

Prevalence of dental caries among children aged 5–15 years from 9 countries in the Eastern Mediterranean Region: a meta-analysis

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Abstract

Background: Dental caries affects all age groups, although children are affected to a greater extent. Several studies have assessed the prevalence of dental caries in the World Health Organization (WHO) Eastern Mediterranean Region. However, prevalence data for dental caries have not been pooled for all countries in the Region.

Aims: To estimate by meta-analysis the pooled prevalence of dental caries among children aged 5–15 years in the Region.

Methods: The study protocol was registered in PROSPERO with registration number CRD42016037157. Twenty-one studies (37 estimates) were identified through systematic search for articles published between 1 January 2005 and 5 July 2018. The required data from each article were extracted into the datasheet. A random-effects meta-analysis was performed for the overall age group and for age 5, 12 and 15 years individually.

Results: Data were available for only 9 of the 21 countries in the Region. Heterogeneity between studies was high ($I^2 > 98\%$). There was considerable variation among the countries for the prevalence of dental caries at different ages. The pooled prevalence for deciduous dentition in children aged 5 years was 65% (45–85%); 61% (50–72%) for permanent dentition in children aged 12 years; 70% (64–75%) for children aged 15 years; and 66% (59–73%) for children aged 6–15 years. The most common index used for oral examination to calculate caries experience was WHO Basic Oral Health Survey Criteria, 1997.

Conclusions: Dental caries continues to be an oral health concern among children in 9 countries in the Region.

Keywords: dental caries, prevalence, children, Eastern Mediterranean Region, meta-analysis

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Introduction

Dental caries has long been a global oral health burden (1). It not only affects oral health but also has a deleterious effect on overall health and quality of life (2), especially in underprivileged countries (3). The World Health Organization (WHO) reports that 60–90% of children are affected by dental caries (4). Dental caries affects all age groups, although children are affected to a greater extent than adults. Part of the solution to overcome this problem is to estimate the current burden accurately and plan for a comprehensive dental programme. The WHO Country Area Profile Program database maintains data on caries prevalence data. However, there are a few limitations: data are not available for all age groups and all the WHO countries; and if data are available, they are not updated on a regular basis. In the WHO Eastern Mediterranean Region, data are available but they are not updated on a regular basis (5). In 2018, Al Ayyan et al. conducted a meta-analysis of the Gulf countries in the Region, and found that prevalence of caries in deciduous teeth was 80.9% (6).

To obtain a complete picture of the dental caries situation among children in all the countries in the Region, a meta-analysis has been planned, which will provide evidence-based information, based upon which, appropriate health care policies can be developed. Along

with prevalence, it is also essential to evaluate the various indices used in the published literature for assessing caries, as different indices give varying results within the same populations (7). For example, the International Caries Detection and Assessment System (ICDAS) considers even white spots as caries, while the traditional Decayed Missing and Filled (DMF) index ignores noncavitated enamel lesions, leading to underestimation of caries (8).

The aim of this review was to assess prevalence of caries among children aged 5–15 years by conducting a meta-analysis, and to identify the most common indices used for estimating caries prevalence in the Region.

Methods

This study was part of a bigger review that was conducted to estimate prevalence of caries across all WHO regions. The review protocol is registered in PROSPERO (registration number CRD42016037157). Here, we discuss only the meta-analysis pertaining to the Eastern Mediterranean Region.

Literature search

A literature search was conducted in PubMed and Google Scholar for the relevant articles using a preset search strategy. The keywords used were “Dental caries AND

Prevalence AND Children AND (name of country)". Only articles published between 1 January 2005 and 5 July 2018 were considered. The search was carried out independently by 1 author (SK) and was verified by 2 others (PK and SHS). The inclusion criteria were: studies that were community based, cross-sectional, English language, and conducted among children aged 5–15 years. Only those studies providing data about children native to the countries of the Region were retrieved. Exclusion criteria were: studies that were conducted with a secondary objective to identify prevalence; studies on caries association and correlation with risk factors; studies on immigrants and special groups; studies including one gender only; and short communications and letters to the editor.

Data extraction

Study characteristics such as authors' names, year of publication, age/age group included, sample size, index used, prevalence of dental caries, type of dentition and risk factors for dental caries are summarized in Appendix 1 (9–29). The caries prevalence of permanent dentition (D) for the age group 6–15 years and caries prevalence of deciduous dentition (d) for the age group 5–15 years were calculated separately. The caries prevalence represented the D component and d component of the Decayed, Missing and Filled Teeth (DMFT) and dmft indices (DMFT is for permanent teeth and dmft for deciduous teeth). The D and d component of DMFS (Decayed, Missing and Filled Surface) and dmfs (deciduous teeth) were not considered.

Caries prevalence data were extracted for individual ages. If individual age prevalence was not mentioned, the combined prevalence of age groups (e.g., 6–15 and 8–10 years) was considered. If prevalence was not mentioned but data about the D and d components, along with the total sample size, were available, the prevalence rate was calculated.

Quality Assessment

The quality assessment of the included studies was performed based on the criteria reported by Kale et al. (30).

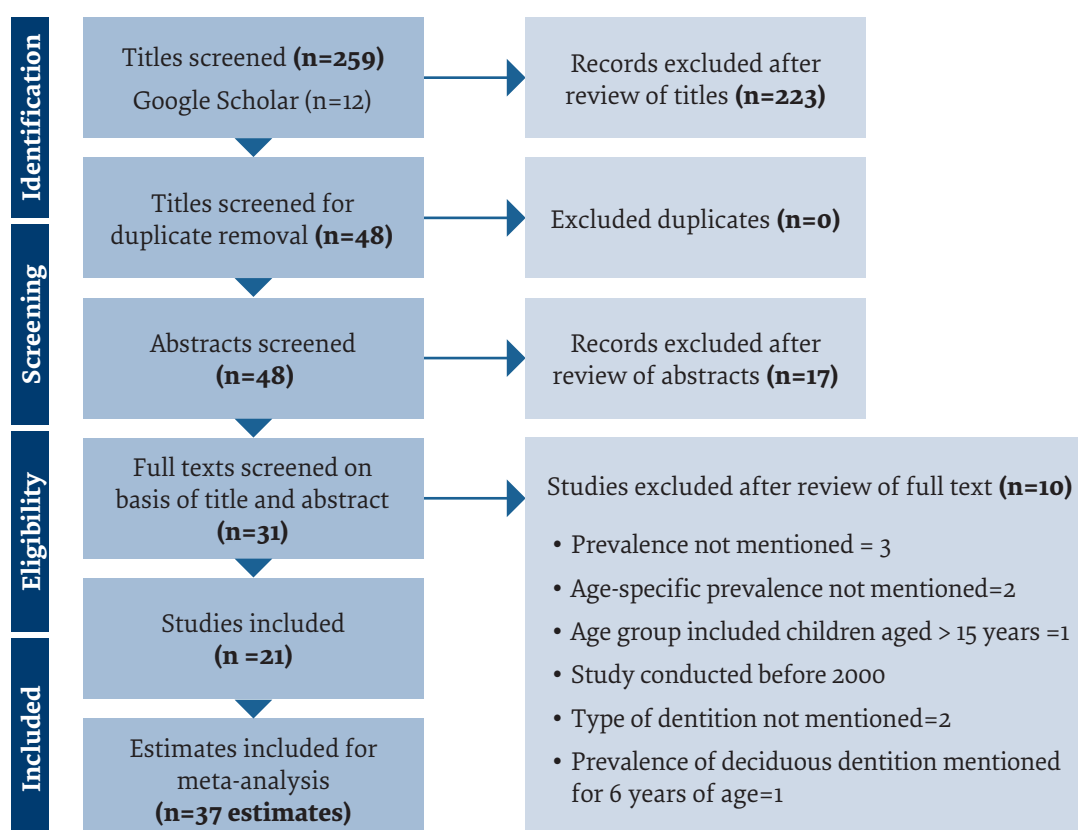
Statistical analysis

A random-effects meta-analysis was performed to estimate the pooled prevalence and 95% confidence intervals (CIs) and were depicted by means of forest plots. Heterogeneity was quantified using I² statistics. Separate meta-analyses were performed for ages 5, 12 and 15 years and overall for 6–15 years. All analyses were performed using STATA version 12.

Results

A total of 259 articles from PubMed and 12 from Google Scholar were retrieved initially (Figure 1). After reviewing the titles of the articles, 133 were excluded, as they did not fit the selection criteria. After reading through the abstracts of the remaining articles, 17 more were excluded. An in-depth reading of the remaining articles led to the exclusion of 7 more, for reasons such as not mentioning the prevalence, inclusion of children aged > 15 years, and

Figure 1 PRISMA flow chart showing the article selection process



providing prevalence of deciduous and permanent dentition together. Ultimately, 21 articles with 37 estimates were considered for meta-analysis. Relevant literature was only found for 9 of the 21 countries currently in the Eastern Mediterranean Region [Islamic Republic of Iran, Iraq, Yemen, Jordan, Libya, United Arab Emirates (UAE), Bahrain, Lebanon and Egypt]. For children aged 5 years there were 4 estimates; for children aged 12 years there were 11 estimates; for children aged 15 years there were 7 estimates; and for children aged 6–15 years there were 33 estimates available. Only 2 studies that were reported by Ahmadzadeh et al. (15) and Hamza (17) were found to have moderate quality as per quality assessment criteria (30). All other studies were of high quality and none was of low quality.

The heterogeneity between the studies was high ($I^2 > 98\%$) and therefore an aggregate data random-effect model was adopted for the meta-analysis. The pooled prevalence for deciduous dentition for children aged 5 years was 65% (95% CI: 45–85%) (Figure 2); 61% (95% CI: 50–72%) for permanent dentition in children aged 12 years (Figure 3); 70% (95% CI: 64–75%) for children aged 15 years (Figure 4); and 66% (95% CI: 59–73%) for children aged 6–15 years (Figure 5). Based on the data extracted from each included study, the index information was obtained (Appendix 1). The number of times the index was used was totalled to meet the second objective. The most common index used for evaluating dental caries experience was the WHO Basic Oral Health Criteria, 1997 (used in 13 studies), followed by the DMFT index, 1937 (3 studies), WHO Basic Oral Health Criteria, 1987 (3 studies) and WHO Basic Oral Health Criteria, 2013 (2 studies).

Discussion

Several studies have been conducted in the Eastern Mediterranean Region to assess the prevalence of dental caries. However, there has been no effort to pool the prevalence data for all the countries in the Region. Hence, this meta-analysis was conducted to obtain prevalence data for dental caries in children aged 5–15 years in the Region, and to establish the most frequently used index for assessing

caries in these studies. The pooled prevalence obtained for children aged 5 years was 65%. This is lower than the prevalence of 80.95% in Gulf countries reported by Al Ayyan et al. (6). Despite the fact that it is lower than the previously reported prevalence, it still does not meet the target set of 50% caries free by WHO in 2000 (31). Our review had data from only 4 studies of deciduous teeth, while the review by Al Ayyan et al. (6) included 34 studies from 1992–2016. This might explain the variation in prevalence. Three of the 4 estimates in the present study were from the UAE and the other was from Yemen. The reason reported for dental caries in these studies was the negative attitude of parents towards their children's dental health.

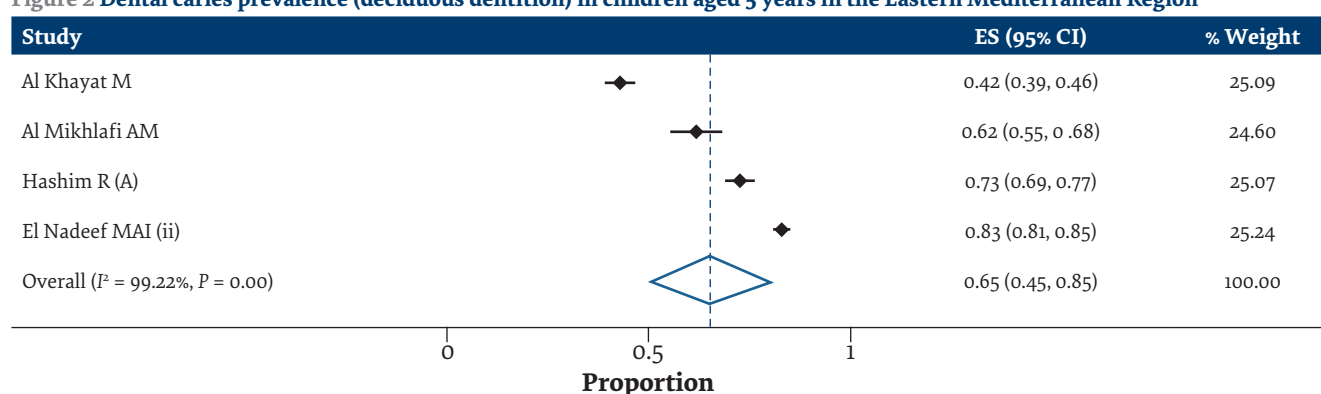
For the children aged 12 years, the pooled prevalence was 61%. This result was obtained by pooling the prevalence from the Islamic Republic of Iran, Jordan, Yemen, Libya, United Arab Emirates, Iraq, Bahrain and Lebanon. Dental caries in this age group was attributed to low socioeconomic status, low parental education, consumption of refined food and poor access to dental services. Two studies (13,19) reported low socioeconomic status to be the reason for high prevalence of caries, whereas another (28) reported it as a reason for low prevalence of caries.

Among children aged 15 years, the prevalence of dental caries was 70%. This was contributed by studies from the Islamic Republic of Iran, UAE, Bahrain and Lebanon. Poor oral hygiene practices among children, consumption of cariogenic diet and low socioeconomic status were the reported factors for the presence of dental caries.

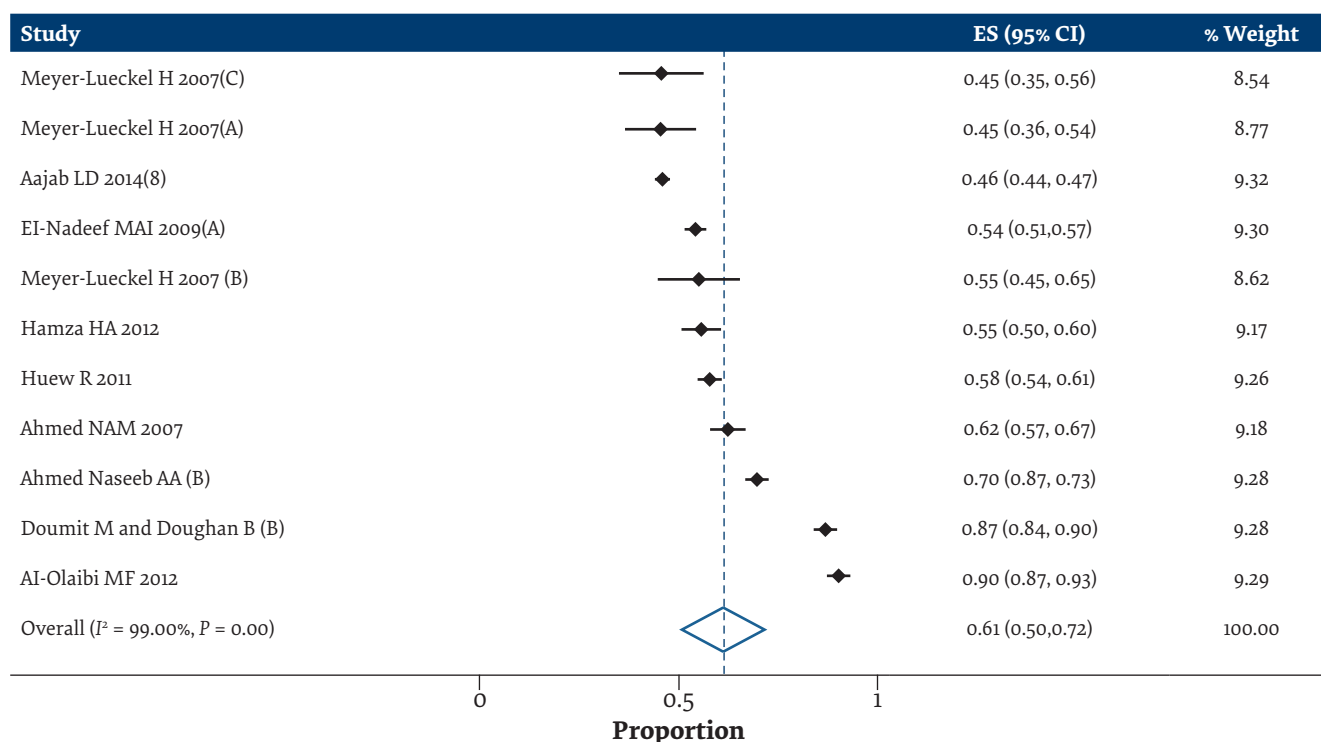
The most common dental caries indices used were WHO criteria 1987, 1997 and 2013 and the DMFT index proposed by Klein, Palmer and Knutson (1937). Castro et al. (8) conducted an interview to investigate the population-based caries detection methods and reported that DMFT index was the most known and used index. However, 95.7% were dissatisfied with the index yet continued to use it. It is recommended that researchers use the WHO Basic Oral Health Survey criteria for assessing caries, which will provide global uniformity and aid effective comparison.

Overall, the pooled prevalence of permanent dentition in children aged 6–15 years was 66%. There was huge

Figure 2 Dental caries prevalence (deciduous dentition) in children aged 5 years in the Eastern Mediterranean Region



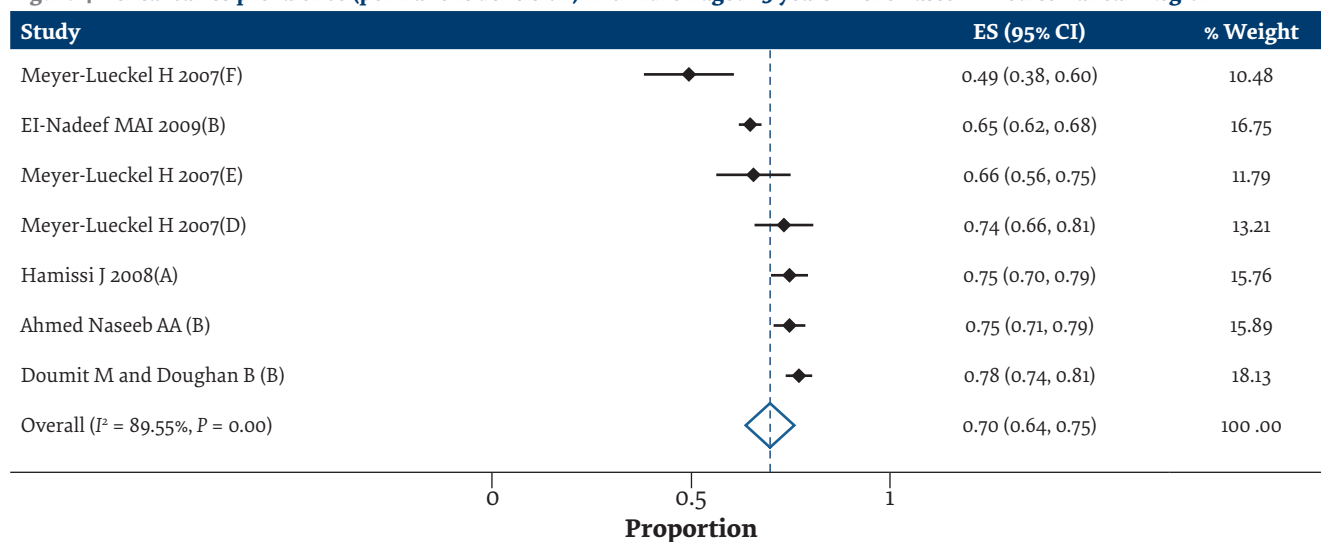
(A) and (ii) as in footnote to Table 1. CI = confidence interval; ES = estimate; I^2 = heterogeneity.

Figure 3 Dental caries prevalence (permanent dentition) in children aged 12 years in the Eastern Mediterranean Region

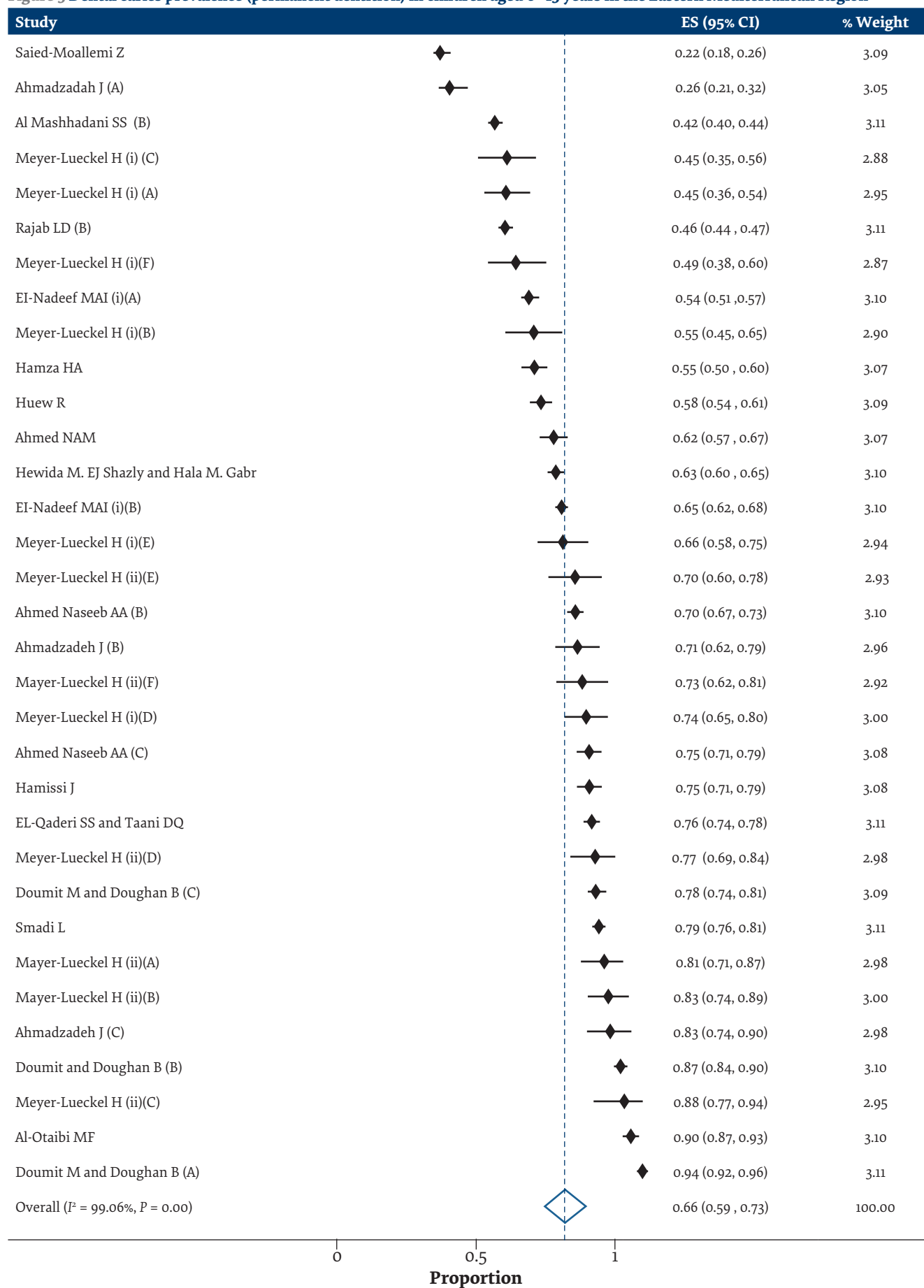
(A–C) as in footnote to Table 1. CI = confidence interval; ES = estimate; I^2 = heterogeneity.

variation among the prevalence rates, with the lowest of 22% reported by Said-Moallemi et al. (11) and the highest of 94% reported by Doumit and Doughan (21). The reasons for high prevalence of caries were low socioeconomic status, cariogenic diet, low parental education, less accessibility to dental care services, and dental health negligence. The reasons for low prevalence of caries were widespread use of fluoridated toothpaste (18) and implementation of a national oral health programme (11). This variation can be attributed to different geographic

locations, differences in the individuals included in the study, variation in sample size, and the use of different indices for assessing caries. Oral health policies, community water fluoridation and oral hygiene products also play a role in the variation among countries. Low levels of water fluoridation are found in most provinces in the Islamic Republic of Iran and only 22% of the Libyan population receive fluoridated water (32). Until 2003, the United Nations had imposed sanctions on the amount of food provided to Iraq, which included freely available

Figure 4 Dental caries prevalence (permanent dentition) in children aged 15 years in the Eastern Mediterranean Region

(B–F) as in footnote to Table 1. CI = confidence interval; ES = estimate; I^2 = heterogeneity.

Figure 5 Dental caries prevalence (permanent dentition) in children aged 6–15 years in the Eastern Mediterranean Region

(A–F) and (i and ii) as in footnote to Table 1. CI = confidence interval; ES = estimate; I^2 = heterogeneity.

Appendix 1 Characteristics of the included studies

Study ID	Author and publication year	Country	Sample size (age/age group)	Dental caries index	Caries prevalence (dentition)	Caries attributable factors
1	Ahmed Naseeb, 2016(9)(A)	Bahrain	810 (12 yr)	WHO 2013, DMFT	70% (P)	Intake of fermentable carbohydrates
2	Ahmed Naseeb, 2016 (B)	Bahrain	428 (15 yr)	WHO 2013, DMFT	75% (P)	
3	El Shazly& Hala, 2016(10)	Egypt	1283 (13 yr)	Klein, Palmer and Knutson for DMFT	62.8% (P)	Low socioeconomic condition, faulty food habits
4	Saied-Moallemi et al., 2006(11)	Islamic Republic of Iran	459 (9 yr)	WHO 1997, DMFT	22% (P)	Low caries due to implementation of comprehensive national oral health programme including fluoride mouth rinse and oral health education
5	Meyer-Lueckel et al., 2006(12)(ii)(A)	Islamic Republic of Iran	103 (6 yr)	Klein, Palmer and Knutson for DMFT	83% (P)	
6	Meyer-Lueckel et al., 2006 (ii)(B)	Islamic Republic of Iran	93 (6 yr)	Klein, Palmer and Knutson for DMFT	81% (P)	Socioeconomic background, dietary sources of fluoride, and urbanization
7	Meyer-Lueckel et al., 2006 (ii)(C)	Islamic Republic of Iran	51 (6 yr)	Klein, Palmer and Knutson for DMFT	88% (P)	
8	Meyer-Lueckel et al., 2006 (ii)(D)	Islamic Republic of Iran	106 (9 yr)	Klein, Palmer and Knutson for DMFT	77% (P)	
9	Meyer-Lueckel et al., 2006 (ii)(E)	Islamic Republic of Iran	90 (9 yr)	Klein, Palmer and Knutson for DMFT	70% (P)	
10	Meyer-Lueckel et al., 2006 (ii)(F)	Islamic Republic of Iran	80 (9 yr)	Klein, Palmer and Knutson for DMFT	72% (P)	
11	Meyer-Lueckel et al., 2007(13)(i)(A)	Islamic Republic of Iran	115 (12 yr)	Klein, Palmer and Knutson for DMFT	45% (P)	
12	Meyer-Lueckel et al., 2007 (i)(B)	Islamic Republic of Iran	89 (12 yr)	Klein, Palmer and Knutson for DMFT	55% (P)	Socioeconomic class, parental education, consumption of refined carbohydrates
13	Meyer-Lueckel et al., 2007 (i) (C)	Islamic Republic of Iran	80 (12 yr)	Klein, Palmer and Knutson for DMFT	45% (P)	
14	Meyer-Lueckel et al., 2007(i)(D)	Islamic Republic of Iran	129 (15 yr)	Klein, Palmer and Knutson for DMFT	74% (P)	
15	Meyer-Lueckel et al., 2007 (i)(E)	Islamic Republic of Iran	100 (15 yr)	Klein, Palmer and Knutson for DMFT	66% (P)	
16	Meyer-Lueckel et al., 2007 (i)(F)	Islamic Republic	80 (15 yr)	Klein, Palmer and Knutson for DMFT	49% (P)	
17	Hamissi et al., 2008(14)	Islamic Republic of Iran	390 (15 yr)	WHO 1997, DMFT	75% (P)	Oral hygiene habits, socioeconomic conditions and cariogenic diet
18	Ahmadzadeh et al., 2015(15) (A)	Islamic Republic of Iran	220 (6–8 yr)	WHO 1997, DMFT	25.9% (P)	
19	Ahmadzadeh et al., 2015(B)	Islamic Republic of Iran	104 (9–10 yr)	WHO 1997, DMFT	71.2% (P)	Sugar consumption and poor dental health
20	Ahmadzadeh et al., 2015 (C)	Islamic Republic of Iran	84 (11–12 yr)	WHO 1997, DMFT	83.3% (P)	
21	Ahmed, 2007(16)	Iraq	392 (12 yr)	WHO 1997, DMFT	62% (P)	?

Appendix 1 Characteristics of the included studies (concluded)

Study ID	Author and publication year	Country	Sample size (age/ age group)	Dental caries index	Caries prevalence (dentition)	Caries attributable factors
22	Hamza, 2012 (17)	Iraq	390 (12 yr)	WHO 1997, DMFT	55.4% (P)	?
23	EL-Qaderi and Taani, 2006(18)	Jordan	1362 (14–15 yr)	WHO 1987, DMFT	76% (P)	Low caries compared to previous study due to widespread use of fluoridated toothpaste and improvement in oral hygiene habits
24	Rajab et al., 2014(19)	Jordan	2560 (12 yr)	WHO 1997, DMFT	45.5% (P)	High caries associated with poor access to dental services, self-care practices, dental attitudes and consumption of sweets and sugary drinks. Caries high in low and middle socioeconomic classes as compared to upper class
25	Smadi et al., 2016(20)	Jordan	1286 (6–12 yr)	WHO 1997, DMFT	78.7% (P)	Oral health negligence, lack of dental care services
26	Doumit and Doughan, 2018(21) (A)	Lebanon	480 (6–8 yr)	WHO 1997, DMFT	94.43% (P)	?
27	Doumit and Doughan, 2018 (B)	Lebanon	480 (12 yr)	WHO 1997, DMFT	86.92% (P)	
28	Doumit and Doughan, 2018 (C)	Lebanon	480 (15 yr)	WHO 1997, DMFT	77.65% (P)	
29	Huew et al., 2011(22)	Libya	791 (12 yr)	WHO 1997, DMFT	57.8% (P)	Less exposure of fluoride due to limited toothbrushing, poor oral hygiene, consumption of sugar, lack of dental hygienist and oral health education programmes
30	El-Nadeef et al., 2009(23) (i)(A)	United Arab Emirates	1323 (12 yr)	WHO 1987, DMFT	54% (P)	?
31	El-Nadeef et al., 2009 (i)(B)	United Arab Emirates	1328 (15 yr)	WHO 1987, DMFT	65% (P)	
32	Hashim et al., 2010(24)	United Arab Emirates	524 (5 yr)	WHO 1997, dmft	72.9% (D)	?
33	El-Nadeef et al., 2010(25) (ii)	United Arab Emirates	1340 (5 yr)	WHO 1997, dmft	83% (D)	?
34	Al Mashhadani et al., 2017(26)	United Arab Emirates	2237 (12–14 yr)	WHO 2013, DMFT	41.6% (P)	Poor oral hygiene practice, lack of supervision while toothbrushing
35	AlKhayat, 2018(27)	United Arab Emirates	716 (5 yr)	WHO 1987, dmft	42.2% (D)	Negative attitude of parent towards children's dental health
36	Al-Otaibi et al., 2012(28)	Yemen	400 (12 yr)	WHO 1997, DMFT	90.2% (P)	Students with low socioeconomic conditions had least caries compared with students with medium socioeconomic status
37	Al-Mikhlaifi et al., 2017(29)	Yemen	202 (5 yr)	WHO 1997, dmft	62% (D)	?

D = deciduous dentition prevalence, P = permanent dentition prevalence, ? = factors not mentioned. (A–F) are same studies representing different age/age group data. (i, ii) represent two different studies reported by the same author in the same year.

sugar (33), but after 2003 the amount of sugar increased and thus consumption of sugar also increased, which is one of the key causative factors of caries. No literature was found with respect to the oral health policies of the countries included in this analysis.

There were some limitations to our meta-analysis. First, only 2 databases were searched. Second, only English-language articles were selected. In cases where

a combined prevalence (deciduous + permanent) was mentioned, such studies were excluded. Caries prevalence should be reported separately for deciduous and permanent dentition, which aids effective meta-analysis. The meta-analysis was intended to cover the Eastern Mediterranean Region; however, data were only available from 9 countries (Islamic Republic of Iran, Iraq, Yemen, Jordan, Libya, UAE, Bahrain, Lebanon and Egypt). No information was available for countries

like Djibouti and Oman. However, for other countries in the Region, some oral health information was available but these articles were not selected as they did not meet the inclusion criteria.

Conclusion

Within the limitations of this meta-analysis, it can be

concluded that dental caries in children is still a major problem in the 9 countries studied in the Region. More studies reporting dental caries from all the countries in the Region are required to obtain an accurate picture of dental caries prevalence among children in the Region.

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Prévalence des caries dentaires chez les enfants âgés de 5 à 15 ans originaires de neuf pays de la Région de la Méditerranée orientale : méta-analyse

Résumé

Contexte : Les caries dentaires concernent tous les groupes d'âge, bien que les enfants soient plus largement touchés. Plusieurs études ont évalué la prévalence des caries dentaires dans la Région de l'Organisation mondiale de la Santé (OMS) pour la Méditerranée orientale. Cependant, les données sur la prévalence des caries dentaires n'ont pas été mises en commun pour l'ensemble des pays de la Région.

Objectifs : La présente étude avait pour objectif d'estimer par méta-analyse la prévalence globale des caries dentaires chez les enfants âgés de 5 à 15 ans dans la Région.

Méthodes : Le protocole d'étude a été enregistré dans PROSPERO sous le numéro CRD42016037157. Vingt-et-une études (37 estimations) ont été identifiées au moyen d'une recherche systématique des articles publiés entre le 1^{er} janvier 2005 et le 5 juillet 2018. Les données requises pour chaque article ont été extraites puis reportées dans la fiche technique. Une méta-analyse à effets aléatoires a été réalisée pour l'ensemble de la classe d'âge et individuellement pour les groupes des 5, 12 et 15 ans.

Résultats : Les données étaient disponibles pour seulement neuf des 21 pays que compte la Région. L'hétérogénéité entre les études était élevée ($I^2 > 98\%$). On a observé des variations considérables entre les pays en ce qui concerne la prévalence des caries dentaires à différents âges. La prévalence globale pour les dents de lait chez les enfants âgés de 5 ans était de 65 % (45-85 %) ; de 61 % (50-72 %) pour les dents définitives chez les enfants âgés de 12 ans ; de 70 % (64-75 %) chez les jeunes âgés de 15 ans et de 66 % (59-73 %) chez les enfants dont l'âge est compris entre 6 et 15 ans. L'indice le plus couramment utilisé pour l'examen bucco-dentaire destiné à évaluer les lésions carieuses était celui des Enquêtes sur la santé bucco-dentaire de l'OMS, méthodes fondamentales.

Conclusions : Les caries dentaires demeurent un problème de santé bucco-dentaire chez les enfants dans neuf pays de la Région.

معدل انتشار تسوس الأسنان في صفوف الأطفال الذين تتراوح أعمارهم بين 5 سنوات و 15 سنة في 9 بلدان في إقليم شرق المتوسط: تحليل تلوي

سونال كالى، برادنيا كاكودكار، ساهان شيتيا، رضوان عبد القادر

الخلاصة

الخلفية: يؤثر تسوس الأسنان على جميع الفئات العمرية، بالرغم من تأثر الأطفال بدرجة أكبر. وأجرت دراسات عديدة تقييماً لمعدل انتشار تسوس الأسنان في إقليم شرق المتوسط التابع لمنظمة الصحة العالمية. وبالرغم من ذلك، فلم تجمع بيانات معدل انتشار تسوس الأسنان لجميع البلدان في الإقليم.

الأهداف: هدفت هذه الدراسة إلى تقييم معدل انتشار تسوس الأسنان وفق البيانات المجموعة عن طريق التحليل التلوي في صفوف الأطفال الذين تتراوح أعمارهم بين 5 سنوات و 15 سنة في الإقليم.

طرق البحث: سُجِّل بروتوكول الدراسة في قاعدة بيانات بروسبيرو برقم CRD42016037157. واختيرت 21 دراسة (37 تقييماً) من خلال البحث المنهجي عن مقالات نُشرت ما بين الأول من يناير/ كانون الثاني 2005 والخامس من يوليو/ تموز 2018. واستُخلصت البيانات المطلوبة من كل مقالة في صحيفة بيانات. وأجري تحليل تلوي عشوائي الأثر في مجمل الفئة العمرية، ولأعمار 5 سنوات، و 12 سنة، و 15 سنة، كل على حدة.

النتائج: توافرت البيانات لتسعة بلدان وحسب من بين 21 بلداً في الإقليم. وكان عدم التجانس بين الدراسات مرتفعاً ($I^2 > 98\%$). كان هناك تباين ملحوظ بين البلدان فيما يتعلق بمعدل انتشار تسوس الأسنان في أعمار مختلفة. وكان معدل الانتشار المجموع لتسعين السواقط (الأسنان اللبنية) في صفوف الأطفال البالغين من العمر خمس سنوات 65% (45%-85%)؛ 61% (50%-72%) لتسعين الأسنان الدائمة في الأطفال البالغين من العمر 12

عاماً 70% (64%-75%) للأطفال البالغين من العمر 15 عاماً؛ 66% (59%-73%) للأطفال الذين تتراوح أعمارهم بين 6 سنوات و 15 سنة. وكان المؤشر الأكثر استخداماً في فحص الفم لقياس تجربة التسوس هو «مقياس منظمة الصحة العالمية الأساسي لمسح صحة الفم، 1997». الاستنتاجات: يظل تسوس الأسنان ظاهرة تبعث على القلق في صفوف الأطفال في 9 بلدان في الإقليم.

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