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REVIEW ARTICLE

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Prevalence of early childhood caries among 5-year-old children: A systematic review

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Abstract

The aim of the present review was to describe the updated prevalence of early childhood caries (ECC) among 5-year-old children globally. Two independent reviewers performed a systematic literature search to identify English publications from January 2013 to December 2017 using MEDLINE, ISI Web of Science, and Scopus. Search MeSH key words were "dental caries" and "child, preschool". The inclusion criteria were epidemiological surveys reporting the caries status of 5-year-old children with the decayed, missing, and filled primary teeth (dmft) index. The quality of the publications was evaluated with the modified Newcastle-Ottawa Scale. Among the 2410 identified publications, 37 articles of moderate or good quality were included. Twenty of the included studies were conducted in Asia (China, India, Indonesia, Korea, Nepal, and Thailand), seven in Europe (Greece, Germany, Great Britain, and Italy), six in South America (Brazil), two in the Middle East (Saudi Arabia and Turkey), one in Oceania (Australia), and one in Africa (Sudan). The prevalence of ECC ranged from 23% to 90%, and most of them (26/37) were higher than 50%. The mean dmft score varied from 0.9 to 7.5. Based on the included studies published in the recent 5 years, there is a wide variation of ECC prevalence across countries, and ECC remains prevalent in most countries worldwide.

KEYWORDS

early childhood caries, epidemiology, oral health, preschool children, tooth

1 | INTRODUCTION

According to the American Academy of Pediatric Dentistry (AAPD), early childhood caries (ECC) is defined 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 at ≤71 months of age.[1] ECC is considered as one of the most prevalent diseases in childhood, affecting many children globally. The American Dental Association identifies that ECC is a significant public health problem in deprived communities, and is also found throughout the general child population.[2] When compared with other common childhood diseases, ECC is five times as frequent as asthma and seven times as common as hay fever.[3] Therefore, the American Dental Association urges the public and health professionals to recognize that a child's teeth are susceptible to decay as soon as they begin to erupt.

Early childhood caries is an infectious disease. Baby bottle tooth decay is recognized as one of the severe clinical manifestations of ECC. The term "ECC" was suggested at the workshop sponsored by the Centers for Disease Control and Prevention in 1994. The aim of this nomenclature was to focus attention on the multiple factors (ie socioeconomic, behavioral, and psychosocial) contributing to caries at such early ages, rather than ascribing sole causation to inappropriate feeding methods. Four main etiological factors are well documented: susceptible host, cariogenic bacteria, fermentable

carbohydrate substrate, and time for interaction of these factors.[4] The characteristics of primary teeth, dietary habits, and the efficiency of plaque removal make young children one a susceptible group.[5] Other environmental risk factors, such as the use of fluoride, access to dental care service, demographic background, and socioeconomic status, are also found to be related to ECC. In this context, underprivileged children have a higher prevalence and greater severity of ECC.[6,7] In some developing countries, the prevalence of ECC is considered to be at epidemic proportions.

A narrative literature review on the prevalence of nursing caries in the 1990s concluded that high caries prevalence was found in Africa and South-East Asia.[8] At that time, the presence of ECC was uncommon in some developed countries, such as England, Sweden, and Finland.[9,10] In contrast, the prevalence of ECC had increased by as much as 56% in some Eastern European countries.[11]

Although no symptoms can be found at the early stage of dental caries, discomfort or pain can occur when the lesion progresses into dentin or involves the dental pulp.[12] Untreated ECC might cause difficulties in sleeping and eating, and possibly affect children's growth and development.[13] Studies have reported that children who suffer from cavitated dentin caries have been found to have lower body weight and height, compared with those without dental caries.[14] In addition, higher rates of absenteeism were found in children with untreated ECC, leading to a negative impact on their school performance.[15] Moreover, hospitalization or emergency dental visits were reported in some severe cases.[16] Such problems could become serious and even life threatening.

Oral health is an important part of general health and influences children's lives and future development. Different preventive strategies have been implemented to reduce the burden of ECC in most countries. It is necessary for health authorities to understand their dental caries situation of primary dentition before setting goals or implementing effective dental services. Because 5-year-old children are in the latest stage of having a complete primary dentition, the World Health Organization (WHO) has chosen them as the index age group in basic oral health surveys for primary dentition.[17] The rapid changes in dietary and lifestyle patterns have been noted throughout the world, possibly linking to the change of ECC pattern and severity. The aim of the present systematic review was to describe the updated information about the prevalence of ECC among 5-year-old children globally.

2 | MATERIALS AND METHODS

2.1 | Search strategy

Three electronic databases (MEDLINE, ISI Web of Science, and Scopus) were selected for searching peer-reviewed articles published in English from January 2013 to December 2017. The last search date was 14 January 2018. Using medical subject headings (MeSH), the search keywords were "dental caries" (MeSH) AND "child, preschool" (MeSH). Duplicate records and papers written in languages other than English were excluded. A manual search was performed to identify additional articles from the bibliography of the retrieved articles.

2.2 | Study selection

Two reviewers (KJC and SSG) screened the titles and abstracts independently. Eligible publications were identified according to the following three inclusion criteria.

(a). study design: only epidemiological surveys investigating the prevalence of dental caries were considered in the present review. Any cross-sectional study that was a part of a longitudinal study or clinical trial was excluded. Other types of studies, including laboratory studies, clinical trials, and case-control studies, were not considered. Studies analyzing secondary data were also excluded;

(b). participants: study participants were 5-year-old (aged 60-71 months) children. The selected participants had to be representative of the general 5-year-old population of the studied districts or countries. The sample size needed to be >100 participants to maintain the representativeness;

(c). outcomes: included studies had to report the caries prevalence and experience using the decayed, missing, and filled primary teeth (dmft) index

The two reviewers retrieved and independently assessed the full texts of studies that met the inclusion criteria or those that could not be determined by screening the titles and abstracts. A third reviewer (DD) was consulted to make a decision if there was disagreement between two reviewers.

2.3 | Data extraction and quality assessment

The following information was extracted and summarized during the full-text assessment: studied site, sampling method, sample size, diagnostic criteria, caries prevalence, and caries experience (dmft index). The Human Development Index (HDI) of the survey site was extracted from the United Nations' website.[18] The HDI reported by the United Nations was used to study the relationship between the HDI and caries prevalence. A linear regression was performed to analyze the relationship between HDI and caries prevalence, and the statistical significance level was set at 0.05.

The quality of the included studies was assessed with the modified Newcastle-Ottawa Scale (NOS) adapted for cross-sectional studies for risk of bias.[19] Two aspects, sample selection and the study outcome, were scored between 0 and 8. Studies that adopted random sampling method, had a favorable sample size (N > 100), established comparability between respondents and non-respondents and good response rate (>80%), used well-established diagnosis criteria, had good reliability between examiners (kappa value >0.6), and adopted appropriate statistic methods were rated as a full score or 8 (Appendix S1). The methodological quality of the studies was categorized as poor (0-2), moderate (3-5), and good (6-8), according to the modified NOS for descriptive purposes. Preferred Reporting Items for Systematic

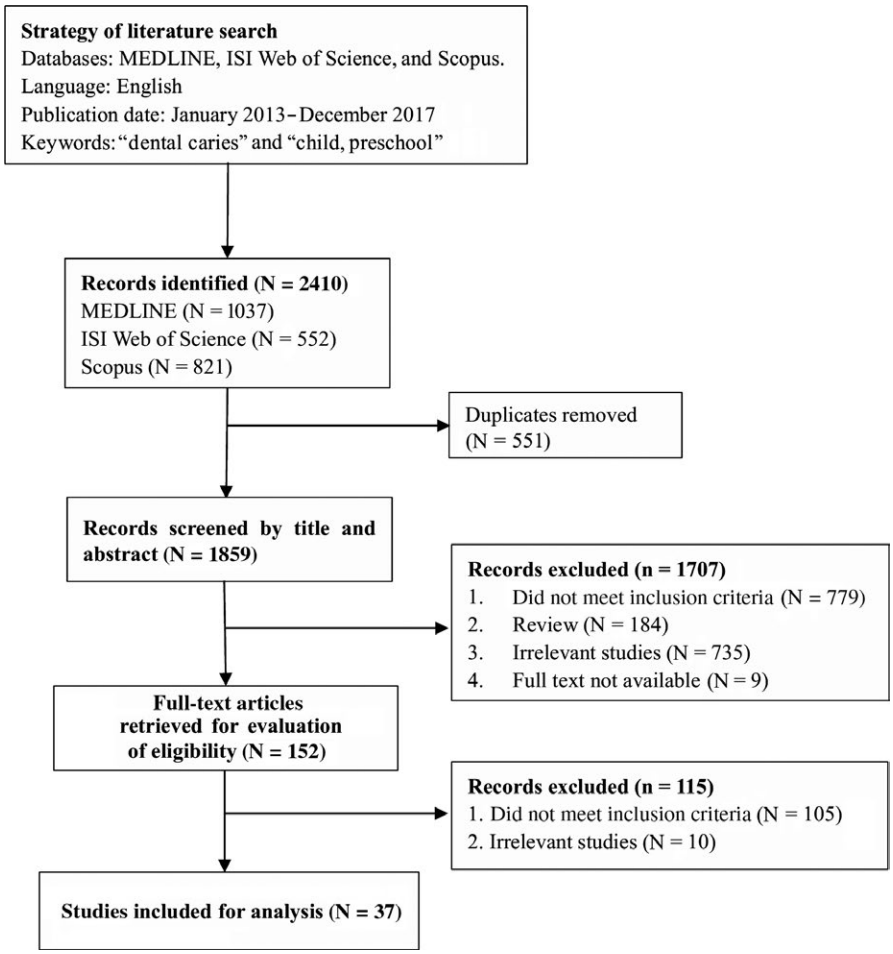

FIGURE 1 Flowchart of literature search

Reviews and Meta-Analyses was used as a basis for reporting in this systematic review.[20]

3 | RESULTS

In total, 2410 articles (1037 from MEDLINE, 552 from ISI Web of Science and 821 from Scopus) were identified and screened based on their titles and abstracts (Figure 1). An initial screening of the title and abstract revealed that 551 articles were duplicates and 1707 articles did not meet the inclusion criteria. Full texts of the remaining 152 articles were assessed, and 37 studies were included in the present study.[21-57] No additional publications were identified from the bibliography of these 152 articles.

The included publications described the dental caries situations of the 5-year-old children in 16 countries/districts from six continents. Most of the studies were conducted in Asia (N = 20, China, India, Indonesia, Korea, Nepal, Taiwan, and Thailand),[21-40] Europe (N = 7, Greece, Germany, Italy, and UK),[41-47] and in South America (N = 6, Brazil).[48-53] Two studies conducted in the Middle East (Saudi Arabia and Turkey),[54,55] one in Africa (Sudan),[56] and one in Oceania (Australia)[57] were included. Of the 37 publications, 28 were from countries/districts with high or very high HDI scores (HDI > 0.70), while only one publication was from a country with a low HDI score (HDI < 0.55) (Table 1).[56]

Among the included articles, the prevalence of caries ranged from 22.5% in India to 90% in Indonesia, and the median of caries prevalence was 62.7%. Approximately two-thirds of the studies (26/37) reported a caries prevalence of >50% (Table 1). ECC prevalence varied between continents. In Asia, the majority of the studies (17/20) reported that more than half of the study children had dental caries experience. Similarly, two-thirds of the studies conducted in South America and all studies in Africa and the Middle East reported that their ECC prevalence was >50%. In contrast, nearly all studies (8/9) conducted in Europe reported lower ECC prevalence, compared to that of other continents. Twenty-six studies (26/37) reported caries experience in mean dmft scores. There was a wide range of dmft scores, from 0.9 in Germany, UK, and Italy to 7.5 in Indonesia. The median of the mean dmft score was 2.6. Eleven publications did not report caries experience. Only 12 publications (12/37) reported untreated caries (dt), which constituted the main component of the caries experience (Table 1).

The caries prevalence reported in the included studies varied among countries and continents. In Australia, where the HDI was the highest among the included studies (0.94), the caries prevalence was 44.4%. In Sudan, where the HDI was lowest (0.49), caries prevalence was 56%. No significant association was found between the HDI and caries prevalence ($P = 0.240$). Through using the modified NOS to assess the quality of the articles, we found that all 37 publications had moderate-to-good methodological quality (Table 2).

TABLE 1 Summary of the selected studies

Region, authors, and year	Study site (Human Development Index)	Sampling method (sample size, N)	Diagnosis criteria	Caries prevalence	Caries experience (dmft ± SD)	Decayed teeth (dt ± SD)
Africa						
Elidrissi et al 2016[56]	Khartoum, Sudan (0.49)	Systematic (196)	dmft (WHO)	56.1%	2.8 ± 4.0	N/A
Asia						
Chen et al 2017[21]	Hong Kong, China (0.92)	Multistage (501)	dmft (WHO)	55%	2.7 ± 3.7	2.6 ± 3.7
Peng et al 2013[22]	Hong Kong, China (0.92)	Multistage (390)	dmft (WHO)	75.3%	4.2 ± 4.6	N/A
Bridges et al 2014[23]	Hong Kong, China (0.92)	Multistage (301)	dmft (WHO)	75.4%	4.2 ± 4.5	3.3 ± 3.9
Han et al 2014[24]	Ulsan, Korea (0.90)	Stratified random (530)	dmft (WHO)	60.9%	N/A	N/A
Lin et al 2017[25]	Kaohsiung, Taiwan (0.88)	Stratified cluster (232)	dmft (WHO)	81.0%	N/A	N/A
Yen et al 2013[26]	Taichung, Taiwan (0.88)	Random selection (146)	deft (WHO)	71.0%	4.8 ± 4.2	N/A
Li et al 2017[27]	Xinjiang, China (0.74)	Multistage (640)	dmft (WHO)	84.5%	5.2 ± 4.0	N/A
Jiang et al 2017[28]	Shandong, China (0.74)	Stratified random (1080)	dmft (WHO)	63.1%	2.6 ± 2.5	N/A
Chen et al 2014[29]	Shanghai, China (0.74)	Multistage (610)	dmft (WHO)	64.8%	3.5 ± 4.1	N/A
Wulaerhan et al 2014[30]	Kashgar, China (0.74)	3-stage stratified (266)	dmft (WHO)	82.0%	N/A	N/A
Krisdapong et al 2014[31]	Bangkok, Thailand (0.74)	Stratified random (503)	dmft (WHO)	77.7%	6.2 ± 5.2	5.2
Pattanaporn et al 2013[32]	Chiang Mai, Thailand (0.74)	Not reported (167)	dmft (WHO)	78.0%	5.3 ± 5.0	N/A
Adiatman et al 2016[33]	Jakarta, Indonesia (0.69)	Cluster random (390)	dmft (WHO)	90.0%	7.5 ± 5.5	6.8 ± 4.9
Kakanur, et al 2016[34]	Bengaluru, India (0.62)	Multiphase (298)	deft (WHO)	27.5%	5.1 ± 3.6	N/A
Sujlana et al 2015[35]	Haryana, India (0.62)	Multistage (400)	dmft (WHO)	59.0%	2.8 ± 3.2	2.7 ± 3.1

(continues)

TABLE 1 (Continued)

Region, authors, and year	Study site (Human Development Index)	Sampling method (sample size, N)	Diagnosis criteria	Caries prevalence	Caries experience (dmft ± SD)	Decayed teeth (dt ± SD)
Gupta et al 2015[36]	Moradabad, India (0.62)	Simple random (568)	deft (WHO)	47.5%	2.4 ± 1.7	2.2 ± 0.7
Gopal et al 2016[37]	Andhra Pradesh, India (0.62)	Simple random (170)	dmft (WHO)	22.9%	N/A	N/A
Mittal et al 2014[38]	Gurgaon, India (0.62)	Multistage (619)	dmft (WHO)	68.5%	1.9 ± 0.4	N/A
Sankeshwari et al 2014[39]	Belgaum, India (0.62)	Simple random (302)	dmft (WHO)	70.2%	3.0 ± 3.6	3.0 ± 3.6
Thapa et al 2015[40]	Nawalparasi, Nepal (0.56)	Systematic random (357)	dmft (Unspecified)	64.4%	4.4 ± 3.1	N/A
Europe						
Grund et al 2015[41]	Ennepe-Ruhr, Germany (0.93)	Multistage (406)	dmft (WHO)	26.2%	0.9 ± 2.0	0.5 ± 1.4
Bissar et al 2014[42]	Heidelberg, Germany (0.93)	Multistage (385)	dmft (WHO)	28.6%	N/A	N/A
Monaghan et al 2014[43]	Wales, UK (0.91)	Multistage (7734)	dmft (BASCD)	41.0%	1.6	N/A
Monaghan et al 2014[43]	England, UK (0.91)	Multistage (133 516)	dmft (BASCD)	27.9%	0.9	N/A
Monaghan et al 2014[43]	Scotland, UK (0.91)	Census (13 232)	dmft (BASCD)	33.0%	1.4	N/A
Ferro et al 2017[44]	Veneto, Italy (0.89)	Random selection (728)	dmft (BASCD)	35.2%	1.3 ± 2.6	1.2 ± 2.5
Nobile et al 2014[45]	Southern Italy (0.89)	2-stage cluster (158)	dmft (WHO)	29.8%	0.9 ± 1.8	0.9 ± 1.7
Ferrazzano et al 2016[46]	Campania, Italy (0.89)	Multistage (387)	dmft (Definition)	43.4%	1.4 ± 2.1	1.1 ± 1.7
Tsanidou et al 2015[47]	North-eastern Greece (0.87)	Not reported (317)	dmft (WHO)	64.2%	2.3 ± 2.6	N/A
Middle East						
Al-Meedani et al 2016[54]	Riyadh, Saudi Arabia (0.85)	Stratified random (252)	dmft (WHO)	75.0%	N/A	N/A
Abbasoglu et al 2015[55]	Turkey (0.77)	Convenient (145)	dmft (Definition)	66.9%	N/A	N/A
Oceania						

(continues)

TABLE 1 (Continued)

Region, authors, and year	Study site (Human Development Index)	Sampling method (sample size, N)	Diagnosis criteria	Caries prevalence	Caries experience (dmft ± SD)	Decayed teeth (dt ± SD)
Blinkhorn et al 2015[57]	New South Wales, Australia (0.94)	Multistage (820)	dmft (Definition)	44.4%	1.7	1.2 ± 0.1
South America						
Abanto et al 2014[48]	Brazil (0.75)	Convenient (335)	deft (WHO)	64.8%	N/A	N/A
Carvalho et al 2014[49]	Federal District, Brazil (0.75)	Cluster (602)	dmft (Definition)	53.6%	2.1 ± 0.1	N/A
Do Amaral et al 2014[50]	Indaiatuba, Brazil (0.75)	Systematic probabilistic (303)	dmft (WHO)	41.6%	1.5	N/A
Scarpelli et al 2014[51]	Belo Horizonte, Brazil (0.75)	Multistage (1635)	dmft (WHO)	46.2%	N/A	N/A
Lourenço et al 2013[52]	Pacoti, Brazil (0.75)	Census (149)	dmft (Definition)	67.8%	N/A	2.2 ± 2.4
Corrêa-Faria et al 2013[53]	Minas Gerais, Brazil (0.75)	Systematic random (134)	dmft (WHO)	62.7%	N/A	N/A

BASCD, British Association for the Study of Community Dentistry; definition, diagnosis criteria set by researchers; deft, decayed, extracted due to caries, filled primary teeth; dmft, decayed, missing, and filled primary teeth; N/A, not applicable; SD, standard deviation; WHO, World Health Organization.

TABLE 2 Quality assessment of the selected publications with the modified Newcastle-Ottawa Scale

Region, authors, and year	Study site	Item						Total	Quality
		1	2	3	4	5	6		
Africa									
Elidrissi et al 2016[56]	Khartoum, Sudan	1	1	1	2	2	1	8	Good
Asia									
Chen et al 2017[21]	Hong Kong, China	1	1	1	2	2	1	8	Good
Peng et al 2017[22]	Hong Kong, China	1	1	0	2	2	1	7	Good
Bridges et al 2014[23]	Hong Kong, China	1	1	0	2	0	1	5	Moderate
Han, et al 2014[24]	Ulsan, Korea	1	1	0	2	2	1	7	Good
Lin et al 2017[25]	Kaohsiung, Taiwan	1	1	0	2	2	1	8	Good
Yen et al 2013[26]	Taichung, Taiwan	1	1	0	2	0	1	5	Moderate
Li et al 2017[27]	Xinjiang, China	1	1	1	2	2	1	8	Good
Jiang et al 2017[28]	Shandong, China	1	1	0	2	2	1	7	Good
Chen et al 2014[29]	Shanghai, China	1	1	1	2	2	1	8	Good
Wulaerhan et al 2014[30]	Kashgar, China	1	1	0	2	2	1	7	Good
Krisdapong et al 2014[31]	Bangkok, Thailand	1	1	1	2	2	1	8	Good
Pattanaporn et al 2013[32]	Chiang Mai, Thailand	0	1	0	2	0	1	4	Moderate
Adiatman et al 2016[33]	Jakarta, Indonesia	1	1	0	2	2	1	7	Good
Kakanur, et al 2016[34]	Bengaluru, India	1	1	0	2	0	1	5	Moderate
Sujlana et al 2015[35]	Haryana, India	1	1	0	2	0	1	5	Moderate
Gupta et al 2015[36]	Moradabad, India	1	1	0	2	2	1	7	Good

(continues)

TABLE 2 (Continued)

Region, authors, and year	Study site	Item 1	2	3	4	5	6	Total	Quality
Gopal et al 2016[37]	Andhra Pradesh, India	1	1	0	2	2	1	7	Good
Mittal et al 2014[38]	Gurgaon, India	0	1	0	2	0	1	4	Moderate
Sankeshwari et al 2014[39]	Belgaum, India	1	1	0	2	2	1	7	Good
Thapa et al 2015[40]	Nawalparasi, Nepal	1	1	0	2	0	1	6	Good
Europe									
Grund et al 2015[41]	Ennepe-Ruhr, Germany	1	1	0	2	2	1	7	Good
Bissar et al 2014[42]	Heidelberg, Germany	1	1	0	2	2	1	7	Good
Monaghan et al 2014[43]	Great Britain, UK	1	1	0	2	2	0	6	Good
Ferro et al 2017[44]	Veneto, Italy	1	1	1	2	2	1	8	Good
Nobile et al 2014[45]	Southern Italy	1	1	0	2	2	1	7	Good
Ferrazzano et al 2016[46]	Campania, Italy	1	1	0	1	2	1	6	Good
Tsanidou et al 2015[47]	North-eastern Greece	0	1	0	2	2	1	6	Good
Middle East									
Al-Meedani et al 2016[54]	Riyadh, Saudi Arabia	1	1	0	2	2	1	7	Good
Abbasoglu et al 2015[55]	Turkey	0	1	0	1	0	1	3	Moderate
Oceania									
Blinkhorn et al 2015[57]	New South Wales, Australia	1	1	0	1	2	1	6	Good
South America									
Abanto et al 2014[48]	Brazil	0	1	0	2	2	1	6	Good

(continues)

TABLE 2 (Continued)

Region, authors, and year	Study site	Item						Total	Quality
		1	2	3	4	5	6		
Carvalho et al 2014[49]	Federal District, Brazil	1	1	0	1	2	1	6	Good
Do Amaral et al 2014[50]	Indaiatuba, Brazil	1	1	0	1	2	1	6	Good
Scarpelli et al 2014[51]	Belo Horizonte, Brazil	1	1	1	2	2	1	8	Good
Lourenço et al 2013[52]	Pacoti, Brazil	1	1	0	1	2	0	5	Moderate
Corrêa-Faria et al 2013[53]	Minas Gerais, Brazil	1	1	0	2	2	1	7	Good

Item 1, representativeness; item 2, sample size; item 3, non-respondents; item 4, ascertainment of risk factor (diagnosis); item 5, outcome assessment; item 6, statistics.

4 | DISCUSSION

Various preventive strategies have been implemented to reduce the burden of ECC in different countries. The World Dental Federation, WHO, and the International Association of Dental Research have embarked on preparing the Global Oral Health Goals for the year 2020.[58] One of the objectives was to minimize the impact of dental caries on individuals and society, and to formulate strategies for the early diagnosis, prevention, and effective management of dental caries. Unfortunately, the majority of the included epidemiological studies showed that ECC remained prevalent among preschool children worldwide. In addition, untreated caries in young children is still a significant health burden in many countries, which suggests that greater attempts and different preventive measures are required if this goal is to be reached by 2020.

The result showed a geographically disproportional distribution of ECC, as the situation in Africa and Asia was unsatisfactory compared to other continents. In China, which is the most populous country in the world, the present review showed no improvement regarding the status of dental caries in Chinese preschool children compared to the results of the third national oral health survey in 2005.[59] In contrast, the situation of ECC among 5-year-old children in Wales and Scotland improved in recent years when compared to the previous survey in 2002-2003.[60] As the fourth most expensive disease to treat, dental caries is one of the major burdens affecting many children and families.[61] Study findings indicate that children from low socioeconomic families have higher risks of developing dental caries, but their access to dental services is difficult. Therefore, it is common for underprivileged children to suffer from dental caries.[62]

The HDI is a composite index of life expectancy, education, and per-capita income indicators. People from countries with a high HDI score generally have long lifespans, high education levels, and high gross domestic product per capita.[18] Studies in European and Oceanian countries that had high HDI scores generally reported a low prevalence of ECC. In Asia, three studies in India, which showed a moderate HDI score, showed low caries prevalence (<50%).[34,36,37] Contradictorily, Korea and Hong Kong had very high HDI scores, but their caries prevalence was high (>50%) compared with their counterparts in Europe. Furthermore, 11 studies in Asia reported mean dmft scores equivalent to or higher than 3.[22-24,27,29,31-34,39,40] It is noteworthy that the HDI can indicate only the development level of the entire country, and that the socioeconomic status of an individual city or district cannot be reflected in this index, which is a limitation of the present review.

The present systematic review has several strengths, including using three main databases (MEDLINE, ISI Web of Science, and Scopus) for searching publications. MEDLINE is a well-established database of the US National Library of Medicine, which is the world's largest biomedical library.[63] MeSH and subheadings make PubMed searches more sensitive, and minimize false-negative (missed) hits by compensating for the diversity of medical terminology.[64,65] Keywords, such as, "dental caries" (MeSH), "dental decay", "carious

dentine", and "white spots", were included; therefore, the keyword search was automatically expanded to include more specific terms. ISI Web of Science was another database used for the literature search in this review. It encompasses more than 12 000 journals and 160 000 conference proceedings.[66] Scopus is also a large database of peer-reviewed literature, with over 4000 health science titles indexed.[67] By using these three databases in this study, the literature search could cover a large number of citation-indexed journals. These journals are generally considered to publish good-quality studies. However, surveys published in local journals and governmental archives could not be found.

No significant disagreement was found between the independent reviewers in selecting relevant studies in the literature search. The WHO recommends that epidemiological studies should be conducted every 5 years to obtain the most updated ECC situation.[17] Therefore, the present review focused on retrieving articles published from January 2013 to December 2017. Only epidemiological surveys were selected. Cohort and randomized clinical studies were not selected, because these studies mostly recruited children from specific community groups. Based on the WHO recommendation, at least 50 participants from a single survey site should be recruited.[17] In the current review, only surveys with a sample size of >100 were included, as multiple survey sites would be better representatives of the situation. The dmft index, which is commonly used in dental surveys, was selected as an outcome of the included studies.[17] Four studies that adopted deft (decayed, extracted due to caries, and filled primary teeth) scores were also included.[26,34,36,48] Following the adopted inclusion criteria, only good-quality studies were included, resulting in a limited number of included studies for the present review.

It should be noted that the definition of ECC by the AAPD includes both non-cavitated and cavitated carious lesions. In the present review, few studies included both non-cavitated and cavitated lesions as their decay component,[46,49,52,55,57] while most of the included studies adopted the WHO diagnostic criteria by defining caries as the cavitation. To assess the methodological quality, a quality-assessment tool was needed. However, no agreed-upon or well-established quality assessment tool for epidemiological surveys existed. In the present study, the NOS was modified and adopted. All studies included in the present review had moderate-to-good methodological quality according to the assessment using the modified NOS. They had adequate sample sizes for statistical analysis. Almost all of the articles stated their statistical analysis methods clearly. Therefore, these observations suggest that the three databases selected in the present study contained mostly acceptable studies, and the methodological quality of the included articles was satisfactory.

The present findings should highlight to dental educators and policymakers that the prevalence of dental caries is still high among preschool children in many countries, particularly in Asia, South America, and Africa. National and international oral health policy should emphasize oral health promotion and prevention for children. It is important to prevent and control ECC, as the consequence of untreated ECC negatively affects chewing ability, speech development, and the formation of a positive self-image.[5] ECC is a preventable disease, and plenty of preventive methods exist. Two important practical approaches are sugar control and the use of fluoride. A systematic review described an association between the amount of sugar intake and dental caries, and suggested that ECC can be reduced by restricting sugar intake.[68] In addition, the topical use of fluoride, including mouth rinse and toothpaste, helps to reduce dental caries.[69,70] Governments and dental authorities should take these two approaches into consideration when proposing oral health-promotion programs. Strategies should be formulated to reduce morbidity from ECC, thereby increasing children's quality of life. Evidence-based dental public health programs should be prioritized and established to promote oral health in a sustainable way. Furthermore, the common risk factor approach can be used to develop accessible cost-effective oral health systems for the prevention and control of ECC. Oral health promotion and services on the prevention and treatment of ECC can be integrated with other health sectors to improve both oral and general health.

Children are often too young to take care of their teeth and cannot brush their teeth effectively. Therefore, parents and caregivers play an important role in promoting oral health for their children. Evidence suggests that parental engagement is required during the perinatal period for the effective prevention of ECC.[70] The government and health professional organizations should reduce disparities in ECC between different socioeconomic groups within countries, as well as reduce inequalities in ECC across countries. In addition, the government should take responsibility for training health-care providers to periodically perform epidemiological surveillance of ECC among young children. In addition to community health workers, social workers and dietitians can play an effective role in the prevention of ECC.

4.1 | Conclusions

Based on the included studies published in the past 5 years (2013-2017), the prevalence of ECC varies significantly across countries. In addition, ECC remains prevalent in most countries worldwide.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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