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Haapasalo M, Qian W: Irrigants and Intracanal Medicaments. In: Ingle JI, Bakland LK: Endodontics6. 6<sup>th</sup> ed. BC Decker Inc, Hamilton; Ontario, Canada. 2008; Chapter 28: 997-9.

## <u>Book</u>

Neville BW, Damm DD, Allen CM, Bouquot JE. Oral and maxillofacial pathology. 2<sup>nd</sup> ed. Philadelphia: W.B Saunders Co.; 2002. pp. 533–87.

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## Effect of environmental tobacco smoke on oral pigmentation: A systematic review

Parsa Firoozi MD<sup>1</sup>, Robab Noormohammadi MD<sup>2</sup>, Sona Rafieyan MD<sup>3</sup>

## **Review Article**

## Abstract

**BACKGROUND AND AIM:** Oral pigmentation is a condition in which the color of oral mucosa such as gingival mucosa changes. Some exogenous and endogenous factors may lead to oral pigmentation. Secondhand smoke (SHS) or environmental tobacco smoke (ETS) is indirect smoking of an active smoker's exhalation that can lead to cardiovascular, respiratory system, and some oral diseases. The aim of this review study is to assess the effect of SHS on oral pigmentation.

**METHODS:** Data in this study were collected from PubMed, MEDLINE, and Scopus databases with the Medical Subject Headings (MeSH) keywords (Passive Smoking, Secondhand Smoke, Environmental Tobacco Smoke, Smoke Pollution, Involuntary Smoking, and Pigmentation) in the English language among the studies conducted in the period of 1990 to 2019. All records were imported into the EndNote software and duplicate articles were removed. The titles and abstracts of all records were pre-screened and among the articles remained, the relevant ones were selected for review based on the inclusion and exclusion criteria. To assess the quality of the studies, the Strengthening the Reporting Observational Studies in Epidemiology (STROBE) checklist was used.

**RESULTS:** Based on the STROBE checklist, the quality of the studies was assessed and finally, seven studies were included in the review, with six of them conducted about children and young adults and one about women. 6 (85.7%) articles showed a strong correlation between ETS and oral pigmentation and 1 (14.2%) showed no correlation.

**CONCLUSION:** ETS probably was correlated to the oral pigmentation.

**KEYWORDS:** Passive Smoking; Mouth Pigmentation; Tobacco Smoking; Environmental Tobacco Smoke Pollution

**Citation:** Firozi P, Noormohammadi R, Rafieyan S. **Effect of environmental tobacco smoke on oral pigmentation: A systematic review.** J Oral Health Oral Epidemiol 2020; 9(1): 1-6.

P igmentation in the oral cavity has been defined as a change in the color of the oral mucosa mainly caused by the melanin-induced pigmentation which may lead to esthetic problems.<sup>1</sup> Becker expressed the presence of melanocytes in the epithelium for the first time.<sup>2</sup> The presence of melanocytes in the gingival tissue was later identified by Laidlaw and Cahn.<sup>3</sup> Melanocytes are present in the basal layer of epithelium and if stimulated by stimuli such as nicotine and benzopyran in cigarette smoke, they increase the production of melanosomes containing

melanin, hence causing oral pigmentation. Melanin is derived from tyrosine during biochemical processes.<sup>4,5</sup> Oral pigmentation is the result of either pathologic or physiologic factors. The pathologic factors are divided into two main categories: exogenous factors and endogenous factors, with exogenous agents including amalgam tattoo, lead poisoning, antimalarial drugs, and cigarette consumption. The endogenous factors are Peutz-Jeghers syndrome (PJS), Addison's disease, hormonal disorders, and physiological factors.<sup>6</sup> Oral pigmentation occurs in various areas such as palate, ventral

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surface of the tongue, labial mucosa, and attached gingiva, with the attached gingiva being the most common place.7 Oral pigmentation in dark-skin individuals is more prevalent compared to the white-skin ones.8 It is also less common among Europeans in comparison to the Asians. Indians have the highest percentage of oral pigmentation in Asia.7,9 There is a close relationship between oral pigmentation and smoking, thus there is a close relation between the number of years of quitting smoking and the reduction of pigmentation. Moreover, increased pigmentation in the oral cavity has been reported due to an increase in the number of cigarettes consumed.5,10 Passive smoking or environmental tobacco smoke (ETS) is the inhalation of a smoker's cigarette smoke.11 ETS causes numerous health problems for humans: Exposure to ETS can cause respiratory diseases, lung cancer, cardiovascular diseases (CVDs), and death.5,12,13 Exposure to ETS through the placenta has also been reported. It can also cause behavioral abnormalities and early childhood cancers.14 Other complications such as orofacial cleft, short clinical crowns (SCC), and dental caries can all be attributed to ETS.15 ETS-induced vasoconstriction reduces blood flow to tissues so it may lead to tissue damage.<sup>16</sup> The aim in this review study is to evaluate the effect of ETS on oral pigmentation.

#### **Methods**

Studies in this systematic review were assessed by systematic searching in the online databases PubMed, Scopus, and MEDLINE. All keywords were checked with the Medical Subject Headings (MeSH) database. The search phrase was ("passive smoking OR secondhand smoke (SHS) OR environmental tobacco smoke (ETS) OR Smoke Pollution OR Involuntary Smoking") AND ("pigmentation"). The searches were limited to the published and peer-reviewed articles in the English language from 1990 to 2019. The inclusion criteria were full-text

articles in the English language, articles related to pigmentation in the oral cavity, and human subjects. The exclusion criteria included unpublished articles, non-peerreviewed articles, conference reports, case reports, and letter to editors. All data were imported into the EndNote software and duplicate studies were deleted. Two reviewers (PF, SR) pre-screened the title and abstract of all search records independently. The articles that did not meet the inclusion criteria and were irrelevant to the study were excluded. Disagreement about eligibility was resolved by a discussion between the two reviewers. If the articles met the inclusion criteria, their full-text versions were obtained for assessment. Two reviewers (PF, RN) evaluated the remaining full-text articles based on the inclusion criteria. The irrelevant articles according to the title, abstract, and body text were excluded.

To evaluate the quality of the final studies, Strengthening the the Reporting Observational Studies in Epidemiology (STROBE) checklist<sup>17</sup> was used. This checklist includes 22 items and each item was allocated a score of 1 in this study. The studies with a total score of less than 15 were excluded and the ones scoring 15 to 22 were included in the review (Table 1). Eventually, for the remaining studies, the data regarding the references, year of publication, study design, sample size, intervention, and the main outcomes were extracted and imported into the Excel software. The search process is depicted in а flowchart demonstrated in figure 1.

## **Results**

The study selection procedure in this systematic review has been detailed in figure 1. Initially, 20 articles were found after removing duplicate records. Finally, 7 articles were included in the systematic review after the quality assessment. The main data of each study is illustrated in table 1. 6 studies were conducted on children and young adults and 1 study was about women.

References	Study Design	Sample Size	Intervention	Main outcomes	Score in the STROBE checklist
Hanioka et al. <sup>5</sup>	Case-control study	59 patients	Two independent examiners evaluated gingival pigmentation via oral photographs MIS was used to determine gingival pigmentation	Children who had smoker parent(s) showed more gingival pigmentation	18
Hajifattahi et al. <sup>18</sup>	Case-control study	400 patients	Case and control groups matched in terms of skin color. Oral pigmentation of the two groups was recorded. MIS was used to determine gingival pigmentation.	Oral pigmentation was seen in 61% of the control group (non-exposed) and 75% of the case group (exposed) ( $P < 0.005$ )	19
Sridharan et al. <sup>8</sup>	Cross-sectional study	153 patients	Urinary cotinine biomarker was obtained for participants. GPI and intra-oral photographs were used to evaluate gingival pigmentation. MIS was used to determine gingival pigmentation.	Increase in the urinary cotinine in all exposed participants More gingival pigmentation in passive smokers (P < 0.050)	17
Yadav et al. <sup>19</sup>	Cross-sectional study	117 patients	Participants were divided into 2 groups (group 1: 10-14 years; group 2: 15-21 years). MIS was used to determine gingival pigmentation.	<ul> <li>17.24% of group 1 showed no pigmentation (MIS 0), while 5.08% pigmentation was observed in group 2 (P &lt; 0.001)</li> <li>On the other hand, 38.98% of group 2 showed band-like hyperpigmentation (MIS2) vs 17.24% in group 1.</li> </ul>	17
Moravej- Salehi et al. <sup>6</sup>	Retrospective cohort study	100 patients	Clinical examination was carried out to evaluate gingival pigmentation. MIS was used to determine gingival pigmentation	54% of passive smokers vs. 28% of controls showed gingival pigmentation ( $P < 0.050$ ) House floor area was correlated with gingival pigmentation ( $P < 0.025$ )	17
Ponnaiyan et al. <sup>9</sup>	Cross-sectional study	200 patients	GPI was used for extension of gingival pigmentation and DOPI was used for the intensity of gingival pigmentation.	Intensity and extension of oral pigmentation were more observed in passive smokers (P < 0.001).	17
Hasmun et al. <sup>15</sup>	Case-control study	44 patients	Gingival pigmentation was assessed using MIS.	Gingival melanin index was the same in children exposed and unexposed to ETS	16

#### Table 1. Information of the studies included in the review

ETS: Environmental tobacco smoke; MIS: Melanin Index Score; GPI: Gingival pigmentation Index; DOPI: Dummett-Gupta oral pigmentation index; STROBE: Strengthening the Reporting Observational Studies in Epidemiology



Figure 1. Flowchart of studies considered in the review

The sample sizes varied from 44 to 400. The oldest and newest studies were carried out in 2005 and 2017, respectively. Among these 7 studies, 3, 3, and 1 were case-control, cross-sectional, and retrospective cohort studies, respectively. In the oral cavity, the most common site discussed was gingival tissue. All ETS-exposed individuals had at least one smoker parent or husband. Melanin Index Score (MIS) or Gingival Pigmentation Index (GPI) that are the same, were used in all studies to evaluate the oral (or gingival) pigmentation.

#### **Discussion**

In this study, 7 articles performed to evaluate the effect of ETS on oral pigmentation were reviewed. These studies showed that ETS has a strong relationship with oral pigmentation.5,6,8,9,15,18,19 In a study bv Hanioka et al.<sup>5</sup> Japan, gingival in pigmentation was evaluated using oral photographs taken by a digital camera among 59 children in the age range of 6 to 16 years old. In this study, the smoker parents were identified using oral photographs. Two examiners independently reviewed the photographs and classified gingival pigmentation based on MIS considering 3 main scores of 0, 1, and 2 indicating no pigmentation, solitary unit of pigmentation, and continuous band-like hyperpigmentation,

respectively. In this study, children who had smoking parent(s) showed more gingival pigmentation. Furthermore, in this study, different lesions similar to the ETS-induced pigmentation like melanoma, antimalarial drug pigmentations, and some others were mentioned, but there was no standard criterion for this distinction. A standard scale may be necessary for differentiation between these lesions. There was no gender predilection oral pigmentation. in Additionally, continuous band-like hyperpigmentation was more obvious than the solitary forms in the subjects but surprisingly, the number of smoking parents in children with a solitary pattern of pigmentation was more in comparison to the children continuous pattern with of pigmentation. Maybe further studies need to be performed to solve this contrast. Skin color matching should be considered by researchers for more reliable results.<sup>5</sup> In a retrospective cohort study in Iran. researchers evaluated 200 children (10 to 11 year-old) with no gender predilection in oral pigmentation. They used a standard scale for the classification of skin colors and matched them. They used the MIS scale in order to assess oral pigmentation. More gingival pigmentation was observed in ETSexposed children (P < 0.005). Fair skin children were more susceptible to oral pigmentation in comparison to the dark skin children. Besides, the anterior surface of the jaws was the most common site for oral pigmentation.18

In a study in India, the same oral pigmentation evaluation method (oral photographs taken by a digital camera) was used as the one used in the study by Hanioka et al.<sup>5</sup> It seems that the method in this study was more reliable compared to the similar method carried out in Japan given the use of standard lighting and backdrop conditions. They also obtained urine samples from their subjects to assess the cotinine level (a metabolite of nicotine) and used the MIS scale in order to assess oral pigmentation like previous studies. They also highlighted the number of years of exposure of the subjects to ETS that may play a key role in the prevalence of oral pigmentation.<sup>8</sup> Yadav et al. carried out a study similar to the studies carried out in Japan and India and used the same methods. They also prooved that there is a logical relationship between the number of cigarette packs smoked by parents and the gingival pigmentation.<sup>19</sup> The only study on women was conducted in Iran bv Moravej-Salehi et al.,6 which showed that pigmentation in buccal mucosa was very rare and the most commonplace for oral pigmentation was the labial surface of the jaws. They showed a connection between house floor area and oral pigmentation in women. Ponnaiyan et al.9 used a different evaluating method the gingival for pigmentation called Dummett-Gupta oral pigmentation index (DOPI) which contains 4 main degrees as 0, 1, 2, and 3 indicating pink, mild brown, moderate brown or mixed brown and pink, and deep brown or blue, respectively Hasmun et al. in New Zealand evaluated children (1-5 year-old) and showed quite different results from the previous studies and demonstrated that the mean melanin index was the same in both ETSexposed and unexposed children. This finding may originate from the lack of years of exposure in these children.

The main limitation in the present study was the insufficient number of articles and high heterogeneity in the studies in terms of the number of years of exposure and number of cigarettes smoked in the subjects' environment. Further studies are needed to solve these heterogeneities and to consider women and adult men. Moreover, it is essential to perform more investigations on other areas involved in the oral cavity.

#### Conclusion

Oral pigmentation is a color-changing condition that occurs in the oral cavity in different areas such as the labial surface of the jaws, buccal mucosa, and gingival tissue and may also lead to unhealthy outcomes such as esthetic problems. Based on the studies, ETS may cause pigmentation in the oral cavity, especially in children and women. Practitioners should inform families about this problem to prevent oral pigmentation caused by ETS and to prevent the associated systematic diseases.

#### **Conflict of Interests**

Authors have no conflict of interest.

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## Assessment of oral health literacy: A systematic review of validated worldwide versus Persian measures

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## **Review Article**

## Abstract

**BACKGROUND AND AIM:** In today's world, oral health literacy (OHL) plays a considerable role in the improvement of quality of life and decrease of health inequalities as one of the most important components of public health. Special attention to the measurement tools of this index is crucial to increase OHL level in the society. This study aimed to systematically review the existing validated tools used to measure OHL level in the world.

**METHODS:** To meet the study objectives, we searched five important electronic databases [PubMed, Web of Science (ISI), Scopus, Embase, and Google Scholar] using the keywords extracted from Medical Subject Headings (MeSH), which was completed by manual search. Afterwards, studies were screened based on the systematic review protocol and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram. Following that, the selected suitable articles were assessed to extract related information.

**RESULTS:** 7 main tools and 19 secondary measures as subgroups have been validated to assess OHL. Some of these tools have been translated into different languages and validated based on the nationality and culture of each region. Currently, there are different tools for measuring OHL worldwide in 13 languages, classified into three categories based on their structure. In addition, we realized that just two OHL measurement tools have been validated in Persian, so far.

**CONCLUSION:** The present study clearly demonstrates the need for a comprehensive and effective tool for measuring OHL. In addition, more studies must be carried out in this field. Given the gap between valid English and Persian tools, it is recommended that a standard tool be established in Persian. Efforts to address these gaps can be a prelude to further research.

**KEYWORDS:** Oral Health; Health Literacy; Questionnaire Design; Systematic Review

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urrently, use of novel approaches to oral health is considered necessary since oral hygiene care can have much more effects on health promotion. In this respect, oral health literacy (OHL) has been introduced as one of the most important approaches in this domain. OHL is thus assumed as a sub-group of health literacy skills.<sup>1</sup>

In accordance with the rules of procedure released by the World Health Organization (WHO), health literacy has been defined as the ability to obtain, process, and understand basic information about health and necessary services to gain access to complete health.<sup>2</sup> Thus, the most widely-used definition of OHL is the ability of individuals to obtain, process, and understand information related to oral health.<sup>3</sup>

Promoting OHL can be effective in improving health-related behaviors, increasing quality of life, reducing social inequalities, avoiding waste of economic resources, enhancing general health due to mutual relationships between oral health and general health, as well as facilitating decision-making,

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implementation, and provision of services by policy-makers in the field of oral health.<sup>4</sup>

OHL is comprised of different dimensions, so developing and evaluating an appropriate assessment tool is of special importance to incorporate all features. To achieve these goals, different assessment tools have been so far introduced to scientific communities.<sup>4</sup> The most commonly-used ones in the domain of OHL have originated from the Rapid Estimate of Adult Literacy in Medicine (REALM) and the Test of Functional Health Literacy in Adults (TOFHLA), extensively applied to assess general health literacy.<sup>5</sup>

The main assessment tools in OHL in dentistry are the Rapid Estimate of Adult Literacy in Dentistry (REALD) and the Test of Functional Health Literacy in Dentistry (TOFHLiD). The REALD is known as a tool developed on the basis of word recognition and TOFHLiD is one of the assessment tools to reflect on the ability of respondents in of understanding and terms applying information.<sup>6</sup> The Comprehensive Measure of Oral Health Knowledge (CMOHK) is also being used to assess communication skills as well as non-numerical conceptual knowledge for OHL.7

Due to the large quantity of assessment tools for OHL in various languages and highlighting the importance of assessing OHL in individuals and populations, the main purpose of the present study was to collect, summarize, and classify assessment tools available for OHL in the form of a systematic review.

#### Methods

The present study was a systematic review designed based on Cochrane's guidelines.<sup>8</sup> The first step in applying evidence-based medicine (EBM) is to design a Problem/Patient/Population, Intervention/ Indicator, Comparison, Outcome (PICO) framework or to address an appropriate research question that is clear, specific, and answerable,<sup>9</sup> which was as follows to conform to the subject of the present study:

P = Problem/Patient/Population: All OHL assessment tools across the world

I = Intervention/Indicator: Translations and validations of health literacy assessment tools

C = Control/Comparison: Standardized versions in Persian compared with those in other languages

O = Outcome: Ratio of standardized Persian assessment tools to all those existing in the world

A comprehensive and systematic search was also fulfilled to identify and access all published articles in this field. To this end, the databases of PubMed, Web of Science (ISI), Scopus, Embase, and Google Scholar were checked with no time limits to enhance the sensitivity of the study. Besides, systematic search and categorization of the retrieved articles was performed by two researchers. Additionally, manual search was utilized in order to obtain missed references from reference links in existing articles. references Likewise, two different in specialized theses related to the subject of the study were reviewed, and finally two new references were added.

Moreover, an extensive search strategy was accomplished using a wide range of keywords. Then, numerous related combinations of keywords were used in search queries to access published articles to the utmost possible extent. The keywords in this search strategy were extracted from Medical Subject Headings (MeSH) as a controlled vocabulary thesaurus used for indexing articles for PubMed. The keywords used in search strategy are listed in table 1. To increase the sensitivity, synonyms of the words were also searched. After searching for keywords related to the independent variable, they were combined with "OR".

A similar search was performed for keywords related to the dependent variable; the result of these searches was then combined with "AND". After doing advanced and extensive search via various combinations of keywords, based on titles and abstracts, the obtained records were imported into the EndNote software (version X7).

Table	1.	Keywords	used	in	search	strategy
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Oral health	Literacy	Measure
Oral health	Literacy	Measure
Oral status	Education	Questionnaire
Dental health*	Information	Scale
Dental status		Instrument
Tooth health		
Tooth status		

Then, articles in the EndNote library were reviewed. Initially, duplicated ones were removed. After that, titles and abstracts of the articles were assessed based on inclusion and exclusion criteria. In case of researchers' differences of opinions, the full texts of the articles were comprehensively reviewed until a consensus was reached.

The inclusion criteria were all epidemiological studies assessing OHL as an outcome with using a validated assessment tool and all studies focusing on validation, development, or translation of tools associated with assessment of OHL. On the other hand, the exclusion criteria included published articles in languages other than English and Persian as well as no access to full texts of articles (n = 1) or no access to abstracts of unpublished ones (n = 3). All studies including letter-to-editor, systematic review, and scoping review were excluded but cross-sectional, case-control, cohort, and clinical ones remained in this study.

In the process of data collection, tools originated from major OHL assessment tools were extracted and introduced as sub-groups of the main parenting tool. Moreover, the language of the extracted tools as well as their year of validation and first authors' names were categorized and recorded to achieve comprehensive dominance.

#### **Results**

Figure 1 illustrates the process of selecting articles for present systematic review. As it is

seen, from the first 6731 articles searched, finally, 42 articles were reviewed.



Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram

Table 2 illustrates that OHL assessment tools are generally divided into three main categories based on structure. First category which focuses on word recognition contains 7 tools, the second category which focuses on comprehension, word recognition, and numeracy contains 12 tools, and the third one which focuses on communication skills and non-numerical conceptual knowledge contains 2 tools. The name and abbreviation of each of the tools are given in table 2.

Structure	Tool	Abbreviation
Word recognition	Rapid Estimate of Adult Literacy in Dentistry (99 items)	REALD-99
	Rapid Estimate of Adult Literacy in Dentistry (30 items)	REALD-30
	Rapid Estimate of Adult Literacy in Medicine and Dentistry	REALM-D
	Hong Kong Rapid Estimate of Adult Literacy in Dentistry	HKREALD-30
	(30 items)	
	Rapid Estimate of Adult Literacy in Medicine and Dentistry	REALMD-20
	(20 items)	
	Rapid Estimate of Adult Literacy in Dentistry (30 items)	AREALD-30
	Two-Stage Rapid Estimate of Adult Literacy in Dentistry	TS-REALD
Functional OHL: reading	Test of Functional Health Literacy in Dentistry	ToFHLiD
comprehension, word	Oral Health Literacy Instrument	OHLI
recognition, and numeracy	Oral Health Literacy Scale	OHLS
	Oral Health Literacy Assessment	OHLA
	Oral Health Literacy Questionnaire	OHLQ
	Oral Health Literacy Inventory for Parents	OHLIP
	Oral Health Literacy Assessment in Spain	OHLA-S
	Oral Health Literacy Assessment in English	OHLA-E
	Oral Health Literacy Adult Questionnaire	OHL-AQ
	Health Literacy in Dentistry Scale (29 items)	HeLD-29
	Health Literacy in Dentistry Scale (14 items)	HeLD-14
	Hong Kong Oral Health Literacy Assessment Task for	HKOHLAT-P
	Pediatric Dentistry	
Communication skills and	Comprehensive Measure of Oral Health Knowledge	CMOHK
non-numerical conceptual	Baltimore Health Literacy and Oral Health Knowledge	BHLOHKP
knowledge	Project Survey	

Table 2. Categorization of oral health literacy (OHL) assessment tools based on structure

OHL: Oral health literacy

Table 3 illustrates for qualitative analysis, 42 articles remained. Articles that measured OHL in a specific population were not reviewed. Only articles that focused on validation of OHL measurement tools were investigated. Validated OHL assessment tools were divided into 7 main groups. Other OHL assessment tools originated from these 7 main tools. Then, tools were categorized by author-year and tool language. Some main assessment tools have a number of derivatives: both REALD and OHL have 6 derivatives and both Health Literacy in Dentistry (HLID) and Health Literacy in Dentistry Scale (HeLD) have 2 derivatives. CMOHK, Perceived Oral Health Literacy Scale (OHLS), and Visual Oral Health Literacy Instrument (OHLI) do not have derivative tools. As the table shows, the two instruments of REALD-99 and Oral Health Literacy Adult Questionnaire (OHL-AQ) have been validated in Persian.

#### **Discussion**

The excessive growth of dental scientific

knowledge requires the increasing understanding of importance of oral health by people in order to make proper decisions about their oral health and benefit from technological advancements.<sup>39</sup> Therefore, it is crucial to focus on OHL measurement tools as a new component affecting the general oral health. This study aimed to collect, summarize, and classify validated OHL measurement tools in the form of a systematic review.

According to the results of the present study, OHL articles have three structures: A) studies that developed and validated OHL measurement tools, including the studies by Pakpour et al.<sup>11</sup> and Naghibi Sistani et al.,<sup>29</sup> B) studies that assessed OHL in different populations using the existing tools, including the research by Mohammadi et al.<sup>40</sup> that evaluated OHL in adults in Southeast of Iran, and C) interventional studies that evaluated changes in OHL after the application of an intervention, such as an educational program. In this regard, we can refer to the research by Farokhi et al.41 who

Table 3. Existing validated oral health literacy (OHL) tools								
Literacy tools	<b>Derivative tools</b>	Author	Tool language					
		Richman et al. <sup>10</sup>	English					
	KEALD-99	Pakpour et al. <sup>11</sup>	Persian					
		Lee et al. <sup>12</sup>	English					
	DEALD 30	Wong et al. <sup>13</sup>	Chinese (HKREALD-30)					
	KLALD-30	Peker et al. <sup>14</sup>	Turkish (TREALD-30)					
DEALD		Junkes et al. <sup>15</sup>	Brazilian (BREALD-30)					
KEALD	DEALMD 20	Gironda et al. <sup>16</sup>	English					
	KEALIVID-20	Cruvinel et al. <sup>17</sup>	Brazilian					
		Tadakamadla et al. <sup>18</sup>	Arabic					
	AKEALD-50	Cartes-Velasquez and Luengo-Machucaa <sup>19</sup>	Chilean					
	TS-REALD	Stucky et al. <sup>20</sup>	English					
	REALMD-84	Atchison et al. <sup>21</sup>	English					
		Sabbahi et al. <sup>22</sup>	English					
		Blizniuk et al. <sup>23</sup>	Russian (OHLI-R)					
	OHLI	Cartes-Velasquez and Luengo <sup>24</sup>	Chilean					
		Rahardjo et al. <sup>25</sup>	Indonesian					
		Lee et al. <sup>26</sup>	Spanish (OHLA-S)					
	OHLA	Bado et al. <sup>6</sup>	English (OHLA-E)					
OHL		Flynn et al. <sup>4</sup>	Brazilian Portuguese (OHLA-B)					
	OHLS	Villanueva Vilchis et al. <sup>27</sup>	Spanish (OHLS-S)					
	OHLQ	Devi et al. <sup>28</sup>	English (OHLS-E)					
		Naghibi Sistani <sup>29</sup>	Persian					
	OHL-AQ	Flynn et al. <sup>30</sup>	English					
		Vyas et al. <sup>31</sup>	Hindi					
	OHLIP	Richman et al. <sup>32</sup>	English					
	AHLID	Stein et al. <sup>33</sup>	Norwegian					
IILID	TOFHLiD	Gong et al. <sup>34</sup>	English					
		Jones et al. <sup>35</sup>	English					
Hal D	HeLD-29	Ju et al. <sup>3</sup>	Australian					
HELD		Rahardjo et al. <sup>25</sup>	Indonesian					
	HeLD-14	Jones et al. <sup>36</sup>	English					
CMOHK	-	Macek et al. <sup>7</sup>	English					
Perceived OHLS	-	LaBelle <sup>37</sup>	English					
Visual OHLI	-	Ueno et al. <sup>38</sup>	Japanese					

REALD: Rapid Estimate of Adult Literacy in Dentistry; OHL: Oral health literacy; OHLI: Oral Health Literacy Instrument; OHLA: Oral Health Literacy Assessment; OHLS: Oral Health Literacy Scale; OHLQ: Oral Health Literacy Questionnaire; OHL-AQ: Oral Health Literacy Adult Questionnaire; OHLIP: Oral Health Literacy Inventory for Parents; HLID: Health Literacy in Dentistry; AHLID: Adult Health Literacy in Dentistry; TOFHLiD: Test of Functional Health Literacy in Dentistry; HeLD: Health Literacy in Dentistry; CMOHK: Comprehensive Measure of Oral Health Knowledge; HKREALD: Hong Kong Rapid Estimate of Adult Literacy in Dentistry; REALD: Two-Stage Rapid Estimate of Adult Literacy in Dentistry; REALD: Rapid Estimate of Adult Literacy in Dentistry; AMLID: Arabic Rapid Estimate of Adult Literacy in Dentistry; REALD: Rapid Estimate of Adult Literacy in Dentistry; Realth Comprehensive Measure of Oral Health Literacy in Dentistry; Realth Comprehensive Measure of Adult Literacy in Dentistry; Realth Comprehensi

showed the effects of an educational intervention on improvement of OHL in students. Finally, systematic review studies are a comprehensive group that can cover any of these areas, such as the systematic review conducted by Firmino et al.<sup>42</sup> on OHL and associated oral conditions.

By reviewing of the literature, it seems that questionnaires' structure is a suitable and reasonable criterion for their classification into three categories. First group: tools are based on word recognition; for instance, we can refer to REALD measure family. These words are retrieved from the American Dental Association (ADA) glossary of common dental terminology.5 While these tools' advantage is short study their weaknesses time, are lack of comprehensiveness of questions and lack of involving all aspects of OHL assessment. In a study, Firmino et al.9 used Brazilian-REALD-30 to evaluate the impact of OHL on information loss in epidemiological studies. The second group is tools that evaluate the ability of a responder to comprehend and information in the form use of comprehension, word recognition, and numeracy reading questions. In this regard, we can refer to ToFHLiD and OHL family measures.<sup>5,34</sup> This type of tools was assessed in studies by Khodadadi et al.,43 Naghibi Sistani et al.,44 and Naghibi Sistani et al.45 to evaluate OHL in a specific population. While this group of tools evaluates functional literacy with better strength, they have the disadvantage of longer study time. The third group is tools that focus on communication skills and non-numerical conceptual knowledge. Macek et al. introduced the CMOHK from this category. Despite the different and new view of this tool to OHL, more verification processes must be carried out in this area.<sup>7</sup> Jagan et al. proposed an example of CMOHK tool to assess OHL.46 It seems that researchers selected the type of questionnaire based on their research goals.

Most measures used for OHL assessment have been derived from medical tools. For instance, the TOFHLA is designed to assess functional health literacy in adults. The specialized questionnaire of TOFHLiD was extracted from the mentioned tool with the title of functional health literacy test in dentistry to assess OHL. Moreover, the OHLI was created by Sabbahi et al. based on the TOFHLA model.<sup>22</sup>

One of the most applicable tools is the REALM, which is developed to measure general health literacy in medicine. The REALD-90, REALD-30, and REALM-D are derived from the mentioned tool and are applicable for rapid estimation of adults' literacy in dentistry.<sup>5,42</sup> Atchison et al. introduced the REALM-D, which involves the psychosocial, dental, medical, and behavioral terms and evaluates medical and dental health literacy in an integrated manner.<sup>21</sup> Therefore, it offers a wide range of different aspects of health and a broad range

of health experiences of dental clinic patients.

It seems that independent medicinerelated tools are required since oral and dental sciences have a wide range and special specificity at the same time. OHL assessment tools have been established as customized tools in a way that they could evaluate and solve issues in a more focused manner. This shows the differences between medical tools and those focusing on oral health.

The majority of measures used to assess OHL in dental studies are derived from the OHL and REALD tools. In addition, the REALD-30, OHLI, and Oral Health Literacy Assessment (OHLA) are tools that are translated into most different languages and their reliability and validity have been confirmed.<sup>12,22,26</sup> Acceptance of these tools might be due to their compatibility to more and different cultures.

In studies by Wong et al.<sup>13</sup> and Richman et al.,<sup>32</sup> Hong Kong Oral Health Literacy Assessment Task for Pediatric Dentistry (HKOHLAT-P) and Oral Health Literacy Inventory for Parents (OHLIP) were used to assess OHL with an emphasis on pediatric dentistry. However, performing such studies in Iran is not possible due to lack of validated Persian measures.

REALD-99 and OHL-AQ measures are the only tools translated to Persian and validated in Iran by Pakpour et al.<sup>11</sup> and Naghibi Sistani et al.,<sup>29</sup> respectively. It seems that the REALD-99 and OHL-AQ have been used in most epidemiological studies.

Of the 19 standard OHL measurement tools in the world, the reliability and validity of 15 and only two measures have been confirmed for English and Persian languages, respectively. The majority of widely-used questionnaires are validated in English; even so, none of the three most used measures of REALD-30, OHLI, and OHLA that are translated into most languages, have validated Persian version.

Internet access restriction was one of the restrictions of this systematic review. Since such studies are so important, it is recommended that researchers conducting such studies be given more access to electronic resources. Another limitation of the present study was that the data collected could not be pooled due to the variety of tools used and therefore not meta-analyzed.

#### Conclusion

Evaluation of OHL in different target groups and populations and presence of a multitude of different tools and approaches have complicated comparing the results and reaching an accurate conclusion for researchers and decision-makers. Simplicity, shortness, and comprehensiveness as well as involving all dimensions of OHL are characteristics that make can а tool applicable. Attention Persian to OHL measurement tools indicates a measure gap between authentic English tools and valid Persian tools. With regard to the extreme diversity of OHL assessment tools in the world and their impact on oral health, it seems necessary to increase the number of standardized Persian tools. In addition, there is a clear need for more research in this area.

## **Conflict of Interests**

Authors have no conflict of interest.

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# Correlation between dental aesthetic index and orthodontics-related quality of life among students in south-east of Iran

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**Original Article** 

## Abstract

**BACKGROUND AND AIM:** Orthodontic treatment aims mainly to improve orodental healthcare and function, but its aesthetic and psychological effects are increasing as well. The aim of the present study was to evaluate the correlation between Dental Aesthetic Index (DAI) and orthodontics-related quality of life (QOL) among first course high school students in Kerman, Iran.

**METHODS:** The present cross-sectional descriptive study was conducted on 400 first course high school students selected through two-stage cluster sampling method during 2017 to 2018. Data were collected using 22-item orthodontics-related QOL and DAI questionnaires, and then analyzed by SPSS software using analysis of variance (ANOVA) and linear regression tests. P-value was considered at significance level of 0.05.

**RESULTS:** According to DAI score, 15.7% of students needed mandatory orthodontic treatment and 39.4% had no orthodontic or minor treatment. Mean orthodontics-related QOL score was  $15.60 \pm 11.16$  out of 88. No significant correlation was found between total score of questionnaire, items of DAI, DAI score, and different domains of questionnaire with DAI. Moreover, there was no significant difference between gender, DAI, and the mean score of orthodontics-related QOL questionnaire.

**CONCLUSION:** Based on the results of the present study, the orthodontics-related QOL was high in first course high school students. Additionally, no statistical correlation was reported between DAI and orthodontics-related QOL and corresponding domains.

**KEYWORDS:** Malocclusion; Quality of Life; Treatment Need; Students

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alocclusion can cause psychosocial appearance-related problems, discrimination, and problems with function of oral cavity.1 Psychosocial consequences of unacceptable dental appearance can be as important as or more significant than even biologic problems.<sup>2-5</sup> Malocclusion is one of the oral problems affecting the physical, social, economic, and psychological aspects of a person.<sup>3,4</sup> Occlusal problems cannot be defined only by physical factors, but psychosocial

consequences of unacceptable dental appearance can be as important as or even more significant than biologic problems.<sup>5</sup>

In modern orthodontics, the number of people who come to orthodontic treatment centers to improve their psychosocial problems in relation to facial appearance have increased more than the past. In the project of orthodontic treatments, more importance is given to the aesthetic issue and the facial appearance as a therapeutic goal.<sup>1</sup>

The malocclusion and dental deformities

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are very common and their psychosocial effects are an important stimulus for orthodontic treatment.<sup>6,7</sup> Hence, oral health related QOL can be used as a measure of orthodontic treatment need.8-10 Dental Aesthetic Index (DAI) is an indicator in epidemiological research to assess treatment need. One of the distinguishing aspects of this index is the presentation of aesthetic and physical features of malocclusion as a single value.<sup>11</sup> This index focuses on assessing dentofacial problems, including missing, crowding, diastema, overjet, reverse overjet, open bite, and molar relationship. World Health Organization (WHO) has accepted it as a cross-cultural index and a model for pathfinder surveys.<sup>12</sup>

A systematic and meta-analytic review concluded that malocclusions were significantly associated with oral healthrelated QOL (OHRQOL).<sup>13</sup> Adolescent patients are extremely worried about their own physical image, which has a major psychosocial compromise in role and academic achievement and can affect QOL. Considering that no research similar to this study has been done so far, this research was conducted to assess the correlation between DAI and orthodontics-related QOL among first course high school students in Kerman, Iran.

#### **Methods**

cross-sectional descriptive The present analytic study was conducted on 400 first course high school students in Kerman, who were chosen through two-stage cluster sampling method during November 2017 to June 2018. First, the city was divided into five districts, including north, south, east, west, and center. After obtaining the necessary education licenses, two high schools were chosen from each of the above districts, and a number of students randomly selected from each of the schools from the first, second, and third grades were examined. The selection of individuals continued to reach the sample size from each course. Exclusion criteria were

orthodontic treatment in the past or at the time of study, unwillingness to participate in the study, history of severe periodontal problems, previous extraction, chronic medical problems, craniofacial or anomalies.<sup>14</sup> Data collection tools included the clinical examinations and questionnaires, including demographic information and orthodontics-related QOL questionnaire.

After obtaining the necessary permissions, trained senior student capable of а responding and resolving any uncertainties initially provided an adequate explanation for study objectives and methodology in the classroom of students. After obtaining consent, the students were examined for occlusion using a disposable mirror and gauge and information was recorded. Examinations took place under supervision of school health educators in the school hygiene room on a normal seat under natural light. The number of visible missing teeth, crowding in the incisal segment, spacing in the incisal segment, midline diastema, the maximum anterior irregularities in millimeters, overjet, reverse overjet, open bite, and molar relationship were evaluated. Then, each criterion was multiplied by the corresponding linear value coefficient, whose sum with a constant number of 13 determined the final DAI value. The numerical values of DAI were categorized into four grades. Grade 1 (DAI  $\leq$  25) shows normal occlusion or mild malocclusion without any need for orthodontic treatment. There is a definite malocclusion and the need for selective treatment in grade 2 (DAI = 26-30). There is a severe malocclusion and severe need for treatment in grade 3 (DAI = 31-35). Grade 4 (DAI  $\geq$  36) shows very severe malocclusion and compulsory treatment.<sup>15</sup>

The orthodontics-related QOL questionnaire includes 22 questions in four domains: 1- social aspects (questions 15, 16, 17, 18, 19, 20, 21, 22) with score range of 0-32, 2- dentofacial aesthetic domain (questions 1, 7, 10, 11, 14) with score range of 0-20, 3- oral function (questions 2, 3, 4, 5, 6) with score

range of 0-20, and 4- knowledge of facialdental aesthetics (questions 8, 9, 12, 13) with score range of 0-16. It was scored on the basis of 5-point Likert scale, indicating never (0), few (1), somewhat (2), high (3), and very high (4). Therefore, the score range was 0-88. A lower score indicates better QOL. Momeni Danaei et al. verified this questionnaire with Cronbach's alpha (reliability) of 0.86 and weighted kappa (validity) of 0.91.16

The collected data were analyzed by SPSS software (version 21, IBM Corporation, USA) Armonk, NY, using frequency distribution tables, analysis of variance (ANOVA), and linear regression analysis. The significance level was considered to be 0.05. This study was approved with code of IR.KMU.REC.1396.1709 Ethics at the Committee of Kerman University of Medical Sciences.

#### Results

The findings of this cross-sectional descriptive analytic study, which was conducted on 400 first course high school students, were as follows: The low answer of "very high" was related to the items: "I have a problem with chewing" and "I refrain from eating some food because the contact of my teeth with each other makes it difficult to eat them", which were not answered by none of the girls.

Moreover, of people 22.02% gave maximally the answers of "high" and "very high" to the question "I spend a lot of time checking my face in mirror" in the domain of knowledge of dentofacial aesthetics. In addition, 17.50% marked the answers of "high" and "very high" to the question "Commenting on my appearance is really annoying to me, even when I know that others are just going to joke about it" in the social domain. Additionally, 14.15% of them gave the answers of "high" and "very high" to the question "I spend a lot of time checking my teeth in the mirror". In the dentofacial aesthetic domain, the mean score in both girls and boys was 3.73 ± 3.63 and 3.09 ± 2.56 out of 20, respectively.

Table 1 shows how to answer the questions. In knowledge of dentofacial aesthetics domain, in response to question 8 "I spend a lot of time looking at my face in the mirror", 11.9% of girls and 10.5% of boys gave the answer of "very high".

The way of answering each question is shown in table 2. The mean and standard deviation (SD) of knowledge of aesthetics in girls and boys was 4.85 ± 3.24 and 3.84 ± 2.99 out of 16. In the context of oral function in responding to the question "I do not like eating in public places", 6.0% of boys and 3.5% of girls gave the answer of "very high".

How to respond to answer each question separately is shown in table 3. In the domain of the oral function, the mean score for boys and girls, respectively, were  $2.33 \pm 1.75$  and  $2.66 \pm 1.96$  out of 20. In the social domain, in response to question 17 "I am worried about giving people an unpleasant view of my appearance", 10.0% of girls and 0.12% of boys gave the answer of "very high".

Table 1. The frequency distribution percentage of participants responses in facial destiletic domain										
Questions	Ne	ver	Few		Somewhat		High		Very high	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
I am self-conscious about the	57.5	61.7	27.0	28.4	9.5	7.0	3.0	2.5	3.0	0.5
appearance of my teeth										
I do not like seeing a side	71.0	62.7	10.6	13.9	4.0	11.9	5.5	4.5	3.5	4.5
view of my face										
I dislike having my	73.0	58.3	12.0	17.4	5.5	10.9	4.0	5.5	5.5	7.5
photograph taken										
I dislike being seen on video	71.0	50.2	17.5	22.4	4.5	12.9	3.5	5.5	3.5	9.0
I am self-conscious about my	73.5	63.2	18.0	22.9	2.0	6.0	5.0	5.0	1.5	1.5
facial appearance										

Table 1.	The frequency	<sup>,</sup> distribution	percentage of	participants'	responses in facial	aesthetic domain
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 Table 2. The frequency distribution percentage of participants' responses in knowledge of aesthetic domain

Questions	Never		Few		Somewhat		High		Very high	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
I spend a lot of time checking my	35.5	22.4	30.5	23.9	16.5	27.4	7.0	13.9	10.5	11.9
face in the mirror										
I spend a lot of time checking my	41.5	26.4	28.0	31.8	17.0	24.4	5.5	12.4	8.0	3.0
teeth in the mirror										
I often stare at other people's teeth	63.0	52.2	23.5	25.9	5.0	10.9	2.0	7.0	3.5	3.5
I often stare at other people's faces	45.0	42.3	28.5	27.9	16.0	16.9	5.0	8.5	5.5	4.0

How to answer for each question is shown in table 4. The mean score of the social domain in boys and girls was  $6.80 \pm 5.79$  and  $6.26 \pm 6.00$  out of 32, respectively.

The mean score of the orthodontics-related QOL questionnaire and the score of each of the respective domains is shown in figure 1. No statistically significant difference was found in the score of orthodontics-related QOL and each of the respective domains between girls and boys.

In this study, 10.25% of people had the missing teeth, 43.25% in the mandibular regions had crowding, and 81.85% had no diastema in the anterior mandible. The anteroposterior molar relationship was normal in 37.6% and in 21.70%, it was a cusp or more abnormal.

The treatment need according to DAI is shown in figure 2. 16.90% of girls and 14.50% of boys had essential need for the orthodontic treatment. The total score for the questionnaire was  $16.59 \pm 11.47$  for girls and 14.56 ± 11.76 for boys. There was no significant difference between orthodontic treatment need with each of the domains of the orthodontics-related QOL questionnaire and the total score of orthodontics-related QOL in boys and girls and the whole population studied (Table 5).

The regression test showed no significant difference between the total score of the questionnaire, DAI grades and total score of DAI, and the different domains of the questionnaire with DAI grades.

#### Discussion

The malocclusion affects the physical, social, economic, and psychological dimensions of the person.<sup>5,17</sup> The DAI is a research tool for assessing a patient's dental aesthetics based on community norms to examine socially-acceptable dental appearance. This index provides the ability to compare individuals based on aesthetic score using objective measurements of psychological and social performance, and is highly useful for studying the influence of malocclusion on social and mental conditions.<sup>18</sup>

In our study, 39.4% of students had DAI < 25. The rate was reported to be 49.8% for Brazilian teens,<sup>15</sup> 58.6% in Spain,<sup>19</sup> and 20.8% in Turkey.<sup>20</sup> No or slight need for orthodontic treatment exists in 48.3% of adolescents aged 14-18 years old in Shiraz, Iran<sup>21</sup> and 54.5% of teenagers in Isfahan, Iran,<sup>22</sup> which is consistent with the findings of this study.

Never		Few		Somewhat		High		Very high	
Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
81.0	79.6	12.0	10.9	4.0	4.5	1.0	4.5	2.0	0.5
86.0	87.1	6.5	9.5	2.0	3.0	4.0	0.5	1.5	0
75.5	78.1	13.9	13.9	7.5	6.5	1.5	1.5	2.5	0
56.5	63.2	22.0	17.9	9.5	11.9	6.0	3.0	6.0	3.5
85.0	81.6	8.0	13.4	4.0	2.5	2.0	1.0	1.0	1.5
	Nev Boys 81.0 86.0 75.5 56.5 85.0	Never           Boys         Girls           81.0         79.6           86.0         87.1           75.5         78.1           56.5         63.2           85.0         81.6	Never         F           Boys         Girls         Boys           81.0         79.6         12.0           86.0         87.1         6.5           75.5         78.1         13.9           56.5         63.2         22.0           85.0         81.6         8.0	Never         Few           Boys         Girls         Boys         Girls           81.0         79.6         12.0         10.9           86.0         87.1         6.5         9.5           75.5         78.1         13.9         13.9           56.5         63.2         22.0         17.9           85.0         81.6         8.0         13.4	Never         Few         Some           Boys         Girls         Boys         Girls         Boys           81.0         79.6         12.0         10.9         4.0           86.0         87.1         6.5         9.5         2.0           75.5         78.1         13.9         13.9         7.5           56.5         63.2         22.0         17.9         9.5           85.0         81.6         8.0         13.4         4.0	Never         Few         Somewhat           Boys         Girls         Boys         Girls         Boys         Girls           81.0         79.6         12.0         10.9         4.0         4.5           86.0         87.1         6.5         9.5         2.0         3.0           75.5         78.1         13.9         13.9         7.5         6.5           56.5         63.2         22.0         17.9         9.5         11.9           85.0         81.6         8.0         13.4         4.0         2.5	NeverFewSomewhatHBoysGirlsBoysGirlsBoysGirlsBoys $81.0$ 79.612.010.94.04.51.0 $86.0$ 87.16.59.52.03.04.0 $75.5$ 78.113.913.97.56.51.5 $56.5$ 63.222.017.99.511.96.0 $85.0$ 81.68.013.44.02.52.0	Never         Few         Somewhat         High           Boys         Girls         Girls         Boys         Girls         Boys         Girls         Boys         Girls         Ins         Formation	NeverFewSomewhat $High$ VeryBoysGirlsBoysGirlsBoysGirlsBoysGirlsBoys $81.0$ 79.612.010.94.04.51.04.52.0 $86.0$ 87.16.59.52.03.04.00.51.5 $75.5$ 78.113.913.97.56.51.51.52.5 $56.5$ 63.222.017.99.511.96.03.06.0 $85.0$ 81.68.013.44.02.52.01.01.0

Table 3. The frequency distribution percentage of participants' responses in oral function domain

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Table 4. The frequency distribution percentage of participants' responses in social domain

Questions		Never		Few		Somewhat		High		high
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
I try to cover my mouth when I meet people	63.0	77.1	17.0	12.4	10.0	3.5	2.5	4.0	7.5	2.5
for the first time										
I worry about meeting people for the first time	50.5	46.3	26.0	23.4	9.0	17.4	6.5	8.5	8.0	4.5
I worry that people will make harmful	53.5	43.3	21.0	15.4	9.5	15.4	4.0	6.5	12.0	10.0
comments about my appearance										
I lack confidence when I am out socially	55.5	40.3	23.0	23.4	10.5	19.4	5.0	9.0	9.0	8.0
I do not like smiling when I meet people	65.5	69.2	16.5	18.9	9.5	7.0	2.5	3.0	6.0	2.0
I sometimes get depressed about my		67.7	11.0	16.9	6.0	8.5	1.0	3.0	3.5	4.0
appearance										
I sometimes think that people are staring at me	47.0	36.3	33.5	23.9	14.0	20.4	4.0	10.0	1.4	4.0
Comments about my appearance really upset	51.5	48.3	22.0	21.9	9.5	13.9	7.0	9.0	10.0	7.0
me, even when I know people are only joking										

15.7% of the examined students had an essential need for treatment. The rate was reported to be 44.0% for Canadian children,<sup>9</sup> 24.7% for teenagers in Malaysia,<sup>14</sup> and 27.8% for Turkish students,<sup>20</sup> which is more than the

current study.

This rate was 10.3% for Brazilian teens<sup>15</sup> and 9.9% for Spanish teens;<sup>19</sup> the reason for this could be attributed to genetic variations between different populations.

Table 5.	The correlation	between orth	nodontic quality	of life (Q	OL) and	orthodontic	treatment r	need
			based on ge	nder				

Questions		Girls	Boys
		Mean ± SD	Mean ± SD
Social domain	Low need	$6.48 \pm 4.99$	$5.99 \pm 5.81$
	Need	$7.00\pm4.75$	$6.80\pm6.71$
	Severe need	$7.72\pm7.40$	$5.72\pm5.19$
	Essential need	$7.00 \pm 6.54$	$6.39 \pm 5.25$
	Total	$6.82\pm5.80$	$6.24 \pm 6.00$
Р		0.740	0.768
Dentofacial aesthetic domain	Low need	$3.58\pm3.38$	$3.11 \pm 2.40$
	Need	$4.59 \pm 3.72$	$3.43 \pm 2.71$
	Severe need	$2.47 \pm 2.50$	$2.74 \pm 2.50$
	Essential need	$4.15 \pm 4.15$	$2.74 \pm 2.57$
	Total	$3.74 \pm 3.65$	$3.09 \pm 2.55$
Р		0.796	0.958
Oral function domain	Low need	$1.82 \pm 1.49$	$2.49 \pm 1.82$
	Need	$2.44 \pm 1.78$	$3.13 \pm 2.07$
	Severe need	$2.49 \pm 1.87$	$2.49 \pm 1.78$
	Essential need	$3.36 \pm 2.15$	$2.14 \pm 2.12$
	Total	$2.33 \pm 1.76$	$2.67 \pm 1.98$
Р		0.441	0.932
Knowledge of dentofacial	Low need	$4.86 \pm 3.12$	$3.73 \pm 2.70$
aesthetic domain	Need	$5.05\pm3.08$	$4.16 \pm 3.35$
	Severe need	$5.23\pm3.91$	$3.53 \pm 2.88$
	Essential need	$3.96 \pm 2.90$	$3.65 \pm 2.84$
	Total	$4.84 \pm 3.25$	$3.83 \pm 3.00$
Р		0.404	0.391
Total score	Low need	$15.76 \pm 9.38$	$13.00 \pm 10.54$
	Need	$16.91 \pm 9.46$	$16.30 \pm 14.33$
	Severe need	$18.75 \pm 16.40$	$13.50 \pm 9.58$
	Essential need	$15.81 \pm 12.69$	$14.36 \pm 9.40$
	Total	$16.59 \pm 11.47$	$14.56 \pm 11.76$
Р		0.612	0.498

SD: Standard deviation

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Figure 1. The mean score of orthodontic quality of life (QOL) and domains according to gender

In the present study, 26.7% of people had DAI = 26-30. This rate was reported at 19.2% in the studies of Khanehmasjedi et al.,<sup>23</sup> 21.2% in Spain,<sup>19</sup> and 20.3% in South Africa,<sup>24</sup> which almost corresponds to current study.

In the present study, the missing tooth rate was 9.47%, which is more than the study by

Karimi Afshar et al.,<sup>25</sup> who reported the rate as 5.4% and the study by Baca-Garcia et al., who stated the frequency of missing teeth as 3.5% in 14-20-year-old Spanish subjects;<sup>19</sup> the reason for this difference can be attributed to the difference between the type of study and the studied population.



Figure 2. The frequency distribution of participant to intensity of orthodontic treatment need according to gender

In the current study, the most common problems in DAI were anterior crowding (43.25%) and molar relationship (62.40%), which is consistent with the study of Uzuner et al.<sup>20</sup> Claudino and Traebert also showed that the incisor crowding and the mandibular incisor irregularities were the most common problems.<sup>26</sup> There was no statistically significant difference between sex and DAI, which is consistent with the study of Khanehmasjedi et al.<sup>23</sup>

In our study, the level of orthodonticsrelated QOL was high (15.60  $\pm$  11.16), which is consistent with the study of Karimiafshar et al.<sup>27</sup> on adolescent girls and the study of Taylor et al.<sup>28</sup>

In questions of the questionnaire, 11.2% of the students gave the answer of "very high" to the question "I spend a lot of time checking my face in mirror". In the study of Karimiafshar et al., the same question had the highest answer of "very high" option.<sup>27</sup>

In the present study, there was no statistically significant difference between orthodontics-related QOL and need for orthodontic treatment, inconsistent with the findings of Kunz et al.<sup>10</sup> The reason for this difference is probably the different questionnaires used in this research.

Although the DAI determines the relative social acceptability and functionality of dental appearance, it should take into account ideally the patient's psychological and social perspective.<sup>29,30</sup> Considering the psychosocial view of the patient provides the possibility of assigning a suitable treatment the patient. The plan to patient's consciousness of occlusion may be inconsistent with its severity. Some patients with severe malocclusion are unconcerned about their condition, while minor dental

irregularities may be of great importance in others. Therefore, using an occlusal index alone and regardless of the patient's psychosocial need may be problematic. DAI is the measure taken by the dentist, while the OHRQOL is the patient's own assessment.<sup>14</sup> It has been revealed that malocclusion has a negative effect on QOL and this effect is more pronounced in social and emotional contexts. It has also been documented that the orthodontic treatment has led to the improvement of orthodontics-related QOL.<sup>29</sup>

Different results can be due to the difference in the index used to evaluate malocclusion and different versions of QOL questionnaires. In addition, QOL is affected by personality traits. The clinicians should consider QOL as the compatibility of patients with living conditions instead of their health status based on expert opinion.

Since this study was conducted on Kerman high school students, the results can not be generalized to other communities.

#### Conclusion

Based on the findings of the present study, the orthodontics-related QOL was high in first course high school students in Kerman. Additionally, no statistical correlation was reported between DAI and orthodonticsrelated QOL and corresponding domains.

#### **Conflict of Interests**

Authors have no conflict of interest.

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## Analysis of strengths, weaknesses, opportunities, and threats of electronic dental and oral records in clinics of School of Dentistry, Tehran University of Medical Sciences, Iran: A qualitative study

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## **Original Article**

## Abstract

**BACKGROUND AND AIM:** The high-quality data are essential for good patient care, optimal management of oral and dental diseases, and policy-making. Electronic dental and oral records have a key role in managing data in health care organizations. Aim of this article is analyzing strengths, weaknesses, opportunities, and threats (SWOT) of electronic dental and oral record implementation in clinics of School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran, from stakeholder perspectives.

**METHODS:** A qualitative interpretive case study was conducted at clinics of School of Dentistry in Tehran University of Medical Sciences in 2016. Data were collected through semi-structured interviews. Interviews involved asking questions and getting answers from 15 participants. They were informed about SWOT of electronic dental and oral records. Data were gathered by two researchers during two months. After fulfilling all interviews, all participants were asked to review the transcript and confirm its accuracy. All raw data and recorded interviews were transcribed, coded, and analyzed by two researchers.

**RESULTS:** The main features in SWOT analysis of electronic dental and oral records were respectively transparency of project implementation stages, absence of mandatory rules and standard business processes, expert and motivated specialists, and finally lack of cultural infrastructure.

**CONCLUSION:** Use of electronic dental and oral records can help to improve quality of information and ultimately leads to improvement in quality of care. SWOT analysis is an optimal technique for understanding SWOT of electronic dental and oral records.

**KEYWORDS:** Electronic Heath Records; Dental Records; Strengths, Weaknesses, Opportunities, and Threats Analysis; Qualitative Research

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ral and dental hygiene is very crucial in promotion of community health and quality of life.<sup>1,2</sup> The 80/20 phenomenon that is an example of it was started in 1989 to promote oral health in Japan. It means retaining of at least 20 natural teeth in the mouth at 80 years of age.<sup>3</sup> Oral diseases are one of the most common chronic diseases and their treatment imposes high costs on individual and community. The report of World Health Organization (WHO) showed that 60-90 percent of school-aged children had dental carries. Also, most adults have same problem

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in most industrialized countries.<sup>4</sup>

Because of the high prevalence of oral (and cancers) and recurrent diseases cumulative nature of caries and periodontal diseases,<sup>5</sup> the high-quality data are essential for good patient care, optimal management of these diseases, and suitable policymakings.<sup>6,7</sup> The Oral Health Assessment and Review Guidelines Scottish Dental Clinical Effectiveness Programme (SDCEP) stated that dental record should be accurate, dated, confidential, secure, contemporaneous, comprehensive, and legible.7 High-quality clinical data can be applied to improve assessment, auality of care research, communication healthcare between providers, the defense of malpractice claims, forensic identification of victims, and education and effectiveness of patient care.2,6,8 Data have a critical role in decision-making in the health system.9 Paper records are not appropriate to achieve these goals in excellent level.10 Also, WHO proposes to establish oral health information systems for data collection and analysis and better access to global information.11

Electronic health record (EHR) facilitates healthcare professional's access to health information and also improves delivery of healthcare.<sup>12</sup> Like other areas of health, the use of electronic records in this area can help to achieve these goals.13 One of the main challenges in dentistry is to access integrated clinical evidence based on information needs and respond to the information needs of dentists for informed diagnoses and treatment.14 integrated system An in orthodontic clinics makes it possible to connect treatment content and diagnostic records and reduce retrieving and analyzing time. Main features of integrated system are efficient administration of patients, integration of image processing, and harmonization of heterogeneous medical and dental data resources.<sup>15,16</sup> Integrated information systems provide uniform access interface for users.<sup>17</sup>

Electronic dental and oral records collect patients' dental and oral health-related

information electronically with high-quality information helping to make effective decisions based on the signs and symptoms of disease for specialists. It can be used for quality assurance and research.<sup>18,19</sup> This electronic record can be applied for dental students' education.<sup>20,21</sup> In recent years, the use of the electronic dental and oral records has grown significantly.<sup>22</sup> This record allows providers to access and analyze patients' dental conditions quickly and easily and show their diagnosis to the patients. Implementing EHR requires different infrastructures, software, hardware, system configuration, documentation, user training and support, report writing, and maintenance of the new system.<sup>23</sup> Due to high cost of implementing information technology (IT) projects, it is important to consider the planning and reviewing of existing infrastructure and implementation priorities.23,24

Strengths, weaknesses, opportunities, and threats (SWOT) analysis as a powerful approach is used for identifying and evaluating strengths and weaknesses as well as opportunities and threats that may exist in a specific business process.<sup>25,26</sup>

The technical, organizational, and financial factors are involved in EHR implementation, which naturally vary across organizations. Therefore, the successful implementation of this system in one organization does guarantee its not successful implementation in another organization. Accordingly, we need to explore the opportunities, challenges, threats, and strengths of the existing system for more comprehensive planning.27 For example, a study was conducted in Portuguese for SWOT analysis of EHR. Results showed that the system had many strength points such as high security, high accessibility, ease of use, and ability to remotely access the system. The weaknesses were limited including old hardware, insufficient professional education, and inappropriate interface.<sup>28</sup>

This article explores major threats, opportunities, benefits, and barriers for

implementation of electronic dental and oral records. The result of study can provide the basic strategies for successful implementation of electronic dental and oral records according to the current business conditions and situations, utilizing strengths and opportunities, reducing weaknesses, and eliminating threats.

#### **Methods**

This study was approved by Ethics Committee of Tehran University of Medical qualitative Sciences, Tehran, Iran. А interpretive case study was conducted at clinics of School of Dentistry, Tehran University of Medical Sciences in 2016. In the first phase, scientific resources were studied to identify the SWOT of implementing the electronic dental and oral records. In literature review, all books, articles, projects, theses, guidelines, manuals, and reports about subject of study were searched in search engines including Google Scholar, PubMed, ProQuest, ScienceDirect, Web of Science, Cochrane, and Embase. Then, an open-ended questionnaire including SWOT was designed.

The interviewer was a member of research team and informed about interview methods. Interviewer met the participants before interview and set the time for interview. In this meeting, participants received information about the study, research goals, and details of the interview. Also, they became aware about reasons why were selected for interview. Participants were selected through a purposeful sampling. All 15 participants were included in the study. 5 of them were female and 10 of them were male and age range was from 25 to 70 years. This sample provided sufficient numbers to ensure exploration of the fields, and data saturation was reached by the final interviews. These participants were working as employer, resident, and assistant/associate/full professor in their respective departments. All participants who were approached cooperated with the interview and none dropped out. The interviews were conducted

in a single session at the participant's workplace. The researcher explained the purpose of the study and confidentiality of information for participants. Also, researcher asked for consent to audio-record the Interview duration interviews. ranged between 30 and 45 minutes. Interviews were recorded in two separate sources and field notes were taken during the sessions. Interviews involved asking questions and getting answers from participants. They were informed about SWOT of electronic dental and oral records. Participants were asked about SWOT of electronic dental and oral records implementation. Data were gathered by two researchers during two months. After the interviews, all participants were asked to review the transcript and confirm its accuracy. All raw data and recorded interviews were transcribed, coded, and analyzed by two researchers.

#### Results

A total of 15 participants were interviewed and their transcription time was almost 150 hours. Team members read line by line of all transcripts. In this study, 10 persons (67%) were male and age range was 25-70 years. Frequency distribution of the experts' position is presented in figure 1.



experts' position

In this section, the results of the interviews are presented in four dimensions including SWOT in 4 separate tables (Tables 1-4). The strengths indicate strong aspects of electronic dental and oral records (Table 1).

Strengths	Participants' viewpoints
Strengths analysis of	One clinical professional says: "Executives are aware of electronic
electronic dental and	systems capabilities and enthusiastically support activities in this area."
oral records	Senior managers commitment and supporting
implementation	Potential of providing major parts of hardware
	Collaboration between clinical experts and technical team
	Private-sector collaboration for system development
	Transparency in project management by private sector
	Staff and users confidence to electronic systems
	Possibility to conduct training workshops for different groups of users
	Sufficient equipment and space
Example	One clinical professional says: "Executives are aware of electronic
	systems capabilities and enthusiastically support activities in this area."

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The weaknesses present areas where require improvement, and range from personnel issues to organizational factors (Table 2).

Opportunities analysis focuses on identifying process that lead to enhancement of the organization's promotion and excellence (Table 3).

Threats analysis identifies dimensions that are vulnerable and pose a risk to system implementation (Table 4).

Researchers identified the main features of participants' viewpoints about SWOT of electronic dental and oral records (Figure 2). During reviewing the transcripts, it was found that some themes were noticeable in all participants' interviews. The main subject that was raised in "strengths" was transparency at every stage of the project and most participants considered it critical for success in the project.

In "weakness" analysis, the important feature was absence of mandatory rules, regulation, and standard business processes, while rules and regulations are the main parts of the requirements that are determined for an information system.

Table 2. Weaking	ss anatysis of electronic dentat and oral records implementation
Weakness	Participants' viewpoints
Weakness analysis of	Lack of strategic and operational planning for electronic dental and oral records
electronic dental and oral	design and implementation
records implementation	Lack of motivated healthcare providers
	Low computer literacy, especially those responsible for managing and
	distributing information
	Lack of integrated databases and high-quality information
	Lack of human resources, especially in data registration
	Low organizational culture in acceptance of electronic systems, resistance to
	change, and resistance to new system acceptance
	Lack of standard work processes
	Lack of defined, standardized, and native guidelines
	Technical problems of web-based systems
	Lack of interest in health care providers to acquire computer skills
	Lack of adequate funding in this field by managers
	Time-consuming data entry and increasing workload of service providers in the
	early stages of system development
	Technical concerns of information managers and problems for information
	transfer from past platform to new platform
Example	One technical expert says: "Due to lack of transparent guidelines, process of
	converting descriptive data to computer rules has problems. The lack of complete
	clinical information and database integration creates challenges for system
	deployment. Sometimes, we encounter duplicate and unnecessary data in manual
	and computer documentation."

 Table 2. Weakness analysis of electronic dental and oral records implementation

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Opportunities	Participants' viewpoints
Opportunities analysis of	User-friendly system
electronic dental and oral	High-speed data acquisition and processing in system
records implementation	Writing clean code in software
	Successful and timely deployment of system
	Adaption of system with existing business processes
	Meeting information needs of the user
	Controlling user access to information
	Drafting and enforcing laws on the extent and type of access to information
	Integrating system with other information systems
	System support services
	Improving the specialists' performance in diagnosis and management of disease
	Providing appropriate recommendations by reminders and alerts
	Criticizing health care orders and suggesting solutions to appropriate treatment plans
	Improving workflow
	Improved decision-making by managers and professionals
	Time saving
	System support from routine daily tasks
	Early benefits of system
	Meeting expectations
	Reducing operational costs
	Reducing reworks and errors
	Better forecasting of business revenues and expenses
	Reducing the problems of managing high-volume data
Example	One of the experts believes that: "The software should be able to search all records
	at high speed and match the rules. The software codes can be developed by another
	person. System should be real-time and entered data should be updated promptly.
	System integration with clinical decision-support systems is essential."

Standard business processes ensure that all activities in the organization are done in the best way. Lack of these two factors is the major weakness in the implementation of system from participants' viewpoints.



Figure 2. Key points of strengths, weaknesses, opportunities, and threats (SWOT) analysis for electronic dental and oral records implementation

**Discussion** The clinical information systems (CISs) should be developed according to the users' needs and organizational resources.<sup>29</sup> The results of SWOT analysis from participants' viewpoint show that system has more opportunities and fewer threats, but the weaknesses are more than strengths that indicates that more effort is needed to eliminate these weaknesses and turn them into strengths, because the strengths of system are one of the main reasons for encouraging investment in IT projects.<sup>30</sup> Other strengths to be mentioned include information confidentiality, reducing the possibility of lost records, cost saving, and improving data storage and accessibility.<sup>31</sup>

In this work, weakness points are greater than strengths while in some studies, results show that the system has a lot of strong points and fewer weak ones.<sup>28</sup>

In our study, there are a lot of opportunities rather than threats while in Kumar and Aldrich study, the threats are greater than opportunities.<sup>32</sup>

Electronic dental and oral record and SWOT analysis

Table 4. Thr	eats analysis of electronic dental and oral records implementation
<b>Fhreats</b>	Participants' viewpoints
Threats analysis of	Lack of critical information infrastructure (documents are manual and incomplete)
electronic dental and oral	Weak cultural infrastructure and some user resistance
ecords implementation	Lack of executive laws and regulations for data registration
Example	One expert believes that: "Despite the large amount of dental and oral information, unfortunately, the lack of standards in this area precludes the use of this information; there is no comprehensive database on this issue, and this is one of the concerns of the researchers. Implementing a system without comprehensive
	information support will definitely bring a lot of problems."

In our study, transparency of project implementation was a salient strength in all participants' interviews. While in the study of Shahmoradi et al., the highest priority in review of strengths from the users' viewpoint was timely and quick access to information.<sup>27</sup> Transparency in all phases of project leads to greater cooperation and better understanding of work by team members.<sup>33,34</sup>

This ultimately will lead to better performance of systems and greater satisfaction of the organization and users.<sup>35</sup>

The most important issue is the existence of mandatory laws and incentives for successful implementation of system.<sup>32</sup> Considering the necessity of having laws, standards, and interoperability at national level, mandatory national law should be enacted for the successful implementation of EHRs.<sup>36,37</sup>

Lack of infrastructure always has been one of the main challenges in successful implementation of the EHR.<sup>38-40</sup> Lack of organizational culture is one of the most important infrastructures that less attention has been paid to it.<sup>41-43</sup> Reforming this culture requires basic and timely work and is one of the factors that can facilitate system implementation. Something that can help solving this challenge can be system design and implementation according to the user needs.<sup>44,45</sup>

Now, the different incentive programs are used for EHR adoption by users and physicians.<sup>46</sup> Understanding the benefits of implementing such systems for clinical professionals can be effective in their acceptance and successful implementation.<sup>47</sup> Because physicians are directly involved with patients and providing care, understanding the amount of quality of care improvement with EHR can have significant impact on their attitude.<sup>48,49</sup>

## Conclusion

The main features in SWOT analysis of electronic dental and oral records were respectively transparency of project implementation stages, absence of mandatory rules and standard business processes, expert and motivated specialists, and finally lack of cultural infrastructure.

The results of various studies prove the importance of dental and oral records. Use of electronic dental and oral records can help to improve quality of information and ultimately leads to an improvement in the quality of care. Also, these data are essential to assess the current situation and take measures to improve. These electronic records have many benefits not only for the healthcare providers but also for the patients. These records can reduce healthcare cost in long term and add new opportunities for organization progress. SWOT analysis improves decision-making and preparedness of organization and informs the organization about forces that could affect the system implementation.

#### **Conflict of Interests**

Authors have no conflict of interest.

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## The effect of education on healthcare workers' knowledge of oro-dental health in a group of Iranian rural children

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## **Original Article**

## Abstract

**BACKGROUND AND AIM:** Oro-dental health is one of the most important factors affecting children's health. Healthcare workers' knowledge is one of the most important factors for oro-dental health services. Therefore, the current study aimed to determine the effect of education on healthcare workers' knowledge of oro-dental health.

**METHODS:** This experimental study was conducted in the rural regions located in south-eastern Iran in Sistan and Baluchestan Province. 120 healthcare workers were selected by a convenience sampling method based on Morgan's table and were randomly divided into experimental (n = 60) and control groups (n = 60). First, both groups completed the questionnaire; then, intervention was conducted for the experimental group in ten 2-hour sessions over 5 weeks. Finally, both groups completed the questionnaire one week after the education.

**RESULTS:** In the pre-test, the mean scores of the healthcare workers about overall knowledge in the intervention (12.50  $\pm$  5.07) and control (12.46  $\pm$  4.71) groups had no significant difference (P = 0.42); whereas, in the post-test, the mean scores of overall knowledge in the intervention (14.23  $\pm$  2.77) and control (12.61  $\pm$  4.84) groups showed a statistically significant difference (P < 0.01). Results of study showed significant differences between the two groups in dimensions of the dental knowledge, oro-dental health principles, and how to provide oro-dental care (P < 0.01).

**CONCLUSION:** Given the importance of preventive oro-dental care in children, it is recommended that health education programs in the field of oro-dental health be designed and implemented within the framework of the educational model.

KEYWORDS: Education; Training Program; Healthcare Workers; Knowledge; Oral Health; Children

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ral health is of equal importance as addition, public health. In knowledge about oral health is listed as an important factor in health.<sup>1,2</sup> Education determining is necessary component for behavior change.<sup>3</sup> Knowledge, attitude, and appropriate behavior about oro-dental health can prevent oro-dental diseases and education can play an effective role in oro-dental health.<sup>4,5</sup>

In modern orthodontics, the number of people who come to orthodontic treatment

centers to improve their psychosocial problems in relation to facial appearance have increased more than the past. In the project of orthodontic treatments, more importance is given to the aesthetic issue and the facial appearance as a therapeutic goal.<sup>1</sup>

About 40% of the Iranian population lives in deprived villages and regions. Therefore, a primary healthcare provider is very important, considering the level of health knowledge and beliefs in these areas.<sup>4</sup> The healthcare system in Iran is hierarchical and

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has regular structures with a logical relationship between levels. Health centers are the first places people contact the healthcare system, and healthcare workers are in charge of case-finding, screening, follow-up, and referral of patients from health centers to health facilities.<sup>6</sup> Healthcare workers are in charge of providing health education and health care in all areas, including oro-dental health and attracting public to health programs.<sup>7,8</sup>

Oro-dental health means to take full care of your teeth through the use of the right toothbrush and toothpaste, as well as dental floss and mouthwash.8 Oro-dental health is very important for physical health.<sup>2</sup> Not only does it add to the beauty and better speech, but also it is essential for physical health. Oro-dental health services provided in health centers are based on education, prevention, and treatment.9 Healthcare workers must examine and record the oro-dental status of children. Oro-dental health influences public health through healthy teeth and gums. Furthermore, prevention and early treatment of primary caries and gum disease in susceptible and vulnerable people avoid imposing heavy medical costs on people and the government.<sup>10</sup>

Gambhir and Gupta showed Indian healthcare workers' insufficient knowledge of oro-dental health. Therefore, some preventive and therapeutic aspects of oro-dental diseases must further be trained.<sup>11</sup> Khademi et al. showed that the healthcare workers' mean knowledge of oro-dental health was not favorable, but their attitude was positive.<sup>12</sup> According to Falahinezhad Ghajari et al., the knowledge of middle school students in southeastern Iran was not desirable.<sup>13</sup>

Therefore, healthcare workers' knowledge of oro-dental health is one of the factors affecting the quality of oro-dental health services. Healthcare workers' knowledge, as well as their attitude towards oro-dental health, is an important step in preventing oro-dental diseases in deprived communities. Therefore, the current study aimed to determine the effect of education on healthcare workers' knowledge of oro-dental health in southeastern Iran.

#### Methods

*Study design and setting*: The present study was an experimental research conducted in the rural areas located in southeastern Iran in Sistan and Baluchestan Province. Eleven health service centers covering two hundred and thirty-eight villages were considered.

*Sample size and sampling:* The study population consisted of 400 healthcare workers working in eleven health service centers in rural areas. In this study, 120 qualified health workers were selected by convenience sampling method based on Morgan's table and were randomly divided into experimental (n = 60) and control (n = 60) groups. Samples were randomized and divided into two groups based on random numbers.

Inclusion criteria were having a degree of healthcare working, no mental illness,<sup>14</sup> and not passing a similar workshop. The exclusion criterion was not participating in more than two training sessions.<sup>15</sup>

Instrument: Demographic information form and the knowledge of oro-dental health questionnaire were used. Demographic information included age, sex, marital status, and education level. To assess the healthcare workers' knowledge of oro-dental health, a questionnaire which was previously used by Moein Taghavi et al.<sup>10</sup> was used. The questionnaire includes 15 multiple-choice questions (MCQ) in scaled measures including correct answer (score 1), wrong answer (score 0), with a minimum score of 0 and a maximum score of 15. This questionnaire consists of 3 components of dental knowledge (6 items), principles of oro-dental health (4 items), and knowledge about how to provide oro-dental care (5 items). Moein Taghavi et al. confirmed the questionnaire validity by content validity. They confirmed its reliability using internal consistency and the Cronbach's alpha coefficient was calculated to be 0.92, 0.93, 0.95, and 0.97 for dental knowledge, principles of oro-dental health, knowledge about how to provide oro-dental care, and overall knowledge, respectively.<sup>10</sup>

collection: This Data studv was conducted after obtaining the code of ethics (No. IR.KMU.REC.1398.380) as well as permission from health authorities. The study aims and phases were explained to the healthcare workers. All participants voluntarily participated in the study and could withdraw at any stage of the study. Also, the control group was provided with the same training after that the study was over. The experimental group was asked not to talk to the control group about the content taught in the classroom at all stages of the study to minimize the effect of classroom instruction on the control group. Both experimental and control groups completed the questionnaire before the intervention. All questionnaires were anonymous with specific codes.

Intervention was conducted for the experimental group in ten 2-hour sessions over 5 weeks with a presentation of an educational booklet by the second researcher. The training was done using lectures, group

discussions, question-and-answer, and videos. The educational content included dental structure, principles of oro-dental health, and how to provide oro-dental care that was confirmed by ten experts. Both groups completed the questionnaire one week after the classes.

Data were analyzed using SPSS software (version 19, SPSS Inc., Chicago, IL, USA). Descriptive statistics [frequency, percentage, mean, and standard deviation (SD)] were used to describe the healthcare workers' demographic and background characteristics and their knowledge. Chi-square test and Fisher's exact test were used to compare demographic variables between the two groups. Independent t-test was used to compare healthcare workers' knowledge of oro-dental health between the two groups.

#### **Results**

According to the results, the majority of the samples from both experimental and control groups were male, aged between 31 and 35 years, with 5-10 years of work experience, and had high/middle school degrees. There was no significant difference between the two groups in demographic characteristics (Table 1).

Variable		Control group	Intervention group	Statistical	Р
		[n (%)]	[n (%)]	test	
Sex	Female	19 (31.6)	19 (31.6)	1.01	0.57*
	Male	41 (68.4)	41 (68.4)	1.01	0.57
Age (year)	18-25	3 (5.0)	4 (6.7)		
	26-30	19 (31.7)	18 (30.0)	0.52	0.45*
	31-35	32 (53.3)	34 (56.6)	0.55	0.43
	> 35	6 (10.0)	4 (6.7)		
Marital status	Single	11 (18.3)	13 (21.7)	0.40	0.42*
	Married	49 (81.7)	47 (78.3)	0.49 0	0.43
Education	Middle school	45 (73.3)	42 (68.3)		
	Diploma	12 (16.7)	14 (18.3)	2.82	$0.30^{**}$
	Associate degree	3 (10.0)	4 (13.4)		
Years of experience	5-10	25 (41.7)	23 (38.3)		
	11-15	12 (20.0)	11 (18.3)		
	16-20	8 (13.3)	9 (15.0)	1.40	$0.42^{*}$
	21-25	8 (13.3)	9 (15.0)		
	25-30	7 (11.7)	8 (13.4)		

Table 1.	Comparison	of participants'	demographic	characteristics	between	interve	ntion
		an	id control grou	ips			

\*Chi-square test, \*\*Fisher's exact test

Variable	Group	Pre-test	Post-test
		Mean ± SD	Mean ± SD
Dental knowledge	Intervepntion	$4.93 \pm 2.11$	$5.71 \pm 1.02$
	Control	$4.91 \pm 1.82$	$4.95 \pm 1.99$
Statistical test (P)		$t = 0.46 (P = 0.42)^*$	$t = 2.64 (P < 0.01)^*$
Oral health principles	Intervepntion	$3.40 \pm 1.29$	$3.80\pm0.77$
	Control	$3.36 \pm 1.26$	$3.45 \pm 1.25$
Statistical test (P)		$t = 0.13 (P = 0.84)^*$	$t = 1.83 (P < 0.01)^*$
How to provide oro-dental care	Intervepntion	$4.16 \pm 1.69$	$4.71\pm0.99$
	Control	$4.18 \pm 1.59$	$4.21 \pm 1.64$
Statistical test (P)		$t = -0.05 (P = 0.67)^*$	$t = 2.01 (P < 0.01)^*$
Overall knowledge	Intervepntion	$12.50\pm5.07$	$14.23 \pm 2.77$
	Control	$12.46 \pm 4.71$	$12.61 \pm 4.84$
Statistical test (P)		$t = 0.03 (P = 0.58)^*$	$t = 2.24 (P < 0.01)^*$
*			

Table 2. Characteristics of healthcare workers'	knowledge and its dimensions
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\*Independent t-test SD: Standard deviation

In the pre-test, the mean scores of the healthcare workers about overall knowledge in the intervention  $(12.50 \pm 5.07)$  and control (12.46 ± 4.71) groups had no significant difference (P = 0.42); whereas, in the post-test, the mean scores of overall knowledge in the intervention  $(14.23 \pm 2.77)$  and control  $(12.61 \pm 4.84)$  groups showed a statistically significant difference (P < 0.01). This means that, after the training, the mean scores of overall knowledge in the intervention group were improved compared to the control group (Table 2). In addition, table 2 shows that in the post-test stage, the mean score of dimensions of healthcare all workers' knowledge of oro-dental health such as dental knowledge (P < 0.01), oro-dental health principles (P < 0.01), and how to provide oro-dental care (P < 0.01) increased significantly in the intervention group compared to the control group.

## Discussion

The present study aimed to investigate the effect of education on healthcare workers' knowledge of oro-dental health in rural children. The results showed that the overall knowledge of healthcare workers significantly increased after intervention. Therefore, the research hypothesis, the effect of education on the healthcare workers' knowledge oro-dental health, of was confirmed. Bahri et al. indicated a positive

impact of educational programs on knowledge, attitude, and improvement of short-term performance of pregnant women in oro-dental health in urban areas of Mashhad in northeastern Iran.9 Other results in urban areas of Tehran, Iran, showed that face-to-face education of students was a good method to teach caring tips and reduce dental plaques.<sup>16</sup> The results also showed that video/lecture-based education not only increased instantaneous awareness but also oro-dental health in the long run. Therefore, video-based education is suggested to promote oral health in all urban and rural areas.<sup>17</sup> The results suggest that although children in urban and rural areas differ culturally and in terms of access to facilities, they need oral health education. A study in Finland showed that understanding, encouraging, and interacting with adolescents with caries may make them more positive and receptive to self-care and Oro-dental care.18

Results also showed that the mean scores of dental knowledge, oral health principles, and how to provide oro-dental care significantly increased in the intervention group compared to the control group. Therefore, education was effective in all dimensions. Mottaghi et al. found that in the rural health centers of Kashan in central Iran, health education had a significant effect on the healthcare workers' knowledge of primary health services. Education plays an important role in developing public awareness of primary health care.<sup>14</sup> Francis et al. showed that in India, about 81.0% of secondary school students had adequate level of knowledge on causes and prevention of dental caries and 66.7% were aware of causes and prevention of periodontal diseases.<sup>19</sup>

According to these results, oro-dental health in children is very important, and rural children's oro-dental care has been neglected. This may be due to poor knowledge and lack of access to educational facilities in the villages. Khademi et al. studied the level of knowledge and attitude of healthcare workers towards the prevention of oro-dental diseases in Isfahan rural areas, Iran. They showed that healthcare workers' knowledge of oro-dental health was not favorable.<sup>12</sup>

A study in Tehran showed that the majority of 9-10-year-old children were not aware of the oro-dental health.<sup>16</sup> According to Arsang Jang et al., the high cost of dental services is a barrier to access for rural children aged 6 to 7 years. Therefore, it is essential to enhance access to the prevention services in rural and urban areas as well as parental awareness of oro-dental health.<sup>20</sup> Research has shown that parents with proper knowledge are taking better care of their children's teeth.<sup>21,22</sup>

Oro-dental health in addition to physical health may affect mental and psychological health. Studies have shown a positive and significant relationship between self-esteem and oro-dental health.<sup>23,24</sup> Mazloumi Mahmoudabad et al. in Yazd urban areas, Iran, showed that the implementation of a scenario proportional to cultural issues could improve students' knowledge, practice, and attitude towards oro-dental health.<sup>25</sup> Experts emphasize on the continuing revised education in the training of community health workers and other healthcare personnel.<sup>26</sup> Researchers in Bangladesh concluded that policymakers should provide guidelines for dental health education in educational institutions.1

One of the study limitations was that data were collected by using a self-report questionnaire. Therefore, we tried to minimize confounding factors while completing the questionnaires.

## Conclusion

The results showed the effectiveness of education on healthcare workers' knowledge of oro-dental health in children. Given the importance of preventive oro-dental care in children, major health problems, lack of specialized human resources in the provision of health services in deprived areas, and use of self-care to overcome oro-dental problems in children, health education is considered as the first practice in primary health care. Therefore, it is recommended that health education programs in the field of oro-dental health be designed and implemented within the framework of the educational model.

### **Conflict of Interests**

Authors have no conflict of interest.

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# Comparison of traditional and novel remineralization agents: A laser fluorescence study

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## **Original Article**

## Abstract

**BACKGROUND AND AIM:** The first clinical symptom of tooth decay is the appearance of a white spot lesion (WSL) on the tooth surface. This study is performed with the aim to evaluate the efficacy of six different remineralization agents in vitro with the DIAGNOdent laser fluorescence method.

**METHODS:** In this study, 44 extracted, impacted human wisdom teeth (88 specimens) without caries were used to obtain standard demineralized enamel surfaces. The teeth were divided into eight groups consisting of two control (positive and negative) and six experimental groups [Fluoride (F) gel, casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) cream, CPPACP + F cream, NovaMin + F toothpaste, Xylitol-Hydroxyapatite + F cream, and Ozone + F]. De-/re-mineralization solutions were applied with a pH-cycle approach to areas of  $3 \times 3$  mm on the buccal/lingual surfaces of the teeth for 9 days. The remineralization agents were applied to the demineralized areas and the samples were then kept in artificial saliva. The DIAGNOdent measurements were performed before and after the application of the remineralization agents. The Wilcoxon and Kruskal-Wallis tests were used for analysis of the data.

**RESULTS:** The mean scores obtained after the DIAGNOdent measurements were 3.82 and 6.91 in the negative-control and positive-control groups, respectively. There were significant differences in the scores before and after the remineralization procedure in all experimental groups (P < 0.050). When the mean differences before and after treatment were compared between the groups, CPP-ACP + F provided significantly more remineralization than other experimental groups (P < 0.050).

**CONCLUSION:** Remineralization of demineralized areas was achieved in all experimental groups. The highest degree of remineralization according to the DIAGNOdent scores before and after the procedure was observed in the CPP-ACP + F group.

**KEYWORDS:** Tooth Remineralization; Lasers; Fluorescence; Xylitol; Ozone

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ooth decay is one of the most common and preventable diseases of childhood. The process of caries of formation cvcle is а remineralization and demineralization, the various stages of which may be reversible or irreversible.1 The first clinical manifestation of tooth decay is the appearance of a white spot lesion (WSL) on the tooth surface, which is thought to be the initial stage of enamel demineralization.<sup>2</sup> If the demineralization process continues, the initial lesion may progress and lead to cavitation.3

A WSL is the earliest macroscopic sign of enamel caries. Typically, the surface layer of the enamel remains intact while demineralization continues in the subsurface, but if no treatment is applied, it will eventually develop into complete cavitation.<sup>4</sup> Saliva, which has an almost neutral pH, has a natural buffering capacity. In the early stage of demineralization, saliva reverses this process with calcium ions, phosphate ions, buffering agents, fluoride, and other substances.<sup>5</sup>

Various methods and agents are available for remineralization of the early enamel

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caries lesions. Topical application of mineralconcentrates can rich be used for remineralization of such initial lesions.6 Some of these agents can be referred to as traditional remineralization agents since they are known and used for a long time. Fluoride-based dental products and materials are frequently used to increase the resistance of the teeth to caries, and the remineralization effects of fluoride-based materials of different densities and shapes have been revealed in many studies.<sup>5,7</sup> In addition to fluoride-based materials, those containing calcium, phosphate, casein phosphopeptide-amorphous calcium (CPP-ACP), phosphate and casein phosphopeptide amorphous calcium fluoride phosphate (CPP-ACFP) have been reported to be effective for remineralization.<sup>1,8,9</sup>

Apart from these agents, new remineralization agents are also available today. These agents are generally produced and/or used in combination with fluoride. NovaMin, Xylitol + Hydroxyapatite, and ozone can be referred to as novel remineralization agents.

De- and re-mineralization of teeth can be detected by both invasive and non-invasive methods. A WSL cannot be detected visually until it has advanced 200-300 µm into the enamel.<sup>10</sup> Non-invasive diagnostic methods include quantitative light-induced fluorescence (QLF), electrical resistance decay monitoring devices, fibre-optic transillumination, optical coherence tomography, laser fluorescence (DIAGNOdent), and scanning electron microscopy (SEM).<sup>11</sup> This study was performed to evaluate the efficacy of six different remineralization agents in vitro with the DIAGNOdent laser fluorescence method.

#### **Methods**

This in-vitro study was carried out at Dicle University Faculty of Dentistry in Diyarbakir, Turkey. Approval was received for this study from the local ethics committee (reference number: 2013; 1-7).

*Preparation of enamel samples:* To obtain standard affected enamel surfaces,

44 extracted, formerly impacted wisdom teeth lacking caries were used. The roots of the teeth were separated using an Isomet water-cooled microtome with a double-sided diamond thin blade, and the crown parts of the samples were separated along the occlusocervical and mesiodistal planes. On the buccal and lingual surfaces of the 88 samples obtained (11 samples for each group), labels measuring  $3 \times 3$  mm were adhered to prepare  $3 \times 3$ -mm<sup>2</sup> windows approximately 1-2 mm above the cementoenamel junction, and the tooth surfaces outside the label were coated with nail polish. Finally, the enamel samples were randomly divided into eight groups, consisting of two control and six experimental groups as follows:

Group 1. Positive (+) control group: Demineralization cycle only

Group 2. Negative (-) control group: Intact tooth with nothing applied

Group 3. Fluoride gel group: Application of Topex® APF gel

Group 4. CPP-ACP cream group: Application of GC Tooth Mousse containing 10% CPP-ACP

Group 5. CPP-ACP + F cream group: Application of MI Paste Plus containing 0.2% (w/w) (900 ppm) NaF in addition to 10% CPP-ACP as casein phosphopeptide amorphous calcium phosphate, forming a CPP-ACFP cream

Group 6. NovaMin-Fluoride-containing toothpaste group: Application of Sensodyne Repair and Protection toothpaste, a toothpaste containing NovaMin and fluoride

Group 7. Xylitol-Hydroxyapatite-Fluoride cream group: Application of Remin Pro, a cream containing xylitol, hydroxyapatite (HA), and fluoride

Group 8. Ozone-Fluoride group: Application of PrOzone ozone generator and Topex® APF gel

Artificial initial enamel caries creation: Initial enamel caries were created in each of the groups except Group 2 by applying a de-/re-mineralization cycle (pH cycle), which was similar to clinical conditions. The pH cycle model was used for the evaluation of materials contributing to the mechanism of caries generation under laboratory conditions by mimicking these phases. The pH cycle used in the present study was administered as a series of 24-hour periods for 9 days.

**Preparation** of de-/re-mineralization cycle: First, the samples were stored for 6 hours in the demineralization solution which included 1.5 mM CaCl<sub>2</sub>, 0.9 mM KH<sub>2</sub>PO<sub>4</sub>, and 50 mM acetic acid with a pH of 4.3 at 37 °C. The samples were then removed from this solution and washed with distilled water. The samples were next stored in the remineralization solution which consisted of 1.5 mM CaCl<sub>2</sub>, 5 mM KH<sub>2</sub>PO<sub>4</sub>, and 100 mM acetic acid with a pH of 7.0 at 37 °C for 17.5 hours. The samples were then removed from this solution, washed with distilled water, and placed back in the demineralization solution. This pH cycle was continued for 9 days, and the solutions were changed every 3 days to prevent any saturation.

*Application of remineralization agents:* The samples were divided into groups and artificial initial enamel caries were formed, except in the positive and negative control groups, Group 1 and Group 2, in which no remineralization agent was applied. In Group 3, the teeth were lightly dried according to the manufacturer's instructions, after which the APF gel was applied for 4 minutes.

CPP-ACP and CPP-ACP + F creams were applied to the teeth in Groups 4 and 5. Briefly, the teeth were lightly dried according to the manufacturers' instructions, and then the creams were applied for 3 minutes. In Group 6, toothpaste containing NovaMin and fluoride was applied for 2 minutes, mimicking the typical tooth brushing time. In Group 7, cream containing xylitol, HA, and fluoride was applied for 3 minutes after the tooth surfaces were lightly dried according to the manufacturer's instructions. In Group 8, PrOzone was used as an ozone generator while ozone gas was applied. Following ozone application, fluoride gel was applied to the teeth for 4 minutes.

All samples were then washed with distilled

water and incubated for 30 minutes at 37 °C in artificial saliva to simulate clinical conditions.

fluorescence (DIAGNOdent) Laser measurements: The laser fluorescence measurements were made using а DIAGNOdent (KaVo) device with a diode laser fluorescent beam with a wavelength of 655 nm and peak power of 1 mV. During the DIAGNOdent measurements, all samples were first calibrated with ceramic standard in accordance with the manufacturer's instructions. After calibration, the enamel surfaces were dried for 5 s with air. Next, the tip of the device was first touched to an area away from the surface to be measured to obtain a base value for that tooth. The tip of the device was then gently moved over the enamel surface and the maximum peak value was read from the screen on the front panel of the device. Measurements were repeated twice for each tooth, and the results were averaged and recorded. All the measurements conducted were by an experienced paediatric dentist.

Statistical analyses were performed with SPSS software (version 23, IBM Corporation, Armonk, NY, USA). To determine the sample size for the method used, a statistical power test (G\*Power software) was performed. The minimum estimated sample size for each group was three samples, calculated considering 95% power and a significance level of 0.050 according to a previous study.<sup>12</sup> Descriptive statistics, as well as Wilcoxon and Kruskal-Wallis tests were employed to analyze the data. Bonferroni correction post hoc test was used for pairwise comparisons. In all analyses, P < 0.050 was taken to indicate statistical significance.

#### Results

The obtained after the mean scores measurements with DIAGNOdent were 3.82 and 6.91 in the negative-control group (Group 2) and positive-control group (Group 1), respectively. The mean scores of the experimental groups before and after remineralization are shown in table 1.

Table 1. Comparison of	pre- and	post-treatment	DIAGNOdent scores
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<b>Experimental grou</b>	ps	Mean ± SD	Median (Min-Max)	Test statistics	Р
Control groups	Positive	$6.9 \pm 2.1$	7 (4-10)	Z= - 2.968	0.003*
	Negative	$3.8 \pm 1.0$	4 (2-5)		
F	Before	$4.5 \pm 0.7$	4 (4-6)	Z= - 3.051	$0.002^{*}$
	After	$3.5 \pm 0.8$	4 (2-5)		
CPP-ACP	Before	$4.3 \pm 0.8$	4 (3-6)	Z= - 3.000	$0.003^{*}$
	After	$3.5 \pm 0.7$	3 (3-5)		
CPP-ACP+F	Before	$5.0 \pm 0.8$	5 (4-6)	Z= - 3.127	$0.002^{*}$
	After	$3.2 \pm 0.6$	3 (2-4)		
NovaMin + F	Before	$4.5 \pm 1.2$	4 (3-7)	Z= - 2.970	$0.003^{*}$
	After	$3.3 \pm 0.6$	3 (2-4)		
Xylitol-HA + F	Before	$4.9 \pm 0.8$	5 (4-6)	Z= - 3.127	$0.002^{*}$
	After	$3.7 \pm 0.8$	4 (3-5)		
Ozone + F	Before	$5.2 \pm 1.2$	5 (3-7)	Z= - 2.972	$0.003^{*}$
	After	$4.1 \pm 0.8$	4 (3-5)		

SD: Standard deviation; F: Fluoride; CPP-ACP: Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP); Z: Wilcoxon test statistics, \*P < 0.050

There were significant differences between the scores before and after the remineralization procedure in all experimental groups (Table 1).

Given the comparison of the mean differences in the pre- and post-treatment scores between the groups, the greatest difference was observed in the control groups. CPP-ACP + F provided significantly greater remineralization than other experimental groups (P < 0.050). This was followed by the NovaMin + F and xylitol + HA + F groups, which showed similar rates of remineralization, and then by the ozone + and **CPP-ACP** F, Fluoride, groups, respectively (Table 2).

#### **Discussion**

The results demonstrate two issues. First, statistically significant remineralization was achieved in all experimental groups. Second, the greatest difference between the mean scores measured with DIAGNOdent before and after remineralization in the experimental groups was seen in the CPP-ACP + F group.

Different methods can be used to evaluate in-vitro de-/remineralization. Previous studies have used one or more tests, including scanning electron microscopy (SEM)/field scanning electron microscope emission force (FE-SEM), DIAGNOdent, atomic microscopy (AFM), and surface microhardness.5,13,14 Because DIAGNOdent has been reported to be a reliable non-invasive means of caries diagnosis,<sup>15,16</sup> this method was used in the present study as well.

In this study, in which traditional and novel remineralization agents were compared, fluoride and CPPACP, which have long been used for remineralization and have been tested by researchers in many studies, have been classified as traditional remineralization agents. Moreover, the combined uses of these agents, which are reported to have synergistic effects, were included in this class.

Table 2. Intergroup comparison of mean differences in the experimental groups (n = 11)						
<b>Experimental groups</b>	Mean difference ± SD	Median(Min-Max)	Test statistics	Р		
F	$1.00\pm0.45$	1 (0-2)#	$\chi^2 = 22.11$	< 0.001		
CPP-ACP	$0.82 \pm 0.40$	1 (0-1)#				
CPP-ACP + F	$1.82 \pm 0.40$	2 (1-2)¥				
NovaMin + F	$1.18\pm0.75$	1 (0-3)#				
Xylitol-HA + F	$1.18 \pm 0.40$	1 (1-2) <sup>#¥</sup>				
Ozone + F	$1.09 \pm 0.54$	1 (0-2)#				

SD: Standard deviation; F: Fluoride; CPP-ACP: Casein phosphopeptide-amorphous calcium phosphate (CPP-ACP);  $^{\#\Psi}$ There is no difference between countries with the same symbol,  $\chi^2$ : Kruskal-Wallis test statistics, Post hoc test: Bonferroni correction for pairwise comparisons

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NovaMin and xylitol-containing products, which have been released and popular in recent years, and applications that have recently been used for remineralization, such as ozone with fluoride, have been evaluated as novel remineralization agents.

In this study, in which traditional and novel remineralization agents were compared, fluoride and CPPACP, which have long been used for remineralization and have been tested by researchers in many studies, have been classified as traditional remineralization agents. Moreover, the combined uses of these agents, which are reported to have synergistic effects, were included in this class. NovaMin and xylitol-containing products, which have been released and popular in recent years, and applications that have recently been used for remineralization, such as ozone with fluoride, have been evaluated as novel remineralization agents.

Altenburger et al. examined the efficacy of CPP-ACP with DIAGNOdent and reported that the lesion size decreased significantly in the group treated with CPP-ACP.<sup>17</sup> Uysal et al. compared a 5-minute CPP-ACP (Tooth Mousse) treatment group with a 5-minute 5% NaF (Fluoridine N5) treatment group, and reported that both caused similar increases in microhardness.<sup>18</sup> In the present study, the results of the DIAGNOdent measurements indicated that Topex® APF gel produced significantly more remineralization compared to CPP-ACP (P < 0.050).

Fredrick et al. divided 45 teeth with occlusal WSLs detected by DIAGNOdent into three groups.<sup>12</sup> For 30 days, 10% CPP-ACP + 0.2% (w/w) NaF (Tooth Mousse Plus), 10% CPP-ACP (Tooth Mousse), and 0.5% (w/w) NaF were applied to the first group, second group, and third group, respectively. Measurements were obtained with DIAGNOdent, and the results showed similar remineralization potentials in Group 1 and Group 2, both higher than those in Group 3.

In the present study, the greatest difference between the average scores before and after remineralization was found in the CPP-ACP + F group, and this difference was statistically significant (P < 0.050). Similar to the results of the present study, Elsayad et al., Karlinsey et al., and Patil et al. reported that the addition of fluoride to CPP-ACP had a synergistic effect on the remineralization of enamel.<sup>5,19,20</sup>

Leila et al. reported that CPP-ACFP was more effective in achieving remineralization than Remin Pro.<sup>13</sup> The DIAGNOdent results of the present study showed that the difference between the scores measured before and after the Remin Pro treatment was significant (P < 0.050), but the difference in the mean scores was lower than that observed with CPP-ACP + F.

Several studies have shown that ozone gas is effective for remineralization.16,21,22 In the current study, the difference between the measurements before and after ozone treatment was significant, and the difference between the measurements was higher in the ozone group in comparison to the APF and CPP-ACP groups, but lower in the other groups.

This study had some limitations, with the first being DIAGNOdent, as although it is known as a reliable tool for the detection of initial carious lesions, it should be supported by other methods. The results indicated by DIAGNOdent are not as precise as those demonstrated by SEM, which may have affected the accuracy of the present results. In the groups included in the class of novel remineralization agents, fluoride was available as a combined agent. The level of contribution of main content and fluoride to remineralization was exactly unknown.

Despite these limitations, according to the results obtained from this study, it can be claimed that the traditional remineralization agents are still effective compared with the novel agents.

#### Conclusion

The de-/re-mineralization solutions and pH cycle model used in this study were sufficient to create artificial WSLs in vitro.

The DIAGNOdent device can be used for caries detection in in vivo and practical conditions, providing rapid and repeatable measurements in a non-invasive manner.

Statistically significant remineralization was achieved in all experimental groups.

The greatest difference between the mean scores measured with DIAGNOdent before and after the remineralization in the experimental groups was seen in the CPP-ACP + F group.

The traditional remineralization agents are still effective compared with the novel agents.

**Conflict of Interests** 

Authors have no conflict of interest.

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## Influence of maternal oral healthcare behavior during childhood on children's oral health care during adolescence

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## **Original Article**

### Abstract

**BACKGROUND AND AIM:** This study investigated whether mothers' knowledge about oral health of children during early ages influences the oral health care behavior of their children during adolescence and beyond.

**METHODS:** This descriptive, cross-sectional, analytic study was carried out among 440 12-13-year-old students from 2 schools in Tehran, Iran, and their mothers in 2015. A self-report questionnaire consisting of 4 sections (demographic characteristics, socioeconomic information, oral health knowledge, and oral care behavior) was designed to assess the influence of mothers' oral health care behavior in controlling early childhood caries (ECC) on their children's oral health knowledge and behavior during their adulthood. Pearson's correlation coefficient, chi-square test, and chi-square linear-by-linear association test were conducted to assess the effect of gender, father's education, mother's education, first dental care, first dental check-up, and teacher's advice about oral health in school on oral health knowledge and behavior.

**RESULTS:** A positive relationship was observed between first dental check-up, oral health knowledge (P = 0.05; CI = 95%) and flossing (P < 0.001; CI = 95%). Surprisingly, no differences were found between first dental check-up and tooth brushing frequency (P = 0.26; CI = 95%).

**CONCLUSION:** The current study showed the importance of mothers' knowledge and behavior toward their children's oral health during early ages and its impact on the oral health care behavior of children in adulthood. This indicates that prevention behaviors starting as early as possible in childhood will cause better outcomes in adulthood.

**KEYWORDS:** Mothers; Oral Health; Adolescent; Health Behavior

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ental caries is an infectious disease and is largely considered as a sociobehavioral problem that affects many children worldwide.<sup>1</sup> There are many risk factors which contribute to the prevalence of dental caries such as health literacy, lifestyle, education, diet, fluoride exposure, psychological and socio-economic factors, and medical conditions.

Despite various preventive strategies, this

chronic condition is still a global public health issue the prevalence of which is increasing particularly in many low-income and middle-income countries.<sup>2,3</sup>

Oral health is an essential component of general health,<sup>4</sup> and oral health status plays an important role in children's normal growth and wellbeing. Evidence shows that controlling the common risk factors of dental disorders is not only beneficial to children's

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overall health, but also has an important impact on the quality of life (QOL) of the whole family.5-8 Despite the numerous oral health-related educational and promotional programs, still no great success has been achieved in controlling dental caries. According to the available literature, preventive approaches are mainly divided into the 3 major categories of social, professional, and home care activities. The major emphasis of these categories is on dietary advice, oral hygiene instructions, and routine dental checkups.<sup>1,9</sup>

Given that children may not be fully aware of correct self-care, parents' knowledge of and attitude towards oral health are extremely important in suitable oral care.10,11 Within families, like other aspects of health, mothers play a crucial role in oral health promotion.<sup>12</sup> The best example for this is the important role of mothers in controlling early childhood caries (ECC) which is a common chronic disease all around the world and can affect children's QOL.<sup>13,14</sup> However, the majority of unattended children will go through advanced stages of ECC disease and develop pain, infection, eating limitation, and disrupted sleep pattern as a result. By preventing or controlling these problems, we can reduce and remove all those barriers to children's normal growth and development. In this matter, the mother's role is non-negligible. Laniado et al. found that mothers' oral health has a significant impact on children's risk of experiencing dental caries.15 Moreover, a study on mothers' knowledge about oral health and oral health behaviour in their children indicated that dental caries had a higher prevalence among children of mothers who lacked sufficient oral health knowledge.16

However, it needs to be clarified whether a mother's attention to childhood oral health can have an extended influence on her child's oral health during adolescence. Thus, the purpose of this study was to investigate whether mothers' knowledge on the oral health of children during early ages may result in better oral health care behavior amongst their children during adolescence and beyond.

#### **Methods**

This descriptive, cross-sectional, analytic study was conducted on 440 adolescents (48% girls and 52% boys) aged 12-13 years from 2 public schools in Tehran, Iran, and their mothers in 2014-15. One of the aims of this study was to estimate the proportion of mothers with correct oral health care behavior in the mentioned population. Soltani et al. found this rate to be 38% in their study.<sup>17</sup> Considering a difference of up to 5% of the true population parameter (d = 0.05)and using the formula  $n = z^2p(1-p)/d^2$ , the minimal sample size required was calculated to be 362 at a confidence interval of 95%. It was assumed that some questioners may not be filled completely by the participants (at least 15%); therefore, the minimum needed sample size in this study was calculated to be 426 [n = 362/(1-0.15) =426]. The schools were randomly selected from the list of schools registered by the Ministry of Education. We treated all the schools in the same way, each one was given a number using a TI-82 calculator (Texas Instruments Incorporated, Dallas, Texas, USA), in other words, all the schools had the same probability of being selected.

All students and their parents who voluntarily agreed to participate in this study asked to fill out a self-report were questionnaire. The questionnaire was designed to assess the impact of mothers' oral health care behavior in controlling ECC on their children's oral health knowledge and behavior during adulthood. The questionnaire was developed in multiple steps. Using the items extracted from the literature, an item pool was developed for expert evaluation. The questions were designed and evaluated by 10 experts including 5 dental health care professionals, 2 epidemiologists, and 3 social scientists. In order to assess the instrument's face validity, 10 mothers were asked to assess the questionnaire and report if they found any difficulty or ambiguity in the questions. For the quantitative evaluation of the importance of each question, the "impact score"

(frequency × importance) was used. The items with an impact score of equal to or greater than 1.5 were considered acceptable. This number corresponds to a mean frequency of 50% and a mean importance of 3 out of 5 points in a Likert scale.

For content validity evaluation, the qualitative and quantitative methods were applied. In the qualitative phase, the invited experts evaluated the grammar and wording and they confirmed the structure of each question. In the quantitative phase, content validity index (CVI) and content validity ratio (CVR) were both measured. Using the CVI, we assessed the clarity, simplicity, and relevancy of each question in the instrument. For CVR calculation, Lawshe's approach was used. Each question was evaluated in terms "essential", "useful but not of being essential", or "non-essential". CVR > 62% was selected as the cut-off point for retaining or removing each question (suggested by Lawshe when employing 10 experts).<sup>18</sup>

To assess the reliability of the questionnaire, test-retest reliability indicator was calculated using kappa and proportion of agreement statistics.19 Acceptable reliability was considered as the values of kappa coefficient greater than 0.75. Therefore, 18 mothers were asked to fill out the same questionnaire under the supervision of the researcher within the school. After 3 weeks, the mothers were asked to come back and fill out the questionnaire again. All questionnaires were labeled with ID numbers in order to be able to merge them into the test-retest data sets. The final version of the questionnaire consisted of 4 parts, demographic information, socioeconomic status (SES), oral health care behaviors and habits, and oral health knowledge.

The questionnaire starts with questions on demographic characteristics and the next section is related to the primary oral healthcare behavior of mothers towards their children's oral health. This section consists of 10 questions 2 of which are related to the child's first dental visit and the child's age of starting tooth brushing. The next section is

about adolescent oral health knowledge. The children's knowledge is evaluated using the 3 questions "What causes dental caries?", "Why is brushing necessary?", and "Is it necessary to have regular dental visits?"; each answer has a point and the sum of these points constitutes the knowledge score. The knowledge score ranges between 0 and 9. The third section is about adolescents' oral health habits, which contains the frequency of tooth brushing (twice or more per day/ once a day/ sometimes/ never) and flossing (once a day/ sometimes/ never) to assess the child's oral behavior. The last section consists of questions regarding socio-economic status including education parents (university degree, diploma, and pre-diploma), father's occupational status, number of siblings, and whether the family owns a car and the listed household appliances (i.e., refrigerator, laptop, or washing machine; each item had 1 score and the total score ranged between 0 and 6).

The oral examinations of the children were performed by 2 dentists in order to obtain parental consent to participate in the study. After oral examination of the children, referral forms were given to mothers if any dental treatment was required.

The oral health knowledge of children was categorized as < 3, 3-6, and > 6, and their brushing and flossing habits (never, sometimes, once, or more) were reported. The distributions of knowledge, and brushing and flossing habits scores were compared among genders using Mann-Whitney U test.

The association between parental education and mothers' primary health care behaviors was assessed using linear trend test. To assess the difference in the distribution of economic variable scores and number of siblings between categories of knowledge and habits, Kruskal-Wallis test was implemented.

Pearson's correlation coefficient, chi-square test, and linear trend test were conducted to assess the effect of gender, parental education, first dental care, first dental visit, and teacher's advice on oral health knowledge and behavior in school. Kruskal-Wallis test was performed to compare the relation between the number of siblings and economic status with considered independent variables.

Ordinal logistic regression analysis was used to assess the relationship of the interested independent variables, oral health behaviors, and the categories of knowledge score with independent variables.

#### **Results**

The study population was composed of mothers and their 12-13-year-old children (48.2% girls and 51.8% boys). Little over 20% of children brushed their teeth twice or more per day, while 48% reported brushing once a day and 30% of them reported not brushing their teeth. About 31% of children did not floss at all. More than 50% of children were aware that using fluoride toothpaste was necessary. About 65% of children correctly answered the questions on the reason for tooth brushing. About 62% of the participating children thought that regular dental visits were important and necessary for improving their oral health status. Only 34% of the subjects correctly recognized the causes of tooth decay. Moreover, 21% of the mothers had started their children's oral care before the age of 2 years and only 7% had taken their children for a dental check-up before the age of 2 years.

The most evident finding is that the mothers' behavior on the first dental checkup was significantly related to adolescents' tooth brushing habit and flossing behavior (P < 0.001) as well as oral health knowledge (P < 0.050). Children who had had their first visit at early ages reported better oral care habits. Results presented in table 1 show that there was a weak relationship between the number of siblings and tooth brushing habit (P = 0.060). Furthermore, another important finding was the association between teachers "talking about oral health in the classroom" and students' frequency of tooth brushing (P = 0.030); those who received advices in the classroom had better brushing habit.

This study did not find any relation between mothers' and fathers' educational level and their child's oral health knowledge and habits. Significantly better oral health knowledge and brushing frequency were reported among girls compared with boys (P < 0.005). This association was poorly significant for dental flossing (P = 0.060).

Children whose mothers' paid more attention to the dental referral form showed significantly better oral health habits.

A positive relationship was detected between first dental check-up and oral health knowledge and flossing. No relation was found between the first dental visit and tooth brushing frequency. Moreover, no significant association was observed between economic status and oral care habits and flossing frequency factors.

The results of ordinal logistic regression analysis to assess the relationship between considered independent variables and oral health behaviors, and the quartiles of knowledge score and independent variables are presented in table 2. The first dental checkup variables had significant relationships with brushing and flossing frequency. Children who had their first dental check-up before the age of 2 showed a greater chance of having tooth brushing (OR = 2.32; P < 0.001) and dental flossing (OR = 2.03; P = 0.030) habits. Similarly, the first dental check-up variable showed a significant positive association with oral health knowledge (OR = 1.70; P = 0.020) and flossing (OR = 3.49; P < 0.001). After adjusting for all covariates, no significant effect was detectable between oral health knowledge and behaviors with the number of siblings. Furthermore, this analysis showed a positive relationship between economic status and brushing frequency after adjusting for other items. However, relationship the economic between status and flossing behavior was nearly significant (P = 0.060). According to the coefficients presented in table 2, the results were similar for bivariate comparisons and regression analysis.

Table 1. The association between considered response variables and socio-demographic characteristics													
Variable	Category		Knowledge*		Р		<b>Brushing</b> *		Р		<b>Flossing</b> <sup>*</sup>		Р
		Q1	Q2	Q3		Never	Some times	Once or more		Never	Some times	Once or more	
Gender	Girl Boy	44 (20.9) 73 (32.4)	93 (44.1) 88 (39.1)	74 (35.1) 64 (28.4)	0.020	26 (12.3) 69 (30.3)	102 (48.1) 109 (47.8)	84 (39.6) 50 (21.9)	0.003	58 (27.4) 80 (35.1)	96 (45.3) 105 (46.1)	58 (27.4) 43 (18.9)	0.062
Father's education**	University degree	48 (27.4)	67 (38.3)	60 (34.3)		37 (20.8)	90 (50.6)	51 (28.7)		60 (33.7)	85 (47.8)	33 (18.5)	
[n (%)]	Diploma	37 (27.2)	60 (44.1)	39 (28.7)	0.840	35 (25.7)	60 (44.1)	41 (30.1)	0.440	34 (25)	67 (49.3)	35 (25.7)	0.360
	Pre- diploma	32 (25.6)	54 (43.2)	39 (31.2)		23 (18.3)	61 (48.4)	42 (33.3)		44 (33.9)	49 (38.9)	33 (26.2)	
Mother's education	University degree	26 (20.6)	55 (43.7)	45 (35.7)		24 (19.0)	64 (50.8)	38 (30.2)		44 (34.9)	52 (41.3)	30 (23.8)	
[n (%)]	Diploma	46 (27.2)	76 (45.0)	47 (27.8)	0.130	35 (20.6)	74 (43.5)	61 (35.9)	0.150	53 (31.2)	75 (44.1)	42 (24.7)	0.770
	Pre- diploma	45 (31.9)	50 (35.5)	46 (32.6)		36 (25.0)	73 (50.7)	35 (24.3)		41 (28.5)	74 (51.4)	29 (20.1)	
Economic status	Median (IQR)	5 (4,6)	5 (4,6)	4.5 (3,6)	0 120	5 (4,6)	4 (3,6)	5 (4,6)	0.178	5 (3,6)	5 (4,6)	5 (3,6)	0.600
	Mean ± SD	$4.65 \pm 1.45$	$4.43 \pm 1.56$	$4.25 \pm 1.59$	0.120	$4.50 \pm 1.44$	$4.30 \pm 1.58$	$4.57 \pm 1.56$		$4.33 \pm 1.60$	$4.48 \pm 1.50$		0.000
First	< 2	8 (25.0)	15 (49.6)	9 (28.1)		8 (25.0)	9 (28.1)	15 (46.9)		10 (31.5)	15 (45.5)	7 (22.6)	
check-up	2-6	74 (24.4)	123 (40.6)	106 (35.0)	0.050	64 (21)	151 (49.5)	90 (29.5)	0.260	88 (28.9)	148 (48.5)	69 (22.6)	< 0.001
(year) [n (%)]	Never	34 (34.3)	43 (43.4)	22 (22.2)	01000	23 (22.8)	51 (50.5)	27 (26.7)	0.200	44 (43.6)	40 (39.6)	17 (16.8)	
First dental	< 2	19 (21.3)	36 (40.4)	34 (38.2)		11 (12.1)	39 (43.8)	39 (43.8)		20 (22.5)	40 (44.9)	29 (32.6)	
care (year)	2-6	72 (26.2)	115 (41.8)	88 (32.0)	0.022	62 (22.2)	133 (47.7)	84 (30.1)	< 0.001	83 (29.7)	134 (48.0)	62 (22.2)	< 0.001
[n (%)]	Not until	24 (35.8)	27(40.3)	16(23.9)		20 (29.9)	36 (53.7)	11(16.4)		32 (47.8)	27 (40.3)	8 (11.9)	
Attention	res	82 (20.9)	127 (41.0)	90 (31.3)		21 (17.8)	51 (25.2)	40 (39.0)		24 (20.3)	60 (50.8)	34 (28.8)	
form	INO	28 (23.9)	51 (43.6)	38 (32 5)	0.632	69 (24 4)	152 (49 4)	87 (28 2)	0.048	108 (35.1)	133 (43.2)	67 (21.8)	0.006
[n(%)]		20 (23.7)	51 (45.0)	30 (32.3)		0)(24.4)	132 (4).4)	07 (20.2)		100 (33.1)	155 (45.2)	07 (21.0)	
Teacher's	Yes	50 (25.4)	82 (41.6)	65 (33.0)	0.400	35 (17.8)	94 (47.7)	68 (34.5)	0.020	56 (28.4)	94 (47.7)	47 (23.9)	0.222
advice [n (%)]	NO	67 (28.0)	99 (41.4)	73 (30.5)	0.488	60 (24.7)	117 (48.1)	66 (27.2)	0.030	82 (33.7)	107 (44)	54 (22.2)	0.322
Number of sisters and	Median (IQR)	2 (2,3)	2 (2,3)	2 (2,3)	0.140	3 (2,4)	2 (2,3)	2 (2,3)	0.067	2 (2,3)	2 (2,3)	2 (2,3)	0.690
brothers	Mean $\pm$ SD	$2.37 \pm 0.91$	$2.50 \pm 0.96$	$2.41 \pm 0.87$		$2.65 \pm 1.01$	$2.38 \pm 0.87$	$2.40 \pm 0.93$		$2.40 \pm 0.92$	$2.50 \pm 0.92$	$2.44 \pm 0.9$	

SD: Standard deviation, IQR: Interquartile range

\*Dependent variables, \*\*Education categories (Good = University degree, Moderate = Diploma, Poor = Lower than diploma)

Variable	<u>_</u>	Tooth brushing		, ,	Tooth flossing		Oral health knowledge			
		OR	95% CI	Р	OR	95% CI	Р	OR	95% CI	P
Intercent coore		0.26	(0.10, 0.65)	< 0.001	1.28	(0.50, 3.21)	0.600	0.38	(0.15, 0.94)	0.030
intercept score		2.90	(1.15, 7.30)	0.020	10.92	(4.22, 28.27)	< 0.001	2.52	(1.02, 6.24)	0.040
Gender	Boys	0.23	(0.14, 0.39)	< 0.001	0.53	(0.33, 0.86)	0.010	0.55	(0.34, 0.88)	0.010
	Girls	1		< 0.001	1		0.010	1		0.010
	< 2	2.32	(1.11, 4.54)	0.010	2.03	(1.03, 3.97)	0.030	1.40	(0.72, 2.71)	0.310
First dental care (year)	2-6	1.33	(0.76, 2.31)	0.300	1.57	(0.90, 2.74)	0.110	1.19	(0.68, 2.08)	0.520
	Never	1		0.300	1		0.110	1		
	University degree	1.78	(0.72, 4.35)	0.200	1.40	(0.77, 2.56)	0.260	0.77	(0.42, 1.43)	0.420
Mother's education	Diploma	1.08	(0.67, 1.75)	0.750	1.11	(0.66, 1.85)	0.680	0.72	(0.43, 1.21)	0.220
	Pre-diploma	1		0.750	1			1		
	University degree	0.82	(0.44, 1.52)	0.530	0.67	(0.37, 1.22)	0.190	1.79	(1.00, 3.18)	0.040
Father's education	Diploma	1.20	(0.71, 2.03)	0.470	1.10	(0.64, 1.86)	0.720	1.23	(0.73, 2.06)	0.420
	Pre-diploma	1		0.470	1		0.720			
Teacher's brushing advice	No	1.26	(0.69, 2.29)	0.430	0.78	(0.54, 1.13)	0.190	0.81	(0.56, 1.17)	0.280
reacher's brushing advice	Yes	0.64		0.450	1			1		
Referral form	Good	1	(0.38, 1.10)	0.100	1.54	(1.02, 2.34)	0.040	1.17	(0.77, 1.78)	0.430
Kelenarionin	Bad	0.61	(0.41, 0.89)	0.010	1			1		
Number of siblings		1			1	(0.81, 1.22)	0.990	1.05	(0.86, 1.28)	0.590
Economic status		1.63	(1.05, 2.52)	0.020	1.14	(0.99, 1.32)	0.060	0.93	(0.80, 1.06)	0.300
	< 2	1.23	(1.06, 1.42)	< 0.001	3.49	(1.48, 8.20)	< 0.001	1.49	(0.66, 3.39)	0.330
First dental check-up (year)	2-6	0.88	(0.71, 1.08)	0.220	1.48	(0.92, 2.38)	0.100	1.70	(1.06, 2.72)	0.020
	Never	1			1			1		

 Table 2. Ordinal regression analysis between tooth brushing habit and considered independent factors

OR: Odds ratio; CI: Confidence interval

## Discussion

Among the parental factors that may affect children's experience of oral disease social determinants (i.e., SES) have mostly been literature, assessed in whilst parental behaviors, knowledge, and attitudes have received less attention.20 The current study showed that mothers' positive behavior toward oral health during early ages had a significant influence on their children's oral health behaviors. This includes mothers' behavior towards their children's first dental check-up and the age of beginning oral health care. This finding is in line with earlier investigations demonstrating that mothers' attitude toward oral health behaviors, like brushing habits or sugar consumption, could be an indicator of these behaviors in children.20,21

We asked questions about the oral health knowledge and behaviors of both mothers and their children. As boys and girls may be influenced by maternal care in different ways, children of both genders were included so we could compare the influence of maternal care between them. As the questionnaire was a self-reporting, there was a chance of misreport in the provided information, but due to the number of participants, it was modified. Some parents did not participate in the study, but the response rate (440 out of 450; 97% response rate) was acceptable.

The target group in this study consisted of adolescents aged 12-13 years in 2 schools in Tehran. During these ages, one of the individuals adolescents look up to is their teacher.<sup>22,23</sup> The influence of teacher's advice on tooth brushing behavior among the participants was also reported by Ramroop et al. in their study on knowledge and attitudes of primary school teachers toward students' health.<sup>24</sup> their oral Thus. empowering teachers with correct knowledge about oral health care can play a major role in promotion health among young oral children. Previous studies have indicated that female participants had more positive behavior toward oral health than male

subjects, which was in line with our findings. However, the present study findings do not support the previous research on the relationship between parents' educational level and oral health knowledge and behaviors. Moreover, we did not find any association between oral health behaviors and socioeconomic factors, even though it is known that such factors are of importance in health related issues.<sup>25,26</sup> Our assumption was that students attending any school are more or less homogenous in terms of SES-related factors. The results of this study suggest that mothers can be a valuable predictor of the future oral health status of their children. Assessing the relationship between first oral care and current oral care habit of 12-13-yearold children showed that a caries preventive program in children can be highly effective in oral health knowledge and behaviors in adolescence. We believe that this is a finding of the outmost importance with essential practical application in the oral health promotion of the future generation.

Although maternal oral health training during pregnancy is preferable, previous studies have shown that preventive dental programs for new mothers after the birth of their baby is effective on the prevention of ECC.<sup>27,28</sup> Our findings suggest that the observed positive effect can be extended to adolescence.

Gender differences in oral health behaviors such as brushing and flossing frequency showed a higher prevalence of these behaviors among girls. This finding is in accordance with that of several investigations on the relationship between gender and oral health status.<sup>29-33</sup> Moreover, girls were more knowledgeable on oral care than boys.

Another important observation was that mothers with a higher number of children paid less attention to their oral healthcare. This may be related to the economic status of families as previously reported.<sup>34-35</sup> This study showed a relationship between oral health knowledge and brushing, but not with flossing. This may be due to most families' lack of attention to flossing.

This study does not support the findings of previous studies on relationship between parental education level and child's oral health status.

Since this was a cross-sectional study, longitudinal studies may provide more detailed information on the mechanisms of impact of parents' behavior on their children and predictive parent-related factors that can enhance children's oral health throughout their lives.

#### Conclusion

The current study showed the significant influence of mothers' knowledge about oral health care on oral health care habits and behavior in their children. Preventive programs starting as early as possible in childhood may lead to better outcomes in adulthood. Controlling most factors leading to ECC depends on mothers. They can eliminate this problem by caring for the sound teeth as soon as they erupt into the oral cavity. Daily brushing since the eruption of teeth with routine dental check-ups had a strong relationship with adolescents' oral health knowledge and better oral habits. Any prevention policy cannot achieve successful results without family support and mothers are the core of the family.

#### **Conflict of Interests**

Authors have no conflict of interest.

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# Perspectives of teachers and students towards the implementation of a new curriculum in school of dentistry in Kerman, Iran, in 2017

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## **Original Article**

## Abstract

**BACKGROUND AND AIM:** The aim of this study is to investigate the views of teachers and students about the new educational curriculum to determine its strengths and weaknesses.

**METHODS:** This cross-sectional descriptive study was carried out in 2015 and data collection was performed from dental students entering the university in the academic year 2010-2012 as well as 35 teachers through the use of a questionnaire in the field. The questionnaire items included various areas of the educational curriculum. T-test, analysis of variance (ANOVA), and Tukey test were used for analysis ( $P \le 0.050$ ).

**RESULTS:** Based on the 98 questionnaires filled, the minimum and maximum age of the subjects were respectively 20 and 34 years old, with the mean age of  $22.98 \pm 2.02$  years old. In addition, 53 (54%) and 45 (46%) of them were males and females, respectively. The mean attitude was respectively  $64.30 \pm 13.66$  and  $58.84 \pm 11.12$  in males and females. A significant relationship was observed between the attitudes toward educational curriculum and gender. Moreover, the results of correlation analysis showed more positive attitude towards educational curriculum with increasing age (P  $\leq 0.034$ ). Post-hoc test scores showed a significant difference between the viewpoints of students entering the university in 2010 and 2011 (P  $\leq 0.001$ ), as well as 2011 and 2012 (senior year students compared to junior ones, P  $\leq 0.003$ ), but no significant difference was observed between the viewpoint entering in 2010 and 2012 (P  $\leq 0.145$ ). The results indicated no significant relationship between the viewpoint of teachers and age. These results showed only a significant relationship regarding teaching experiences and viewpoint toward educational curriculum.

**CONCLUSION:** This study showed no positive views of the teachers and students about theoretical and practical training in the new curriculum, which may be mainly due to the lack of attention to the educational needs of students as well as their practical usage. Furthermore, by increasing teaching experiences of the teachers followed by increasing their clinical experiences, their satisfaction reduced.

**KEYWORDS:** Students; Curriculum; Dental Education

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Il dental hygiene programs are well-thought-out in dental curriculum. In this way, a new essential concept for promoting and improving the oral health has been set in the curriculum of dental schools. While the Iranian medical graduates and related authorities would agree on the inadequacy of the medical education,<sup>1</sup> it needs to take comprehensive steps to improve medical education. Obviously, dentistry as one of the important branches of medicine with its prominent role in training experts and professionals is not exempt from such

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deficiencies. The training program in dental field requires special attention, especially in the area of clinical practice due to the high volume of practical units and wide dimensions of learning and acquiring skill.<sup>2</sup> To create constructive change, descriptive information about the current status and knowing students' attitudes toward learning outcomes is necessary. Using these positive factors information, can be strengthened and the possible negative effects can be adjusted, bringing optimistic academic experience results.3 Students' dissatisfaction is significantly associated with negative health outcomes of the patients.<sup>4</sup>

The attitude of the students as the main body of the health care system and society in the future and their satisfaction are contributing factors to motivate them and keep the educational quality improved.5 American Dental Association (ADA) has proposed an outline about changing the education system. The proposed changes include a greater emphasis on self-learning, development of critical thinking, and lifelong learning.6 Additionally, American Dental Education Association (ADEA) published a collection called "curriculum guide" for the first time in 1986 and last time in 1993. In 1997, "Competencies for the New General Dentist" was published by American Association of Dental Schools-House of Delegates, upon which the founding of education should include basic information desired qualifications, related to the including skills for a general dentist to serve oral health needs in the community. "Competencies for the New General Dentist" is not the end point in the ADEA development; however, it is a point of reference for innovative changes.7 School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran has created major changes in the educational curriculum according to the program issued by the ministry. These changes are based on the correction of defects in the former curriculum that had been implemented for many years.

Some deficiencies in the realm of basic science and pre-clinical studies toward clinics, including the allocation of fewer hours to some important lessons, too much attention to less significant subjects, the lack of a coherent training program, the lack of relative balance in the provision of courses in different semesters, poor training practice in a number of departments, and finally the late entrance of students into some departments, were among the drawbacks of the former curriculum.

The new training curriculum was designed for the first time in the country by the Ministry of Health and Medical Education (Dentistry Planning Council) and then was implemented since 2011. It is clear those rapid advances in medical science and ever-increasing demands of society, on the other hand, need implementing regular review for the educational curriculum to be accommodated with these factors.

The aim of this study is to investigate the views of teachers and students about the new educational curriculum to determine its strengths and weaknesses.

#### **Methods**

This cross-sectional descriptive study was carried out in 2015 and data collection was performed from dental students entering the university in 2010, 2011, and 2012, as well as 35 teachers through the use of a questionnaire in the field.

The items of the questionnaire (22 and 28 items for the teachers and students, respectively) included various areas of the educational curriculum. Questionnaires were designed based on items added to the new curriculum which did not exist in the previous curriculum. A new and an old dental curriculum were used to design the questionnaire. Answers to the items, ranging from very good to very poor, were designed based on the Likert's scale to fit a score of 0 to 4 (extremely weak = 0, weak = 1, average = 2, good = 3, and very good = 4). Therefore, the questionnaire scores of the

teachers and students were in the ranges of 0-88 and 0-112, respectively.

The items were designed based on personal views and first author's experiences, as well as experts' opinions. In order to design the questionnaire, to check the content and to cover various fields related to the educational status and clinical setting of the departments (checking the validity), the items were shared with a number of experts in the field. After the required amendments, achieving for the reliability, the questionnaires were given to a group of students and teachers at two different times within two weeks and after reviewing the questionnaire, the questions that were not reliable were excluded.

Finally, using Cronbach's alpha coefficient analysis, the questionnaire reliability was determined to be as 0.84 and 0.96 for teachers and students, respectively. Then, two types of questionnaires were anonymously distributed among the teachers and students. The subject of the questionnaire and objective of the study were explained to them before distribution of the questionnaires. After collecting the questionnaires, descriptive information was scored. In this study, for an easy comparison, the mean scores were converted to percentages.

T-test analysis was used to investigate the relationship between scores of attitudes and gender for both teachers and students. The correlation coefficient was employed to compare the mean score ranges of the teaching experience and age, ANOVA test to consider the scores based on the university entrance year, and Tukey test (post hoc) for multivariate analysis in relation to the nonlinear regression of the mean scores ( $P \le 0.050$ ).

#### Results

Of the 120 dental students as the target group, 110 questionnaires were collected, of which 12 questionnaires were excluded due to factors such as the lack of response to all inquiries and failure to complete the demographic data. From the 98 questionnaires remained, the age range of the subjects was 20-34 years old with the mean of 22.98  $\pm$  2.02 years old. Besides, 53 (54%) and 45 (46%) of the participants were males and females, respectively. 30 (30%), 40 (40.8%), and 28 (28.6%) entered the university in 2010, 2011, and 2012, respectively.

The mean percentage of the teachers' and students' scores was assessed as respectively 61.26 and 61.81.

The mean ± standard deviation (SD) of score of the questionnaire was  $58.78 \pm 14.86$ and  $63.22 \pm 9.98$  in male teachers and female teachers, respectively. The mean ± SD of attitude was 64.3 ± 13.66 and 58.84 ± 11.12 in male students and female students, respectively. significant There was no relationship between attitudes the and scientific degree ( $P \le 0.012$ )

This study indicated a significant relationship between the attitudes toward educational curriculum and gender in students (men more than women,  $P \le 0.410$ ) (Table 1).

Table 1. Mean and standard deviation (SD) of
scores of the questionnaire of the teachers and
students based on sex

Score of questionnaire		Mean ± SD	$\mathbf{P}^*$				
Teachers	Male	$58.78 \pm 14.86$	0.305				
	Female	$63.22\pm9.98$					
Students	Male	$64.3 \pm 13.66$	0.041**				
	Female	$58.84 \pm 12.66$					

SD: Standard deviation

\*Independent t-test, \*\*P < 0.050 is significant.

Additionally, the results of correlation analysis showed more positive attitude towards educational curriculum with increasing age (younger students than older students ( $P \le 0.034$ ).

The mean  $\pm$  SD of attitude was  $69.83 \pm 10.94$ ,  $53.96 \pm 12.37$ , and  $63.87 \pm 11.66$  in students entering the university in years 2010, 2011, and 2012, respectively (Table 2). The results of correlation analysis showed more positive attitude towards educational curriculum with increasing age, r = 0.221, and P = 0.034.

**Table 2.** Mean and standard deviation (SD) of scores of the questionnaire of the teachers and students based on different entrance years

students based on different entrance years							
Student entrance year	n (%)	Mean ± SD					
2010	30 (30.6)	$63.22\pm9.98$					
2011	40 (40.8)	$64.3 \pm 13.66$					
2012	28 (28.6)	$58.84 \pm 12.66$					
CD. Chandrad deaded at							

SD: Standard deviation

The post hoc test scores revealed a significant difference between the viewpoints of students entering in 2010 and 2011 ( $P \le 0.001$ ), as well as 2011 and 2012 ( $P \le 0.003$ ), but no significant difference was observed between the viewpoints of students entered in 2010 and 2012 ( $P \le 0.145$ ).

According to multivariate analysis of the students' assessment results (age, gender, and year of entry to university) based on linear regression analysis, only age ( $P \le 0.034$  and B = 1.426) showed a significant relationship with attitude towards the educational curriculum.

Of the 50 teachers of the school of dentistry, target group, only 40 individuals responded to the questionnaire, of whom 5 were excluded for reasons such as failure to respond to all items or failure to complete the demographic information.

35 teachers with the mean age of  $39.02 \pm 9.02$  years old completed the questionnaires, of who 16 (45.7%) and 19 (54.3%) were respectively males and females (age range = 28-56 years old). The mean teaching experience was 10.74 ± 8.82 years, with the lowest and highest being 1 and 28 years, respectively. The results of evaluation of the overall attitude of teachers by gender suggested that the mean viewpoint score of the male and female teachers was respectively 58.78 ± 14.86 and 63.32 ± 9.98. There was no significant relationship between the viewpoint of teachers and gender (Table 1).

The results of evaluation of the overall viewpoint of teachers by age showed no significant relationship ( $P \le 0.066$ ). This study showed that with increasing the teaching experience, the viewpoint toward educational

curriculum became more negative ( $P \le 0.400$ ).

These results showed only significant relationship regarding teaching experiences and viewpoint toward educational curriculum.

#### Discussion

This study showed no positive views of the teachers and students towards the theoretical and practical training in the new curriculum. Furthermore, by increasing teachers' teaching experiences followed by increasing their clinical experiences, their satisfaction reduced. More fulfillments of experienced teachers regarding their profound and practical capabilities in boosting student achievement should be considered.

Evaluation of training programs is a means by which the training process in practical and theoretical courses can be improved. According to the opinions of the people trained, the students, and those who teach, the teachers, this evaluation can increase the efficiency of training.<sup>8</sup> Medical students conduct preparation aimed at improving overall human health. So, the realization of the provision of inclusive education based on their educational needs is important.<sup>6</sup>

In an educational setting, paying attention to students' educational needs and asking about their expectations and satisfaction with educational programs, such as a full-face mirror, shows the effectiveness of educational programs. In this study (the only study in Iran regarding educational curriculum), the views of professors as well as clinical and pre-clinical students of School of Dentistry, Kerman University of Medical Sciences were surveyed to determine their satisfaction with the training provided in the theoretical and practical units of the new educational curriculum using a questionnaire.

Regarding the relationship between curriculum satisfaction with teachers' age and gender, no significant difference was observed. The analysis of difference in the scores showed significant mean а relationship between the students' curriculum satisfaction and gender, demonstrating more positive views of the boys compared to the girls. In a similar study regarding the success of clinical skills' training performed at the School of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran, male students showed more positive attitudes.<sup>9</sup>

Professors with a long history of dealing with patients from different cultures and communities with various medical needs in both educational setting and personal office, and with a huge background of clinical experience can provide valuable insights. Therefore. designing and delivering theoretical and practical training are necessary and efficient.

Comparison of the mean scores of students showed that gender had an almost significant relationship with the curriculum, so that the boys had a more positive view compared to the girls.

In comparable studies on the educational situation of periodontics, endodontics, and restorative departments of School of Dentistry, Kerman University of Medical Sciences, male students had more positive views than those of females.<sup>10-12</sup>

In the present study, with increasing age, students were more positive towards educational curriculum. Considering the year of entrance to the university, a significant relationship was found between the students entering the university in 2010 and 2011, as well as 2011 and 2012, however no significant difference was observed between students entered in 2010 and 2012. So those who entered in 2010 and 2012 were more satisfied with the educational curriculum.

The differing perspective of students entering in 2011 was likely because they had passed more credits and were more familiar with the new curriculum, unlike the perspective difference of the students entering in 2010 with those entered in 2011, because they had passed the old curriculum and were less familiar with the new curriculum. In the study by Eslamipour et al. at School of Dentistry, Isfahan University of Medical Sciences, Isfahan, Iran, students' attitude toward the educational situation was different in different years of entry.<sup>13</sup>

The mean percentage of students' and teachers' attitude were respectively 61.81% and 61.26%, showing teachers and students satisfaction with the curriculum. Thus, according to the scores obtained, students and teachers assessed new curriculum as average. Eslamipour et al. assessed the satisfaction of the students of School of Dentistry, Isfahan University of Medical Sciences fairly favorable.<sup>13</sup>

In another study, Jabarifar et al. concluded that positive measures of medical and dental students toward the academic learning environment were much less than the negative ones, needing to consider these fields for review purposes for the students.<sup>14</sup> In another study in the United States, the importance of the revision of the topics presented in the course of dentistry was noted that is consistent with the current study.<sup>15</sup> Slight changes, such as adding practical courses to the courses offered at the clinic and pre-clinic, can increase students' satisfaction.

#### Conclusion

This study (the only study in Iran about the educational curriculum) showed no positive views of the teachers and students about theoretical and practical training in the new curriculum, which is likely to be due to the lack of attention to the educational needs of students as well as their practical usage. Moreover, by increasing teaching experiences of teachers followed bv increasing their clinical experiences, their satisfaction reduced.

Generally, this study showed that despite the objectives set to improve the quality of education for dental students, the new educational curriculum contains some defects that cannot help finding it remarkable for teachers and students.

Lack of evaluation of all student years, lack of evaluation by basic science professors, and lack of conducting qualitative studies were among the limitations of the present study.

#### **Conflict of Interests**

Authors have no conflict of interest.

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