Original paper

Comparison of periodontal indices, DMFT, xerostomia, hyposalivation and oral health-related quality of life in Sjögren's syndrome patients versus healthy individuals: A case–control study

Tahereh Molania[1,E,F], Maede Salehi[1,D,E], Hodis Ehsani[2,A], Mahmood Moosazadeh[3,C], Fatemeh Niksolat[4,A], Atefe Rezaei[5,B,D], Negareh Salehabadi[6,B,D], Fateme Rezaei[6,B], Mohammad Ebrahimi Saravi[7,E,F]

[1] Department of Oral Medicine, Dental Research Center, Faculty of Dentistry, Mazandaran University of Medical Sciences, Sari, Iran
[2] Department of Periodontology, Dental Research Center, Faculty of Dentistry, Mazandaran University of Medical Sciences, Sari, Iran
[3] Gastrointestinal Cancer Research Center, Non-Communicable Diseases Institute, Mazandaran University of Medical Sciences, Sari, Iran
[4] Department of Internal Medicine, Orthopedic Research Center, Faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran
[5] Dentist, Sari, Iran
[6] Dentistry student, Students' Research Committee, Faculty of Dentistry, Mazandaran University of Medical Sciences, Sari, Iran
[7] Department of Prosthodontic, Dental Research Center, Faculty of Dentistry, Mazandaran University of Medical Sciences, Sari, Iran

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;
D – writing the article; E – critical revision of the article; F – final approval of the article

Dental and Medical Problems, ISSN 1644-387X (print), ISSN 2300-9020 (online) *Dent Med Probl*. 2023;60(1):99–107

Address for correspondence
Mohammad Ebrahimi Saravi
E-mail: mohammadebrahimisaravi@gmail.com

Funding sources
Mazandaran University of Medical Sciences, Sari, Iran.

Conflict of interest
None declared

Acknowledgements
This study is the result of a research project with project code IR.MAZUMS.REC.1398.6148, approved by Mazandaran University of Medical Sciences, Sari, Iran. We would like to thank the esteemed
Vice Chancellor for Research for the financial support of the project.

Received on December 2, 2021
Reviewed on February 6, 2022
Accepted on February 17, 2022

Published online on March 31, 2023

Cite as
Molania T, Salehi M, Ehsani H, et al. Comparison of periodontal indices, DMFT, xerostomia, hyposalivation and oral health-related quality of life in Sjögren's syndrome patients versus healthy individuals: A case–control study. *Dent Med Probl.* 2023;60(1):99–107. doi:10.17219/dmp/146771

DOI
10.17219/dmp/146771

Abstract

Background. Sjögren's syndrome (SS) is a common systemic autoimmune disease that affects oral health, and consequently oral health-related quality of life (OHRQoL) due to the involvement of exocrine glands.

Objectives. The present study aimed to evaluate the oral health-related quality of life and oral health indicators in patients with SS in comparison with healthy individuals.

Material and methods. In the case and control groups (45 patients and 45 healthy individuals), questions about demographic data, other systemic disorders, medications, the years of infection, xerostomia, as well as inquiries about the quality of life (Oral Health Impact Profile-14 – OHIP-14) were asked. The patients were evaluated clinically, and oral health indicators, including the plaque index (PI), the gingival index (GI), the sulcus bleeding index (SBI), and the number of decayed, missing and filled teeth (DMFT) were assessed on the Ramfjord teeth. Unstimulated saliva samples from both groups were obtained and weighed. The data was analyzed using IBM SPSS Statistics for Windows, v. 24.0. Quantitative variables were compared between the case and control groups with the use of the independent t test or their non-parametric equivalent (the Mann–Whitney test).

Results. The comparison of the quantitative variables between the study groups showed a statistically significant difference in the OHRQoL scores ($p = 0.037$) and the unstimulated saliva flow rate ($p = 0.002$) between the case and control groups. Also, there was a statistically significant difference in the DMFT index between patients with primary and secondary SS in the case group ($p = 0.048$).

Conclusions. The lower OHRQoL of patients with SS requires more attention and follow-up to solve periodontal and dental problems in this group of patients.

Keywords: oral health-related quality of life, Sjögren's syndrome, plaque index, gingival index

Introduction

Sjogren's syndrome (SS) is an autoimmune disease of the exocrine glands that mainly affects the salivary and lacrimal glands.[1] This disease affects 3–4% of the adult population and primarily affects middle-aged to older women. The prevalence of this disease in the European population varies from 0.05 to 1%.[2,3] The condition can be divided into primary and secondary SS.[4] It can be present alone (primary SS, pSS) or in association with other systemic autoimmune disorders such as lupus, rheumatoid arthritis, and connective tissue diseases (secondary SS, sSS). The clinical presentation of this disease is characterized by dryness of the entire mucosa. Symptoms may range from localized outcomes of the exocrine glands to systemic complications such as vasculitis.[5] Although the etiology of this disease is still unknown, the current hypothesis supports an autoimmune reaction within the exocrine glands, which triggers the uptake of salivary gland and lacrimal cell nuclear factors. Over the years, this pathological process leads to lymph node destruction and disruption or even total loss of saliva and tears.[6] SS can affect the overall quality of life related to general health.[1] Fatigue, pain, and systemic manifestations are the predominant complications of this disease that affects the health-related quality of life.[7] Quality of life is a multidimensional and broad concept that means a person's understanding of their life situation according to culture and value systems, expectations, standards, and life experiences that affect the state of physical, mental, social communication, and personal beliefs.[8] Quality of life is a valuable indicator used to measure health status in research.[9] Oral health-related quality of life (OHRQoL) includes a part of the quality of life affected explicitly by oral health.[10]

Decreased salivation in patients with pSS can have a significant negative effect on oral health.[11] Oral symptoms of SS are mainly due to decreased salivary flow.[12] Xerostomia can be severe and can lead to discomfort and problems with speech, eating, swallowing, changes in taste, candidiasis of the mouth, tooth decay, and periodontal problems.[13] In these patients, oral issues play a critical role in OHRQoL.[14] Numerous studies have linked decreased salivation to oral problems.[15,16] A few studies have reported taste and smell disorders in patients with early SS.[17] However, the effect of oral symptoms of SS on OHRQoL is not yet fully understood.[18] Health interventions are increasingly being used to assess the impacts of oral disorders.[19] A comprehensive approach to measuring OHRQoL combines the use of general and specific oral criteria with specific conditions.[20] Oral Health Impact Profile (OHIP) is currently one of the most comprehensive measures of the effect of oral status on health-related quality of life.[21] Assessing patient-based health status is essential to measuring health. Oral diseases are prevalent and have physical, social, economic, and psychological consequences on patients. Many of these patients' quality of life is impaired, and various aspects of their lives, such as chewing food and speech, can be affected.[22] The OHIP was developed by Slade and Spencer in 1994 and is an advanced OHRQoL tool that is used internationally.[23] The main OHIP consists of 49 items that can be long and time-consuming. In 1997, Slade developed a short form with 14 questions called the OHIP-14 that was found to have good reliability, accuracy, and credibility.[24] These fourteen items of the OHIP fall into seven aspects: functional limitations, physical pain, mental discomfort, physical disability, mental disability, social disability, and disability.[23]

Therefore, considering the significant effects of SS on general health and oral health, the lack of a similar study in Iran, and to measure of some variables that have not been studied so far, this study aims to evaluate the OHRQoL of patients with SS referred to the Touba Clinic in Sari in 2020. The null hypothesis is that there is a difference between SS patients and healthy individuals when looking at periodontal indices, Decayed, Missing, and Filled Teeth (DMFT) index, xerostomia, hyposalivation, and OHRQoL.

Material and methods

The present study is a case-control study of patients referred to the Touba Clinic in Sari, India, in 2020. The Research Ethics Committee of Mazandaran University of Medical Sciences approved this study (Ethics Code: IR.MAZUMS.REC.1398.6148). The sample size was estimated using the results of a study by Meijer et al.[4] In their study, the mean and standard deviations were 59.2 ±26.0 in the case group and 74.8 ±25.8 in the control group, respectively. Considering these results, a 95% confidence level, an 80% test power, two test ranges, and using the comparison formula between means and using the G*power software, the sample size was estimated to be 90 people (45 people in the case group and 45 in the control group).

The inclusion criteria included people with primary or secondary SS diagnosed using the American-European Consensus Group criteria[5] with an age range of 30–80 years who had at least 20 teeth in their mouth and no history of periodontal treatment in the past three months. The exclusion criteria included patients who are illiterates, patients who were unable to complete the questionnaire, and patients with chronic gastrointestinal diseases, organ transplantation, diabetes mellitus, infectious diseases (hepatitis, HIV), seizure disorder or neuropathy, heart failure, drug users, pregnant women, smokers, and alcoholics.[25] The control group was selected from patients referred to the Sari Dental School clinic. In addition to the mentioned inclusion and exclusion criteria, age and gender were considered for the case group. Also, the control group was negative for diabetes based on fasting blood sugar (FBS) test results in the month before the start of the study.

Data collection

The purpose of the research and its steps were initially explained to all participants, and after obtaining written consent, patients were assured that their information would remain confidential. This study's data collection method used a question-and-answer session, a questionnaire, patient records, and a clinical oral examination by a periodontist. Demographic information for the patients (age, gender) and information related to the patient (duration of illness, medications) were recorded in the patient's files. To determine the presence of xerostomia, patients were asked 9 questions, and those who answered 9 to 5 questions positively were diagnosed with xerostomia.[25]

Unstimulated saliva flow rate

To assess the unstimulated saliva flow rate (USFR), individuals were asked to avoid drinking, eating, and smoking for at least 2 h before sampling. Patients with partial dentures were asked to remove them from their mouths. While collecting unstimulated saliva samples, individuals were asked to sit and reduce their mouth movement and not swallow or suck. Saliva was then collected from the floor of their mouths for 60 s. They were then asked to spit it in a pre-weighed tube for five consecutive minutes. The saliva samples were stored in the freezer at –70°C until assayed. The amount of unstimulated saliva was measured by the weighting method and expressed in milliliters per minute. A USFR <0.1 mL/min was considered to indicate hyposalvation.[26]

Oral health-related quality of life

To assess OHRQoL in this study, the OHIP-14 questionnaire was used, and the validity and reliability of the Persian version were confirmed[27] and included the seven subgroups: functional limitation, physical pain, mental discomfort, physical disability, mental disability, social disability, and disability. Each subgroup consisted of 2 questions. Two methods were considered to evaluate the responses. The additive[17] method in which test options were scored as never = 0, seldom = 1, sometimes = 2, most often = 3, in the majority of cases = 4. The OHIP-14 scores could range between 0 and 56, and the lower the score, the better the quality of life for the patient. In another evaluation method called simple count (SC), the score given for "never" and "seldom" options is zero, and the score given for sometimes, most often, and in the majority of cases is one. This method was used because some people do not understand the real difference between the questionnaire options. The OHIP-14 score ranges from zero to 14 using the SC method, and again the lower the score, the higher quality of life in the patient.[27]

Periodontal indices

Finally, the patients were clinically examined by a periodontist. The DMFT, the plaque index (PI), the gingival index (GI), and the sulcus bleeding index (SBI) were performed on the Ramfjord teeth (teeth numbers 3, 9, 12, 19, 25, and 28), and if one of these teeth were missing, the lateral tooth was used.[28]

Statistical analysis

To analyze the data, all the recorded information was entered into the IBM SPSS Statistics for Windows software, v. 25.0 (IBM Corp., Armonk, USA). The normality of quantitative variables was assessed using the Kolmogorov–Smirnov and Shapiro–Wilk tests. The variables were described as mean and standard deviation ($M \pm SD$), minimum and maximum, and as number and percentage (n (%)). The normally distributed variables were compared using the independent t tests, whereas abnormal parameters were compared using a non-parametric comparative test (the Mann–Whitney test), and for multiple groups, the non-parametric Kruskal–Wallis H comparison test was performed. To examine the correlation relationships, normal data utilized the Pearson correlation method, whereas abnormal data used the Spearman method. Also, for the comparison of variables between the groups, the χ^2 test and Fisher's exact test were used. Finally, to rank and prioritize abnormal data, the Friedman ranking method was used. The criterion in which all cases reached statistical significance was a p-value <0.05, except for the normality and equality of variance.

After obtaining a license from the esteemed vice-chancellor of research at the university, the ethics committee began the process in Sari using the ethics code IR.MAZUMS.REC.1398.488 and obtained approval from the competent authorities. This research started by obtaining patient consent after explaining the potential advantages and disadvantages of the study, the goals of the project, the voluntary nature of the study, the possibility of leaving the study at any time, and the process of keeping the patients' information and identity confidential.

Results

A total of 90 people (45 in the case group and 45 in the control group) participated in this study. In the case group, 19 patients (42%) had pSS, and 26 patients (58%) had sSS (22 patients with rheumatoid arthritis and 4 patients with scleroderma). There were 40 women (88%) and 5 men (12%) in both groups. The mean age of the case group was 50.62 ±7.82 years, and the control group was 50.62 ±7.82 years, which had a similar distribution that was not statistically significant (p = 0.999). The mean age in the case group with pSS was 47.68 ±8.42 years. The case group

with sSS was 52.77 ±6.73 years, which was not statistically significant based on a non-parametric comparison test (Mann–Whitney; $p = 0.373$). The disease duration in the case group varied from 4 months to 20 years. The period of the disease had a significant relationship with the patient's age ($p = 0.027$) but had no statistical association with any other measured indicators. It should be noted that in the case group, 17 people (38%, 8 people with pSS, and 9 people with sSS), and in the control group, 6 people (13%) had hyposalivation. Examination of the 9-item xerostomia questionnaire revealed that 20 patients (45%) in the case group (8 patients with pSS and 9 patients with sSS) and only 4 patients (90%) in the control group had xerostomia.

The results of the analyzed quantitative variables in this study, as presented in Table 1, show that the mean DMFT index in the case group was 10.29 ±4.70. In the control group, it was 10.24 ±4.78, which was not statistically significant ($p = 0.965$). PI, GI, and SBI were also examined in the case and control groups, and the results showed that the mean PI in the case group was 1.33 ±0.44 and 1.37 ±0.39 in the control group, which was not significantly different ($p = 0.646$). The mean GI in the case group was 6.93 ±1.43 and 7.67 ±1.87 in the control group, which was not significantly different ($p = 0.206$). Also, the mean SBI in the case group was 0.93 ±1.42 and 1.53 ±1.77 in the control group, which was not statistically significant despite the apparent difference ($p = 0.210$). Saliva samples collected from the two groups after weighing showed that the mean USFR per minute in the case group was 0.93 ±0.99. The USFR per minute in the control group was 1.36 ±0.99, in which the difference was statistically significant ($p = 0.002$). It should be noted that 17 patients in the case group (38%) and 6 in the control group (13%) had hyposalivation (Table 1).

Table 2 summarizes the results of the correlation relationships between the quantitative variables. These results show that in the case group, there were significant correlations between PI with GI and SBI with coefficients of $r = 0.397$ and $r = 0.305$, respectively. There is also a stronger positive correlation between GI and SBI ($r = 0.89$).

Examination of Pearson correlations in the control group also shows that there is a significant and negative correlation between patient age and USFR ($r = 0.40$). There is also a relationship between age and PI ($r = 0.38$). There is a significant correlation ($p = 0.32$) between PI

Table 1. Statistical comparison of the studied quantitative variables in the case and control groups

Variables	Case group			Control group			p-value
	n	*M* ±*SD*	range	*n*	*M* ±*SD*	range	
ADD_OHIP14	45	19.56 ±12.46	0–50	45	14.42 ±10.46	0–42	0.037*
SC_OHIP14	45	6.60 ±4.02	0–14	45	4.71 ±3.81	0–13	0.025*
Age [years]	45	50.62 ±7.82	32–70	45	50.62 ±7.82	32–70	0.999
PI	45	1.33 ±0.44	1–3	45	1.37 ±0.39	1–3	0.646
GI	45	1.17 ±0.25	1–3	45	1.27 ±0.31	1–3	0.206
SBI	45	0.16 ±0.24	0–1	45	0.25 ±0.30	0–1	0.210
DMFT	45	10.29 ±4.70	2–21	45	10.24 ±4.78	1–21	0.965
USFR	45	0.19 ±0.20	0.00–4.18	45	0.27 ±0.20	0.14–4.54	0.002**

M – mean; *SD* – standard deviation; ADD_OHIP14 – additive oral health impact profile; SC_OHIP14 – simple-count oral health impact profile; PI – plaque index; GI – gingival index; SBI – sulcus bleeding index; DMFT – number of decayed, missing and filled teeth; USFR – unstimulated saliva flow rate;
* statistically significant ($p < 0.05$); ** statistically significant ($p < 0.015$).

Table 2. Correlation relationships between the quantitative variables in both study groups

Quantitative research variables	*n*	Statistical index	Case group – quantitative research variables					Control group – quantitative research variables				
			USFR	DMFT	SBI	GI	PI	USFR	DMFT	SBI	GI	PI
Age	45	correlation coefficient	–0.098	–0.075	0.081	0.233	0.119	–0.398**	0.224	–0.001	0.074	0.383**
		p-value	0.523	0.624	0.597	0.123	0.435	0.007	0.139	0.995	0.630	0.009
PI	45	correlation coefficient	–0.244	0.210	0.305*	0.397**	–	–0.364*	0.082	0.260	0.325*	–
		p-value	0.106	0.166	0.042	0.007	–	0.014	0.592	0.084	0.029	–
GI	45	correlation coefficient	–0.075	0.181	0.892**	–	–	–0.176	0.130	0.931**	–	–
		p-value	0.626	0.235	0.000	–	–	0.248	0.393	0.000	–	–
SBI	45	correlation coefficient	–0.075	0.181	–	–	–	–0.169	0.139	–	–	–
		p-value	0.626	0.235	–	–	–	0.260	0.362	–	–	–
DMFT	45	correlation coefficient	0.060	–	–	–	–	0.155	–	–	–	–
		p-value	0.695	–	–	–	–	0.310	–	–	–	–

* statistically significant ($p < 0.05$); ** statistically significant ($p < 0.015$).

and GI with a 95% accuracy. As in the case group, there is a strong correlation (r = 0.93) between the GI and SBI variables (Table 2).

In the study of OHRQoL as a dependent variable with the independent quantitative variables using Pearson correlation coefficient analysis, we observed that additive oral health impact profile (ADD_OHIP14) and simple-count oral health impact profile (SC-OHIP14) in the case group had a positive and significant correlation with PI (r = 0.31 and r = 0.35, respectively). But in the control group, this correlation was not statistically significant. Other quantitative data, such as GI, SBI, and DMFT did not show a significant relationship with oral quality of life variables collected in the questionnaire (Table 3).

Comparative evaluation of patients with primary and secondary SS

Quantitative indices in patients with primary and secondary SS

The analyzed results of SS patients in the two groups of pSS and sSS in Table 4 showed that the mean ADD_OHIP-14 in pSS patients was 21.00 ±10.30. In sSS, it was 18.50 ±13.93, and the mean SC_OHIP14 in pSS was 7.21 ±1.08. In sSS, it was 6.15 ±4.01, which did not show a statistically significant difference (p = 0.493 and p = 0.392, respectively). Also, PI, GI, and SBI indices between primary and secondary Sjogren's were examined. The mean PI in pSS was 1.342 ±0.37, and in sSS was 1.314 ±0.495 (p = 0.829). The mean GI was 1.123 ±0.156 in pSS and 1.212 ±0.304 in sSS (p = 0.660). The mean SBI in pSS was 0.114 ±0.125, and in sSS was 0.186 ±0.292 (p = 0.980). Also, the mean USFR values were not statistically significant between the two groups of Sjogren's patients (p = 0.260). However, the mean DMFT in primary Sjogren's patients was 12.05 ±4.65, and in secondary patients, it was 9.31 ±4.15, which was statistically significant (p = 0.048) (Table 4).

Comparison of the quantitative indices in SS patients with regard to gender

The results showed no statistically significant difference in ADD-OHIP14, SC-OHIP14, age, GI, SBI, and DMFT in men and women with SS, but this difference was statistically significant for PI (p = 0.045). A comparison of the mean USFR in Sjogren's patients also showed that the mean in women was higher than in men (p = 0.026) (Table 5).

Table 3. Correlation relationships between the oral health-related quality of life (OHRQoL) dependent variables and the quantitative variables in both study groups

Quantitative variables	Case group				Control group			
	ADD-OHIP14		SC-OHIP14		ADD-OHIP14		SC-OHIP14	
	correlation coefficient	*p*-value	correlation coefficient	*p*-value	correlation coefficient	*p*-value	correlation coefficient	*p*-value
Age	0.024	0.876	0.141	0.356	–0.168	0.269	–0.105	0.491
PI	0.313*	0.036	0.354*	0.017	0.145	0.343	0.239	0.113
GI	–0.209	0.169	–0.179	0.240	0.070	0.648	0.108	0.479
SBI	–0.210	0.166	–0.190	0.211	0.105	0.492	0.138	0.365
DMFT	–0.019	0.899	–0.024	0.877	0.131	0.392	0.158	0.301
USFR	–0.90	0.559	–0.106	0.488	0.197	0.148	0.195	0.200
ADD_OHIP14	–	–	0.895**	0.000	–	–	0.958**	0.000
SC_OHIP14	0.895**	0.000	–	–	0.958**	0.000	–	–

* statistically significant (p < 0.05); ** statistically significant (p < 0.015).

Table 4. Comparison of the quantitative indices between the 2 groups of primary and secondary patients with Sjögren's syndrome (SS)

Quantitative variables	Primary SS			Secondary SS			*p*-value
	n	*M* ±*SD*	range	*n*	*M* ±*SD*	range	
ADD_OHIP14	19	21.00 ±10.30	3–39	26	18.50 ±13.93	0–50	0.493
SC_OHIP14	19	7.21 ±1.08	1–13	26	6.15 ±4.01	1–14	0.392
Age	19	47.68 ±8.42	32–63	26	52.77 ±6.73	37–70	0.037*
PI	19	1.342 ±0.370	0.5–2.0	26	1.314 ±0.495	0.2–2.0	0.829
GI	19	1.123 ±0.156	1.0–1.5	26	1.212 ±0.304	1.0–2.0	0.660
SBI	19	0.114 ±0.125	0–0.3	26	0.186 ±0.292	0–1.0	0.980
DMFT	19	12.05 ±4.65	2–21	26	9.31 ±4.15	3–18	0.048*
USFR	19	0.888 ±1.152	0.02–4.20	26	0.960 ±0.879	0.09–3.99	0.260

* statistically significant (p < 0.05).

Table 5. Comparison of the quantitative indices between the women and men with Sjögren's syndrome (SS)

Quantitative variables	Women			Men			*p*-value
	n	*M* ±*SD*	range	*n*	*M* ±*SD*	range	
ADD_OHIP14	40	18.75 ±11.58	0–50	5	26.0 ±18.47	7–50	0.224
SC_OHIP14	40	6.45 ±4.10	1–14	5	7.80 ±3.70	3–12	0.486
Age	40	50.25 ±7.28	32–64	5	53.60 ±11.97	37–70	0.373
PI	40	1.28 ±0.43	0.17–2.00	5	1.70 ±0.41	1.00–2.00	0.045*
GI	40	1.20 ±0.26	1–2	5	1.00 ±0.00	1–1	0.056
SBI	40	0.18 ±0.24	0–1	5	0.00 ±0.00	0–0	0.056
DMFT	40	10.53 ±4.60	2–21	5	10.00 ±4.36	5–17	0.811
USFR	40	1.01 ±1.02	0.01–4.20	5	0.30 ±0.18	0.10–0.59	0.026*

* statistically significant ($p < 0.05$).

Investigating the effect of the duration of the disease

Examination of the correlations between the studied quantitative variables and the duration of SS in Table 6 shows that there is a significant relationship between the studied indices ADD_OHIP14, SC_OHIP14, PI, GI, SBI, and USFR in patients with SS in relation to the duration of the disease. Still, there was a correlation with patient age ($r = 0.33$) which was also obvious ($p = 0.027$). Also, the mean DMFT in Sjogren's patients had a positive and significant relationship with the disease's duration (Table 6)

Table 6. Evaluation of correlation relations (Spearman' coefficient) between the duration of Sjögren's syndrome (SS) and the quantitative variables

Number	Quantitative variables	Duration of SS		
		n	correlation coefficient	*p*-value
1	ADD_OHIP14	45	–0.132	0.386
2	SC_OHIP14	45	–0.067	0.662
3	Age	45	0.329	0.027*
4	PI	45	0.036	0.814
5	GI	45	–0.147	0.336
6	SBI	45	–0.070	0.648
7	DMFT	45	0.297	0.048*
8	USFR	45	–0.057	0.708

* statistically significant ($p < 0.05$).

Effect of different drug therapies on the quantitative indices in SS patients

In this study, 100% of people used hydroxychloroquine and adjuvant drugs such as folic acid, calcium, and omega-3, 33% of patients were treated with methotrexate or prednisolone in addition to the above, and 11% of patients also used bromhexine. The results of a comparative analysis of the quantitative indices mean and the three types of prescribed drug treatments: (1) immunosuppressives with supplements and sialagogue; (2) immunosuppressives with supplements; and (3) immunosuppressive drugs with supplements and anti-rheumatic drugs using non-parametric multi-group comparisons with 95% accuracy showed that there was no significant differences or preferences between the mean of the variables ADD_OHIP14, SC_OHIP14, PI, GI, SBI, USFR, and DMFT (Table 7).

Table 7. Evaluation of the quantitative indicators with regard to the drugs used by Sjögren's syndrome (SS) patients (non-parametric comparative test – the Kruskal–Wallis method with 95% accuracy)

Quantitative variables	Drug groups used by the patients									*p*-value
	immunosuppressive + supplements + sialagogue			immunosuppressive + supplements			immunosuppressive + supplements + anti-rheumatic			
	n	*M* ±*SD*	range	*n*	*M* ±*SD*	range	*n*	*M* ±*SD*	range	
ADD_OHIP14	5	21.40 ±9.40	9–34	25	20.36 ±11.03	3–41	15	17.6 ±15.74	0–50	0.464
SC_OHIP14	5	7.00 ±3.94	2–13	25	5.87 ±4.17	1–14	15	6.60 ±4.02	1–12	0.588
PI	5	1.33 ±0.20	1.17–1.67	25	1.39 ±0.45	0.17–2.00	15	1.21 ±0.49	0.17–1.83	0.284
GI	5	1.03 ±0.07	1.00–1.17	25	1.21 ±0.27	1.00–2.00	15	1.16 ±0.25	1.00–1.83	0.256
SBI	5	0.07 ±0.09	0.00–17.00	25	0.19 ±0.26	0.00–1.00	15	0.13 ±0.23	0.00–0.83	0.587
DMFT	5	13.00 ±5.83	7.00–21.00	25	9.24 ±4.31	2.00–17.00	15	11.67 ±4.05	4.00–20.00	0.198
USFR	5	0.44 ±0.61	0.01–1.4	25	0.89 ±0.99	0.02–4.00	15	1.16 ±1.07	0.30–4.20	0.108

Discussion

The present study compared OHRQoL in patients with primary and secondary SS and healthy individuals. Based on the study results, PI, GI, SBI, and DMFT indices did not show a statistically significant difference between the two groups. USFR was significantly different between patients with SS and healthy individuals ($p = 0.002$).

The results of many studies have linked SS to poor periodontal status for more than three decades,[28,29] with PI, GI, and bleeding on probing (BOP) indices higher in Sjogren's patients than in healthy patients. In a meta-analysis of 512 studies examining PI, GI, probing pocket depth (PPD), clinical attachment loss (CAL),[30] and DMFT in patients with SS, only 10 studies were eligible for the meta-analysis. Four studies showed a statistically significant difference in the GI between patients and healthy individuals,[12,31–33] and 5 studies reported PLI in Sjogren's patients higher than controls.[32–36] The final results of the meta-analysis between 163 patients with SS and 164 healthy individuals did not show a statistically significant difference in the PI and GI in these two groups.[37] Some studies have reported a higher risk of periodontal involvement in patients with SS than in healthy individuals.[28,31] In contrast, other studies have not reported an increase in periodontal involvement in Sjogren's patients.[32,33,35,36]

Finally, the meta-analysis results in 2019 showed that despite the higher rates of periodontal disease in Sjogren's patients compared to healthy individuals, the statistical difference between the two groups was not significant.[37]

In another review study on the relationship between SS and a patient's periodontal status, 17 studies were reviewed, with only 8 studies being included in the meta-analysis.[33] The PI and GI were higher than in healthy individuals in 4 studies of Sjogren's patients, and the BOP in the case group was higher than in the control group.[38] A meta-analysis of 303 patients with primary and secondary SS with 288 healthy individuals showed that the GI was statistically significant in primary and secondary SS compared to the control group. The meta-analysis reported differences in the results related to PI, GI, BOP, and PPD due to differences in the examiners used in the different studies. This means that these indicators are subjective, and each examiner may use different pressures to examine these indicators. Even one examiner may not have the same examination pressure on periodontal tissues during the study.[38] Good oral hygiene and less severe disease are cited in a study to explain the lack of significant association between SS and periodontal disease.[39]

Also, there was no significant relationship between periodontal involvement in Sjogren's patients and healthy individuals due to long-term use of drugs such as NSAIDs, DMARDs, and immunosuppressive drugs, which can effectively treat periodontal inflammatory responses.[40]

In our study, the lack of a significant relationship between GI, PI, and SBI indices between the case and control groups and the reasons mentioned in the above examinations can also be related to the inclusion or exclusion criteria of the participants. Destructive and influential factors on the periodontium, especially smoking, and diabetes were among the participants' exclusion criteria in our study. To accurately evaluate the effect of the disease on the periodontal status, we applied strict criteria in selecting individuals for the two groups, which some studies neglected.[12,41]

In this study, the DMFT index did not show a statistically significant relationship between the two groups. In Antoniazzi's study, a tooth missing in patients with pSS was not statistically significant compared to the healthy control group.[31] The results of a meta-analysis mentioned DMFT in the group of Sjogren's patients to be higher than in the control group. It should be noted that one of the possible reasons for this result in comparison with our study is the role of smoking and its use which was reported in 7 studies of this meta-analysis.[12,31,33,35–37,42] Despite the lack of a significant relationship between the DMFT index between case and control groups in our study, there was a statistically significant difference in DMFT between primary and secondary SS compared to patients with primary and secondary SS ($p = 0.048$).

Kalk noted that the submandibular and sublingual salivary flow rate in SS was lower than usual.[43] This result was consistent with our study and some studies that reported higher DMFT in patients with pSS due to decreased salivary gland function and decreased salivary buffering capacity compared to sSS.[12,39,41] Hyposalivation can also be another cause of higher DMFT in pSS. In our study, 42% of people with pSS had hyposalivation, while 34% of people with sSS showed decreased salivary gland function.

The study of oral health variables related to the quality of life in Sjogren's patients with healthy individuals showed that ADD-OHIP-14 ($p = 0.037$) and SC-OHIP-14 ($p = 0.025$) were statistically significantly different between the two groups. Participants in all 7 subgroups and 14 questions showed a statistically significant difference. The effects of SS on an individual's quality of life have been evaluated in various studies.[19,44,45] In these articles, the patient's quality of life with SS was lower than that of healthy individuals in the community, especially regarding severe limitations in the physical functioning of SS patients.[39,46]

Rusthen examined the effects of salivation, halitosis, chemosensory function, burning sensation of the tongue (BST), and OHRQoL in people with pSS and healthy individuals. The results showed that the case group had a lower mean OHRQOL in the following 4 subgroups of physical limitation, functional limitation, psychological limitation, and social limitation than in the control group. Stimulated and unstimulated salivary flow rates were significantly lower in Sjogren's patients with a higher prevalence of dysgeusia, BST, and halitosis in

SS, which is a sign of salivary and chemosensory dysfunction.[25] Enger evaluated systemic health effects on the OHRQoL in patients with pSS and a healthy group. In this study, higher oral distress in Sjogren's patients led to decreased OHRQoL, which had significant effects on health-related quality of life. Patients with SS in this study had a significant difference from the control group in all 14 questions. The biggest differences were seen in the subgroups of physical pain, psychological distress, and functional limitation.

Enger noted that xerostomia plays a crucial role in causing oral complications, increasing tooth decay, and leading to frequent dental visits in Sjogren's patients. It was also mentioned in this study that oral distress has significant effects on a patient's physical and mental health, and the powerful impact on their self-esteem, self-confidence, and social relationships is undeniable. Therefore, the main focus on oral health aspects in patients with SS is strongly recommended to improve their systemic health.[12]

This study is the first study to evaluate the effect of periodontal indices, DMFT, and USFR on OHRQoL in patients with SS. Despite the limited number of patients, especially patients with pSS, we used strict inclusion criteria to evaluate the effect of the disease on oral health care. We suggest that more multicenter studies be conducted with a larger sample size over a more extended period of time in the future. Another limitation of the present study was that periodontal variables such as the CAL and PPD were not measured in these patients because normal periodontal conditions or mild gingivitis were observed in the small sample size of the patients with SS we examined. It is suggested that these periodontal factors be examined in future studies.

Conclusions

In our study to evaluate OHRQoL as a dependent variable concerning the quantitative variables studied, including PI, GI, SBI, DMFT, and USFR, only the PLI in the case group was statistically significant and had a positive correlation with OHRQoL. According to the results, in addition to regular examinations and the drug treatment of patients with SS, regular oral examinations are recommended to check for dry mouth and prevent its consequences, such as dental caries and periodontal disease.

Ethics approval and consent to participate

The study was approved by the Research Ethics Committee at Mazandaran University of Medical Sciences, Sari, Iran (IR.MAZUMS.REC.1398.6148). Written informed consent was obtained from all participants prior to the commencement of the study.

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.

ORCID iDs

Tahereh Molania https://orcid.org/0000-0002-1528-2149
Maede Salehi https://orcid.org/0000-0003-0587-6952
Hodis Ehsani https://orcid.org/0000-0003-2651-1741
Mahmood Moosazadeh https://orcid.org/0000-0002-5452-514X
Fatemeh Niksolat https://orcid.org/0000-0003-4907-517X
Atefe Rezaei https://orcid.org/0000-0001-8020-0376
Negareh Salehabadi https://orcid.org/0000-0003-3706-5791
Fateme Rezaei https://orcid.org/0000-0002-7067-0769
Mohammad Ebrahimi Saravi https://orcid.org/0000-0002-2922-1021

References

1. Thomas E, Hay E, Hajeer A, Silman A. Sjögren's syndrome: A community-based study of prevalence and impact. *Br J Rheumatol*. 1998;37(10):1069–1076. doi:10.1093/rheumatology/37.10.1069
2. Binard A, Devauchelle-Pensec V, Fautrel B, Jousse S, Youinou P, Saraux A. Epidemiology of Sjögren's syndrome: Where are we now? *Clin Exp Rheumatol*. 2007;25:1-4.
3. Gøransson L, Haldorsen K, Brun J, et al. The point prevalence of clinically relevant primary Sjögren's syndrome in two Norwegian counties. *Scan J Rheumatol*. 2011;40(3):221–224. doi:10.3109/03009742.2010.536164
4. Fox RI. Sjögren's syndrome. *Lancet*. 2005;366(9482):321–331. doi:10.1016/S0140-6736(05)66990-5
5. Vitali C, Bombardieri S, Jonsson R, et al. Classification criteria for Sjögren's syndrome: A revised version of the European criteria proposed by the American-European Consensus Group. *Ann Rheum Dis*. 2002;61(6):554–558. doi:10.1136/ard.61.6.554
6. Delaleu N, Jonsson MV, Appel S, Jonsson R. New concepts in the pathogenesis of Sjögren's syndrome. *Rheum Dis Clin North Am*. 2008;34(4):833–845. doi:10.1016/j.rdc.2008.08.004
7. Ngo DY, Thomson WM, Nolan A, Ferguson S. The lived experience of Sjögren's syndrome. *BMC Oral Health*. 2016;16:7. doi:10.1186/s12903-016-0165-4
8. The World Health Organization Quality of Life assessment (WHOQOL): Position paper from the World Health Organization. *Soc Sci Med*. 1995;41(10):1403–1409. doi:10.1016/0277-9536(95)00112-k
9. Razavian F, Abbasi M, Kazemnejad A. The relationship between depression and the quality of life in patients with rheumatoid arthritis. *Daneshvar Medicine*. 2009;16(2):27–34.
10. Reissmann DR, John MT, Schierz O, Kriston L, Hinz A. Association between perceived oral and general health. *J Dent*. 2013;41(7):581–589. doi:10.1016/j.jdent.2013.05.007
11. Delaleu N, Jonsson R, Koller MM. Sjögren's syndrome. *Eur J Oral Sci*. 2005;113(2):101–113. doi:10.1111/j.1600-0722.2004.00183.x
12. Pedersen AM, Reibel J, Nauntofte B. Primary Sjögren's syndrome (pSS): Subjective symptoms and salivary findings. *J Oral Pathol Med*. 1999;28(7):303–311. doi:10.1111/j.1600-0714.1999.tb02045.x
13. Sreebny LM, Valdini A. Xerostomia. A neglected symptom. *Arch Intern Med*. 1987;147(7):1333–1337. doi:10.1001/archinte.147.7.1333
14. Enger TB, Palm Ø, Garen T, Sandvik L, Jensen JL. Oral distress in primary Sjögren's syndrome: Implications for health-related quality of life. *Eur J Oral Sci*. 2011;119(6):474–480. doi:10.1111/j.1600-0722.2011.00891.x
15. Christensen LB, Petersen PE, Thorn JJ, Schiødt M. Dental caries and dental health behavior of patients with primary Sjögren syndrome. *Acta Odontol Scand*. 2001;59(3):116–120. doi:10.1080/000163501750266684
16. Fox PC, Bowman SJ, Segal B, et al. Oral involvement in primary Sjögren syndrome. *J Am Dent Assoc*. 2008;139(12):1592–1601. doi:10.14219/jada.archive.2008.0101

17. Kamel UF, Maddison P, Whitaker R. Impact of primary Sjögren's syndrome on smell and taste: Effect on quality of life. *Rheumatology (Oxford)*. 2009;48(12):1512–1514. doi:10.1093/rheumatology/kep249
18. Sutcliffe N, Stoll T, Pyke S, Isenberg D. Functional disability and end organ damage in patients with systemic lupus erythematosus (SLE), SLE and Sjögren's syndrome (SS), and primary SS. *J Rheumatol*. 1998;25(1):63–68. PMID:9458204.
19. Allen PF, McMillan AS, Walshaw D, Locker D. A comparison of the validity of generic- and disease-specific measures in the assessment of oral health-related quality of life. *Community Dent Oral Epidemiol*. 1999;27(5):344–352. doi:10.1111/j.1600-0528.1999.tb02031.x
20. Cunningham SJ, Garratt AM, Hunt NP. Development of a condition-specific quality of life measure for patients with dentofacial deformity: I. Reliability of the instrument. *Community Dent Oral Epidemiol*. 2000;28(3):195–201. doi:10.1034/j.1600-0528.2000.280305.x
21. Allen PF, McMillan AS. The impact of tooth loss in a denture wearing population: An assessment using the Oral Health Impact Profile. *Community Dent Health*. 1999;16(3):176–180. PMID:10641078.
22. Naito M, Yuasa H, Nomura Y, Nakayama T, Hamajima N, Hanada N. Oral health status and health-related quality of life: A systematic review. *J Oral Sci*. 2006;48(1):1–7. doi:10.2334/josnusd.48.1
23. John M, Hujoel P, Miglioretti DL, LeResche L, Koepsell T, Micheelis W. Dimensions of oral-health-related quality of life. *J Dent Res*. 2004;83(12):956–960. doi:10.1177/154405910408301213
24. Slade GD. Derivation and validation of a short-form oral health impact profile. *Community Dent Oral Epidemiol*. 1997;25(4):284–290. doi:10.1111/j.1600-0528.1997.tb00941.x
25. Rusthen S, Young A, Herlofson BB, et al. Oral disorders, saliva secretion, and oral health-related quality of life in patients with primary Sjögren's syndrome. *Eur J Oral Sci*. 2017;125(4):265–271. doi:10.1111/eos.12358
26. Agha-Hosseini F, Moghaddam PP, Mirzaii-Dizgah I. Stimulated whole saliva composition in dental healthy students and menopausal women in 2004. *Journal of Dental School*. 2007;25(1):6–11.
27. Motallebnejad M, Hadian H, Mehdizadeh S, Hajiahmadi M. Validity and reliability of the Persian version of the oral health impact profile (OHIP)-14. *Caspian J Intern Med*. 2011;2(4):314–320. PMID:24551438. PMCID:PMC3895829.
28. Ergun S, Cekici A, Topcuoglu N, et al. Oral status and *Candida* colonization in patients with Sjögren's syndrome. *Med Oral Patol Oral Cir Bucal*. 2010;15(2):e310–e315. doi:10.4317/medoral.15.e310
29. Seck-Diallo A, Diallo S, Benoist HM, Diouf A, Sembène M, Diallo PD. Periodontal status of Senegalese patients with Sjögren's syndrome. A case control study at the Service of Internal Medicine [in French]. *Odontostomatol Trop*. 2009;32(126):39–46. PMID:20069965.
30. Escalona L, Rivera H. Evaluación inicial de índices periodontales en pacientes diagnosticados con síndrome de Sjögren. *Acta Odontológica Venezolana*. 2004;42(1):29–33.
31. Antoniazzi RP, Miranda LA, Zanatta FB, et al. Periodontal conditions of individuals with Sjögren's syndrome. *J Periodontol*. 2009;80(3):429–435. doi:10.1902/jop.2009.080350
32. Kuru B, McCullough MJ, Yilmaz S, Porter SR. Clinical and microbiological studies of periodontal disease in Sjögren syndrome patients. *J Clin Periodontol*. 2002;29(2):92–102. doi:10.1034/j.1600-051x.2002.290202.x
33. Pedersen AM, Andersen TL, Reibel J, Holmstrup P, Nauntofte B. Oral findings in patients with primary Sjögren's syndrome and oral lichen planus – a preliminary study on the effects of bovine colostrum-containing oral hygiene products. *Clin Oral Investig*. 2002;6(1):11–20. doi:10.1007/s00784-001-0148-x
34. Le Gall M, Cornec D, Pers JO, et al. A prospective evaluation of dental and periodontal status in patients with suspected Sjögren's syndrome. *Joint Bone Spine*. 2016;83(2):235–236. doi:10.1016/j.jbspin.2015.02.015
35. Márton K, Boros I, Varga G, et al. Evaluation of palatal saliva flow rate and oral manifestations in patients with Sjögren's syndrome. *Oral Dis*. 2006;12(5):480–486. doi:10.1111/j.1601-0825.2005.01224.x
36. Pedersen AM, Bardow A, Nauntofte B. Salivary changes and dental caries as potential oral markers of autoimmune salivary gland dysfunction in primary Sjogren's syndrome. *BMC Clin Pathol*. 2005;5(1):4. doi:10.1186/1472-6890-5-4
37. Maarse F, Jager DH, Alterch S, et al. Sjögren's syndrome is not a risk factor for periodontal disease: A systematic review. *Clin Exp Rheumatol*. 2019;37 Suppl 118(3):225–233. PMID:31464667.
38. de Goés Soares L, Rocha RL, Bagordakis E, Galvão EL, Douglas-de-Oliveira DW, Moreira Falci SG. Relationship between Sjögren syndrome and periodontal status: A systematic review. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2018;125(3):223–231. doi:10.1016/j.oooo.2017.11.018
39. Leung KC, McMillan AS, Leung WK, Wong MC, Lau CS, Mok TM. Oral health condition and saliva flow in southern Chinese with Sjögren's syndrome. *Int Dent J*. 2004;54(3):159–165. doi:10.1111/j.1875-595x.2004.tb00273.x
40. Ferro F, Marcucci E, Orlandi M, Baldini C, Bartoloni-Bocci E. One year in review 2017: Primary Sjögren's syndrome. *Clin Exp Rheumatol*. 2017;35(2):179–191. PMID:28337967.
41. Celenligil H, Eratalay K, Kansu E, Ebersole JL. Periodontal status and serum antibody responses to oral microorganisms in Sjögren's syndrome. *J Periodontol*. 1998;69(5):571–577. doi:10.1902/jop.1998.69.5.571
42. Najera MP, al-Hashimi I, Plemons JM, et al. Prevalence of periodontal disease in patients with Sjögren's syndrome. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 1997;83(4):453–457. doi:10.1016/s1079-2104(97)90144-x
43. Kalk WW, Vissink A, Stegenga B, Bootsma H, Nieuw Amerongen AV, Kallenberg CG. Sialometry and sialochemistry: A non-invasive approach for diagnosing Sjögren's syndrome. *Ann Rheum Dis*. 2002;61(2):137–144. doi:10.1136/ard.61.2.137
44. Belenguer R, Ramos-Casals M, Brito-Zerón P, et al. Influence of clinical and immunological parameters on the health-related quality of life of patients with primary Sjögren's syndrome. *Clin Exp Rheumatol*. 2005;23(3):351–356. PMID:15971423.
45. Tensing EK, Solovieva SA, Tervahartiala T, et al. Fatigue and health profile in sicca syndrome of Sjögren's and non-Sjögren's syndrome origin. *Clin Exp Rheumatol*. 2001;19(3):313–316. PMID:11407086.
46. Meijer JM, Meiners PM, Huddleston Slater JJ, et al. Health-related quality of life, employment and disability in patients with Sjogren's syndrome. *Rheumatology (Oxford)*. 2009;48(9):1077–1082. doi:10.1093/rheumatology/kep141