



## Status of decayed, missing, filled teeth index among Iranian children and adults: A systematic review and meta-analysis

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### Abstract

**Introduction:** Oral health status is one of the health-related priorities in Iran. The present study was conducted with the aim to systematically review the status of oral health in Iran using the decayed, missing, filled teeth (DMFT) index.

**Methods:** In this meta-analysis, all data available on DMFT were reviewed and 35 published studies were included in the study based on search strategy. To estimate overall DMFT and perform the meta-analyses, Comprehensive Meta-Analysis (CMA) software was used.

**Results:** Of all 876 articles, 35 were included in the study. A total of 21849 individuals were included in the meta-analysis. The overall DMFT index was 3.65 [95% confidence interval (CI), 3.01-4.34]. In addition, this rate was 2.30, 8.60, and 3.85 among children, adults, and children with mental/physical disabilities with (CI 95%, 1.76-2.95), (CI 95%, 6.10-9.60), and (CI 95, 2.98-4.80), respectively.

**Conclusion:** Mean DMFT in the assessed published data was higher than that set forth by the World Health Organization (WHO). Further planning and taking effective preventive measures to improve the oral health status seems necessary.

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### Introduction

In 1979, the main objective ever to be formulated for global oral health was announced by The World Health Organization (WHO). By 2000, the global average for dental caries was to be no more than 3 decayed, missing, filled teeth (DMFT) at 12 years of age. At the World Health Assembly in 1979, this declaration was generally allocated as being the prevailing

priority for WHO. In 1983, oral health was declared as part of the Strategy of Health for All (WHA36.14) and in 1989 the organization endorsed the promotion of oral health as an integral part of Health for All by the year 2000 (WHA42.39).<sup>1</sup> In addition, World Health Day in 1994 was dedicated to oral health which also reflects the importance of this issue.<sup>2,3</sup>

The oral and dental health is a major social

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health issue in every country, which is highlighted by changing life styles and modernization.<sup>4</sup> In order to prevent oral and dental diseases, assessment of their ongoing status in the community is of greatest advantage, especially for planning future preventive strategies.<sup>5,6</sup> Although the condition of oral and dental health has shown signs of improvement in recent years, it is still a major health problem in many modern and developing countries.<sup>7-9</sup> One applicable index for evaluating the condition of oral and dental health is the DMFT index, which comprises the number of decayed, missing, and filled teeth in an individual.<sup>10,11</sup>

Many studies on evaluation of the oral health status in the community have used and reported DMFT index.<sup>12-16</sup> Iran is among the countries where DMFT of the population has been studied.<sup>17-19</sup> However, these studies were carried out in limited geographical areas, and in order to plan and intervene on the condition of oral health on a national level, valid precise information on this subject is required.

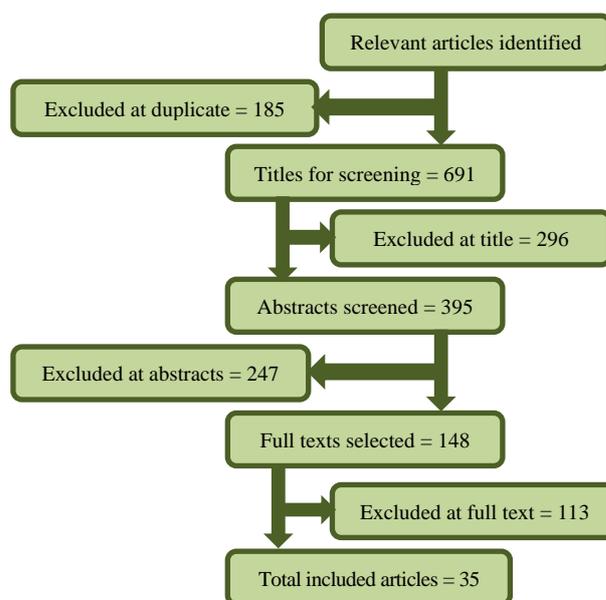
The present study was conducted with the aim to review all published data available on DMFT among the Iranian population, in addition to performing meta-analyses and reporting the results.

## Methods

This was a meta-analysis study and the required data were gathered searching for the key words "oral health, DMFT index, dental caries, decayed, missing, filled, teeth, epidemiology, prevalence, incidence, occurrence, Iran" in databases including PubMed, ScienceDirect, Iranmedex, Magiran, SIC, and Irandoc. No time limit was applied in the searches. Articles both in English and Farsi (Persian) reporting DMFT among an Iranian population were included. Studies on primary teeth (DMFT) among children younger than 6 years old, abstracts presented in conferences, case reports, and interventional studies were excluded. Two reviewers evaluated the articles found in the systematic searches according to the checklist

of STrengthening the Reporting of Observational studies in Epidemiology (STROBE). The selected papers extracted from the databases were assessed by two investigators using checklists. Discrepancies between the two raters were referred to the third investigator. First, the titles of all articles were reviewed to screen for eligibility and the cases inconsistent with the objectives of the study were excluded from the survey. In the later stages, the abstracts and full text articles were, respectively, examined to identify and exclude those that did not satisfy the inclusion criteria, or had a weak correlation with the objectives of the study. Computer software for reference management (Endnote X5, Thomson Reuters, Philadelphia, PA 19130, USA) was used for organizing and assessing the titles and abstracts, and also for recognizing the repetitive items.

The searches returned 876 articles, and excluding the irrelevant items, or items repetitive between databases, with weak relevance to the study, or matching the exclusion criteria, 35 articles were entered in the study (Figure 1).



**Figure 1.** Process of entering the meta-analysis

These articles were read precisely, and the required data for the systematic review were inserted into the extraction table designed for

the purpose of the study. The selected papers were fully reviewed and the required information for the systematic review was extracted and summarized using extraction table in Microsoft Office Excel software. Comprehensive Meta-analysis (CMA) software was used to estimate and conduct a meta-analysis to determine the incidence of the disorder. Forest plot diagrams were used to illustrate the study findings in which the area of each square was proportionally sized to signify the sample size and the lines drawn in each square represented 95% confidence interval (CI) for the incidence rate of gestational diabetes in each of the studies.

Funnel plot was used to examine the publication bias.

**Results**

Finally, 35 articles were included in the study and analyzed. Totally, 21849 subjects were evaluated in these studies. The subjects of 10, 3, and 23 of the studies were individuals with physical or mental disabilities, studying adult subjects ( $\geq 19$  years old), and children (6-18 years old), respectively. In addition, 1 of the studies included the 3 categories together. The details of the reviewed studies are given in table 1.

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

Author-City	Rate and characteristics of samples	DMFT	Mean $\pm$ SD
Khademi and Talab <sup>20</sup> -Isfahan	254 elementary students, 7-12 years old	Najaf Abad, Filor, Dor Juzdan, and Rahmat Abad with 6.66, 3.37, 5.51, and 3.13, respectively	4.66 $\pm$ 0
Mortazavi et al. <sup>21</sup> -Dayr city of Boushehr	506 students, 11-16 years old	1.62 $\pm$ 1.66 = D, 0.04 $\pm$ 0.22 = M, 0.13 $\pm$ 0.45 = F	1.80 $\pm$ 0
Basir et al. <sup>22</sup> -Khuzestan	1152 students, 12-15 years old	Maroun, Karoun, and Karkhe respectively with 1.48 $\pm$ 1.97, 1.35 $\pm$ 1.73, and 66.00 $\pm$ 1.10 and total of 1.16 $\pm$ 1.68	1.16 $\pm$ 1.68
Nasehi Nia and Naseri <sup>23</sup> -Damghan	560 students, 12-16 years old	1.79	1.79 $\pm$ 0
Dobaradaran et al. <sup>24</sup> -Dashtestan	2287 children, 6-11 years old	0.14-1.08	-
Rahmani et al. <sup>25</sup> -Nour Abad Mamsani	3349 children at ages of 6, 9, 10, and 12 years old	Nour Abad, Babamonir, Ab Pakhshan, Joyhan, Mourki, Parin, and Mirjan with 0.180, 0.240, 0.160, 0.143, 0.180, 0.220, and 0.202, respectively	1.90 $\pm$ 0
Davari et al. <sup>26</sup> -Ardekan	607 12-year-old students	54.10 $\pm$ 1.50, minimum 0 and maximum 8, 41.10 $\pm$ 1.41 = D, 0.70 $\pm$ 0.34 = M, 0.32 $\pm$ 0.67 = F	54.1 $\pm$ 1.50
Ghari Zadeh et al. <sup>27</sup> -Ahwaz	300 pregnant women	32.60 $\pm$ 3.10 = total, 25.30 $\pm$ 2.54 = D, 53.10 $\pm$ 1.79 = M, 53.10 $\pm$ 1.82 = F	32.60 $\pm$ 3.10
Basir and Khaneh Masjedi <sup>28</sup> -Ahwaz	264 6-year-old students	Mean of total DMF = 3.36, D = 2.76, M = 0.24, F = 0.36 Mean of total DMF with 3.30 and 3.40 for boys and girls, respectively	3.36 $\pm$ 0
Ashrafizadeh et al. <sup>29</sup> -Ahwaz	300 12-year-old students	Mean of total DMF = 1.98 with 1.92 and 2.05 for boys and girls, respectively	1.98 $\pm$ 0
Fani <sup>30</sup> -Bouvanat	407 students 11-16 years old	Mean of total DMF	2.25 $\pm$ 1.90
Asl Amin Abadi et al. <sup>31</sup> -Tabriz	60 children suffering from major thalassemia, 60 healthy children, in 3 age ranges of 1-5, 5-12, and over 12 years old	Age 5-12 years old: Mean of DMF among healthy children = 8.20 $\pm$ 2.13 Mean of DMF for all children with thalassemia = 55.60 $\pm$ 3.24 Over 12 years old: Mean of DMF among healthy children = 9.20 $\pm$ 1.67 Mean of DMF for all children with thalassemia = 7.60 $\pm$ 2.24 Total: Mean of DMF among all healthy children = 8.20 $\pm$ 2.13 Mean of DMF among all children with thalassemia = 6.50 $\pm$ 3.24	8.20 $\pm$ 2.13 6.50 $\pm$ 3.24

**Table 1.** Characteristics of selected and reviewed articles in the study (continue)

Author-City	Rate and characteristics of samples	DMFT	Mean $\pm$ SD
Mortazavi and Karimian <sup>32</sup> -Upper and lower Jorguye	518 students	Mean for lower and upper Jorguye as 2.05 and 2.24, respectively	2.14 $\pm$ 0
Deyhimi <sup>33</sup> -Isfahan	202 dentistry students	Mean of total DMF = 34.40 $\pm$ 4.49 D = 90.10 $\pm$ 1.90, M = 0.45 $\pm$ 1.28, F = 62.40 $\pm$ 3.96 Total DMF for boys and girls was 45.50 $\pm$ 3.87 and 33.50 $\pm$ 4.02, respectively	34.40 $\pm$ 4.49
Ghasempoor et al. <sup>34</sup> -Babol and Babolsar	165 mentally and physically disabled individuals between 6 and 18 years old	Mean of total DMF = 29.20 $\pm$ 2.31 With 26.20 $\pm$ 2.06 and 73.30 $\pm$ 2.76 for boys and girls, respectively With a minimum and maximum of 0 and 18, respectively	29.20 $\pm$ 2.31
Hassani Tabatabaei et al. <sup>35</sup> -Tehran	523 mentally disabled individuals, 14-20 years old	Mean of total DMF = 38.40 $\pm$ 2.31 With 1.50 $\pm$ 4.84 and 65.40 $\pm$ 4.45 for boys and girls, respectively	65.40 $\pm$ 4.83
Ramezani et al. <sup>36</sup> -Behshahr	165 individuals in case group (Fluoride less than 0.4 ppm) 164 individuals in control group (proper fluoride 0.6-1.2 ppm)	Mean of total DMF in case group = 7.11 $\pm$ 7.90 Mean of total DMF in control group = 4.80 $\pm$ 6.60	7.11 $\pm$ 7.90 6.60 $\pm$ 4.80
Sadeghi and Bagherian <sup>37</sup> -Rafsanjan	353 12-year-old students	Mean of total DMF = 64.20 $\pm$ 2.00 With 87.20 $\pm$ 1.80 and 31.20 $\pm$ 2.10 for boys and girls, respectively	64.20 $\pm$ 2.00
Meamar et al. <sup>38</sup> -Sanandaj	439 12-year-old students	Mean of total DMF = 6.20 $\pm$ 1.81	6.20 $\pm$ 1.81
Nozari et al. <sup>39</sup> -Boushehr	502 12-15-year-old students	Mean of total DMF = 1.49 with 1.32 and 1.63 for boys and girls, respectively	1.49 $\pm$ 0.00
Ajami et al. <sup>9</sup> -Mashhad	165 children suffering from thalassemia	Mean of total DMF = 6.30 $\pm$ 0.29, D = 98.20 $\pm$ 2.83, M = 0.64 $\pm$ 0.84, F = 0.42 $\pm$ 0.66	6.30 $\pm$ 0.29
Ghandehari Motlagh and Mahboobi <sup>40</sup> -Soumesara	144 12-year-old students	Mean of total DMF = 86.10 $\pm$ 1.78, D = 74.10 $\pm$ 1.65, M = 0.82 $\pm$ 0.14, F = 0.81 $\pm$ 0.67 Mean of total DMF for boys and girls with 44.10 $\pm$ 1.64 and 81.50 $\pm$ 2.58, respectively	86.10 $\pm$ 1.78
Eskandarian et al. <sup>41</sup> -Shiraz	302 10-12 year-old children with mental retardation	Mean of total DMF = 40.50 $\pm$ 1.96, D = 8.40 $\pm$ 2.38, M = 0.61 $\pm$ 0.22, F = 0.91 $\pm$ 0.06 Mean of total DMF for boys and girls with 69.40 $\pm$ 3.08 and 81.50 $\pm$ 2.58, respectively	40.50 $\pm$ 1.96
Davari et al. <sup>42</sup> -Yazd	100 students with mental retardation, 8-12 years old	Mean of total DMF = 59.50 $\pm$ 3.83, D = 3.40 $\pm$ 3.09, M = 64.10 $\pm$ 0.64, F = 57.10 $\pm$ 0.19 Mean of total DMF for boys and girls with 11.50 $\pm$ 0.53 and 39.60 $\pm$ 0.52, respectively	59.50 $\pm$ 3.83
Shidfar et al. <sup>43</sup> -Ilam	320 women workers, 20-34 years old	Mean of DMF = 4.3	4.30 $\pm$ 0
Seyed Akhavan et al. <sup>44</sup> -Karaj	768 12-year-old students	Mean of total DMF = 31.30 $\pm$ 2.39 with 95.30 $\pm$ 2.59 and 76.20 $\pm$ 2.20 for boys and girls, respectively	31.30 $\pm$ 2.39
Salem et al. <sup>45</sup> -Guilan Province	885 12-year-old students	Langroud City: Mean of total DMF = 56.10 $\pm$ 1.61 with 16.10 $\pm$ 1.50 and 86.10 $\pm$ 1.61 for boys and girls, respectively Lahijan City: Mean of total DMF = 94.10 $\pm$ 1.56 with 92.10 $\pm$ 1.44 and 7.10 $\pm$ 1.68 for boys and girls, respectively Siahkal City: Mean of total DMF = 6.10 $\pm$ 1.45 with 54.10 $\pm$ 1.38 and 77.10 $\pm$ 1.51 for boys and girls, respectively	56.10 $\pm$ 1.61
Shahrabi et al. <sup>46</sup> -Tehran	117 12-year-old deaf students	Mean of total DMF = 3.07	3.07 $\pm$ 0

**Table 1.** Characteristics of selected and reviewed articles in the study (continue)

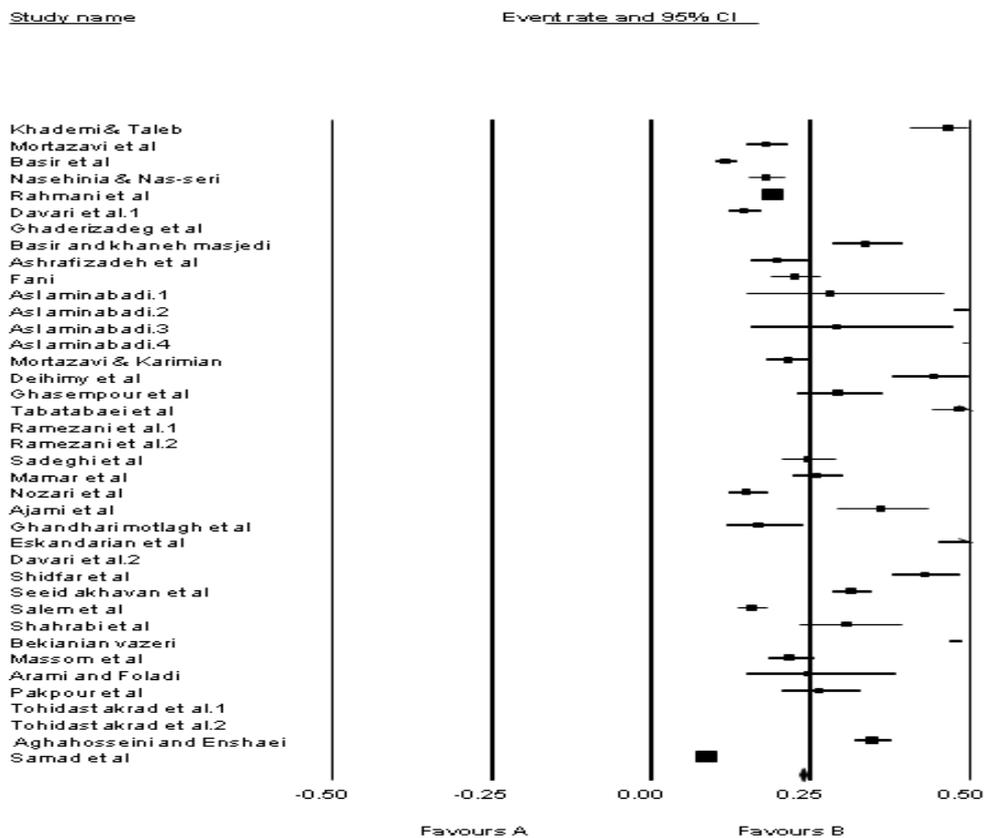
Author-City	Rate and characteristics of samples	DMFT	Mean ± SD
Bakianian Vaziri et al. <sup>47</sup> -Hamadan	37 individuals with down syndrome	Mean of total MDF = 6.40 with 6.10 and 2.22 for boys and girls, respectively	6.40 ± 0
Massom et al. <sup>48</sup> -Hamadan	480 12-year-old students	Mean of total MDF = 71.20 ± 1.39 with 2.12 ± 0.00 and 2.22 ± 0.00 for boys and girls, respectively	71.20 ± 1.39
Arami and Foladi <sup>49</sup> -Tehran	50 patients with hemodialysis, 12-20 years old	Mean of total MDF = 64.20 ± 3.41, D = 84.10 ± 3.19, M = 0.03 ± 0.84, F = 0.86 ± 1.17 With a minimum and maximum of 0 and 22, respectively	64.20 ± 3.41
Pakpour et al. <sup>50</sup> -Qazvin	180 teenagers	Mean of total DMF = 26.20 ± 1.89, D = 3.10 ± 1.04, M = 0.14 ± 0.57, F = 0.88 ± 0.73 Mean of total DMF as 18.20 ± 2.02 and 34.20 ± 1.74 for boys and girls, respectively	26.20 ± 1.89
Tohidast Akrad et al. <sup>51</sup> -Tehran	251 workers of chocolate and cable factories	Chocolate factory: Mean of total DMF = 5.21 ± 6.50 Cable factory: Mean of total DMF = 7.90 ± 5.40	5.21 ± 6.50 7.90 ± 5.40
Aghahosseini and Enshaei <sup>52</sup> -Tehran	1000 patients	Mean of total DMF = 74.30 ± 0.50	74.30 ± 0.50
Samadzadeh et al. <sup>53</sup> -Iran	6200 children 6-12 years old	6 year-old: Mean of total DMF = 0.20 ± 0.02 9 year-old: Mean of total DMF = 0.90 ± 0.05 12 year-old: Mean of total DMF = 5.10 ± 0.01	2.00 ± 0.86

SD: Standard deviation; DMFT: Decayed, missing, filled teeth

In conducting meta-analysis of oral and dental health status, each of the above groups had been separately calculated and reported.

According to the Q statistics indicating

heterogeneity of results in different studies, the random effects model was used to perform meta-analyses. Figure 2 shows DMFT index with 95% CI in the evaluated studies.



**Figure 2.** Incidence of dental caries in the evaluated studies

The incidence of DMFT in the three studied groups of children, adults, and individuals with disabilities based on the random effect was determined to be 3.65 [95% CI, with lower and upper bounds of 3.01 and 4.34, respectively,  $Q = 2370.910$ , Degree of freedom (df) = 38,  $P < 0.001$ ].

Mean DMFT index for each studied group is given in figures 3, 4, and 5.

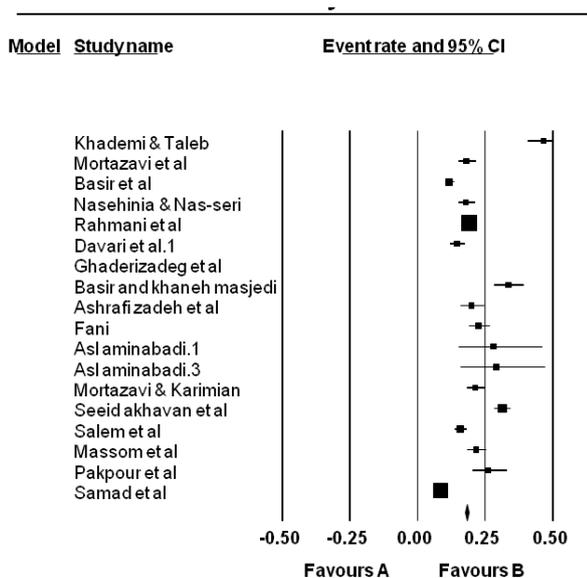


Figure 3. Incidence of dental caries among the children group

The mean of DMFT index for children has been shown in figure 3.

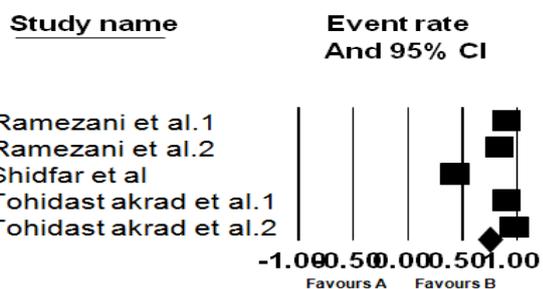


Figure 4. Mean of decayed, missing, filled teeth (DMFT) index among adults

Mean DMFT among adults based on randomized model was estimated 8.60 with 95% CI (with lower and upper bounds of 6.10 and 9.60, respectively) ( $df = 4$ ,  $Q = 182.294$ ,  $P < 0.001$ ).

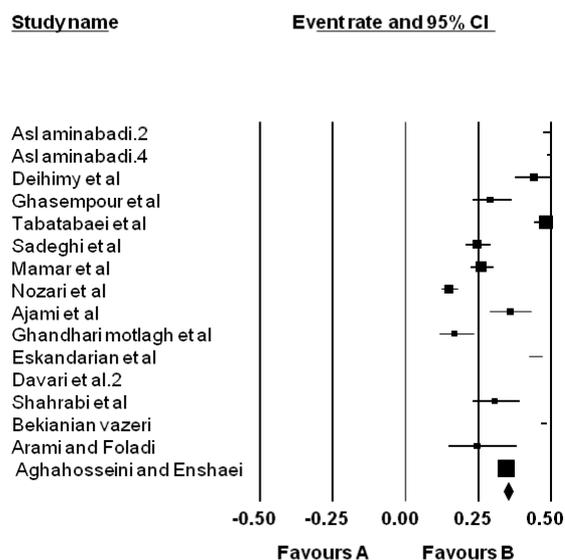


Figure 5. Mean of decayed, missing, filled teeth (DMFT) index among children and adults with physical problems and specific disabilities

The mean DMFT index for children and adults with physical problems and specific disabilities has been shown in figure 5.

Mean of DMFT index for children and adults with physical problems and specific disabilities was estimated as 3.85 with 95% CI based on randomized model (with lower and upper bounds of 2.98 and 4.80, respectively) ( $Q = 1764.840$ ,  $df = 22$ ,  $P < 0.001$ ).

### Discussion

During the past years, the consensus of many reports worldwide indicated that dental caries was remarkably declining among general population. The dental community has made very much effort to reduce dental caries using topical and systemic fluorides, toothpastes, sealants, improvement in diet, oral health education, and dental care. Based on recent reports, there is a warning about increase in caries of primary and permanent teeth among children and adults, including coronal and root surfaces. The results of this study showed that the mean DMFT index was 3.65 among all individuals studied in the mentioned studies and this rate was 2.30, 8.60, and 3.85 for children, adults, and individuals with physical problems and specific disabilities, respectively.

The mean DMFT obtained for children

was calculated as 2.30 in the present study, which is in agreement with the rates reported in studies by Fani<sup>30</sup> and Sadeghi and Bagherian<sup>37</sup> in Iran, however, it was higher than those reported in the studies conducted by Casanas et al.<sup>54</sup> and Makoni et al.<sup>55</sup> in Spain and Zimbabwe, respectively. The mean DMFT of children in the present study is lower than that reported in the study by Khademi and Talab in Iran.<sup>20</sup> In general, the present results indicate a high DMFT for children in Iran, which is far from the goals set by WHO for the year 2015 (DMFT equal to 1 or lower).<sup>56</sup> Adding fluoride to the drinking water in Iran as a preventive measure against dental caries is a plausible suggestion,<sup>57,58</sup> as the present study has shown substandard drinking water fluoride levels in parts of Iran.<sup>59</sup> Inadequate exposure to fluoride may explain, in part, the higher DMFT in Iran. As for caries prevention among children, one effective approach would be to implement preventive programs in schools. Such approach should entail repeated oral health instructions, fluoride therapy, periodic oral examinations, and taking measures for raising general awareness of the issue.

Of the 4 studies used for estimating the DMFT among adults in the present study, 2 had been conducted among workers. The estimated value (8.60) in this category is higher than those reported by Shidfar et al.<sup>43</sup> in a previous study in Iran among women workers. The results of the present study are in line with those reported by Rekha and Hiremath<sup>60</sup> obtained among an Indian population. Another study conducted by Tohidast Akrad et al.<sup>51</sup> in Iran among two groups of workers of chocolate factory and cable factory has indicated higher mean DMFTs compared to that of the present study. In a study by Mahvi et al. on fluoride concentration in drinking water sources and incidence of DMFT among the 12 year old students in Behshahr City, it was concluded that the mean DMFT index was  $1.48 \pm 0.13$  and was higher among girls in comparison to boys.<sup>61</sup> In a study conducted by Splieth et al.

in Germany<sup>62</sup> and also the study by Alvarez-Arenal et al. in Spain,<sup>63</sup> mean of DMFT index among adults has been reported higher than that of the present study. Generally, mean of DMFT index for adults in this study was much more than that of children. This could be due to the subjects investigated in the reviewed studies, since the subjects in 2 out of 4 studies included adult workers and in another study, the subjects were adult pregnant women, as occupational status and pregnancy could have adverse effect on increase of this index. Another reason for higher mean rates of DMFT index among adults could be the ignorance and decrease of sensitivity of these individuals due to their daily lives and labor problems. However as it has been mentioned in most of the studies, education on oral and dental health, periodic examinations, health instructions, and controlling water fluoride could have the most effective results for these ages.<sup>64-66</sup>

The individuals with physical problems and specific disabilities were the third group the mean DMFT index of whom was estimated separately, and the index was obtained as 3.85. This rate was more and less than that of healthy children and adults, respectively. The majority of individuals in these groups were children with mental retardation. According to the results of this study, results of some studies showed that mean of DMFT index among children with disability and mental retardation was more than that of their healthy peers.<sup>67-69</sup> However, the results of the study by Vyas and Damle<sup>70</sup> was in contradiction to this result, as the mean of DMFT index among individuals with disability and mental retardation was less than that of their healthy peers. Results of the studies on other groups with physical problems, disability, and specific diseases have shown that this group of people have higher mean of DMFT index.<sup>71,72</sup> In a study by Pereira et al. regarding the estimation of DMFT index using teeth most affected by dental caries among 12 year old children, it was concluded that while the real DMFT was 1.7, the estimated DMFT was 1.67 using teeth

46 + 36 + 16 + 26.<sup>73</sup> Due to physical and mental problems of these individuals and limitations in their lives, their high mean of DMFT index could be justifiable, showing the necessity of providing specific educations to dentists to care and cure caries among this group of people, as both principles of prevention and therapy of this group of individuals are along with specific problems which requires dentists to have skill of coping with these individuals. In addition, education and training of caregivers for these individuals could be an effective strategy for decreasing DMFT index and improving health status among them.

### Conclusion

The results of the current study showed that mean of DMFT index among all individuals under investigation in the reviewed studies and among the 3 groups under study (children, adults, and individuals with disability and specific problems) was higher than the international standard value and standard proposed by WHO, which was considered as one of the incident health

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problems in Iran. Therefore, planning and conducting effective efforts to prevent and decrease this index is an inevitable issue.

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### Authors' Contribution

All of the authors contributed equally.

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### Conflict of Interest

Authors have no conflict of interest.

### Ethical Approval

This study was approved by the Medical Ethics Committee of Tabriz University of Medical Sciences with registration code 5/4/8091.

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