation of brushing of a child helps to maintain good oral hygiene and secure primary dentition from cavity formation. Healthy baby teeth is an assurance that well-maintained primary dentition lead to safe and healthy permanent teeth. The appropriate tooth brushing and use of tooth paste is found to have a valuable outcome on dentition. The habit of brushing with emphasis on proper holding of brush is found equally important in prevention of caries. It is found difficult to train the young child but as the child grows and acquires skill to perform routine activities it is become easier to practice. It is the duty of elders to facilitate the child in learning the right way to clean teeth and proper holding of brush. Several studies reported that child should start tooth brushing independently from two years of age.<sup>47,65,66,80-85</sup>

To decrease the risk of developing ECC, the American Association of Pediatric Dentistry (AAPD) encouraged professionals to take following preventive measures; to decrease the MS level among mothers to prevent the transmission of cariogenic bacteria to child, the infant should not sleep with a bottle containing carbohydrates, taking oral hygiene measures from the eruption of the first primary tooth, use of fluoridated tooth paste<sup>84</sup> and parents should be encouraged that infant should start drinking with a cup from the first birthday. Infants should be

weaned from the bottle between 12 to 18 months of age.<sup>86</sup> Preventive interventions taken up to the six months showed that the proportion of teeth with new decay reduced to 52% in primary teeth and 39% in permanent teeth of children. Moreover, the percentage of newly decayed or restored primary and permanent teeth in children is reduced to 25.4% and 53.2%, respectively.<sup>87,88</sup>

#### TREATMENT

ECC is a preventable disease but neglected worldwide. It is a manageable disease if precise information is provided to mothers regarding risk factors and dexterity to treat the young toddler. Oral health education for mothers, early referral and prompt handling of children having signs of dental decay are critically important in promoting dental health of children.

The treatment of ECC is dependent on the disease progression, age of the child and extent of the disease. The social, behavioural and medical factors must be considered while treating children with ECC. Early intervention at first birthday of child is considered ideal.<sup>89</sup> At this stage, risk assessment should be performed and children found at higher risk identified. The children at moderate risk require restoration of progressed and cavitated lesion, white spot and enamel proximal lesion needs to be treated by preventive methods and monitored for further progression of disease. The children at high risk require early restorative interventions for enamel proximal lesion and intervention for progressed and cavitated lesions to reduce caries development.<sup>90</sup> The standard treatment for S-ECC is general anaesthesia despite its low risk of complications.

Atraumatic Restorative Treatment (ART) is a procedure based on removing carious teeth tissues using hand instruments alone and restoring the cavity with an adhesive restorative material.<sup>91-94</sup> ART is a simple technique with many advantages, including reduced,<sup>95</sup> and no necessity for electricity; and it is more cost-effective than the traditional approaches such as amalgam and no local anaesthesia is needed.<sup>96</sup> It is therefore indicated for use in children, for managing ECC particularly in developing countries.

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#### COMPETING INTEREST

The authors declare that they have no conflicts of interest.

#### REFERENCES

1. Zafar S, Harnekar SY, Siddiqi A. Early childhood caries: etiology, clinical considerations, consequences and management. *J*

- Int Dent SA.* 2009; 11(4): 24-36.
2. Tinanoff N. Introduction to early childhood caries conference: initial description and current understanding. *Community dentistry and Oral Epidemiology.* 1998; 26(Suppl 1): 5-7. doi: [10.1111/j.1600-0528.1998.tb02089.x](https://doi.org/10.1111/j.1600-0528.1998.tb02089.x)
3. American Academy of Pediatric Dentistry. Definition of early childhood caries (ECC). American Academy of Pediatric Dentistry 2009-10 Definitions. *Oral Health Policies, and Clinical Guidelines.* 2008; 13.
4. Schroth RJ, Brothwell DJ, Moffatt MEK. Caregiver knowledge and attitudes of preschool oral health and early childhood caries (ECC). *International Journal of Circumpolar Health.* 2007; 66: 153-167.
5. Poureslami HR, Van Amerongen WE. Early childhood caries (ecc) an infectious transmissible oral disease. *Indian J Pediatr.* 2009; 76(2): 191-194. doi: [10.1007/s12098-008-0216-1](https://doi.org/10.1007/s12098-008-0216-1)
6. Borutta A, Wagner M, Kneist S. Early childhood caries: a multi-factorial disease. *OHDMBSC.* 2010; 9(1): 32-38.
7. World Health Organization. *Global Strategy for Infant and Young Child Feeding.* Geneva Switzerland: WHO; 2003.
8. Azevedo TD, Bezerra AC, de Toledo OA. Feeding habits and severe early childhood caries in Brazilian preschool children. *Pediatr Dent.* 2005; 27: 28-33.
9. Dini EL, Holt RD, Bedi R. Caries and its association with infant feeding and oral health-related behaviors in 3-4 year-old Brazilian children. *Community Dent Oral Epidemiol.* 2000; 28: 241-248. doi: [10.1034/j.1600-0528.2000.280401.x](https://doi.org/10.1034/j.1600-0528.2000.280401.x)
10. Sayegh A, Dini EL, Holt RD, Bedi R. Oral health socio-demographic factors, dietary and oral hygiene practices in Jordanian children. *J Dent.* 2005; 33: 379-388. doi: [10.1016/j.jdent.2004.10.015](https://doi.org/10.1016/j.jdent.2004.10.015)
11. Al-Dashti AA, Williams SA, Curzon ME. Breast feeding, bottle feeding and dental caries in Kuwait, a country with low fluoride levels in the water supply. *Community Dent Health.* 1995; 12: 4247.
12. 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 Dent Child.* 1994; 61: 338-341.
13. Milnes AR. Description and epidemiology of nursing caries. *J Public Health Dent.* 1996; 56: 38-50. doi: [10.1111/j.1752-7325.1996.tb02394.x](https://doi.org/10.1111/j.1752-7325.1996.tb02394.x)
14. Douglass JM, Tinanoff N, Tang JM, Altman DS. Dental caries patterns and oral health behaviors in Arizona infants and toddlers. *Community Dent Oral Epidemiol.* 2001; 29: 14-22. doi: [10.1034/j.1600-0528.2001.00004.x](https://doi.org/10.1034/j.1600-0528.2001.00004.x)
15. Davies GM, Blinkhorn FA, Duxbury JT. Caries among 3-year-olds in greater Manchester. *Br Dent J.* 2001; 190: 381-384. doi: [10.1038/sj.bdj.4800979](https://doi.org/10.1038/sj.bdj.4800979)
16. Szatko F, Wierzbicka M, Dybizbanska E, Struzycka I, Iwanicka-Frankowska E. Oral health of Polish three-year-olds and mothers' oral health-related knowledge. *Community Dent Health.* 2004; 21: 175-180.
17. Harrison R, Wong T, Ewan C, Contreras B, Phung Y. Feeding practices and dental caries in an urban Canadian population of Vietnamese preschool children. *ASDC J Dent Child.* 1997; 64: 112-117.
18. Albert RJ, Cantin RY, Cross HG, Castaldi CR. Nursing caries in the Inuit children of the Keewatin. *J Can Dent Assoc.* 1988; 54: 751-758.
19. Harrison R, White L. A community-based approach to infant and child oral health promotion in a British Columbia First Nations community. *Can J Community Dent.* 1997; 12: 7-14.
20. Ferro R, Besostri A, Meneghetti B, et al. Oral health inequalities in preschool children in North-Eastern Italy as reflected by caries prevalence. *Eur J Paediatr Dent.* 2007; 8: 13-18.
21. Hallett KB, O'Rourke PK. Caries experience in preschool children referred for specialist dental care in hospital. *Aust Dent J.* 2006; 51: 124-129. doi: [10.1111/j.1834-7819.2006.tb00415.x](https://doi.org/10.1111/j.1834-7819.2006.tb00415.x)
22. Tsai AI, Chen CY, Li LA, Hsiang CL, Hsu KH. Risk indicators for early childhood caries in Taiwan. *Community Dent Oral Epidemiol.* 2006; 34: 437-445. doi: [10.1111/j.1600-0528.2006.00293.x](https://doi.org/10.1111/j.1600-0528.2006.00293.x)
23. Carino KM, Shinada K, Kawaguchi Y. Early childhood caries in northern Philippines. *Community Dent Oral Epidemiol.* 2003; 31: 81-89. doi: [10.1034/j.1600-0528.2003.00010.x](https://doi.org/10.1034/j.1600-0528.2003.00010.x)
24. Jin BH, Ma DS, Moon HS, Paik DI, Hahn SH, Horowitz AM. Early childhood caries: Prevalence and risk factors in Seoul, Korea. *J Public Health Dent.* 2003; 63: 183-188.
25. Jose B, King NM. Early childhood caries lesions in preschool children in Kerala, India. *Pediatr Dent.* 2003; 25: 594-600.
26. Weinstein P, Harrison R, Benton T. Motivating parents to prevent caries in their young children: One-year findings. *J Am Dent Assoc.* 2004; 135: 731-738. doi: [10.14219/jada.archive.2004.0299](https://doi.org/10.14219/jada.archive.2004.0299)
27. Rajab LD, Hamdan MA. Early childhood caries and risk factors in Jordan. *Community Dent Health.* 2002; 19: 224-229.

28. Al-Malik MI, Holt RD, Bedi R. The relationship between erosion, caries and rampant caries and dietary habits in pre-school children in Saudi Arabia. *Int J Paediatr Dent.* 2001; 11: 430-439. doi: [10.1046/j.0960-7439.2001.00308.x](https://doi.org/10.1046/j.0960-7439.2001.00308.x)
29. Al-Hosani E, Rugg-Gunn A. Combination of low parental educational attainment and high parental income related to high caries experience in pre-school children in Abu Dhabi. *Community Dent Oral Epidemiol.* 1998; 26: 31-36. doi: [10.1111/j.1600-0528.1998.tb01921.x](https://doi.org/10.1111/j.1600-0528.1998.tb01921.x)
30. Al-Hosani E, Rugg-Gunn AJ. The relationship between diet and dental caries in 2 and 4 year old children in the Emirate of Abu Dhabi. *Saudi Dent J.* 2000; 12: 149-155.
31. Wyne AH, Al-Ghannam NA, Al-Shammery AR, Khan NB. Caries prevalence, severity and pattern in preschool children. *Saudi Med J.* 2002; 23: 580-584.
32. Huntington NL, Kim IJ, Huges CV. Caries risk factor for Hispanic children affected by early childhood caries. *Pediatr Dent.* 2002; 24: 536-542.
33. Iida H, Auinger P, Billings RJ, Weitzman M. Association between infant breastfeeding and early childhood caries in the United States. *Pediatrics.* 2007; 120: 944-952. doi: [10.1542/peds.2006-0124](https://doi.org/10.1542/peds.2006-0124)
34. DenBesten P, Berkowitz RJ. Early childhood caries: an Overview with reference to our experience in California. *Journal of the California Dental Association.* 2003; 31: 139-143.
35. Berkowitz RJ. Causes, treatment and prevention of ECC: A microbiologic perspective. *J Can Dent Assoc.* 2003; 69: 304-307.
36. US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, US Public Health Service. Oral Health in America: Report of the US Surgeon General. NIH publication no. 00-213. Washington, DC, USA: DHHS, NIDCR, USPHS; 2000.
37. Centers for Disease Control and Prevention. Trends in oral health status-United States 1988-1994 and 1999-2004. *MMWR Morb Mortal Wkly Rep.* 2005; 54: 1-44.
38. Uribe S. Early childhood caries—risk factors. *Evid Based Dent.* 2009; 10(2): 37-38. doi: [10.1038/sj.ebd.6400642](https://doi.org/10.1038/sj.ebd.6400642)
39. Leong PM, Gussy MG, Barrow SY, de Silva-Sanigorski A, Waters E. Asystematic review of risk factors during first year of life for early childhood caries. *Int J Paediatr Dent.* 2013, 23(4): 235-250. doi: [10.1111/j.1365-263X.2012.01260.x](https://doi.org/10.1111/j.1365-263X.2012.01260.x)
40. Featherstone JDB. The science and practice of caries prevention. *Journal of the American Dental Association.* 2000; 131(7): 887-899.
41. Tanzer JM, Livingston J, Thompson AM. The microbiology of primary dental caries in humans. *J Dent Educ.* 2001; 65: 1028-1037.
42. 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 Res.* 2010; 44: 402-407. doi: [10.1159/000316664](https://doi.org/10.1159/000316664)
43. Schafer TE, Adair SM. Prevention of dental disease. The role of the pediatrician. (v-vi). *Pediatr Clin North Am.* 2000; 47: 1021-1042. doi: [10.1016/S0031-3955\(05\)70256-X](https://doi.org/10.1016/S0031-3955(05)70256-X)
44. Caufield PW, Griffen AL. Dental caries. An infectious and transmissible disease. *Pediatr Clin North Am.* 2000; 47: 1001-1019.
45. Hallett KB, O'Rourke PK. Early childhood caries and infant feeding practice. *Community Dent Health.* 2002; 19: 237-242.
46. Mohebbi SZ, Virtanen JI, Vahid-Golpayengani M, Vehlahti MM. Feeding habits as determinants of early childhood caries in population where breastfeeding is a norm. *Community Dent Oral Epidemiol.* 2008; 36(4): 363-369. doi: [10.1111/j.1600-0528.2007.00408.x](https://doi.org/10.1111/j.1600-0528.2007.00408.x)
47. Tyagi R. The prevalence of nursing caries in Davangere pre-school children and its relationship with feeding practices and socioeconomic status of the family. *J Indian Soc Pedod Prevent Dent.* 2008: 153-157. doi: [10.4103/0970-4388.44030](https://doi.org/10.4103/0970-4388.44030)
48. Gussy MG, Waters EG, Walsh O, Kilpatrick NM. Early childhood caries: Current evidence for aetiology and prevention. *Journal of Paediatrics and Child Health.* 2006; 42: 37-43. doi: [10.1111/j.1440-1754.2006.00777.x](https://doi.org/10.1111/j.1440-1754.2006.00777.x)
49. McLeroy KR, Bibeau, D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q.* 1988; 15(4): 351-377.
50. Ribeiro NM, Ribeiro MA. Breastfeeding and early childhood caries: a critical review. *J Pediatr (Rio J).* 2004; 80(5 Suppl): S199- S210.
51. Valaitis R, Hesch R, Passarelli C, Sheehan D, Sinton J. A systematic review of the relationship between breastfeeding and early childhood caries. *Canadian Journal of Public.* 2000; 91(6): 411-417.
52. Hallett KB, O'Rourke PK. Caries experience in preschool children referred for specialist dental care in hospital. *Aust Dent J.* 2006; 51: 124-129.
53. Van Palenstein Helderma WH, Soe W, van't Hof

- MA. Risk Factors of Early Childhood Caries in a South-east Asian Population. *J Dent Res*. 2006; 85(1): 85-88. doi: [10.1177/154405910608500115](https://doi.org/10.1177/154405910608500115)
54. Wyne A, Chhohan A, Al-Begomi R. Feeding and dietary practices of nursing caries children in Riyadh, Saudi Arabia. *Odontostomatol Trop*. 2002; 25(100): 37-42.
55. Serwint JR, Mungo R, Negrete VF, Duggan AK, Korsch BM. Child-rearing practices and nursing caries. *Pediatrics*. 1993; 92: 233-237.
56. Mattos-Graner RO, Zelante F, Line RC, Mayer MP. Association between caries prevalence and clinical microbiological and dietary variables in 1,0 to 2,5-year-old Brazilian children. *Caries Res*. 1998; 32: 319-323.
57. Ripa LW. Nursing caries: a comprehensive review. *Pediatr Dent*. 1988; 10: 268-282.
58. Davies GN. Early childhood caries – a synopsis. *Community Dent Oral Epidemiol*. 1998; 26: 106-116.
59. Bowen WH, Lawrence RA. Comparison of the cariogenicity of cola, honey, cow milk, human milk, and sucrose. *Pediatrics*. 2005; 116: 921-926. doi: [10.1542/peds.2004-2462](https://doi.org/10.1542/peds.2004-2462)
60. Reisine ST, Psoter W. Socioeconomic status and selected behavioral determinants as risk factors for dental caries. *J Dent Educ*. 2001; 65: 1009-1016.
61. Newacheck PW, Hughes DC, Hung YY, Wong S, Stoddard JJ. The unmet health needs of America's children. *Pediatrics*. 2000; 105(4(2)): 989-997.
62. Nunn ME, Dietrich T, Singh HK, Henshaw MM, Kressin NR. Prevalence of early childhood caries among very young urban boston children compared with US Children. *J Public Health Dent*. 2009; 69(3): 156-162. doi: [10.1111/j.1752-7325.2008.00116.x](https://doi.org/10.1111/j.1752-7325.2008.00116.x)
63. Johansson I, Holgerson P, Kressin NR, Nunn ME, Tanner AC. Snacking habits and caries in young children. *Caries Res*. 2010; 44: 421-430. doi: [10.1159/000318569](https://doi.org/10.1159/000318569)
64. Wyne A, Khan N. Caries prevalence in 2 and 3 year old Children of adelaide, Australia. *Odonto-Stomatologie Tropicale*. 1998; 8: 115-122.
65. Slade GD, Sanders AE, Bill CJ, Do LG. Risk factors for dental caries in the five-year-old South Australian population. *Australian Dental Journal*. 2006; 51(2): 130-139. doi: [10.1111/j.1834-7819.2006.tb00416.x](https://doi.org/10.1111/j.1834-7819.2006.tb00416.x)
66. Hallett KB, Rourke PK. Social and behavioural determinants of early childhood caries. *Australian Dental Journal*. 2003; 48: 1-27.
67. Livny A, Assali R, Sgan-Cohen H. Early Childhood caries among a bedouin community residing in the eastern outskirts of Jerusalem. *BMC Public Health*. 2007; 7: 167. doi: [10.1186/1471-2458-7-167](https://doi.org/10.1186/1471-2458-7-167)
68. Vachirarojpisan T, Shinada K, Kawaguchi Y, Laungwechakan P, Somkote T, Detsomboonrat P. Early childhood caries in children aged 6-19 months. *Community Dent Oral Epidemiol*. 2004; 32: 133-142. doi: [10.1111/j.0301-5661.2004.00145.x](https://doi.org/10.1111/j.0301-5661.2004.00145.x)
69. Sufia S, Khan AA, Chaudhry S. Maternal factors and child's dental health. *J Oral Health Comm Dent*. 2009; 3(3): 45-48.
70. Peres MA, Peres KG, Barros AJD, Victora CG. The relation between family socioeconomic trajectories from childhood to adolescence and dental caries and associated oral behaviours. *J Epidemiol Community Health*. 2007; 61: 141-145. doi: [10.1136/jech.2005.044818](https://doi.org/10.1136/jech.2005.044818)
71. 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 Dent Child*. 1999; 66: 395-403.
72. Wyne AH. Caries prevalence, severity, and pattern in pre-school children. *J Contemp Dent Pract*. 2008; 3: 24-31.
73. Segovia-Villanueva A, Estrella-Rodriguez R, Medina-Solis CE, Maupome G. Dental caries experience and factors among preschoolers in southeastern Mexico: a brief communication. *J Public Health Dent*. 2006; 66: 88-91.
74. Wanjau J, du Plessis JB. Prevalence of early childhood caries in 3- to 5-year-old children in Philadelphia district, Mpumalanga Province. *SADJ*. 2006; 61: 390-392.
75. Du M, Luo Y, Zeng X, Alkhatib N, Bedi R. Caries in pre-school children and its risk factors in 2 provinces in China. *Quintessence Int*. 2007; 38: 143-151.
76. Matilla ML, Rautava P, Ojanlatva A, et al. Will the role of family influence dental caries among seven-year-old children? *Acta Odontologica Scandinavica*. 2005; 63: 73-84.
77. Kanasi E, Johansson J, Lu SC, et al. Microbial risk markers for childhood caries in pediatrician's offices. *J Dent Res*. 2010; 89(4): 378-383. doi: [10.1177/0022034509360010](https://doi.org/10.1177/0022034509360010)
78. Milgrom P. Response to reisine & douglass: psychosocial and behavioral issues in early childhood caries. *Community Dentistry and Oral Epidemiology*. 1998; 26: 45-48.
79. Kishi M, Abe A, Kishi K, Ohara-Nemoto Y, Kimura S, Yonemitsu M. Relationship of quantitative salivary levels of Strep-

- tococcus mutans and *S. sobrinus* in mothers to caries status and colonization of mutans streptococci in plaque in their 2.5-year-old children. *Community Dent Oral Epidemiol.* 2009; 37: 241-249. doi: [10.1111/j.1600-0528.2009.00472.x](https://doi.org/10.1111/j.1600-0528.2009.00472.x)
80. Tsai AI, Chen C, Li3 L, Hsiang C, Hsu K. Risk indicators for early childhood caries in Taiwan. *Community Dent Oral Epidemiol.* 2006; 34: 437-445.
81. Gussy MG, Waters EG, Walsh O, Kilpatrick NM. Early childhood caries: Current evidence for aetiology and prevention. *Journal of Paediatrics and Child Health.* 2006; 42: 37-43. doi: [10.1111/j.1440-1754.2006.00777.x](https://doi.org/10.1111/j.1440-1754.2006.00777.x)
82. Calache DSH, Gussy M, Dashper S, Gibson J, Waters E. The VicGeneration study - a birth cohort to examine the environmental, behavioural and biological predictors of early childhood caries: background, aims and methods. *BMC Public Health.* 2010; 10: 97. doi: [10.1186/1471-2458-10-97](https://doi.org/10.1186/1471-2458-10-97)
83. Santos A, Soviero VM. Caries prevalence and risk factors among children aged 0 to 36 months. *Pesqui Odontol Bras.* 2002; 16(3): 203-208. doi: [10.1590/S1517-74912002000300004](https://doi.org/10.1590/S1517-74912002000300004)
84. Al-Hussyeen A, Al-Sadhan D. Feeding practices and behaviour of Saudi children with early childhood caries and dental knowledge of mothers. *J Saudi Dent.* 2002; 14(3): 112-117.
85. Ohsuka K, Chino N, Nakagaki H, Kataoka I, Oshida Y, Ohsawa I, Sato Y. Analysis of risk factors for dental caries in infants: a comparison between urban and rural areas. *Environ Health Prev Med.* 2009; 14: 103-110.
86. American Academy of Pediatrics. Patient education on line: Weaning to a cup. Available at: [http://www.aapd.org/media/Policies\\_Guidelines/P\\_ECCClassifications.pdf](http://www.aapd.org/media/Policies_Guidelines/P_ECCClassifications.pdf) Accessed July 6, 2014.
87. US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, US Public Health Service. Oral Health in America: Report of the US Surgeon General. NIH publication no. 00-213. Washington, DC, USA: DHHS, NIDCR, USPHS; 2000.
88. Niederman R, Gould E, Soncini J, Tavares M, Osborn V, Goodson J.M. A model for extending the reach of the traditional dental practice. The ForsythKids program. *J Am Dent Assoc.* 2008; 139: 1040-1050. doi: [10.14219/jada.archive.2008.0306](https://doi.org/10.14219/jada.archive.2008.0306)
89. Policy on early childhood caries (ECC): Classifications, consequences, and preventive strategies. *Pediatr Dent.* 2008; 30: 40-43.
90. Tinanoff N, Douglass JM. Clinical decision-making for caries management in primary teeth. *J Dent Educ.* 2001; 65: 1133-1142.
91. Dulgergil CT, Soyman M, Civelek A. Atraumatic restorative treatment with resin-modified glass ionomer material: Short-term results of a pilot study. *Med Princ Pract.* 2005; 14: 277-280. doi: [10.1159/000085750](https://doi.org/10.1159/000085750)
92. Ercan E, Dülgergil ÇT, Dalli M, Yildirim I, Ince B, Çolak H. Anticaries effect of atraumatic restorative treatment with fissure sealants in suburban districts of Turkey. *J Dent Sci.* 2009; 4: 55-60.
93. Dalli M, Çolak H, Mustafa Hamidi M. Minimal intervention concept: A new paradigm for operative dentistry. *J Investig Clin Dent.* 2012; 3(3): 167-175. doi: [10.1111/j.2041-1626.2012.00117.x](https://doi.org/10.1111/j.2041-1626.2012.00117.x)
94. Ercan E, Dulgergil CT, Soyman M, Dalli M, Yildirim I. A field-trial of two restorative materials used with atraumatic restorative treatment in rural Turkey: 24-month results. *J Appl Oral Sci.* 2009; 17: 307-314. doi: [10.1590/S1678-77572009000400008](https://doi.org/10.1590/S1678-77572009000400008)
95. Frencken JE, Pilot T, Songpaisan Y, Phantumvanit P. Atraumatic restorative treatment (ART): Rationale, technique, and development. *J Public Health Dent.* 1996; 56: 135-140. doi: [10.1111/j.1752-7325.1996.tb02423.x](https://doi.org/10.1111/j.1752-7325.1996.tb02423.x)
96. Seale NS, Casamassimo PS. Access to dental care for children in the United States: A survey of general practitioners. *J Am Dent Assoc.* 2003; 134: 1630-1640.