

# Dental caries

## *A meta analysis on a Saudi population*

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### ABSTRACT

**الأهداف:** تحديد نسبة انتشار تسوس الأسنان في الأسنان اللبنية و الدائمة في المجتمع السعودي.

**الطريقة:** لقد تم البحث في العام 2010م عن جميع الأوراق البحثية المنشورة بين عامي 1999 و 2008م والتي تتعلق بتسوس الأسنان في المملكة العربية السعودية. تم جمع 60 مقال علمي من محرك البحث (PubMed) منشورة في الفترة المذكورة. و من خلال المعايير الخاصة بهذا التحليل تم اختيار 16 مقال. تم اختيار شريحة السعوديين من عمر 2 إلى 12 عام لتحديد نسبة تسوس الأسنان اللبنية و الدائمة.

**النتائج:** تم تحليل نسبة تسوس الأسنان اللبنية و الدائمة حيث أظهرت تحاليل (Chi-square) وجود تباين واضح في النتائج. متوسط التسوس، والأسنان المفقودة والأسنان المعالجة (DMFT) كانت 5.38 (95% CI: 4.314, 6.436) في الأسنان اللبنية بينما كانت في الأسنان الدائمة 3.34 (95% CI: 1.97, 4.75). لقد أظهر الارتياح في تشخيص تسوس الأسنان في المقالات المنشورة مبالغة في نسبة انتشار التسوس في الأسنان الدائمة و ليس اللبنية.

**خاتمة:** أظهرت نتائج الدراسة ارتفاع نسبة التسوس والأسنان المفقودة والمعالجة لدى الأطفال والمراهقين في المجتمع السعودي. نحن بحاجة إلى العديد من الأبحاث المنشورة وقد لا تكون الصورة واضحة في نتائج هذه الدراسة.

**Objectives:** To determine the prevalence of caries in the primary and permanent teeth in a Saudi population.

**Methods:** This study was conducted at the College of Dentistry, University of Dammam, Dammam, Kingdom of Saudi Arabia. In June 2010, a literature search was started and found all studies conducted in Saudi Arabia on dental caries from 1999 to 2008. Sixty articles were found on PubMed, which had been published during the considered time period. Sixteen studies were passed through inclusion criteria

and included in analysis. A 2 to 12-year-old Saudi population was included to determine the prevalence of caries in primary teeth, and for permanent teeth, the age range was 6-18 years.

**Results:** The prevalence of caries in primary and permanent teeth were analyzed separately. Forest plot and Chi-square test revealed considerable heterogeneity. A random effect model was used to find caries prevalence in primary and permanent teeth. The mean decayed, missing and filled teeth (dmft) was 5.38 (95% CI: 4.314 - 6.436), and in the permanent teeth the DMFT was 3.34 (95% CI: 1.97 - 4.75). Publication bias diagnostics suggested possible overestimation of caries prevalence in permanent teeth but not in primary teeth.

**Conclusion:** The results in this study present a high decayed, missing, and filled teeth score in the adult and young population of Saudi Arabia, however, more published data is required as the results obtained from this meta analysis may not give a true picture, and reality may be worse.

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Dental caries is one of the diseases occurring from ancient times, and the trend shows there is an increase in its occurrence and gravity in the nineteenth century.<sup>1</sup> Dental caries is a very common infection disease in the world. In 2009, almost 70% of youth have experienced dental caries in America by late adolescence.<sup>2,3</sup> In the growth and health of children, primary teeth play an important role. Children and adults both should know how to maintain oral hygiene so that they can remain caries free. Beside personal care, dental science of modern age is advance enough to save teeth from decay, and to retain the teeth as long as possible.<sup>3</sup> According to the World Oral Health report published in 2003, dental caries affected 60-90% of schoolchildren in industrialized countries. In 1981, the World Health Organization, and the World Dental Federation announced to achieve some goals by the year 2000.<sup>4</sup> Some of the goals were as follows: 50% of 5-6 year olds to be caries free; global average of decayed, missing, and filled teeth should not be more than 3; and 85% of 18-year-olds should have all their teeth.<sup>4</sup> Researchers repeatedly perform studies to find prevalence of caries burden in children and adult population. Such studies have been performed almost in every part of the world, but studies give idea and knowledge regarding the prevalence of caries in certain city and in certain time.<sup>5</sup> The population of the Kingdom of Saudi Arabia (KSA) has also been studied since the past many years, and the prevalence of dental caries in primary and permanent teeth was addressed.<sup>6</sup> Such studies were conducted in different cities of KSA, however the question "what is the prevalence of dental caries in KSA?" remains unanswered. That question demands systematic review of the literature published on dental caries, however no such literature review was carried out in KSA. In Africa and Swaziland, literature reviews has been carried out to find the trend of dental caries.<sup>7,8</sup> This study included all published articles on prevalence of dental caries from 1999-2008. In this study, the age group considered for caries in primary teeth was 2-12 years, and for permanent teeth, it was 6-20 years. The aim of the study was to find caries prevalence in primary teeth (dmft) and permanent teeth (DMFT) of a population living in KSA.

**Methods.** In June 2010, a literature search on the prevalence of dental caries in KSA was conducted at the College of Dentistry, University of Dammam, Dammam, KSA. PubMed database was used to search all publications on caries prevalence by the key words 'dental caries', 'dmft' and 'DMFT'. Articles were preselected, which had been published between

1999 and 2008. Ethical approval was obtained from the Scientific Research Committee of the College of Dentistry, University of Dammam, KSA. PubMed results showed 60 published studies from 1999 through 2008, which had text terms "dental caries" and "dmft/DMFT" in the title or abstract. Then, inclusion criteria were applied on searched articles. First inclusion criteria were the "availability of dmft or DMFT value or both". After employing the first criteria, 18 articles were left for further screening. The second criteria included the study for analysis; the age range for primary teeth was 2-12 years, and 6-20 years for permanent teeth. Out of the 18 studies, 2 studies<sup>9,10</sup> did not fulfill the second inclusion criteria, and 16 was included in the analysis.<sup>11-26</sup> Data extracted from the included articles and information was gathered into 2 separate tables (Table 1 and Table 2). Table 1 was created for primary dentition and Table 2 for permanent dentition. Among the 16 articles, 6 were conducted for 2 different age groups, and revealed regarding the caries prevalence in primary and permanent teeth.<sup>11,13,14,18,22,23</sup> Nine studies was conducted to find the prevalence of caries in primary teeth only,<sup>12,15-17,19-21,24,25</sup> and one study revealed regarding the prevalence of caries in permanent teeth only.<sup>26</sup> Standard deviation (SD) of mean dmft data were missing in 2 studies.<sup>11,21</sup> There was no specific characteristic of SD noted with change of caries prevalence data. Regression equation formed by the studies contained complete information (SD=1.97+0.302×mean, r=0.73).<sup>27</sup> This equation was used to estimate missing SDs.

Comprehensive meta analysis (version 2) was used for statistical analysis. In the meta analysis, random effect model and fixed effect model are commonly used for analysis. In the presence of heterogeneity random effect model is appropriate to use for analysis. Visual inspection of forest plot and Chi square test was used to test presence of heterogeneity. Funnel plot was used to check possibility of publication bias. A plot of sample size according to effect size must show funnel shape.<sup>28</sup> To verify visual inspection of funnel plot, Egger's test and Begg's test was used.

**Results.** The total sample size of the studies performed from 1999-2008 to find out caries prevalence in primary teeth was 5201, and for permanent teeth the total sample size was 3381. Studies stating the prevalence of caries in primary teeth were conducted as follows: 6 (37.5%) were performed in Riyadh; 4 (3%) in Jeddah; Al-Ahsa and Qaseem had the same number of studies, which was 2 (12.5%); 1 (6.3%) in Al-Kharj and 1 (6.3%) in Abha. Similarly, among 7 articles on permanent dentition, 5 (62.5%) were performed in

Riyadh, 2 (25%) in Qaseem, and 1 (12.5%) in Abha. **Figure 1** shows a forest plot for primary teeth caries reporting studies. Visual inspection of forest plot revealed considerable heterogeneity, chi-square test was also used to check heterogeneity (Q statistic:  $p=0.00$ ), and index of heterogeneity was calculated and found  $I^2$  more than 75%, which means presence of high heterogeneity. And hence, random effect model is more appropriate in the presence of heterogeneity. Estimated caries prevalence in primary dentition from random effect model was 5.38 (95% confidence interval [CI]: 4.314-6.436). **Table 1** shows the inclusion of 2 small sample studies, which may lead to publication bias, the reported dmft in both studies<sup>12,14</sup> was very small, while other studies with sufficiently large sample sizes are showing different picture. Hence, both studies removed from the data and meta analysis was performed again through random effect model, and found the mean dmft was 6.001(95% CI: 5.039-6.976). **Figure 2** shows

a forest plot for the studies on permanent dentition. Both visual inspection of forest plot and chi square test revealed about substantial heterogeneity, chi-square test provided  $p$ -value ( $p=0.00$ ), and index of heterogeneity was calculated, and found  $I^2$  was more than 75%, which means presence of high heterogeneity. And hence, random effect model was more appropriate in the presence of heterogeneity. Estimated caries prevalence in permanent dentition from random effect model was 3.34 (95% CI: 1.97-4.75). Funnel plots was employed to assess the possibility of publication bias. In the absences of publication bias, studies are distributed symmetrically around the mean dmft/DMFT. By contrast, in the presence of publication bias, it is expected that bottom of funnel plot would show a higher concentration of studies on one side of mean than the other. Funnel plot for primary dentition (**Figure 3**) appeared symmetrical at the top even with the presence of high heterogeneity. However, there appears a slight

**Table 1 -** Studies and variables included after inclusion criteria (in chronological method) year-wise on reported prevalence of caries in primary teeth in a study conducted at the College of Dentistry, University of Dammam, Dammam, Kingdom of Saudi Arabia.

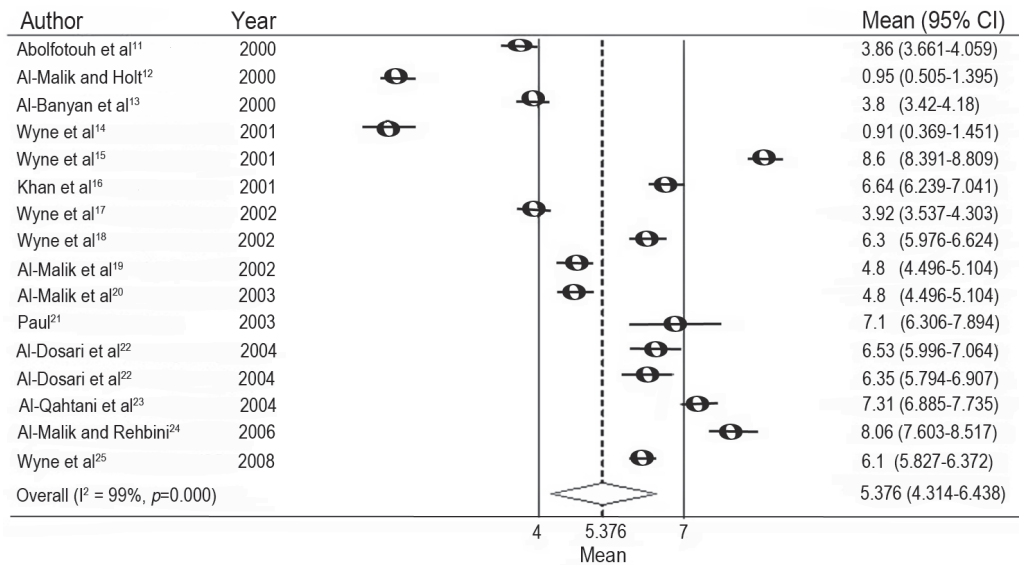
Authors	Year	City	n	Mean age	dmft	SD
Abolfotouh et al <sup>11</sup>	2000	Al Abha	959	6-13	3.86	3.14
Al-Malik & Holt <sup>12</sup>	2000	Jeddah	80	4-5	0.95	2.03
Al-Banyan et al <sup>13</sup>	2000	Riyadh	272	5-12	3.8	3.2
Wyne et al <sup>14</sup>	2001	Qaseem	77	2-6	0.91	2.42
Wyne et al <sup>15</sup>	2001	Riyadh	1016	2-6	8.6	3.4
Khan et al <sup>16</sup>	2001	Al-Ahsa	470	6-7	6.64	4.43
Wyne et al <sup>17</sup>	2002	Al-Ahsa	322	4-5	3.92	3.51
Wyne et al <sup>18</sup>	2002	Riyadh	449	7-12	6.3	3.5
Al-Malik et al <sup>19</sup>	2002	Jeddah	987	2-5	4.8	4.87
Al Malik et al <sup>20</sup>	2003	Jeddah	987	2-5	4.8	4.87
Paul <sup>21</sup>	2003	Al-Kharj	103	5	7.1	4.11
Al-Dosari et al <sup>22</sup>	2004	Riyadh	249	6-7	6.53	4.3
Al-Dosari et al <sup>22</sup>	2004	Qaseem	182	6-7	6.35	3.83
Al-Qahtani & Wyne <sup>23</sup>	2004	Riyadh	218	6-7	7.31	3.21
Al-Malik & Rehbini <sup>24</sup>	2006	Jeddah	300	6-7	8.06	4.04
Wyne <sup>25</sup>	2008	Riyadh	789	4-6	6.1	3.9

n - number, dmft - decayed, missing, and filled teeth, SD - standard deviation

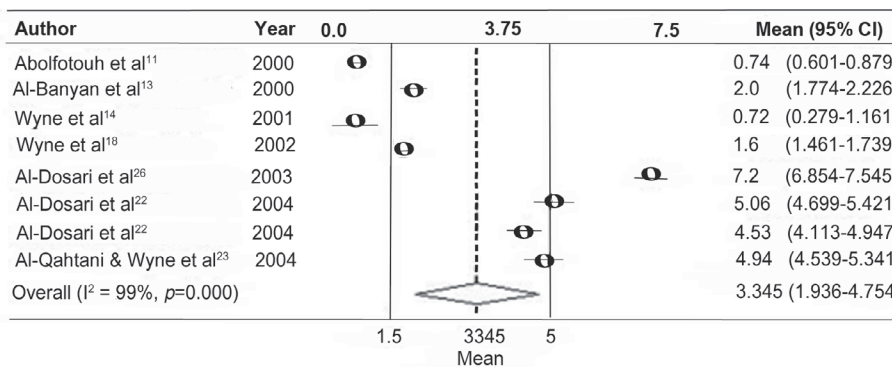
**Table 2 -** Studies and variables included after inclusion criteria (in chronological method) year-wise on reported prevalence of caries in permanent teeth in a study conducted at the College of Dentistry, University of Dammam, Dammam, Kingdom of Saudi Arabia.

Authors	Year	City	n	Mean age	DMFT	SD
Abolfotouh et al <sup>11</sup>	2000	Al Abha	959	6-13	0.74	2.19
Al-Banyan et al <sup>13</sup>	2000	Riyadh	272	5-12	2	1.9
Wyne et al <sup>14</sup>	2001	Qaseem	76	9.7	0.72	1.96
Wyne et al <sup>18</sup>	2002	Riyadh	449	6-12	1.6	1.5
Al-Dosari et al <sup>26</sup>	2003	Riyadh	734	15-19	7.2	4.78
Al-Dosari et al <sup>22</sup>	2004	Riyadh	392	12-13	5.06	3.65
Al-Dosari et al <sup>22</sup>	2004	Qaseem	281	12-13	4.53	3.57
Al Qahtani & Wyne <sup>23</sup>	2004	Riyadh	218	11-12	4.94	3.02

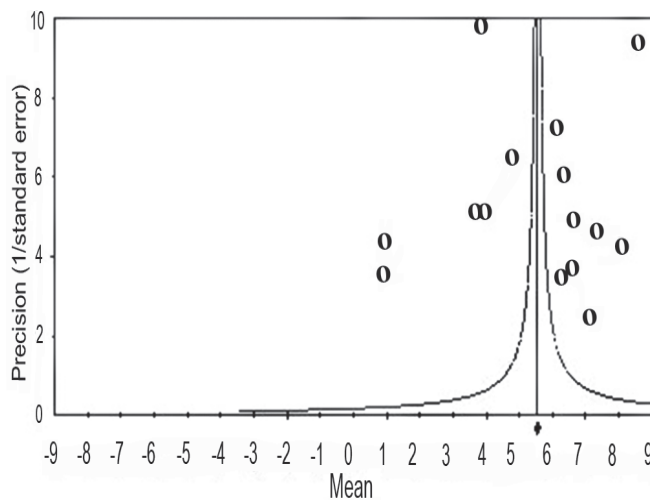
n - number, DMFT - decayed, missing, and filled teeth, SD - standard deviation



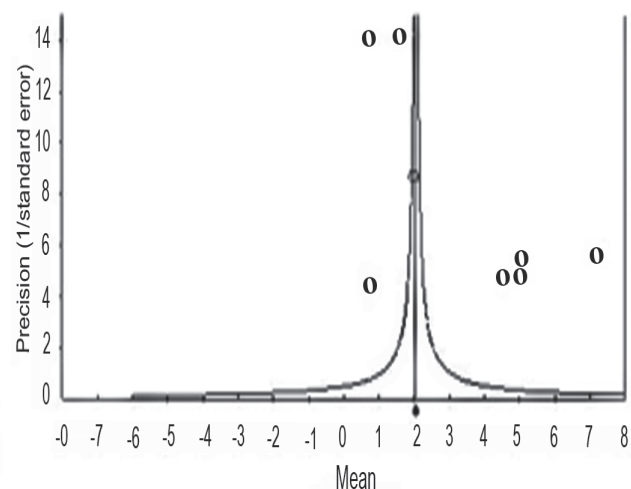
**Figure 1** - Study-specific and summary effect estimates (mean and 95% confidence interval [CI]) for mean decayed, missing, and filled in primary teeth (1999-2008).



**Figure 2** - Study-specific and summary effect estimates (mean and 95% confidence interval [CI]) for mean decayed, missing and filled in permanent teeth (1999-2008).



**Figure 3** - A funnel plot of precision by mean. Mean caries prevalence in primary teeth according to precision (1999-2008).



**Figure 4** - A funnel plot of precision by mean. Mean caries prevalence in permanent teeth according to precision (1999-2008).

asymmetry in the middle and bottom of the funnel plot. For more confirmation, the visual impression Egger's and Begg's test were used to test publication bias. Egger's test ( $p=0.30$ ) and Begg's test ( $p=0.5$ ) supported visual impression and did not indicate any publication bias. The "trim-and-fill" method was used to find out the missing number of studies, which could help remove publication bias, results showed that there were no missing studies, and the method suggested the same calculated mean dmft and class interval. Funnel plot for permanent dentition (Figure 4) was asymmetrical at the top and in the middle, as well. Egger's and Begg's test showed dissimilar results. Begg's test ( $p=0.268$ ) did not indicate publication bias but Egger's ( $p=0.018$ ), based on regression, showed possibility of publication bias. The "trim-and-fill" method suggested inclusion of 3 more studies to achieve symmetrical funnel plot. The estimated mean DMFT changed from 3.34-1.64 in the random effect model, and from 2.04-1.42 in the fixed effect model.

**Discussion.** Although many studies have been performed to report prevalence of caries burden in a Saudi population, review of articles was lacking to report the prevalence of caries during a certain time period. The study focused on all the articles published from 1999-2008 reporting caries prevalence among children population living in KSA. Altogether, 16 articles had passed through inclusion criteria, in which 15 reported caries in primary dentition and 7 on permanent dentition, and found relevant for this meta analysis. Almost 62% of the total included articles were reporting caries prevalence in Riyadh and Jeddah. The mean dmft in primary dentition was 5.38 (95% CI: 4.314-6.436) and for permanent dentition, it was 3.34 (95% CI: 1.97-4.75). Publication bias was not found in primary teeth but it was noticed in permanent teeth. The "trim-and-fill" method suggested inclusion of 3 more studies to remove publication bias.

Funnel plot and statistical tests were used to check publication bias. No publication bias was found when checked for primary teeth data. On the other side for permanent teeth, publication biased was suggested. The "trim-and-fill" method suggested inclusion of 3 more studies to make funnel plot symmetrical and effect estimate would have been 1.417 (95% CI: 1.34-1.49) in the fixed effect model, and 1.64 (95% CI: 0.0819-3.206) in the random effect model. Dental caries trend was determined in Africa in 1999.<sup>7</sup> The study was based on all published articles on dental caries reported from 1967-1997. It was found that in primary dentition, the prevalence of dental caries was comparatively high

than caries prevalence in permanent teeth.<sup>7</sup> Trend of dental caries in 5-6 and 11-13 year old children in Latin America and Caribbean was determined by Bonecker and Cleaton-Jones.<sup>29</sup> They found high caries prevalence in primary teeth as compared to permanent teeth. In the current meta analysis, results showed almost the same behavior of dental caries, it was found that prevalence of dental caries in primary teeth was higher than the prevalence of caries in permanent teeth. Some other review studies have also been performed to uncover the prevalence of caries, and the factors, which may be the cause of caries. Maupome et al<sup>30</sup> studied the relation between asthma and dental caries, and revealed that there was no sign to suggest a relation between asthma and caries. Another systematic review took the same topic (asthma and caries), and aimed to explore relation between asthma and caries, and the study came up with different results and showed a strong relation between asthma and caries.<sup>31</sup> But it is not the end to report relation between asthma and caries, the type of medication used by asthma patients can also have different association between caries.<sup>32</sup> Medical problems and use of different medicine is not only the reason of caries. There are other several reasons, which is the cause of dental caries. Different types of drinks (soft drinks, sports drinks, yoghurt products, and so forth) have also been associated with dental problems.<sup>33</sup> Actually, foods and drinks with a pH below 5.0-5.7 have also been known to trigger dental erosion effects.<sup>34</sup> For instance, pH of analyzed sample of Coca Cola was 2.30, where 0.58 was the mean calcium and 0.066 was the fluoride ion concentration. Low calcium and fluoride ion concentration with low pH indicate high erosive potential.<sup>35</sup>

There are some limitations of the study as well, the study was limited to a 10-year period, and a longer period might change the results. Secondly, the study focused only on prevalence of caries not on the factors associated with caries. However, this systematic review uncovered the fact that most of the studies were conducted in big cities. A big part of KSA is still uncovered, and the prevalence of caries is still unknown. So, it can be said that presented results might not present the true picture of caries prevalence in KSA. There is a need to access in the population living in small cities and rural areas. Furthermore, associated factors with dental caries should also be explored to find the root cause of the disease in KSA.

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