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Original Article

Assessment of the relationship between xerostomia and oral health related quality of life in cardiovascular patients

Sahar Mafi[1], Nader Salari[2], Zahra Nazari[3], Arezoo Alaee[1,4,5*]

[1]Department of Oral and Maxillofacial Medicine, Faculty of Dentistry, TeMs.C., Islamic Azad University, Tehran, Iran
[2]Department of Biostatistics, School of Health, Kermanshah University of Medical Sciences, Kermanshah, Iran
[3]DDS, Dentist, Kermanshah, Iran
[4]Dental Material Research Center, Islamic Azad University, Dental Branch, Tehran Iran
[5]Student of Medical Education, School of Medical Education and Learning Technologies, Shahid Beheshti University of Medical sciences, Tehran,Iran

***Corresponding Author:** Arezoo Alaee, Email: arezoo.alaee@yahoo.com

Abstract

Background: This manuscript investigated the link between dry mouth and oral health-related quality of life (OHQoL) in patients with cardiovascular diseases. Xerostomia, or dry mouth, results from reduced saliva production and can cause difficulties in speaking, swallowing, and maintaining oral hygiene. It significantly impacts OHQoL, leading to discomfort and a higher risk of dental problems, which affects overall well-being.

Methods: This cross-sectional study included 209 patients with cardiovascular diseases referred to Imam Ali Hospital in Kermanshah. The standard Fox questionnaire was used to assess xerostomia and OHQoL, measured using a 14-step OHIP-14 questionnaire. Data were analyzed using SPSS software version 25, Pearson's correlation test, linear regression, and T-test with a significance level of $P<0.05$.

Results: The mean age of patients was 62.3 years, with 46.4% being female. The average score for OHQoL was 25.1 ± 7.3 (total score: 56). Dry mouth was reported by 68.6% of patients, with a mean score of 8.6 ± 3.2 (total score: 36). There was a direct and significant correlation between the total QoL score and dry mouth ($P=0.001$). Direct and significant correlations were also found for the subscales of functional limitation ($P=0.001$), mental distress ($P=0.006$), physical disability ($P=0.001$), social disability ($P=0.009$), and handicap ($P=0.001$). There was a significant difference in the mean score of QoL based on the patient's age ($P=0.01$), number of medications used ($P=0.001$), and underlying diseases ($P=0.001$).

Conclusion: The study showed that dry mouth decreases the OHQoL in patients with cardiovascular diseases.

Keywords: Xerostomia, Quality of Life, Oral Diseases, Cardiovascular disease, OHQoL Questionnaire, Hyposalivation

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Introduction

Saliva is critical for oral homeostasis, offering antimicrobial defense, mucosal lubrication, and enamel remineralization. Saliva also aids in chewing, swallowing, and speaking. Studies report xerostomia in 5.5%–46% of populations, disproportionately affecting women.[1] It is more prevalent in the 60s, which is probably related to increasing age, increased drug use, and underlying diseases such as high blood pressure, diabetes, depression, etc.[2] This problem is almost four times more common in patients who take medications compared to those who do not use any drugs.[3] The leading cause among the elderly is the use of medications.[4] Dry mouth can lead to impaired chewing, swallowing, taste, and speech, significantly reducing oral health-related quality of life (OHQoL).[5-7]

The prevalence of cardiovascular disease in Iran during the past forty decades has been reported to be between 20-30%.[8] These diseases are among the most common medical disorders that dentists face, and the number of prescription drugs used to control and treat them, including high blood pressure drugs, ischemic heart disease, congestive heart failure, or arrhythmia, is numerous. This makes it difficult to manage side effects, many of which have the potential to cause adverse oral reactions such as dry mouth, burning feeling and ageusia. Targeted interventions can help reduce these oral complications and improve OHQoL in patients.[8-10]

Quality of life represents a person's subjective well-being, influenced by their satisfaction across significant life aspects. Although the concept of OHQoL has emerged relatively recently, it carries major ramifications for clinical dental practice and research. OHQoL is a critical public

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health component, formally acknowledged by the World Health Organization (WHO) as an essential element of its global oral health program.[11] Although various treatment options are available, dry mouth remains a significant issue among patients with cardiovascular diseases; however, it has received little attention in research concerning its impact on QOL. Each current treatment method has its limitations, leading many patients to continue suffering from xerostomia and its side effects. In light of these considerations, the present study was designed to examine the association between xerostomia and OHQoL in patients with cardiovascular diseases.[7,12-14]

Materials and Methods

It was an analytical cross-sectional study. The sample was selected using simple sampling, focusing on all patients with cardiovascular diseases hospitalized at Imam Ali Hospital in Kermanshah. The study was approved by the Ethics Committee of Kermanshah University of Medical Sciences (IR.KUMS.REC.1400.646). After obtaining informed consent, the participants were guaranteed strict confidentiality, with assurances that all responses would be anonymized and reported in aggregate. The sample size of 209 participants was determined based on the methodology established by Chamani et al in their previous study.[6]

Xerostomia was assessed using the standardized Persian version of the Fox-modified questionnaire, a nine-item instrument designed to evaluate the presence and severity of dry mouth symptoms.[15,16] The questionnaire focuses on both subjective experiences and functional limitations associated with xerostomia.

- **Question Structure**: The questionnaire includes items that ask respondents about their perception of dry mouth, difficulties with swallowing, and the impact of these symptoms on daily activities.
- **Scoring Method**: Responses were graded 0–4 (0 = symptom absence; 4 = constant symptoms.[15]
- **Total Xerostomia Score**: The questionnaire's nine items are scored cumulatively (range: 0-36), with higher aggregate scores reflecting increased xerostomia severity. This scoring continuum serves as a quantitative indicator of both oral health impairment and broader QoL consequences.
- If individuals answer positively to three of the nine questions (questions 4,5, or 6), they are considered to have dry mouth.

Means and standard deviations (SD), were calculated for total xerostomia scores to summarize the severity of symptoms. Frequency analysis was conducted to determine the prevalence of dry mouth, defined as a positive response to at least one of items 4, 5, or 6.[17]

We used the standard Persian version of OHIP-14 to assess OHQoL.[18] This index is measured using the OHIP-14 questionnaire, which assesses the effects of oral health on a person's QOL in seven different areas, including functional limitation, physical discomfort (pain), psychological discomfort, physical disability, psychological disability, social disability, and handicap.

The participants rated each item using a five-point frequency scale (never = 0, rarely = 1, sometimes = 2, most of the time = 3, and always = 4), where higher scores indicated a greater negative impact on OHQoL. OHIP-14 scores ranged from 0 (no impact) to 56, and a higher score indicated a lower OHQoL. Descriptive statistics for continuous variables were expressed as mean ± SD, while categorical variables were summarized as frequencies and percentages. Assuming the normal distribution and limited sample size, the relationship between OHQoL and xerostomia scores was assessed using Pearson's correlation coefficient. Independent t-tests and analysis of variance were used to assess the relationship between OHQoL scores and dry mouth scores across different demographic variables, such as age, number of medications, gender and number of underlying diseases. Additionally, linear regression was used to predict the factors affecting dry mouth due to the small average score of dry mouth. First, simple linear regression was used to determine the relationship between each variable and dry mouth, and then the multiple linear regression model was used to determine the effective factors in an adjusted manner. The significance level was set at $P < 0.05$.

Results

A total of 209 patients participated in the research, with an average age of 62.3 ± 11.5 years. Of the participants, 97 (46.4%) were females and 112 (53.6%) were males. Their age range was 31 to 95 years, and they were divided into four groups: less than 50 years, 50 to 60 years, 60 to 70 years, and more than 70 years. The highest percentage of patients (32.5%) were in the 60 to 70-year age group (Table 1).

In terms of concomitant underlying diseases, 8.1% of the patients had no other diseases, 19.1% had one comorbidity, 36.8% had two other comorbidities, and 27.8% had three comorbidities. All patients had heart disease. Moreover, 7.7% of the patients did not take any medicine, 22.4% took 1 to 4 drugs, and 45% took 5 to 7 drugs. The average score for OHQoL was 25.1 ± 7.3. The lowest average score was in the social disability area, indicating better OHQoL in this area (2.9 ± 1.5). The average physical disability score was 4.2 ± 1.6, with the higher score representing more challenging patient conditions in this domain.

Based on positive responses to questions 4, 5, or 6 of the questionnaires, 68.6% of the patients had dry mouth. The dry mouth score, obtained from the total score of all questions in the questionnaire, was 8.6 ± 3.2 (Table 2).

Pearson's correlation test showed a significant positive correlation between the overall OHQoL score and dry

mouth ($P=0.001$). As the dry mouth score of the patients increased, their OHQoL score increased, showing a decline in their QOL. We also observed a statistically significant direct association between the sub-scales of Functional limitation ($P=0.001$), Psychological disability ($P=0.006$), Physical discomfort (pain) ($P=0.001$), Social disability ($P=0.009$), and Handicap ($P=0.001$) (Table 3).

Males showed marginally better OHQoL scores than females, though nonsignificant ($P=0.5$). Gender differences were similarly nonsignificant for other measured outcomes ($P=0.1$).

Table 1. Demographic and Health Data Summary

Variable	Mean (SD)	Range (Min-Max)	Frequency (n)	Percentage (%)
Age	62.3 (11.5)	31 - 95		
Gender				
Female			97	46.4
Male			112	53.6
Total			209	100
Age Group				
<50 years			52	24.9
50 to 60 years			68	32.5
60 to 70 years			59	28.2
>70 years			30	14.4
Number of Comorbidities				
None			17	8.1
1			40	19.1
2			77	36.8
3			58	27.9
4 or more			17	8.1
Total			209	100
Number of Medications				
None			16	7.7
1 to 4			47	22.4
5 to 7			94	45.0
8 or more			52	24.9
Total			209	100

The one-way analysis of the variance test showed a statistically significant difference in the average score of OHQoL among different age groups ($P=0.01$). As the age of the patients increased, the average score of OHQoL increased, indicating a worse QOL at older ages. However, the average score of dry mouth was similar among age groups, and did not show a statistically significant difference ($P=0.15$).

There was a significant difference in the average OHQoL scores based on the number of medications taken by the patient ($P=0.001$). As the number of medications consumed by the patient increased, the average OHQoL score of the patients significantly increased, indicating a weaker QoL. Additionally, the average score of dry mouth significantly increased with an increase in the number of medications consumed by the patient ($P=0.001$).

The OHQoL scores and instances of dry mouth were significantly different among individuals with varying numbers of underlying diseases. ($P=0.001$ and $P=0.002$, respectively). Patients with more comorbid conditions reported progressively worse QoL outcomes and more severe dry mouth symptoms.

Simple and multiple linear regressions were used to predict factors affecting dry mouth. In the crude model, the total QOL score, the number of medications, and the number of underlying diseases were predictors of dry mouth score among them. In the adjusted model, only the variables of QoL and the number of medications used

Table 3. The relation of seven domains of OHIP-14 questionnaire and xerostomia

Subscale	Average Score	Standard Deviation	Correlation Size	Significance Level
Functional limitation	2.3	6.1	-0.36	0.001
Physical discomfort (pain)	8.3	1.1	-0.13	0.057
Psychological discomfort	9.3	7.1	-0.19	0.006
Physical disability	2.4	6.1	-0.28	0.001
Psychological disability	7.3	4.1	-0.11	0.119
Social disability	3.3	2.1	-0.18	0.009
Handicap	9.2	5.1	-0.24	0.001
Total score	25.1	3.7	-0.32	0.001

Table 2. The state of dry mouth of the participants in the study based on Fox's standard questionnaire

Dry Mouth Score	Average	Standard Deviation	At least	Maximum
	8.6	3.2	1	12
Has a dry mouth?	**Number (yes)**	**Percent**	**Number (no)**	**Percent**
Based on question 4 of the questionnaire: the feeling of dry mouth during the night or when waking up	167	79.1%	42	20.9%
Based on question 5 of the questionnaire: the feeling of dry mouth at other times of the day	132	62.9%	77	37.1%
Based on question 6 of the questionnaire: the need for water next to the bed while sleeping	126	60.3%	83	39.7%
Presence of dry mouth based on all three questions	181	85.9%	28	13.1%

* The minimum score that can be obtained in this questionnaire is zero and the maximum is thirty-six.

maintained their significance. For every unit increase in an OHQoL score, the dry mouth score rises by 0.07 units, assuming all other variables remain unchanged. Additionally, the severity of dry mouth increases by 1.05 units for each additional medication the patient uses.

Discussion

The study found a meaningful difference in the average score of QOL based on the patient's age, the number of medications taken by the patient, and the number of underlying diseases. In this study, 46.4% of patients with cardiovascular diseases were female. These results align with findings from other studies in Iran and worldwide.[19-22]

Although the ratio of men to women in our study is lower than in these other studies, the overall trend of higher incidence of heart diseases in men is consistent.

Regarding the number of comorbidities in this study, 1.8% of patients had no other diseases, 19.1% had one comorbidity, 36.8% had two other comorbidities, and 27.8% had three comorbidities, while other patients had more than three diseases in addition to heart disease. Since no other studies have investigated the number of underlying diseases in heart patients, it is impossible to compare these results with another research.

Choi et al's study investigated 41 patients with an average age of 55.2 ± 13.8 years, and the Oral Health Impact Profile -14 (OHIP-14) score of patients with dry mouth was high (44.3 ± 13.2). He found that the severity of dry mouth symptoms, frequency of behaviors related to dry mouth, and presence of difficulty in speaking were characteristics associated with a high OHIP-14 score in patients with dry mouth. The study also revealed that patients' self-reported saliva levels during routine activities and their perceived speech difficulties negatively impacted OHQoL in individuals with xerostomia. Specifically, subjective assessments of reduced saliva production and speech impairment were significantly associated with poorer OHQoL outcomes in this population.[23]

Molania et al studied 240 patients with cardiovascular diseases. The age of the patients was reported as 59.34 ± 18. (19) The age range of cardiac patients in that study was 29 to 88 years, which is similar to the age range of the subjects in the present study.

In researches conducted by Schmalz et al in Germany, the age of the patients was reported as 55.26 ± 12.6 and 58.20 ± 9.37. The average age of their study participants was lower compared to our study.[21,24] The differences in age range across studies might be due to epidemiological differences in heart diseases among different geographical regions and differences in sampling methods.

In Segura-Saint-Gerons et al's study on heart transplant patients, using the OHIP-49 questionnaire, the average QOL score related to oral health was 24.3, which reinforces our findings.[22] In Molania et al's study on patients with cardiovascular diseases, the QOL score was reported as 21.34 ± 17.40. The average OHQoL score in patients with dry mouth was 26.32 ± 16.93, while it was determined as 17.65 ± 16.87 in patients without xerostomia.[19]

Chamani's study on rheumatoid patients, using the OHIP-14 questionnaire, found that in patients with xerostomia, the average score was 10.9, which was lower than the scores obtained for patients with cardiovascular diseases. For those without xerostomia, the score was 7.7. The lowest score was obtained in the social disability subscale, which is like the results of our findings. The analysis revealed particularly elevated scores in the physical pain domain, suggesting rheumatoid arthritis patients experience more frequent oral and masticatory discomfort compared to cardiac patients. Notably, rheumatoid subjects with xerostomia showed statistically significant impairments across multiple quality-of-life dimensions - including functional restrictions, physical discomfort, activity limitations, and social participation challenges-when contrasted with their non-xerostomic counterparts.[6]

In this study, using the OHIP-14 questionnaire, ranging from 0 to 56, the average score of OHQoL was reported as 25.1 ± 7.3. The study found a moderate effect of dry mouth on OHQoL. It is important to note that different diseases, medications, and underlying conditions can lead to different results when comparing the average score of OHQoL in people with different diseases.

In Molania's study in Sari on cardiac patients, 42.5% of patients reported dry mouth.[19] The average score obtained in that study was 3.7 ± 3.5, which shows a better condition of patients compared to our findings regarding dry mouth. In the research conducted by Rad et al in Kerman, the prevalence of xerostomia in community-dwelling adults was reported to be 55%.[17] In Locker's study in Canada, 20.6% of the elderly population studied did not have xerostomia, 30.6% reported moderate dry mouth, and 43.2% reported severe dry mouth.[25] Considering these findings, the prevalence of dry mouth in the present study seems appropriate and reasonable. Molania's study reported a lower prevalence of dry mouth compared to the Population-based samples of Iran, which is expected to have a higher occurrence of dry mouth considering the risk factors in cardiac patients.[19]

No study has investigated the correlation between QOL score and dry mouth in patients with cardiovascular diseases. However, some researches have examined the incidence of problems related to mouth health, such as alveolar bone loss, as well as the relationship between periodontal diseases and cardiovascular diseases. A direct correlation between dry mouth and OHQoL in patients with type 1 diabetes has also been reported, where OHIP-14 scores were higher in people with dry mouth compared to those without dry mouth, which is consistent with our findings.[26]

In a research designed by Jellema et al on cancer

patients undergoing chemotherapy, it was found that radiation-induced xerostomia had a negative and significant correlation with OHQoL in patients with head and neck cancer, which is in line with the results of our study for cardiac patients.[27] Henson et al documented a pronounced decline in OHQoL among patients post-radiation therapy, primarily attributed to salivary gland dysfunction. Their longitudinal analysis revealed that subsequent recovery of salivary function correlated with measurable OHQoL improvements, a finding consistent with the outcomes observed in our investigation.[28]

our findings are substantiated by the understanding that xerostomia (dry mouth) can precipitate a range of oral pathological conditions, including caries, bad breath, burning mouth syndrome, plaque accumulation, stomatitis, mucositis, ulcerations, microbial opportunism disorders, periodontal diseases, and other related disorders. Consequently, a deterioration in OHQoL is anticipated among patients with oral dryness. Global research findings have indicated that this condition is associated with a decline in mouth health status, an increase in carious lesions, and diminished oral health indices, thereby corroborating the findings of the present research.[27,28]

Molania et al's investigation yielded distinct age-related patterns, revealing no significant association between OHQoL and age, while demonstrating a clear correlation between advancing age and xerostomia prevalence. Their cohort analysis showed marked age differences between groups, with xerostomia patients averaging 11.9 years younger (SD = 11.62) than unaffected participants (M = 62.12, SD = 11.9). The study additionally identified gender disparities in OHQoL outcomes, with male participants exhibiting more pronounced impacts than females in contrast to our null findings. This discrepancy likely stems from demographic variations, as our sample showed a balanced gender distribution (53.6% male) compared to Molania's male-dominated cohort (63.2%).[19]

In the research conducted by Charandabi et al, females showed a lower QOL than males.[29] which could be related to women's age and postmenopausal stress condition.

Yavsan and colleagues in Türkiye overviewed the relationship between the QOL and the presence of dental plaque, inflammation, and gingivitis in seventy-five children aged 3-6 years with congenital heart disease. In this study, the amount of dental plaque, inflammation, and gingivitis was higher in the case group; however, the QOL scores were not statistically significant. They concluded that caries in these individuals is an important public health issue in society.[30]

Some studies assess the QOL and oral manifestations in different conditions[31-34]; however, our research is the first study to examine the relationship between the number of medications taken, the number of underlying diseases, and their impact on dry mouth and OHQoL. Studies have shown that patients with cardiovascular diseases who take cardiac drugs often experience dry mouth as the most common oral complication. There is also a clinically meaningful correlation between the number of medications consumed and the increase in oral complications.[7]

Strengths and Limitations

The study faced time constraints as some patients were either illiterate or unable to complete the questionnaire due to physical issues. In these cases, the questions were read aloud by the examiner, who then accurately recorded the responses. The Fox questionnaire, along with individuals' subjective perceptions of dry mouth, was utilized to assess dry mouth. However, this method is less precise compared to objective measurements using saliva tests. Additionally, the COVID-19 pandemic conditions prevented the measurement of saliva flow, which is a limitation of the research.

Due to the variety of medications used by patients, this study only examined the number of medications being used.

Conclusion

Our findings indicate that xerostomia significantly impacts the oral health-related quality of life (OHQoL) in patients with cardiovascular diseases. This relationship underscores the essential value of mitigating xerostomia in this population, as it can lead to increased discomfort and hinder effective oral hygiene practices.

Although it is well-established that various drugs prescribed for cardiovascular conditions may contribute to changes in QOL, varied medication profiles and their progressive clinical manifestations create challenges in determining which specific treatments most affect patients' oral health quality.

Given these findings, patient care providers need to consider the impact of dry mouth when managing patients with cardiovascular diseases. We recommend that future studies could concentrate on the specific effects of different drugs on xerostomia and its Resultant impact on Oral Health-Related Quality of Life. Such research could inform clinical practices and lead to improved intervention approaches for enhancing the overall well-being of patients with cardiovascular diseases.

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Authors' Contribution

Conceptualization: Sahar Mafi, Zahra Nazari, Nader Salari.
Data curation: Zahra Nazari.
Formal analysis: Nader Salari, Sahar Mafi.
Investigation: Zahra Nazari.
Methodology: Sahar Mafi, Nader Salari.
Project administration: Arezoo Alaee, Sahar Mafi.

Resource: Arezoo Alaee, Sahar Mafi.
Software: Nader Salari.
Supervision: Arezoo Alaee, Sahar Mafi.
Validation: Zahra Nazari, Nader Salari.
Visualization: Zahra Nazari, Nader Salari.
Writing-original draft: Arezoo Alaee, Sahar Mafi.
Writing-review & editing: Arezoo Alaee, Sahar Mafi.

Competing Interests
The authors declare no competing interests.

Data Availability Statement
All data related to the study are included within the text.

Ethical Approval
The Code of Ethics 569-1400 conducted the study IR.KUMS.REC.

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