

# Oral health-related quality of life and xerostomia in type 2 diabetic patients

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## Conflict of interest

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## Abstract

**Background.** Diabetes mellitus (DM) is a known risk factor for xerostomia. Oral health-related quality of life (OHRQoL) is a multi-dimensional issue reflecting several effects of the oral condition on the quality of life.

**Objectives.** The present study aimed to assess OHRQoL and its relationship with xerostomia severity in type 2 diabetic patients.

**Material and methods.** A total of 200 patients participated in this cross-sectional study. The Xerostomia Inventory (XI) assessed xerostomia severity and the Oral Health Impact Profile-14 (OHIP-14) questionnaire evaluated OHRQoL. In addition, the fasting blood sugar (FBS) and glycated hemoglobin (HbA1c) tests were conducted, and the results were recorded, as well as the disease duration and denture wearing. Data analysis employed the *t* test and Pearson's correlation coefficient.

**Results.** The mean XI score was  $22.27 \pm 6.92$  and the mean OHIP-14 score was  $13.76 \pm 8.41$ . The mean FBS, HbA1c and disease duration values were  $161.23 \pm 49.14$  mg/dL,  $7.90 \pm 1.12\%$  and  $11.02 \pm 7.78$  years, respectively. The OHIP-14 score correlated significantly with the XI score, age, FBS, HbA1c, the disease duration, and denture wearing ( $p < 0.05$ ).

**Conclusions.** There was a significant correlation between OHRQoL and xerostomia severity in patients with type 2 DM. Age, denture wearing, the disease duration, and the medical management of DM also correlated significantly with OHRQoL. Treating both the underlying disease and oral health comorbidities, such as xerostomia, seems to be essential for achieving a better OHRQoL in type 2 diabetic patients.

**Keywords:** xerostomia, diabetes, oral health, quality of life

## Cite as

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## Introduction

Diabetes mellitus (DM) is a metabolic disorder typically characterized by the triad of polyphagia, polydipsia and polyuria.<sup>1</sup> Most DM patients are elderly with type 2 disease.<sup>2</sup> Amongst miscellaneous side effects, oral health is severely affected by DM as a result of hyperglycemia, impaired healing, and qualitative or quantitative salivary alterations.<sup>3,4</sup> Caries, oral burning, malodor, and periodontal problems are the common comorbidities of xerostomia in these patients, and might influence their oral health-related quality of life (OHRQoL).<sup>5</sup>

Xerostomia is a subjective feeling of a dry mouth, and it can be caused by many local or systemic factors, including direct damage to salivary tissue.<sup>6</sup> Several medical conditions may precede or exacerbate xerostomia, such as Sjögren's syndrome, systemic lupus erythematosus and sarcoidosis, as well as metabolic diseases, like DM.<sup>7</sup> Polyuria, dehydration and autonomic imbalance due to angiopathic disturbances have been proposed to underlie xerostomia in DM.<sup>8</sup> Regardless of its cause, xerostomia has extraordinarily detrimental effects on oral health. Rampant caries, periodontitis, and a reduced ability to chew or speak are significant side effects that can clearly influence a patient's OHRQoL.<sup>9</sup>

The OHRQoL score reflects the impact of the oral health status on several aspects of one's daily life. Oral health-related quality of life is measured with the use of patient-centered approaches. The OHRQoL score combined with clinical criteria constitute a suitable technique for evaluating oral treatment needs and outcomes.<sup>10</sup> Means available to achieve such a goal are reliable questionnaires, validated for specific populations. The Oral Health Impact Profile-14 (OHIP-14) questionnaire is a popular tool in this regard, and it is applied in xerostomic and DM patients.<sup>2</sup> Some studies have utilized this questionnaire to assess OHRQoL in DM and other systemic conditions.<sup>2-6,10-12</sup>

Molania et al. concluded that low medical control of type 2 DM resulted in hyposalivation as a side effect of the disease, and xerostomia affected the OHRQoL of DM patients in a negative way.<sup>6</sup> Xerostomia is a significant oral side effect of DM that may interfere with the oral function of the patients suffering from the disease, resulting in poor OHRQoL among them.<sup>2</sup> Therefore, evaluating the relationship between xerostomia and OHRQoL in people with DM might help clinicians to prioritize the treatment planned for DM patients. The present study investigated OHRQoL and its relationship with xerostomia severity in type 2 DM patients. The null hypothesis of the present investigation was that there is no correlation between OHRQoL and xerostomia severity in type 2 DM patients.

## Material and methods

The present analytical cross-sectional study was conducted between September 2020 and February 2021.

## Ethical considerations

The local medical ethics committee at Isfahan University of Medical Sciences, Iran, approved the study protocol (IR.I.MUI.RESEARCH.REC.1399.505). The patients were informed of the objectives of the investigation, the confidentiality of the data, and that they could stop participating in the study at any time. They all provided written consent, and dental treatment was provided to them irrespective of whether they participated in the study or not.

## Participants

Type 2 diabetic patients referred to the Department of Oral Medicine at the School of Dentistry of Isfahan University of Medical Sciences, Iran, were invited to participate in the present study.

Patients who met the following criteria were included: a confirmed diagnosis of type 2 DM; and literacy sufficient to fill out the questionnaires.

The exclusion criteria to minimize bias were the presence of any systemic diseases affecting the salivary glands, such as Sjögren's syndrome, alcoholism, a corticosteroid or hormone therapy, and a history of head and neck radiotherapy/chemotherapy (Fig. 1).

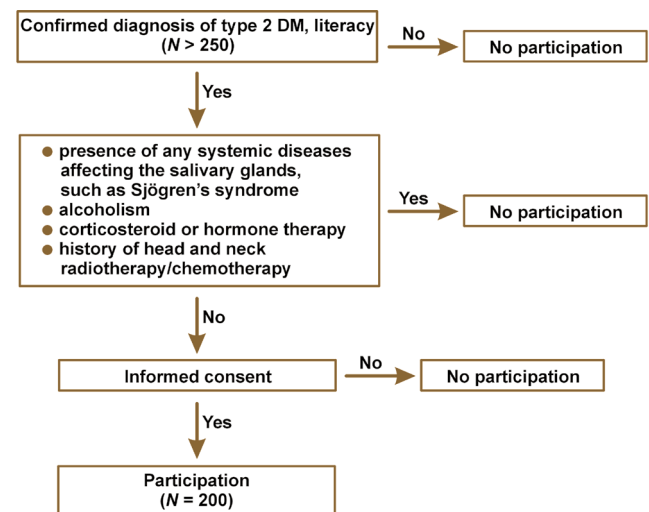


Fig. 1. Patient selection flowchart  
DM – diabetes mellitus.

## Sample size calculation

The following formula (Equation 1) was used to calculate the study sample size:

$$N = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2}{d^2} + 3 \quad (1)$$

Assuming  $\alpha = 0.05$  (significance level) and  $1-\beta = 0.8$  (power),  $z_{1-\alpha/2}$  and  $z_{1-\beta}$  were considered 1.96 and 0.84, respectively. The correlation analyses used  $d = 0.2$ . The calculation indicated  $N = 199$ , and  $N = 200$  was set for the sample size.

## Xerostomia evaluation

To measure xerostomia severity, the participants were asked to answer the questions in the Xerostomia Inventory (XI) (Table 1). The XI is composed of 11 questions regarding a dry mouth feeling, and the score for each question varies on a Likert scale from 1 to 5, with worse conditions scoring more, as follows: never – 1; seldom – 2; sometimes – 3; often – 4; and always – 5. Therefore, xerostomia severity was reported as a sum between 11 and 55. The Persian version of the XI questionnaire was used, which was valid and reliable.<sup>13</sup>

Table 1. Xerostomia Inventory (XI)

| No. | Statement  |
|-----|--|
| 1   | I sip liquids to help swallow food                   |
| 2   | My mouth feels dry when eating a meal                |
| 3   | I get up at night to drink                           |
| 4   | My mouth feels dry                                   |
| 5   | I have difficulty eating dry foods                   |
| 6   | I suck sweets or cough lozenges to relieve dry mouth |
| 7   | I have difficulty swallowing certain foods           |
| 8   | The skin of my face feels dry                        |
| 9   | My eyes feel dry                                     |
| 10  | My lips feel dry                                     |
| 11  | The inside of my nose feels dry                      |

## OHRQoL evaluation

Each patient was then asked to fill out the OHIP-14 questionnaire, which consists of 14 questions measuring OHRQoL in 7 domains. The score for each question varies on a Likert scale from 0 (never) to 4 (always). As a result, the score for each section is a sum between 0 and 8, and the total score of the questionnaire ranges from 0 to 56. A higher score in this questionnaire indicates a lower OHRQoL. The Persian version of the OHIP-14 questionnaire was used, which was valid and reliable.<sup>14</sup>

## Data collection

The patients' medical and dental records, as well as denture wearing, the duration of the disease, and the latest fasting blood sugar (FBS) and glycated hemoglobin (HbA1c) test values were recorded. Demographic data regarding patients' age and gender were also recorded and attached to the questionnaires.

## Statistical analysis

The data was analyzed with IBM SPSS Statistics for Windows, v. 22.0 (IBM Corp., Armonk, USA), using relevant statistical tests, with the *t* test used to compare the

OHIP-14 and XI scores between the gender groups. Pearson's correlation coefficient assessed the relationship between the OHIP-14 and XI scores. The level of significance was set at  $p < 0.05$ .

## Results

Among more than 250 patients referred during the study period, 200 who fulfilled the eligibility criteria and gave informed consent participated in the study (Fig. 1). The mean age of the participants was  $62.42 \pm 10.04$  years, with 63.5% being female and 36.5% male. The mean FBS and HbA1c values were  $161.23 \pm 49.14$  mg/dL and  $7.90 \pm 1.12\%$ , respectively. The mean duration of the disease was  $11.02 \pm 7.78$  years. Denture (complete or removable partial) wearers composed 45% of the sample. There was no missing data.

The mean XI score was  $22.27 \pm 6.92$ , and the total and domain OHIP-14 scores are shown in Table 2. There was a direct and statistically significant relationship between the XI and OHIP-14 total/domain scores (Table 2). The relationship between the OHIP-14 score and other study variables is shown in Table 3. Figure 2 shows that as the XI score increased, the total OHIP-14 score also increased, which translates into worse OHRQoL ( $p < 0.001$ ;  $r = 0.444$ ).

Table 2. Oral Health Impact Profile-14 (OHIP-14) questionnaire total and domain scores related to the Xerostomia Inventory (XI) score

| OHIP-14 domain           | Score<br><i>M</i> ± <i>SD</i> | <i>p</i> -value | Pearson's <i>r</i> |
|--------------------------|-------------------------------|-----------------|--------------------|
| Functional limitation    | 2.15 ± 1.59                   | <0.001*         | 0.503              |
| Physical pain            | 2.46 ± 1.89                   | 0.001*          | 0.247              |
| Psychological discomfort | 2.35 ± 1.84                   | <0.001*         | 0.275              |
| Physical disability      | 1.91 ± 1.60                   | 0.003*          | 0.230              |
| Psychological disability | 1.83 ± 1.68                   | <0.001*         | 0.292              |
| Social disability        | 1.39 ± 1.51                   | <0.001*         | 0.332              |
| Handicap                 | 1.65 ± 1.55                   | <0.001*         | 0.383              |
| Total                    | 13.76 ± 8.41                  | <0.001*         | 0.444              |

*M* – mean; *SD* – standard deviation; *r* – Pearson's correlation coefficient; \* statistically significant.

Table 3. Relationship between the Oral Health Impact Profile-14 (OHIP-14) score and other study variables

| Correlation   | Study variable   | <i>p</i> -value | Pearson's <i>r</i> |
|---------------|------------------|-----------------|--------------------|
| OHIP-14 score | age              | <0.001*         | 0.254              |
|               | gender           | 0.815           | –                  |
|               | FBS              | 0.040*          | 0.146              |
|               | HbA1c            | 0.030*          | 0.198              |
|               | disease duration | <0.001*         | 0.421              |
|               | denture wearing  | <0.001*         | –                  |

FBS – fasting blood sugar; HbA1c – glycated hemoglobin; \* statistically significant.

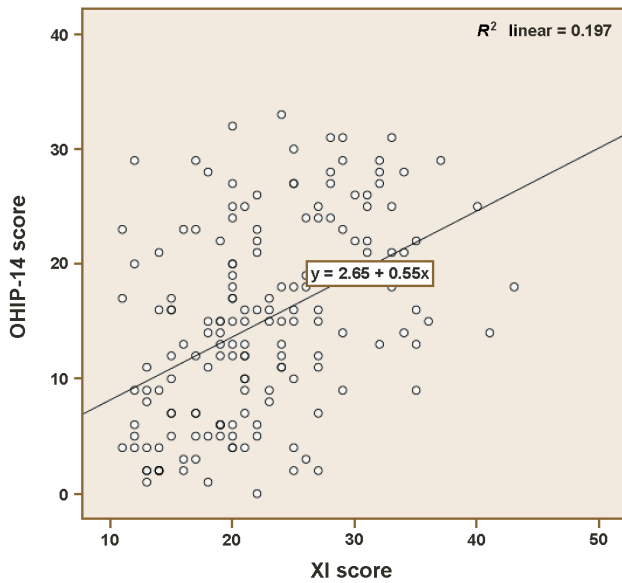


Fig. 2. Relationship between the Oral Health Impact Profile-14 (OHIP-14) score and the Xerostomia Inventory (XI) score ( $p < 0.001$ ;  $r = 0.444$ )

## Discussion

Xerostomia is a side effect of type 2 DM that can have detrimental consequences on a patient's oral health.<sup>2</sup> The present study was conducted to evaluate OHRQoL in patients with type 2 DM and its correlation with xerostomia severity. The mean OHIP-14 score was  $13.86 \pm 8.41$ , which was relatively low, depicting a good OHRQoL. Moreover, a significant correlation was observed between the above-mentioned variables.

Several studies have investigated OHRQoL in type 2 DM or other medically compromised patients. Similar to our results, Sadeghi et al. reported acceptable OHRQoL in Persian diabetics,<sup>15</sup> and Hajian-Tilaki et al. reported a relatively good OHRQoL in Persian hemodialysis patients.<sup>11</sup> Machado et al.,<sup>12</sup> Pereira Oliveira et al.<sup>10</sup> and Verhulst et al.<sup>3</sup> came across even lower OHIP-14 scores in diabetic patients in comparison with our study, reporting mean scores of  $9.5 \pm 11.3$ ,  $5.37 \pm 4.95$  and  $2.5 \pm 5.2$ , respectively. Of note, Hsu et al.<sup>4</sup> and Verhulst et al.<sup>3</sup> found lower OHIP-14 domain scores as compared to our study.

On the other hand, Khalifa et al.<sup>5</sup> and Irani et al.<sup>16</sup> reported no difference in the OHIP-14 scores in people with DM vs. healthy controls. Meanwhile, Mohamed et al. reported worse OHRQoL in Sudanese diabetic patients in comparison with the matched controls,<sup>17</sup> and Molania et al. reported a higher OHIP-14 score than our results.<sup>6</sup> Geographical variances and miscellaneous understandings of OHRQoL might explain the differences in the overall health support given to patients in different countries and even cities in the same country, which may be in line with their socioeconomic status.

The OHIP-14 questionnaire has proven to be a valuable tool for the subjective measurement of oral health

in DM.<sup>2</sup> The present study showed a significant relationship between the OHIP-14 score and self-perceived xerostomia severity in diabetic patients, in line with studies by Nikbin et al.,<sup>2</sup> Molania et al.<sup>6</sup> and Azogui-Lévy et al.<sup>18</sup> These findings confirm its value and adaptation to other means of examining the clinical oral status. In fact, combining the subjective means of need evaluation with the classic objective methods provides patients with the best remedies for improving their OHRQoL.<sup>12</sup>

Oral health-related quality of life refers to both general and oral aspects of health.<sup>2,3</sup> In the present study, the indices related to the underlying disease (i.e., FBS, HbA1c, the disease duration, and age) and oral health conditions (i.e., the XI score and denture wearing) were significantly correlated with the OHIP-14 score. In line with our results, Sadeghi et al. found direct correlations between the OHIP-14 score and age and the disease duration in diabetic patients.<sup>15</sup>

On the contrary, Machado et al.<sup>12</sup> and Azogui-Lévy et al.<sup>18</sup> reported that the elderly experienced better OHRQoL among people with DM. Meanwhile, Irani et al. concluded that the burden of medical conditions in diabetic patients (e.g., multiple drug consumption) deteriorates OHRQoL so heavily that oral health finds no room to show its impact; therefore, the underlying medical condition seems to be a better predictor of OHRQoL than the oral health indices in diabetic patients.<sup>16</sup>

From another point of view, several studies have highlighted the impact of oral health on OHRQoL in diabetics, especially regarding its physical domains. The present study found the most significant impact on the 'physical pain' domain, and the strongest correlation with the XI score was found for the 'functional limitation' domain ( $p < 0.001$ ;  $r = 0.503$ ). The most important oral health parameters noted in the literature include denture wearing and xerostomia, similar to our findings.<sup>1,2,4-6,10,19</sup>

Several studies have also reported a strong correlation between xerostomia and OHRQoL, especially its physical domains, in the general population.<sup>7,20-23</sup> Since various factors potentially impact OHRQoL, including general and oral health parameters, planning treatment models to simultaneously improve general and oral health, as proposed by Machado et al.,<sup>12</sup> seems necessary for OHRQoL improvement in diabetic patients.

## Limitations

Of course, this investigation was conducted within the limitations of a cross-sectional study; therefore, detecting the exact effect of xerostomia on OHRQoL might have been confounded by other variables with an impact on OHRQoL. Future research is suggested, with case-control or other controlled studies, to more precisely investigate the impact of xerostomia or other specific oral health parameters on OHRQoL among diabetic patients in order to improve their quality of life.

## Conclusions

There was a significant correlation between OHRQoL and xerostomia severity in patients with type 2 DM. Furthermore, age, denture wearing, the disease duration, and the medical management of DM were other factors influencing OHRQoL in these patients. Prompt medical treatment of the underlying disease, as well as alleviating xerostomia, seem to be essential factors in improving OHRQoL in type 2 diabetic patients.

## Ethics approval and consent to participate

The study was approved by the local medical ethics committee at Isfahan University of Medical Sciences, Iran (IRI.MUI.RESEARCH.REC.1399.505). All the participants provided informed written consent.



## Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Consent for publication

Not applicable.

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