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Evaluation of prevalence and pattern of maxillary sinus mucosal thickening in cone beam computed tomography of dental implant candidates in Shiraz, Iran

Leila Khojastepour DDS, MSc[1], *Maryam Zangooei-Booshehri DDS, MSc[2]*, *Arezoo Rajaei DDS, MSc[3]*, *Mustafa Rezaei DDS, MSc[4]*

Original Article

Abstract

BACKGROUND AND AIM: This study aimed to assess maxillary sinus floor membrane thickness and ostium patency (OP) in patients undergoing cone beam computed tomography (CBCT) evaluation for implant placement in the posterior maxilla. Mucosal thickening (MT) could be cause of post-operative complications in implant procedures; awareness of this incidence could help proper detection and further success of implantation.

METHODS: The CBCT scans of 620 implant candidates were examined and MT of ≥ 2 mm was considered pathological. The mucosal appearance, the OP as "patent" or "obstructed", and unilateral or bilateral MT was assessed. Age, gender, smoking condition, and season were considered. Chi-square test was used to show the association between different variants in our study. A value of $P < 0.05$ was considered significant.

RESULTS: An MT ≥ 2 mm was detected in 39.8% of patients; cases were mostly bilateral (56.3%) and detected during the winter (38.1%). There was a higher incidence among male patients (59.9%). Most participants who smoked had an MT ≥ 2 mm (70.8%). The irregular shape was the most prevalent appearance (43.5%). Ostium obstruction was observed in (55.7%) of sinuses with MT and was mostly seen as unilateral sinus involvement. The complete appearance had the highest risk of ostium obstruction (100%) and the round shape had the lowest (17.3%).

CONCLUSION: The present study revealed that maxillary sinus MT was highly prevalent during the winter and among smokers and men. Complete and unilateral type of MT is associated with an increased risk of ostium obstruction. Therefore, the precise study of a CBCT scan could influence dental implant planning or necessitate special consideration.

KEYWORDS: Cone-Beam Computed Tomography; Dental Implant; Maxillary Sinus; Mucous Membrane; Smoking

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The maxillary sinus is the largest and most important of the paranasal sinuses. It has a closed relationship with the upper posterior teeth and is considered to be a critical anatomical structure during surgical procedures in the maxillary posterior region.[1] A mucous membrane which is composed of respiratory epithelium lines the maxillary sinus with a normal thickness of approximately 1 mm.[2] The maxillary sinus ostium is located on the highest part of the sinus medial wall. Mucous, which is produced by goblet cells in mucociliary escalator, is pushed toward the ostium and then to the nasal cavity. Some factors and diseases may interrupt this basic process by reducing activities of mucociliary cells or obstruction. Any disease within the lining of the sinus, the adjacent paranasal sinuses, nasal space, dental and oral tissues, or in the adjacent bone with expansion into the sinus could involve the maxillary sinuses

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as well.[3] The inflammatory disease is the most reported disease in maxillary sinuses.[4]

Approximately 10%–12% of cases of inflammatory maxillary sinus disease are of dental origin and most of them relate to pulpal necrosis, periapical disease, and oro-antral communications following dentoalveolar surgery.[3,5] Malignancy disease of paranasal sinuses is relatively rare (1.0%), with mostly arising in the maxillary sinus (80%).[3] According to Beaumont et al., who studied the prevalence of maxillary sinus diseases, the chronic sinusitis following sinus cysts was the most common diagnosis in their study.[6]

The normal membrane cannot be seen on routine radiographs. However, when the mucosa is inflamed from either infectious or allergic process, it may be imaged on radiographs as radiopaque areas and identified as different types of maxillary sinus inflammatory disease such as sinusitis or pseudocyst. The inflammation of the maxillary sinus mucosa could be a response to a wide variety of factors such as infectious or allergic processes.[7,8] Smoking could also cause mucosal inflammation.[9] Although mild mucosal thickening (MT) is often asymptomatic and is considered to be a normal radiographic finding, some studies have reported that the maxillary sinus with thickness of mucosa greater than > 2 mm is probably a pathologic condition and could be used as the threshold for identification of MT.[10,11] Sinus infections or inflammatory conditions may increase the risk of dental procedures and cause post-operative complications.[12] MT may compromise the prognosis of maxillofacial surgeries such as implant insertion and ridge augmentation.[13]

Endosseous dental implants and augmentation of the maxillary sinus are well-documented in procedures that include elevation of the sinus floor and placing a bone graft in that area to increase the thickness of upper jaw bone.[14] Any abnormal alterations, such as pre-existing sinus diseases or allergic conditions that may lead to chronic reactive mucosal changes, could cause postoperative

complications in sinus augmentation and should cause concern.[15] Proper preoperative evaluation of implant candidates could help to minimize these problems.[6]

MT could be detectable with the use of panoramic images; however, it provides a two-dimensional (2D) representation of a three-D (3D) object and suffers from superimposition.[16] Cho et al. evaluated the value of panoramic radiography for assessment of maxillary sinus inflammation and suggested that panoramic radiography may not be adequate for clinical decision-making.[17] According to studies, computed tomography (CT) is the gold standard imaging method and the coronal cross-section is the preferred imaging plane to measure the amount of MT in the paranasal sinuses.[18]

Cone beam CT (CBCT) with its unique ability to provide 3D information with a relatively low radiation dose, has become an established diagnostic tool for dental implant surgery and visualization of the paranasal sinuses.[19,20] It is also an accurate method for dimensional measurements.[21]

The objectives of present study were to 1) evaluate the effects of age, gender, smoking, and seasonal variations on the thickness of maxillary sinus mucosal membrane, 2) study the correlation of the MT appearance and type of involvement with ostium obstruction, and 3) provide information to dental surgeons about the incidence and characteristics of maxillary sinus MT, and suggest to use preoperative CBCT images of patients to predict sinus outflow obstruction, especially for dental implant placement in the molar and premolar region of maxilla.

Methods

This cross-sectional study included 620 CBCT images (1240 maxillary sinuses) of implant candidates (310 men, 310 women) with one or more missing maxillary posterior teeth. MT was studied in the coronal plane in which the maxillary ostium could be observed. The patients were referred by their dentists to a private oral and maxillofacial radiology clinic

in Shiraz, Iran, between March 2014 and March 2015 for CBCT examination prior to maxillary dental implant insertion. The Ethics Committee of Shiraz University of Medical Sciences reviewed and approved the study (Code NO# IR.SUMS.REC.1394.S311). All pre-implant CBCT images of all participants were taken with a Planmeca Promax 3D (Planmeca Oy, Helsinki, Finland) with a field of view (FOV) of 10 cm × 10 cm. The standard resolution mode in this machine was 0.3 mm with the following specifications: tube potential: 90 kV, tube current: 10-12 mA, scan time: 2.7-16 seconds, and reconstruction time: 13-26 seconds. The image analysis was performed with Planmeca Romexis dental imaging software in illumination of dim light.

Placema Romexis 3.2.0 3D software was used in a multiplanar reconstruction window in which the axial, coronal, and sagittal planes could be visualized. We studied the images in which the whole maxillary sinuses (medial and lateral walls plus the floor of sinuses) could be seen. Patients with maxillary sinus aplasia or hypoplasia, previous dental implant placement or bone grafting in the maxillary area, and a history of trauma or other manipulations of the maxillary sinus were excluded from the study. The criterion for hypoplasia was about 15 ml (range 9.5-20 ml) which was less than the average capacity of the maxillary sinus.[22] Height was classified according to metric thickening of < 2 mm as a normal condition of mucous membrane and greater than 2 mm as MT.[10] The measurement was taken separately at the thickest part of the mucous membrane in two sinuses. Thickening of the mucous membrane was evaluated at the floor and the medial and lateral walls of the maxillary sinus. An experienced oral and maxillofacial radiologist evaluated the coronal cross-sections of the right and left maxillary sinuses for measurement of the MT, its shape, and ostium patency (OP) which was categorized as "patent" or "obstructed".

In addition to demographic information including sex, age, and smoking status, the season in which the CBCT study was performed and the type of maxillary sinus MT (unilateral or bilateral) were also recorded. The patients' age ranged from 24 to 63 years, with a mean age of 46.75 ± 9.29.

In this study, we included the participants as smokers who were current active tobacco smokers (direct use of tobacco). We considered a person as a tobacco smoker who smoked any tobacco products (cigar, cigarette, pipe, and smokeless types) at least once a day in the past one month. We excluded the people as smokers who were passive smokers (second-hand tobacco exposure) and former smokers. We defined "former smokers" as those who smoked in past but did not currently smoke. Since smoking status was determined by self-reporting, we had limitation for classifying smokers in details according to quantity and duration of smoking. Intra-observer reliability was assessed by re-evaluating 50 randomly selected cases with a minimum interval of 14 days using interclass Kappa test (correlation coefficient = 0.91).

The shape of the MT was classified into four categories of A-D as follows[23] (Figure 1):

A: round: massive round thickening resembling a mucosal pseudo-retention cyst.

B: circumferential: uniform shallow MT following the sinus outline.

C: complete: opacification of whole sinus completely.

D: irregular: without any specific outline, and including one or more sinus walls.

A normal maxillary sinus with MT < 2 mm with patent ostium was showed in figure 2.

Data were analyzed using SPSS software (version 17, SPSS Inc., Chicago, IL, USA). The results of the descriptive analysis were presented as frequency and percentage. A chi-square test was used to show the associations between the frequency of MT and gender, smoking, and the season in which CBCT was taken. The association between smoking and MT was determined using Pearson's χ^2 test. It was also used to evaluate the possible association between ostium obstruction and MT appearance, as well as the type of sinus involvement (unilateral or bilateral).
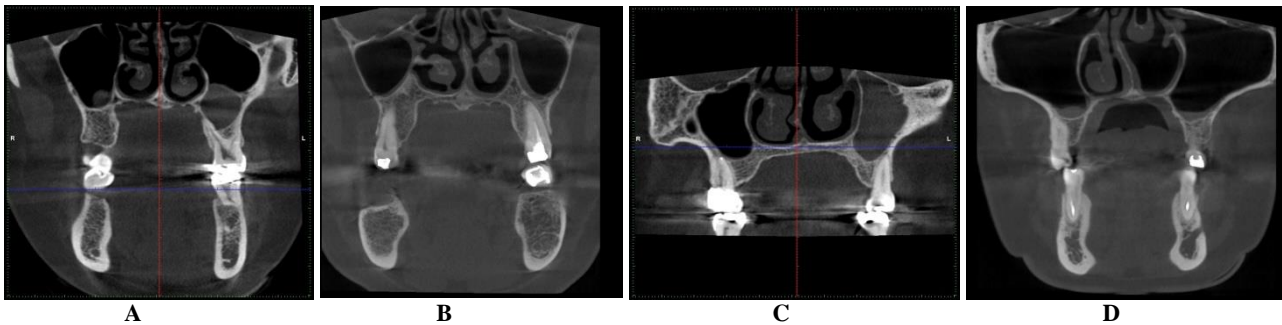
Figure 1. Sample of cone beam computed tomography (CBCT) images of 4 patients in this study showing classification of maxillary sinus mucosal thickening (MT) by appearance

A) Rounded shape: (MT > 2 mm) in right sinus which could resemble retention cyst; B) Circumferential shape: (MT > 2 mm) in left and right sinus with obstruction of right sinus ostium; C) Complete shape: (MT > 2mm) in left sinus with obstruction of ostium; D) Irregular shape: bilateral (MT > 2 mm) involvement of right and left sinus with obstruction of left sinus ostium

A Student's t-test was used to compare the mean age of cases with and without MT. A value of P < 0.050 was considered significant.
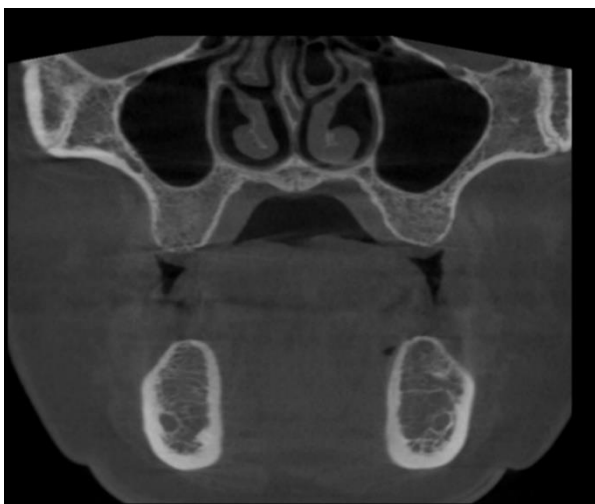
Figure 2. Normal maxillary sinus with mucosal thickening (MT) < 2 mm with patent ostium
Taken by Planmeca Promax 3D, Helsinki, Finland, Standard resolution mode: 0.3 mm, Tube potential: 90 (KV), Tube current: 10-12 (mA), Reconstruction time: 13-26 (s), Scan time: 2.7-16 (s), Field of view: 10 cm × 10 cm

Results

In this study, we evaluated the CBCT images of 620 patients (1240 maxillary sinuses; 310 women, 310 men) who met the study criteria. There was no significant difference between the mean age of the cases with and without MT. A total of 373 patients (60.2%) had a normal mucous membrane (≤ 2 mm). An MT > 2 mm was found in at least one of the maxillary sinuses (left or right) in 247 cases (39.8%) and in 386 sinuses (31.1%).

Distribution of MT ≥ 2 mm according to gender, smoking, sinus involvement, and OP are shown in table 1. The study included 139 cases of bilateral and 108 cases of unilateral maxillary sinus MT. There was no significant difference in the distribution of MT between the right and left sinuses.

Table 2 shows the distribution of MT by sinus involvement and the association between MT involvement and ostium obstruction. Most of the obstructed sinuses were unilateral rather than bilateral. There was a significant relationship between ostium obstruction and sinus involvement. The most common appearance of MT was irregular, followed by complete, round, and circumferential, respectively.

Table 1. Distribution of mucosal thickening (MT) ≥ 2 mm according to gender, smoking, sinus involvement, and ostium patency (OP)

| | MT ≥ 2 mm | Gender | | Smoker | Bilateral | Unilateral | | OP | |
		Men	Women			Right sinus	Left sinus	Patent	Obstructed
n	247	148	99	34	139	51	57	98	149
%	39.8	59.9	40.1	70.8	56.3	20.6	23.1	39.7	60.3
P	0.001	0.001		0.001		0.001		0.001	

MT: Mucosal thickening; OP: Ostium patency

Table 2. Association of mucosal thickening (MT) sinus involvement and ostium obstruction

Patients	Sinus involvement [n (%)]	Obstructed ostium [n (%)]
Unilateral	108 (43.7)	83 (55.7)
Bilateral	139 (56.3)	66 (44.3)
P = 0.021		
$X^2 = 5.3420$		

All sinuses with a complete shape of MT showed ostium obstruction, and most sinuses with a circumferential shape had ostium obstruction. Table 3 reports the distribution of MT by appearance and the association between appearance and ostium obstruction which was significant.

Table 3. Distribution of mucosal thickening (MT) by appearance and association between MT appearance and ostium obstruction

Appearance of MT in sinuses	Mucosal appearance [n (%)]	Obstructed ostium [n (%)]
Round	75 (19.4)	13 (17.3)
Irregular	168 (43.5)	76 (42.2)
Circumferential	59 (15.3)	42 (71.2)
Complete	84 (21.8)	84 (100)
P = 0.001		
$X^2 = 55.9640$		

MT: Mucosal thickening

There was a significant difference among the distributions of MT in different seasons (P < 0.050). MT had the highest frequency in winter, followed by autumn, spring, and summer (Table 4).

Table 4. Prevalence of maxillary sinus mucosal thickening (MT) identified by cone beam computed tomography (CBCT) imaging in different seasons

Season	Patient with MT [n (%)]
Spring	44 (17.8)
Summer	41 (16.6)
Autumn	68 (27.5)
Winter	94 (38.1)
P = 0.003	
$X^2 = 41.0380$	

MT: Mucosal thickening

Discussion

Kahnberg et al. reported successful outcomes of sinus floor augmentation even with the present of MT in the maxillary sinus before the surgery.[24] Maska et al. also concluded that the physiologic MT could not cause failure in implant placement or grafting.[11] However, according to Timmenga et al., only a pre-disposition for sinusitis could result in post-operative chronic sinusitis.[25]

Vallo et al. reported that most patients with maxillary sinusitis had MT > 2 mm, and 12% of 5021 individuals in their study had MT.[16] In the present study, maxillary sinus MT was observed in 39.8% of cases, which was very close to the findings of Carmeli et al.[23] and Ritter et al.[26]

We also found that the frequency of MT was higher in men (59.9%) than women (40.1%), which concurred with other studies.[26,27] Janner et al. studied CBCT of patients who needed implant treatment to evaluate the characteristics of the Schneiderian membrane of maxillary sinus. They concluded that gender was the most important parameter influencing mucosal thickness in asymptomatic patients.[19] Since the dental pathologies which could cause irritation of the sinus mucosa are more prevalent among men, we can explain the reason of higher prevalence of MT among this gender.[16]

Several studies have investigated the effects of smoking on the health of the upper airways and paranasal sinuses.[28] Lieu and Feinstein analyzed the association of smoking with the prevalence of any sinusitis, including both acute and recurrent or chronic sinusitis. They reported a higher prevalence of any sinusitis in current cigarette smokers compared to former smokers or patients who had never smoked.[29] The prevalence of MT in the present study was also significantly higher among participants who smoked than among nonsmokers, which concurs with the findings of Lieu and Feinstein.[29]

Our analysis revealed that most of the maxillary sinus MT occurred bilaterally (56.30%). Unilateral involvement had approximately the same frequency in both the right (20.65%) and left sides (23.08%). In

contrast to our results, a study by Ritter et al. reported a higher rate of unilateral thickening.[26] Differences in the study population, variations in sample size, and the definition of MT could be possible causes for the variations in results.

Irregular MT was the most frequent form observed in this study (43.5%), followed by complete (21.8 %), round (19.4%), and circumferential (15.3%) MT. Carmeli et al. used the same categories for classification of MT in the maxillary sinus. They reported that the round shape was the most frequent type of MT, followed by irregular, circumferential, and complete.[23]

In our study, we concluded that among 386 maxillary sinuses with MT, 215 had ostium obstruction (55.7%). These ostium obstruction cases were mostly unilateral.

 Similar to the study of Carmeli et al.,[23] we also found a significant relationship between the different appearance of MT and the prevalence of sinus obstruction. Carmeli et al. found a higher risk of sinus obstruction (100%) in the circumferential and complete forms of MT. In contrast, the round appearance had the lowest risk for obstruction (6.1%).[23] In our study, we concluded the same final results, as all MT with a complete shape has shown ostium obstruction (100%), followed by circumferential (71.2%), irregular (42.2%), and round (17.3 %). The association between the shape of MT and ostium obstruction was significant; there was a higher risk of obstruction if the shape was round or circumferential.

Janner et al.[19] classified the appearance of MT according to criteria adapted from Soikkonen and Ainamo[30]; where the most frequent MT appearance diagnosed according to their definition was flat (circumferential).[19]

The present study revealed a significant relationship between the prevalence of MT and the season. Most cases were observed during the coldest season (winter) (38.1%), followed by autumn (27.5%), spring (17.8%), and summer (16.6%). Some studies suggested that the prevalence of sinus cysts may vary according to the mean temperature, the relative air humidity, and seasons of the year, with winter likely to play a role due to the low temperature, and summer due to the use of air conditioners.[31,32]

Carter et al. found significant differences in the prevalence of MT in the shape of pseudo cysts in winter compared with summer (44.3% vs. 8.6%, respectively). They stated that this marked increase in MT during cold months supported the concept that seasonal variation may be related to an increased incidence of inflammatory conditions of the maxillary sinus, or irritation from dry, forced air heating during this period.[33] In contrast, patients in Riyadh, Saudi Arabia, a place with mild winter seasons, did not show this seasonal variation.[34]

Conclusion

Based on the present study, MT of the maxillary sinus with unilateral ostium obstruction is a relatively common finding in CBCT examinations of implant candidates, especially during cold seasons. The MT is more likely to occur among men, in an irregular shape, with bilateral involvement of the maxillary sinus. Membrane thickening ≥ 2 mm, especially of a complete and unilateral type, is associated with an increased risk of ostium obstruction. Smoking was strongly associated with the maxillary sinus MT. Considering the possible effect of MT on the post-operative complications of implant surgery, ridge augmentation, and sinus lifting in cold seasons, it is wise to be more careful in performing such procedures during these seasons. Assessing CBCT images, especially in an area with seasonal variations, could help predict pre-implant diseases and prevent post-operative complications.

Further studies are necessary to determine how osteointegration could be affected by the presence of MT, and to study the prevalence of MT before and after ridge augmentation. In addition, the severity of MT on post-operative complications could be evaluated clinically.

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Comparison of oral hygiene diagnosis using oral clinical examination and photography based on global oral health scale

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Original Article

Abstract

BACKGROUND AND AIM: The present study aims in assessing the compliance in diagnosis of oral hygiene by means of clinical examination, oral photography, and Global Oral Health Scale criteria.

METHODS: The total number of 100 patients referring to the school of dentistry was examined regarding the teeth decay, cavities, as well as gum and periodontal conditions. Finally, 20 patients were selected among them and the standard registered intraoral photos were provided from each of them in order to prepare an archive. The completed archive was examined by 60 specialists and specialist residents and 100 general dentists. The participants were requested to grade oral health of each patient based on the photographs. Grading system was as follows: very good (0), good (1), medium (2), and poor (3). The results of reviews were analyzed by Kruskal-Wallis test, t-test, chi-square, and Bonferroni correction via SPSS software. P-value of less than 0.05 was considered significant.

RESULTS: 94 persons or 59.1% correctly diagnosed the oral hygiene of 7 to 12 patients based on the photography. However, the number of the correct diagnoses did not exceed more than 14 cases by none of the participants. The overestimation was observed in 84.1% (134 persons) of the participants about the case number 10 (one 1st-grade patient) and also underestimation in the case number 1 (one 3rd-grade patient). The female participants showed higher compliance regarding the 2nd grade (P = 0.001), while male participants showed higher compliance regarding the 1st grade (P = 0.002). In addition, statistically significant differences were attained with respect to the field of specialization of respondents. General dentists had the highest conformity rate in their answer to grade one, and periodontists and postgraduate students had highest conformity rates reported for grades 2 and 3.

CONCLUSION: The results revealed that compared to the patients' photography, utilizing the Global Oral Health Scale as an innovative indicator can be very useful, especially for the patients with perfect or weak oral hygiene, epidemiological studies, and comparisons of different populations.

KEYWORDS: Diagnosis; Photography; Oral Examination

Dental caries and periodontal disease are two kinds of infectious diseases that are related to colonization of bacteria (biofilm) on the tooth surface. The onset, pattern of progression, and clinical characteristics of these two diseases can be influenced by factors such as type of bacteria, its virulence, and resistant of the person.[1]

Periodontal disease and dental caries are the leading causes of adult tooth extraction and they are known as the most common chronic diseases in general population. These diseases have a big impact on health system of a country due to high prevalence rate, influence on person and society, and treatment fees; in some countries, the fourth budget in health and treatment fees is

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allocated to these diseases.[2,3]

Studies have shown that dental and oral health embraces psychological and social influences that can exert a direct impact on chewing, speaking, and appearance, and also exert an indirect impact on growth and social welfare.[4,5]

In recent years, several authors remarked upon the relation between oral infection and the increased risk of systemic diseases.[6,7] The most common related diseases in this field are cardiovascular disease (CVD),[8] respiratory diseases,[9] diabetes, rheumatoid arthritis (RA), osteoporosis, pancreatic cancer, metabolic syndrome, renal disorders,[9] premature birth, and even degenerative conditions such as Alzheimer's disease.[10-12]

According to research studies, the gold standard intraoral examination comes with visual and tactile examination that includes palpation of oral soft and hard tissues and related structures and use of a special light source for examination of oral cavity, periodontal probe, mouth mirror, gloves, mask, gowns, and etc.[8,13]

Based on the importance of oral health in prevention of systemic diseases, in early 1990, some of other major references mainly in nursing strived to smoke out a technique in quick examination of oral cavity, and this step led to attaining a simple improvement in oral examination technique, that included maintenance of guidelines in infection control and making use of an appropriate extra oral light source, designed in a sophisticated manner mainly for nurses, physicians, and other health team personnel.[14]

This technique is simply classified based on visual examination, and one of the most common uses of it is to examine quality of oral health of the elderly that can be performed by a social worker, and a little training is required.[15]

Literature review shows that few studies about combination of different variables in assessment of oral health exist, and epidemiological studies are not always renewable; therefore, there are always problems in comparison of these studies;[7] that's why various scales like Total Dental Index,[16] modified Total Dental Index,[17,18] Asymptotic Dental Score (ADS), and Brief Oral Health Status Examination (BOHSE) are designed.[19]

At any rate, the greater severity of criterion indicates higher grade for the patient. Chalmers and Pearson[18] inferred that evaluation of oral health status was only possible by visual examination. Visual examination gives more credibility to the result of oral examination being done by nurses and oral health team workers.

Jamieson et al. stated that visual oral examination could be done as a useful method for evaluation of oral health of children, and this method includes predictive values, specificity and sensitivity more than 90% (in order for evaluation of prevalence of dental caries) compared to visual examination and palpation of tissue of the mouth.[22]

Cross-sectional Burt surveys, that were conducted to assess the prevalence of dental caries, showed that the gold standard way to conduct research studies included visual examination and palpation of the tissue; and making use of an appropriate light source, periodontal probe, mouth mirror, gloves, face mask, and gown is essential for running oral examination.[8-13] Currently, the clinical photographs are a visual tool used for an examination.[23-25]

Latest scale designed in this field is Global Oral Health Scale that was designed in 2013 by Relvas et al.[13] According to designer's claim, this scale provides evaluation of factors of oral health (dental caries and periodontal disease) in a simple way.[13] This index indicates presence of dental caries and gingival disease and is designed based on the number of carious teeth, extent of supragingival plague, gingivitis, severity of dental caries, extent of periodontal plaque, and number of periodontal pocket and their severity.[12,13]

This study was aimed to evaluate the conformity of diagnosis of oral hygiene using clinical oral examination and photography based on criteria of Global Oral Health Scale.

Table 1. Grade of dental health and periodontal health

Dental health	Grade 0	Grade 1	Grade 2	Grade 3
Supragingival plaqe	0	1-56	57-112	> 112
Careis	0	1-4	5-8	9≥
Severity of caries (median)	0	1	2	3
Periodontal health				
Gingival inflammation	0	1-56	57-112	> 112
Pockets ≥ 4 mm	0	1-56	56-112	> 112

Methods

This descriptive cross–sectional study received ethical approval from Ethics Committee of Kerman University of Medical Sciences, Kerman, Iran (KA. 930572).

Initially, 100 patients (aged 20 years or older and having at least 24 teeth) referring to the school of dentistry were evaluated for dental caries and periodontal status. Examination was performed by a senior dental student and accomplished under the supervision of oral medicine specialists in the dental school. All teeth (except third molar) were evaluated from 6 sites as follows: mesio-buccal, medio-buccal, mesio-lingual, medio-lingual, disto-bucaal, and disto-lingual as well as tooth surfaces with supragingival plaque; the number of decayed teeth (detected using mouth mirror and explorer), severity of dental caries (zero: caries free, 1: enamel dental caries, 2: dental caries of dentin and enamel, 3: dental caries of enamel, dentin extended to pulp), tooth surfaces in vicinity of inflamed gingival,[17] average periodontal probing depth, and pocket depth more than 4 mm were recorded (Table 1).

From each of the groups listed in table 1, four patients (total of 20 patients) were selected and these patients had documented standard photos of following views: frontal, left lateral, right lateral, occlusal, lingual and palatal of occlusion, and occlusal surface of upper and lower jaw (photos were taken under the same conditions in terms of location, light source, and the photographer (Canon Rebel T7i With 18-135 mm Lens with 18-135 mm Lens– Japan). Photos were processed and prepared in form of an album. In the next stage, the provided album was rendered to 60 specialists and postgraduate students in periodontics, oral diseases and reconstructive surgery, oral and maxillofacial surgery, endodontics, and prosthodontics, as well as 100 general dentists of Kerman City (Figures 1-4).

Figure 1. Grade 0

The purpose of this study was explained and verbal informed consent was obtained from the participants. The participants were requested to grade oral health of each patient based on the photographs. Grading system was as follows: very good (0), good (1), medium (2), poor (3).

Figure 2. Grade 1

Figure 3. Grade 2

The data was compared with the data attained from the examination of patients based on the Global Oral Health Scale, and the overestimation, underestimation, and concordance was identified and reported. Meanwhile, a number of demographic questions such as age, sex, profession, work history, and profession background were collected from dentists.

Figure 4. Grade 3

The result of reviews was analyzed by Kruskal-Wallis test, t-test, chi-square, and Bonferroni correction via SPSS software (version 18, SPSS Inc., Chicago, IL, USA). P-value < 0.05 was considered significant.

Results

In this study, 60 specialists and postgraduate students and 100 general dentists were assessed. 96 persons were women and

64 persons were men. The average age of participants was 31.14 ± 5.90 (range: 25-66 years) (Table 2).

Table 2. Demographic profiles of the participants (n = 160)

Parameter		n (%)
Sex	Men	64 (40.00)
	Women	96 (60.00)
Years since graduation	< 2	30 (18.75)
	2-5	70 (46.87)
	> 5	60 (55.62)
Degree of education	Dentist specialist	50 (31.25)
	Postgraduate student	10 (6.25)
	General dentist	100 (62.50)
Type of activity	Clinic	12 (7.50)
	Dental office	80 (50.00)
	Dental faculty	30 (18.75)
	Multiple locations	38 (23.75)

More than half of the participants (59.1%) diagnosed the oral health of 7-12 patients correctly based on photographs. None of the participants diagnosed oral health of more than 14 patients correctly based on photographs. Overestimation was observed by 84.1% of postgraduate students and general dentists in case number 10 (one patient with grade 1) and underestimation in case number 1 (one patient with grade 3). The study showed that the diagnostic concordance for grade zero was high (61.2%) and for grade 1 was too low (15.1%), mainly overestimation for grade 2 was low (25.1%) and for grade 3 was average (36.6%).

For grade one, the average diagnostic matching was 1.15 ± 3.57 and the least diagnostic concordance was for grade 2 and 3 with average of 1.22 ± 2.11 and 0.77 ± 1.13, accordingly. Case analysis in this study showed a considerable discrepancy (Table 3).

According to gender, significant differences were observed in response to the case (Table 4). Women had respectively the highest correct grade allocation (CGA) for grade 2 (P = 0.001) and men had the highest rate for grade 1 (P = 0.020). Moreover, statistically significant differences were attained with respect to the field of specialization of respondents. General

dentists had the highest conformity rate in their answer to grade one, and periodontists and postgraduate students had highest conformity rates reported for grades 2 and 3.

Table 3. Overestimation, underestimation, and concordance in 20 cases

	Grade 3	Grade 2	Grade 1	Grade 0
Case number	17	3	2	8
Overestimation	12.9	45.9	23.6	32.1
Underestimation	56.1	12.8	29.8	12.2
Concordance	32.4	34.3	54.7	56.4
Case number	18	7	4	9
Overestimation	34.0	34.2	23.5	34.4
Underestimation	12.0	21.3	18.7	1.2
Concordance	56.5	45.2	47.9	57.1
Case number	19	11	5	13
Overestimation	34.1	32.1	70.5	43.1
Underestimation	22.7	24.4	12.1	34.2
Concordance	78.2	45.1	44.6	22.1
Case number	12	15	6	20
Overestimation	45.0	44.4	45.1	24.1
Underestimation	47.2	13.5	7.4	0
Concordance	12.1	32.1	48.0	81.2
Case number	1	14	10	16
Overestimation	0	1.1	84.1	18.7
Underestimation	57.2	53.7	1.2	0
Concordance	32.8	43.9	8.9	71.5
Case number	Total	Total	Total	Total
Overestimation	12.5	14.1	65.3	39.6
Underestimation	45.4	25.2	43.8	0
Concordance	36.6	25.1	15.1	61.2

Data are presented as percentage.

Discussion

This study evaluated the level of conformity in the diagnosis of oral hygiene using oral clinical examination and photographs based on Global Oral Health Scale criteria. New index of Global Oral Health Scale was introduced by Relvas et al. in 2013 for evaluation of oral health status.[13]

In this study, we requested the participants to diagnose the oral health status of the patients based on provided photographs, and there was not any clinical examination conducted.

Besides restrictions of the use of photographs, we could mention restriction in retraction of cheek and tongue and exposing oral mucosa. In addition to that, we should try to present a three dimensional object in two dimensional image in a way that it would provide the complete visibility to lay out the right clinical decision. Studies show that the appearance of the person and making use of cosmetics could have a good influence on the examiner.[20-22]

More than half of the respondents (59.1%) diagnosed the oral health of 7-12 patients correctly based on photographs; none of the respondents diagnosed oral health of more than 14 patients correctly, based on the photographs. In a study conducted by Relvas et al., 69.1% diagnosed the patients' oral health status correctly in 8-12 patients based on photographs.[13]

Table 4. Mean of grades based on demographic characteristics

Parameter		Grade 3	Grade 2	Grade 1	Grade 0	P
Sex	Men	2.21 ± 1.40	2.19 ± 1.02	3.11 ± 0.42	2.21 ± 1.01[*]	0.001
(mean ± SD)	Women	1.13 ± 0.77[*]	2.34 ± 1.12	3.16 ± 1.12	3.42 ± 0.21	
Age (year)	< 30	2.18 ± 0.54	3.12 ± 1.02	2.58 ± 1.40	3.25 ± 0.45	0.125
(mean ± SD)	> 30	2.45 ± 1.02	3.49 ± 1.12	2.45 ± 1.45	3.21 ± 1.12	
Years since graduation	< 2	3.12 ± 1.34	3.39 ± 1.08	3.10 ± 1.14	2.61 ± 0.25[*]	0.010
(mean ± SD)	2-5	3.34 ± 1.23	3.29 ± 1.42	3.14 ± 1.24	3.12 ± 1.11	
	> 5	3.45 ± 1.02	3.44 ± 1.02	3.24 ± 1.21	3.15 ± 1.40	
Degree of education	Dentist specialist	3.19 ± 1.08	3.19 ± 1.22[*]	3.57 ± 1.15	2.68 ± 1.40[*]	0.001
(mean ± SD)	Postgraduate student	3.09 ± 0.42	2.11 ± 1.22	3.17 ± 1.40	2.41 ± 1.42[*]	
	General dentist	3.09 ± 1.09	2.32 ± 1.12	3.31 ± 1.01	3.12 ± 0.98	
Type of activity	Dental school	3.19 ± 1.41	3.21 ± 0.42	3.14 ± 1.40	3.01 ± 1.14	0.090
(mean ± SD)	Dental office	3.39 ± 1.25	3.19 ± 0.23	2.49 ± 1.25	3.00 ± 0.42	
	Clinic	3.09 ± 1.34	3.19 ± 1.21	2.45 ± 1.16	3.13 ± 1.45	
	Multiple locations	3.19 ± 1.45	3.23 ± 0.88	2.36 ± 1.54	3.15 ± 1.14	

[*]P < 0.05 is significant, SD: Standard deviation

The highest rate of CGA is obtained in grade zero that does not have conformity with the study of Relvas et al.,[13] in which, the highest rate of CGA was for grade 3 and zero, which it shows that respondents in the study were not able to diagnose the patients with one surface caries and complex caries based on the photograph.

The lowest conformity of CGA was observed among cases with grade 1 and 2. Moreover, in this study, dental plaque was not identified by photograph, and number of tooth surfaces with supragingival plaque was estimated by participants. The survey shows that thorough clinical oral examination is more effective than examination that is exclusively visual for detection of dental plaque, but both techniques are appropriate for examination of teeth without plaque.[23-26]

In this study, the researcher made use of periodontal probe for evaluation of periodontal status of patients, average depth of periodontal pocket, and number of periodontal pockets that are pathologic in nature; and participants in this study evaluated the periodontal status of the patient only based on the appearance of gingiva, that it might be the cause of underestimation in patient one with grade 3.

Periodontal probe is a critical tool used in visual examination for evaluation of quality of periodontal tissue and conducting epidemiologic studies. However, in a study conducted in 2001, it was inferred that periodontal probes provided a few diagnostic information and in some of cases it might exert a negative influence.[27]

In this study women gained the highest CGA rate for grade zero and men gained the highest CGA rate for grade 1. General dentists showed the highest conformity in grade 1 and periodontists and residents of postgraduate studies had highest conformity for grade 2. Relvas et al.[13] conducted a study which showed the similar results observed in men and women, and surgeons showed the highest conformity. One of the main causes of this discrepancy could be the difference in educational methods of different specialties. Review of related literature implies that until now dental researches are being done by visual and clinical examination. Although, current study and study conducted by Relvas et al.[13] show that making use of Global Oral Health Scale as a new index and comparison with photography of patients especially in patients with very good and poor oral hygiene could be useful for epidemiologic studies and comparison of different populations.

Conclusion

Current study shows that making use of Global Oral Health Scale as a new index and comparison with photographs of patients, especially in patients with very good and poor oral hygiene, could be useful for epidemiologic studies and comparison of different populations.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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An investigation on the rate of communication skills among dental students from patients' point of view in Kerman dental school, Iran, in 2016

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Original Article

Abstract

BACKGROUND AND AIM: The patient's viewpoint on prevention, healthy diet, and disease recovery clearly relates to the relationship between the therapist and the patient. In this research, the importance of communication techniques between the patients and the dentists are investigated in order to improve the level of functional knowledge of patients for observing the oral hygiene and carrying out the activities in the field of dental diseases prevention and treatment.

METHODS: In this study, the patients who had received dental treatment were interviewed by a dental student at a general or specialized department in one of the clinical departments and then a questionnaire was completed for each patient. Later on for measuring the data, SPSS software was used. $P < 0.0500$ was considered statistically significant. The collected data were analyzed by t-test, chi-square test, and logistic regression.

RESULTS: In this cross-sectional study, 276 patients were studied along with a number of students who were enrolled. Of 276 patients, 46.4% were men and 53.6% were women. The dental students were 53.6% men and 46.4% women, 79.3% were general dentists and 20.7% were specialists. The average score for answering the aforementioned questionnaire was 18.30 ± 1.91 out of 20. This score had a significant relationship with students' age ($P = 0.0001$), but did not have a significant relationship with the gender of the students ($P = 0.2700$) or that of patients ($P = 0.5600$).

CONCLUSION: By increasing the age of the therapists, regarding the viewpoint of the patients, the communication skills were used more effectively, but the use of communication skills was not affected by the therapists' or patients' gender.

KEYWORDS: Communication; Students; Patients; Dentistry

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Education is a necessity to take care of our health. Using communication techniques by relevant professionals increases adaptation and admission of a person toward receiving the health care. Communication techniques are important in order to transfer or share the important points of how to prevent the oral and dental illness related to a patient. This shows that an ability to communicate effectively with patients and share dental protection information is crucial in order to improve the effectiveness of treatment.[1] Thus, dentists' recommendation will promote the level of patients' interest and performance. Yet, diet therapy and recovery are clearly related to the way of communication between the dentists and the patients.[2] Using present skills and knowledge-based methods, dentists could considerably improve the patients' level of awareness relating to oral and dental health issues in the way that they will be able to understand this information well and consequently use them in the right way.[3,4]

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The lack of coordination between literacy and health knowledge of patients' and dentists' informative requests has been demonstrated in many conducted studies. Many patients are shown to have difficulty in terms of obtaining process and understanding health information in the way that nearly 80 percent of them forgot about dentists' instructions as soon as they left the clinic. More interestingly, approximately 50 percent of their memories on what they had been told were incorrect.[5] As in US National Assessment of Adult Literacy (NAAL), more than 36 percent of individuals above 16 years old had a very low level of health literacy.[6] The necessary communication skills which have been recognized by present study include avoiding the expression of specialized terminology related to dentistry or medical sciences, using the common terms in the society, and taking notes to sings indicating that patients have understood the health instructions. Also it is believed that using simple and brief sentences, as well as listening and seeing visual cues provide short-term instructions and asking the patients with low level of literacy to repeat them among the others may increase the effectiveness of the communication.[7,8]

Oral and dental health specialists tend to use traditional health education strategies such as consulting sessions and pamphlet distribution which are not always effective. In a conducted research for the case of periodontal diseases, constructing the reliable relationship with patients is crucial to prevent the diseases and treat them.[9] The results of a review suggest that the psychology of behavior change is the key to oral health promotion and greater emphasis on teaching oral health professionals about health psychology would make oral health promotion more effective in the dental surgery.[10] The present investigation provides additional support for validity of the Comprehensive Measure of Oral Health Knowledge (CMOHK).[11] A paper identifies points in the care-seeking process where

every level factors influence individuals' behavior.[12] Although oral and dental specialists have a critical role in terms of preventing the onset of dental and oral diseases, diagnosing a disease in early stages, training a patient in order to have an active role in preventing from disease, and maintaining oral and dental health, a necessary condition for the role is having an effective communication with the patients. Regarding the importance of assessment of communication skill techniques between the patients and the dentists, this study aimed to evaluate the communication skills in dental students of Kerman City, Iran (just those who have recently entered to clinic for treating the patients) using a questionnaire filled by their patients. Therefore, the main aim is to assess students' communication skills to improve patients' knowledge of oral and dental health care and prevent and treat these diseases. As a communication skills course is introduced, patients are an appropriate target group for practical evaluation of students and getting the feedback in terms of how much they have learned those communicational skills and use them in real circumstances. Thus, the results could be used by students studying in School of Dentistry, Kerman University of Medical Sciences; as it helps them to know their communicative skills strength and weakness points at the very beginning steps of their career.

Methods

This survey was conducted in School of Dentistry, Kerman University of Medical Sciences, at the second half of the academic year of 2016-2017. The sample included patients who received medical services from school's dental students. Students are due to provide fully practical services at the fourth year of their academic curriculum. At the time of conducting present research, the number of general students was 219 as well as 57 specialized students. Each student entered the research process once and the questionnaire (made by the research team) was filled by his patients. The total population was 276. The

questionnaire was provided to the patient at the end of the treatment session without a general or specialized students' notice. The questionnaire contained two parts: the first one included questions related to the application of students' communication skills which was answered by the patients. There were three response options for each question: "yes", "no", and "do not know".

The responses were scored from 1 (yes) indicating the satisfactory performance and effective communication between the students and the patients to 0 (no) and 0 (do not know) both indicating the patients' dissatisfaction and lack of effective communication.[13] Score 20 indicated satisfaction of the patients. At the second part, students were asked to respond questions relating to demographic information (age of the students, and sex of the students and the patients). This measure was carried out at the end of the treatment by the dental students responsible for the project. To evaluate the validity of the index, the questionnaire was provided to 10 experts and 6 questions changed. To evaluate the reliability of the index, the questionnaire was randomly assigned to 20 subjects in a 3-week

interval. The reliability of the questionnaire was optimal using Cronbach's alpha (0.79). Data were analyzed using t-test, chi-square test, and analysis of variance (ANOVA) via SPSS software (version 21, IBM Corporation, Armonk, NY, USA). The percentage of the exclusion criteria on the items was low (0.3%). This study has been approved by Human Ethics Committee of the School of Dentistry, Kerman University of Medical Sciences (code: IR.KMU.REC.1395.102).

Results

In this study, 219 (79.3%) of general dentistry students and 57 (20.7%) of specialty students were investigated in order to evaluate the communication skills of the students which were 148 men (53.6%) and 128 women (46.4%) with a mean age of 24.70 ± 1.62 years. For each dental student, one patient answered the questions. Out of 276 patients, 148 were women (53.6%) and 128 were men (46.4%). The percentage of the exclusion criteria on the items was one person (0.3%). The frequency of the patients' responses to all 20 questions of questionnaire is shown in table 1. The frequency and average scores of students in each clinical department are shown in table 2.

Table 1. The frequency and percentage of "yes" and "no" responses to all 20 questions of questionnaire

Question	No [n (%)]	Yes [n (%)]
1- Was the student's descriptions clear to you?	2 (0.7)	274 (99.3)
2- Did the student give you the necessary guidance if your treatment should be done in another department?	9 (3.3)	267 (96.7)
3- Was the student friendly and respectful to you?	1 (0.4)	275 (99.6)
4- Did the student check the steps of treatment with his master?	0 (0)	276 (100)
5- Did the student's talk and behavior assure you about treatment?	6 (2.2)	270 (97.8)
6- Did the student determine your next visit? (if needed)	20 (7.2)	256 (92.8)
7- Did the student answer your questions regarding the treatment process?	5 (1.8)	271 (98.2)
8- Did the student call to check your teeth after treatment?	112 (40.6)	164 (59.4)
9- Did the student speak slowly and step by step to you?	3 (1.1)	273 (98.9)
10- Did the student speak in plain language that was understandable to you?	4 (1.4)	272 (98.6)
11- Did the student use educational tools (brochure, dental models, film, and photo) to explain the treatment?	110 (39.9)	166 (60.1)
12- Did the student explain the possible treatment plans to you?	83 (30.1)	193 (69.9)
13- Did the student explain the conditions (duration, cost of treatment, and etc.) of each treatment?	70 (25.4)	206 (74.6)
14- Did the student provide the post-treatment necessary trainings to you?	6 (2.2)	270 (97.8)
15- Are you satisfied with the way of your dentist's dealing and behaving?	2 (0.7)	274 (99.3)
16- Have the dentist had enough time to hear your talk?	4 (1.4)	272 (98.6)
17- Was the student's behavior with you such that you could easily talk to him?	2 (0.7)	274 (99.3)
18- Was your demand considered in making decision for treatment and oral health care?	20 (7.2)	256 (92.8)
19- Did the student's advice help your oral health care?	8 (2.9)	268 (97.1)
20- Did the student's conversation change your oral health awareness?	6 (2.2)	270 (97.8)

Table 2. Frequency and percentage of patients based on different departments of dental school and the mean score of each department in the population studied

Department	n (%)	Mean score
Periodontology	47 (17.0)	18.1
Endodontics	67 (24.3)	18.1
Pediatric	36 (13.0)	18.1
Restorative	65 (23.6)	17.9
Prosthodontics	36 (13.0)	18.6
Orthodontics	7 (2.5)	20.0
Social dentistry	4 (1.4)	20.0
Surgery	9 (3.3)	20.0
Oral diseases	5 (1.8)	20.0
Total	276 (100)	18.3

The students' mean score was 18.30 ± 1.91 out of 20 which was considered to be a very good score as it indicated the effective communication between the students and the patients. The score was significantly correlated (the correlation coefficient was 0.54) with the age of the students (P = 0.0001). As students' age goes up, they seem to communicate more effectively with the patients. The mean score of "communication" quantitative variable obtained by students based on their "educational level" [i.e., dental public health (DPH) students and specialized students], "sex of the students", and "sex of the patients" is presented in figure 1.
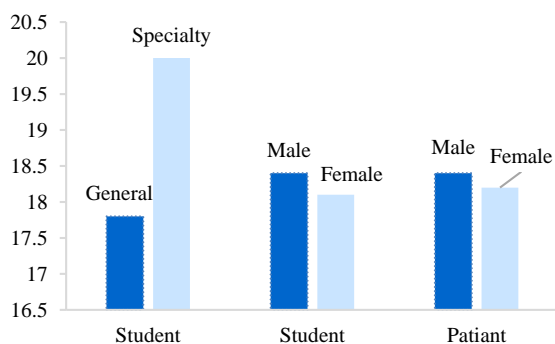
Figure 1. The student's mean score (out of 20) based on "educational level of students", "gender of students", and "gender of patients" in the population studied

There was statistically significant relationship between students' educational level and their score (P = 0.0001), as the patients' level of satisfaction has been higher for specialized students than DPH students. Moreover, there was no statistically significant relationship between "sex of the students" (P = 0.2700) and "sex of the patients" (P = 0.5600) factors with the mean of scores.

The average score of all different sections was compared with those of other sections. The difference was not statistically significant (P > 0.0500) showing that patients' satisfaction level was equal for all sections. It was statistically significant just in the case of comparing surgical section with restorative section (P = 0.0200) as surgical students obtained higher score than restorative section counterparts. According to table 3, the age factor was the only statistically significant factor in examining students' effective behavior, i.e., the older the student, the higher the score by the patient.

Table 3. The effect of different variables on the dependent variable of "communication skills" according to the regression coefficient in the population studied

Variable	Coefficient β	P
Student's educational level	0.25	0.6000
Gender of student	0.90	0.6000
Gender of patient	0.15	0.6000
Age	0.60	0.0001
Departments	0.01	0.8000

Discussion

This study aimed to evaluate students' communication skills at School of Dentistry, Kerman University of Medical Sciences, via getting patients' perspective. It investigates the patients' receiving dental services from 9 different sections of school in both DPH level and specialized ones. The mean of students' obtained score in all sections which patients could receive dental services was 18.30, indicating that there has been an effective communication between the students and the patients. In other words, students have taken communication skills and techniques and applied them in real practical circumstances. This is especially important, as preventive dental cares, treatment regime, and disease

recoveries obviously depend on the dentists and patients interactions.[2]

As the results show, from patients' perspective, as students' age goes up, they use the communication skills more effectively. Therefore, specialized dental students have shown to have higher scores than the DPH students. This may indicate that they are practically more experienced comparing to the first group. Hamasaki et al. show the statistically significant relationship between dentists' inter-professional relationships and patients' satisfaction.[14] Also, Chapman et al. argue that communication skills and sharing the decision-making process reduce patients' anxiety and complaints and consequently decrease malpractice claims. But dentists' emotional processing needs to be improved.[15] Many studies have been conducted to assess communication skills in both micro and macro levels using countless variables playing the role in constructing an effective communication between the dentists and the patients. As a consensus between all those studies, any positive change, even if it is a little one, could lead to a better and more effective communication and as a result the patients eagerly pursue both prevention and treatment processes. In other words, it may lead to a deep and reliable relationship between them.

Among variables surveying in the present study, "age" seemed to be an effective factor. Meanwhile, an increasing rate of diagnostic, preventive, and total services was observed when moving from older practitioners to younger practitioners among Australian dentists suggesting a sustained shift towards these services into the future.[16] Moreover, there was not a statistically significant relationship between "dentists' sex" and "patients' sex" factors with patient satisfaction. Findings show that using communication skills is a transgender issue as any female or male dentist could effectively learn and use them. On the other hand, from dentists' perspective, patients' sex

does not seem to be a determinant factor in creating pleasant sensation of a treatment and confidence among the patients. The important factor is the quality of right communication from the beginning to the end of treatment process and in some cases it could become a lifelong friendly relationship between the patient and the dentist. In fact, the effectiveness of mutual respect, using simple words, eye-contact, taking enough time to listen to the patients, noting patients' emotions, and so on is very high and does not seem to be influenced by gender of both the patients and the dentists. Weatherspoon et al.[8] and Koo et al.[13] found the same results. Koo et al. argued about the importance of patients' satisfaction and introduced communicational skills courses.[13] Schwartzberg et al. considered dentists' update level in the field of communication skills as an important factor.[17]

Based on the results of this study, there was no statistically significant difference between the mean scores from different sections of the department. The restorative section got the lowest score and the highest one belonged to oral diseases, surgery, social dentistry, and orthodontics sections which all got 20. The difference was not significant and from patients' perspective, used communicational skills by both the students of DPH and specialized levels were satisfactory. This little difference could be justified as the restorative section is the section in which students confront with the patients and they are still learning. Thus, in this section, learning stress and implementation of treatment process do not allow students to use and also focus on communicational skills.

Conclusion

From patients' perspective, the level of students' communicational skills is influenced by their age. The older they get, the higher the effectiveness of their relationship with the patients are. The performance of specialized dentist assistants

is better than their DPH counterparts. Finally, using communicational skills is not influenced by the sex of both the dentists and the patients. Some of the limitations of the present study were that there was not any patient in some clinical sections and some of the patients were not able to read the questionnaire since they were illiterate and needed more time.

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Self-perception prevalence of halitosis and oral hygiene habits in volunteers admitted to the school of dentistry in Kerman, Iran

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Original Article

Abstract

BACKGROUND AND AIM: This study was conducted to investigate the self-perception of mouth odor and its correlation with different variables.

METHODS: This cross-sectional study was carried out on 260 individuals who were asked about their perception of personal mouth odor. Factors such as age, gender, oral hygiene, periodontal and dental status, tongue coating, and medical history were recorded on a checklist. Halitosis was evaluated using an etiquette checker. The variables were analyzed using the independent samples t-test and multiple logistic regressions.

RESULTS: Of 260 individuals, 101 persons claimed to have halitosis. The prevalence of pseudo-halitosis was 13.5%. Female gender, spontaneous bleeding and bleeding during dental brushing, periodontal index (PI), and tongue coating had a significant association with genuine halitosis according to logistic regression. The decayed, missing, and filled teeth (DMFT) index had a significant association with pseudo- and genuine halitosis.

CONCLUSION: Dental status, tongue coating, female gender, and periodontal disease were most significantly related to halitosis.

KEYWORDS: Halitosis; Oral Health; Prevalence

Bad breath, which is also called oral malodor and halitosis, is a general term that refers to unpleasant smell of breath with an intraoral or extraoral origin,[1] which can cause social, emotional, and psychological problems. About 25% of people around the world suffer from halitosis, and most of them suffer from it occasionally.[2] In different studies, its prevalence rate was reported as being 50%[3] and 60%.[4]

The main factor behind halitosis is anaerobic gram-negative proteolytic microorganisms in the mouth. The activity of these microorganisms on proteins like exfoliative epithelium cells from the mouth, blood cells, and food debris leads to the production of cysteine and methionine amino acids and finally leads to a volatile sulfur compound (VSC). VSC includes hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH), and dimethyl sulfide [$(CH_3)_2S$].

If there is no halitosis but the patient believes that it exists, it is called halitophobia. Most of these people consider the behavior of others like covering the nose, turning the face, or moving away from them as an evidence of their halitosis. This type of social phobia intimidates a patient, and thus both patients

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with halitophobia and those with genuine halitosis may have psychological problems.[6] Different intraoral factors can cause halitosis including tooth decay, pericoronitis, exposing of a necrotic tooth, food debris, and unclean prosthodontics which can lead to a decrease of saliva. Mouth sores which are covered with pseudomembrane like herpetic ulcers, wounds caused by cancer, periodontal diseases, and some systemic factors are among the factors of halitosis.[7] Kakoei et al. showed that stress, menstrual cycle, and xerostomia could play a role in halitosis, but halitosis had no relationship with female hormones such as beta-estradiol.[8]

In general, halitophobia or genuine halitosis may affect the psychological health of the individuals and can negatively affect the quality of life to some degree. The purpose of this study was to assess the level of halitosis in the individuals who referred to the school of dentistry in Kerman City, Iran. After measurement of halitosis by a portable etiquette checker device, a questionnaire was completed by the patients. This questionnaire asked the patients opinions on halitosis. Hence, the level of halitophobia and genuine halitosis was studied in the above population; and with this information, it is possible to reduce the levels of anxiety in individuals regarding their halitosis. Furthermore, it is possible to give opportunities for further assessment and treatment.

Methods

This was a cross-sectional study of simple randomly selected 260 volunteers (among all students and patients who referred to School of Dentistry of Kerman University of Medical Sciences. The inclusion criteria for individuals in the study included age of over 18 years and participant satisfaction. Furthermore, those who used the medication that could affect halitosis directly or indirectly (through the reduction of saliva) were excluded from the study. Written informed consents were obtained from all participants. The study conforms to the Declaration of Helsinki regarding research involving human subjects and was approved by Ethic Committee of Kerman University of Medical Sciences (IR.KMU.K/90/41).

The demographic data were collected using a questionnaire including a number of demographic data as well as those on medical and lifestyle history such as smoking, patient's habits, history of systemic diseases, drug use, and a self-assessment about halitosis and oral hygiene status.

For the purpose of content validity, an expert panel consisting of seven oral medicine specialists reviewed and revised the questionnaire. The content validity index (CVI) was above 0.78 and was considered as valid. In order to evaluate the reliability of the questionnaire, 30 patients referred to dental school answered the questionnaire twice in between three weeks and intraclass correlation coefficient (ICC) was reported more than 0.74 that was considered reliable.

Afterwards, a text about the conditions and measurement of halitosis was given to them. These conditions were as follows: the individual must avoid eating garlic and onions two days before the experiment. They must also refrain from smoking and drinking coffee or alcohol for 12 hours before the examination. On the day of referral, they must avoid using gum, mint, perfume, or mouthwash. However, patients were free to eat breakfast and brush their teeth as usual. The time of examining halitosis was restricted to at least two hours after eating and drinking. The participants were examined from 8-12 a.m. The patients were examined in terms of oral status like teeth decay, oral hygiene status (accumulation of dental plaque and gingivitis), xerostomia, and tongue coating which were recorded in a checklist.

The tongue coating degree was recorded as follows: 0) without coating, 1) coating less than 1/3 of tongue dorsal surface, 2) coating between 1/3 and 2/3 of tongue dorsal surface, and 3) coating more than 2/3 of tongue dorsal surface.

To determine xerostomia, the Fox questionnaire was used. Determining the accuracy of the Fox questionnaire in evaluating oral problems in Persian language was performed as a thesis in 2009. According to this investigation, at least one positive item was considered as xerostomia.[9] Self-perception of individuals was investigated by the questionnaire. There were questions about feelings toward halitosis and how they felt it affected their lives, whether they were worried about it, and whether the severity of their halitosis was low, average, or high. The obtained results were compared to the results obtained from etiquette device. Then, the level of genuine halitosis and halitophobia of individuals was assessed.

To determine the level of genuine halitosis a portable etiquette checker device (Etiquette Topland Co., Japan) was used. Portable etiquette checker is a small device that can be carried easily. The validation of this device checking for mouth odor detection has been studied previously.[5] Halitosis was considered according to rank of 1 to 6 (1 = no halitosis, 2 = very low, 3 = mild, 4 = average, 5 = high, and 6 = very high). Genuine halitosis referred to the cases in which the subject's response to the question was positive, and the value shown by etiquette checker device was 3 or higher. Halitophobia referred to those who gave a positive answer to the question and where the etiquette value was equal to 2 or less.

Categorical variables were presented as numbers (percentages). The variables were compared between two groups by chi-square/Fisher's exact test. The t-test was used to compare the quantitative variables between groups. Multiple logistic regression was also used. The statistical analyses were performed using the SPSS software (version 19, SPSS Inc., Chicago, IL, USA). P-values less than 0.0500 were considered statistically significant.

Results

In this study, 260 subjects participated whose demographic information is shown in table 1. Of total subjects, 101 (38.8%) ones suffered from halitosis, and 66 subjects (25.4%) reported genuine halitosis while 35 (13.5%) ones reported halitophobia.

Table 1. Demographic information of the studied subjects

Variables	n (%)
Gender	
Men	106 (40.8)
Women	154 (59.2)
Marital status	
Single	208 (80.0)
Married	48 (18.5)
Level of education	
Under diploma	5 (1.9)
Diploma	57 (21.9)
Associate degree	36 (13.8)
Bachelor and higher	159 (61.2)
History of smoking	
Yes	21 (8.1)
No	239 (91.9)
History of drinking alcohol	
Yes	30 (11.5)
No	226 (86.9)

Missing caused the percent of sum of some columns be less than 100%.

Feeling of oral mouth odor had significant relationship with daily brushing and frequency of tooth brushing, history of gum bleeding, and toothache (P < 0.0500) (Table 2).

Table 2. The relationship of self-perceived halitosis with oral hygiene habits in the participants

Variables		Self-perceived halitosis		P
		Yes [n (%)]	No [n (%)]	
Do you brush during 24 hours of day?	Yes	90 (89.1)	154 (96.8)	0.0110
	No	11 (10.9)	5 (3.2)	
Time number of brushing teeth per day	0	12 (12.0)	4 (2.5)	0.0100
	1	58 (58.0)	78 (49.6)	
	More than 1	30 (30.0)	75 (47.7)	
Do you use dental floss?	Yes	43 (42.5)	83 (52.3)	0.0800
	No	58 (57.4)	76 (47.7)	
Do you have gingival bleeding while brushing your teeth?	Yes	42 (41.5)	36 (22.7)	0.0010
	No	59 (58.4)	123 (77.3)	
Do you have toothache?	Yes	39 (39.0)	37 (23.9)	0.0100
	No	61 (61.0)	118 (76.1)	

Table 3. The relationship of halitosis and halitophobia with oral hygiene in the participants

Variables	Genuine halitosis [n (%)]	Halitophobia [n (%)]
Do you brush during 24 hours of day?		
Yes	56 (84.5)	34 (97.1)
No	10 (15.5)	1 (2.9)
P	< 0.0001*	0.3800**
Time number of brushing teeth per day		
0	11 (16.9)	1 (2.9)
1	38 (58.5)	20 (57.1)
More than once	16 (24.6)	14 (40.0)
P	< 0.0001*	0.2500**
Do you use dental floss?		
Yes	21 (31.8)	22 (62.8)
No	45 (68.2)	13 (37.2)
P	0.0020*	0.0600**
Do you have gingival bleeding while brushing your teeth?		
Yes	30 (45.4)	12 (34.3)
No	36 (54.6)	23 (65.7)
P	0.0020*	0.5000**
Do you have toothache?		
Yes	28 (43.1)	11 (31.4)
No	37 (56.9)	24 (68.6)
P	0.0070*	0.8000**

*P-value in genuine halitosis compared with all subjects, **P-value in halitophobia compared with all subjects

Univariate analysis of questions on oral hygiene in those who had positive response to feeling oral mouth odor and those who had genuine halitosis showed a significant relationship with poor dental hygiene. In the subjects who did not brush their teeth or had a less frequent number of brushing per day and also had toothache, halitosis was more severe (P < 0.0500). However, there was not such a relationship in those with halitophobia (Table 3).

The study of the periodontal index (PI) showed that 36 subjects (13.8%) had no plaque in their gums (PI = 0). 94 subjects (36.2%) had low level of plaque stuck to the free edge of their gums (PI = 1), 93 subjects (35.8%) had average plaque in periodontal pocket and gingival margin (PI = 2), and 37 subjects (14.2%) had high plaque in periodontal pocket and adjacent surface of tooth (PI = 3). The mean score of PI was 1.50 ± 0.90. Furthermore, the mean of number of decayed, missing, and filled teeth (DMFT) was 7.60 ± 5.30. Tongue coating investigations showed that 55 subjects (21.2%) had tongues without coating, 90 subjects (30.8%) had coating less than 1/3

of the tongue's dorsal surface, 69 subjects (26.5%) had coating between 1/3 and 2/3 of the tongue's dorsal surface, and 55 subjects (21.2%) had coating more than 2/3 of the tongue's dorsal surface (data are not shown).

The features of variables according to genuine halitosis and halitophobia are shown in table 4.

The univariate relationship regarding halitophobia and genuine halitosis showed the lack of a significant relationship between the variables except for DMFT. The results showed that DMFT was significantly (P = 0.0001) higher both in individuals with genuine halitosis (mean = 9.88 ± 5.30) and those with halitophobia (mean = 5.43 ± 3.80) in all subjects. Moreover, the t-test conducted in relation to DMFT showed that both in terms of genuine halitosis and halitophobia, those who had genuine halitosis were more numerous than those who did not have halitosis (results are not shown).

Multivariate analysis was used to determine the effect of all variables in relation to halitophobia and genuine halitosis. Accordingly, those with higher education [odds ratio (OR) = 1.60, P = 0.0230)

Table 4. Frequency of the variables according to halitophobia and genuine halitosis in the participants

Variables	Genuine halitosis [n (%)]	Halitophobia [n (%)]
Gender		
Men	28 (42.4)	11 (31.4)
Women	38 (57.6)	24 (68.6)
Marital status		
Single	52 (81.2)	26 (76.5)
Married	12 (18.8)	8 (12.5)
Level of education		
Under diploma	2 (3.0)	0
Diploma and associate degree	22 (33.3)	13 (37.1)
Bachelor and higher	42 (63.7)	22 (62.9)
Xerostomia		
Yes	53 (80.3)	26 (74.3)
No	13 (19.7)	9 (25.7)
Smoking		
Yes	10 (15.5)	1 (2.9)
No	56 (84.5)	34 (97.1)
Drinking alcohol		
Yes	13 (20.0)	1 (2.9)
No	52 (80.0)	34 (97.1)
Using medicine		
Yes	11 (16.7)	5 (14.3)
No	55 (83.3)	30 (85.7)
History of systemic disease		
Respiratory disease	18 (27.3)	5 (1.9)
Diabetes mellitus	2 (3.0)	1 (0.4)
Gastrointestinal disease	6 (9.0)	4 (1.5)
Kidney disease	0 (0)	1 (0.4)
Liver disease	1 (1.5)	0 (0)
Haematic disease	0 (0)	1 (0.4)
Other diseases	3 (4.6)	9 (3.5)
More than one disease	12 (18.2)	25 (9.6)
No history	24 (36.4)	17 (6.5)

and a higher PI (OR = 1.93, P = 0.0800) had a higher degree of genuine halitosis than those with lower level of education and no PI (this problem is confirmed through the significance of questions on gingival bleeding). The relationship of other variables with halitophobia was not significant (Table 5).

Discussion

It is clear that if people feel they have halitosis, they will more likely be guided to the diagnosis and treatment of oral and non-oral health problems. In the present study, 260 volunteers were asked to assess whether or not they had halitosis.

Table 5. Regression analysis in genuine halitosis

Variables	B	P	OR Exp (B)
Gender	0.71	0.0600	2.04
Average plaque compared to the lack of plaque	8.40	0.0080	8.40
High plaque compared to the lack of plaque	16.57	0.0010	16.57
Tongue coating	1.39	0.0730	1.39
Education	1.60	0.0230	1.60
Bleeding during dental brushing	1.93	0.0800	1.93
Spontaneous bleeding	5.11	0.0530	5.11

OR: Odds ratio

Of 101 subjects (38.8%) who felt they had halitosis according to the questionnaires, 35 ones (13.5%) did not actually have halitosis according to the etiquette checker (EC) device. It can be said that they experienced pseudo-halitosis.

Different values for this trait have been reported in previous studies. Oho et al.[10] and Iwanicka-Grzegorek et al.[11] reported that the rate of pseudo-halitosis was 25% to 50%. However, Romano et al. reported this percentage to be 6.1.[12] Quirynen et al. reported a value of 16%.[17] The large differences in self-assessment of halitosis can relate to the population studied in these reports. Populations can vary either culturally or mentally in terms of degree of sensitivity to such problems. Another possibility is that there could have been differences in the estimation of halitosis by the devices used. In the present study, 66 subjects (68.3%) diagnosed themselves as having halitosis or of being aware of it. Romano et al. found that 25.0% of subjects complained about having halitosis and 35.6% were made aware of halitosis by others.[12] Al-Ansari et al. found that most subjects (57.3%) detected their halitosis themselves,[13] and these results were more similar to those of the present study.

A comparison of the current questionnaire results with the results of EC showed that of the total research population, 25.4% of individuals had genuine halitosis and 13.5% had pseudo-halitosis. Similar to the present study, Romano et al. reported that a majority of subjects had genuine halitosis rather than pseudo-halitosis (93.9% to 6.1%).[12] This difference can relate to the expectations and views of individuals on the definition of halitosis and also the results of the halitosis measurement devices. For example, in Romano et al. study, the assessment of halitosis was done using the organoleptic method.[12]

In the present study, none of the study variables showed a significant relationship with pseudo-halitosis. In terms of gender, female participants showed a relatively significant relationship with genuine halitosis. Al-Ansari et al.[13] and Romano et al.[12] both reported that women reported a higher percentage of halitosis. This was related to the stress of most women about the possibility of having halitosis. This problem may show the role of hormones in detecting halitosis or increased sensitivity to halitosis. Kakoei et al. reported that women experiencing their menstrual cycles were more likely to report halitosis.[8] This is another factor in the significantly higher prevalence of halitosis in women.

Individual perception of halitosis is a subjective feeling. The result of other studies indicates that it is not always an accurate feeling. To address this issue, the psychological status of individuals should be analyzed, which was not possible in the current study.

The results of univariate analysis indicated that those who used toothbrush and toothpaste daily had less genuine halitosis, which is similar to the results of previous studies. Nalcaci and Baran measured factors related to self-perception of halitosis in healthy people. They showed that those who less brushed their teeth, more often had halitosis.[14] Oral hygiene can be effective in prevention of tooth decay and periodontal disease and thus the control of halitosis.[15]

Lopes et al. investigated self-assessment of halitosis in teenagers in Brazil and showed that the frequency of teeth brushing and oral hygiene was related to the presence of halitosis as reported by others. Self-perception of halitosis was found to be more dependent on the social and economic status of individuals.[16]

In the present study, a history of systemic disease had no significant relationship with pseudo-halitosis or genuine halitosis, which may be due to the low prevalence of these diseases in the individuals studied. However, individuals with respiratory diseases (such as sinusitis) suffered more from genuine halitosis than the other participants. These findings are consistent with those of

Al-Ansari et al.,[13] who found that the two participants suffering from gastrointestinal disease and sinusitis showed a direct relationship with halitosis. In addition, similar to the findings of the present study, their study showed no significant relationship between diseases such as diabetes, kidney disease, or the use of medicine and self-perception of individuals as having halitosis.

In the present study, those who had coated tongues had a significantly higher prevalence of genuine halitosis. This is consistent with previous studies.[12,17] Tongue coating consists of dental epithelial cells, food debris with microorganisms, and an accumulation of leukocytes in the gingival sulcus.[18] It is a suitable place for the growth of bacteria, especially anaerobic bacteria that leads to halitosis.[15,19]

Although smoking increases halitosis from an external source,[20] the current study showed no significant relationship between smoking and genuine halitosis or pseudo-halitosis. Al-Ansari et al. reported that a subject's self-perception of halitosis indicated that those who smoked had a greater tendency to feel halitosis.[13] In the current study, the researchers showed that halitosis caused by smoking related more to the smell of cigarette and probably had no direct relationship with halitosis with a sulfur source.[13] It is plausible that smoking in the long term has an indirect relationship with periodontal diseases. The current study had a low number of smokers. It can be said that assessment of halitosis using a device by VSCs may account for the insignificance.

In the present study, those with periodontal disease had higher genuine halitosis than the other participants. Periodontal disease can be considered a cause of halitosis. This issue has been studied widely.[21,22] Liu et al. investigated a number of periodontal indices and found that halitosis had a direct relationship with an increase in gingival indices.[23] Gingival disease increases the liquid in the gingival sulcus and causes bleeding.[24] The hemoglobin provided by such bleeding is necessary for the growth of porphyromonas gingivalis bacteria and can increase halitosis. In addition, blood sedimentation can produce peptides containing sulfur and cause halitosis.[23]

In the present study, individuals with higher levels of DMFT had genuine halitosis or pseudo-halitosis, which was in agreement with previous study.[25] Nevertheless, the assessment of tooth decay has been less considered in previous studies and this index has been less frequently investigated. A lack of oral hygiene can lead to decay and loss of teeth.[26-28] Cavities caused by dental decay are good sites for the accumulation of microorganisms and can lead to halitosis.[29,30] However, the number of filled or pulled teeth as assessed in this index can have no direct relation with halitosis.[25]

In the current study, most of the measured variables had no relationship with genuine halitosis and the individuals' self-perception of the level of their halitosis was similar to their actual level of halitosis. Nalcaci and Baran in a review showed that the estimations of individuals regarding their halitosis were highly unreliable and objective evaluation was not consistent with self-perception.[14]

Conclusion

The current study found a significant relationship between all research variables including periodontal disease, spontaneous bleeding during dental brushing, tongue coating, and genuine halitosis. It also showed that the individuals' self-perception of halitosis was not reliable.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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Effect of social-behavioral factors on dental caries in 3-6-year-old children in Kerman, Iran

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Original Article

Abstract

BACKGROUND AND AIM: Dental caries is a multifactorial disease with a complex etiology. The social-behavioral factors play an important role in development of dental caries. This study aimed to evaluate the effect of social-behavioral factors on dental caries in 3-6-year-old children in Kerman, Iran.

METHODS: This cross-sectional descriptive-analytical study was conducted on 857 children aged 3-6 years. Data collection tools were clinical examination and a form which contained two sections. The first section included demographic characteristics of children and record of their decayed, missing, and filled teeth (DMFT) index, whereas the second section contained questions on social-behavioral factors of children and parents, which were designed in four areas of oral health service system, as well as environmental, social-cultural, and risk behaviors factors. Data analysis was performed by SPSS software using statistical tests, analysis of variance (ANOVA), t-test, and multiple linear regression model. In addition, P-value of 0.0500 was considered significant.

RESULTS: In this research, 456 subjects were female and 401 were male. Moreover, mean age of the children was 4.76 ± 1.04 years. A significant relationship was observed between the mean DMFT index and level of education and marital status of parents (P = 0.001). Children of parents with higher education and occupational status had lower mean DMFT index. On the other hand, a significant association was found between mean DMFT index and the variables of milk consumption at night (P = 0.001), consumption of sweets and biscuits (P = 0.038), and use of toothbrush (P = 0.005) and dental floss (P = 0.001). Furthermore, a significant relationship was observed between the mean DMFT index and age of children (P = 0.001).

CONCLUSION: Despite the advancements made in social, cultural, economic, and health aspects of treatment over the past few years, there is still a direct relationship between social-behavioral factors and dental caries in preschool children.

KEYWORDS: Dental Caries; Social Factors; Behavioral Factors; Preschool Children

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A considerable share of oral diseases in the world is allocated to dental caries.[1] Generally, changes in oral hygiene of children are low in developing countries and dental caries are still found in a significant percentage of children.[2-5] Risk of social-behavioral factors of dental caries is described in a model by the World Health Organization (WHO), which includes oral healthcare service system, risk behaviors (oral hygiene and sugar consumption) as well as environmental (drinking water, sewage system, hygiene, nutritional status) and social-cultural (level of education, occupational status, level of income, race, life style, support of social

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networks) risk factors.[6] According to the literature, environmental and socioeconomic factors are significant determinants of oral and dental diseases.[7] Casanova-Rosado et al. conducted a research in Mexico, concluding that the frequency of daily tooth brushing was higher in children who had dental visits during the last year. On the other hand, the frequency of daily tooth brushing was lower in children of large families and those without dental visits in the past year.[8]

In a research on six-year-old children in India, Tadakamadla et al. demonstrated a relationship between the experience of dental caries and parental occupational status and level of education.[4] Some studies have shown that children with lower socioeconomic levels had higher incidence of dental caries. On the other hand, children of parents with high salaries and levels of education were less at risk of dental caries.[2,9] Evidence shows a considerable association between Significant Caries Index (SiC Index) of students and the variables of gender, number of family members, level of education of mothers, frequency of brushing, and use of fluoride mouthwash.[10] In a research by Peltzer et al., risk factors related to dental caries were presented to be low socioeconomic status, frequent consumption of sweets, unfavorable amount of fluoride in water resources, and irregular tooth brushing.[6] Due to the cultural, behavioral, and social differences in various societies and countries in the field of nutrition, oral hygiene, and oral healthcare services, the type of factors affecting dental caries in children can vary in different societies. With this background in mind, this study aimed to evaluate the effect of social-behavioral factors on dental caries in children aged 3-6 years in Kerman, Iran.

Methods

This cross-sectional descriptive-analytical research was conducted on 857 children aged 3-6 years in kindergartens of Kerman City in 2016. The study protocol was approved by the Ethics Committee of Kerman University

of Medical Sciences (IR.KMU.REC.1395.190). Inclusion criteria were lack of systematic diseases and orthodontic appliances, and living with at least one of the parents. Subjects were selected through multistage sampling. In the first stage, names of all kindergartens of districts one and two of Kerman City were collected from the welfare organization. Given the difference between the children of these two districts in terms of cultural, economic, and social status, participants were selected from both districts. At first, 22 kindergartens were randomly selected from the two districts, followed by random selection of eligible students from the list of names of children with regard to the sample size of the research. At first, a briefing was held for parents of the children in one of the kindergartens to explain about the objectives and importance of the research. Written informed consents were obtained from the parents who were willing to participate in the research. All stages of the study were performed by a trained senior dental student.

In addition, parents were ensured of voluntary participation, meaning that they could withdraw from the research at any time. Data collection tools were clinical examination and a form which consisted of two sections. The first section was related to the demographic characteristics of children (i.e., age, gender, and parental occupational status and level of education) and record of decayed, missing, and filled teeth (DMFT) index (number of decayed, restored, and lost deciduous teeth due to dental caries) according to the WHO criteria. The second section contained questions related to the social-behavioral factors of children and their parents designed in four dimensions,[11] including oral health service system (two items), as well as environmental (three items), social-cultural (ten items), and risk behaviors (five items) factors. To assess validity, the data collection form was given to 10 pediatric dentists and their comments were applied in the questionnaire. The

content validity of the questionnaire was calculated using the content validity index (CVI) as 0.86, which was approved. Subjects were categorized based on DMFT index (DMFT > 4, DMFT < 2, and 4 > DMFT > 2), and were defined as children with high, moderate, and low decay condition.[12]

On the other hand, clinical examination was carried out by trained senior dentistry students with the use of dentistry mirror and under natural light to record the DMFT index of each participant in the form.[13] Before the process, teeth surface of children was cleaned with gauze, if required.[14] After clinical examination, the data collection forms were provided for parents to answer the questions. In addition, all dental and oral problems of the subjects were announced to their parents after examination and oral health principles were described. Following that, the participants were referred to clinics and school of dentistry to receive treatment or preventive measures. Data analysis was performed by SPSS software (version 19, SPSS Inc., Chicago, IL, USA) using

descriptive tests, analysis of variance (ANOVA), t-test, and regression model. The ANOVA and t-test were used to investigate the relationship between DMFT index with age and sex. The multiple linear regression analysis was performed to determine the relationship between the factors related to DMFT. Furthermore, P-value of 0.0500 was considered significant.

Results

In this research, the majority of form fillers (85.3%, n = 731) were mothers, and only 10 (1.2%) forms were filled by both parents. In terms of level of education, most of the mothers (58.0%) had diploma degree, whereas most of the fathers (53.0%) had Bachelor of Science (BSc) degree. In addition, the majority of fathers (62.3%) were self-employed and most of mothers (43.8%) were housewives (Table 1). Furthermore, mean age of the subjects was 4.76 ± 1.04 years. Mean and standard deviation (SD) of DMFT index was 3.70 ± 2.00 in all subjects, specifically 3.71 ± 1.91 in male subjects and 3.72 ± 2.07 in female participants.

Table 1. Relationship between decayed, missing, and filled teeth (DMFT) index and demographic characteristics

Variable		Frequency n (%)	DMFT indicator Mean ± SD	P
Gender	Female	456 (53.2)	3.72 ± 2.07	0.964
	Male	401 (46.8)	3.71 ± 1.91	
Level of education of fathers	Below diploma	56 (6.5)	4.37 ± 1.89	0.001*
	Diploma	280 (32.8)	4.18 ± 1.98	
	BSc	454 (53.0)	3.49 ± 1.96	
	Higher education	66 (7.7)	2.59 ± 1.78	
Level of education of mothers	Illiterate	2 (0.2)	5.00 ± 0	0.001*
	Below diploma	90 (10.5)	4.52 ± 2.12	
	Diploma	497 (58.0)	4.01 ± 1.90	
	BSc	250 (29.2)	2.86 ± 1.84	
	Higher education	18 (2.1)	2.77 ± 2.21	
Occupational status of fathers	Self-employed	534 (62.3)	3.97 ± 1.95	0.001*
	Employee	281 (32.8)	3.33 ± 2.09	
	Unemployed	15 (1.8)	3.53 ± 2.09	
	Physician-dentist	20 (2.3)	2.35 ± 1.56	
	No answer	7 (0.8)	-	
Occupational status of mothers	Housewife	375 (43.8)	3.97 ± 1.95	0.001*
	Self-employed	352 (41.1)	3.63 ± 1.99	
	Employee	123 (14.4)	3.17 ± 2.06	
	Physician-dentist	7 (0.8)	2.16 ± 2.04	

*P < 0.050
BSc: Bachelor of Science; SD: Standard deviation

Table 2. Relationship between decayed, missing, and filled teeth (DMFT) index and high-risk factors and behaviors

Variable		Frequency n (%)	DMFT indicator Mean ± SD	P
Milk consumption at night during the first two years	Yes	447 (52.2)	3.89 ± 2.00	0.001*
	No	374 (43.6)	3.43 ± 1.96	
	No answer	36 (4.2)	-	
Nutrition status in the first two years	Breast milk	351 (41.0)	3.87 ± 2.02	0.123
	Bottle	366 (42.7)	3.58 ± 2.02	
	Both	140 (16.3)	3.63 ± 1.58	
Consumption of sweets and biscuits	Once a day	336 (39.2)	3.88 ± 2.04	0.038*
	More than once a day	201 (23.5)	3.43 ± 1.95	
	Irregular	320 (37.4)	3.70 ± 1.97	
Use of toothbrush	Once a day	321 (37.5)	3.67 ± 1.93	0.005*
	More than once a day	435 (40.3)	3.86 ± 2.10	
	Irregular	162 (18.9)	3.60 ± 1.87	
	Never	29 (3.4)	2.41 ± 1.88	
Use of dental floss	Once a day	172 (20.1)	3.54 ± 1.96	0.001*
	More than once a day	137 (16.0)	3.11 ± 2.01	
	Irregular	229 (26.7)	3.99 ± 1.95	
	Never	319 (37.2)	3.70 ± 2.00	

*P < 0.050, SD: Standard deviation

According to the categorization of DMFT index,[12] all of the children had moderate to high caries conditions. According to the results of ANOVA and t-test analysis, no statistically significant difference was observed between the genders (P = 0.964). However, a significant association was found between DMFT index and age of the subjects. In this regard, higher DMFT mean was found in older children.

The relationship between the DMFT index and risk behaviors and factors is presented in table 2. In total, 532 subjects had never visited a dentist. On the other hand, 592 participants participated in the fluoride therapy or fissure sealant plan. The association between DMFT index and use of health system is shown in table 3.

In this study, most of the participants lived in a three-member family (54.1%). According to the results of multiple linear regression analysis, a statistically significant relationship was observed between level of income of parents and DMFT index of children (P = 0.001); so that, the children of parents with an income of above five million tomans had less DMFT index. The relationship between DMFT index and social-cultural risk factors is demonstrated in table 4. In addition, the association between DMFT index of the subjects and variables of maternal age, birth weight, and presence of caries in maternal teeth is shown in table 5.

Table 3. Relationship between decayed, missing, and filled teeth (DMFT) index and use of health system

Variable		Frequency n (%)	DMFT indicator Mean ± SD	P
Visiting a dentist	Never	352 (41.1)	3.90 ± 1.98	0.066
	One-two times in the last year	373 (43.5)	3.60 ± 2.00	
	More than two times in the last year	99 (11.6)	3.60 ± 2.09	
	No opinion	33 (3.9)	3.13 ± 1.73	
Participation in fluoride therapy or fissure sealant plan in kindergarten	Yes	592 (69.1)	3.71 ± 2.05	0.285
	No	188 (21.9)	3.81 ± 1.90	
	No opinion	77 (9.0)	3.38 ± 1.83	

SD: Standard deviation

Table 4. Relationship between decayed, missing, and filled teeth (DMFT) index and social-cultural risk factors

Variable		Frequency n (%)	DMFT indicator Mean ± SD	P
Level of income	Below one million tomans	341 (39.8)	4.40 ± 1.91	0.001[*]
	Between one-five million tomans	337 (39.3)	3.32 ± 1.99	
	Above five million tomans	179 (20.9)	3.11 ± 1.80	
Separation of parents	Yes	40 (4.7)	3.17 ± 1.74	0.093
	No	817 (95.3)	3.73 ± 2.01	
Living with parents	Father	6 (0.7)	4.16 ± 1.60	0.311
	Mother	24 (2.8)	3.00 ± 1.71	
	Father and mother	820 (95.3)	3.72 ± 2.01	
	Mother, grandparents	5 (0.6)	2.50 ± 1.73	
	Father, grandparents	2 (0.2)	2.50 ± 0.71	
Number of family members	Two	22 (2.6)	3.31 ± 1.78	0.670
	Three	464 (54.1)	3.73 ± 1.94	
	Four	229 (26.7)	3.76 ± 2.04	
	Five	73 (8.5)	3.73 ± 2.14	
	Six	35 (4.1)	4.02 ± 2.07	
	Seven	7 (0.8)	2.85 ± 1.95	

[*]$P < 0.050$, SD: Standard deviation

Results were also indicative of a significant relationship between DMFT index of the participants and maternal age and caries presence. So that, the children of younger mothers with more caries had higher DMFT index.

Discussion

The socioeconomic level is a key factor in determining the need for dental treatments and the prevalence of dental caries.[15] In the current research, which was conducted on 3-6-year-old children in Kerman City, mean and SD of DMFT index was 3.70 ± 2.00, whereas means of D, M, and F indicators were 2.27 ± 1.46, 0.87 ± 0.55, and 0.88 ± 1.14, respectively. As observed, there was a high mean of dental caries and low mean of restored teeth, which is in line with the results obtained by Borges et al.[2] The higher rate of dental caries might be due to inadequate parental awareness of importance of deciduous teeth in growth and development of permanent teeth. In the current research, no significant difference was observed between the male and female subjects in terms of mean DMFT index, which is consistent with the results obtained by Casanova-Rosado et al., who reported no significant association between mean DMFT index and gender of the subjects.[3]

Table 5. Relationship between decayed, missing, and filled teeth (DMFT) index and environmental risk factors

Variable		Frequency n (%)	DMFT indicator Mean ± SD	P
Birth weight (kg)	Below 2.5	483 (56.4)	3.72 ± 1.94	0.962
	Above 2.5	374 (43.6)	3.71 ± 2.07	
Maternal caries presence	Pit-and-fissure caries	430 (50.2)	3.80 ± 1.93	0.024[*]
	No caries	327 (38.2)	3.38 ± 2.11	
	No opinion	100 (11.6)	4.04 ± 1.83	
Drinking water resource	Tap water	735 (85.5)	3.71 ± 1.97	0.354
	Mineral water	8 (0.9)	3.12 ± 1.45	
	Purified water	104 (12.1)	3.82 ± 2.13	
	All types	10 (0.8)	2.28 ± 2.87	
	14-24	218 (25.4)	4.08 ± 2.01	
Maternal age (year)	25-35	572 (66.7)	3.64 ± 1.99	0.001[*]
	36-46	55 (6.4)	2.78 ± 1.71	
	No response	12 (1.4)	-	

[*]$P < 0.050$, SD: Standard deviation

However, there is a lack of consistency between our findings and the results obtained by Eskandarizadeh et al., who found a significant difference between male and female 6-year-old children and their mean DMFT index in Kerman; so that, the boys had higher DMFT index.[16] This contrast might be due to the difference in the population of studies, since DMFT index of children aged six years was assessed in the aforementioned research. In the present study, a significant relationship was observed between mean DMFT index and variables of parental occupational status and level of education. According to the results, children of parents with higher education had lower mean DMFT index. In this regard, our findings are in congruence with the results obtained by Kumar et al.,[9] Li et al.,[17] Nematollahi et al.,[18] Kiwanuka et al.,[19] and Pakpour et al.[20] in Iranian adolescents.

On the other hand, Casanova-Rosado et al. marked that children of mothers with higher education had lower number of dental caries.[3] It seems that higher levels of education increased parental awareness of oral health and led to greater attention to the oral health of their children, thereby improving their oral health index. In the current research, the parental occupational status had a significant impact on DMFT index. In studies by Tadakamadla et al.[4] and Narang et al.,[21] parental occupation status significantly changed the dental caries in children, in a way that dental caries was observed in a small number of children of parents with higher level of occupation; so that, the children of parents who had professional occupations had less DMFT index than children of unemployed parents. In this respect, our findings are not consistent with the results obtained by Eskandarizadeh et al.[16] and Tanaka et al.,[22] which demonstrated lack of observing a significant relationship between parental occupational status and DMFT index of children, and also with the study by Torabi et al.,[23] in which the lack of a significant association between

parental occupational status and the SiC index of 7-year-old children was reported. This lack of consistency might be due to the sample populations of the studies.

According to the results of the current research, a statistically significant relationship was observed between milk consumption at night during the first two years of life and DMFT index of children aged 3-6 years. In a research by Vejdani et al., a significant relationship was found between early childhood caries (ECC) and milk consumption at night. Drinking milk at night prolongs exposure to fermentable carbohydrates and creates an improper oral environment during sleep, which can cause dental caries.[24] In the current study, a significant relationship was observed between DMFT index and consumption of sweets, which is in congruence with the results obtained by Vejdani et al.,[24] Naidu et al.,[25] and Alshehri.[26] Increased consumption of sweets leads to higher risk of enamel demineralization and shorter duration of remineralization by saliva. After that, demineralization becomes the dominant phenomenon. Initiation of consumption of sweet foods and drinks at early ages can turn this act into a habit in adulthood.[24] According to the results of the present study, a significant relationship was observed between DMFT index and use of toothbrush and dental floss, which is consistent with the results obtained by Tadakamadla et al.,[4] Naidu et al.,[25] Alshehri,[26] and Sajadi et al.[27]

In the present research, 41.1% of the subjects never visited a dentist. In this regard, a significant association was found between mean DMFT index and visiting a dentist. In general, the DMFT index of children who never visited a dentist was higher. In a research by Kiwanuka et al., a great number of children never visited a dentist.[19] In the study by Tadakamadla et al. in India, 93.3% of the participants never visited a dentist.[4] Generally, visiting a dentist can increase the people's awareness of the current oral situation of children, leading to the treatment

of present caries and prevention of oral and dental problems and losing teeth. In the present research, no statistical relationship was found between the type of drinking water and mean DMFT index. Given the fact that the drinking water of 85.5% of the cases was tap water, it seems that water resource had no significant impact on DMFT index. In a research by Peltzer et al. in Thailand, consumption of fountain and rain water led to increased dental caries.[6] In addition, a significant relationship was observed between mean DMFT index and maternal age at the birth of neonate. Generally, children of younger mothers had higher DMFT index. It seems that younger mothers have low level of knowledge about oral health of children, and increase of age is associated with more experience in this respect, which leads to improved dental condition of children.[28]

In the current research, a significant relationship was found between level of income of families and mean DMFT index. In general, the dental situation of children was better in families with higher level of income. Given the high expenses of dental treatments, parents with low level of income fail to treat the dental and oral problems of their children. In two researches by Al-Mohammadi et al.[29] and Amanlou et al.[30] a reverse relationship was observed between economic status of parents of pre-elementary children and incidence of dental caries, which is in line with our findings. Moreover, a significant association was found between maternal dental caries at birth and mean DMFT index of children. It was demonstrated that poor oral hygiene of parents and frequency of consuming sweets increased the possibility of maternal-neonatal infection transfer.[31,32] In the present research, no statistical relationship was observed between the separation of parents and mean DMFT index of the evaluated subjects. In a study by Wigen and Wang, change of the condition of the family (from two parents to one parent) might affect the ability of parents to properly perform oral cares, increasing the risk of

dental caries in children.[32]

On the other hand, no association was found between birth weight and mean DMFT index, which is in contrast with the results obtained by Peltzer et al., who marked a relationship between low birth weight and increased dental caries.[6] Furthermore, no significant relationship was observed between the use of fluoride therapy and fissure sealants and mean DMFT index. Given the fact that fluoride therapy and fissure sealants has been recently stablished in the form of a national plan, its impact on reduction of dental caries in children is still not tangible. In addition, no significant association was observed between the number of family members and DMFT index. Studies have shown that increased number of children in a family leads to lack of proper attention to children and more focus on the first child, which can have negative effect on oral health of children.[28,32] In the study by Eskandarizadeh et al., no significant relationship was observed between the number of children and mean DMFT index.[16] In the current research, a significant relationship was found between age of children and mean DMFT index, in a way that older children had higher DMFT index. This might be due to more exposure to factors of dental caries at older ages, which leads to an increased number of dental caries as well as filled or lost teeth. The limitations of this study were the large sample size, lack of cooperation of children for examination, and lack of cooperation of parents in giving information about their occupation and income.

Conclusion

According to the results of the current research, social-behavioral factors had significant associations with DMFT index of preschool children in all four dimensions of oral health service system, as well as environmental, social-cultural, and risk behavior factors, including maternal dental caries at birth of children, maternal age, level of income of family, consumption of milk at

night, consumption of sweets, use of toothbrush and dental floss, and parental level of education and occupational status.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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A PRISMA assessment of reporting the quality of published dental systematic reviews in Iran, up to 2017

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Original Article

Abstract

BACKGROUND AND AIM: Proper scientific reporting is necessary to ensure correct interpretation of study results by readers. Systematic reviews (SRs) are of critical importance in evidence-based dentistry. This study assessed the reporting quality of published dental SRs in Iran.

METHODS: The PubMed and ISI electronic databases were searched to collect published Iranian dental SRs up to the end of 2016. A 17-item checklist, based on the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) Statement, was used to analyze the completeness of SRs reporting.

RESULTS: 42 SRs were included in this study. The majority were published in the two fields of endodontics and oral and maxillofacial surgery (38.0%). The mean overall reporting quality score was 18.48 ± 5.03 out of 30 for meta-analyses and 24 for SRs. Inadequate reporting of PICO question (Problem/Patient/Population, Intervention/Indicator, Comparison, Outcome) (73.8%), level of strength (57.1%), and financial supporter (52.4%) were observed.

CONCLUSION: The results of this study suggest that the reporting quality of Iranian dental SRs should be further improved.

KEYWORDS: Systematic Review; Dentistry; Iran

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Systematic reviews (SRs) are considered as the standard references for the synthesis of evidence in health care systems and these studies are widely used to support clinical guidelines and provide information for clinical decision-making processes. Data acquired from SRs have the highest validity and reliability in the evidence-based pyramid and are in fact the most reliable level of evidence.[1-3] The ever-increasing publication of SRs has resulted in their daily publication since 2010-2011.[4] The quality of design and the methods used to carry out SRs significantly affect the validity of their results, and a SR with a poor methodology results in nonfactual report of the results of therapeutic interventions. The consequences of these wrong reports will have negative effects on the treatments provided for the patients.[5]

Critical appraisal of the results of collected studies is an important part of evidence-based approach. To this end, some guidelines have been suggested for critical evaluation of SRs. These standard guidelines are available in the form of checklists. An increase in the number of SRs and meta-analyses published in recent years has necessitated the use of such guidelines more than ever, so that these reports can be more easily interpreted and used. Use of these protocols gives rise to a decrease in potential problems such as preferred decision-making by researchers during the study procedures and also

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avoiding bias which is a serious problem in clinical trials and SRs. Preferred Reporting Items for Systematic Review and Meta-analysis Protocol (PRISMA-P) is one of the most accurate and most reliable tools for appraisal of SRs. Use of PRISMA-P is considered a standard to promote the quality of meta-analysis reports, and its application increases the validity and applicability of SR and meta-analysis reports.[4-7]

A literature review in relation to similar studies around the world in the field of dentistry revealed 19 studies to date.[8-26] Therefore, considering the interest of Iranian researchers in undertaking SRs in the field of dentistry, the necessity of using this standard tool by Iranian researchers, and lack of a similar Iranian study to date, the present study was undertaken to critically appraise the SRs carried out and published in the field of dentistry in Iran with the use of PRISMA-P tool.

Methods

In the present cross-sectional study, first the full texts of all the SRs carried out in Iran, which had been indexed in PubMed and ISI databases up to the end of 2016, were collected. To this end, the key words 'systematic review' and 'meta-analysis' were joined to 'dentistry', 'dental', 'oral', and 'Iran' with the use of 'AND', and searched in PubMed and ISI databases. Then the list of all the articles brought up with the use of this search was prepared and their full texts were collected through the free facilities of ISI and PubMed databases, by direct requests from the authors through email and procuring the articles from private institutions. In the next stage, the full text of each article was checked with the PRISMA-P 2015 checklist (the latest version) by two researchers separately and their agreement was assessed in two stages. Before the main evaluations, the items of the PRISMA-P tool were reviewed in a session by the two researchers and their opinions were calibrated as far as possible. Then 10 articles were selected randomly, which were

evaluated by the two researchers separately. Intraclass correlation (ICC) coefficient was used to estimate agreement rate between the two observers, which yielded a coefficient of 0.88 [95% confidence interval (CI): 0.80-0.93] for the 10 articles, considered as an acceptable level. In the third and main step, the articles were randomly (using odd and even numbers) divided between the two researchers and each critically evaluated half of the articles separately and recorded the results of the evaluation in datasheets which had already been prepared for each article. The PRISMA-P 2015 checklist consists of 17 general items in three sections related to the operator, introduction, and methods. The items in each section are as follows:

5 items for the first section (title, registration, data on the authors, correction of the previous protocol, and financial supporters)

2 items for the second section (the main reason, aim)

10 items for the third section (inclusion and exclusion criteria, search databases, search strategy, the mechanism of article selection, extraction and simplification of data, taking into account all the primary and secondary outcomes, evaluation of the risk of bias, meta-analysis, consideration of meta-bias, and evaluation of the power of evidence).

Observation of all the 17 items above in the full texts of the articles was checked and its conformity with the PRISMA-P tool was recorded. For each item of each article three options (yes, no, incomplete) were considered and 'yes' received a score of 2, 'incomplete' received a score of 1, and 'no' received a score of zero. The two reviewers had been calibrated to assign a score of 2 to the 'complete observation' of the relevant items, a score of 1 to the 'incomplete observation' of the item, and a score of zero to 'not observing' the item.

Since it is not always possible to carry out a meta-analysis in all the SRs, and the items 14 to 16 of the checklist used in the present study are specifically used for the evaluation of meta-analyses, a score range of 0-34 was

considered for studies with meta-analysis and a range of 0-28 (for 4 items) for studies without meta-analyses.[4-7]

For each article, data on its title, the year of publication, the title of the journal, and the specialty field of the article were recorded. Data were recorded in data sheets and analyzed with the latest version of SPSS software. Descriptive statistics were used to estimate distribution of data. The authors' names were not reported and the scores of each article were kept confidential.

Results

In the present study after running a search for the relevant articles, finally 42 articles were included for the final analysis; 25 of which were SRs (59.5%) and the rest (17 articles) were meta-analyses. Table 1 presents the frequency distributions of the collected articles in terms of the year of publication and the specialty field. As shown in table 1, the articles were published in 2006-2016 and 50% of the articles were published in 2015 and 2016. In addition, the majority of the articles were in the fields of endodontics and oral and maxillofacial surgery (each with 19 articles, comprising 38% of all the articles).

Table 2 presents the frequencies of the items of the protocol for 42 articles in the present study. As shown in the table, item 3 (registration of the names of all the authors in

the articles) had been observed in all the articles, followed by mentioning the type of study in its title (97.6% of the articles) and the databases used for carrying out the search (73.8% of the articles); however, in 73.0% of the studies PICO question (Problem/ Patient/Population, Intervention/Indicator, Comparison, Outcome) had not been explained. In more than half of the articles (57.1%) the power of the evidence collected had not been evaluated and in 52.4% of the articles the functional support had not been mentioned.

Table 1. Main characteristics of studied papers

Year	n (%)	Field	n (%)
2006	1 (2.4)	Dental material	1 (2.4)
2007	1 (2.4)	Periodontics	4 (9.5)
2008	1 (2.4)	Endodontics	8 (19.0)
2009	1 (2.4)	Pediatric dentistry	2 (4.9)
2011	5 (11.9)	Oral pathology	3 (7.1)
2012	1 (2.4)	Community dentistry	3 (7.1)
2013	7 (16.7)	Maxillofacial surgery	8 (19.0)
2014	4 (9.5)	Oral medicine and laser	8 (19.0)
2015	10 (23.7)	Orthodontics	3 (7.1)
2016	11 (26.2)	Prosthodontics	2 (4.9)

In evaluation of the article scores using the PRISMA-P, first the items 2 and 4 (indexing of the articles in a valid database and a mentioning of changes or revision of the previous protocol) were eliminated from the score evaluation step, because they had not been mentioned in any of the articles.

Table 2. Frequency of 17 modified Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) items observed among 42 articles

No	Item	Acceptable (%)	Incomplete (%)	Missed (%)
1	Stipulation of study type in the title	97.6	2.4	0
3	Stipulation of authors' information	100	0	0
5	Mentioning financial support	42.9	4.7	52.4
6	Justification of the necessity of the study	61.9	38.1	0
7	Mentioning the main purposes	33.3	64.3	2.4
8	Illustration of the question of the study (PICO)	16.7	9.5	73.8
9	Mentioning the databases	73.8	26.2	0
10	Illustration of the search strategy	40.5	45.2	14.3
11	Illustration of the process of paper selection	57.1	21.4	21.5
12	Illustration of the data simplification	69.0	11.9	19.1
13	Considering the outcomes	69.0	26.2	4.8
14	Assessment of the level of evidence	38.1	4.8	57.1
15	Assessment of the risk of bias	58.8	23.5	17.7
16	Accomplishing meta-analysis	100	0	0
17	Considering the publication bias	47.0	0	53.0

Then items 14 and 16 were taken into account only for the evaluation of meta-analysis studies; therefore, 12 items (items 1, 3, 5-13, and 17) were used for the evaluation of SRs. The mean score of the modified PRISMA-P for all the articles was 18.48 ± 5.03, with a range of 7-28 (the maximum achievable scores for SRs and meta-analyses were 24 and 30, respectively). Separate calculation of the score for SRs and meta-analyses yielded mean scores of 15.72 ± 4.22 and 22.53 ± 2.98, respectively. The mean score of the articles based on modified PRISMA-P exhibited a relative increase from 2013 up to the present.

Discussion

The present study is the first Iranian study to critically evaluate the SR reports in the field of dentistry, indexed in valid databases. Currently, considering the special position of SRs in evidence-based dentistry, it is necessary, more than ever, to more seriously and critically evaluate these studies, and lack of interest of researchers in the dental field in Iran in this field to date has raised some concerns. In this context, Brito et al. also expressed this concern in the field of endocrinology, reporting that only a small number of clinical guidelines in this branch of medicine have been founded on valid SRs and the quality of the relevant SRs was poor.[27]

The most principal finding of the present study indicated significant defects in relation to the correct definition of the research question, evaluation of the validity of the collected evidence, and reporting of financial supporters in the SR reports. However, Lang and Teich believe that lack of standardization of the reported data, non-standard definition of outcomes, and the effect of the duration of the study are some of the main problems that should be taken into account in order to promote the quality of SRs in dentistry.[28]

In the present study, finally, 42 articles were critically evaluated. The number of articles evaluated in the present study was somehow at a mean level of studies carried out all over the world. Some similar studies have only critically evaluated the abstracts of SRs, of which studies by Kiriakou et al.,[8] Faggion and Giannakopoulos,[10] and Polychronopoulou[13] can be mentioned that evaluated SRs in the fields of implant and periodontology. In the study by Faggion et al., 146 abstracts were evaluated;[12] however, it appears that evaluation of the full texts of articles is more accurate than the evaluation of abstracts only.

PRISMA-P 2015 was used for critical evaluation of SRs in the present study; the majority of researchers believe that it is the most valid tool for such evaluations.[4-7] In similar dental studies, Pidgeon et al.[15] and Fleming et al.[24] used PRISMA-P; however, the majority of researchers have used the Assessment of Multiple Systematic Reviews (AMSTAR) protocol for this end.[8-26] As discussed above, currently different protocols are available for critical evaluation of SRs; however, it appears that it is necessary to take into account the comprehensive nature of these protocols in order to select a more appropriate protocol. In this context, it has been reported that AMSTAR is a valid tool for the evaluation of the quality of the methodology of interventional SRs, and it appears that since the majority of SRs in dentistry are related to therapeutic interventions, AMSTAR is selected for the evaluation of these studies. In this context, a tool referred to as MOOSE (Meta-analysis of Observational Studies in Epidemiology), is mostly used for the evaluation of epidemiological reviews, and a tool referred to as Quality Assessment of Diagnostic Accuracy Studies (QUADAS) is mostly used for the evaluation of the methodology of diagnostic reviews. However, the dominant opinion at present is that the most comprehensive protocol for the evaluation of SRs in which meta-analyses have been carried out is PRISMA.[4-7] It appears that researchers should use similar protocols as far as possible in order to facilitate comparison of the results of different studies

around the world; multiplicity of protocols somehow makes such comparisons difficult.

The results of the present study showed that in all the articles the names of all the authors had been mentioned in a proper manner. It should be pointed out that this item is considered in a standard format by journals for accepting articles for publication. In some cases, no separate space has been allocated in journal formats to mentioning the financial supporters of the study, which is the reason why in half of the SRs there was no mention of the financial supporters. Pidgeon et al. reported that in only 37.1% of the articles evaluated the financial supporters had been mentioned.[15] It is also possible that SRs might not require any financial support due to the nature of their methodology.

In the present study, the mean scores of the articles based on modified PRISMA-P for both SRs and meta-analyses were > 50% of the whole achievable score. In relation to the report of the general quality level of the articles, there are great diversities in similar studies and such levels have been reported qualitatively in some studies. In this context, Kiriakou et al.[8] and Polychronopoulou[13] reported that the quality of the studies should improve. Papageorgiou et al.[19] reported that the overall quality of the studies was moderate, and Atieh et al.[16] reported a high quality for the SRs that they evaluated. Faggion et al. reported that the quality of 35 studies out of 54 studies was poor.[20] Elangovan et al.,[11] Pidgeon et al.,[15] and Fleming et al.[24] used scores for the assessment of the quality of articles that they evaluated, similar to the method used in the present study. Another similarity between the methods used in studies by Pidgeon et al.[15] and Fleming et al.[24] and the present study was the use of PRISMA-P; however, Pidgeon et al. evaluated only SRs in the field of craniofacial surgeries and Fleming et al. evaluated SRs in the field of orthodontics. In the present study, SRs in all the specialty fields of dentistry were evaluated.[24] In the study by Elangovan et al.,[11] the scores of 6

studies out of 10 studies were ≤ 4. In the study by Pidgeon et al.,[15] the mean score of the articles was reported to be 72.5%, and in the study by Fleming et al.,[24] the mean PRISMA-P score was 64.1%. Therefore, the mean score of the articles in the present study was higher than that in the study by Pidgeon et al.[15] and almost similar to that in the study by Fleming et al.[24]

A lack of explanation of the research question (PICO) and no evaluation of the validity score of the evidence collected with standard tools such as Grading of Recommendations, Assessment, Development, and Evaluation (GRADE), both being related to the methodology of the articles, are the most important shortcoming of the articles that were evaluated in the present study. This is different from the results of a study by Alarcon et al.,[17] because they reported that in all the studies evaluated the research question had been explained. Flores-Mir et al.[18] reported important shortcomings such as an unacceptable search strategy, inadequate search in databases, and unacceptable review of the evidence collected in the articles they evaluated; however, all these three items were almost acceptable in the evaluations carried out in the present study. Aziz et al.[21] and Schmitter et al.[22] also reported significant shortcomings in relation to publication bias and announcement of search in grey sources. In the present study, publication bias had been evaluated in almost half of the meta-analysis studies; however, similar to the two studies above, almost none of the studies completely explained the mechanisms of search in grey sources. Faggion et al. reported that comprehensive search and evaluation of publication bias were unacceptable.[20] We know that a lot of reviews were carried out in Iran, but the derived articles are published in journals belonging to the other countries; therefore, it is numbered as a kind of limitation, because we may miss some of the mentioned data indeed. In this context, for example no mention has been made of the financial

supporters in an acceptable way, and this is a shortcoming in terms of the ethics principles in research.[29]

Conclusion

The results of the present study showed that although the rate of acceptability in the majority of the items of the protocol used was ≥ 50, there is still a long way to go before it can be claimed that the SR reports in the field of dentistry in Iran have a completely favorable quality.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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Effect of orthodontic treatments on quality of life in adolescents

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Original Article

Abstract

BACKGROUND AND AIM: Dental problems and oral diseases can have their own effects on social-psychological aspects, physical conditions, as well as quality of life (QOL) in individuals. In this regard, malocclusion can influence functional, socio-economic, and psychological aspects in patients. Therefore, the purpose of the present study was to evaluate the effects of orthodontic treatments on QOL.

METHODS: This prospective study was conducted on 65 patients with malocclusion selected through simple convenience sampling method. The data were collected via a demographic characteristics information form and 22-item Orthognathic Quality of Life Questionnaire (OQLQ) in 4 domains (social aspects, dentofacial aesthetics, oral functions, and awareness of dentofacial aesthetics) before treatment, six months after treatment, and at the end of treatment. The data were then analyzed using SPSS software and analysis of variance (ANOVA) with repeated measures. The P-value was considered at a 0.0500 significance level.

RESULTS: In the present study, 73.8% of the patients were women. The mean and standard deviation (SD) of the age of the study participants was also equal to 18.79 ± 7.35 years. As well, the mean and SD scores of the questionnaire before treatment, six months after treatment, and at the end of treatment were reported as 14.71 ± 11.37, 18.05 ± 12.12, and 12.07 ± 8.13, respectively. No significant correlation was also observed between gender and QOL. In addition, QOL had significantly degraded six months after treatment. Furthermore, there was a significant difference between QOL at pre- and post-treatment stages.

CONCLUSION: Based on the finding of the present study, OQLQ was reported significantly poorer six months after treatment compared to that before treatment. Orthodontic treatment could also significantly boost QOL. Finally, it was recommended to consider QOL in orthodontic treatments.

KEYWORDS: Quality of Life; Orthodontic Treatment; Malocclusion

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The concept of oral health-related quality of life (OHRQOL) has been utilized to measure the effects of oral health on daily functioning and quality of life (QOL).[1] In recent years, more attention has been correspondingly paid to OHRQOL in children and adolescents for the reason that dental problems and oral diseases such as dental caries or cavities and malocclusion can have an adverse impact on physical and mental satisfaction in the youth.[2,3] Likewise, dental problems and oral diseases influence a person's social-psychological aspects, physical conditions, as well as QOL through interruptions in terms of presence in society and interpersonal relationships.[4] In this regard, malocclusion is known as a dental problem that affects people's

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functional, social, and psychological aspects.[5]

Some studies have similarly reported that individuals with malocclusion tended to feel embarrassed.[6,7] Although the goal of orthodontic treatments is to improve oral health status and functions, importance of beauty and its psychological impact is ever-increasing. Following the completion of orthodontic treatment, patients have normally reported a better physical appearance and higher levels of self-confidence.[8,9] Accordingly, Chen et al., investigating the effect of malocclusion on OHRQOL in adolescents, demonstrated that malocclusion could have a negative effect on psychological discomfort and disability.[10] Examining the impact of the type and the severity of malocclusion on OHRQOL, it was confirmed that the mean score of OHRQOL had become critical in patients suffering from more severe malocclusion.[11-13] Furthermore, Zheng et al. showed that the type of malocclusion was significantly correlated with the improvement of various aspects of OHRQOL.[14] Fixed orthodontic treatments in patients aged 12-15 years could also significantly enhance individuals' understanding of their beauty,[15] and orthodontic treatments in adults significantly increased their self-esteem.[16] Over the past years, several research instruments have been employed to measure QOL in orthodontic patients including Orthognathic Quality of Life Questionnaire (OQLQ) used as a research tool for assessing QOL associated with orthodontic conditions.[17,18] The given questionnaire contained 22 items and 4 domains of social aspects, dentofacial aesthetics, oral functions, and awareness of dentofacial aesthetics.[18] Since it has been reported that sociocultural differences[19] as well as individual and environmental characteristics can affect QOL,[17] and considering that the same study had not been carried out thus far in the city of Kerman, Iran, the present study aimed at determining the effects of orthodontic treatments on QOL in patients referred to orthodontic centers in this city.

Methods

The present study was a longitudinal research of descriptive-analytical type that was conducted on patients referred to two private orthodontic centers and the School of Dentistry in Kerman City to undergo fixed orthodontic treatments. The inclusion criteria in this study were patient's consent, no history of orthodontic treatments, and lack of oral and maxillofacial surgery (OMFS) in their treatment plan, as well as mild malocclusion in need of fixed orthodontic treatments. To this end, a trained student of dentistry attended these centers for 3 days, identified patients meeting the inclusion criteria, explained the project procedure, and then provided them with OQLQ. Patient collection was done through randomized simple method. The questionnaire contained 22 items in 4 domains of social aspects, dentofacial aesthetics, oral functions, and awareness of dentofacial aesthetics. It should be noted that the validity and the reliability of the Persian version of this questionnaire had been already confirmed. Validity of this questionnaire based on Cronbach's alpha was 0.86 and reliability based on weighted kappa was 0.91.[20] The demographic characteristics information about patients also included age, gender, level of education, and type of malocclusion which were then recorded in the questionnaire. The questionnaires were then coded and maintained by the project executor. Afterwards, at intervals of 6 months and at the end of orthodontic treatments, the questionnaire was provided to the patients for completion.[21] The questionnaire was also scored based on a four-point Likert-type scale in which point zero indicated that the statement did not annoy the patient at all, point 1 showed that the statement was somewhat annoying, point 2 meant that the statement was annoying a lot, and point 3 showed that the statement was extremely annoying. As a result, the range of the scores was between 0-66. So, the domain of social aspects (8 items) was in a score range of 0-24, and dentofacial aesthetics (5 items), oral

functions (5 items), and awareness of dentofacial aesthetics (4 items) were in the score range of 0-15, 0-15, and 0-12, respectively. After 12 months, the questionnaires were scored using SPSS software (version 21, IBM Corporation, Armonk, NY, USA) at a significance level of 0.0500 and then analyzed via analysis of variance (ANOVA) with repeated measures. The research proposal was also approved with the code number of IR.KMU.REC.13 95.747 by the Ethics Committee of Kerman University of Medical Sciences.

Results

Of 97 patients at the onset of the study, 65 individuals responded all the items within three intervals. Out of 65 patients, 17 (26.2%) were men and 48 (73.8%) were women. The mean age of the participants was also reported as 18.79 ± 7.35 years. The mean orthognathic QOL before treatment was 14.77 ± 11.37, and this value was equal to 18.05 ± 12.12 and 12.07 ± 8.13 six months after treatment and at the end of treatment, respectively (Figure 1). Considering the completion of the questionnaire at the pre-treatment stage, the most highly answered items by 11 patients (16.9%) was "item 22" reading "I feel really upset to comment on my appearance, even when I know that others are just joking about it" associated to social aspects domain and then "item 9" as "I spend a lot of time looking at and investigating my teeth in the mirror" in the domain of awareness of dentofacial aesthetics answered by 9 patients (13.8%) as too much. Within 6 months after treatment, "item 9"

reading "I spend a lot of time looking at and investigating my teeth in the mirror" in the domain of awareness of dentofacial aesthetics was answered as too much by 10 individuals (15.4%) and the item 10 "It is hurting to take picture of me" in the domain of dentofacial aesthetics was responded by 9 patients (13.8%) as too much. At the end of the treatment, none of the responses was assigned as too much.

There was also a significant difference between QOL scores before treatment, 6 months after treatment, and at the end of treatment. However, no statistically significant difference was observed between the mean scores of different domains before treatment, 6 months after treatment, and at the end of treatment (Table 1). In the present study, there was similarly a significant difference between male and female patients in terms of orthognathic QOL in the domain of awareness of dentofacial aesthetics before and 6 months after treatment. As well, female patients reported poorer QOL (Table 2).
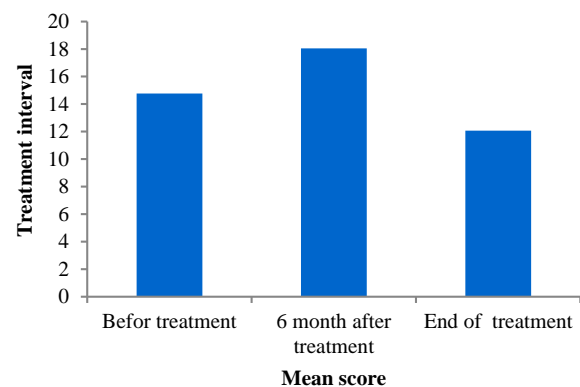

Figure 1. The mean score of questionnaire according to treatment interval

Table 1. Correlation between mean score of orthodontic quality of life (QOL) and domains according to treatment interval

Variables	Before treatment (mean ± SD)	6 months after treatment (mean ± SD)	The end of treatment (mean ± SD)	P
Social aspects domain	5.68 ± 5.59	6.90 ± 6.19	3.88 ± 3.38	0.0001
Dentofacial aesthetic domain	3.84 ± 3.62	4.56 ± 4.23	3.37 ± 2.24	0.0140
Oral function domain	2.46 ± 2.23	3.68 ± 2.75	3.77 ± 2.29	0.0001
Dentofacial knowledge domain	4.47 ± 2.76	4.71 ± 2.84	3.29 ± 2.46	0.0010
Orthodontic QOL	14.77 ± 11.37	18.05 ± 12.12	12.07 ± 8.13	0.0030

SD: Standard deviation; QOL: Quality of life

Table 2. Correlation between mean score of orthodontic quality of life (QOL) and domains in different treatment interval according to gender

Variables		Before treatment (mean ± SD)	6 months after treatment (mean ± SD)	End of treatment (mean ± SD)
Social aspects domain	Men	6.06 ± 4.50	7.70 ± 6.50	4.68 ± 3.39
	Women	7.17 ± 5.94	6.60 ± 6.12	3.60 ± 3.13
P		NS	NS	NS
Dentofacial aesthetic domain	Men	3.67 ± 3.00	4.06 ± 3.15	3.14 ± 3.00
	Women	4.11 ± 3.69	4.73 ± 4.55	3.50 ± 2.33
P		NS	NS	NS
Oral function domain	Men	2.64 ± 2.52	4.47 ± 3.18	3.87 ± 2.44
	Women	2.41 ± 2.13	3.39 ± 2.56	3.74 ± 2.66
P		NS	NS	NS
Dentofacial knowledge domain	Men	2.64 ± 2.13	3.38 ± 1.69	2.23 ± 2.41
	Women	5.02 ± 2.75	5.16 ± 3.09	3.31 ± 2.50
P		0.0150	0.0040	NS
Total score of orthodontic QOL	Men	12.53 ± 10.75	20.66 ± 11.67	14.66 ± 10.32
	Women	17.89 ± 11.96	18.55 ± 12.59	14.18 ± 8.25
P		NS	NS	NS

NS: Not significant; SD: Standard deviation; QOL: Quality of life

Discussion

Dental problems and oral diseases can affect a person's social-psychological aspects and physical conditions and they can consequently influence QOL through interruptions in terms of presence in society and interpersonal relationships.[4] In this respect, malocclusion is considered as a dental problem that can affect functional, social, and psychological aspects of individuals.[5] In the present study, there was no statistically significant difference between the total score of QOL and gender although women had generally experienced poorer orthodontic QOL. These findings were not consistent with the results of other investigations.[22,23] The cause of this inconsistency was the study population or the questionnaires used in the present study.

At the end of the treatment, orthognathic QOL was significantly improved in patients compared to that before treatment. Thus, the results were in line with those reported in other studies.[22,24,25] Additionally, Choi et al. described QOL in individuals using 36-item Short Form Survey (SF-36), Oral Health Impact Profile-14 (OHIP-14), and OQOL, and found that the mean scores of OHIP-14 and OQOL had significantly improved during treatment compared to pre-treatment stage,[26]

which were in agreement with the findings in the present study.

In this study, the most frequent answers were to the option of too much (indicating the deterioration of the situation in the questionnaire) in the item reading "I feel really upset to comment on my appearance, even when I know that others are just joking about it" by 11 patients (16.9%). Considering the mean age of the individuals recruited in this research, it seemed that appearance in adolescence and early adolescence was one of the factors that had caused discomfort. At the end of the treatment, no one responded to this item choosing the option of too much. In fact, orthodontic treatments could have a positive impact on this issue, and they could consequently make patients' appearance more attractive.

The effect of orthodontic treatments could be also observed in the item of "I spend a lot of time looking at and investigating my teeth in the mirror". At the onset of treatment, 38.5% of the individuals had spent time and a lot of time on this issue, which dropped to 16.9% at the end of treatment.

The results of this study showed that the mean scores in terms of social aspects increased slightly within 6 months after treatment. That is, QOL had worsened and it

had significantly improved at the end of the treatment. It should be noted that malocclusion is not by itself a life-threatening condition but may have an unpleasant effect on social interactions and good psychological feelings in patients.[27-29]

The findings of this study showed that the mean score of OQLQ in the domain of dentofacial aesthetics had improved 6 months after treatment compared to that before treatment and it had consequently decreased at the end of treatment. In fact, QOL had worsened 6 months after treatment and it was better at the end of treatment. The reason for this might be that some orthodontic appliances placed in patients' mouth and aligning the teeth during the treatment until their return to the final position could affect this part of orthognathic QOL.

The results of the study by Isiekwe et al. showed a difference between self-assessment, beauty norm, and QOL associated with individuals' health status especially in psychological domains.[30]

In the research by Pabari et al., tendency to correct and straighten their teeth to improve smile view was the most important motivational factor for patients aged 18-64 years to undergo orthodontic treatments.[31] In the research by Bortoluzzi et al. aimed at localization of OQLQ, it was reported that facial beauty was the most important factor affecting QOL in individuals with dentofacial deformities.[17]

Moreover, 6 months after treatment, the mean score of oral functions was more than that at the beginning and the end of treatment. In fact, orthodontic QOL had become poorer in this respect. The presence of orthodontic appliances in the mouth had similarly affected oral functions. In the research study by Alghamdi et al., QOL had significantly worsened in the domain of chewing experience in patients with palatal expanders.[24]

Assessing OHRQOL in patients with fixed appliances and twin blocks, Alzoubi et al. reported that in the early stages, QOL had worsened in both groups and it had improved at the end of the treatment.[22]

The results of this study showed that the mean score in the domain of dentofacial aesthetics increased 6 months after treatment compared to the onset of the treatment and after it. There was also a significant difference between gender and mean scores in this domain before treatment and at intervals of 6 months. Women also had lower QOL in this domain. It could be concluded that women had paid more attention to their appearance than men.

Limitations: This study was conducted on selected centers and patients without tooth extraction in treatment plan and sever malocclusion; so, the results cannot be extended to all orthodontics patients.

Conclusion

The results of this study showed that orthodontic treatments could have positive effects on orthodontic QOL. All the domains of orthodontic treatments had also improved QOL. There was no statistically significant difference between gender, years of education, and QOL scores. It seemed QOL was required to be more taken into account in orthodontic treatments.

It was suggested to conduct further studies on QOL in orthodontic patients within different intervals in terms of types of treatment and appliances used.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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Evaluation of the effect of Kidi Lact probiotic product on streptococcus mutans in saliva in a group of 8-12-year-old children

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Original Article

Abstract

BACKGROUND AND AIM: Previous studies have shown that lactobacillus presented in food products affects oral ecology. In this study, we decided to show the effect of periodic use of Kidi Lact, a product containing probiotic bacteria which is recommended for improvement of gastrointestinal (GI) function in babies and children by physicians, on level of streptococcus mutans (S. mutans) in saliva among children between 8-12 years old. There are no previous studies in this relation.

METHODS: This randomized crossover double-blind study was conducted on 30 healthy children between the age of 8-12 years. It included four steps. In the first step, children randomly were divided in two groups; in the step two, one of them used 1gr Kidi Lact every day and other group used placebo every day during two weeks, randomly. In the third step, children used none of them for one month, and finally in the step four, those who used Kidi Lact at step two, used placebo and other group vice versa. At the end of each step, samples of the children saliva was prepared and then, the number of S. mutans in the non-stimulated saliva samples was measured with microbial culture method. SPSS statistical software was used for data analysis.

RESULTS: S. mutans reduction in saliva after using Kidi Lact was statistically significant (P < 0.001), but it showed no significant reduction after using placebo (P = 0.100). The amount of S. mutans in the two groups had no significant difference before using Kidi Lact and placebo (P = 0.406). Amount of S. mutans in the groups after using placebo and Kidi Lact was significant (P < 0.001).

CONCLUSION: According to the present study, periodic use of Kidi Lact as a mouth wash has a strong effect on amount of S. mutans in saliva. So, physicians can be advised to tell their patients about rinsing of Kidi Lact before its swallowing.

KEYWORDS: Streptococcus Mutans; Saliva; Probiotic

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Currently, use of probiotic bacteria has been established for the prevention of some medical conditions such as gastrointestinal (GI) tract disorders and genitourinary system diseases. These useful bacteria which are mostly from the lactobacillus family occupy the positions of harmful and pathogenic bacteria, resulting in a decrease in their counts, finally decreasing the incidence and severity of the condition.[1] In relation to the prevention of dental caries, as a condition whose etiologic factor is streptococcus mutans (S. mutans), with the use of products

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containing probiotic bacteria (such as ice cream and yoghurt), studies have yielded very favorable results. In this context, too, probiotic bacteria occupy the sites in the dental plaque that are usually occupied by S. mutans, resulting in a decrease in their counts in the dental plaque, finally decreasing the pathogenicity of S. mutans as an etiologic factor for dental caries. However, it should be noted that this positive effect depends on the duration of the use of probiotic products, and termination of the use of such products has again resulted in an increase in S. mutans counts in the dental plaque.[2-4]

Since dental caries is highly prevalent and preventive measures have not been able to completely overcome this problem in many countries and also since research on the use of probiotics to control dental caries has not been sufficient, we decided to evaluate the effect of one oral therapeutic product, containing probiotic bacteria on S. mutans counts in the dental plaque of a group of children.

The product is Kidi Lact (Zist Takhmir Co., Iran) and has been marketed in Iran for restoring normal flora and improving GI function in infants and children through its repeated oral use via dissolving in water. An interview to some of pediatricians showed this product as prescribed a lot by them. Based on the data provided by the manufacturer, this product contains high concentrations of 7 probiotic bacterial species, consisting of 6 lactobacillus species such as lactobacillus casei and one streptococcus species (S. thermophilus); these bacteria help re-establish the normal microbial flora of the GI tract, exerting various protective effects on the body. In addition, the manufacturer has reported that the product is effective in the treatment of different infectious diarrheas, traveler's diarrhea, antibiotic-induced diarrhea, chronic diarrhea, flatulence, and colitis, and helps prevent and resolve different infections by strengthening the immune system and exerting protective

effects on pathologic bacteria, with a great role in providing the factors necessary for children's growth. On the other hand, the manufacturer has reported a total colony-forming unit (CFU) of 10^9 for useful bacteria in the product, with other non-bacterial ingredients as follows: fructo-oligosaccharides (FOS) as a prebiotic agent, lactose, colloidal silicone dioxide, flavoring agents, and magnesium stearate. Therefore, the manufacturer has reported that Kidi Lact is a symbiotic product that contains both probiotic bacteria and prebiotic beneficial ingredients providing a proper environment for the survival and proliferation of probiotic bacteria. As a result, it has recommended that although the product can be stored at room temperature for 2-3 weeks, it is advisable to preserve it at 2-8 °C in a refrigerator to extend the survival of probiotic bacteria. The packaging of the product consists of 15 sachets in one pack and based on the physician's recommendations, it is possible to dissolve 1-2 sachets in water, fruit juice, milk, or the child's food for the child's consumption (the instructions pamphlet).

Previous studies have shown that lactobacillus presented in food products affects oral ecology. The aim of this study was to investigate the effect of periodic use of Kidi Lact, a product containing of probiotic bacteria which is recommended for treatment of GI disorders in babies and children by physicians, on level of S. mutans in saliva among children.

Methods

The protocol of this randomized crossover double-blind study was approved by the Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran, under the code of IR.MUMS.6d.REC.1394.265. (IRCT Code: 20161007030193N2). Thirty 8-12-year-old children from an institutional care center were included in this study on a voluntary basis. All the children and their guardians accepted to take part in the study and signed informed consent forms after

receiving the necessary explanations.

The inclusion criteria consisted of the following: thorough physical health, absence of any systemic disorder, no use of antibiotics during the 1-month period before the study, no use of fluoride-containing mouthwashes or gels, no use of xylitol-containing chewing gums during the 1-month period before the study, absence of untreated cavitated teeth, and a daily habit of tooth brushing.[5] Subjects with signs of dental caries, those lacking compliance, those taking antibiotics, those with systemic conditions, and those with any of the conditions discussed in the inclusion criteria section were excluded from the study.

The study design was double-blind and randomized crossover.

The procedural steps consisted of 4 stages as follows:

Stage 1 (run-in): The subjects were asked not to use any probiotic products for 1 week and observe routine oral hygiene measures. After 1 week, the authorities in the institutional care center asked the subjects to collect their unstimulated salivary samples at one specific hour in one minute in coded containers. Since unstimulated salivary samples are normally collected after at least one hour of abstinence from eating, drinking, chewing gums, and tooth brushing, the salivary samples were collected before breakfast. After this step, the subjects were assigned to two groups by the use of random numbers table, and the second stage of the study was initiated.[5]

Stage 2: The authorities in the center were asked to give a 1-gr sachet of Kidi Lact product dissolved in water to the subjects to gargle daily for two weeks and to give the second group, during the same period, a placebo solution.[5,6] The placebo solution contains all of Kidi Lact compounds except the bacteria. Both of them were similar in color and taste. During this stage, the researchers were blinded to group assignments in relation to the use of the probiotic product. At the end of this stage,

too, unstimulated salivary samples[6] of the subjects were collected in coded capped containers[5] and sent to the laboratory to determine S. mutans counts.

Stage 3 (wash-out): In this stage of the study, the subjects received their normal diets for a month and after this 1-month period, the subjects did not consume any probiotic products for 1 week and observed their routine diet based on the inclusion criteria. After this 1-week period, too, the subjects' unstimulated salivary samples were collected and sent to the laboratory to determine S. mutans counts.[5-7]

Stage 4: In this stage, the authorities in the center were asked to give a 1-gr sachet of Kidi Lact probiotic product or placebo daily. In this design, those taking placebo in the previous step received the probiotic product, and vice versa. After two weeks, unstimulated salivary samples of the subjects were collected and S. mutans counts were determined.

The laboratory techniques used in the present study to determine S. mutans counts included homogenization subsequent to culturing of salivary samples and using of gram-staining and various diagnostic tests to identify other bacterial species, which have been used in similar studies too.[7,8]

Data were not normal (P < 0.050); so, Mann-Whitney U test was used to compare the number of S. mutans in saliva in both case and control groups. In addition, Wilcoxon test was used to measure the number of S. mutans before and after process.

Results

S. mutans reduction in saliva after using Kidi Lact was statistically significant (P < 0.001), but it showed no significant reduction after using placebo (P = 0.100). The amount of S. mutans in the two groups had no significant difference before using Kidi Lact and placebo (P = 0.406). Amount of S. mutans in the groups after using placebo and Kidi Lact was significant (P < 0.001) (Tables 1 and 2).

Table 1. Salivary streptococcus mutans (S. mutans) counts in the four stages of the study after the use of placebo and Kidi Lact probiotic product

Groups	Before using the product (group 1)	Before using the product (group 2)	After using the product (group 1)	After using the product (group 2)
Placebo (CFU/ml)	23.7×10^6	42.3×10^6	33.6×10^6	35.9×10^6
Kidi Lact (CFU/ml)	31.3×10^6	37.6×10^6	3.6×10^6	2.0×10^6

CFU: Colony-forming unit

Discussion

According to the present study, periodic use of Kidi Lact as a mouth wash has a strong effect on amount of S. mutans in saliva. One of the most novel methods to prevent and decrease the incidence of dental caries is bacteriotherapy through which the counts of harmful and cariogenic bacteria decrease in the oral cavity, resulting in a decrease in the incidence of dental caries. Use of probiotics is one of the bacteriotherapy techniques to improve the oral health status. Of all the useful probiotic species lactobacillus and bifidobacterium species are more predominantly used in probiotic and dairy products. These bacterial species decrease the salivary counts of S. mutans through different techniques such as competition for initial colonization and formation of bacterial colonies in the dental plaque, competition for nutrients in the dental plaque ecosystem, and a direct effect through bacteriocins. Therefore, based on the previous studies on the effect of probiotic products on orodental health, in the present study, the effect of a new probiotic product, Kidi Lact, on decreasing the salivary counts of S. mutans was evaluated.[8-11]

No previous study is available on the effect of Kidi Lact product on oral S. mutans counts; therefore, the results of the present study should be compared with those of studies on products such as yoghurt, spar, and ice cream containing probiotic bacteria in their composition.

In a number of studies by Caglar et al.[7,12,14-16], use of dairy products containing probiotic agents resulted in a significant decrease in the salivary counts of S. mutans. Since Kidi Lact product contains a large number of probiotic bacteria, the results of the present study are consistent with those of previous studies and it can be concluded that use of products containing probiotic bacteria results in a decrease in the salivary counts of cariogenic bacteria. Such a decrease in the counts of these bacteria results from competition of bacterial species for colonization in the oral cavity.[14,17]

Nase et al. evaluated the effect of long-term use of milk that contained probiotic bacteria of the lactobacillus rhamnosus species, which is present in the Kidi Lact product, on the salivary counts of S. mutans and in plaque samples in 1-6-year-old children. The results showed that the S. mutans counts and the overall rate of dental caries decreased, which is consistent with the results of the present study.[18]

Nikawa et al. reported a significant decrease in salivary counts of S. mutans after consuming probiotic yoghurt;[19] in the present study, too, a significant decrease was observed in the salivary counts of S. mutans after the use of Kidi Lact probiotic product.

Table 2. Comparison of mean of streptococcus mutans (S. mutans) counts between the two groups

Groups	Before using (mean ± SD)	After using (mean ± SD)	P
Placebo (CFU/ml)	$33.0 \times 10^6 \pm 1.59 \times 10^7$	$34.7 \times 10^6 \pm 1.24 \times 10^7$	0.100
Kidi Lact (CFU/ml)	$34.4 \times 10^6 \pm 1.13 \times 10^7$	$2.8 \times 10^6 \pm 6.46 \times 10^6$	< 0.001
P	0.406	< 0.001	-

SD: Standard deviation; CFU: Colony-forming unit

Poureslami et al.[8] carried out a study on fifty 13-17-year-old adolescents and reported that spar (an indigenous probiotic dairy product in Kerman Province, Iran) had a significant effect on decreasing salivary counts of S. mutans, consistent with the results of the present study. The procedures in that study were exactly similar to those in the present study; however, Poureslami et al.[8] included adolescents in their study, while the present study was carried out on children. Both studies were carried out in Kerman Province and the technique used to evaluate S. mutans counts (microbial culture) was exactly similar in both studies.

Lesan et al. evaluated the effect of the use of probiotic yoghurt on S. mutans and lactobacillus counts in unstimulated salivary samples of 32 subjects with S. mutans and 28 subjects with lactobacillus (with an age range of 23-55 years in both groups). The results showed that use of probiotic yoghurt resulted in a non-significant decrease in S. mutans counts; however, there was a significant decrease in salivary counts of lactobacillus. The study above was carried out using a crossover design, similar to the present study. The researchers pointed out that non-significant decrease in S. mutans counts, contrary to the results of other studies, might be attributed to the study design, the age of the subjects, the duration of the use of probiotic products, the culture media used, and more importantly to the type of the probiotic product used, considering the strain-specific effect of probiotics.[20]

Conclusion

According to the present study, periodic use of Kidi Lact as a mouth wash has a strong effect on amount of S. mutans in saliva. Therefore, physicians can recommend Kidi Lact to be rinsed before swallowing.

Conflict of Interests

Authors have no conflict of interest.

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