

DMFT status in 12 years old Iranian population: A systematic review and meta-analysis study

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Abstract

Background: Twelve years old, because of the ending eruption permanent teethes, has encountered with a great importance. The aim of this is to determine DMFT status of this age group using systematic review and meta-analysis method. **Methods:** Internal and external databases were searched on the basis of inclusion and exclusion criteria using the considered keywords. Heterogeneity and the quality of studies were assessed using I2 index and STROBE checklist. Forest plot was plotted using Random Effects Model. Funnel plot and Eggers' test were used to indicate publication bias. **Results:** 95 studies with 12145 total persons, on average 393 person in each study, were entered to the final step of meta-analysis. Using Random Effects model, total mean DMFT of 12 years olds was estimated 2.01 (1.83-2.19) and separately for girls and boys was estimated 2.10 (1.95-2.26) and 2.16 (1.94-2.38), respectively. Funnel plot and Eggers' test were insignificant which indicate reliability of the study results and low publication bias. **Conclusion:** DMFT status in Iranian 12 years old population is higher than the region and most developed countries. Dental health policy makers must take to account the important of permanent teethes and perform reforms in provision of the services.

Background

One of the most prevalent infectious diseases is dental decay and higher than 80% of people in the higher income countries have experienced it (1-3), but in comparison with lower income countries, only half of dental caries are left untreated (4). From several decades ago, especially after integration of dental healthcare into primary health care (PHC) in Iran (5), many studies have been performed regarding dental decay status in different age and gender groups (Table 1). After this integration, it was expected to see improvement in the Iranian dental health status. Health Sector Evolution Plan (HSEP) was another national wide plan which was launched from 2013 to increase access to healthcare services, health literacy and health insurance for all Iranian people (6). However, 2012 national dental health survey indicated that decay, missing and filled teeth (DMFT) index in 12 years old children is equal to 2.09 which unfortunately have increased 7% in comparison with its previous national survey in 2005 (7).

Regarding the cause of selecting 12 years old age as the aim group of this study, World Health Organization (WHO) has considered this as the most important age to evaluate dental healthcare programs performed in countries. The reasons for this importance are numerous. The main causes are the completion of permanent teeth eruption in 12 years old except the third molars so that it is a special age to evaluate dental health systems and also children in this age are usually in the schools and it is easy to access them and lastly WHO has placed 12 years old for international comparisons (8-10).

Caries prevalence is measured using different indices including DMFT which means the number of Decayed, missed and filled teethes in the mouth of each person (11). This is an important index indicating society dental health status and has an important role in healthcare decision making. WHO goals regarding dental health include an average DMFT not more than 3 in 2000 and not more than 1.0 in 2010 at the age of 12. Based on WHO (2005), the best index of DMFT is 1 among 12-year-old children all over the world (12).

Regarding the importance of current study, though there are some systematic review and meta-analysis studies assessing the relation between socio-economic status and dental caries (13-15) and also there are abroad studies regarding systematic review of DMFT status in 12 years old students (16, 17), but there is no single review study to indicate DMFT status in 12 years old Iranian population. So, the aim of current study is to determine DMFT of 12 years old Iranian population using systematic review and meta-analysis.

Methods

Systematic review and meta-analysis studies combine the results of studies performed on a same topic and after the analysis present the final conclusion of the baseline original studies. The importance of these studies is in resolving the need to perform large scale and country wide studies. A systematic review study, collects, reviews, assesses and analyzes the published valid studies regarding a given topic. On the other hand, meta-analysis is a method in which the results of different studies are combined to obtain a more accurate estimation rather than traditional reviews. In other word, the aim of meta-analysis is to estimate the amount of real effect more powerful than an individual study (18).

Search time

In this study, all published studies from 1995 to 2018 regarding dental caries which were performed in all Iran provinces are collected and DMFT status of 12 years old Iranian population are presented through systematic review and meta-analysis. Regarding the cause of selecting 1995 to 2018 to collect articles, it is necessary to say that dental services were integrated to primary health care (PHC) in Iran in 1995 in order to increase access of low socioeconomic groups to the services. This integration led to equipment of dental healthcare centers, allocating dentists and dental care providers to them, performing educational, preventive and therapeutic programs and covering some services by public insurances.

Search strategy

In order to retrieve the most number of articles, a very extensive search strategy was selected. So that only "DMFT" keyword was searched in the internal (Persian) databases and "DMFT" and "IRAN" keywords were searched in the external databases. Though this study assesses DMFT in 12 years old population, but "12 years old" keyword was neglected when searching databases. This is because, however, some studies have not mentioned it in the title or abstract, but have reported some results regarding DMFT in 12 years old.

All epidemiological studies including cross-sectional, case-control, cohort and clinical trial were eligible to be entered to the study. The specific question of current study was: What is DMFT index in 12 years old Iranian population totally and separately for two sexes?

Persian databases of Scientific Information Databases (<http://sid.ir/>), and Magiran (<http://www.magiran.com/>) and external databases of Google Scholar (<https://scholar.google.nl/>), PubMed (<http://www.ncbi.nlm.nih.gov/pubmed>), Embase (<https://www.embase.com>), Scopus (www.scopus.com), and Web of Science (<http://www.isiknowledge.com>) were searched systematically.

Inclusion and exclusion criteria

The inclusion criteria were existence of DMFT word and 12 years old age group in the articles, studies with random sampling, response rate higher than 50% and attrition rate lower than 50 %. The exclusion criteria were caries studies in children covered by supportive organizations, diabetics, mental diseases, exceptional children, thalassemia, factory workers, asthma, kindergarten, blind, military children, hemophilia, kidney disease and other diseases and problems.

Also, letter to editor articles, grey literature and studies before 1995 were excluded from the study. The final extracted studies from the databases were entered to the EndNote software and duplicated were deleted.

Assessment quality of articles

The quality of articles was assessed using STROBE checklist. This checklist includes 22 questions which assesses all sections of an article including title, abstract, introduction, methods, results and discussion. This instrument help authors in correct writing observational studies and help editors and reviewers to correct assesses articles to be published in the journals and lastly help readers to critically assesses published articles (19).

As a simple method to score this checklist, we consider 0-2 scores for each one of its questions. The lowest obtainable score for each article to be entered to the data extraction process and meta-analysis was considered 16. The articles in Tables 1 & 2 have obtained this lowest acceptable score.

Predict standard deviation

Articles in which only have stated sample mean not standard deviation (SD), it was estimated using linear regression. So that, at the first, mean and SD in studies which these two measures are specified were entered in 2 separate columns in the SPSS and linear regression test was performed. In the results, if R Square was more than 0.7, so we can use this model to predict SD in the studies which have not calculated it. In this way, by multiplying B amount obtained from linear regression test in the mean of articles which SD is not specified, we can estimate SD amount. In this study, R Square amount was obtained 0.83 which is more than 0.7, so by multiplying B coefficient amount (which is 0.788) in the reported mean DMFT of each study, SD amount was estimated. Also, articles in which have reported DMFT/dmft for boys and girls but have not reported pooled mean and SD, they were estimated using the statistical formula. The studies in which have reported confidence interval, they were converted to SD using the statistical formula.

Continuous vertical line in forest plot indicates “no effect” or neutral state which its amount for articles have reported mean is equal to zero. Interrupted vertical line is corresponding on diamond vertical line which is an indicative of index under study (20).

Heterogeneity and publication bias

Heterogeneity was predicted using I^2 index. Because of predicting internal and external heterogeneity between studies, Random Effect Model Used to draw forest plot.

Funnel plot and Egger's test used to indicate publication bias. Funnel plot indicates the effect measure of each study. Symmetric funnel plot indicates no publication bias. Eggers' test was used to interpret funnel plot statistically.

If the study had no publication bias, so its Eggers' test is insignificant and its confidence interval encompass 0 digit. Also, funnel plot turns into an inverted funnel. In forest plot, whatsoever study size become larger, its precision increases and its mean index would place in the higher place of funnel plot. This case is opposite in the smaller studies. Finally, the data were analyzed using Stata 13.1, Stata Corp, College Station, TX, USA.

Results

The first search on the basis of articles title in the mentioned databases retrieved 854 articles. 512 articles were remained after entering these articles to EndNote and deleting duplicates. After cross checking of the references, 15 new articles were identified and the articles reached to 527. In the next step, the abstract and full text of the articles were searched on the basis of inclusion and exclusion criteria to find DMFT index in 12 years old children. Finally, 95 articles were entered to the final step of the study (Figure 1).

The characteristics of final articles are presented in the table 1. In this table, DMFT mean and SD for 12 years old Iranian population are presented totally and separately for two sexes. The total sample size of these studies is 12145 persons totally and 393 persons on average for each study (Table 1).

Calculating mean DMFT, SD and publication bias

Part 1. Calculating mean DMFT, SD and publication bias for total 12 years old Iranian population

Mean DMFT and SD

The forest plot of mean DMFT and 95% CI for 12 years olds (sum of boys and girls) is presented in the figure 2. Accordingly, mean DMFT in these persons is 2.01 with 1.83-2.19 CI. Also, on the basis of this figure, heterogeneity of articles which have assessed DMFT in 12 years old Iranian population is 99.8%. By attention that I^2 index lower than 25%, between 25% and 75% and higher is considered as low, middle and high heterogeneity, respectively, so heterogeneity in this study is high. So, Random Effects Model used to analyze articles (Figure 2).

Publication bias

The funnel plot of publication bias of DMFT status for 12 years olds is presented in Figure 3. Accordingly, standard error has depicted against mean DMFT. Symmetric funnel plot indicates low publication bias which confirm the reliability of the study results. Also, publication bias using Egger's test was not confirmed, because firstly its test was not significant statistically ($p > 0.05$) and secondly its CI encompass zero (-0.1767032, 0.9576957) (Figure 3 and Table 2).

Part 2. Calculating mean DMFT, SD and publication bias for 12 years old Iranian girls' population

Mean DMFT and SD

Forest plot of mean DMFT and its 95% CI for 12 years old girls is presented in figure 4. Accordingly, mean DMFT in these persons is 2.10 with 1.95-2.26 CI. By attention that heterogeneity rate is 97.7 %, so Random Effects Model used to depict forest plot (Figure 4).

Publication bias

Funnel plot of publication bias of DMFT status of 12 years old Iranian girls is depicted in figure 5. Accordingly, standard error has been depicted against mean DMFT. Symmetric funnel plot indicates low publication bias which confirm the reliability of the study results. Also, publication bias using Egger's test was not confirmed, because firstly its test was not significant statistically ($p>0.05$) and secondly its CI encompass zero (-0.1638292, 0.4297928) (Figure 5 and Table 3).

Part 3. Calculating mean DMFT, SD and publication bias for 12 years old Iranian boys' population

Mean DMFT and SD

Forest plot of mean DMFT and its 95% CI for 12 years old boys is presented in figure 6. Accordingly, mean DMFT in these persons is 2.16 with 1.94 -2.38 CI. By attention that heterogeneity rate is 97.1 %, so Random Effects Model used to depict forest plot (Figure 6).

Publication bias

Funnel plot of publication bias of DMFT status of 12 years old Iranian boys is depicted in figure 7. Accordingly, standard error has been depicted against mean DMFT. Symmetric funnel plot indicates low publication bias which confirm the reliability of the study results. Also, publication bias using Egger's test was not confirmed, because firstly its test was not significant statistically ($p>0.05$) and secondly its CI encompass zero (-1.785516, 13.60859) (Figure 7 and Table 4).

Discussion

The status of DMFT in 12 years old Iranian population was determined in this study on the basis of all articles which have assessed this index all of the country. It is worth fully to state that 12 years old is the latest age of permanent teeth eruption and have an important role in comparison dental health situation between countries, because this age is a suitable indicative of countries health situation, administered educational and preventive plans and universal health coverage.

The results indicated that DMFT index in 12-year Iranian population is 2.1, in girls 2.10 and in boys 2.16. A study on 12 years old suburban Nigerian school children indicated that DMFT is 0.14 (21). Also, it was 1.94, 1.1 and 1.9 in 12 years old Macedonian, Italian and Turkish children, respectively (10, 22, 23). On the basis of Gavriilidou study in 2015, DMFT level for 209 countries was estimated 1.86. On the basis of World Health Organization (WHO) Region specific weighted DMFT among 12-year-old children, DMFT rate in east Mediterranean region (EMRO), which includes Iran, was 1.64. Also, the estimation of WHO for 12 years olds globally indicates DMFT equal to 1.86 (24).

On one hand, all these studies indicate that DMFT index has no good status in Iran and is higher than many of global and between countries comparisons. On the other hand, an study performed previously by current study researchers regarding the relation between socio-economic situation and dental caries in Iran through systematic review and meta-analysis indicated that Iranian households with low socioeconomic status (SES) (considering income, education and employment) had higher dental caries (15). This means that not only DMFT index in Iran has a bad situation

compared with other countries, but also equity in access to the services is not favorite and the poor and low SES groups have much difficulties in this regard. This is while, dental health insurance in Iran is in its weakest situation, because in one hand there is no public dental health package and on the other hand private insurances are accessible only for the rich (25). In this regard, it is necessary to dental health policymakers, to consider improving primary health care programs such as educational and preventing ones not only merely developing specialized centers, equipping dental units and dental schools (26).

In the recent years, dental schools have developed all over the country rapidly, dental units are produced or are imported as fast as possible, this is while the missing link is lack of attention to preventive health measures actually and seriously. Now, PHC providers and employees have not enough motivation to deliver prestigious services. Their status and dignity have fallen and their services is not acknowledged as it should be.

Limitations and strengths

In this study, DMFT status of 12 years olds in Iran was estimated using systematic review and meta-analysis. However, this estimation is not without problems and weakness points. These problems originate from different material and methods of basic articles, and different sampling and analyzing styles. This is while, all these articles have used DMFT index to report dental situation, so the comparability rate increases.

In order to reliable the DMFT index obtained from the current study, it is necessary to administer nationwide surveys. The most important thing is that these surveys should be performed independently from governmental agencies to their findings be real and generalizable to the country.

One of the study strengths is that the articles entered to the systematic review were from different parts of the country and have a high and good variation. On the other hand, funnel plot and egger's tests indicated low heterogeneity and publication bias. These measures increase the generalizability of the results to Iran.

Conclusion

Dental health status of 12 years olds indicates deployment status of universal health coverage among countries and comprehensiveness of preventive healthcare programs. This study indicated that dental health situation in Iranian 12 years old population have no good status in comparison with EMRO region and globally. This issue gets worse when consider the poor have very low access to the services and there is no persist and permanent public dental insurance. Extensive interventions from the macro level to small villages and towns and reforms in dental health system are among the needed proposed changes to decrease DMFT index in Iran.

Abbreviations

DMFT: Decayed, Missed, Filled Teeth; PHC: Primary Health Care; HSEP: Health Sector Evolution Plan; WHO: World Health Organization; PHC: Primary Health Care; SD: Standard Deviation

Declarations

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Authors' contributions

Conception and design of study/review/case series: SA, MA(CA). Acquisition of data: SA, MA(CA). Analysis of collected data: RM, SA, MA(CA). Interpretation of data: SA, ZA, JN, RM, MA, MA(CA). Drafting of paper and/or critical revision: SA, ZA, JN, RM, MA, MA(CA). All the authors have read and approved the manuscript to be submitted to BMC Oral Health.

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Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics approval

This study was approved by Ethical Committee of Kerman University of Medical Sciences (Ethical code number: IR.KMU.REC.1395.363).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests

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Tables

Table 1. Characteristics of selected and reviewed articles in the study

| NO | Author, year | Province/city | Location data collection | Sampling | No. samples | Gender | DMFT(SD) |
|----|-------------------------------------|----------------------------|--------------------------------|-------------------------------------|-------------|-----------------------|---|
| 1 | Afshar et al. 2004 17() | Kashan, Isfahan | schools | Random cluster method | 242 | 242 girls | 1.45(1.73) |
| 2 | Fadaei and Amiri, 2010 18() | Charharmahal and Bakhtiar | School | Multi-stage cluster random sampling | 215 | - | 2.4(0.19) |
| 3 | Eskandarian et al, 1999 19() | Nomads, Eghlid, Fars | Visit to the nomadic residence | Random cluster sampling | 244 | 124 Boys 120 girls | Boys:1.44(1.13) Girls:1.35(1.06) Total:1.39(1.09) |
| 4 | Faezi et al, 2011 20() | Tehran, Tehran | School | Purposive sampling | 450 | Girls | 3.56(2.65) |
| 5 | Mahvi et al, 2005 21() | Behshahr, Mazandaran | School | Census | 300 | 150 girls 150 boys | Girls:1.75(0.19) Boys:1.21(0.16) Total:1.48(0.13) |
| 6 | Farhadi et al. 2013 22() | Hadishahr, East Azerbaijan | School | All 12 years old students | 266 | - | 1.23(0.09) |
| 7 | Momeni et al, 1999 23() | Tehran | school | Random | 754 | - | 1.10 (1.50) |
| 8 | Momeni et al, 1999 23() | Villages near Isfahan | school | Random | 348 | - | 0.38 (0.82) |
| 9 | Sajadi et al, 2008 24() | Sirjan, Kerman | School | Cluster and random sampling | 700 | - | 3.56(2.34) |
| 10 | Toumarian et al, 2003 25() | Qom, Qom | School | Multi stage sampling | 300 | 150 boys 150 girls | Boys:2.78(2.18) Girls:2.87(2.03) Total: 2.28(2.1) |
| 11 | Nokhostin et al, 2009 26() | Kermanshah; Kermanshah | School | 2 stage cluster sampling | 450 | 225 girls 225 boys | Girls:1.65(1.82) Boys:3.88(2.72) Total:2.76(2.57) |
| 12 | Ghandehari & Mahboobi, 2002 27() | Sowme'eh Sara, Gilan | School | Random | 144 | 76 boys 68 girls | Boys:1.44(1.64) Girls:1.69(1.91) Total:1.68(1.78) |
| 13 | Sadeghi & Bagherian, 2007 28() | Rafsanjan, Kerman | School | Stratified random sampling | 353 | 180 boys | Boys:2.78(1.8) Girls:2.13(2.1) |

| | | | | | | | |
|----|-------------------------------------|-----------------------------|------------------------|-------------------------------|------|-----------------------|---|
| | | | | | | 173 girls | Total:2.46(2) |
| 14 | Hazave'ee et al, 2001 29() | Hamedan, Hamedan | School | Multi stage stratified | 268 | - | 2.25(1.74) |
| 15 | Shariat et al, 2009 30() | Saveh, Markazi | School | Multi stage random sampling | 282 | 152 boys 130 girls | Boys:2.3(1.3) Girls:1.95(3.9) Total:2.1(4.3) |
| 16 | Daneshkazemi et al, 2001 31() | Yazd & Hadishahr, Yazd | School | Random | 1223 | 654 boys 569 girls | Boys:1.95(1.91) Girls:1.65(1.55) Total:1.8(1.75) |
| 17 | Mirzamohammadi et al, 2017 32() | Piranshahr, West-Azarbaijan | School | Random | 320 | 320 girls | 2.53(2.28) |
| 18 | Arbabzadeh-Zavareh et al, 2000 33() | Shahreza, Isfahan | School | Random | 200 | 100 girls 100 boys | Girls:6.12(3.67) Boys:4.52(3.05) Total:5.32(3.46) |
| 19 | Salem et al, 2003 34() | Langeroud, Gilan | School | 2 stage stratified randomized | 298 | 148 girls 150 boys | Boys:1.61(1.5) Girls:1.68(1.61) Total:1.65(1.61) |
| 20 | Salem et al, 2003 34() | Lahijan, Gilan | School | 2 stage stratified randomized | 247 | 122 girls 125 boys | Boys:1.70(1.68) Girls:1.29(1.44) Total:1.49(1.56) |
| 21 | Salem et al, 2003 34() | Siahkal, Gilan | School | 2 stage stratified randomized | 340 | 161 girls 179 boys | Boys:1.77(1.51) Girls:1.45(1.38) Total:1.60(1.45) |
| 22 | Sadr et al, 2011 35() | Zarand, Kerman | School | Cluster-classified sampling | 350 | - | 2.03(1.6) |
| 23 | Shafiezadeh et al, 2007-2008 36() | Tehran, Tehran | Social welfare centers | Census | 113 | - | 1.32(0.86) |
| 24 | Shakerian et al, 2016 37() | Rafsanjan, Kerman | School | Random | 460 | 230 girls 230 boys | Girls:2.71(1.45) Boys:2.61(1.35) Total:2.66(1.40) |
| 25 | Asgari & eghbal, 1996 38() | Qazvin, Qazvin | School | Random classified | 960 | - | 1.1(0.81) |
| 26 | Mehralian et al, 2013 39() | Qazvin, Qazvin | Houses | Stratified | 187 | - | 3.53(4.22) |

| | | | | | | | |
|----|--------------------------------|-------------------------------------|---------------|--|-----|-----------------------|---|
| 27 | Bayat-Movahed et al, 2004 400) | Iran | Health center | Cluster multistage probability sampling | 748 | 378 boys 370 girls | Boys:1.7 (0.2) Girls:2.0 (0.2) Total:1.9 (0.2) |
| 28 | Fadaee et al, 2006 410) | Shahrekord, Chaharmahal & Bakhtiari | School | Simple random stratified multistage | 257 | - | 1.26(0.57) |
| 29 | Mozaffari et al, 2013 420) | Kermanshah, Kermanshah | School | Randomly cluster systematic sampling | 402 | 210 boys 192 girls | Boys:1.67(1.69) Girls:2.17(1.87) Total:1.91(1.79) |
| 30 | Forouzanfar et al, 1996 430) | Birjand, South Khorasan | School | Multi stage stratified systematic sampling | 404 | - | 1.85(1.76) |
| 31 | Pourhashemi, 1997 440) | Tehran, Tehran | School | Randomized | 320 | - | 3.08(2.43) |

Table 2. Eggers' test of publication bias in DMFT situation of 12 years olds Iranian population.

Due to technical limitations, Table 2 is only available as a download in the supplemental files section.

Figures

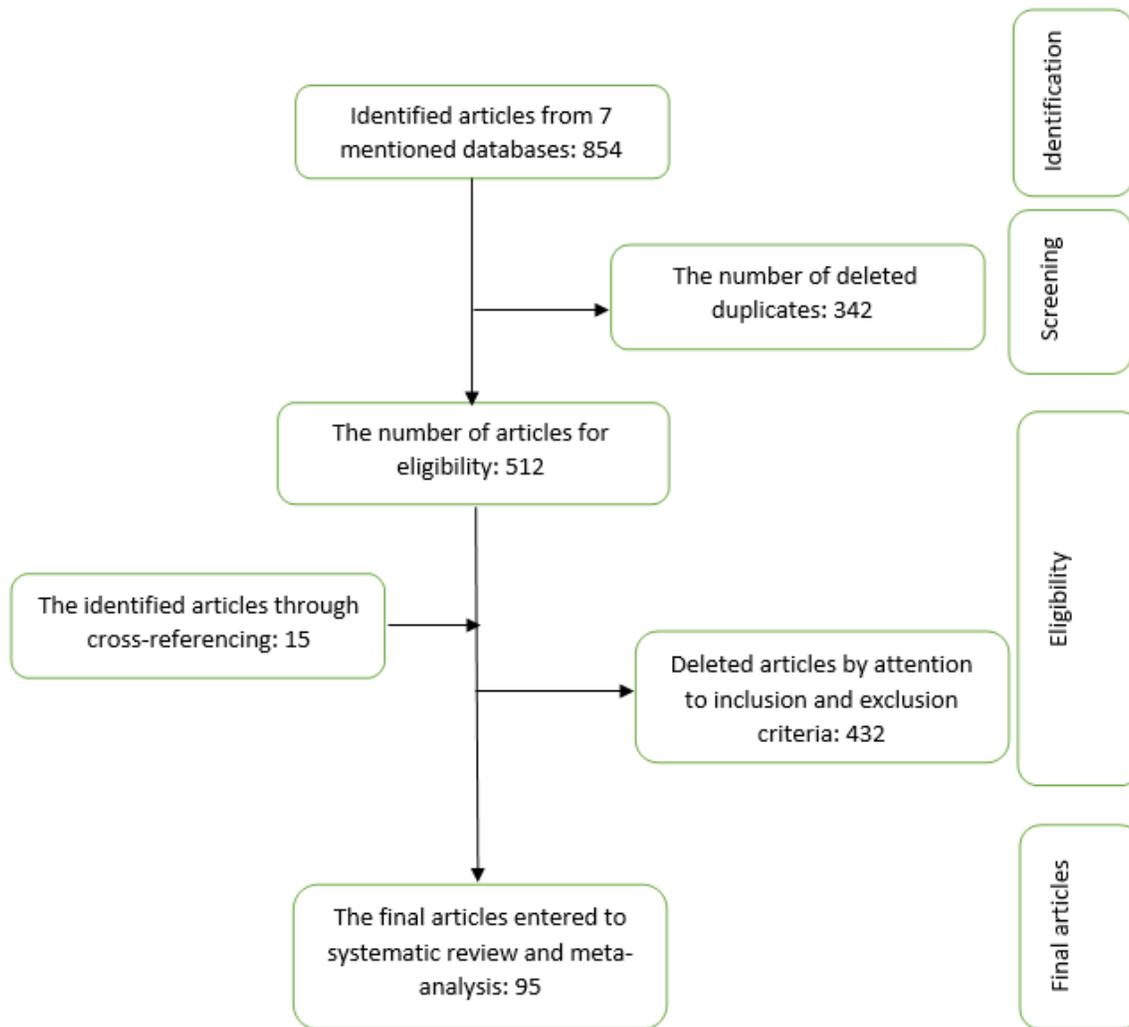


Figure 1

Flowchart of the steps entering studies to the systematic review and meta-analysis

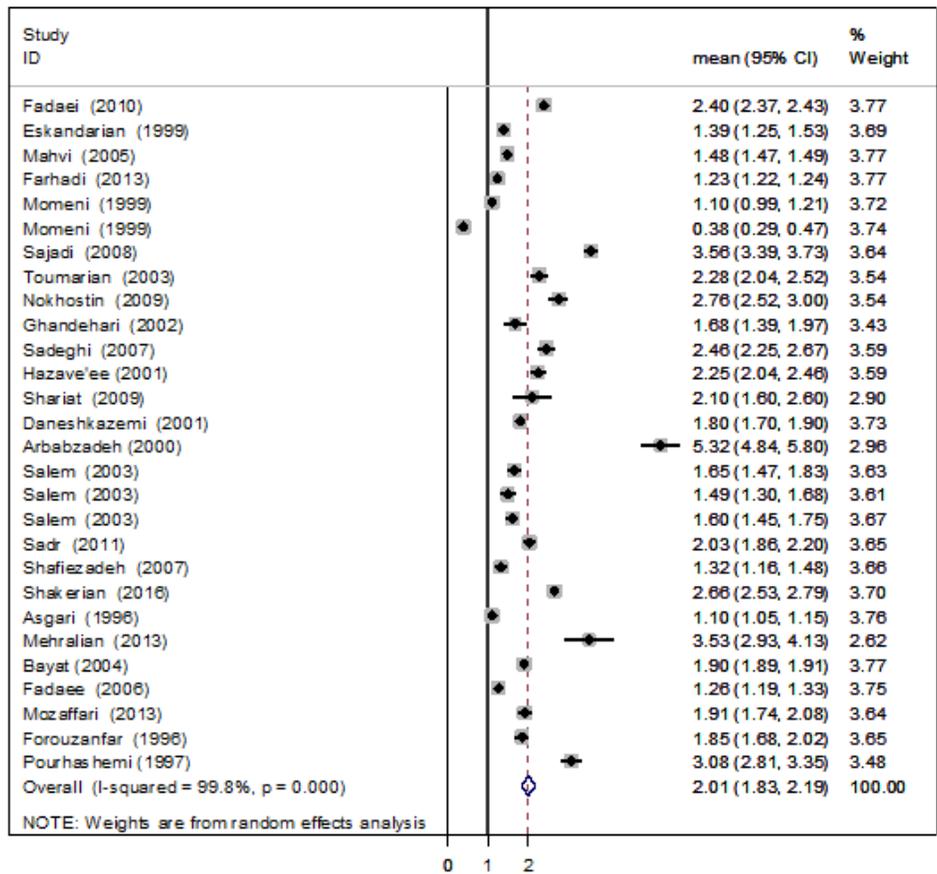


Figure 2

Forest plot of mean DMFT and 95% CI for 12 years old Iranian population

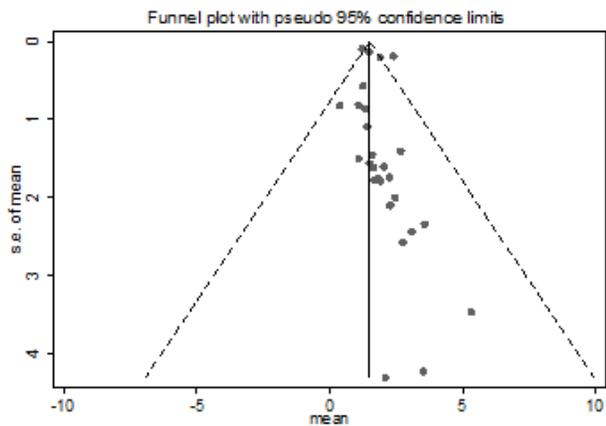


Figure 3

Funnel plot of publication bias of DMFT status of Iranian 12 years olds

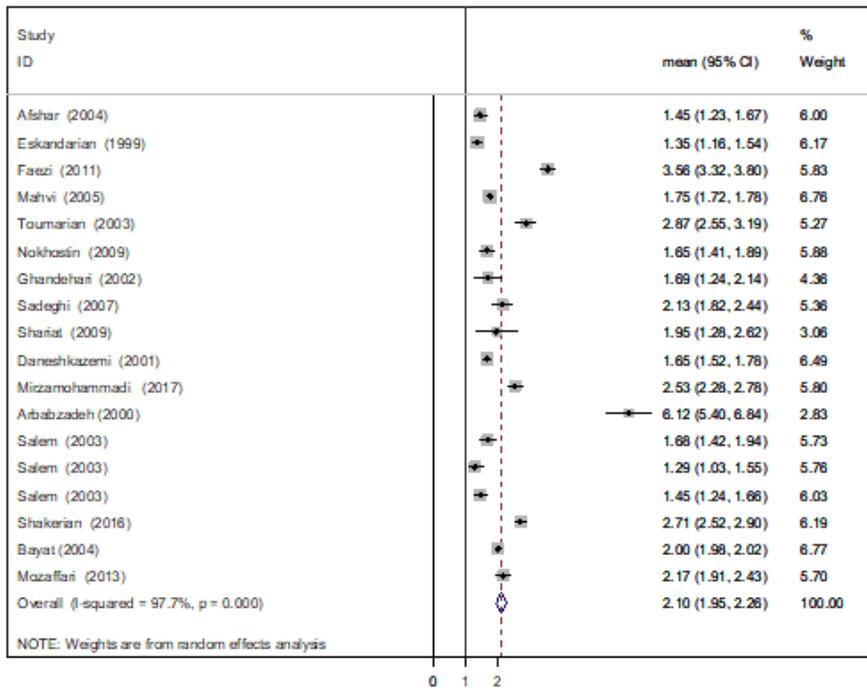


Figure 4

Forest plot of mean DMFT and its 95% CI for 12 years old Iranian girls

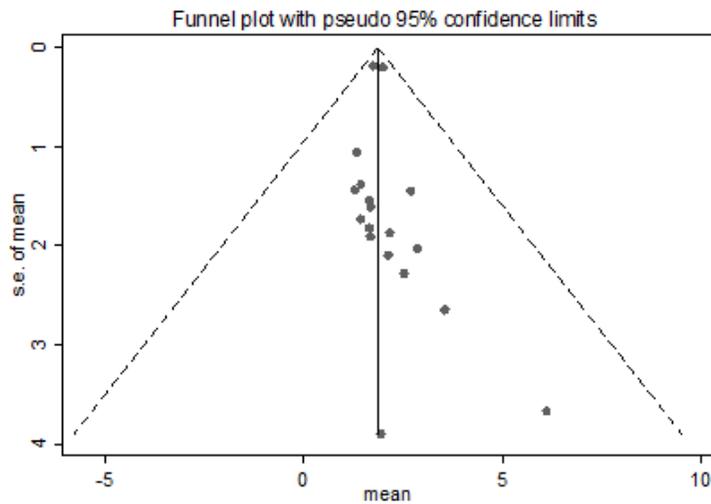


Figure 5

Funnel plot of publication bias in DMFT status in 12 years old Iranian girls' population

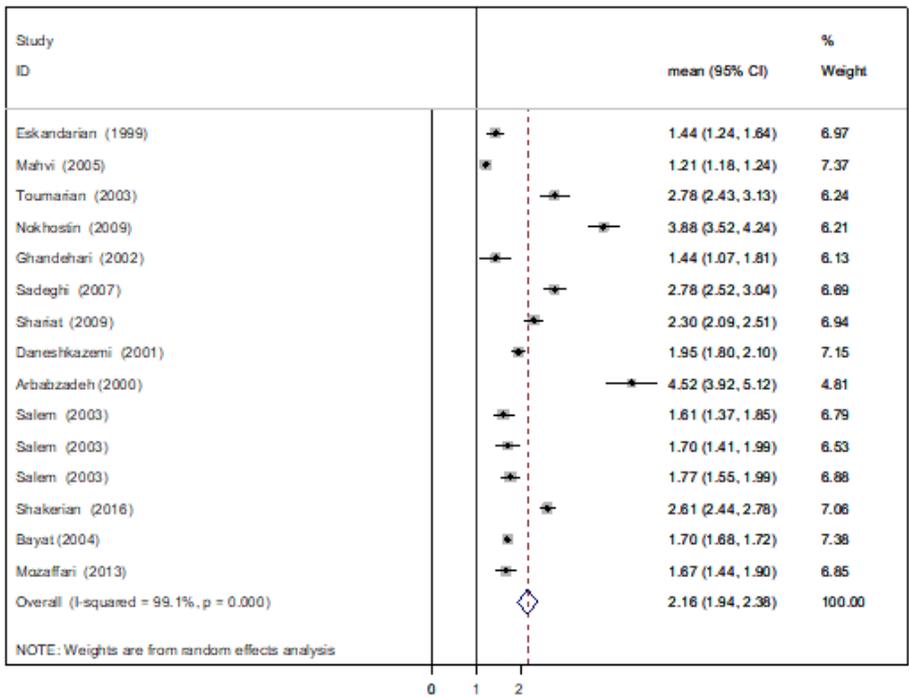


Figure 6

Forest plot of mean DMFT and its 95% CI for 12 years old Iranian boys

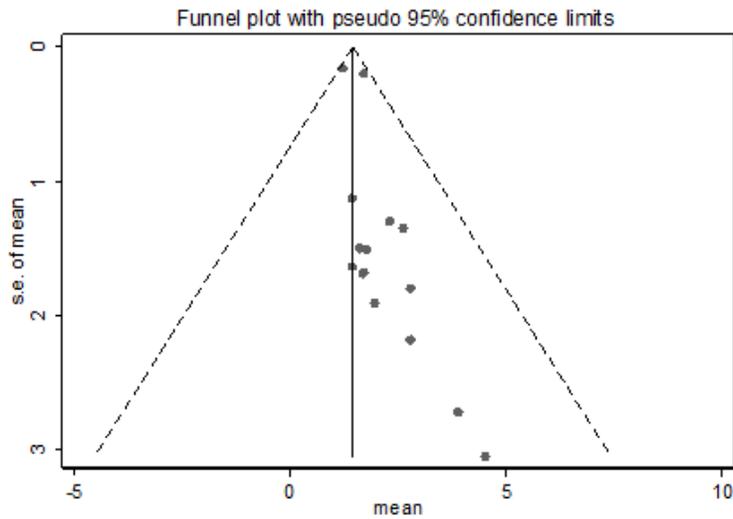


Figure 7

Funnel plot of publication bias in DMFT status in 12 years old Iranian boys' population

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table2.jpg](#)