Original Article

Evaluation of Oral Health-Related Quality of Life in Elderly People with Type II Diabetes Mellitus

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Abstract

***Background and purpose*:** Type 2 diabetes mellitus (T2DM) is the most common form of diabetes, and a metabolic disorder affecting patients' general health in various ways. The present study aimed to evaluate the oral health-related quality of life (OHRQoL) among older adults of Amirkola, Northern Iran.

***Materials and Methods*:** A case-control study was conducted with a sample of 500 elderly people (250 with T2DM and 250 healthy controls) who answered geriatric oral health assessment index (GOHAI) questionnaire and a questionnaire evaluating xerostomia. Then, all participants underwent clinical dental examinations. The obtained data were then analyzed by t-test, chi-square test, and Pearson's correlation coefficient, and $p < 0.05$ was considered significant.

***Results*:** The prevalence of xerostomia was not statistically significant between the T2DM patients and control groups ($p < 0.079$). Greater number of patients suffering T2DM reported xerostomia according to the records; however, the correlation between this disorder and periodontal disease index (PDI), Plaque index (PI), oral health index-simplified (OHI-S), and geriatric oral health assessment index (GOHAI) in the subjects of the two study groups was not significant ($p < 0.0001$).

***Conclusion*:** In the present study, there was no significant relationship between GOHAI and periodontal indices, demonstrating no difference in the OHRQoL of elderly patients with T2DM and older healthy adults.

***Keywords*:** Quality of Life; Diabetes Mellitus; Oral Health; Oral Health-Related Quality of Life

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1. Introduction

Diabetes mellitus is a systemic disorder that is defined by high levels of blood glucose, becoming a public concern all over the globe as a result of its high prevalence (1). In 2017, almost 425 million adults were diagnosed with diabetes worldwide, and it is expected to reach 629 million by the end of 2045 (2). Type II diabetes mellitus (T2DM) is more prevalent than type I, affecting about 95% of the population suffering from the disease (3). WHO appraised that the number of individuals with T2DM will meet a vast increase in the prevalence in the USA, the Middle East, and Southeast Asia. T2DM can cause various complications, including diabetic macroangiopathies, such as atherosclerosis phenomena, diabetic ulcers, carpal tunnel syndrome, glaucoma, diabetic neuropathies, cataracts, oral or dermatological infections, and paradontopathies (4-6). Dhillon et al. demonstrated that patients with T2DM who had a glycated hemoglobin level (HbA1c) ≤ 6.5%, had a better quality of life (QoL) (7). On the other hand, an increase in the elderly population is occurring all around the world, and as it continues, population aging is becoming a global concern. It is estimated that the elderly adult group will reach 1.209 billion people by the year 2025 (8). Aging is considered as a risk factor in developing prediabetes and T2DM (9).

Periodontal diseases are among the most common oral complications among individuals having diabetes mellitus. Other complications include xerostomia, dental caries, edentulism, and higher rates of oral infections (10, 11). Previous studies have suggested that people with diabetes mellitus tend to be more prone to chronic periodontitis than healthy individuals (12). Jiang et al. conducted a study to investigate the underlying mechanisms of the interaction between diabetes mellitus and periodontal disease (13). These diseases can negatively affect QoL due to functional, psychological, and social influences (14).

Oral infections and other oral complications may have an impact on oral health-related quality of life (OHRQoL), a multidimensional concept toward QoL, and are specifically associated with oral health and disease (15).

OHRQoL encompasses halitosis, difficulty while eating or speaking, taste disorders, and dissatisfaction with other aspects of oral health (16). A study by Huang et al. demonstrated that among elderly people suffering from T2DM, lower levels of health-related quality of life (HRQoL) was associated with poor oral health and a lack of dental care (17).

Poor glycemic control can lead to severe bleeding, bone loss, and other complications in the periodontium (18). Consequently, appropriate periodontal treatment may positively affect blood-sugar control. Insufficient oral health has been attributed to poor general HRQoL in patients with diabetes mellitus (17). Hence, some international organizations have recommended paying more attention to oral health in diabetes care (2).

Due to the lack of information about the effect of oral health on the QoL of patients with diabetes and need for more studies in both developed and developing countries owing to their different healthcare system and cultural differences, this study aimed to evaluate the OHRQoL in elderly people with T2DM in Amirkola, Northern Iran.

2. Materials and Methods

We used a case-control design in this study to evaluate the clinical predictors of OHRQoL among older adults with T2DM. This study was part of a larger study investigating the HRQoL, and the subjects of the second phase of the Amirkola Elderly Health Center cohort study were recruited for the study. By considering a confidence interval of 95% and a power of 90% for the study and assuming $\sigma_1 = \sigma_2 = 3$, to detect 1 unit difference between the two groups based on the geriatric oral health assessment index (GOHAI) questionnaire, the sample size for the present study was calculated to be 189 subjects in each case and control group (14). Finally, 500 subjects, 250 patients with T2DM, and 250 healthy controls were included in the study. Older adults aged ≥ 60 years old (19) who were diagnosed with T2DM and were using medication for their diabetes (fasting blood sugar (FBS) ≥ 126 mg/dL) were recruited in the study (20). Edentulous individuals and patients with uncontrolled systemic diseases were excluded from the study. Participants with T2DM who did not respond to the given treatment or patients with T2DM who were not in decent physical or psychological status and not able to give reliable answers during the interview were excluded from the study. Informed consent was obtained from all the individuals enrolled in the study. Data collection form was used to obtain participant demographics, clinical characteristics, and HRQoL. Demographic data included: age, gender, and occupation. Experienced clinicians recorded the clinical characteristics of individuals, such as FBS level, past medical and dental history, periodontal disease index (PDI), plaque index (PI), and simplified oral hygiene index (OHI-S). Besides, a structured questionnaire was developed to obtain data on xerostomia and another one on OHRQoL.

Trained and calibrated clinicians (M.M. and N.J.) performed dental examinations at the center. All pathologic lesions and periodontal problems were recorded entirely. Clinical examinations were conducted according to the following instructions: Periodontal Disease Index (PDI) was assessed using the Ramfjord Method (21). Only six selected teeth were scored to evaluate Ramfjord Periodontal Index including tooth 3 (maxillary right first molar), tooth 9 (maxillary left central incisor), tooth 12 (maxillary left first bicuspid), tooth 19 (mandibular left first molar), tooth 25 (mandibular right central incisor), and tooth 28 (mandibular right first bicuspid). Regarding this approach, the following classification was used:

- Grade 0; healthy gingiva, without any signs of inflammation
- Grade 1; mild to moderate inflammation in the gingiva, not extending around the teeth
- Grade 2; mild to moderately severe gingival inflammation, extending all around the teeth
- Grade 3; severe gingivitis, marked redness, swelling, and tendency to bleed
- Grade 4; clinical attachment loss (CAL) in any of the two measured areas extended apically to the cementum-enamel junction (CEJ) ≤ 3mm
- Garde 5; CAL in any of the two recorded areas extended apically to CEJ from 3-6 mm (including 6 mm)
- Grade 6; whenever the CAL extends more than 6mm

All participants were measured for plaque index using Silness and Leo Method (22). Each of the four areas of the gingival surface of a tooth was given a score from 0-3, and then the scores from all surfaces were added

and divided by four to obtain the Plaque Index (PI) for every tooth.

$$\textbf{PI} = \frac{\frac{Sum\ of\ the\ Scores\ Obtaied\ from\ each\ Gingival\ Surface\ of\ a\ Tooth}{4}}{}$$

Each surface was scored as followed:

- Grade 0; free of plaque.
- Grade 1; plaque can be detected on the point of the probe after moving on the tooth surface, but not detectable by the unaided eye.
- Grade 2; thin to a moderately thick layer of plaque is observed with the naked eye.
- Grade 3; tooth surface, gingival margin, and interdental area are all covered with soft debris.

Six surfaces were examined for obtaining the Oral Hygiene Index-Simplified (OHI-S) index. This index was only investigated among fully erupted teeth. Selected surfaces for OHI-S assessment were as followed (23): buccal/ lingual surface of the first tooth distal to the second premolar in the upper and lower jaws, respectively. In the anterior region, the labial surface of the upper right and lower left central was examined. If these teeth were absent, the central incisor of the opposite side was considered. At least, two of the surfaces mentioned above should be examined to calculate an individual score. Each surface was first examined for debris and then calculus assessment.

$$\textbf{Debries or Calculus Index} = \frac{Total\ Score\ for\ Debris\ or\ Calculus}{Number\ of\ Scored\ Surfaces}$$

Oral debris were scored as followed:

- Grade 0; no debris or stains.
- Grade 1; soft debris covering less than one-third of the tooth or extrinsic stains without debris regardless of covering the tooth surface.
- Grade 2; soft debris present on more than one-third of the tooth but not more than two-thirds of the surface.
- Grade 3; soft debris covering more than two-thirds of the tooth surface.

Oral calculus are graded as followed:

- Grade 0; no calculus.
- Grade 1; supragingival calculus covering less than one-third of the tooth.
- Grade 2; supragingival calculus covering more than one-third but not exceeding two-thirds of the tooth surface or subgingival flecks of calculus around the cervical portion.
- Grade 3; supragingival calculus covering more than two-thirds of the tooth surface or continuous subgingival calculus around the cervical portion.

The questionnaire for evaluating the xerostomia consisted of 9 yes/no questions. Five positive answers led to xerostomia diagnosis for each participant. We used the GOHAI questionnaire to evaluate the OHRQoL among the participants in the present study. GOHAI questionnaire consists of 12 questions comprising three different domains, including physical status, psychological and social status, and pain or discomfort (14). The responses were evaluated using a 5-point scales as follows: always = 1, often = 2, sometimes = 3, rarely = 4, and never = 5. Questions number 3, 5, and 7 were inversely scored so that higher scores regarded for better OHRQoL. Finally, statistical analysis was performed by SPSS Version 17. T-test, chi-square test, and Pearson's correlation coefficient were applied for evaluating the quantitative variables. P-value < 0.05 was considered significant.

All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee. Informed consent was obtained from all individual participants included in the study. The Ethics Committee of Babol University of Medical Sciences approved the study (IR.MUBABOL.HRI.REC.1397.282).

3. Results

A total of 500 participants (more than calculated sample size) enrolled in the study, including 250 patients with T2DM and 250 healthy controls. The mean age of the subjects in the T2DM group was 69.56 ± 6.27, while healthy subjects were aged 69.68 ± 6.28, and there was no significant difference in the age between the two groups. Both groups of the study consisted of 50% female and 50% male participants. The mean FBS level was 153.37 ± 55.32 among the individuals in the T2DM group and 89.07 ± 10.24 among the controls. Table 1 shows all the demographic, clinical, and periodontal characteristics of the participants.

Table 1. Clinical, demograpgic, and periodontal description of participants with/ without type 2 diabetes mellitus

Variables	Participants with T2DM	Healthy Controls	P-Value
Age (years)	69.56 ± 6.27	69.68 ± 6.28	0.825
Age, n (%)			
• **60-69**	140 (56.00%)	140 (56.00%)	> 0.05
• **70-79**	92 (36.80%)	92 (36.80%)	> 0.05
• **80-99**	16 (6.40%)	16 (6.40%)	> 0.05
FBS (mg/dL)	153.37 ± 55.32	89.07 ± 10.24	0.000
Xerostomia, n (%)			
• **Yes**	52 (20.80%)	37 (14.80%)	0.079
• **No**	198 (79.20%)	213 (85.20%)	
Xerostomia (Female), n (%)			
• **Yes**	38 (30.40%)	29 (23.20%)	0.199
• **No**	87 (69.60%)	96 (76.80%)	
Xerostomia (Male), n (%)			
• **Yes**	14 (11.20%)	8 (6.40%)	0.180
• **No**	111 (88.80%)	117 (93.60%)	
PDI, mean (n)	3.09 ± 1.53	3.03 ± 1.56	0.781
• **Female**	3.12 ± 1.51	2.79 ± 1.45	0.272
• **Male**	3.05 ± 1.57	3.24 ± 1.64	0.548
PI, mean (n)	1.62 ± 0.98	1.52 ± 1.02	0.495
• **Female**	1.53 ± 0.96	1.45 ± 0.95	0.690
• **Male**	1.70 ± 1.01	1.58 ± 1.09	0.548
OHI-S, mean (n)	2.63 ± 1.68	2.56 ± 1.69	0.792
• **Female**	2.59 ± 1.70	2.43 ± 1.64	0.624
• **Male**	2.66 ± 1.68	2.69 ± 1.73	0.926
GOHAI, mean (score)	51.21 ± 8.00	51.06 ± 7.75	0.829
• **Female**	50.40 ± 7.88	51.17 ± 8.09	0.819
• **Male**	52.01 ± 8.07	51.94 ± 8.07	0.941

Regarding the Xerostomia Questionnaire, xerostomia was recognized more frequently in patients with T2DM (both males and females), but this finding was not statistically significant ($p < 0.079$). No statistically significant difference was also observed between the two groups for PDI ($p = 0.781$; Female: $p = 0.272$, Male:

p=0.548), PI (p = 0.495; Female: p = 0.690, Male: p = 0.548), OHI-S (p = 0.792; Female: p = 0.624, Male: p = 0.926), and GOHAI (p = 0.829; Female: p = 0.819, Male: p = 0.941). These variables did not differ significantly between the groups when analyzing based on their sex Table 1. Pearson's correlation coefficient of the variables is presented in Table 2 and Figure 1. These data points out that PDI was positively correlated to PI and OHI-S (r = 0.528 and r = 0.453, respectively), and there was a significant relationship between these variables (p < 0.001). Furthermore, Pearson's correlation coefficient showed a positive correlation between PI and OHI-S (r = 0.748, p < 0.001). Unlike previously mentioned variables, GOHAI and xerostomia were found to be inversely correlated (r = - 0.368, p < 0.001).

Table 2. Pearson correlation coefficienct between variables

		PDI	PI	OHI-S	GOHAI	Xerostomia
PDI	Correlation coefficient	1.000	0.528	0.453	-0.087	-0.087
	P value	.	<0.0001	<0.0001	0.210	0.215
PI	Correlation coefficient	0.528	1.000	0.748	-0.183	-0.007
	P value	<0.0001	.	<0.0001	0.008	0.918
OHI-S	Correlation coefficient	0.453	0.748	1.000	- 0.120	- 0.022
	P value	<0.0001	<0.0001	.	0.086	0.754
GOHAI	Correlation coefficient	-0.087	-0.183	- 0.120	1.000	- 0.368
	P value	0.210	0.008	0.086	.	<0.0001
Xerostomia	Correlation coefficient	-0.087	-0.007	- 0.022	- 0.368	1.000
	P value	0.215	0.918	0.754	<0.0001	.

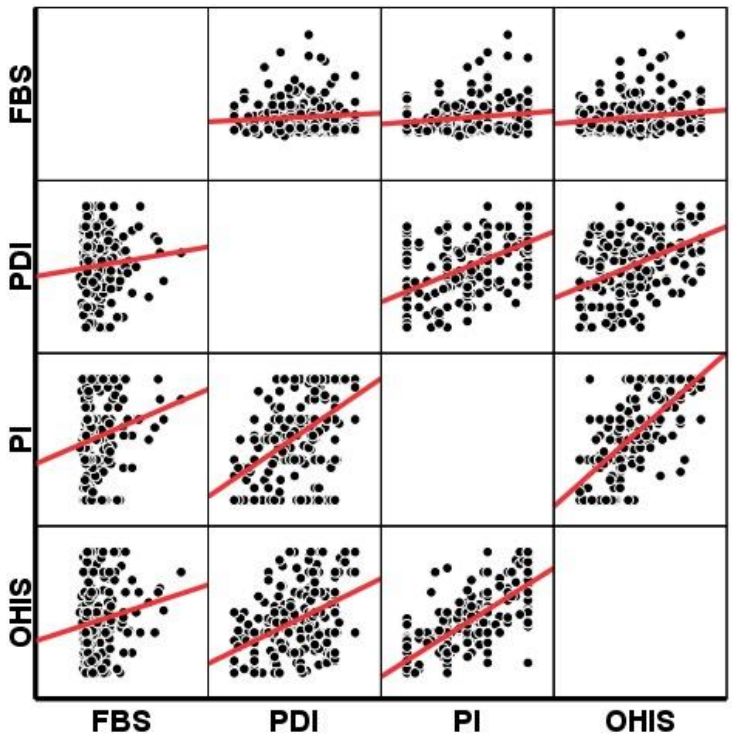

Figure 1. Graph showing the Pearson's correlation coefficient between PI, PDI, OHI-S, and FBS

As well, we analyzed the GOHAI in different age groups enrolled in the study among men and women. Mean scores obtained from the GOHAI Questionnaire did not show a statistically significant difference between both men and women with and without T2DM (Figure 2). The relationship between xerostomia and age based on the sex of participants is displayed in Figure 3. These data revealed that xerostomia increased among women with T2DM but not statistically significant. Regarding the pathological lesions in the oral cavity, as detected samples did not reach an adequate number and subsequently were not statistically valuable, we omitted this variable from the study.

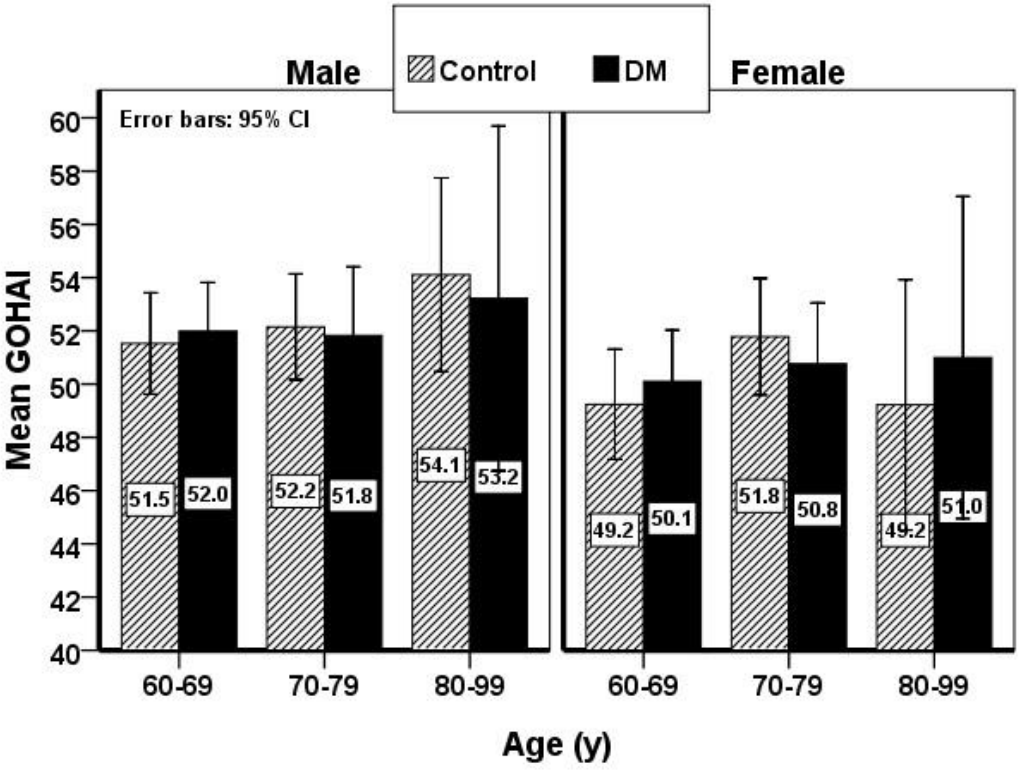

Figure 2. Mean GOHAI in different age groups between men and women

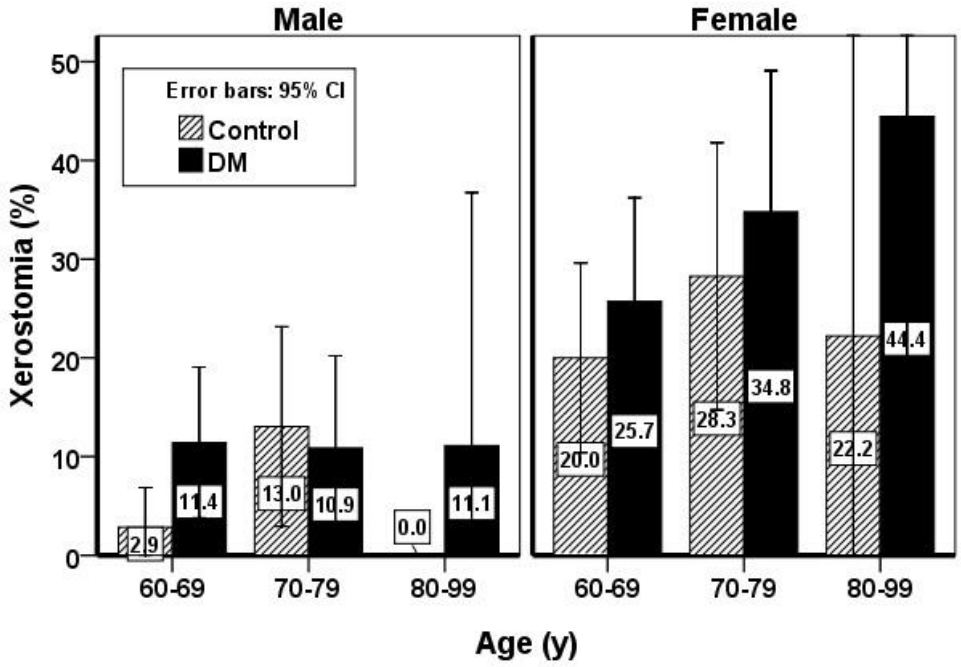

Figure 3. Amount of xerostomia (%) between men and women of different ages

4. Discussion

This case-control study was conducted to assess the OHRQoL associated with T2DM among the elderly population of Amirkola in Northern Iran. Studies on HRQoL expresses all clinical and psychological aspects of people's lives and thus can be used for future planning of the public health policies. Although several studies have investigated the HRQol among elderly T2DM patients, less data was available on OHRQoL among this population, especially in Iran. GOHAI is not specifically designed for clinical evaluation of patients; hence, using this questionnaire as a supplement for clinical investigations could be useful. Different results were achieved through GOHAI based on cultural differences and individuals' opinions toward the quality of life. As a result, some studies proved a positive correlation between GOHAI and clinical evaluations (24), while others showed a negative correlation between clinical observation and this questionnaire (25).

The results of the present study indicated that T2DM did not have a negative impact on the OHRQoL of older adults, and the difference between the OHRQoL of the T2DM group and healthy controls was not statistically significant. This finding was in accordance with the results of some previously conducted studies. A study by Sadeghi et al. (26) signified that diabetes mellitus did not negatively affect the OHRQoL of the assessed population for the study. However, other studies reported a negative impact of diabetes mellitus on OHRQoL among the diabetic population (20, 27-29). These studies revealed that oral health status was significantly lower among patients with diabetes mellitus and that OHRQoL was associated with the blood-sugar level; patients with higher FBS had lower levels of OHRQoL. These controversial reports can be due to cultural

differences among the populations enrolled in the studies, as well as various approaches employed in the study design.

Xerostomia is mentioned among the most common oral complications of diabetes mellitus. Prior studies substantiated a reduction in total saliva in patients with T2DM compared to health controls. They mentioned higher levels of dryness both at night and on waking with a greater sensation of lingual burning (30).There are some individual's functions that are affected by the amount of saliva secreted, including speaking, the use of dentures, ingestion, and food intake. These functions are inversely influenced by xerostomia, hence negatively affecting OHRQoL (14). No significant differences in xerostomia were exerted in the present study between the T2DM group and the control population. On the contrary, a study by Maruthur showed that oral medication that is taken by diabetic patients decreased the activity of the salivary gland, thus leading to the manifestation of xerostomia. Afterward, xerostomia, increased glucose in the gingival crevicular fluid (GCF), and elevated dental plaque which can cause a growth in dental caries (31).

There is a consensus in the previous investigations regarding the association between periodontal problems among the T2DM population and OHRQoL. Khalifa et al. suggested that decayed teeth and CAL had a significant impact on OHRQol of patients, irrespective of their diabetic status (32).

Mohamed et al. reported that chronic periodontitis, tooth mobility, furcation involvement, and oral impacts on daily performance (OIDP) was higher among patients with T2DM than the control group (33). Another study evaluating the OHRQoL in individuals with T2DM indicated that xerostomia, denture need, and periodontitis increased among patients with T2DM (20). The findings of mentioned studies were in contrast with the data obtained from the present study. Some prior studies implied that following routine dental prophylaxes and oral hygiene instructions could help patients with T2DM improve their periodontal status and prevent the risk of chronic periodontitis (34). Better oral hygiene can be one of the reasons for our study's controversial results with previous research on this issue. Better oral hygiene among patients with T2DM who participated in our study might have influenced periodontal status and xerostomia. However, further investigations are pivotal to substantiate the idea.

5. Conclusion

From these data, we can conclude that OHRQoL was not affected by T2DM, and OHRQoL of the patients with T2DM was not associated with periodontal status and xerostomia. This study was conducted among a large group of the older adults of Amirkola, but the contradictory findings of the present study with previous experiments imply the necessity of further investigations in this field.

We recommend that the drugs used by the patients that can result in xerostomia to be taken into considerations in future studies. As well, it is better to use other indices rather than PDI, PI, and OHIS for older edentulous patients.

Conflicts of interest

The authors report no conflicts with any product mentioned or concept discussed in this article.

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