Kerman Oral and Dental diseases research center

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# Molecular markers as an indicator in the malignant potential of oral lichen planus: A systematic review

*Zahra Atai DDS, MD[1], Zahra Khodadadi-Bohlouli DDS[2], Nader Navabi DDS, MD[3]*

**Review Article**

## Abstract

**BACKGROUND AND AIM:** Oral lichen planus (OLP) is a chronic, autoimmune, inflammatory disease. The progression of OLP to oral squamous cell carcinoma (OSCC) has generated a longstanding controversy about the details of this malignant transformation potential. This study aimed to do a systematic review on the molecular markers related to the malignant transformation of OLP.

**METHODS:** We searched the databases PubMed, Google Scholar, Science Direct, Scopus, Cochrane and Thomson Reuters Web of Science (1990-2015) with the MeSH key words of: ("oral lichenoid reaction", "oral lichenoid lesion", "oral lichenoid eruption", "oral lichen planus" "lichen planus", "lichenoid") AND ("malignant transformation", "premalignant character", "cancerization", "pre-neoplasm", "squamous cell carcinoma"). The reviewers screened the identified publications in three steps according to title, abstract and full text, extracted all the investigated markers in screened articles and finally classified the markers according to the frequency. Extracted data were saved in Excel software.

**RESULTS:** Out of 570 articles, 66 were finally enrolled in the study. The most frequent evaluated markers were p53, cyclooxygenase-2 (COX-2), Ki67, B-cell lymphoma-2 (Bcl-2), Bax, p21, and caspase-3.

**CONCLUSION:** The present study concluded that there were some documented evidences for association between malignant transformation of OLP and seven molecular markers (p53, COX-2, Ki67, Bcl-2, Bax, p21, and caspase-3).

**KEYWORDS:** Biomarkers; Tumor; Gene Expression; Oral Lichen Planus

**Citation:** Atai Z, Khodadadi-Bohlouli Z, Navabi N. **Molecular markers as an indicator in the malignant potential of oral lichen planus: A systematic review.** J Oral Health Oral Epidemiol 2017; 6(2): 54-62.

Oral lichen planus (OLP) is an autoimmune muco-cutaneous chronic disease that commonly involves the oral cavity. The prevalence of OLP varies from 0.5% to 3.0%. It mainly occurs among females between the ages 30 and 60. OLP is classified as white (reticular or plaque) and red (atrophic or erosive) lesions.[1-6] Malignant transformation of OLP has been reported,[7] and its frequency ranges from 0% to 5.3%. The highest malignant transformation frequency rate occurs in erythematous and erosive lesions.[7,8] The World Health Organization (WHO) has categorized this lesion as precancerous, which is "a generalized state associated with a significant increased risk of cancer".[7] The transformation of OLP into oral squamous cell carcinoma (OSCC) has led to a longstanding controversy about its malignant potential.[8]

Fitzpatrick et al. conducted a systematic review in 2014.[9] They evaluated 16 studies on the malignant transformation of OLP and they focused on its prevalence in clinical evidence. The rate of malignant transformation ranged between 0% and 3.5%. The authors concluded that while there is little possibility of malignant degeneration in OLP, regular follow-up is necessary for OLP patients.[9] Molecular markers provide the possibility of identifying patients with

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potential malignancy that are progressing toward OSCC before histological detectability of malignant cells at the primary region. Previous studies have found various types of molecular pathways that are possibly involved in the transformation of OLP into OSCC, such as p53, CDKN1A, LCK, PIK3CA, BIRC5, IL-2, and PI3K.[8]

Nowadays, there are no specific markers to recognize which OLP lesions have a higher risk for malignant transformation. Every patient with OLP should be observed ultra-carefully to detect early findings for cancer development; thus, it is critical to identify the main molecular markers such as those mentioned. Since Fitzpatrick et al.[9] only evaluated the clinical characteristics of the malignant alteration of OLP, this study aimed to identify the specific molecular markers related to the malignant transformation of OLP.

## Methods

In the present study we systematically reviewed all the published papers in English since January 1990 to December 2015. Toward this end, the international electronic databases including PubMed, Google Scholar, Science Direct, Scopus, Cochrane, and ISI Web of Science were searched. Our search included (MeSH) the medical keywords "oral lichenoid reaction", "oral lichenoid lesion", "oral lichenoid eruption", "oral lichen planus", "lichen planus", and "lichenoid" in combination with "malignant transformation", "premalignant character", "cancerization", "pre-neoplasm", and "squamous cell carcinoma". In the next step, to identify other related articles we considered summaries of all presentations at international congresses in the field of oral health during the specified period (1990–2015). In addition, we used the references cited in the related papers in order to prevent us from missing any pertinent data or studies. All the obtained articles were imported into EndNote software. The software eliminated duplicate studies. The investigator screened the relevant publications in three steps based on the titles, abstracts, and body text. The investigator also screened the articles according to the strength of their methods.[10,11]

Therefore, case-reports or studies without any comparison with a control group or without a reliable diagnostic test were excluded. The included papers were case-control studies with both human and biopsy samples. We extracted data in two phases. First, we evaluated the overall related qualified studies and we extracted all the investigated molecular markers. In the second data extraction phase, we categorized the molecular markers according to their frequency. The obtained data included papers that examined special molecular markers. The collected papers were classified based on the number of repeated markers they contained: repeated more than once and repeated once. The data were extracted and then saved separately in an Excel worksheet.

## Results

First, 570 articles were collected from the previously mentioned databases (Cochrane: 8, PubMed: 347, Google Scholar: 141, Science Direct: 41, Scopus: 27, Web of Science: 6). after removing duplicate articles, the remaining records were evaluated based on their title and abstract. Finally, 66 records were selected (Figure 1). Reviewing the full texts of those 66 articles enabled us to clarify the most important molecular markers in these studies. The extracted and stratified data [regarding the author, year, study group(s), technique, and detection of markers in the OLP group] for these reviewed articles are shown in tables 1-3.




**Figure 1.** Flow diagram of study

**Table 1.** Description of the reviewed studies for the main seven markers

| Studies/ Marker | Author | Year | Study group(s) | Technique | Detection of marker in OLP |
|---|---|---|---|---|---|
| Twelve studies for p53 | Acay et al.[13] | 2006 | 22 OLP, 27 OLL | IHC | + |
| | Agha-Hosseini and Mirzaii-Dizgah[14] | 2015 | 35 OLP, 38 NM | ELISA | NC |
| | Arreaza et al.[15] | 2013 | 31 OLP, 34 OLR | IHC | + |
| | de Sousa et al.[29] | 2009 | 24 OLP, 24 OSCC | IHC | + |
| | Gonzalez-Moles et al.[33] | 2006 | 51 OLP, 26 NM | IHC | + |
| | Lee et al.[38] | 2004 | 56 OLP, 20 NM, 20 EH, 30 ED, 38 SCC | IHC | NC |
| | Leyva-Huerta et al.[39] | 2012 | 21 OLP, 16 OSCC, 4 NM | IHC | + |
| | Ogmundsdottir et al.[55] | 2002 | 55 OSCC, 48 OLP, 12 NM | IHC | NC |
| | Oliveira Alves et al.[56] | 2013 | 5NM, 25 IFH, 65 OLP, 16 OED, 19 OSCC | IHC | + |
| | Safadi et al.[65] | 2010 | 18 OLP, 10 NM, 10 OSCC, 13 NM, 20 OFK, 30 OED | IHC | - |
| | de Sousa et al.[29] | 2009 | 24 OLP, 24 OED | IHC | + |
| | Valente et al.[73] | 2000 | 28 OLP, 7 NM | IHC | NC |
| Seven studies for COX-2 | Abdel Hay et al.[12] | 2011 | 50 OLP, 50 NM | RFLP, RT-PCR, RIA | - |
| | Arreaza et al.[16] | 2014 | 34 OLR. 31 OLP | IHC | + |
| | Cortes-Ramirez et al.[26] | 2010 | 44 OLP | IHC | + |
| | Danielsson et al.[28] | 2011 | 20 OLP, 20 NM | RT-PCR, IHC, Western blot | + |
| | Li et al.[40] | 2013 | 33 OLP, 38 OSCC, 10 NM | IHC, RT-PCR | + |
| | Lysitsa et al.[42] | 2007 | 30 OLP, 8 NM | Western blot | + |
| | Neppelberg and Johannessen[53] | 2007 | 7 NM, 45 OLP | IHC | - |
| Seven studies for Bcl-2 | Arreaza et al.[16] | 2014 | 34 OLR, 31 OLP | IHC | + |
| | de Sousa et al[29] | 2009 | 24 OLP, 24 OSCC | IHC | - |
| | Gonzalez-Moles et al.[33] | 2006 | 51 OLP, 26 NM | IHC | + |
| | Leyva-Huerta et al.[39] | 2012 | 21 OLP, 16 OSCC, 4 NM | IHC | + |
| | Nafarzadeh et al.[51,52] | 2013 | 11 WOSCC, 30 OLP, 20 NM | IHC | ? |
| | Pigatti et al.[57] | 2014 | 14OLP, 14 OLL , 9 NM | IHC | + |
| | Sousa et al.[69] | 2009 | 24 OLP, 24 OED | IHC | + |
| Six studies for Ki67 | Acay et al.[13] | 2006 | 22 OLP, 27 OLL | IHC | - |
| | Gonzalez Moles et al.[32] | 2009 | Ninety OSCCs from 73 patients | IHC | + |
| | Gonzalez-Moles et al.[33] | 2006 | 51 OLP, 26 NM | IHC | NC |
| | Mattila et al.[46] | 2007 | 70 OLP | IHC | - |
| | Pigatti et al.[57] | 2014 | 14 OLP, 14 OLL, 9 NM | IHC | ?+ |
| | Zargaran et al.[75] | 2013 | 17 EH, 16 OLP, 10 MED, 10 SED, 10 WOSCC,10 POSCC | IHC | + |
| Five studies for Bax | Bascones et al.[17] | 2005 | 32 OLP, 20 NM | TUNEL assay, IHC | - |
| | Bascones-Ilundain et al.[18] | 2007 | 32 OLP (18 reticular and 14 atrophic-erosive) | IHC | NC |
| | de Sousa et al.[29] | 2009 | 24 OLP, 24 OSCC | IHC | - |
| | Nafarzadeh et al.[51,52] | 2013 | 11 WOSCC, 30 OLP, 20 NM | IHC | + |
| | Sousa et al.[69] | 2009 | 24 OLP, 24 OED | IHC | + |
| Four studies for p21 | Bascones et al.[17] | 2005 | 32 OLP, 20 NM | TUNEL assay, IHC | + |
| | Bascones-Ilundain et al.[19] | 2006 | 32 OLP, 20 NM | IHC, TUNEL assay | + |
| | Gonzalez-Moles et al.[33] | 2006 | 51 OLP, 26 NM | IHC | + |
| | Safadi et al.[65] | 2010 | 18 OLP, 10 NM, 10 OSCC, 13 OM, 20 OFK, 30 OED | IHC | + |
| Four studies for Caspase-3 | Bascones et al.[17] | 2005 | 32 OLP, 20 NM | TUNEL assay, IHC | + |
| | Bascones-Ilundain et al.[18] | 2007 | 32 OLP (18reticular and 14 atrophic-erosive) | IHC | - |
| | Bascones-Ilundain et al.[19] | 2006 | 32 OLP, 20 NM | IHC, TUNEL assay | + |
| | Gonzalez-Moles et al.[33] | 2006 | 51 OLP, 26 NM | IHC | + |

OLP: Oral lichen planus; OLL: Oral leukoplakia; OLR: Oral lichenoid reaction; NM: Normal mucosa; OSCC: Oral squamous cell carcinoma; EH: Epithelial hyperplasia; OED: Oral epithelial dysplasia; MED and SED: Mild; Moderate and severe epithelial dysplasia; OFK: Oral focal keratosis; WOSCC and POSCC: Well-differentiated and poorly-differentiated OSCC; NC: Non-conclusive; OM: Oral mucositis; IHC: Immunohistochemistry; ELISA: Enzyme-linked immunosorbent assay; RFLP: Restriction fragment length polymorphism; RT-PCR: Reverse transcription polymerase chain reaction; RIA: Radioimmunoassay; TUNEL assay: Terminal deoxynucleotidyl transferase dUTP nick-end labeling assay

**Table 2.** Markers repeated in two studies

| Marker | Author | Year | Study group(s) | Technique | Detection of marker in OLP |
|---|---|---|---|---|---|
| PCNA | Lee et al.[38] | 2004 | 56 OLP, 20 NM, 20 EH, 30 ED, 38 SCC | IHC | ? |
| | Sousa et al.[69] | 2009 | 24 OLP, 24 dysplasia | IHC | + |
| MMPs | Chen et al.[22] | 2008 | 27 OLP, 15 OSCC, 11 NM* | IHC | + |
| | Li et al.[40] | 2013 | 33 OLP, 38 OSCC, 10 NM | IHC, RT-PCR | + |
| E-cadherin | Mattila et al.[47] | 2008 | 70 OLP | IHC, static DNA cytometry | - |
| | Neppelberg and Johannessen[53] | 2007 | 7 NM, 45 OLP* | IHC | - |

MMP: Matrix metalloproteinases; PCNA: Proliferating cell nuclear antigen; OLP: Oral lichen planus; NM: Normal mucosa; EH: Epithelial hyperplasia; ED: Epithelial dysplasia; SCC: Squamous cell carcinoma; OSCC: Oral squamous cell carcinoma; NM: Normal mucosa; IHC: Immunohistochemistry; RT-PCR: Reverse transcription polymerase chain reaction

As shown in those tables, the main result of the reviewed studies denotes the significant existence of a particular marker in OLP. Table 1 shows the collected data for seven markers repeated in more than two studies: p53, cyclooxygenase-2 (COX-2), Ki67, B-cell lymphoma-2 (Bcl-2), Bax, p21, and caspase-3.

**Table 3.** Markers repeated in one study

| Author | Year | Marker(s) | Detection of marker in OLP |
|---|---|---|---|
| Rivarola de Gutierrez et al.[63] | 2014 | CK1 | - |
| Chen et al.[44] | 2008 | TIMP-2, TGF-b1 | + |
| Cheng et al.[23] | 2014 | DUSP1; H3F3A; OAZ1;S100P; SAT1 | + |
| Cheng et al.[24] | 2011 | ET-1 | + |
| Czerninsk et al.[27] | 2013 | SCCA | + |
| Czerninsk et al.[27] | 2013 | TPS, VEGF | - |
| Danielsson et al.[28] | 2011 | miR-26b | + |
| Gonzalez Moles et al.[29] | 2009 | SP, NK-1R | + |
| Hakkinen et al.[36] | 1999 | Integrin a9 subunit, tenascin | + |
| Li et al.[40] | 2013 | CXCL9 | - |
| Ma et al.[43] | 2013 | Bmi1 | + |
| Mattila et al.[46] | 2007 | CK-19 | - |
| Mattila et al.[46] | 2007 | Topoisomerase II | + |
| Mattila et al.[47] | 2008 | cdk-1, Rad-51 | - |
| Mattila et al.[47] | 2008 | desmocollin-1 | + |
| Montebugnoli et al.[49] | 2011 | p16INK4A | - |
| Nafarzadeh et al.[51,52] | 2013 | Smad3 | + |
| Oliveira Alves et al.[56] | 2013 | SUMO-1 | - |
| Oliveira Alves et al.[56] | 2013 | MDM2 | + |
| Pimenta et al.[58] | 2004 | hMSH2 | + |
| Poomsawat et al.[59] | 2011 | cdk6 | - |
| Poomsawat et al.[59] | 2011 | cdk4, p16 | + |
| Prodromidis et al.[60] | 2013 | p-Akt, p-mTOR, phospho-pS6 | + |
| Rhodus et al.[62] | 2005 | NF-Kb, TNF-a, | + |
| Rivarola de Gutierrez et al.[63] | 2014 | CK13, CK14 | - |
| Segura et al.[66] | 2013 | MYC status | + |
| Shi et al.[67] | 2010 | Podoplanin, ABCG2 | + |
| Sun et al.[70] | 2013 | CD133 | + |
| Thongprasom et al.[72] | 1998 | Telomerase activity | + |
| Valente et al.[73] | 2000 | MIB-1 | - |
| Xu et al.[74] | 2013 | ALDH1 | + |
| Zhang et al.[76] | 1997 | LOH | + |

OLP: Oral lichen planus; OLL: Oral leukoplakia; OLR: Oral lichenoid reaction; NM: Normal mucosa; OSCC: Oral squamous cell carcinoma; EH: Epithelial hyperplasia; ED: Epithelial dysplasia; OED: Oral epithelial dysplasia; MED and SED: Mild; moderate and severe epithelial dysplasia; OFK: Oral focal keratosis; WOSCC and POSCC: Well-differentiated and Poorly-differentiated OSCC; NC: Non-conclusive; OM: Oral Mucositis; IHC: Immunohistochemistry; ELISA: Enzyme-linked immunosorbent assay; RFLP: Restriction fragment length polymorphism; RT-PCR: Reverse transcription polymerase chain reaction; RIA: Radioimmunoassay

It is important to note that these markers were highlighted in 45 studies. The marker studied most often was p53 (in 12 studies). The markers that were least often studied were p21 and caspase-3 (in four studies). The markers that were only repeated in two studies are listed in table 2. The markers that were only repeated in one study are presented in table 3.

## Discussion

This review focused on the most frequent molecular markers of OLP malignancy, which were examined in 66 articles, and reported on the frequency of these markers. Based on those 66 studies, there were seven principal markers for malignant transformation: p53, COX-2, Ki67, Bcl-2, Bax, p21, and caspase-3.[12-77]

p53 is the maker that is most frequently investigated in the studies in this systematic review. In the normal development of a cell, the p53 protein level is low because it has a short half-life; otherwise, in situations in which a cell can tolerate additional pressure the production of this marker saves the cell and it would not prevent apoptosis. The wild-type p53 protein has an opposite effect on cell proliferation, and it can inhibit the cell cycle process between the G1 and S phases. It has been shown that the p53 mutation increases proliferative activity; the expression of this protein is altered in OSCC and in potentially malignant oral lesions.[13,15,38,39,73] COX-2 and Bcl-2 (the second most frequent markers found in this systematic review) are important factors in inflammation and carcinogenesis. Overexpression of COX-2 is indicated in cancer development, including invasion, metastasis, angiogenesis, and other cancer-related steps. The increased expression of COX-2 has been reported in pre-cancerous lesions, including squamous cell carcinoma and OLP.[12,26,28,40,42]

The Bcl-2 protein is responsible for translocation in follicular lymphoma. Bcl-2 could protect cells against apoptosis. Bcl-2 is located in the inner mitochondrial membrane, and to a lesser extent in the nuclear membrane and the endoplasmic reticulum. Bcl-2 activity correlates with p53 because its expression prevents apoptosis. Cell proliferation and apoptosis are altered in the carcinogenesis process. Bcl-2 and Bax have an important role in this alteration. Therefore, any altered expression and function of Bcl-2 and Bax could be an indicator of malignant transformation in a lesion. This mechanism has been described for oral cancer.[30,34,39,52] in the present study, the expression of Ki67 was ranked fourth in terms of its effect on the creation of precancerous and cancerous oral lesions. It has been described that Ki67 has an effect on the active phases of a cell cycle (G1, S, G2). Its expression rate depends on cellular proliferation. It might be promising as a first index of malignancy.[13,46] p21 tumor suppressor genes produce the p53 protein. p21 induces suppressive outcome on the function of cyclin-dependent kinase. This enzyme plays a controlling role in G1 to S phase (cell cycle). It has been shown that p21 overexpresses in oral epithelial dysplastic lesions and OSCC. Therefore, this gene expression could be used to identify the prognosis of oral malignancy.[65] Apoptosis is a defensive factor. It might protect cells from malignant transformation. The process of apoptosis depends on many molecular effecters. Caspase-3 is involved in proteolysis, and this special factor leads to the activation of apoptosis.[17]

In almost all the reviewed studies, the case group consisted of a number of cases with the diagnosis of lichen planus, unlike the control groups that showed a remarkable diversity of diseases, including oral leukoplakia, OSCC, oral epithelial dysplasia, and epithelial hyperplasia as well as normal mucosa. The wide clinical and histological spectra of these entities in the control groups are significant. Safadi et al.[65], Zargaran et al.[75] and Lee et al.[38] divided their studied patients into five groups. Nevertheless, it seems that comparing more than two groups in one study causes

complexity in the data interpretation. Significantly, studies, such as those conducted by Bascones-Ilundain et al., have examined the high-risk clinical view of lichen planus (atrophic-erosive) for malignancy.[17-19]

In the present study, review of the 66 articles also found a notable diversity in the sample sizes, ranging from 14 to 70 cases for OLP in the examined studies. It seems that using the average number from that range (almost 40 cases of lichen planus) is reliable.

As shown in tables 1 and 2, the reviewed articles used eight different diagnostic methods to determine the presence of the molecular markers mentioned in their samples. These eight methods included immunohistochemistry (IHC), Enzyme-linked immunosorbent assay (ELISA), Restriction fragment length polymorphism (RFLP), Reverse-transcription polymerase chain reaction (RT-PCR), double-antibody radioimmunoassay (RIA), Western blot, the Terminal deoxynucleotidyl transferase dUTP nick-end labeling (TUNEL) assay, and static DNA cytometry. IHC was the primarily used method (45 out of 66 studies). The influence that using a specific test had on the result of the studies is unclear. Abdel Hay et al.[12] were the only researchers who used RFLP and RIA, and Agha-Hosseini and Mirzaii-Dizgah exclusively utilized ELISA in their study.[14] Some researchers, such as Danielsson et al.[28] and Abdel et al.[12] used three different techniques in one study; however, the advantage of this approach is unclear.

Giacomelli et al.[8] studied the relationship between OLP and OSCC in a new way using the leader genes approach. In this method, the data search for genes involved a specific process done systematically. Then, the data are ranked based on the number of interconnections with the other identified genes. This suggests that some key genes and encoded proteins are possibly involved in the malignant potential of OLP;[8] hence, that study has a good agreement with the findings of this study.

One of the limitations of this study was that the collected data could not be pooled due to different methods that were used and the study groups that were examined; thus, there was not a possibility to carry on a meta-analysis.

## Conclusion

The present study concluded that several molecular alterations, including p53, COX-2, Ki67, Bcl-2, Bax, p21, and caspase-3, which are involved in pre-neoplastic alterations, are measurable in OLP. It seems that three factors have serious implications for the lack of agreement in this field of research: 1) using different diagnostic tests, 2) choosing different numbers for the sample sizes, and 3) considering miscellaneous features for the case and control groups. To identify a definite relationship, we suggest further studies on both the most possible and the uncertain groups of molecular markers in this field.

## Conflict of Interests

Authors have no conflict of interest.

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# Evaluation of mothers' awareness about early childhood caries in Yasuj, Iran, 2015-2016

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**Original Article**

## Abstract

**BACKGROUND AND AIM:** Early childhood caries (ECC) is a multifactorial disease and several factors are implicated in its establishment. Considering the numerous problems those children with ECC face and the important role of parents in preventing them, the aim of this study was to evaluate the mothers' awareness about ECC in Yasuj, Iran.

**METHODS:** It was a cross-sectional study. The study population included 384 mothers of children below 6 years, who were randomly selected from the children referring to 4 urban health care centers. The data were collected using a 30-item questionnaire to assess mothers' awareness about definition, diagnosis, prevention, and treatment of ECC. The face and content validities of the questionnaire were confirmed by pediatric dentists and experts in questionnaire design. Its reliability was confirmed with a Cronbach's alpha of 0.73. Descriptive (mean, standard deviation, frequency) and analytic statistics (Spearman correlation coefficient) were used for data analysis.

**RESULTS:** The mean age of children was 2.45 ± 1.46 years while the mean age of mothers was 29.71 ± 5.04 years. Almost half of the mothers had high school education, while others had higher degrees. Mothers' awareness about ECC was poor in 20.8% of the cases, moderate in 62.2% of the cases, and good in 16.9% of the cases. It was observed that mother's awareness about ECC had statistically significant direct relationships with both mother's age and education. Based on multivariate linear regression, mother's age ($\beta = 0.17$, $P = 0.0001$) and their education ($\beta = 0.20$, $P = 0.0001$) had significantly direct relation with mother's awareness, too.

**CONCLUSION:** Considering the undesirable ECC awareness level in the majority of Yasujian mothers and its association with mothers' educations, the implementation of interventions to increase mothers' awareness seems essential in this regard.

**KEYWORDS:** Dental Caries; Awareness; Mothers

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Tooth decay in toddlers and preschool children is called early childhood caries (ECC), which refers to the existence of one or more decayed surfaces (with or without cavity), lost surfaces (due to caries), or restored deciduous teeth in children 71 months or younger.[1]

ECC is a serious problem worldwide which affects infants' and toddlers' teeth in all communities and is becoming a global problem in many countries.[2,3] ECC leads to pain and dental abscess, reduced growth due to reduced ability to chew, low self-esteem due to anterior tooth decay, reduced chewing ability, reduced speaking ability, and malocclusion. On the other hand, these children do not cooperate when being treated, and dentists are also less willing to treat 1-5-year-old children with ECC. Treatment of

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such caries is carried out under general anesthesia imposing high costs. Infants and toddlers do not have control on maintaining their oral hygiene and prevention of caries, making them prone to ECC at this age. This makes the role of parents very important so that some studies attribute the high prevalence of this disease to poor awareness and attitudes of parents towards ECC.[4]

Improving health literacy in a population should be looked at as a desired outcome to a successful health promotion program. Such outcomes involve more than health information transmission. Therefore, developing an effective oral health promotion strategy in any given community must be based on an in-depth understanding of the unique needs of the population.[5]

A simple assessment of the knowledge level may be the first step in identifying areas of weakness. Since limited studies have been so far conducted on mothers' awareness in this regard in Iran, the present study was aimed at assessing the mothers' awareness level on ECC in Yasuj, Iran.

The results can be used in educational and health care plans so that in case of low awareness, proper strategies can be developed to raise mothers' awareness about the disease and its complications.

## Methods

It was a cross-sectional study and its protocol was approved by the ethics committee of Yasuj University of Medical Sciences (93.12.25.06). After receiving a letter from the Provincial Health Center, all 4 urban health centers were visited in Yasuj, and the list of children younger than 6 years was extracted from the records in coordination with the family health experts. Sample size was calculated via proportion formula using p = 20%, d = 0.2 P and α = 0.05. Ninety-six children younger than 6 years were randomly selected from each center based on a computer generated random number table. Totally, 384 samples were selected. The mothers of the children were contacted via phone to visit the center. The inclusion criteria for mothers included literacy. Incomplete questionnaires were excluded and another participant was replaced. After taking written informed consent from mothers, the data were collected using a 30-item researcher-made questionnaire to assess the mothers' awareness about definition, diagnosis, prevention and treatment of ECC. The face and content validities of the questionnaire were confirmed by pediatric dentists and experts in questionnaire design. Prepared questionnaire was completed by 96 referred mothers (25% of calculated sample size) to urban health centers. Then reliability was calculated and confirmed with a Cronbach's alpha of 0.73. Two items were on definition, 16 were on causes, 6 were on prevention, and 6 were on treatment. To answer the items, three choices of "true", "not true", and "I don't know" were considered. One point was given for each correct answer, and zero point was given for each wrong answer. The "I don't know" choice was also scored zero. A total score of 0-10 was considered low awareness while a score of 11-20 was considered moderate awareness, and a score of 21-30 was considered high awareness (total score of 30 was divided to 3 categories).[6] SPSS software (version 21, IBM Corporation, Armonk, NY), descriptive statistics (mean, standard deviation, frequency), and analytic statistics [Spearman correlation coefficient: mothers' ages did not follow a normal distribution (P = 0.0001) and education is an ordinal variable] were used for data analysis. P-value < 0.05 was considered the significance level.

## Results

Total of 384 children younger than 6 years old with their mothers were enrolled in the study. Demographic characteristics of the children and their mothers are shown in table 1.

The minimum and maximum ages of children were 1 and 6 years, respectively. Minimum and maximum ages of mothers were 17 and 47 years, respectively.

**Table 1.** Demographic characteristics of children and their mother

| Variables | Descriptive |
|---|---|
| Age of children (year) (mean ± SD) | 2.45 ± 1.46 |
| Sex [n (%)] | |
| Girl | 185 (48.2) |
| Boy | 199 (51.8) |
| Age of mother (year) (mean ± SD) | 29.71 ± 5.04 |
| Education of mothers [n (%)] | |
| Illiterate | 58 (15.1) |
| Sub diploma | 127 (33.1) |
| Diploma and technician | 61 (15.9) |
| Bachelor | 115 (29.9) |
| Master | 23 (6.0) |

SD: Standard deviation

The average score of mothers' awareness was 1.26 ± 0.63 regarding ECC definition; 8.26 ± 2.91 regarding causes of decay; 2.50 ± 1.37 regarding methods of prevention of caries; and 2.96 ± 1.99 regarding treatment of ECC. The mean total score of mothers' awareness about ECC was 15.03 ± 5.20.

Regarding the level of awareness, 80 mothers (20.8%) had poor awareness, 239 (62.2%) had moderate awareness, and 65 (16.9%) had a good awareness (Figure 1).

A statistically significant direct relationship was found between mothers' age and their awareness about ECC according to Spearman test (P < 0.0010, r = 0.17). A statistically significant direct relationship was also found between mothers' education and their awareness about ECC according to the Spearman test (P < 0.0010, r = 0.21).

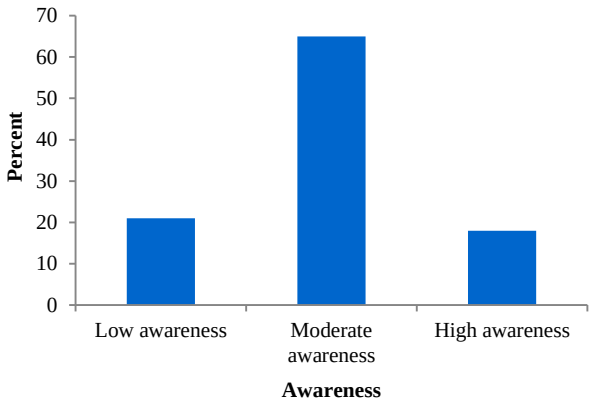



**Figure 1.** Frequency of level of mothers' awareness about early childhood caries (ECC)

Based on multivariate linear regression, mother's age (β = 0.17, P = 0.0001) and their education (β = 0.20, P = 0.0001) had significantly direct relation with mother's awareness, too. The frequency of correct and wrong answers to items can be seen in figure 2.

## Discussion

There was a significant relationship between mothers' awareness about ECC and their education and also there was a significant relationship between mothers' awareness about ECC and their age. In other words, awareness increased with age and education, a fact which is consistent with the study conducted by Hallet and O'Rourke.[7]

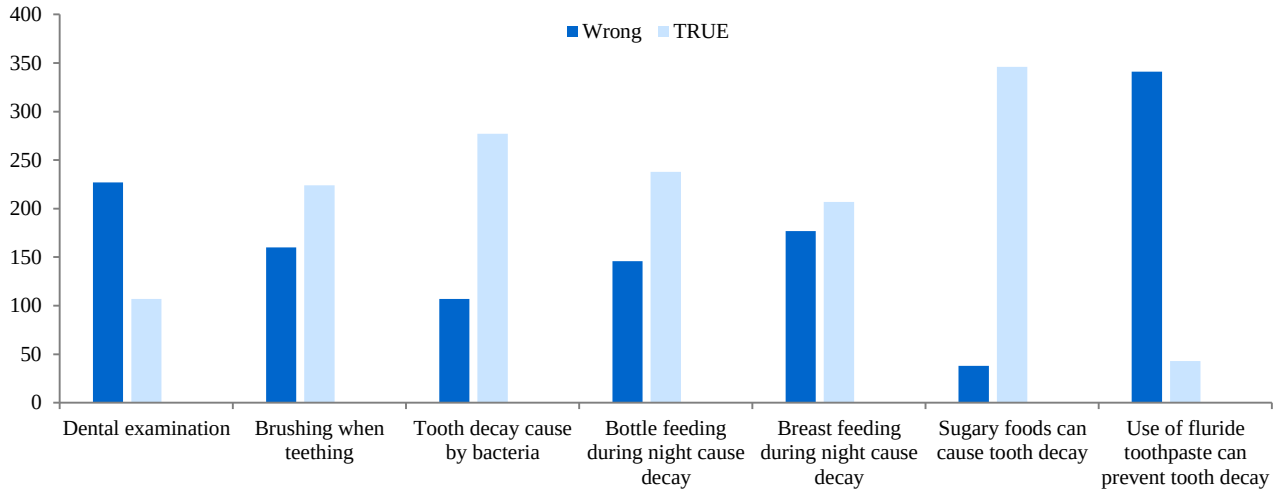



**Figure 2.** Frequency of mother's response to the questionnaire by each item

The total mothers' awareness score regarding ECC was good in 20.8% of the cases, moderate in 62.2% of the cases, and poor in 16.9% of the cases. In a similar study in Malaysia, the total awareness of participants regarding ECC was suitable, indicating the need for raising mothers' awareness in the pregnancy period regarding the importance of deciduous teeth and ECC. The raised awareness in Malaysia is attributed to the oral health trainings and promotions through school dental services, prenatal clinics and other approaches implemented by the Malaysian Ministry of Health.

Awareness programs should be developed for mothers to encourage them to seek preventive primary teeth health care. The emphasize should be on the possible consequences of decay, improper cleaning, and prolonged use of sweets. Also it should be extended to school teachers, provincial health centers, radio/TV so that they can educate mothers. It is recommended to seek professional oral health counseling programs as soon as possible especially as soon as or before the primary teeth start to erupt.

Cleaning the gums pad before teething and brushing the teeth after teeth eruption is recommended at least once a day.[8,9] Mothers' awareness of these issues was 71.4% and 58.3% respectively. In a study examining knowledge and attitude of 102 parents towards the prevention of ECC in Malaysia, 92.2% of participants believed that cleaning the child's teeth after feeding should be started before teething, and 97.0% believed brushing affects children's oral health.[10] Compared to that study, the awareness of participants in present study about cleaning teeth before and after teething was lower.

The best time for children' dental examination is at ages younger than 12 months or at least 6 months after the first deciduous tooth erupts.[9,11] In the present study, 72.1% of mothers did not agree with examinations before the age of 1 year, and 54.4% stated dental examinations are not necessary unless the baby's teeth hurt. In another study, half of the participants believed that children younger than the age of 3 years should be examined by a dentist, whereas 78.0% stated that children younger than the age of 1 year do not need dental examination.[8] In the study by Mani et al., 22.0% of the parents believed that one-year-old children should be examined by a dentist,[10] whereas 25.0% stated that dental examinations were not necessary unless the baby's teeth hurt.[9] The awareness of participants in present study regarding dental examination before the age of 1 year was similar to the previous studies. Two main reasons for not visiting the dentist are dental phobia and also high costs of dental treatment.[5]

As mentioned before, the Streptococcus mutans bacterium is the main cause of tooth decay with two main ways of transmission: vertical or horizontal. In the vertical transmission, bacteria are transmitted to the baby's mouth from saliva of a nurse or mother.[12,13] In a question on the role of bacteria in dental caries, 72.1% of mothers knew about this issue; however, only 34.9% knew about the transmission of bacteria through kissing their children, whereas 33.6% knew about the transmission of bacteria through tasting food by the mother and feeding the child. Thirty-three percent of mothers in Romania,[14] and 35.0% in China[15] believed that bacteria were the cause of tooth decay. Participants in the present study a had higher awareness about the role of bacteria in tooth decay; however, like previous studies, parents had poor awareness about decay transmitting behaviors, which necessitates educating parents regarding the behaviors which can transmit the bacteria responsible for dental caries.

Low-fluoride toothpastes at a pea-sized amount are recommended for children under 2-3 years.[9,11] In this study, 57.3% of mothers did not believe in the use of toothpaste in children lower than 3 years, while only 11.2% believed that fluoride toothpaste could prevent dental caries. In a study by Gussy et

al., 74.0% of mothers believed that fluoride toothpaste could prevent tooth decay but did not know whether or not it should be used for a toddler. In another study, 85.3% of participants believed that fluoride toothpastes were important in preventing dental caries.[16,17] Compared to previous studies, awareness about the role of fluoride in preventing dental caries was lower in our study. The reason for poor knowledge and low value regarding preventing dental caries in primary teeth was not understood. It might be due to beliefs or cultural based opinions.

With respect to the role of bottle and breast feeding in case of long and continuous use by children, 62.0% of the mothers believed that prolonged bottle feeding during the night caused dental caries, whereas 57.0% believed that prolonged bottle feeding during the day caused dental caries. In total, 53.9% believed that breast feeding during the night sleep could cause dental caries. In another study, 51.0% of mothers agreed that bottle and breast feeding caused dental caries, whereas 64.0% believed that bottle and breast feeding during the day could not cause dental caries in children.[8] In a study conducted by Mani et al., 71.0% of mothers stated that prolonged bottle and breast feeding during the night did not cause dental caries. It can be concluded that awareness about dental caries due to bottle and breast feeding was higher in the present study compared to the previous studies.[10]

In total, 90.1% of mothers believed that sweet foods cause dental caries, 88.5% believed that carbonated beverages caused dental caries, and 76.0% believed that bottles juices caused dental caries, while in the study by Mani et al., 97.0% of the parents knew about the role of sweet foods and beverages in dental caries, indicating a high awareness in this regard.[10] In the current study, 64.8% of mothers believed that iron drop caused dental caries, and 41.4% of them believed that iron drop only discolored the child's teeth and did not cause dental caries. In a study conducted by Talebi et al., 88.6% of parents knew that iron drop would change the teeth color, and 38.9% confirmed the connection between iron drop and dental caries, showing that many parents would mistake the blackening of teeth for tooth decay.[18] The participant in the present study had lower awareness levels in this regard compared to Talebiet al.'s study.[18]

Research shows that the most common reason why parents do not give iron drops to children or give it irregularly is that they believe iron drops cause dental caries, whereas iron deficiency and iron deficiency anemia is a major public health problem in Iran with the most vulnerable groups of children under 2 years. On the other hand, a recent study conducted by Esmaeilzadeh et al., showed that not only iron would cause dental caries, but also it would have a preventive and inhibitor effect against it.[19] Therefore, healthcare services should provide parents with information about the importance of this vital element, teeth discoloration following iron drop consumption, ways to prevent blackening of children's teeth, as well as the misconception regarding the association between dental caries and iron drops.

## Conclusion

The results of the present study showed Yasujian mothers' awareness about the risk factors associated with ECC was insufficient. Raising awareness is critical as a prerequisite for changes in behavior and prevention of ECC. Since the population living in Yasuj contributes to a small portion of the Iranian population, similar studies should be carried out on larger populations in Iran.

## Conflict of Interests

Authors have no conflict of interest.

## Acknowledgments

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# Evaluation of halitosis using Halitosis Associated Life Quality Test questionnaire and the Etiquette checker device

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**Original Article**

## Abstract

**BACKGROUND AND AIM:** Halitosis is an unpleasant disorder and a common phenomenon in people. The study aim was evaluation of halitosis using Halitosis Associated Life Quality Test questionnaires (HALT) and the Etiquette checker device.

**METHODS:** The questionnaires were given to 345 individuals who referred to the Kerman Dental School and dental clinics, Kerman, Iran. At the same time, their halitosis was evaluated by Etiquette checker device. T-test analysis, chi-squared, one way analysis of variance, Fisher's exact test and SPSS were used.

**RESULTS:** The prevalence of halitosis was 54%. The analysis of the collected data showed that halitosis in women was more than men (P = 0.86), this disorder was more in individuals older than 35 in comparison with younger people (P = 0.01). This study showed that a significant relationship existed between the HALT score and the Etiquette score.

**CONCLUSION:** There was a significant relation between self-estimated halitosis and higher Etiquette score, therefore HALT questionnaire can be a valid device for evaluating the life quality especially for halitosis.

**KEYWORDS:** Halitosis; Questionnaire; Life; Quality

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Bad breath, also called halitosis in medical terminology, and oral malodor is an unpleasant disorder that most of the people try to avoid. Halitosis is an unpleasant smell that with expiration comes out through the mouth or nose.[1,2] The principles of biochemistry and the pathogenesis of halitosis were determined by Tonzetich.[2]

The epidemiological research about halitosis must be continued because it is still an important yet underrated taboo. The differences in racial and cultural recognized of smell for patients and researchers cause the lack of scientific data. Halitosis prevalence has a wide range in the world, about 50% in the USA and between 6% to 23% in China.[3-7] Halitosis is a multi-factorial disorder that is divided to genuine halitosis, halitophobia and, pseudo-halitosis.[4,5] Dentists estimate that only 25% have real halitosis and the other 75% have halitophobia.[8,9] The aim of this study was to evaluate halitosis using Halitosis Associated Life Quality Test (HALT) questionnaire and Etiquette checker device.

## Methods

This study was descriptive-analytic and cross-sectional. First, based on defined standard procedures of methodology, the HALT questionnaire was translated. Accordingly, first two bilingual translators

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translated the texts separately and faithfully into Persian so that it met English grammatical and vocabulary standards and also the intentions of the source texts. For cases where preserving a literal translation of the source text disrupted the meaning of a questionnaire item, conceptual translation was used. Then, two bilingual individuals who were blind to the English questionnaire were asked to back translate the Persian questionnaire into English. Next, the final texts were compared with the source text and if there were any inconsistencies, we referred to the translators to discuss the matter and agree upon a more accurate translation. The Persian questionnaire were then finalized.[10]

The validity of this study was determined using the content validity index before data collection. In order to achieve validity, the questionnaire was submitted to 6 specialists in Kerman Dental School, Kerman, Iran, who were asked to give their opinion on the questions based on the options perfect, good, no idea, poor and very poor. After collecting and evaluating the comments, discussions were held about the questions and the comprehensibility of the questions. Based on dentists' views and review of the literature, the validity of the questionnaire was satisfactory. Validity of the questionnaire was 79% and validity of the questions ranged from 77% to 89%. Reliability coefficients were determined by submitting the questionnaire to 10 patients within an interval of 10 days. The patients were asked to respond to questions. Reliability coefficient was determined using Cronbach's alpha (α = 0.70), which proved satisfactory.

HALT questionnaire has several advantages including a simple scale making it easy and quick to use. The summation of this questionnaire can be in percentage so it could be easier to grade and quicker to understand the patients status for both the practitioner and the patient. This tool is easy to read as well as to fill out.[11] This questionnaire consists of 18 statements, to which the respondents indicate their level of agreement on a 5-point scale regarding how they feel at a given moment (1 = never, 2 = rarely, 3 = sometime, 4 = often, 5= always). The potential scores range from 18 to 90, with high scores representing high levels of halitosis associated life quality. Next, the questionnaire was distributed among 345 individuals who were patients and those who were with them, who had referred to the dentistry department or dentistry clinics throughout Kerman. Before conducting the examination, willing participants were asked to fill in questionnaire that held their agreement to the terms of the present study both written and orally (k: 214/92).

The inclusion criteria was age 18 years and above. The participants were not allowed to use deodorants or alcohol one week before performing the examination. Also, 24 hours before performing the exam the patients were not allowed to eat or drink anything that held essence, garlic, or onions in it, 2 hours before the examination the patients were asked to avoid eating and drinking anything but water, and also they were asked to not use scented cosmetics. Patients could be brush their teeth regularly.

The participants were examined during 8 AM until 12 PM and their halitosis was measured by the Etiquette system [Topland Etiquette Checker, Size:110 × 30 × 18 mm, weight: 52 g, material: ABS plastic, power: AAA battery × 2 (included), Sasli Boor Factory, Tokyo, Japan] (Figure 1) and the results were marked from 1 to 6 indicating: 1 = without halitosis, 2 = very mild halitosis, 3 = mild halitosis, 4 = moderate halitosis, 5 = intensive halitosis, 6 = severe halitosis.




**Figure 1.** Etiquette Topland Co., Japan

T-test analysis, chi-squared, one way analysis of variance, and Fisher's exact test were used. SPSS for Windows (version 21, IBM Corporation, Armonk, NY) was used to analyze the data. Values of $P < 0.05$ were considered significant.

## Results

Among the 345 participants of the study, 210 (50.8%) were female, and 135 (39.2%) were male. The mean age of the patients was 35.23 ± 8.50 (Table 1).

**Table 1.** Demographic data of participants

| Variables | n (%) |
|---|---|
| Gender | |
| Male | 135 (39.2) |
| Female | 210 (50.8) |
| Age (year) | |
| ≤ 20 | 25 (7.2) |
| 21-30 | 25 (7.2) |
| 31-40 | 128 (37.1) |
| 40-50 | 89 (25.8) |
| 51-62 | 78 (22.7) |
| Smoking | |
| Yes | 41 (12.0) |
| No | 304 (88.0) |
| Brushing | |
| Yes | 317 (92.0) |
| No | 20 (6.0) |
| Dental floss | |
| Yes | 113 (33.0) |
| No | 225 (65.0) |

According to their own statement, 186 participants (54.0%) suffered from halitosis (94 women and 92 men). Among 49 healthy individuals, nine (18.4%) reported having a problem with halitosis ($P < 0.001$) (Table 2).

Halitosis was observed to be more in women than in men ($P = 0.860$); and in the participants who were above 35 years of age ($P = 0.010$) in comparison to the younger participants (Figure 2); and in the smokers ($P = 0.001$). Participants who used dental floss and those who brushed their teeth at least once per day had less halitosis than those who did not brush or brushed on an irregular basis. ($P = 0.010$ and $P = 0.030$ respectively).

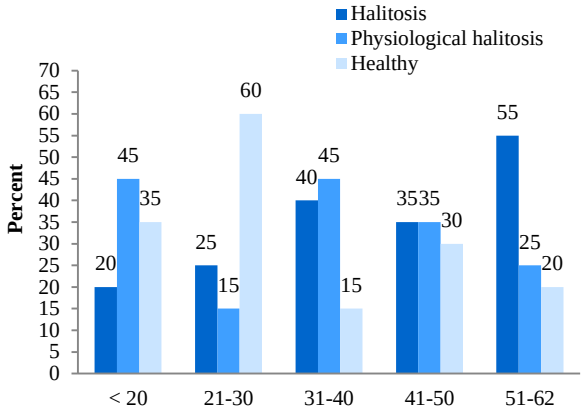



**Figure 2.** Distribution of respondents by clinical diagnosis and age groups

Halitosis = average level of Etiquette checker device was ≥ 4; Physiological halitosis = average level of Etiquette checker device was > 1 and < 4; Healthy = level of Etiquette checker device was ≤ 1.

Halitosis and its acuteness were measured by Etiquette checker device and the results are demonstrated in table 3. The results show that 24.0% of individuals, who according to their own statements did not have bad breath, gained a score higher or equal to 3 with the Etiquette checker.

**Table 2.** Self-evaluation of respondent's bad breath

| Do you have problem with bad breath? | | | | | |
|---|---|---|---|---|---|
| Patients' answers* | | | | | |
| Clinical diagnosis | Yes, often n (%) | Yes, sometimes n (%) | No, rarely n (%) | No, never n (%) | Total n (%) |
| Halitosis | 70 (37.6) | 100 (56.2) | 10 (5.6) | 6 (0.6) | 186 (100) |
| Physiological halitosis | 5 (4.5) | 30 (27.3) | 50 (45.5) | 25 (22.5) | 110 (100) |
| Healthy | 4 (8.2) | 5 (10.2) | 10 (20.4) | 30 (61.2) | 49 (100) |
| Total | 79 (22.9) | 135 (39.1) | 70 (20.3) | 61 (17.7) | 345 (100) |

*Chi-square test = 95.25, P = 0.001

Halitosis = average level of Etiquette checker device was ≥ 5; Non-physiological halitosis = average level of Etiquette checker device was ≥ 4; Physiological halitosis = average level of Etiquette checker device was > 1 and < 4; Healthy = level of Etiquette checker device was ≤ 1.

**Table 3.** Halitosis status in the participants using Etiquette device

| Etiquette degree | Halitosis, according to the person opinion | | |
|---|---|---|---|
| | Yes | No | Total |
| | n (%) | n (%) | n (%) |
| One | 10 (5.38) | 100 (62.90) | 110 (31.88) |
| Two | 12 (6.45) | 21 (13.21) | 33 (9.57) |
| Three | 85 (45.70) | 20 (12.58) | 105 (30.44) |
| Four | 47 (25.27) | 8 (5.03) | 55 (15.94) |
| Five | 10 (5.38) | 5 (3.14) | 15 (4.35) |
| Six | 22 (11.83) | 5 (3.14) | 27 (7.83) |
| Total | 186 (100) | 159 (100) | 345 (100) |

The average score gained by the participants was 58.5 ± 2.5 (men 52.3 ± 3.6 and women 58.7 ± 1.9). The highest average was for items 4 and 5 and the lowest was for items 2 and 3 (Table 4). This study showed a significant relationship between the HALT test score and the score given by the Etiquette checker. On each scale level, the mean HALT scores and standard deviations were calculated (Table 3). The mean HALT scores were significantly associated with the scales of Etiquette checker test (F = 125, P = 0.001; r = 0.96, P = 0.001) (Table 5). This study showed that the sensitivity and specificity of this questionnaire were 92.8% and 85.1% respectively.

## Discussion

The Etiquette checker is a small portable device that its specify and sensitivity was approved by Kakoei et al.[12] These authors showed that Etiquette checker had acceptable sensitivity and specificity for detection of oral malodor and, this device could be used in future epidemiologic studies. In addition, Brunner et al.[6] estimated the correlation between organoleptic method and the devices used for measuring halitosis such as Halitox, Fresh Kiss, and Halimeter in 2010. The result showed that the measures from Halimeter and Halitox had a high correlation with organoleptic method.[6]

This study showed that 54% of the individuals suffered from self-reported halitosis. In a study by Talebi Ardakani et al.[13] halitosis prevalence was 27.8% that was compatible with other studies.[14,5]

**Table 4.** Relative and absolute frequency of the answers to the Halitosis Associated Life Quality Test (HALT) questions in participants

| Question | Always n (%) | Often n (%) | Sometime n (%) | Rarely n (%) | Never n (%) |
|---|---|---|---|---|---|
| Mouth breathing | 15 (4.35) | 10 (2.90) | 28 (8.12) | 120 (34.78) | 172 (15) |
| Recurrent infection of the tonsils | 10 (2.90) | 10 (2.90) | 10 (2.90) | 300 (86.96) | 15 (10) |
| Frequent sinus infections | 25 (7.25) | 30 (8.70) | 15 (4.35) | 200 (57.97) | 75 (25) |
| Worried about bad breath | 45 (13.04) | 55 (15.94) | 10 (2.90) | 205 (59.46) | 30 (45) |
| Anxiety because of bad breath | 55 (15.94) | 40 (11.59) | 25 (7.25) | 100 (28.99) | 125 (55) |
| Difficulty in chewing or limiting certain foods because of bad breath | 35 (10.14) | 25 (7.25) | 20 (5.80) | 120 (34.78) | 145 (35) |
| Change in the taste of food and beverages due to bad breath | 28 (8.12) | 15 (4.35) | 10 (2.90) | 124 (35.94) | 168 (28) |
| Difficulty speaking (or covering the mouth) because of bad breath | 30 (8.70) | 12 (3.48) | 10 (2.90) | 210 (60.87) | 83 (30) |
| Affecting the appearance because of halitosis | 22 (6.41) | 12 (3.48) | 15 (4.35) | 280 (81.16) | 16 (22) |
| Depression and isolation because of bad breath | 10 (2.90) | 10 (2.90) | 17 (4.93) | 300 (86.96) | 8 (10) |
| Trouble concentrating because of bad breath | 12 (3.48) | 15 (4.35) | 21 (6.09) | 290 (84.06) | 7 (12) |
| Embarrassment for halitosis | 12 (3.48) | 10 (2.90) | 12 (3.48) | 300 (86.96) | 11 (12) |
| Loss of time (waste of time) to halitosis | 25 (7.25) | 10 (2.90) | 15 (4.35) | 280 (81.16) | 15 (25) |
| Speaking from a distance because of bad breath | 10 (2.90) | 20 (5.80) | 35 (10.14) | 250 (72.46) | 30 (10) |
| Not wanting to go out because of halitosis | 10 (2.90) | 10 (2.90) | 25 (7.25) | 300 (86.96) | 0 (10) |
| Communication problems due to bad breath | 5 (1.45) | 5 (1.45) | 20 (5.80) | 250 (72.46) | 65 (5) |
| The pain of losing money because of bad breath | 10 (2.90) | 10 (2.90) | 25 (7.25) | 200 (57.97) | 100 (10) |
| Suffering due to loss of a social character/job because of bad breath | 10 (2.90) | 5 (1.45) | 25 (7.25) | 100 (28.99) | 205 (10) |

**Table 5.** The correlation between mean scores of Halitosis Associated Life Quality Test (HALT) questionnaire and evaluation of Etiquette device test (n = 345)

| Etiquette degree | n (%) | Scores of HALT (mean ± SD) |
|---|---|---|
| 1 | 110 (31.9) | 11.35 ± 21.07 |
| 2 | 33 (9.6) | 15.50 ± 28.28 |
| 3 | 105 (30.4) | 14.45 ± 38.90 |
| 4 | 55 (15.9) | 12.45 ± 54.25 |
| 5 | 15 (4.4) | 11.45 ± 67.20 |
| 6 | 27 (7.8) | 12.90 ± 65.12 |

F = 125, P = 0.001, Correlation coefficient (r) = 0.96, P = 0.001
HALT: Halitosis Associated Life Quality Test; SD: Standard deviation

Whereas Setia et al.[15] reported halitosis prevalence 45.0% in dentistry students. Studies done in Japan[16], America[17], France[18,19] showed similar percentages (42%, 45%, 41% and 41% respectively). The difference between the prevalence of self-perceived halitosis could be influenced by the age of the study group, difference in the expression of halitosis (in some of the cultures even a bit of smell could be known as halitosis), and the studied population.

Halitosis in women was more than men that is compatible with others studies.[13,16,12,20-24] Also, this disorder was more in individuals older than 35 years, and was also more in smokers than nonsmokers. Talebi Ardakani et al.[13] showed that there was no significant difference between halitosis and sex and increase in age. This was in contrast to results from Iwakura et al. study.[25]

In studies by Setia et al.[15], Almas et al.[4], Al-Atrooshi and Al-Rawi[3], incidence of halitosis in girls was reported lower than boys. These researchers showed that the prevalence of halitosis in smokers was more than nonsmokers that is in line with our study, and Tohidast Ekrad and Ghasemzadeh[14] showed aging increased halitosis. Nalcaci and Sonmez[26] reported that age was a considerable factor in the amount of volatile sulfur compounds (VSC). The increase in halitosis prevalence with aging could be due to less attention to oral hygiene, influence of systemic disease, taking multiple drugs that decreases saliva secretion and causes salivary gland atrophy, and increased xerostomia with aging.

In this study, it was shown that the individuals who used dental floss and those who brushed at least once a day, had more halitosis in comparison with the individuals who did not floss or brushed lesser, that is compatible with other studies.[2,7,13-15,27] In research done by Kakoei et al.[12], halitosis was higher in individuals who did not floss and brush their teeth compared to those who brushed and flossed, but this difference was not significant.

This study showed that the sensitivity of the present questionnaire was 92.8 and the qualification was 85.1% and it seems that the above mentioned questionnaire could be used as a screen for self-evaluation of halitosis in the individuals.

Iwanicka-Grzegorek et al.[28] conducted a study on halitosis. They distributed a questionnaire to ask the individuals' own personal opinion about halitosis and simultaneously each participant's halitosis was evaluated by a Halimeter and by using organoleptic procedure. The results showed that a significant relationship existed between the organoleptic procedure to recognize halitosis and the VSC level which was measured by a Halimeter.

The relation between the score achieved from HALT questionnaire and the procedure used by the Etiquette device has been evaluated for the first time in this study. The average score of the participants 58.5 ± 2.8. The highest average was for questions 4 (worried about bad breath) and 5 (anxiety because of bad breath), and the lowest average was for questions 2 (recurrent infection of the tonsils) and 3 (frequent sinus infections).

The results showed that there was a significant relation between HALT score and Etiquette score. The individuals with higher HALT score had a higher Etiquette score and stronger halitosis that is compatible with the Kizhner et al.[29] study.

## Conclusion

This study showed that HALT questionnaire can be a valid device for evaluating the quality of life especially for halitosis.

### *Limitations*

1. Small sample size
2. Checking of questionnaire with others tools such as organoleptic, gas chromatography.

## Conflict of Interests

Authors have no conflict of interest.

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# Evaluation of gustatory and olfactory function among premenopausal and postmenopausal women and men

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**Original Article**

## Abstract

**BACKGROUND AND AIM:** The sense of taste is a chemical sense which allows everyone to perceive the flavor of what is eaten or drunk. Also, the sense of olfaction is also a chemical sense contributing to the sense of taste to perceive the taste and flavor of food. In the present work, the gustatory and olfactory function in pre- and postmenopausal women and men were studied and compared to each other.

**METHODS:** Fifty postmenopausal women, 50 age-matched men, 50 young women and 50 young men were evaluated in this study and enrolled through simple sampling method. The aim of this study was explained for patients and in case of their consent, they were given the questionnaire. Taste threshold for each of the four main tastes for all of the participants in the study was determined at one step between 8 am to 11 am while they had not consumed any food since one hour before the test. The whole mouth taste method was used in this study. Also, the Davidson and Murphy tests were performed and the quality identification and intensity ratings of olfaction were measured.

**RESULTS:** Three individuals among the postmenopausal women group and 2 old men were not able to detect sweet taste even in high concentration; in the group of young men, one man was not able to detect bitter taste even in high concentration. This study showed that 2% of postmenopausal women and 4% of matched men were not able to detect the odor of isopropanol even at a concentration of 70% and there was a significant relationship between odor perception of isopropanol and olfactory intensity between the two groups of pre- and postmenopausal women as well as men.

**CONCLUSION:** Taste dysfunction directly influences nutritional status. In this study, the strength of the sweet taste perception was significantly lower among women after menopause; however, there was no significant difference between the perception of other tastes among postmenopausal women and men of same age.

**KEYWORDS:** Taste; Olfactory; Menopause

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The sense of taste is a chemical sense which allows everyone to perceive the flavor of what is eaten or drunk. This sense is of vital importance as it allows individuals to distinguish between harmful and deadly substances or undesirable and desirable foods.[1-3] The sense of taste is important for dentistry from two perspectives: first, taste is a stimulus for the secretion of saliva; and second, sweet taste is considered desirable for most of people. However, carbohydrates are the main cause of tooth decay.[4,5] The nature of certain chemicals stimulating the receptors of taste has not yet been completely identified. Physiology studies have identified at least 13 chemical receptors for perceiving taste. In general, the ability of mentioned receptors is categorized into four major groups, i.e. main types of taste including sour, sweet, salty and bitter.[6,7]

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Taste disorder among adults is very prevalent in many communities and it is considered as the most common oral sensory disorder following pain. The prevalence of taste disorder increases with age, and about 40% of those with this disorder are more than 65 years of age. In the United States, nearly 100000 people visit a dentist or doctor complaining about taste disorder annually. Taste disorders include a range of sensory disorders varying from incomplete perceiving to the loss of taste. Compared with males, females complain more about taste disorder. Taste disorder is multifactorial and menopause is considered as one of its factors.[8-14]

Olfaction is also a chemical sense contributing to the sense of taste to perceive the taste and flavor of the food. This sense is one of the most unknown senses for human, mostly due to the fact that the sense of olfaction is a subjective phenomenon which is not easy to study in lower animals. Changes in taste and olfaction make the food tasteless and therefore, the nutrition and quality of life could be endangered.[14] There is little information available concerning taste changes among postmenopausal women. The present study aimed to assess probable changes in taste and olfaction among pre- and postmenopausal women and compare it with men.

## Methods

This research was cross-sectional analytical study which was conducted among 200 patients in Kerman, Iran, who referred to the department of oral medicine in the School of Dentistry, offices and clinics of dentistry from October 2010 to January 2011. The method of sampling was simple. The purpose of the study was described to all the persons and after obtaining consent, they were given the questionnaire. All participants were informed of the purpose of the questionnaire and apprised that a decision to decline participation would not affect their medical care. A trained clinical assistant was available to respond to any questions or concerns.

Inclusion criteria included physical health and lack of systemic disease, absence of oral diseases and diseases affecting saliva such as Sjogren's syndrome, lack of taking any medication affecting saliva such as blood pressure medication, lack of upper respiratory tract infection such as common cold during the last 15 days, lack of smoking and drinking alcohol. Also, people should not have been under stress and or exposed to very cold weather. They were told not to use chewing gum, foods and drinks one hour prior to the study and to avoid eating spicy food from the night before and avoid applying perfume, cologne, any cream and soap, or any aromatic substance on their face, hands and their body on the day of study. About postmenopausal women, at least 6 months should have passed from the cessation of menstruation.[3,8,14]

All patients were studied by a researcher and a questionnaire[3,8,14] was completed for each patient. The purpose of the study was described to all of the participants and the questionnaire was distributed to them. In the meantime, all the individuals were assured of the confidentiality of the information of the questionnaire and that the information was used only for statistical analysis.

Before the experiments, each subject was given a questionnaire for taste function that included five general questions, five specific taste questions and three questions for women only as follows:

A. General questions:

1. Have you experienced a loss in taste?
2. How long have you had taste loss? Was the loss sudden or gradual?
3. What was the precipitating event for your taste problem?
4. Have you experienced changes in hot and cold sensations in your mouth?
5. Have you experienced reduced salivation or dry mouth?

B. Specific taste questions:

1. Can you taste the sweetness of ice-cream?
2. Can you taste the saltiness of potato chips?

3. Can you taste the sourness of lemons?
4. Can you taste bitterness of coffee?
5. Which taste you prefer most?

C. Questions for women only:

1. What is the duration of complete amenorrhea?
2. Can you taste four basic tastes as strongly as before menopause?
3. Do you have a diet change after menopause?

***Determination of the taste threshold:*** Taste threshold for each of the persons in the study was determined at one step. The test was conducted between 8 am to 11 am. The whole mouth taste method was used in this study.[15] Using four primary substances including sodium chloride (NaCl), sucrose, citric acid and quinine hydrochloride (HCl-quinine, Merk Germany), solutions in different concentrations were prepared (each of four tastes were in 5 concentrations based on molarity). During the study, the solutions were kept at room temperature and were changed every six months. First, 3 ml of the most dilute solution (solution number 1 related to each of four tastes) was given to each person to keep it in the mouth for 30 seconds and then spit it out of the mouth. If the person stated the desired taste correctly, then the first concentration was considered as his/her taste threshold for that taste. But if a person could not distinguish a certain taste or could not distinguish it correctly, then he/she was given solution number 2 with higher concentration; and this continued till the taste was correctly distinguished and the taste threshold was determined. In the intervals between using different concentrations related to one taste, 5 ml of distilled water was given to the person to wash his/her mouth for 30 seconds in order to remove the effect of previous solution.[9,16] In The meantime, a questionnaire for individuals was completed.

***Determination of olfactory threshold:*** The Davidson and Murphy test was used to determine the olfactory threshold[16]. In this test, isopropanol solutions (9.9%, 15%, 23%, 32%, 48%, 53% and 70%) and a glass of water were given to the patient (each time one of each concentrations in one glass and the same amount of water in the other glass) and the patient was asked to smell the content of two glasses and choose the proper substance. If the person selected the substance correctly, then that concentration was detected as his/her olfactory threshold, otherwise, the higher concentration was given to the person. In this method, the patient should be seated; with his head resting on a flat surface and parallel to the Frankfurt plane in a quiet room with closed doors and just patient and the researcher should be in the room.

Also, Smell function was measured using the Sniffin' Sticks odor identification test kit (Burghart Medical Technology, Wedel, Germany) which is based on pen-like odor dispensing devices.[17] The pens are approximately 14 cm long, with an inner diameter of 1.3 cm. Instead of liquid dye, the pen's tampon is filled with 4 ml of liquid odorants. Using a four-alternative forced-choice paradigm, odor identification was assessed for 16 common odors. The threshold, discrimination and identification test was performance based on Welge-Luessen et al. study.[18]

Ethical considerations were taken into account throughout the study, and the patients' names and medical information remained completely confidential. The research proposal was approved by the Ethics Committee of Kerman University of Medical Sciences, Kerman, approval code 126.92.k.

Data were analyzed with SPSS for Windows (version 13.5, SPSS Inc., Chicago, IL, USA) using chi-square test and Student's unpaired t-test. The highest frequency observed in each concentration related to a taste or an odor was considered as the taste and olfactory thresholds for that taste and odor.

## Results

In this research, 50 postmenopausal women [mean age ± standard deviation (SD): 59.7 ± 6.7], 50 old men (60.4 ± 5.5), 50 young

**Table 1.** Correct quality identification using whole mouth taste test

| Taste solutions | Menopause women | Young women | Old men | Young men |
|---|---|---|---|---|
| | n (%) | n (%) | n (%) | n (%) |
| Sucrose | 47 (94) | 50 (100) | 48 (96) | 50 (100) |
| NaCl | 50 (100) | 50 (100) | 49 (98) | 50 (100) |
| Citric acid | 50 (100) | 50 (100) | 50 (100) | 50 (100) |
| Quinine hydrochloride | 50 (100) | 50 (100) | 50 (100) | 49 (98) |

women (22.6 ± 4.5) and 50 young men (24.4 ± 5.2) were studied in terms of sense of taste and olfaction. To compare the data, the postmenopausal women were compared with men at the same age and again they were compared with young women. Also, men in both groups were compared with each other and finally young men were compared with young women. Among the postmenopausal women, 15 individuals (30%) complained about feeling of an unfavorable taste in the mouth (bitter, pus, sweet, blood, salty and sour taste). Among postmenopausal women, 8 individuals (16%) and also 4 old men (8%) had experienced loss of sense of taste for sweetness of ice cream and saltiness of potato chips and its duration had been between 3 and 15 years. Almost in all these people, the loss of sense of taste had been gradual and had not been associated with a specific event. None of the participants had experienced changes in feeling cold and warm substances in their mouth. Five postmenopausal women (10%), 4 old men (8%), 1 young woman (2%) and 2 young men (4%) complained about the reduction of saliva and dry mouth. Also, 3 postmenopausal women group and 2 old men were not able to detect sweet taste even in high concentration; in the group of young men, one man was not able to detect bitter taste even in high concentration (Table 1).

Among the postmenopausal women, 5 individuals stated that they were not able to detect sweet taste like before the menopause. The duration of menopause varied between 3 to 15 years. There was no relation between duration of menopause and changes in sense of taste. The strength of the sweet taste among postmenopausal women after menopause was significantly lower than that of men at the same age (Table 2). Also, there was a statistically significant relationship between detecting taste and the strength of the sweet and sour tastes among postmenopausal women and young women. This study showed a statistically significant relationship between detecting taste and the strength of the sour taste among old and young men (Table 3).

In this study, one person (2%) of the group of postmenopausal women and 2 old men (4%) were not able to recognize the odor of isopropanol even in a concentration of 70% (Table 4). There was a statistically significant relationship between the olfaction of this substance and the strength of sense of olfaction among postmenopausal women and young women and also between old and young men (Table 5).

**Table 2.** Percentage of intensity of whole mouth taste test

| Concentration levels of taste solutions | Sucrose | | P | NaCl | | P | Citric acid | | P | Quinine hydrochloride | | P |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Group 1 | Group 2 | | Group 1 | Group 2 | | Group 1 | Group 2 | | Group 1 | Group 2 | |
| | n (%) | n (%) | | n (%) | n (%) | | n (%) | n (%) | | n (%) | n (%) | |
| 1 | 10 (20) | 2 (4) | | 5 (10) | 0 (0) | | 2 (4) | 0 (0) | | 2 (4) | 0 (0) | |
| 2 | 14 (28) | 2 (4) | | 3 (6) | 3 (6) | | 0 (0) | 3 (6) | | 2 (4) | 0 (0) | |
| 3 | 15 (30) | 10 (20) | *0.012 | 12 (24) | 9 (18) | 0.212 | 10 (20) | 5 (10) | 0.425 | 2 (4) | 18 (36) | 0.091 |
| 4 | 11 (22) | 21 (42) | | 25 (50) | 24 (48) | | 28 (56) | 24 (48) | | 22 (44) | 2 (4) | |
| 5 | 0 (0) | 13 (26) | | 5 (10) | 14 (28) | | 10 (20) | 18 (36) | | 19 (38) | 25 (50) | |

Group 1: Menopause women, Group2: Old men, Group3: Young women, Group 4: Young men
*P < 0.05 is significant

**Table 3.** Mean total taste intensity ratings from whole-mouth taste test

| Taste solutions | Total taste score (mean ± SD) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Group 1 | Group 2 | P | Group 1 | Group 3 | P | Group 3 | Group 4 | P | Group 2 | Group 4 | P |
| Sucrose | 1.30 ± 2.50 | 1.40 ± 3.70 | *0.010 | 1.30 ± 2.50 | 1.09 ± 3.42 | *0.010 | 1.09 ± 3.42 | 1.15 ± 3.32 | 0.460 | 1.40 ± 3.70 | 1.15 ± 3.32 | 0.080 |
| NaCl | 1.30 ± 3.52 | 1.10 ± 3.90 | 0.060 | 1.30 ± 3.52 | 1.10 ± 3.46 | 0.140 | 1.10 ± 3.46 | 1.15 ± 3.51 | 0.090 | 1.10 ± 3.90 | 1.15 ± 3.51 | 0.250 |
| Citric acid | 0.90 ± 3.85 | 0.85 ± 4.15 | 0.210 | 0.90 ± 3.85 | 1.05 ± 4.17 | *0.010 | 1.05 ± 4.17 | 1.09 ± 3.22 | 0.060 | 0.85 ± 4.15 | 1.09 ± 3.22 | *0.020 |
| Quinine hydrochloride | 1.00 ± 4.19 | 0.65 ± 4.51 | 0.280 | 1.00 ± 4.19 | 0.90 ± 4.65 | 0.710 | 0.90 ± 4.65 | 1.01 ± 4.50 | 0.220 | 0.65 ± 4.51 | 1.01 ± 4.50 | 0.110 |

Group 1: Menopause women, Group2: Old men, Group3: Young women, Group4: Young men
*P < 0.05 is significant
SD: Standard deviation

**Table 4.** Percentage of intensity of isopropanol

| Concentration levels of isopropanol | Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|---|
| | n (%) | n (%) | n (%) | n (%) |
| 9.9 | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| 15 | 0 (0) | 10 (20) | 0 (0) | 7 (14) |
| 23.3 | 0 (0) | 10 (20) | 10 (20) | 15 (30) |
| 32 | 19 (38) | 14 (28) | 15 (30) | 15 (30) |
| 48 | 16 (32) | 16 (32) | 10 (20) | 12 (24) |
| 53 | 10 (20) | 0 (0) | 13 (26) | 1 (2) |
| 70 | 5 (10) | 0 (0) | 2 (4) | 0 (0) |

Group 1: Menopause women, Group 2: Old men, Group 3: Young women, Group 4: Young men

**Table 5.** Mean total isopropanol concentration from whole-mouth taste test

| | Total taste score (mean ± SD) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Group 1 | Group 2 | P | Group 1 | Group 3 | P | Group 3 | Group 4 | P | Group 2 | Group 4 | P |
| Isopropanol | 4.50 ± 1.21 | 4.30 ± 1.05 | 0.200 | 4.50 ± 1.21 | 5.50 ± 1.42 | *0.010 | 5.50 ± 1.42 | 5.40 ± 1.12 | 0.320 | 4.30 ± 1.05 | 5.40 ± 1.12 | *0.010 |

Group 1: Menopause women, Group 2: Old men, Group 3: Young women, Group 4: Young men
*P < 0.05 is significant
SD: Standard deviation

Three postmenopausal women (6%), 2 young women (4%) and one old man (2%) stated that they had felt changes in their sense of olfaction. However, this disorder has not any effect on their daily activities.

Three postmenopausal women were not able to identify the smell of the pen, even at high concentrations (n-butanol 4 percent), score = 0. The analogy of threshold discrimination identification (TDI) scores of postmenopausal women showed a decrease in the olfactory function (31.4 ± 3.6) (Figure 1).

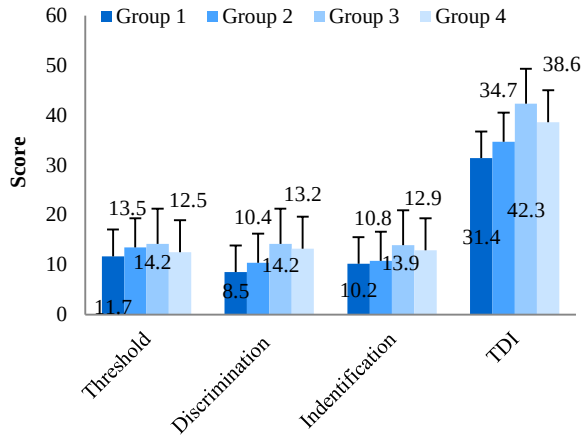



**Figure 1.** The threshold, discrimination and identification (TDI) scores of all patients
Group 1: Menopause women, Group 2: Old men, Group 3: Young women, Group 4: Young men

## Discussion

The senses of taste and olfaction play a role in our nutrition, respiration and protect us from harmful chemical substances around us. Thus, disorder in these senses may significantly influence quality of life. For instance, increased use of sugar and salt as well as impaired sense of taste among people with diabetes or high blood pressure has been reported.[19,20] Taste problems are prevalent in human communities; and ear, nose and throat specialists and oral health specialists are mainly the first ones who detect these disorders. Various tastes either satisfy body needs or cause avoidance reactions. The smell stimulates appetite and also protect us from toxins. For a long time, flavor has been considered as a part of the sense of olfaction. Many patients complain about the loss of the sense of taste; however, they still show a normal sense of taste. In most of these patients, flavor has a problem.[14]

Complaining about flavor is seen in two ways: complaining about reduction or loss of the sense of taste (hypogeusia or ageusia) or continuous unpleasant taste in the mouth (phantogeusia), often related to the change in the quality of flavor (dysgeusia) or burning mouth syndrome (BMS).[21] Etiopathology of disorder in the sense of taste is multifactorial; and menopause is considered as one of these factors. Menopause is a natural phenomenon in women that occurs around the age of 50 years and is associated with some physical changes. Changes after menopause occur in various sensory organs such as organ of taste which cause disorder in the sense of taste and oral discomforts. During this period, changes such as mucosal dryness, burning sensation and disorder in the sense of taste in the oral cavity can be seen. However, the cause and main relationship between taste changes and menopause have not been identified (hormonal changes). Also, disorder in the sense of taste causes food to be tasteless and results in disorder in eating, nutrition and quality of life.[14] The reduction of taste perceptions and willingness to intake more salt and sugar in diet may lead to dangerous health status in elderlies' life.[3,4] Some studies have been conducted to identify probable causes of change in taste among women after menopause. The reduction of taste performance after menopause not only is important to enjoy eating food, but also directly influences food consumption and consequently nutritional status. This study investigated the sensed of taste and olfaction among pre- and postmenopausal women and compared them with the men of the same age.

This study showed that 30% of postmenopausal women complained about the feeling of an unfavorable taste in the oral cavity. The strength of the sweet taste among postmenopausal women after menopause

was lower than that of men. Also, there was a statistically significant relationship between detecting taste and the strength of the sour taste among old and young men.

Wardrop et al.[22] showed that prevalence of oral discomforts among women after menopause was 46%. However, this value for women before menopause was 6%. These researchers showed that symptoms of oral discomforts after hormone replacement therapy were relieved in almost 2/3 of postmenopausal women. However, Delilbasi et al.[3] and Tarkkila et al.[23] suggested that there was no difference in the reduction of oral symptoms between women who have taken hormone replacement therapy and those who have not. Based on these studies, changes in the mouth among women after menopause may have various causes and may not be necessarily associated with hormonal changes.[3,23] Wardrop et al.[22] conducted a study on postmenopausal women and reported the correlation between mouth changes and psychological symptoms. Bercovici et al.[24] concluded that mouth problems among women after menopause were due to the effect of topical stimulants and in other words, it was concluded that the high maturation values found in the oral smears of the menopausal women were not the result of hormonal effect but that of local mechanisms or irritating factors.

One of the differences between this study and that of Kaneda et al.[8] is that we studied women in two groups but Kaneda et al. evaluated women in general. Kaneda et al.[8] indicated that there was no difference in detecting threshold for sucrose between young and old individuals. However, the present study showed that the perceived sweetness was significantly lower after menopause. Studies conducted by Ahne et al.[1] and Hummel et al.[25] showed that women in general were more sensitive about the sense of taste compared with men. Mojet et al.[12] concluded that there was a direct relationship between the loss of sense of taste and aging and also men were subjected to this phenomenon more than women.

Formaker and Frank[5] showed that sensitivity to perceive salty and sweet tastes decreased among patients suffering from BMS and they provided a hypothesis that activation of pain pathways may have an effect on neural and behavioral taste functions.

In this study, all those who suffered from taste disorder stated that this had been a gradual status which is similar to studies conducted by Delilbasi et al.,[3] Dangore-Khasbage et al.[14] and Delilbasi et al.[4] showed that in addition to aging, factors such as smoking, eating habits, and dental status may gradually reduce taste. A study conducted by Ziskin and Moulton[26] reported that 24% of postmenopausal women complained about abnormal taste such as salty, spicy and unpleasant tastes in the mouth to an extend that they became malnourished due to further problems and avoidance of eating. Aghahosseini and Akhavan Karbasi[27] showed that postmenopausal women complained about unpleasant taste in the mouth. According to available articles, it seems that there are various causes for the change in taste among women after menopause, including biological and psychological factors.

Liu et al.[28] showed that age, gender, ethnicity, education, family income, alcohol, asthma and malignancy were risk factors for smell dysfunction, whereas only ethnicity, heavy alcohol consumption and cardiovascular disease (CVD) history were associated with a higher prevalence of taste that is compatible with Rawal et al. study.[29]

Boesveldt et al.[30] showed that gustatory test scores were significantly correlated with age, education, and number of medications taken. The sense of olfaction provide human with valuable information on the environment. Olfactory disorder causes lots of problems in daily life no matter what the cause is.[31] Also, olfactory system is a warning for risks, such as spoiled food, leaking natural gas, air pollution and smoking; and the dysfunction of olfaction can be an early indication for serious diseases such as

Alzheimer's and Parkinson. The change in the sense of olfaction can happen in two ways: quantitative change in the form of hyposmia (reduction of ability to detect odors) or anosmia (the inability to perceive odor) and qualitative change in the form of troposmia (lack of matching between perceived and real odor) or phantosmia (the perception of an odor in the absence of any olfactory stimulus or olfactory hallucination).

Mackenzie in 1884 showed that the loss of the sense of taste is rare; however, the loss of the sense of olfaction is more prevalent.[32] Studies conducted by Goodspeed et al. in modern chemosensory clinic have proved these observations.[33] Also, studies conducted in flavor and aroma clinic in Pennsylvania and in the Monell-Jefferson clinic showed that while nearly 70% of patients visiting clinics complain about the loss of the taste, less than 10% of them suffer from this disorder; and finally, aging or factors related to aging may put more people at the risk of olfactory disorder.[15,34] This study showed that 2% of the group of postmenopausal women and 4% of old men were not able to detect the odor of isopropanol even in a concentration of 70%. There was a statistically significant relationship between detection of isopropanol and the strength of sense of olfaction among postmenopausal women and young women and also between old and young men. Also, 6% of postmenopausal women, 4% of young women and 2% of old men stated that they had felt changes in their sense of olfaction. However, this disorder has not had an effect on their daily activities.

To the best of our knowledge, there has been no research on the sense of olfaction among postmenopausal women and young women and its comparison with men of the same age.

The rate of loss of smell increases with age in men despite adjusting for differences in psychological and health conditions, suggesting that physiological factors as mediators.

Pinto et al.[35] showed that in elderly population, age dependent changes affecting taste were less than factors affecting olfaction. Boesveldt et al.[30] showed that olfactory test scores were significantly correlated with age, body mass index, depressive symptoms, sex and education.

However, in a chemosensory clinic, Cowart et al.[36] found that old people over 65 years reported phantogeusia and the reduction of taste significantly more than young and middle-aged patients but complained less about olfactory disorders.

## Conclusion

Taste dysfunction directly influences nutritional status. In this study, the strength of the sweet taste perception was significantly lower among women after menopause; however, there was no significant difference between the perception of other tastes among postmenopausal women and men.

### *Limitations*

Electrogustometry is an up to date method, although in this study, whole mouth taste method was used because of limitations.

## Conflict of Interests

Authors have no conflict of interest.

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# Cost-savings of community water fluoridation program; Kerman, Iran, 2016

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**Original Article**

## Abstract

**BACKGROUND AND AIM:** Oral diseases are very important because they impose economic and social burden on societies. Given the resource scarcity, it is necessary to devise cost-effective and scientific strategies to prevent and control oral diseases. This study aimed to estimate the potential cost-savings for dental caries treatment associated with Community Water Fluoridation Program (CWFP) in Kerman, Iran.

**METHODS:** An economic model to compare the costs of CWFP with treatment savings achieved through averted tooth decay was developed. Direct cost of prevented caries was taken equal to treatment savings. Implementation cost and the associated savings was estimated for Kerman in 2016. We obtained required data and parameters for costs and savings estimation through published documents and other sources.

**RESULTS:** Annual cost-savings associated with implementing the water fluoridation in Kerman was estimated about $11160415.5 to $44350544.11. About $34.9 to $136 could be achieved per each dollar spent. Annual cost and benefit per capita was $0.66 and $23.4-$91.09 respectively. Net benefit per capita was $22.7 to $90.4.

**CONCLUSION:** This study indicates significant annual savings from CWFP; additional savings could be achieved if this program is implemented in other regions. We could also receive even more if this program is integrated with other public oral health programs such as screening school children, community dentistry and oral health education.

**KEYWORDS:** Water Fluoridation; Dental Caries; Cost Savings; Cost-Benefit; Oral Health

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Proper oral and dental performance along with human nutritional needs is not possible without growth and evolution, desirable daily performance and sense of pleasure.[1]

Dental caries is one of the most prevalent health problems that most of the people face. Reduction of decayed, missing, and filled teeth (DMFT) index to less than 1 until 2010 was one of the World Health Organization (WHO) and Fédération Dentaire International (FDI) goals. This index which depends on factors such as hygiene level, economic and cultural variables, community context, climate conditions and genetics was introduced by WHO as a parameter to measure oral health in different communities.[2] Despite significant advances

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in the field of oral health, many people, especially in the lower socio-economic class of society, both in developed and developing countries are suffering from oral diseases. Dental caries as a disease is still a major public health problem that affects 60 to 90 percent of school children and most adults.[3]

In 2000, Health and Human Services Department of United States in a report entitled "Oral health in America: A report of the Surgeon General" introduced oral disease as a silent epidemic.[4] Dental decay can be prevented by adding the appropriate amount of fluoride into drinking water. WHO considered water fluoridation program as one of the most effective strategies which can be implemented by encouraging governments to reduce dental caries. Fluoride can be obtained by drinking water, salt, milk and specialized ways such as toothpaste or mouthwash, however, the best way is adding fluoride to the drinking water.[5] Community Water Fluoridation Program (CWFP) has been implemented for 60 years to reduce dental decay. Water fluoridation is approved by Health Association of Canada, the WHO, the American Center for Disease Control and Prevention (CDC) and more than 90 agencies or health professional associations. Water fluoridation is considered safe, effective and economic by the scientific community. CDC regards water fluoridation as one of the best public health achievements of the 21st century for preventing dental decay in the last 60 years and it was stated that 38 dollars saved in oral diseases cost for each dollar spend on community water fluoridation.[6]

Dental caries is a prevalent disease among Iranian adults and also children. Water fluoridation has been considered as one of the most effective methods of preventing and controlling dental caries and it could be a potential solution to the problem of dental caries and oral health in Iran.[7] In Iran in 2004, mean DMFT index in children under 6 years (1.8 in 3-years-old children and 4.8 in 6-years-old children) was so high and the D component of this index composed about 90%-95% of this index.[8] Mean DMFT index at 6 years old children in Iran in 2011 was estimated 5.7 and D, M and F components were 5.2, 0.3 and 0.2 respectively.[9] Jahani et al. estimated that mean DMFT index in 12-years old students was 3.6 ± 2.2 and caries free index was 30.1% in Kerman in 2012.[10] Torabi et al. showed that mean DMFT index was 10.90 ± 6.47 in Kerman. The results of this study indicated the high prevalence of dental caries and periodontal disease in this age group.[11]

Pooreslami et al. showed that the amount of fluoride in Kerman drinking water was 0.17 ppm which was less than WHO standards (0/8-1 ppm).[12] Considering the low amount of fluoride in Kerman drinking water and given the role of fluoride in preventing tooth decay and lack of information about the cost-savings of implementing this method in our country, the study aimed to determine the costs savings due to drinking water fluoridation carried in Kerman.

## Methods

This cost-benefit economic evaluation study estimated cost-saving of water fluoridation of Kerman in 2014. The studied population was people residing in Kerman (621347 individuals).[13] Based on the evidence, the highest impact of water fluoridation to prevent dental caries belonged to the people under 45 years of age.[3] Therefore, the population of Kerman who were under 45 years (490493 people, 78.9%) were used as the purpose population of the study to calculate benefits of water fluoridation.[13] The data related to mean DMFT in various age groups was extracted from Najafipour et al.[14] and Jahani et al.[10] study. The study was carried out in three steps: in the first step, annual cost of the water fluoridation was estimated. The benefits of the project (in monetary unit) were estimated in the second step and in the third step, the difference between the costs and benefits was calculated and the annual cost-savings was determined

(all the costs and benefits have been reported based on US dollars).

The perspective of this study was societal and the discounting was not necessary because of annual out costs and benefits.

First step: calculating the project cost

Three compounds used for water fluoridation are: $H_2SiF_6$, NaF and $F_6Na_2Si$. Based on evidence, $H_2SiF_6$ is recommended because of safety, economic, and accessibility reasons.[4,15] Therefore, it was used for calculating the cost as the optimal compound in this study.

At first, the annual consumption of water was estimated to calculate the CWFP in Kerman, and then the difference between natural fluorides and the standard amount of fluoride for preventing dental caries was determined. Next, based on the $H_2SiF_6$ molecular weight, the annual required amount of fluoride to reach to standard level was calculated. Then the annual required amount of $H_2SiF_6$ was multiplied to the price of $H_2SiF_6$, so that the total annual cost of providing $H_2SiF_6$ was obtained. Finally, the other costs including required manpower and water fluoridation equipment were estimated and add to $H_2SiF_6$ cost so that annual cost of the project was estimated.

Total annual cost of project = annual cost of providing $H_2SiF_6$ + annual manpower cost + annual cost of buying and maintenance of equipment for implementation of water fluoridation projects

Second step: calculating the benefits obtained from the project (the dental caries treatment cost saved by project implementation)

First, based on the rate of DMFT, prevalence of caries in Kerman population per year was estimated to calculate the benefit of the project. This index rate was extracted from Najafipour et al.[14] and Jahani et al. studies.[10] Then the prevalence of dental caries and the effect of water fluoridation on decreasing the rate of tooth decay based on previous studies done in this area was estimated between 30-50 percent,[4,6,15-17] and was multiplied to determine total prevented caries due to implementation of the project. In the next step, to convert the benefits of plan into money, the total amount of decay prevented was multiplied into average cost of treatment for each decayed tooth, and the benefits of the plan was determined.

Project benefit = caries incidence per year per person × population × effect size of water fluoridation in caries reduction × average treatment cost per decay tooth

In this study, indirect and intangible benefits were not calculated because of data limitations.

Third Step: determining the amount of savings

To calculate the amount of potential savings, the total estimated costs of implementing water fluoridation program has been subtracted from the potential benefits of the program.

The annual cost-savings = total benefits obtained from project - total cost of the project.

## Results

Calculating the project expenses:

a. estimating the cost of providing $H_2SiF_6$

Total population of Kerman = 621374

Per capita consumption of water per day per person = 180 liter

Total annual water consumption of Kerman = Kerman population × per capita water consumption over one year = 621374 × 65700 = 40824271800 lit/year

Based on previous studies, the amount of natural fluoride in drinking water of Kerman was 0.17 mg per liter and since the standard rate of fluoride to reduce tooth decay has been determined 1 mg per liter, the required amount of fluoride that should be added to drinking water was 0.83 mg per liter:

Required amount of fluoride per liter = 1-0.17 = 0.83 mg/liter

Net amount of fluoride needed per year = 40824271800 × 0.83 = 33904145594 mg

The amount of net fluoride required annually was estimated 33904145594 mg per year (33904 kg). Since in this study the composition of fluoride was H2SiF6 55% and

the molecular weight and the amount of fluoride in $H_2SiF_6$ are 144.08 and 79.20 percent respectively, based on the following formula, 77832 kg of fluoride must be purchased per year in order to supply the sufficient amount of fluoride in drinking water by this composition:

The amount of $H_2SiF_6$ 55% required = 0.792 × 0.55 × 33904 = 77832 kg/year

The cost of providing each ton of $H_2SiF_6$ with calculating transportation cost was estimated $3823.5 so total cost to provide 77.832 ton of this material would be more than $297592.9.

b. The cost of purchasing and maintaining the water fluoridation equipment

According to the Kerman drinking water authority, distribution of drinking water in Kerman is conducted through 4 main tanks, so in order to fluoridate drinking water fluoridation, four water fluoridation equipment was needed. Based on the calculations, the cost of purchasing, installing and commissioning of each water fluoridation equipment was $5882.3. Assuming a useful life of 5 years for each machine and 20 percent of the purchase price paid for annual repairs and maintenance, $4705.8 for the annual purchase and $4705.8 annual cost of repairs and maintenance was considered making up a total of $9411.7 per year for 4 water fluoridation sets.

c. Manpower recruitment cost

For the operation of the injection and monitoring of fluoride in drinking, water four trained manpower are required. Assuming that they are paid $441 per person, including $294 for a total cost of training, cost of hiring manpower was estimated at $21470.5 for one year.

Costs of fluoridating: Taking into account total costs for providing H2SiF6, costs of the purchase and maintenance of equipment and labor costs, total implementation costs of water fluoridation in Kerman was estimated $328475.2 per year.

Annual total cost of the project = $297592.9 + $9411.7 + $21470.5 = $328475.2

Annual cost of the project per person = $328475.2 / 490493 = $0.66 per person

The calculation of the total benefits derived from the project (prevented costs through water fluoridation):

To calculate the benefits of the project in the first stage, the annual average rate of tooth decay and annual total decay in each age group of the study was estimated based on studies by Najafipour et al.[14] and Jahani et al.[10] which can be seen in table 1.

The mean DMFT per year in each age group = Mean DMFT in each age group/average period (year)

Estimates of averted decay: According to the above table, the total number of decayed teeth in all age groups during the year was estimated 434024.76. Since the effect of fluoride in reducing tooth decay in different studies have been reported between 30 and 50 percent which expressed the benefits of assuming the impact of 30%, 40% and 50% of fluoride in reducing tooth decay, these amounts of assuming impacts were calculated. Total numbers of caries-prevented effect with the assumption of 30%, 40% and 50%, were 130207.42, 173609.90 and 217012.38 teeth respectively.

**Table 1.** The estimated annual average rate of decay and annual total decay in each age group

| Age group (year) | Mean DMFT in each age group | Average period (year) | Mean DMFT per year in each age group | Population of each group | Total decay in each age group per year |
|---|---|---|---|---|---|
| under 6 | 4.7 | 6.0 | 0.8 | 51560 | 40216.8 |
| 7-14 | 3.6 | 4.0 | 0.9 | 96575 | 86917.5 |
| 15-24 | 9.5 | 9.0 | 1.1 | 130972 | 137520.6 |
| 25-34 | 12.1 | 14.0 | 0.9 | 128572 | 110571.9 |
| 35-45 | 14.0 | 19.5 | 0.7 | 82814 | 58797.9 |
| Total decay in all age groups per year | | | | | 434024.8 |

DMFT: decayed, missing, and filled teeth

**Table 2.** The cost-benefit ratio of drinking water fluoridation project in Kerman (US$)

| The impact of fluoride on decay reduction | Treatment cost of each decayed tooth | Total benefit | Total cost | Total net benefit | Cost-benefit ratio |
|---|---|---|---|---|---|
| Scenario 30% | 88.2 | 11488890.70 | 328475.2 | 11160415.50 | 34.9 |
| | 147.0 | 19148151.17 | 328475.2 | 18819675.88 | 58.2 |
| | 205.8 | 26807411.64 | 328475.2 | 26478936.35 | 81.6 |
| Scenario 40% | 88.2 | 15318520.94 | 328475.2 | 14990045.64 | 46.6 |
| | 147.0 | 25530868.23 | 328475.2 | 25202392.94 | 77.7 |
| | 205.8 | 35743215.58 | 328475.2 | 35414740.29 | 108.8 |
| Scenario 50% | 88.2 | 19148151.17 | 328475.2 | 18819675.88 | 58.2 |
| | 147.0 | 31913585.29 | 328475.2 | 31585110.00 | 97.1 |
| | 205.8 | 44679019.41 | 328475.2 | 44350544.11 | 136.0 |

Next, considering the cost of treatment of a decayed tooth and also cost of total preventable decayed teeth through the implementation of fluoride program for all age groups per year, total benefits from the project (cost of treatment prevented decay for the project) were calculated. It was estimated that the cost of repairing decayed teeth by dental specialists were estimated between $88.2 to $205.8 that our calculations for the three scenarios would be, $88.2, $147 and $205.8, respectively.

The total annual benefits from the implementation = cost of treatment per tooth decay × total number of caries prevention through the implementation of drinking water fluoridation per year

Cost-savings from averted decay:

Based on the table above, the obtained benefits per year were estimated about $34.9 to $136 for each dollar spent. Total net benefit was about $11160415.5 to $44350544.11 per year. The total net benefit per person was estimated about $22.7 to $90.4 per year.

The main variables affecting the results of the study were the prevalence of dental caries, effect of fluoride in reducing tooth decay and dental treatment costs. As demonstrated in table 2, to increase the effectiveness of fluoride from 30% to 50%, the cost of treatment per tooth decay increased from $88.2 to $205.8, and the cost-benefit ratio of the project was increased from $34.9 to $136.

## Discussion

The cost-savings of this project was about $34.9 to $136 per dollar spent. Based on calculations, the annual cost of the project per person per year was $0.66 and the annual benefit of the project per person per year was about $23.4 to $91.09. Net annual benefit of this project was about $22.7 to $90.4 per person.

In the study by Wright et al. in New Zealand, water fluoridation in communities with more than 1000 people led to savings in costs that varied based on population, size of region, and level of dental decay and savings cost from the implementation of the project was estimated to be between $24-$40.[18] In another study by Griffin et al. the savings resulting from water fluoridation per person ranged from $15.95 in small communities to $18.62 in large communities.[15]

Tchouaket et al. reported that the average effectiveness of water fluoridation programs in dental decay reduction was around 30% and each dollar invested in drinking water fluoridation program led to a saving of $71.5-$82.83 per person in dental decay treatment cost or over 560 million dollars savings for the entire Quebec.[19] Assuming 30% caries reduction as a result of fluoride impact, per dollars expenses in project resulted $34.9-$81.6 saving in costs related to dental decay treatment and this measures are in line with Tchouaket et al. ($71.5-$82.83)[19] and O'Connell et al. ($46.97 to $76.41)[4] studies but is higher than the results of the studies by Griffin et al. ($15.95 - $18.62)[15] and Wright et al. ($24-$40).[18]

Since in Tchouaket et al.'s study,[19] the impact of fluoride was also considered 30 percent, it is more logical to compare our results with this study. The reasons for the

difference observed in results of Griffin et al.[15] and Wright et al.[18] studies could be related to differences in the population size, population age composition, the level of socio-economic development, the amount of dental caries, the natural level of fluoride in drinking water and also providing other interventions for the prevention of dental caries in any community.

Assuming 40% effect for fluoride on caries reduction, per dollars expenses in project resulted in $46.6-$108.8 saving in costs and 30% impact assumption is consistent with Tchouaket et al. ($71.5-$82.83)[19] and O'Connell et al.'s ($46.97 to $76.41)[4] study, but is higher than the amount obtained from the Griffin et al.[15] and Wright et al.'s[18] studies. However, like 30% effect of fluoride, these differences are related to differences in the variables affecting the cost-savings of drinking water fluoridation projects.

Given the 50% impact of fluoride in caries reduction, per dollars in the project costs, between 58.2 to 136 dollars in costs related to caries treatment will be saved. This rate was higher than studies in this area. The comparison of the results of the study which considered 30% and 40% in caries reduction in decayed rate with other studies was more logical.

In general, the cost-savings resulting from the implementation of the project per each dollar was between 34.9 to 136 dollars and this is consistent with the studies by Tchouaket et al.[19] and O'Connell et al.[4] and is higher than Griffin et al.[15] and Wright et al.'s[18] studies. Based on conducted calculations, the annual cost of implementation of this project was $0.66 per person and annual benefit was about $23.4 to $91.09 per person. Annual net benefit of project was about $22.7 to $90.4 per person. The reasons for the differences between the results of the present study and Griffin et al.[15] and Wright et al.'s[18] studies can be due to the differences in prevalence of dental caries, cost of tooth decay treatment in various populations and water fluoridation effectiveness in different communities.

Since oral health status and the prevalence of dental caries, tooth decay treatment costs and the level of natural fluoride in the water is different in various communities, the benefits resulted from this project would be different in various countries. Also, according to the results of previous studies in this area, the size and age structure of the population affect the benefits resulting from this project so that in communities with larger population and countries with young population and more number of children will benefit from this project more.

## Conclusion

Based on the review of the literature in this area and the results of the present study, this health action was a safe, effective and cost-effective method in the reduction of dental caries, so that the cost-savings of this project was about $34.9 to $136 per dollar spent for this project. Based on calculations, the annual cost of the project per person per year was $0.66 and the annual benefit of the project per person per year was about $23.4 to $91.09. Net annual benefit of this project was about $22.7 to $90.4 per person. It is noteworthy that the health policy makers should pay attention to this issue and implement other actions to do this project.

## Conflict of Interests

Authors have no conflict of interest.

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# Factors associated with parental awareness of dental caries in preschool children in Shiraz, Iran, in 2014

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**Original Article**

## Abstract

**BACKGROUND AND AIM:** Parents have an important role in making decisions about their children's oral health problems and their awareness of children's oral health status may affect their care-seeking behaviors. The aims of this study were to determine parental awareness about the presence and absence of dental caries in preschool children and factors associated with their awareness.

**METHODS:** The participants of this cross-sectional study were 3 to 6-year-old children and their parents who were recruited from 10 randomly selected kindergartens in Shiraz, Iran. Normative and perceived caries status of the children was assessed through a dental examination and parental assessment, respectively. Parents' awareness was determined by comparing their perception of presence and absence of caries (perceived status) and the actual caries status of their child (normative status). Factors associated with parental awareness were determined using univariate and multiple logistic regression analyses.

**RESULTS:** Among the 396 parents, who completed the questionnaire, 56% were aware of presence and 76% were aware of absence of caries. Awareness of presence was associated with children's previous dental visit ($P < 0.001$) and experience of caries ($P = 0.007$). Parents who considered their child's teeth unclean ($P = 0.005$) and their overall oral health status not good ($P < 0.001$) were more likely to be aware of presence of caries. Parents who perceived their child's teeth clean ($P = 0.030$) and overall oral health status good ($P < 0.001$) were more likely to be aware of absence of caries.

**CONCLUSION:** Many parents were not aware of the presence of dental caries, which may result in them deferring the seeking of care for their children. Having a dental visit increased parental awareness. Regular dental visits, therefore, should be promoted for young children for early detection of dental caries and to enhance parental awareness of children's oral health condition.

**KEYWORDS:** Parents; Awareness; Dental Caries; Children

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Despite some improvements in the oral health of adolescents and adults, dental caries in young children remains a serious worldwide public health problem.[1] Dental caries can affect children's quality of life (QOL) by causing pain, infection, greater risk of hospitalization, and discomfort during eating and sleeping.[2] It affects children's nutrition, growth, and weight gain and may result in loss of school days and reduced learning ability.[2] Management of children's dental caries is also costly and time-consuming since extensive dental treatment is often required for these children.[3]

According to a national survey conducted

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in Iran in 2004, the decayed, missing, and filled teeth (DMFT) index scores for children of 3 and 6 years of age were 1.9 and 5.0, respectively.[4] In Tehran, the capital of Iran, the prevalence of dental caries was reported to be 3%, 9%, 14%, and 33% for 12-15, 16-19, 20-25, and 26-36-month-olds.[5] In other words, about 1 out of 3 children had some carious lesions by age 3.

Young children's oral health greatly depends on their appropriate oral hygiene at home and optimal use of oral health services.[6] Parents often tend to seek care if they feel that there is a problem.[7] As a result, they may not take actions unless they recognize a dental problem. Unfortunately, research has shown that parental awareness of children's oral health status is relatively low. For example, a study in Brazil reported that almost half (42.5%) of parents were not aware of their young children's dental traumas.[8] In another study conducted on African immigrants in Canada, 44% of parents described their child's dental status as good, while 56% of the children had dental caries.[9] In this study, clinical and parental assessments did not coincide in 62% of the studied children.[9]

Parental awareness of children's dental status has been associated with level of parent's education, household income, child's age, and severity of the problem.[8,10] Among a group of African immigrants in Canada, family structure was also found to be significantly associated with parents' awareness as single parents were more aware of their children's caries status than families with both parents.[9] However, most studies conducted to explore parental awareness did not differentiate the awareness of absence from the awareness of presence of disease, and consequently, did not sufficiently explore factors associated with these two forms of awareness separately. In addition, factors associated with parental awareness have not been consistent across studies. The identification of these two sets of factors is important for the development of preventive interventions since it helps to better define the modifiable factors that need to be targeted to enhance parental awareness of children's dental status, care-seeking behavior, and ultimately, use of dental services.

To the best of our knowledge, no research has evaluated the awareness of Iranian parents regarding their child's dental caries status. Furthermore, it is not clear whether increased level of education, especially among Iranian women in recent years,[11] directly or indirectly (e.g., through regular dental visits) influences their oral health awareness. Therefore, the aims of this study were to assess parents' awareness of the presence and absence of dental caries in their children and to determine factors associated with these two forms of awareness.

## Methods

This cross-sectional study was conducted on 3 to 6-year-old children and their parents in Shiraz, Iran, in 2014. The participants were recruited through randomized cluster sampling. From among 147 kindergartens in Shiraz (our clusters), 10 were selected by balloting and parents of all children registered in the selected kindergartens were asked to participate in the study. The required sample size was calculated to be 382 participants based on the percentage of parents who were aware in the pilot study conducted on 30 parents using type I error of 0.05, sampling error of 0.05, and estimated proportion of 0.5. However, a total of 453 parents were invited to participate in the study in order to compensate the possible excluded and withdrawn participants from the study. To persuade the parents and children to participate in the study, the objectives of the study were explained for the authorities of the kindergartens, parents, and children. Furthermore, the children with dental caries were referred to the clinic of the School of Dentistry of Shiraz University of Medical Sciences for treatment. However, the children who were uncooperative or absent on the examination day, did not have any

teeth, or did not have parental consent were excluded from the study.

The study was approved by the Research Ethics Committee of the School of Dentistry. Informed consents were obtained from the parents and they were asked to complete a questionnaire on demographic characteristics and perceptions related to their child's dental health, presence/absence of caries, and dental cleanness. All children received a dental examination to determine their caries and dental cleanness status.

To collect data on parents' perception of their child's dental status, a Persian language questionnaire was developed based on questionnaires previously used for similar purposes.[9,10] Two faculty members of the School of Dentistry of Shiraz University of Medical Sciences reviewed the questionnaire and approved its content validity. To evaluate the reliability of the questionnaire, 30 parents completed the questionnaire twice, two weeks apart and the agreement between the two measures was assessed. Kappa coefficient showed significant and high agreements for all items (Kappa coefficient ranged from 0.609 to 0.841). Demographic characteristics were collected in the first part of the questionnaire. The second part included 3 questions on parental assessment of the child's untreated dental decay, dental cleaning, and dental health status. The question "Does your child have cavities?" was used to assess children's untreated dental decay. The question "Do you think your child's teeth are clean?" was used to assess children's dental cleanness. The answers to both questions were "yes", "no", or "not sure". The dental health status of the children was assessed by the question "How would you describe your child's dental condition?" The responses to this question included "very good", "good", "fair", "poor", "very poor", and ''I do not know''. However, during the analysis, we merged "very good" and "good" and defined them as "good" and the remaining options were defined as "not good".

One calibrated senior dental student performed all dental examinations in the selected kindergartens using a tongue blade, a probe, a disposable dental mirror, and a headlight. Dental caries and cleaning status were recorded. Children's dental decay was evaluated according to the World Health Organization (WHO) criteria[12] and untreated carious teeth (cavitated and non-cavitated) were recorded. To assess children's dental cleaning, the debris component of the Simplified Oral Hygiene Index, the Simplified Debris Index (DI-S), was used.[13,14] In each child, 4 labial surfaces and 2 lingual surfaces of 6 different teeth were examined for visible debris and each tooth was scored from 0 to 3 based on the inciso-cervical/occluso-cervical extent of the debris. The DI-S of each child was recorded as the mean of scores for the 6 teeth. These scores (0-3) were further categorized as very good (0-0.2), good (0.3-0.6), fair (0.7-1.8), and poor (1.9-3.0).[15]

Parent's awareness of their child's dental caries was determined by comparing parents' perceived absence or presence of dental caries with the actual clinical examination results. They were considered aware of the presence or absence of caries if their assessment matched that of the professional assessment and were considered unaware if their assessment was different from that of the professional assessment or if they were unsure about their child's caries status.[9]

The collected data were analyzed in SPSS software (version 22, IBM Corporation, Armonk, NY). Kappa agreement coefficient was used to determine the agreement between parents' perception of their child's dental caries and child's actual caries status. The percentage of parents who were aware of the absence and presence of dental caries in their child were determined. Associations between parental awareness and children's characteristics were evaluated using chi-square, Fisher's exact test, and independent sample t-test. Variables significantly

associated with parental awareness in univariate analysis were further analyzed using multiple logistic regression analysis. For all analyses, statistical significance was considered as $P < 0.05$.

## Results

Of the 453 parents who were invited to participate in the study, 396 completed the questionnaire. Demographic characteristics of the participants are presented in table 1.

**Table 1.** Participants' characteristics (n = 396)

| Variables | | Outcome measure |
|---|---|---|
| Demographic characteristics of the parents | Respondent's relation [n (%)] | |
| | Mother | 343 (86.6) |
| | Father | 53 (13.4) |
| | Respondent's Education [n (%)] | |
| | Without university degree | 232 (58.6) |
| | With university degree | 164 (41.4) |
| | Father's occupation [n (%)] | |
| | Self-employed | 258 (65.2) |
| | Employee | 138 (34.8) |
| | Mother's employment status [n (%)] | |
| | Employed | 107 (27.0) |
| | Homemaker | 289 (73.0) |
| Demographic characteristics of the children | Age (Month) [mean ± SD] | 60.63 ± 8.92 |
| | Sex [n (%)] | |
| | Girl | 194 (49.0) |
| | Boy | 202 (51.0) |
| | Number of children in the family [n (%)] | |
| | One child | 162 (40.9) |
| | More than one child | 234 (59.1) |
| | Child priority in the family [n (%)] | |
| | First child | 226 (57.1) |
| | Not the first child | 170 (42.9) |
| | Previous dental visits [n (%)] | |
| | Yes | 207 (52.3) |
| | No | 189 (47.7) |
| Clinical examination of the children | Caries experience (DMFT) [median (Min-Max)] | 3 (0-15) |
| | Dental caries [n (%)] | |
| | Yes | 277 (69.9) |
| | No | 119 (30.1) |
| | Dental cleanness (DI-S) [n (%)] | |
| | Fair to very good (DI-S ≤ 1.8) | 301 (76.0) |
| | Poor (DI-S ≥ 19) | 95 (24.0) |
| Parental perception of children's dental health status | Perceived presence of dental caries [n (%)] | |
| | Yes | 166 (41.9) |
| | No | 175 (44.2) |
| | Not sure | 55 (13.9) |
| | Perceived dental cleanness [n (%)] | |
| | good | 226 (57.1) |
| | Not good | 103 (26.0) |
| | Not sure | 67 (16.9) |
| | Perceived dental health [n (%)] | |
| | Good | 219 (55.3) |
| | Not good | 177 (44.8) |

SD: Standard deviation; DI-S: Simplified Debris Index; DMFT: decayed, missing, and filled teeth

A total of 219 parents (55.3%) evaluated their child's dental health status as good and only 166 (42.0%) indicated that their child had dental decay. However, in the dental examination, about 70% of the children had dental caries, 50% had a DMFT of 3 or higher, and 24% had poor dental cleanness. Although more than half of the children had visited a dentist before, only 77 had visited for check-up (Table 1).

The comparisons between parents' assessment of their child's dental caries (both presence and absence) and our clinical assessment showed that 246 parents (62.1%) were aware and 150 (37.9%) were unaware. Of the 277 parents whose children had dental caries, 156 (56.3%) were aware of the presence of the decay. Of the 119 parents whose children did not have dental caries, 90 (75.6%) were aware of the absence of the decay. The agreement coefficient between parental and clinical assessment was statistically significant (kappa = 0.449) (P < 0.001).

In univariate analysis, awareness of presence was significantly associated with parent's education level (P < 0.001), mother's employment status (P < 0.001), number of children in the family (P = 0.019), and previous dental visits (P < 0.001). Furthermore, the children of the parents who were aware had a higher mean DMFT than those of the parents who were unaware (P < 0.001). Likewise, a higher percentage of children with clinically determined poor oral hygiene (DI-S ≥ 1.9) had parents who were aware (P < 0.001). Moreover, the parents who thought their child's teeth were clean (P < 0.001) and believed that their child's dental health was good (P < 0.001) were more likely to be unaware of the presence of caries (Table 2).

Logistic regression model also showed a significant association between parental awareness of the presence of caries and the child's caries experience (DMFT) (P = 0.007). Furthermore, the parents whose children had visited a dentist previously were 6.11 times [95% confidence interval (CI) = 3.06-12.21] more likely to be aware of their child's dental caries than those whose child never had (P < 0.001). Moreover, the parents who believed their child's teeth was not clean were 3.05 times (95% CI = 1.40-6.65) more likely to be aware of the presence of caries than those believing otherwise (P = 0.005) (Table 3).

Parental awareness of absence of caries was not significantly associated with child's previous dental visit or any other demographic factors in univariate analysis. In addition, no significant association was found between parental awareness and the child's dental cleanness (P = 0.571) and caries experience (P = 0.920). However, the parents who believed their child's teeth were clean (P < 0.001) and their dental health status was good (P < 0.001) were more likely to be aware (Table 2). Logistic regression analysis also confirmed the presence of a significant association between parental awareness of absence of caries and the perceived dental health status (P < 0.001) and dental cleanness of the child (P = 0.030) (Table 3).

## Discussion

This cross-sectional study evaluated parents' awareness of their young child's dental caries status and factors associated with the awareness. Overall, most parents were unaware of their child's caries status. However, they were more aware of the absence than the presence of caries. There was a significant association between parental awareness and perception of the child's dental health status.

In the present study, about 40% of the parents were unaware of their child's dental caries status. Low parental awareness regarding children's dental caries was also reported in other studies.[10,16-18] More than half of the parents in a Canadian study were not aware of their child's caries status.[9] Moreover, studies in Maryland, USA, showed that parental perceived awareness of dental caries was consistently lower than the actual clinically determined dental caries in children.[10,18]

**Table 2.** Factors affecting parental awareness regarding presence and absence of dental caries in children (n = 277)

| Variables | | Awareness regarding presence of dental caries | | | Awareness regarding absence of dental caries | | |
|---|---|---|---|---|---|---|---|
| | | Aware parents | Unaware parents | P | Aware parents | Unaware parents | P |
| Demographic characteristics of the parents | Respondent's relation [n (%)] | | | 0.856* | | | 0.732*** |
| | Mother | 134 (56.5) | 103 (43.5) | | 79 (74.5) | 27 (25.5) | |
| | Father | 22 (55.0) | 18 (45.0) | | 11 (84.6) | 2 (15.4) | |
| | Respondent's Education [n (%)] | | | < 0.001* | | | 0.489* |
| | Without university degree | 112 (64.7) | 61 (35.3) | | 43 (72.9) | 16 (27.1) | |
| | With university degree | 44 (42.3) | 60 (57.7) | | 47 (78.3) | 13 (21.7) | |
| | Father's occupation [n (%)] | | | 0.088* | | | 0.494* |
| | Self-employed | 107 (60.1) | 71 (39.9) | | 59 (73.8) | 21 (26.3) | |
| | Employee | 49 (49.5) | 50 (50.5) | | 31 (79.5) | 8 (20.5) | |
| | Mother's employment status [n (%)] | | | < 0.001* | | | 0.564* |
| | Employed | 25 (36.2) | 44 (63.8) | | 30 (78.9) | 8 (21.1) | |
| | Homemaker | 131 (63.0) | 77 (37.0) | | 60 (74.1) | 21 (25.9) | |
| Demographic characteristics of the children | Age (month) (mean ± SD) | 61.60 ± 8.60 | 60.71 ± 9.04 | 0.407** | 59.0 ± 9.3 | 60.1 ± 8.6 | 0.570** |
| | Sex [n (%)] | | | 0.611* | | | 0.712* |
| | Girl | 77 (57.9) | 56 (42.1) | | 47 (77.0) | 14 (23.0) | |
| | Boy | 79 (54.9) | 65 (45.1) | | 43 (74.1) | 15 (25.9) | |
| | Number of children in the family [n (%)] | | | 0.019* | | | 0.367* |
| | One child | 47 (47.0) | 53 (53.0) | | 49 (79.0) | 13 (21.0) | |
| | More than one child | 109 (61.6) | 68 (38.4) | | 41 (71.9) | 16 (28.1) | |
| | Child priority in the family [n (%)] | | | 0.101* | | | 0.499* |
| | First child | 80 (51.9) | 74 (48.1) | | 56 (77.8) | 16 (22.2) | |
| | Not the first child | 76 (61.8) | 47 (38.2) | | 34 (72.3) | 13 (27.7) | |
| | Previous dental visits [n (%)] | | | < 0.001* | | | 0.822* |
| | Yes | 126 (75.0) | 42 (25.0) | | 61 (76.3) | 19 (23.7) | |
| | No | 30 (27.5) | 79 (72.5) | | 29 (74.4) | 10 (25.6) | |
| Clinical examination of the children | Caries experience (DMFT) (mean ± SD) | 6.65 ± 3.51 | 4.03 ± 3.06 | < 0.001** | 0.09 ± 0.74 | 0.10 ± 0.40 | 0.920** |
| | Dental cleanness (DI-S) [n (%)] | | | < 0.001* | | | 0.571*** |
| | Fair to very good (DI-S ≤ 1.8) | 87 (46.8) | 99 (53.2) | | 86 (74.8) | 29 (25.2) | |
| | Poor (DI-S ≥ 1.9) | 69 (75.8) | 22 (24.2) | | 4 (100) | 0 (0) | |
| Parental perception of children's dental health status | Perceived dental cleanness [n (%)] | | | < 0.001* | | | < 0.001* |
| | Yes | 40 (29.4) | 96 (70.6) | | 78 (86.7) | 12 (13.3) | |
| | No | 116 (82.3) | 25 (17.7) | | 12 (41.4) | 17 (58.6) | |
| | Perceived dental health [n (%)] | | | | | | < 0.001* |
| | Good | 30 (24.6) | 92 (75.4) | | 86 (88.7) | 11 (11.3) | |
| | Not good | 126 (81.3) | 29 (18.7) | < 0.001* | 4 (18.2) | 18 (81.8) | |

SD: Standard deviation; DI-S: Simplified Debris Index; DMFT: decayed, missing, and filled teeth; *Chi-square, **Independent sample t-test, ***Fisher's exact test

**Table 3.** Logistic regression model with parental awareness regarding children's dental decay as dependent variable

| Dependent variable | Independent variables | B | SE | OR | 95% CI for OR | P |
|---|---|---|---|---|---|---|
| Parental awareness regarding presence of dental decay in children (n = 277) | Mother's employment status (Homemaker/Employed) | 0.02 | 0.49 | 1.02 | 0.39-2.65 | 0.971 |
| | Parents' education (Without university degree/With university degree) | 0.65 | 0.43 | 1.91 | 0.83-4.40 | 0.129 |
| | Previous dental visits (Yes/No) | 1.81 | 0.35 | 6.11 | 3.06-12.21 | < 0.001 |
| | Number of children in the family (More than one child/One child) | 0.15 | 0.35 | 1.16 | 0.58-2.32 | 0.666 |
| | Caries experience (DMFT) | 0.17 | 0.06 | 1.19 | 1.05-1.35 | 0.007 |
| | Dental cleanness (Poor/Fair to very good) | 0.12 | 0.45 | 1.13 | 0.47-2.72 | 0.791 |
| | Perceived children's dental cleanness (No/Yes) | 1.12 | 0.40 | 3.05 | 1.40-6.65 | 0.005 |
| | Perceived children's dental health (Not good/Good) | 1.66 | 0.40 | 5.25 | 2.39-11.51 | < 0.001 |
| Parental awareness regarding absence of dental decay in children (n = 119) | Perceived children's dental cleanness (Yes/No) | 1.32 | 0.61 | 3.75 | 1.14-12.38 | 0.030 |
| | Perceived children's dental health (Good/Not Good) | 3.07 | 0.67 | 21.45 | 5.76-79.79 | < 0.001 |

SE: Standard error; OR: Odds ratio; CI: Confidence interval; DMFT: decayed, missing, and filled teeth

Furthermore, only half of the mothers in England were able to correctly estimate the oral health status of their child.[17] One of the most important causes of parental unawareness, reported by previous studies, was parents' low involvement in their child's tooth brushing practices,[17,19,20] while it is well-documented that parents are responsible for taking care of children's oral hygiene.[21] The lack of parental awareness can be an important indicator of children's poor oral hygiene.[22] Therefore, parents should be encouraged to engage in their child's oral hygiene practices more actively.

In our study, 75% of the parents were aware of the absence of dental caries in their child while only 56% of them were aware of the presence of caries. Similarly, in a study conducted in the United States, parents were more aware of the absence than the presence of dental caries in their child.[23] Other studies also documented caregivers' tendency to rate their child's dental status positively.[24,25] Parents' lack of awareness of the presence of caries is of concern given that the recognition of caries or dental problems in general is a powerful drive for parents to seek dental care. Furthermore, it may be the result of parents' optimistic view of their child's dental status. This view may result from a combination of factors including lower rate of dental caries experience in younger children compared to older children,[24] less experience of all the consequences of dental caries by younger children,[25] and low awareness of parents about the existing caries.[16] This optimistic view can also result from a self-serving mechanism to avoid unpleasant feelings associated with lack of parenting skills and commitment to the child's dental health. Moreover, a study showed that parental awareness of cavitated caries was higher than non-cavitated caries because parents often rely on visual recognition to detect caries.[16] To improve parents' awareness of the presence of caries, routine dental check-up of children is recommended. Only 20% of the children in the present study had a previous dental check-up. This can explain high parental unawareness about the presence of caries in our study.

In the current study, parents of children with a previous dental visit were more aware of presence of dental caries in their child than those of children with no dental visit. However, there was no significant association

between a previous dental visit and parental awareness of absence of dental caries. Furthermore, children of parents who were aware of the presence of their children's dental caries had higher scores of DMFT index than parents who were unaware. Nevertheless, there was no significant difference between the DMFT index of the children whose parents were aware or unaware of the absence of dental caries in their children. These findings may be because most children in our study had visited a dentist due to having a dental problem and only a few children had dental visits for check-up. Other studies also showed a significant association between awareness of dental caries and use of dental services.[26,27] Furthermore, in a study performed in the US, the main reason for not seeking dental care was perceived absence of dental problems.[18] In contrast, a study conducted in Canada reported no correlation between parental awareness about children's dental status and children's dental attendance.[9] A study conducted in Brazil demonstrated that seeking care only when a problem is visually recognized can negatively affect early detection of dental disease and the implementation of appropriate actions required to prevent further consequences.[28] Therefore, the importance of regular dental visits should be emphasized by dental and other health professionals.

In this study, parental awareness regarding presence and absence of dental caries in children was significantly associated with parental perception of children's dental health and cleanness status. Similarly, a study conducted in the United States indicated that perceived need for dental cleaning and treatment was significantly associated with parental awareness of children's dental health.[29] Furthermore, an Iranian study showed that children of mothers with more positive/optimistic attitude towards oral health experienced lower caries.[30] The scarce literature on the subjective dimension of children's dental health has mainly focused on how the dental status of children is perceived by parents and children themselves and factors associated with their perceptions. In this line of research, studies have found significant correlations between parents' poor assessment of their child's dental status and presence of untreated dental caries, especially number of cavitated lesions, filled surfaces, and missing teeth due to caries.[25,31] This may be because parent's perceived dental need is the main reason for seeking pediatric dental care.[16] Yet, little is known about parental awareness of children's dental health status and its main determinants.

This study has several limitations that need to be acknowledged. First, as a cross-sectional study, no casual inferences can be made between parental awareness of the presence/absence of caries and their associated factors. Second, although DMFT index was associated with parental awareness, correlations between parental awareness and each component of the index would have offered a more comprehensive view of the phenomenon under study. Third, correlations between different forms of parental awareness and perceived need for treatment and dental service utilization were not examined. These correlations are particularly important because studies on perceived child's dental status are generally framed within the context of intended and actual utilization of dental services.

## Conclusion

A high percentage of children in this study experienced early childhood caries (ECC) and were at risk of developing more sever forms of dental decay as a result of parents' lack of awareness of children's dental status and their tendency to seek dental care when there is a problem. Past dental visits increased parental awareness. Therefore, oral health education is needed to better inform parents about short-term and long-term consequences of ECC, its prevention and early detection, and the importance of regular dental attendance to provide optimal and timely dental care and to enhance parental awareness of children's oral

health in general. Further research is needed to explore caries-related factors linked to parental awareness and the relationship between parental awareness and perceived need for dental services.

## Conflict of Interests

Authors have no conflict of interest.

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# The dietary patterns of 12-year-old children and their awareness about the effect of diet on oral health in Iran

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**Original Article**

## Abstract

**BACKGROUND AND AIM:** Foods containing carbohydrates have a major effect on the pathogenesis of dental caries. There is a direct correlation between frequency of consumption of foods containing sugar and dental caries. The purpose of this study was to evaluate the dietary patterns of 12-year-old children and their awareness about the effect of diet on oral health in Iran.

**METHODS:** A cross-sectional survey was conducted on 1554 children aged 12 years in 5 provinces in Iran. Subjects were selected based on a multistage stratified cluster random sampling procedure. Data were collected by a culturally adapted questionnaire that included demographic data (such as sex, age, parents' job and education, and area), and questions about the frequency of consumption of cariogenic and non-cariogenic foods during the previous week.

**RESULTS:** The mean score of diet-related behavior was 17.5 ± 5.9 (from 40). Approximately, 31.0% of children ate sweet foods (chocolate/cake/biscuit/chips), and 39.4% drank soft drinks (sugared tea or coffee or milked/soda/syrup) more than once a day, while 15 percent of children consumed fresh fruit and raw vegetables more than once a day. Students living in urban areas had higher scores in diet-related behavior (18.3 ± 5.4 vs. 16.1 ± 6.4, $P < 0.001$). The mean scores in Tehran (the Capital of Iran) was significantly higher than other urban areas. In rural areas, the mean scores of villages in Esfahan province, Iran, were higher than other villages. Children whose mothers were employed, and had higher education had significantly higher scores ($P = 0.030$ and $P = 0.012$, respectively). Sex and fathers' education and job had no significant association with diet-related behavior.

**CONCLUSION:** The results showed that dietary patterns was not satisfactory, and the level of consumption of cariogenic foods was high. Study findings recommend that school-based oral health programs should be designed for modifying the dietary habits in Iran.

**KEYWORDS:** Oral Health; Dental Caries; Cariogenic Agents; Diet; Food Habits

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Globally, the most prevalent oral diseases in children is dental caries,[1] which is a multi-factorial disease.[2] Recent studies indicate that tooth decay is on the rise in the world.[3] Studies have shown a correlation between the frequency of consumption of sugars and other fermentable carbohydrates and dental caries. Besides sugars, other factors such as food or liquid form, duration of remaining in mouth, the composition of nutrients, eating sequence, the flow of saliva and hygiene of mouth are involved in the process of decay.[4]

The time of remaining of the food on the teeth depends on the form of the carbohydrate. Liquid sugar are transmitted through the oral cavity relatively quickly with restricted exposure time or adherence to

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the teeth surfaces compared to long-term sources of sugars, such as hard candy and breath mints. Also, it seems the frequency of consumption is a major factor in cariogenicity of the food,[4,5] and the exposure time may be affected by frequency and quantity of fermentable carbohydrates consumed.[4]

In contrast to carbohydrates, some foods are non-cariogenic, such as cheese, raw vegetables, meat rolls and fresh fruits. Epidemiological studies indicate that fresh fruits are not associated with dental caries, and increasing consumption of fresh fruits designed to replace soft drinks (sugared tea or coffee or milk/soda/syrup) in the diet is presumably to reduce dental caries rate in a population.[6]

A study showed that there was a consistent evidence of moderate quality supporting a relationship between the amount of sugars intake and tooth decay development.[7] The results of a systematic review showed that dental caries was lower when free-sugars intake was < 10% of total energy.[8] The results of studies in Zimbabwe,[9] Nairobi,[10] and Laos[1] showed a significant association between regular consumption of sugary products and a high Decayed, Missing, Filled Teeth index (DMFT) among students.

Twelve-year-old represent a standard age group that is used by the World Health Organization (WHO) to evaluate and compare dental caries.[11] In a national study by WHO in Iran (1989–1999), the prevalence of dental caries in 12-year-olds was reported to be 52.3%.[12] Despite the high rate of dental caries in this age group, there are no socio-epidemiologic data on oral health behaviors of children at national level. However, to determine the habits associated with dental caries risk in students, a diet history about food intake patterns, diet adequacy and consumption of fermentable carbohydrates is necessary. Therefore, this study was conducted to collect information about diet practice of 12-year-old children in different areas in Iran. Such data would be essential for health authorities to design educational school-based oral health programs.

## Methods

This cross-sectional study was approved by the Research Center of Oral Medicine, Kerman University of Medical Sciences, Iran (Code of ethics IR.KMU.rac.1394.26). Included in this study were 1691 twelve-year-old children studying in the sixth grade in various schools in five provinces (7 urban and 8 rural areas) of Iran in 2013-2014. The sample size was determined based on WHO guidelines in relation to the oral cavity diseases.[11] According to these guidelines, to obtain a sample representing a nation, in any age group, according to the expected incidence and severity of the disease (in this study, tooth decay), 4 clusters in the capital, two clusters in two major cities (each including two clusters), and a cluster of four villages in different parts of the area should be selected. The number in each cluster contains 25 to 50 individuals. In present study, given the high prevalence of caries, in addition to the capital (Tehran), six urban areas and eight rural regions in four provinces (Khorasan in the northeast, Isfahan in the center, Hormozgan in the south and Kerman in the southeast) were selected. After that, a multistage stratified random sampling technique was conducted in each province and cluster (school). In each stratum, a number of schools were chosen, and in each school a random sample of sixth grade students, according to the number of students in each school were selected.

A questionnaire was used for evaluation of diet-related practice of 12-year-old schoolchildren. The questions were about the frequency of taking of cariogenic and non-cariogenic foods during the previous week. The questionnaire was designed based on a systematic review of relevant articles,[13] and was translated and back-translated using standard methods from English to Persian, and the face validity and reliability of the questionnaire was evaluated. For this purpose, a preliminary study was conducted on 30 students in sixth grade with an interval of three weeks. The children's ability in order

to understand the questions and fulfill the questionnaire without any help was assessed. To test the reliability, the consistency rate in responses between the two intervals was measured, which was over 80% (by interclass correlation coefficient).

For assessment of reliability, Cronbach's alpha was computed, and reported as desirable (0.88).[14] The questionnaire included demographic data (such as sex, age, parents' job and education, and area of living), and the frequency of consumption of cariogenic and non-cariogenic foods during the previous week. Also, for further evaluation between dietary behaviors and awareness, three questions about knowledge on cariogenic foods were asked.

After coordination with the school authorities and student consent, the questionnaires were filled by children in school, supervised by teachers. The subjects received a full explanation for completing the questionnaires. The questions about diet practice were eight, and the answers to each questions were "several times a day, one time a day, several times a week, one time a week, seldom, and never". Therefore, the variable "diet practice" was measured with a score range of 0-40 to answers to questions about the frequency of consumption of cariogenic (chocolate, cake, toffee, sugared tea and milk) and non-cariogenic (fresh fruit and raw vegetables) foods during the previous week. For analysis of cariogenic foods, a score of 5 was given to the least frequent intake and a score of 0 was given to the most frequent intake, and for non-cariogenic items a score of 5 was given to the most frequent intake, and a score of 0 was given to the least frequent intake.

Data were processed and analyzed with SPSS (version 21, IBM Corporation, Armonk, NY). The statistical evaluation of means was done by analysis of variance (ANOVA), and the chi-square test was applied for comparison of proportions. In order to assess the relative effect of sociodemographic and "healthy diet practice" (HDP), linear regression was carried out. A P-value of $< 0.05$ was defined significant.

## Results

The response rate was 92 percent of the 1691 students, and questionnaires of 137 students, which were incorrectly filled, were not analyzed. Of the 1554 students surveyed in five provinces, 49.5% were male. Around 61.0% were from urban areas (Table 1).

**Table 1.** The basic demographic of the subjects according to living in urban and rural region

| Variable | Urban areas [n (%)] | Rural areas [n (%)] | Total [n (%)] |
|---|---|---|---|
| Sex | | | |
| Male | 465 (48.9) | 305 (50.5) | 770 (49.5) |
| Female | 485 (51.1) | 299 (49.5) | 784 (50.5) |
| Mother's education | | | |
| Illiterate | 35 (3.7) | 49 (8.1) | 84 (5.4) |
| 1-6 classes | 114 (12.0) | 101 (16.7) | 215 (13.8) |
| 7-9 classes | 91 (9.6) | 127 (21.1) | 218 (14.0) |
| 10-11 classes | 79 (8.3) | 125 (20.7) | 204 (13.1) |
| 12 class | 484 (50.9) | 165 (27.3) | 649 (41.8) |
| University | 147 (15.5) | 37 (6.1) | 184 (11.8) |
| Father's education | | | |
| Illiterate | 34 (3.6) | 41 (6.8) | 75 (4.8) |
| 1-6 classes | 113 (11.9) | 94 (15.6) | 207 (13.3) |
| 7-9 classes | 91 (9.6) | 132 (21.9) | 223 (14.4) |
| 10-11 classes | 34 (3.6) | 88 (14.6) | 122 (7.9) |
| 12 class | 504 (53.1) | 202 (33.4) | 706 (45.4) |
| University | 174 (18.3) | 47 (7.8) | 221 (14.2) |
| Mother's job | | | |
| Housekeeping | 612 (64.4) | 448 (74.2) | 1060 (68.2) |
| Specialized manual jobs | 125 (13.2) | 76 (12.6) | 201 (12.9) |
| Specialized non-manual jobs | 197 (20.7) | 74 (12.3) | 271 (17.4) |
| Managerial jobs | 16 (1.7) | 6 (1.0) | 22 (1.4) |
| Father's job | | | |
| No job | 29 (3.1) | 9 (1.5) | 38 (2.4) |
| Specialized manual jobs | 584 (61.5) | 485 (80.3) | 1069 (68.8) |
| Specialized non-manual jobs | 316 (33.3) | 107 (17.7) | 423 (27.2) |
| Managerial jobs | 21 (2.2) | 3 (0.5) | 24 (1.5) |

**Table 2.** The percent of the true responses to knowledge questions according to living in urban and rural region

| Knowledge questions | True (% total) | True (% urban) | True (% rural) | P |
|---|---|---|---|---|
| Do you think that drinking fruit juice will prevent tooth decay? | 73.4 | 78.6 | 70.0 | < 0.001 |
| Do you think that eating mint candies and pastilles will prevent tooth decay? | 69.8 | 73.8 | 63.6 | < 0.001 |
| Do you know which one of the following foods can cause tooth decay? | 86.0 | 87.6 | 83.4 | 0.220 |
| Cookie, chocolate, biscuit, cake, potato chips, and wafers | | | | |
| Fresh fruits, raw vegetables | | | | |
| I do not know | | | | |

The percentages of true answers to knowledge questions are shown in table 2. Urban students were significantly more knowledgeable about the impact of fruit juice and mint candies and pastilles on dental caries (Table 2).

The mean score of HDP was 17.5 ± 5.9 (from 40). Approximately 27.3% of students ate sugary foods (chocolate/cake/biscuit/chips), and 43.0% of them drank soft drinks (sugared tea or coffee or milked/soda/syrup) two or more times a day. However, the habit of eating fresh fruits and raw vegetables was stated by 15.0% of subjects two or more times a day (Figure 1). Seventeen percent of students consumed fresh fruits and raw vegetables once a day.

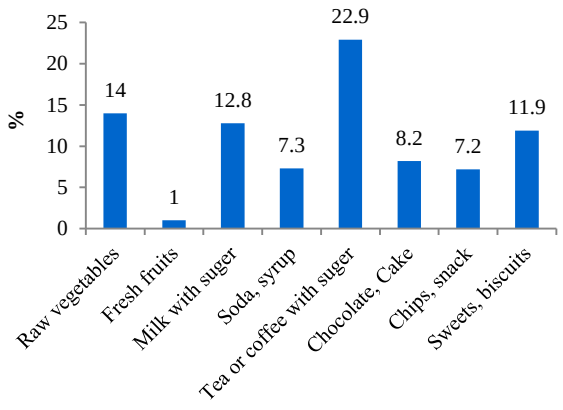



**Figure 1.** The percentage of students who used different snacks several times a day

Generally, students who were living in urban areas had higher scores in HDP (18.3 ± 5.4 vs. 16.1 ± 6.4, P < 0.001). The levels of HDP in urban and rural areas in different provinces are shown in figure 2 and 3.

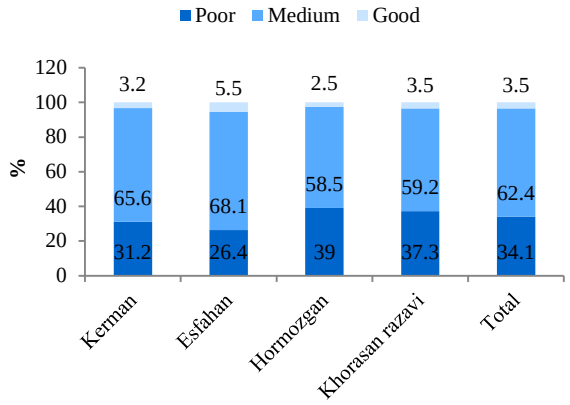



**Figure 2.** The level of diet related behavior of students in rural areas in different provinces

HDP scores in urban areas in various provinces were significantly lower than those in Tehran, the capital of Iran. Students residing in villages in Khorasan province had significantly lower mean score of HDP than other rural areas. Girls and boys had similar scores in HDP (17.4 ± 6.1 versus 17.5 ± 5.6, P = 0.740).

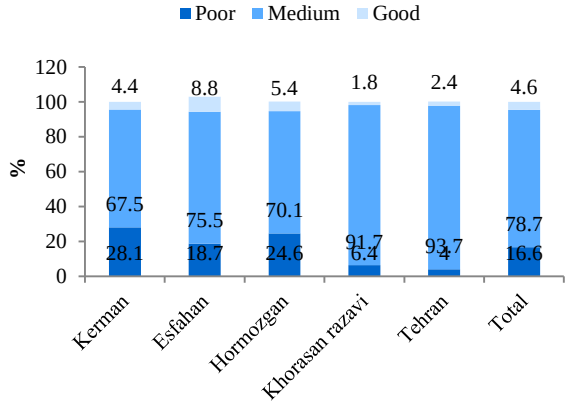



**Figure 3.** The level of diet related behavior of students in urban areas in different provinces

**Table 3.** Prediction of the diet practice score in the multivariate regression model

| Variables in diet practice | Mean ± SD | Coefficient regression (B)* | P |
|---|---|---|---|
| Province (urban areas) | | | |
| Tehran** | 47.8 ± 8.3 | | |
| Kerman | 43.0 ± 15.1 | -5.1 | < 0.001 |
| Esfahan | 47.3 ± 14.4 | -0.5 | 0.700 |
| Hormozgan | 44.1 ± 16.6 | -4.6 | 0.001 |
| Khorasan | 46.7 ± 11.0 | -1.5 | 0.500 |
| Province (rural areas) | | | |
| Esfahan*** | 42.5 ± 14.4 | | |
| Kerman | 41.1 ± 14.0 | -2.1 | 0.300 |
| Hormozgan | 38.1 ± 13.9 | -5.2 | 0.020 |
| Khorasan | 37.5 ± 17.8 | -5.5 | 0.006 |
| Location | | | |
| Urban | 45.7 ± 13.5 | 4.4 | < 0.001 |
| Rural | 40.3 ± 16.0 | | |
| Sex | | | |
| Boy | 43.7 ± 14.1 | 0.05 | 0.900 |
| Girl | 43.5 ± 15.3 | | |
| Mother education | | | |
| 12 classes or more | 45.6 ± 13.2 | 2.2 | 0.012 |
| < 12 classes | 41.3 ± 16.0 | | |
| Father education | | | |
| 12 classes or more | 45.2 ± 13.5 | 1.1 | 0.270 |
| < 12 classes | 41.3 ± 16.0 | | |
| Mother job | | | |
| Employers | 45.3 ± 13.0 | 1.5 | 0.030 |
| Housekeeping | 42.8 ± 15.4 | | |
| Father job | | | |
| Specialized manual jobs | 45.2 ± 14.4 | 0.5 | 0.500 |
| Specialized non manual and managerial jobs | 42.9 ± 15.0 | | |

SD: Standard deviation

*Adjusted for other variables included in the table; **Tehran is reference for urban areas. (The negative sign of regression coefficient showed that the average scores in Esfahan, Kerman, Hormozgan, and Khorasan were lower than Tehran); ***Esfahan for rural areas is reference. (The negative sign of regression coefficient showed that the average scores in Kerman, Hormozgan, and Khorasan were lower than Isfahan).

The results of multivariate regression analysis have been shown in table 3. In this model, HDP was inserted as dependent variable and sex, province and urbanization, parents' education and parents' job were considered as predictor variables. The most important factors were urbanization, province of residence, mothers' education and job. The results indicated that the average score for students in urban areas was 4.4 units higher than students in rural areas, and the difference was statistically significant [regression coefficients (β) = 4.4, P < 0.001]. The average score of children whose mothers had higher education (12 classes or more) was 2.2 units higher than students whose mothers had lower education (< 12 class) (β = 2.2, P = 0.012). Students whose mothers were employed had scores significantly higher than the average (1.5 units), in comparison with housewives (β = 1.5, P = 0.030). In addition, the regression coefficients showed that the average scores in urban areas in Tehran, and in rural areas in Esfahan were higher than other areas. There was no significant correlation between fathers' job and education with diet behavior of students.

## Discussion

The purpose of this research was to evaluate of the dietary patterns of 12-year-old children in Iran, which would aid the planning of oral health improvement programs. In the our

study, although it was shown that awareness of the students about the impact of too much sweets or soft drinks was high (86.0%), 43.0% of children had drank sweetened drinks (sweet tea or coffee/soda/syrups) and 27.3% had consumed some kind of sweet foods (chocolates/cakes/biscuits) two or more times a day during the previous week. This is higher than the outcome of an investigation in India, where 12.8% of the students with 10-19 years of age consumed sweet snacks one time a day.[15] Our finding is nearly identical to the results of two studies among 12-year-old schoolchildren from Iraq[2] and Albania[16]. In Iraq, 29.0% of children had consumed sweet snacks (chocolate/ice-cream/toffee) and 31.9% had consumed soft drink (sugared tea or milk) most frequently, more than once a day.[2] In Albania, 45.2% had consumed sweets and 26.6% had drunk soft drinks twice or more than twice a day.[16] The results of a study in India showed that consumption of cariogenic foods had no significant difference between students with good knowledge and poor knowledge that was similar to our findings, showing that diet behaviors are not fully explained by knowledge. In mentioned study, 24.5% of 12-year-old children had consumed a kind of sweet food (biscuits/jam/sweets) and 6.9% of students had drunk soft drinks more than 4 times a day.[17] Therefore, according to our study and the above-mentioned studies, it appears that consumption of cariogenic foods in developing countries is high.

Some epidemiological studies have indicated that fresh fruits and raw vegetables are non-cariogenic, and there is limited evidence to demonstrate fruit as a major factor in the development of dental caries. According to these studies, patients may be advised to eat more starchy main dishes and vegetables and whole fruit to replace sugary foods.[18] Therefore, although dried fruits may potentially be cariogenic, fresh fruits have not been associated with dental caries.[6] In addition, raw vegetables can lead to a boost in salivary flow and likely a decline in dental caries.[4] In our study, consumption of fresh fruits and raw vegetables was low. The habit of eating these foods was reported by 15% of students, multiple times a day, and by 17% once a day. In most studies on the oral health behavior in children, diet questions were about consumption of cariogenic foods, and there were no questions about consumption of non-cariogenic foods. Only researchers in both studies asked questions about consumption of fresh fruit. In a study conducted in India,[19] it was shown that 40.8% of 12-year-old children consumed fresh fruits at least once a day, which is high in comparison with our study (32.0%). In another study in Burkina Faso,[20] consumption of fresh fruit at least once a day was 36.0% which was similar to our study.

Although dietary habits among children who lived in urban areas, children whose mothers were employed, and students whose mothers had higher education were significantly better, the amount of consumption of cariogenic foods among all the subjects was high. This could be owing to the lack of educational programs about the effect of diet (form, frequency and composition of food) on dental caries. Therefore, this is a strategy for professionals in the field of health to determine the diet-related caries and health-risk behaviors of population, and to promote oral health of children by planning educational programs for students, teachers and parents. Oral health education should include dietary and nutritional advice on oral health. Individuals should be recommended: 1. to decrease the frequency of intake of sweet foods; 2. to have balanced diets including a variety of foods (grains, fruits, and vegetables); 3. To combine dairy products (cheese), with fermentable carbohydrates and other sugars, add raw fruits or vegetables to the meals to boost the flow of saliva; 4. To limit consumption of sugary and acidic beverages; and 5. To chew sugar-free gums between meals and snacks.[6,21,22]

Anyway, this research might have had

certain limitations. In the present study, the information on diet practice was gathered by a questionnaire, and might be subjected to biased. It is possible that students have overestimated positive behaviors that are socially desirable answers, such as consumption of non-cariogenic foods and underestimated negative practices, such as consumption of cariogenic foods. Therefore, some over reporting would be considered likely with respect to the answers on behaviors towards healthy practice. Furthermore, recall bias must be taken into account that probably occurs in association with diet history and the students may have forgotten the exact number of foods. Furthermore, we cannot generalize the findings of this cross-sectional study, because oral health-related behaviors, in addition to knowledge and attitudes, are related to various factors like the socio-economic status, habits, and lifestyle. However, according to our research, it appears that consumption of cariogenic foods among 12-year-old children in Iran is high. And the study gives a possible association of the existing diet behaviors in the study population with the study variables.

Therefore, there is a need for further studies in the future. These studies should be designed to upgrade oral health behaviors and to find the most effective method of oral health education which changes individual behavior and sustains it for a longer period.

## Conclusion

The results of our research indicated that dietary patterns were not satisfactory, and despite the relatively good knowledge, the amount of consumption of cariogenic foods was high. Therefore, we recommend designing school-based oral health educational programs with emphasis on the role of diet on dental caries that can have satisfactory effects on promotion of oral health due to effective networking within the schools.

## Conflict of Interests

Authors have no conflict of interest.

## Acknowledgments

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# Bibliometric Study of periodontal publications by Iranian authors between 1995-2015: A Medline approach

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**Short Communication**

## Abstract

**BACKGROUND AND AIM:** One of the methods to measure scientific achievement in a particular field is bibliometric analysis of scientific publications. The main goals of this study were bibliometric analysis of Iranian periodontal literature, study design, and topics investigated in periodontal research published from 1995 to 2015 in PubMed.

**METHODS:** PubMed search strategy was developed to identify all the international papers published in the field of periodontology (periodontics) by the Iranian scientists between 1995 and 2015. We performed the search protocol by typing "periodont*" in the title/abstract search box, and also the word "Iran" in the affiliation search box. We reviewed all the abstracts and removed the unrelated articles from the study. Retrieved data were analyzed using SPSS.

**RESULTS:** Total of 178 papers from 83 peer-reviewed journals were found from the PubMed database and were reviewed. Seventy articles (37.4%) were published in Iranian PubMed indexed journals, and 117 (62.6%) papers were published in the journals of other countries. According to the publication type of the articles, 173 (92.5%) of them were original research papers, 6 articles (3.2%) were review papers, and 5 papers (2.7%) were case reports. The results indicated that maximum number of articles was published in 2013. The most frequent article types were cross-sectional studies (29.9%) followed by clinical trials (22.5%) and case-control studies (18.7%).

**CONCLUSION:** In recent years, the periodontal research production has made significant progress in Iran. It seems that the Iranian periodontists should emphasize more on the design and quality of works in addition to the quantity of articles.

**KEYWORDS:** Bibliometrics, Medline, Periodontics, Authorship

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One of the methods widely used to measure scientific achievement of a research center, university or country in a particular field of study is bibliometric analysis of the scientific publications.[1] Bibliometric analysis is a set of statistical methods that are used to measure the quality and quantity of scientific research outputs.[2] Bibliometric study of a subject can help research policy makers to frame policies and develop a coherent strategy for the growth of the subject.[3]

Like the other fields of the medical sciences, the development of academic research has substantial influences on the improvement of dental health system. Periodontics is an integral part of dentistry and has a principal role in interdisciplinary dental studies. However, to date, there is lack of studies on contribution of the Iranian researchers to the field of periodontics. There have been some studies on bibliometric analysis in various other fields of dentistry in Iran and for periodontics in other parts of the world.[4-8] However, we could not find any published document about bibliometric study in periodontal literature in Iran.

The objectives of this study were to carry out a bibliometric analysis of all Iranian periodontal literature published from 1995

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to 2015 in PubMed.

## Methods

A PubMed search strategy was developed to identify all the international papers published in the field of periodontology (periodontics) by the authors affiliated to Iranian institutions. The research was conducted in April 2015. We activated the filters in PubMed website to consider the papers published between 1 January 1995 and 1 January 2015. We performed the search protocol by typing "periodont*" in the title/abstract search box and the word "Iran" in the affiliation search box.

All the abstracts were reviewed by both of the authors and the papers not related to the field of periodontology were excluded from the study. Finally, 187 articles were selected, constituted our database, and were reviewed.

A checklist for retrieving the data from the articles was prepared while the following information/criteria were considered:

Year of publication, number of authors, name and country of publication of the journal [indicated in National Library of Medicine (NLM) catalogue], specialty of the first author, name of the university and the department mentioned in the affiliation of first author, type of article (original article, case report, review article or letter to the editor), and study design (systematic review, narrative review, clinical trial, cohort study, case-control, cross-sectional, case series, case report, in vitro study, animal study or letter to editor paper).

The full text of the paper was retrieved and reviewed if it was not possible to obtain the above information from the title and abstract alone.

We pursued a descriptive research approach by means of bibliometric analysis. The data obtained were organized and analyzed using SPSS (version 16, SPSS Inc., Chicago, IL, USA). Descriptive statistics were applied to summarize the results.

## Results

The mentioned search protocol resulted in a total of 365 articles. Employing the methodology described, 178 papers were finally selected from the PubMed database.

The articles were published in 83 different peer-reviewed journals. Among these, 66 journals published just one or two papers from the Iranian researchers in the field of periodontics during the study period (20 years). The "Dental Research Journal", followed by "Journal of Dental Research, Dental Clinics, Dental Prospects" published the largest number of papers in the field of periodontics from Iranian authors (16 and 14 respectively).

Based on the country of publication, 70 papers (37.4%) were published in Iranian PubMed indexed journals and 117 (62.6%) articles were published in the journals of other countries, mostly in American journals (18.2%), followed by the journals published in England (10.2%) and India (8.0%).

Years 2012 and 2013 were the most prolific years in this regard with 21 and 20 international published papers, respectively.

According to the publication type, 173 (92.5%) were original research papers, 6 articles (3.2%) were reviews and 5 papers (2.7%) were case reports. There were only 3 letters to the editor.

The mean number of authors per article was 4.67 with a range of 1 to 9 authors. First authors of the retrieved papers were from 22 universities of Iran. The top 5 prolific universities of Iran in periodontal sciences are listed in table 1. Most of the papers (according to the affiliation of the first authors) originated from the universities located in the capital city of Iran, Tehran (26.7%).

The largest number of articles was published in 2013. Figure 1 depicts the inter-annual variation in the publication of Iranian papers in this field of study.

Based on the study design of the articles, the most frequent article types were cross-sectional studies (29.9%) followed by clinical trials (22.5%) and case-control studies (18.7%) (Figure 2).

**Table 1.** Frequency of article published by Iranian authors in the field of periodontology from 1995 till 2015 according to the university affiliated

| University | n (%) |
|---|---|
| Beheshti | 29 (15.5) |
| Esfahan | 22 (11.8) |
| Mashhad | 22 (11.8) |
| Tehran | 21 (11.2) |
| Tabriz | 20 (10.7) |
| Shiraz | 15 (8.0) |
| Babol | 11 (5.9) |
| Azad Tehran | 8 (4.3) |
| Hamadan | 7 (3.7) |
| Qazvin | 4 (2.1) |
| Azad | 3 (1.6) |
| Zahedan | 3 (1.6) |
| Baghiatollah | 3 (1.6) |
| Ahvaz | 3 (1.6) |
| Yazd | 2 (1.1) |
| Kermanshah | 2 (1.1) |
| Shahed | 2 (1.1) |
| Hormozgan | 1 (0.5) |
| Kerman | 1 (0.5) |
| Guilan | 1 (0.5) |
| Tarbiat | 1 (0.5) |
| Chabahar | 1 (0.5) |
| Not affiliated by university | 4 (2.1) |
| Total | 187 (100) |

About 60.9% of the papers were published under the affiliation of a periodontology department. The other published papers (39.1%) had the affiliation of first author from a department or research group other than the periodontology or periodontics.

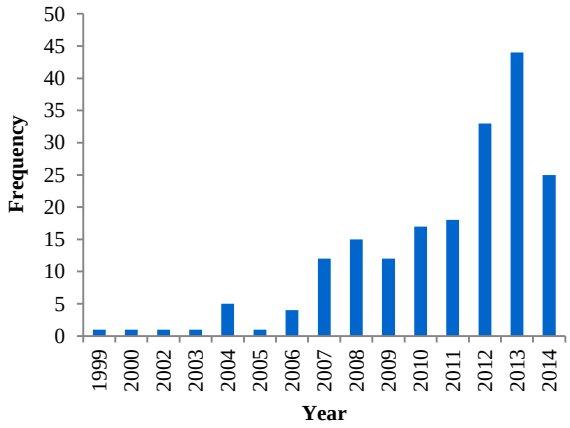



**Figure 1.** Frequency of paper published by Iranian authors in periodontology field in PubMed data base from 1995 till 2015
There was not any citation from 1995 till 1999

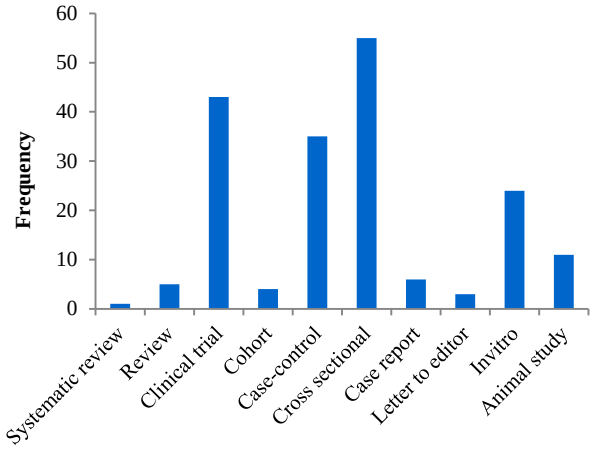



**Figure 2.** Frequency of different designs of article published by Iranian authors in the field of periodontology in PubMed data base from 1995 till 2015

## Discussion

Evaluation of the research output is necessary and important for the scientific societies, universities, and funding organizations to frame policies and take necessary actions.[9,10] To the best of the authors' knowledge, this is the first study that evaluated Iran's research productivity in the field of periodontology.

We are aware that a lot of valuable papers from Iranian scientists are not included in Medline database and consequently, were not analyzed in our study.[11] However, we used the PubMed as the data source, because of its open access and international visibility.

The first noticeable pattern in the Iranian scientific research papers in the field of periodontics is its concentration in the 4 main universities. More than half (50.3%) of the whole articles in this field were published by authors with affiliation of only 4 universities (Tehran, Shahid Beheshti, Esfahan and Mashhad) and the other half of the papers were published by researchers of more than 18 universities and research centers. These 4 dental faculties have a lot of research facilities, a large number of academic members and research funding, compared to other Iranian dental faculties.[12]

According to the results, about 80% of the articles were published from 2009 to 2014, and just 38 papers (20.3%) were indexed over

the previous 14 years from the Iranian authors in the field of periodontics. In the recent years, Iran has gained one of the fastest growth rates in scientific production in the world.[13-16] This could be also the first reason of this increasing trend in the number of publications in this specific field of research. PubMed Indexing of some Iranian peer-reviewed dental journals, during recent years, can be considered as another reason of significant increase in the number of Iranian papers in the field of periodontics, after 2009.[17] This growth has previously been reported in a number of articles regarding pedodontics and orthodontics, published by the Iranian scientists during the past decade.[5,6]

The number of case-report papers (3.2%) and review articles (2.7%) were relatively small, comparing with the absolute number of the papers. Case-reports are important for the advancement of clinical science and usually need less preparation in terms of manpower and cost.[18] Case-reports could be quickly written after a fortuitous encounter with a patient with rare disease.[19] On the other hand, systematic reviews are so important regarding the evidence based dentistry, and are ranked as first quality articles.[20] This type of research also does not need large amounts of economic resources or manpower. It is considerable that the second most frequent type of study published by Iranian authors in this field was clinical trials. Although we did not attempt to categorize the quality and type of clinical trials according to randomized and controlled, it is obvious that randomized clinical trials are considered as strong evidence in evidence-based methods of prevention and treatment in dentistry.[21] However previous investigations regarding the critical appraisal of Iranian clinical trials in the field of dentistry showed that the necessary criteria have not been observed in an acceptable level in the works published.[22] Future studies should concentrate on evaluating the quality of Iranian periodontal papers.

It should be emphasized that, in the PubMed, only the affiliation of the first author is presented.[23] Hence, articles with an Iranian scientist as the corresponding author or coauthor could be missed by this method if the first author was not from Iran. Moreover, in the past years, some Iranian researchers did not pay enough attention to the principles that should be considered in writing the scientific affiliations. This fact could also lead our search protocol to miss out some papers that were belonging to Iranian authors.

## Conclusion

In the recent years, the number of periodontal research productions in Iran demonstrated a constant growth. The change was most obvious in certain journals in Iran (domestic journals). The most frequent Iranian periodontal papers published in PubMed-indexed Journals were cross-sectional studies followed by clinical trials. It seems that the Iranian periodontists should consider to conduct more systematic reviews and to publish more clinical case-reports in international peer-reviewed journals.

## Conflict of Interests

Authors have no conflict of interest.

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