Dental Caries Prevalence among 5- to 15-Year-Old Children from SEAR Countries of WHO: A Systematic Review and Meta-Analysis

Abstract
Objectives: The aim of this review was to estimate the prevalence of dental caries in children 5–15 years of age in the countries of the South-East Asia Region (SEAR) of World Health Organization (WHO) and to describe the different caries indices used in these population-based studies. Materials and Methods: A systematic search was carried out in two databases from 1st January 2005 to 31st May 2015. Studies were included if they met the predetermined eligibility criteria. Quality assessment was done with eight-item checklist. Meta-analysis was done for 5, 12, 15, and 6–15 years age group using software STATA version 12. Results: The search strategy yielded 265 unique articles of which 36 met the inclusion criteria included for the review. Data were available for only three SEAR countries. The quality of the majority of the studies ranged from moderate to high. Heterogeneity between the studies was high ($I^2 > 98\%$). Variation in dental caries prevalence was found among different ages and among different SEAR countries. The most commonly used index for measuring dental caries was the dentition status of the 1997 WHO criteria. Conclusion: Dental caries continues to be a prominent oral health problem among children in the SEAR countries with huge variation in the prevalence across ages and countries. This review results can be used to update the “WHO Oral Health Country/Area Profile Program” for dental caries among children for SEAR.

Keywords: Children, dental caries, meta-analysis, prevalence, Southeast Asia, systematic review

Introduction
Dental caries is considered to be the most important oral health burden worldwide. World Health Organization (WHO) has reported that about 60%–90% of the world’s school children and 100% adults have dental caries. Prevalence of caries is high not only in underprivileged areas and countries but also in industrialized and high-income countries.

The “WHO Oral Health Country/Area Profile Program (CAPP) presents information on dental diseases and oral health services for various countries/area. The decayed, missing, and filled teeth (DMFT) data for South-East Asian Region (SEAR) countries are available on “CAPP” from the year 1960. Of the 11 countries, 10 countries report mean DMFT for 12 years old and only one country East Timor is for 12–14 years old. There is no prevalence mentioned for any other age/age groups. However, the literature is replete with numerous cross-sectional studies reporting caries prevalence among children of other age/age groups belonging to SEAR countries.

In population-based studies, the selection of an index for assessing dental caries is critical because the index determines the real disease outcome based on which the prevalence is decided. Studies have shown that prevalence varies when different indices are used in the same population. This has been reported in a study undertaken by Joseph et al., among 6 years old children of France wherein the prevalence of dental caries was 32% by dmft index and 61% by ICDAS-II. Apart from the most popular and traditional 1930s DMFT/dmft index, many newer indices like the PUFA, ICDAS-I, ICDAS-II, CAST, and Nyvad’s caries diagnostic criteria have been developed in the past decade, for assessing dental caries. However, these scales are used sparingly in epidemiological studies.

With this background, the present review was undertaken, first to systematically

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review all available studies estimating the dental caries prevalence among 5- to 15-year-old children in different SEAR countries of WHO and second to describe the different types of caries indices used in these studies.

Materials and Methods

Literature search

The review protocol is registered in PROSPERO (CRD42016037157). This article presents the results of SEAR countries only. A systematic search was carried out in PubMed and Google Scholar using specific keywords [Table 1]. In addition, the reference list of eligible studies was also searched manually. The authors of articles not available in the web and those that needed clarification were emailed at least twice.

Eligibility criteria of studies

Inclusion criteria for the studies to be included were as follows: population/community-based studies, cross-sectional studies, national surveys, study including children between 5 and 15 years of age, study assessing oral health which includes caries prevalence as a part, manuscripts in English language and/or any other language with relevant summary in English, and published between 1st January 2005 and 31st May 2015. The exclusion criteria were as follows: studies not reporting prevalence, case-control, or cohort studies; letters or review articles; studies recording dental caries as a part of other objectives such as body mass index, nutrition status, and socioeconomic status; hospital-based studies; studies done in special populations like disabled children, immigrants, non-indigenous, adopted children of any country, and tribal community children; studies done in only males or only females; clinical surveys conducted before the year 2000 though reported between 2005 and 2015.

Assessment of relevant studies

Two reviewers independently performed the first stage of screening, by titles only. Round 2 included screening the abstracts. Round 3 was full-text assessment. Any discrepancies were resolved by discussion or referred to the co-author. The first author independently reviewed the included full-text articles and extracted the data. After completion of the data sheet, each data entry was then cross-checked by authors.

Data extraction

Data extracted included study ID, author’s name, year of publication, country, sample size, age/age group, dental caries index, caries prevalence, and dentition. The criteria used for extracting the caries prevalence data were as follows. For 5-year-old children, prevalence of caries in deciduous dentition was recorded, and for 6–16 years old children prevalence of caries in permanent dentition only was recorded. In cases where the prevalence of caries for deciduous, mixed, and permanent dentitions was given, only the prevalence of the permanent dentition was recorded. In cases where only one prevalence figure (deciduous and permanent together) was given, the same was recorded but not used for meta-analysis. As far as possible, the prevalence for individual ages was recorded, but if combined prevalence was given, the prevalence of that age group was recorded provided the age group was within 5–15 years. In studies that reported prevalence among immigrants and native children, data for native children alone were recorded.

Quality assessment

A self-designed scoring instrument was used to assess the quality of the study. The instrument consisted of eight questions [Table 2]. Content validity of the instrument was checked by three experts in the field, and the content validity ratio was 0.89. About 5% of studies were rechecked by the first reviewer and the intraexaminer reliability was 0.91. For each question, a score of 0 or 1 was awarded to the response of “No” or “Yes,” respectively. The sum of the points awarded to the eight questions was divided by the highest possible score (8) to generate a fraction (between 0 and 1). For ranking the studies, the following classification was followed: 0–0.3 low quality, 0.4–0.6 moderate quality, and 0.7–1.0 high quality.

![Table 1: Search strategy used and the number of articles in hits and after screening for titles](image)

| Search strategy                     | Articles in hits | Selected articles |
|-------------------------------------|------------------|------------------|
| Dental caries AND prevalence AND children AND Bangladesh | 6                | 0                |
| Dental caries AND prevalence AND children AND Bhutan      | 0                | 0                |
| Dental caries AND prevalence AND children AND Democratic people’s Republic of Korea | 0                | 0                |
| Dental caries AND prevalence AND children AND India        | 183              | 39               |
| Dental caries AND prevalence AND children AND Indonesia    | 2                | 0                |
| Dental caries AND prevalence AND children AND Maldives     | 6                | 0                |
| Dental caries AND prevalence AND children AND Myanmar     | 3                | 2                |
| Dental caries AND prevalence AND children AND Nepal        | 10               | 2                |
| Dental caries AND prevalence AND children AND Sri Lanka    | 9                | 1                |
| Dental caries AND prevalence AND children AND Thailand     | 46               | 2                |
| Dental caries AND prevalence AND children AND Timor-Leste   | 0                | 0                |
Statistical analysis

Data analysis was done using STATA software version 12. Meta-analysis (pooled prevalence) was performed separately for children age 5 years (only deciduous dentition) and 12, 15, and 6–15 years considering only the permanent dentition. Prevalence was obtained irrespective of the type of index used. The heterogeneity between the studies was assessed with the software and random effect model was used because the heterogeneity observed was high.

Results

Figure 1 shows the PRISMA flowchart of search results and study selection. A total of 271 unique articles were found, of which 219 were excluded after title review. In all, 52 articles were screened for duplicates of which one was excluded. 51 articles were reviewed by abstract, of which 46 were available for full-text review. After full-text review, an additional 10 were excluded (the reasons are presented in Figure 1). Finally, 36 articles (and 80 estimates from these articles) were considered for systematic review.

Study characteristics

The characteristics of the included studies are presented in web Table 3. Of the 11 SEAR countries of WHO, information was available for only three countries (India, Myanmar, and Nepal). The majority of the studies were from India.

For systematic review, data were extracted from 80 estimates, out of which 10 gave detailed information for 5-year olds, 15 for 12-year olds, 6 for 15-year olds, and 46 for combined ages between 6 and 15 years old. Meta-analysis was performed on 56 estimates. The remaining 24 estimates were excluded because 2 estimates gave a combined prevalence, 13 provided deciduous dentition prevalence in 6–15 years age group, and in 9 there was no clarity whether prevalence was of deciduous, permanent, or mixed dentition.

Quality assessment

Table 4 shows in detail the results of the quality assessment per question, the total score, and quality grading. The majority of the studies, n = 20, were of high quality, n = 14 were of moderate quality, and only 2 studies belonged to low quality. The majority of the studies (n = 35) clearly mentioned the objectives. It was observed that in 11 studies the population description was not given, and in 15 studies the study setting was not explained. Eighteen studies failed to provide the eligibility criteria for study participants. Eight studies did not mention about sampling strategy, while there were five studies which did not explain the sample size calculation, and also the precision score was more than 20%. Seven studies did not use a standard measuring tool for assessing caries prevalence and 15 studies lacked generalizability.

Prevalence of caries

Figures 2 and 3 depict forest plot for the different SEAR countries of WHO. There was wide variation observed...
Table 3: Study characteristics of the included studies

| Study Id | Author’s Name         | Year of Publication | Country | Sample size | Age/age group included | Dental caries index                  | Caries Prevalence | Dentition |
|----------|-----------------------|---------------------|---------|-------------|------------------------|--------------------------------------|-------------------|-----------|
| 1        | Saravanam S et al.123 | 2005                | India   | 1009        | 5yrs                   | Dentition status WHO 1997 criteria   | 44.40%            | D         |
| 2        | Joshi N et al.16      | 2005                | India   | 150         | 6-12yrs                | Klein, Palmer and Knutson 1938 for DMFT index/ Grunobel AO for deft index | 77%               | ?         |
| 3        | Sudha P et al.7(A)    | 2005                | India   | 193         | 5-7yrs                 | Klein, Palmer and Knutson 1938 for dmft index | 94.30%            | D         |
| 4        | Sudha P et al.7(B)    | 2005                | India   | 160         | 8-10yrs                | Klein, Palmer and Knutson 1938 for DMFT index/ Grunobel AO for deft index | 82.50%            | ?         |
| 5        | Sudha P et al.7(C)    | 2005                | India   | 171         | 11-13yrs               | Klein, Palmer and Knutson 1938 for DMFT index/ Grunobel AO for deft index | 82.50%            | ?         |
| 6        | Kumar M et al.14(A)   | 2005                | India   | 600         | 5yrs                   | Dentition status WHO 1997 criteria for dmft index | 83%               | D         |
| 7        | Kumar M et al.14(B)   | 2005                | India   | 600         | 12yrs                  | Dentition status WHO 1997 criteria for DMFT index | 80%               | P         |
| 8        | Mahajabeen R et al.7  | 2006                | India   | 821         | 5yrs                   | Dentition Status, WHO 1997 criteria for dmft index | 60.90%            | D         |
| 9        | Dhar V et al.20(A)    | 2007                | India   | 188         | 5-7yrs                 | Dentition Status, WHO 1997 criteria for DMFT index | 18.62%            | P         |
| 10       | Dhar V et al.20(B)    | 2007                | India   | 587         | 8-10yrs                | Dentition Status, WHO 1997 criteria for DMFT index | 49.23%            | P         |
| 11       | Dhar V et al.20(C)    | 2007                | India   | 812         | 11-14yrs               | Dentition Status, WHO 1997 criteria for DMFT index | 51.48%            | P         |
| 12       | Bhat M et al.1(A)     | 2007                | India   | 96          | 5-9yrs                 | Dentition Status, WHO 1997 criteria for DMFT index | 11.46%            | P         |
| 13       | Bhat M et al.1(B)     | 2007                | India   | 155         | 10-14yrs               | Dentition Status, WHO 1997 criteria for DMFT index | 63.88%            | P         |
| 14       | Saravanam S et al.1(A)| 2008                | India   | 181         | 5-6yrs                 | Dentition Status, WHO 1997 criteria for DMFT index | 15.70%            | P         |
| 15       | Saravanam S et al.1(B)| 2008                | India   | 198         | 7-8yrs                 | Dentition Status, WHO 1997 criteria for DMFT index | 22.60%            | P         |
| 16       | Saravanam S et al.1(C)| 2008                | India   | 129         | 9-10yrs                | Dentition Status, WHO 1997 criteria for DMFT index | 41.10%            | P         |
| 17       | Grewal H et al.13(A)  | 2009                | India   | 168         | 7-9yrs                 | Dentition Status, WHO 1997 criteria for dmft index | 67.26%            | D         |
| 18       | Grewal H et al.13(B)  | 2009                | India   | 554         | 10-12yrs               | Dentition Status, WHO 1997 criteria for dmft/DMFT index | 80.86%            | ?         |
| 19       | Dhar V & Bhatnagar M.12(A) | 2009              | India   | 163         | 6-7yrs                 | Dentition Status, WHO 1997 criteria for dmft index | 51.53%            | D         |

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in the caries prevalence and the heterogeneity was significantly high.

In an attempt to explain heterogeneity, subgroup analysis was performed: first, selecting studies by quality. The two low-quality studies were excluded and there was no significant difference noted in the prevalence between moderate and high-quality studies. Second, by age, caries prevalence was analyzed by the WHO age categories (5, 12, and 15). Wide variation in prevalence was obtained for the data coming from the same age too. Forest plots [Figure 2] present the pooled prevalence values for children of 5, 12, and 15 years of age. The pooled prevalence for 5 years old for deciduous dentition was obtained as 55%, for 12 years it was 45%, and for 15 years as 51%,
respectively. Pooled caries prevalence was calculated for DMFT and dmft separately; however, all the studies were combined irrespective of the index used. Except for one study\cite{7} (which used PUFA), all of them expressed caries prevalence as DMFT and dmft/deft although they used different indices [Table 5]. The heterogeneity was significantly high for the individual ages too.

It was also observed that even if the data came from the same geographical area, the prevalence trend was not consistent.

The indices used in these studies are mentioned in Table 5. Of 36 studies, 21 studies\cite{8-28} used WHO 1997 criteria for assessing DMFT/dmft status and expressing prevalence, three studies\cite{29-31} used WHO 1987 criteria, six studies\cite{32-37} used ICADS-II criteria, and one study\cite{7} used PUFA criteria.

**Table 3: Contd...**

| No. | Authors and Year | Location | Population | Age (yrs) | Index | Caries Prevalence |
|-----|-----------------|----------|------------|-----------|-------|-------------------|
| 20  | Dhar V & Bhatnagar M\textsuperscript{2}(B) | 2009 | India | 587 | 8-10yrs | Dentition Status, WHO 1997 criteria for dmft | 66.44% | D |
| 21  | Simratvir M et al\textsuperscript{38} | 2009 | India | 275 | 5-5.11 | deft index by Gruenberg AO | 58.55% | D |
| 22  | Das UM et al\textsuperscript{39}(A) | 2009 | India | 229 | 6yrs | Dentition status, WHO 1987 criteria for dmft index | 57.20% | D |
| 23  | Das UM et al\textsuperscript{39}(B) | 2009 | India | 201 | 12yrs | Dentition status, WHO 1987 criteria for DMFT index | 49.25% | P |
| 24  | Grewal H et al\textsuperscript{40}(A) | 2011 | India | 18 | 9yrs | Dentition Status, WHO 1997 criteria for dmft/DMFT | 61.11% | ? |
| 25  | Grewal H et al\textsuperscript{40}(B) | 2011 | India | 80 | 10yrs | Dentition Status, WHO 1997 criteria for dmft/DMFT. | 63.75% | ? |
| 26  | Grewal H et al\textsuperscript{40}(C) | 2011 | India | 169 | 11yrs | Dentition Status, WHO 1997 criteria for dmft/DMFT. | 69.82% | ? |
| 27  | Grewal H et al\textsuperscript{40}(D) | 2011 | India | 253 | 12yrs | Dentition Status, WHO 1997 criteria for dmft/DMFT. | 36.36% | ? |
| 28  | Moses J et al\textsuperscript{40} | 2011 | India | 1484 | 5-15yrs | Dentition status, WHO 1987 criteria for DMFT/dmft index | 63.83% | ? |
| 29  | Singh S et al\textsuperscript{40} | 2012 | India | 273 | 5yrs | deft index by Gruenberg AO | 41% | D |
| 30  | Basha S & Hiremath SS\textsuperscript{51}(A) | 2012 | India | 196 | 6yrs | Dentition status WHO criteria for dmft, ICADS-II by Braga MM et al 2009 | 50.51% | D |
| 31  | Basha S & Hiremath SS\textsuperscript{51}(B) | 2012 | India | 204 | 13yrs | Dentition status WHO criteria for DMFT, ICADS-II by Braga MM et al 2010 | 37.75% | P |
| 32  | Sohi RK et al\textsuperscript{51}(A) | 2012 | India | 579 | 5yrs | Dentition status, WHO 1987 criteria for dmft index | 48.30% | D |
| 33  | Sohi RK et al\textsuperscript{51}(B) | 2012 | India | 534 | 12yrs | Dentition status, WHO 1987 criteria for DMFT index | 30.50% | P |
| 34  | Fotedar S et al\textsuperscript{52}(A) | 2013 | India | 497 | 12yrs | Dentition Status, WHO 1997 criteria for DMFT. | 32.60% | P |
| 35  | Fotedar S et al\textsuperscript{52}(B) | 2013 | India | 514 | 15yrs | Dentition Status, WHO 1997 criteria for DMFT. | 42.20% | P |
| 36  | Das D et al\textsuperscript{53}(A) | 2013 | India | 417 | 6-8yrs | Dentition Status, WHO 1997 criteria for DMFT. | 15.11% | P |
| 37  | Das D et al\textsuperscript{53}(B) | 2013 | India | 623 | 9-11yrs | Dentition Status, WHO 1997 criteria for DMFT. | 27.93% | P |
| 38  | Das D et al\textsuperscript{53}(C) | 2013 | India | 724 | 12-14yrs | Dentition Status, WHO 1997 criteria for DMFT. | 42.40% | P |
| 39  | Joshi N et al\textsuperscript{54}(A) | 2013 | India | 225 | 6yrs | Klein, Palmer and Knutson 1938 for dmft index | 68% | D |

Contd...
### Table 3: Contd...

| Sl. No | Authors          | Year | Country | Age (Years) | Methodology | Prevalence (%) | Criteria |
|-------|------------------|------|---------|-------------|--------------|----------------|----------|
| 40    | Joshi N et al.   | 2013 | India   | 227         | 7 yrs        | 73%            | D        |
|       |                  |      |         |             |              | Klein, Palmer and Knutson 1938 for dmft index |          |
| 41    | Joshi N et al.   | 2013 | India   | 226         | 8 yrs        | 74.33%         | D        |
|       |                  |      |         |             |              | Klein, Palmer and Knutson 1938 for dmft index |          |
| 42    | Joshi N et al.   | 2013 | India   | 228         | 9 yrs        | 77.63%         | D        |
|       |                  |      |         |             |              | Klein, Palmer and Knutson 1938 for dmft index |          |
| 43    | Joshi N et al.   | 2013 | India   | 233         | 10 yrs       | 74.24%         | P        |
|       |                  |      |         |             |              | Klein, Palmer and Knutson 1938 for DMFT index |          |
| 44    | Joshi N et al.   | 2013 | India   | 230         | 11 yrs       | 66.95%         | P        |
|       |                  |      |         |             |              | Klein, Palmer and Knutson 1938 for DMFT index |          |
| 45    | Joshi N et al.   | 2013 | India   | 231         | 12 yrs       | 50.21%         | P        |
|       |                  |      |         |             |              | Klein, Palmer and Knutson 1938 for DMFT index |          |
| 46    | Ravishankar PL et al. | 2013 | India   | 109         | 6 yrs        | 43%            | P        |
| 47    | Ravishankar PL et al. | 2013 | India   | 149         | 7 yrs        | 50%            | P        |
| 48    | Ravishankar PL et al. | 2013 | India   | 139         | 8 yrs        | 59%            | P        |
| 49    | Ravishankar PL et al. | 2013 | India   | 134         | 9 yrs        | 63%            | P        |
| 50    | Ravishankar PL et al. | 2013 | India   | 159         | 10 yrs       | 62%            | P        |
| 51    | Ravishankar PL et al. | 2013 | India   | 154         | 11 yrs       | 58%            | P        |
| 52    | Ravishankar PL et al. | 2013 | India   | 112         | 12 yrs       | 42%            | P        |
| 53    | Datta P & Datta PP\(\) | 2013 | India   | 49          | 13 yrs       | Not mentioned  | 61.20%  |
| 54    | Datta P & Datta PP\(\) | 2013 | India   | 65          | 14 yrs       | Not mentioned  | 80%     |
| 55    | Munjal V et al.  | 2013 | India   | 1250        | 12 yrs       | 81.36%         | P        |
| 56    | Munjal V et al.  | 2013 | India   | 1250        | 15 yrs       | Dentition status WHO 1997 criteria for DMFT index | 86.16%  |
| 57    | Sarumathi T et al. | 2013 | India   | 168         | 5 yrs        | Dentition status WHO 1997 criteria for DMFT index | 72%     |
| 58    | Sarumathi T et al. | 2013 | India   | 135         | 6 yrs        | Klein, Palmer and Knutson 1938 for dmft index | 74.10%  |
| 59    | Sharma A et al.  | 2014 | India   | 1878        | 5-8 yrs      | Dentition Status, WHO 1997 criteria for dmft/DMFT. | 56.80%  |

Discussion

A large number of studies have been conducted on caries prevalence in different parts of SEAR, but as there were no data which gave a pooled picture of the prevalence

used DMFT/dmft index proposed by Klein, Palmer, and Knutson, three\(^{[38-40]}\) studies used deft index proposed by Gruebbel, and one\(^{[7]}\) used PUFA index. One study\(^{[41]}\) did not mention what index was used, while one\(^{[2]}\) other did not mention which WHO criteria were used.
across all the countries in SEAR, this systematic review and meta-analysis was commenced with the aim of obtaining prevalence among children of 5–15 years of age of SEAR countries and to gauge the choice of index used in these studies.

The pooled dental caries prevalence of 55% for 5 years old was slightly high as compared to the target which was set by WHO for the year 2000. (Caries-free children at 5 years should be not less than 50%).[2] For 12 years old, the pooled prevalence was 45%, and for 15 years old children, it was 51%. The age group of 6–15 years gave a pooled prevalence of 47%.

There was wide variation in caries prevalence. Probably the reason for variation could be the heterogeneity of the study population itself. The authors of the included studies

| Study   | Authors | Year | Country | Age | Index | WHO 1997 Criteria | Pooled Prevalence |
|---------|---------|------|---------|-----|-------|-------------------|-------------------|
| 60      | Sharma A et al[22] (B) | 2014 | India    | 1191 | 9-12yrs | 9-12yrs | 61.20% | M |
| 61      | Sukhobogi JR et al[23] (i)(A) | 2014 | India    | 331  | 12yrs  | Klein, Palmer and Knutson 1938 for DMFT index | 51.70% | P |
| 62      | Sukhobogi JR et al[23] (i)(B) | 2014 | India    | 273  | 15yrs  | Klein, Palmer and Knutson 1938 for DMFT index | 28.90% | P |
| 63      | Sukhobogi JR et al[23] (ii)(A) | 2014 | India    | 924  | 12yrs  | Dentition Status, WHO 1997 criteria for DMFT. | 39.90% | P |
| 64      | Sukhobogi JR et al[23] (ii)(B) | 2014 | India    | 951  | 15yrs  | Dentition Status, WHO 1997 criteria for DMFT. | 46.70% | P |
| 65      | Mehta A & Bhalla S[24] | 2014 | India    | 603  | 5-6yrs | Monse B et al 2010 for pufa index | 69.50% | D |
| 66      | Ingle NA et al[25] (A) | 2014 | India    | 700  | 12yrs  | Dentition Status, WHO 1997 criteria for DMFT. | 47.80% | P |
| 67      | Ingle NA et al[25] (B) | 2014 | India    | 700  | 15yrs  | Dentition Status, WHO 1997 criteria for DMFT. | 44% | P |
| 68      | Mittal M et al[26] (A) | 2014 | India    | 619  | 5yrs   | Dentition Status, WHO 1997 criteria for dmfl. | 68.50% | D |
| 69      | Mittal M et al[26] (B) | 2014 | India    | 384  | 12yrs  | Dentition Status, WHO 1997 criteria for DMFT. | 37.50% | P |
| 70      | Malvania EA et al[27] | 2014 | India    | 1539 | 12yrs  | Dentition status WHO 1997 criteria for DMFT index | 17.15% | P |
| 71      | Gupta D et al[28] | 2015 | India    | 568  | 5yrs   | dfc index by Grueneb AO | 47.30% | D |
| 72      | Chu CH et al[29] (A) | 2012 | Myanmar  | 95   | 5yrs   | Dentition status WHO 1997 criteria for dmft index | 25.20% | D |
| 73      | Chu CH et al[29] (B) | 2012 | Myanmar  | 80   | 12yrs  | Dentition status WHO 1997 criteria for DMFT index | 15% | P |
| 74      | Phyo AZZ et al[30] | 2013 | Myanmar  | 220  | 12-13yrs | Dentition status WHO 1997 criteria for DMFT index | 51.20% | P |
| 75      | Subedi B et al[31] (A) | 2011 | Nepal    | 313  | 5-6yrs | WHO criteria 1997 for dmft, SIC index | 69% | D |
| 76      | Subedi B et al[31] (B) | 2011 | Nepal    | 325  | 12-13yrs | WHO criteria 1997 for DMFT & dmft, SIC index | 53.23% | P |
| 77      | Khanal S & Acharya J[32] (A) | 2014 | Nepal    | 115  | 12yrs  | Dentition status WHO 1997 criteria for DMFT index | 67.80% | P |
| 78      | Khanal S & Acharya J[32] (B) | 2014 | Nepal    | 51   | 13yrs  | Dentition status WHO 1997 criteria for DMFT index | 52.90% | P |
| 79      | Khanal S & Acharya J[32] (C) | 2014 | Nepal    | 46   | 14yrs  | Dentition status WHO 1997 criteria for DMFT index | 39.10% | P |
| 80      | Khanal S & Acharya J[32] (D) | 2014 | Nepal    | 40   | 15yrs  | Dentition status WHO 1997 criteria for DMFT index | 60.00% | P |
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Table 4: Quality assessment of the included studies

| Sr. No | Authors                     | Clearly mentioned objectives | Population description (general/special group or area) | Study setting | Eligibility criteria | Sampling strategy | Sample size/Precession | Measurement tool | Generalizability | Total | Quality |
|--------|-----------------------------|-----------------------------|--------------------------------------------------------|---------------|---------------------|-------------------|------------------------|----------------|----------------|-------|---------|
| 1      | Basha S & Hiremath S        | 1                           | 1                                                      | 1             | 1                   | 1                 | 1                      | 1              | 0.88            | High  |         |
| 2      | Bhat M et al                | 1                           | 0                                                      | 1             | 0                   | 0                 | 1                      | 1              | 0.50            | Moderate |         |
| 3      | Chu Ch et al(i)             | 1                           | 0                                                      | 0             | 0                   | 0                 | 1                      | 1              | 0.25            | Low    |         |
| 4      | Das D et al                 | 0                           | 0                                                      | 1             | 0                   | 1                 | 0                      | 1              | 1              | 1.50   | Moderate |
| 5      | Das UM et al                | 1                           | 1                                                      | 0             | 1                   | 0                 | 1                      | 0              | 0.50            | Moderate |
| 6      | Datta P & Datta PP          | 1                           | 0                                                      | 0             | 0                   | 0                 | 0                      | 1              | 1              | 0.25   | Low     |
| 7      | Dhar V & Bhatnagar M        | 1                           | 0                                                      | 1             | 1                   | 1                 | 1                      | 0              | 0.63            | Moderate |
| 8      | Dhar V et al                | 1                           | 0                                                      | 1             | 0                   | 1                 | 0                      | 1              | 0.50            | Moderate |
| 9      | Fotedar S et al             | 1                           | 1                                                      | 1             | 1                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 10     | Grewal H et al 2009         | 1                           | 1                                                      | 1             | 0                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 11     | Grewal H et al 2011         | 1                           | 0                                                      | 1             | 0                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 12     | Gupta D et al               | 1                           | 0                                                      | 0             | 0                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 13     | Ingle NA et al              | 1                           | 1                                                      | 0             | 1                   | 1                 | 1                      | 1              | 0.88            | High    |         |
| 14     | Joshi N et al               | 1                           | 0                                                      | 1             | 1                   | 1                 | 1                      | 0              | 0.63            | Moderate |
| 15     | Joshi N et al 2013          | 1                           | 1                                                      | 0             | 1                   | 1                 | 1                      | 0              | 0.63            | Moderate |
| 16     | Khanal S & Acharya J        | 1                           | 1                                                      | 0             | 1                   | 0                 | 1                      | 1              | 0.75            | High    |         |
| 17     | Kumar M et al               | 1                           | 1                                                      | 0             | 1                   | 1                 | 1                      | 1              | 0.75            | High    |         |
| 18     | Mahajabeen R et al          | 1                           | 1                                                      | 0             | 1                   | 0                 | 1                      | 1              | 1.00            | High    |         |
| 19     | Malvania EA et al           | 1                           | 1                                                      | 1             | 1                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 20     | Mehta A & Bhalla S          | 1                           | 1                                                      | 1             | 1                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 21     | Mittal M et al              | 1                           | 0                                                      | 1             | 1                   | 0                 | 1                      | 1              | 0.63            | Moderate |
| 22     | Moses J et al               | 1                           | 1                                                      | 1             | 1                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 23     | Munjal V et al(B)           | 1                           | 1                                                      | 1             | 1                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 24     | Picho AZZ et al             | 1                           | 1                                                      | 1             | 0                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 25     | Ravishankar PL et al        | 1                           | 1                                                      | 1             | 0                   | 0                 | 0                      | 0              | 1              | 0.50   | Moderate |
| 26     | Saravanam S et al 2005      | 1                           | 1                                                      | 0             | 1                   | 1                 | 1                      | 0              | 0.63            | Moderate |
| 27     | Saravanam S et al 2008      | 1                           | 0                                                      | 1             | 0                   | 0                 | 1                      | 1              | 0.50            | Moderate |
| 28     | Sarumathi T et al           | 1                           | 1                                                      | 0             | 0                   | 1                 | 1                      | 1              | 0.75            | High    |         |
| 29     | Sharma A et al              | 1                           | 1                                                      | 1             | 1                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 30     | Simratvir M et al           | 1                           | 1                                                      | 0             | 0                   | 1                 | 1                      | 1              | 0.63            | Moderate |
| 31     | Singh S et al               | 1                           | 1                                                      | 0             | 1                   | 0                 | 1                      | 1              | 0.75            | High    |         |
| 32     | Sohi RK et al               | 1                           | 1                                                      | 0             | 0                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 33     | Subedi B et al              | 1                           | 1                                                      | 0             | 1                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 34     | Sudha P et al               | 1                           | 1                                                      | 1             | 1                   | 1                 | 0                      | 1              | 0.88            | High    |         |
| 35     | Sukhabogi JR et al(i)       | 1                           | 1                                                      | 1             | 1                   | 1                 | 1                      | 1              | 1.00            | High    |         |
| 36     | Sukhabogi JR et al(ii)      | 1                           | 1                                                      | 1             | 1                   | 1                 | 1                      | 0              | 0.88            | High    |         |

Table 5: Indices used for assessing prevalence

| Index used                          | No. of studies |
|-------------------------------------|----------------|
| WHO 1997 criteria                   | 20             |
| DMFT (Klein, Palmer, Knutson, 1938) | 6              |
| WHO 1987 criteria                   | 3              |
| deft (Gruebel AO, 1944)             | 3              |
| Others*                             | 4              |

*PUFA index, WHO criteria not mentioned, index not mentioned

increased consumption of sugary food and rich carbohydrate diet,[8,9,14-17,33] low socioeconomic status of family,[8,11,33,35-45] lack of utilization of dental services,[33,43] poor oral hygiene practices,[18,29,35,38] and low parental education.[11,34,39]

The children who presented with low caries prevalence were found to have less access to refined and sugary food stuffs,[19,36] had a special anti-cariogenic diet,[20] had a constant exposure to fluorides through drinking water,[19,21,35] belonged to lower social class, and were not able to afford sugary food and followed good oral hygiene practices.[22]

It was observed that of 11 countries in SEAR, data for only three countries were found. Probably, for the remaining countries the data were either not published or were not included because it did not fit our eligibility criteria. Maximum studies reported were from India (32 studies,[22,8,15,34,41] with 71 estimates) followed by
Nepal (2 studies\cite{17,18} with 6 estimates), and Myanmar (2 studies\cite{16,19} with 3 estimates) accounting for a total of 80 estimates [Table 3].

India, Myanmar, and Nepal do not have community water fluoridation, but various oral health programs are being conducted in these countries. In Nepal, there is a project for oral health care of rural area and a school-based oral health project called Hasilo (“smiley”) by Health and Development society which started in 2008 incorporating school dental check-ups, camps, and training of school teachers regarding oral health.\cite{44} In Myanmar, an Oral Health Project was started in 2008 which helped in improving the awareness regarding oral health among children.\cite{45} Among all the SEAR countries, India has the highest number of dental colleges (n = 309). Mostly, every college on their level conducts oral health check-up camps in villages and nearby schools. Along with this, preventive treatments like topical fluoride application and pit and fissure sealant placements are also done by the colleges. Indian Dental Association in collaboration with Colgate-Palmolive Pvt Ltd observes the month of October as an Oral Health Month\cite{46} and conducts free check-ups and also distributes oral health kit to school children. Though National Oral Health Policy is drafted for India, it is not yet implemented. Oral health programs at the community level are conducted sporadically for children by government and private undertaking. However, India is falling short in providing preventive care programs for the community. In Sri Lanka though National Oral Health Policy is drafted but not yet implemented, while Bangladesh does not have dental hygienist or oral health workers who would carry out the programs in the community. Bhutan provides free oral health services in the community but lack manpower to provide these services.

It was found that the most common choice for caries assessment was the Dentition status of the WHO criteria 1997. In spite of development of newer indices capable of expressing the exact caries load, it was found that only few studies used newer indices. Unlike the traditional DMFT index, newer indices will help in identifying caries and treating the lesions at initial stages rather than categorizing the initial caries and white spots into sound tooth and waiting for caries to advance and later treating them at dentinal level (D$_3$) which will eventually cause extra tooth destruction. During quality assessment, a number of remarkable points were noted which should be considered by the researchers for future studies. More importantly, caries prevalence should be reported separately for deciduous and permanent dentition. Along with the mean prevalence of the age groups considered in the study, caries prevalence should also be mentioned clearly for individual ages. The accuracy of prevalence estimates largely depends on the sample size, and hence in cross-sectional studies, the sample size should be calculated to increase the precision of the study results. In order to ensure generalizability of the study results, a correct sampling frame should be chosen giving representation to the entire geographical location.

This review has few limitations. Since only two databases were searched, we would have missed on articles from other sources. The other limitation was that we had to exclude many articles because the authors presented a combined prevalence of deciduous and permanent teeth together as a single value, and also on few occasions there was no clarity whether the prevalence obtained is of deciduous or permanent dentition. Moreover, studies published only in English language were included, and thus more databases along with different language articles of other countries of SEAR need to be searched.

**Conclusion**

Dental caries is still a prevailing problem among children in SEAR countries. A huge variation in prevalence was found among 5, 12, 15 years, and 6–15 years age group across the countries of SEAR. The results of this review can be used to update CAPP\cite{3} More population-based studies are required to fill the gap in literature for the countries whose data are not available. Also, a standard dental caries assessment tool should be used in future studies permitting for unbiased comparison between the countries. Such a kind of data will help in planning and implementing preventive programs and working on policy development for enhancing the life of children.

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Conflicts of interest

There are no conflicts of interest.

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