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Dental Health Status of HIV-Positive Patients and Related Variables in Southeast Iran

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Abstract

Background: Different factors can be responsible for the increased prevalence of dental caries and missing teeth in HIV-positive patients.
Objectives: This study evaluates dental health status and its relationship with social, behavioral, and medical factors in HIV-positive patients under the coverage of Zahedan University of Medical Sciences in Southeast Iran.
Patients and Methods: In a cross-sectional study, the dental health status of 119 HIV-positive patients was assessed in accordance with WHO indices and included decayed, missing, and filled teeth (DMFT). A questionnaire on different social, behavioral, and medical variables was filled out for every case and the relationship and correlation of the variables to dental health status were investigated using One-way ANOVA, the Kruskal Wallis test, the t-test, the Mann-Whitney test, Spearman's rho correlation coefficient, and Pearson correlation.
Results: The mean value of DMFT index was 11.87 ± 8.08, where the mean values of decayed and missing teeth were 8.42 ± 5.44 and 3.43 ± 4.07, respectively. DMFT index, decayed, and missing teeth correlated only with age ($P < 0.0001$, $P = 0.009$, $P < 0.0001$) and duration of HIV involvement ($P = 0.004$, $P = 0.031$, $P = 0.007$).
Conclusions: The dental health status of HIV-positive patients in this region was almost inappropriate. Most social, behavioral, and medical factors had no influence on dental health; only a correlation between dental health, age, and duration of HIV involvement was observed.

Keywords: Dental Heath, HIV, Iran

1. Background

The human immunodeficiency virus (HIV) epidemic is entering its 4th decade and it has remained a general health problem in different countries (1). According to studies, HIV-positive cases are more susceptible to dental caries when compared to HIV-negative ones (2, 3). The reason may be traced to the increased level of *Streptococcus mutans* the main pathogen associated with dental caries in HIV-positive cases compared to healthy cases (4). In addition, the immune system affects the prevalence of dental caries in HIV-positive cases in such a way that the significant decrease of CD4 (cluster-differentiated 4) cells is associated with the increase in dental caries in these patients (5). However, patients are more susceptible to xerostomia and decreased salivary gland function; it has been suggested that this condition is associated with the decreased number of CD4 cells (6). In addition, the buffering capability and pH of saliva decreased significantly in these patients. This may also be considered a factor for the increased number of caries in these patients (2, 7). Today, antiretroviral therapy (ART) is prescribed to treat HIV-positive patients, sometimes for extended periods (8). ART has been introduced as a threat factor for children's dental health as a causative factor of xerostomia with its physical properties and sugar content (6, 8). However, some studies have shown the decreased prevalence of caries in patients who receive ART (9, 10). On the other hand, some socio-demographical factors including age, marital status, education, employment, smoking, and use of health services can all play a role in the weak dental status of HIV-positive patients (11, 12). According to reports, the value of the DMFT (decayed, missing, and filled teeth) index in HIV-positive patients ranges from 8.7 to 18.8 (3, 13). Since inappropriate dental health has a negative effect on the quality of life for HIV/AIDS (acquired immunodeficiency syndrome) patients, investigating their dental health status can prepare an appropriate background for conducting preventive programs and treating their dental diseases.

2. Objectives

We decided to investigate dental health status as well as social, behavioral, and medical factors of HIV-positive patients who are in the care of Zahedan University of Medical Sciences (Southeast Iran).

3. Patients and Methods

This cross-sectional study's population consisted of all 119 HIV-positive patients with active files in Zahedan University of Medical Sciences (the largest province of southeast Iran) from September 2013. Fifteen patients were not available and excluded. The ethics committee research deputy of Zahedan University of Medical Sciences approved this study with code 2527. After written consent from all patients were collected, their teeth were observed in a dental unit from a vertical position using a mirror and probe under sufficient lighting. World Health Organization (WHO) criteria were used to determine dental health status (14). To determine the DMFT index, the total number of decayed, missing, and filled teeth was calculated. After the dental examination, every patient was given oral and dental hygiene training, were made aware of their dental problems, and were referred to treatment centers approved by the Zahedan University of Medical Sciences for any dental procedures. A group of data including age, sex, marital status, residence, education level, employment, habits (like smoking, pan, or smokeless tobacco use), oral hygiene, weight loss in the last 6 months, body mass index (BMI: weight in kilograms/[height in meters]^2), modes of contamination, taking ART, and the duration of HIV involvement was collected and registered either by direct communication with the patients or by referring to their file. Data was analyzed by SPSS version 21 (Chicago IL, USA) and the significance level was set at $P < 0.05$. Next, the Kolmongrov-Smirnoves test was used to determine whether or not the distribution of data was normal, and then the relationship between different factors and dental health status was investigated using One-way ANOVA, the Kruskal Wallis test, the Student t-test, the Mann-Whitney test, Spearman's rho correlation Coefficient, and Pearson correlation.

4. Results

The mean value of the DMFT index in the studied cases was 11.87 $\pm$ 8.08. Two cases were free of caries (DFMT = 0), while five cases presented a DFMT index of 32 (DFMT = 32). The mean value of decayed and missing teeth was 8.42 $\pm$ 5.44 and 3.43 $\pm$ 4.07 respectively, and only one 35-year-old woman had 3 filled teeth. The average length of HIV involvement was 5.75 $\pm$ 4.19 years. According to Spearman's rho Correlation Coefficient, there was a correlation between the DMFT index (P = 0.004, r = 0.27), decayed (P = 0.03, r = 0.19), missing (P = 0.007, r = 0.24), and the duration of HIV involvement. The mean value of patients' BMI was 20.8 $\pm$ 6.5 kg/m2 and Spearman's rho Correlation coefficient showed no correlation between the DFMT index (P = 0.55, r = -0.06), decayed (P = 0.24, r = -0.11), missing (P = 0.56, r = 0.06) and BMI. The average age of cases was 35.4 $\pm$ 12.7 years and, according to our results, there was a correlation between the DMFT index ($P < 0.0001$, r = 0.36; Pearson Correlation), decayed (P = 0.009, r = 0.23; Pearson Correlation), missing ($P < 0.0001$, r = 0.53; Spearman's rho Correlation Coefficient), and age. In the studied population, 37 percent of patients have been active cigarette smokers for 9.36 $\pm$ 5.95 years. There was no relationship found between the duration of smoking and the DMFT index (P = 0.08, r = 0.27; Pearson Correlation) for decayed (P = 0.59, r = 0.08; Pearson Correlation) and missing (P = 0.49, r = 0.11; Spearman's rho correlation coefficient) teeth. Tables 1 - 3 reveal the relationship between the DMFT index, decayed, and missing teeth with the other variables in the studied population.

5. Discussion

The dental health status of HIV-positive patients has been investigated in different communities and in different ways. Some studies have only mentioned dental caries in this group of people, while other studies similar to this one used the DMFT index to determine patient dental health status (9, 11, 12, 15, 16). The mean value of the DFMT index in this study was 11.9 (D = 8.4, M = 3.4, F = 0.03). It is higher than the results shown by Liberali et al. (DMFT = 8.7, D = 0.6, M = 1.6, F = 6.6) in Australia and lower than those found by Santo et al., (DMFT = 16.44, D = 5.28, M = 9.25, F = 1.91) in Portugal, Aleixo et al., (DMFT = 16.9, D = 1.7, M = 11.1, F = 3.3), Soares et al., (DMFT = 17.64, D = 2.85, M = 9.12, F = 5.67), and Pinheiro et al. (DMFT = 18.8, D = 3.9, M = 8.2, F = 6.6) in Brazil (3, 9, 11-13). This noted difference may be traced to differences of race, oral hygiene behaviors, nutrition, types of treatment, the fluoride content of drinking water, extent of dental services, and the implementation of training and preventative programs. In this study, the mean of filled teeth was apparently lower than others (3, 9, 11-13). Since the people of the studied region need serious dental services, essential plans should be prepared to build a context from which these people can benefit by using dentistry services. This study showed a correlation between the average age of cases and the mean value of the DMFT index, decayed, and missing teeth. Similar to this study, Soares et al. showed that the DMFT index and missing teeth increase with patients' age, but there was no re-

lationship between age and decayed teeth (11). In contrast with this study, Santo et al. observed no relationship between the DMFT index and age. In addition, they reported that dental caries occur in younger people because older people are more likely to completely lose their teeth (12). Different studies have reported age as an influential risk factor for tooth loss and stated that the reason may be that the probability of dental caries, tooth pain and inflammation, trauma, periodontal diseases, and usage of dentures (prosthetic devices) increases as age rises (17-19). Khazaei et al. observed a relationship between male sexuality and missing teeth in an Iranian population. He stated that a number of factors like smoking, ill-oral hygiene, and dental diseases like trauma, periodontal disease, and caries are probable reasons for the prevalence of tooth loss in males (17). Despite the fact that in the current study, the mean values of the DMFT index, decayed, and missing teeth were higher in males, the difference was not significant. This coincides with studies performed by Santo et al. and Soares et al. on HIV-positive patients (11, 12).

The results of this study showed that the mean value of the DMFT index is higher in single individuals than those who are married, but the increase was significant only for decayed teeth. Soares et al. showed a significant increase in the DMFT index in single HIV-positive patients (11). The probable reason for this is the increased probability of social exclusion, resulting in depression and, in turn, a lack of observing oral hygiene issues. Medina-Solis et al. reported a greater prevalence of dental problems in non-HIV individuals in large cities compared to villagers (20). This study, however, showed increased mean values of the DMFT index, decayed, and missing teeth in HIV-positive patients living in large cities. The probable reason may be the accessibility of industrial confections and refreshments in larger cities. Similar to this study, those performed by Santo et al. and Soares et al. showed no significant relationship between caries and employment in HIV-positive patients. Unlike this study, however, theirs showed the mean values of the DMFT index as significantly lower in employed individuals when compared with the unemployed (11, 12). It appears that employed individuals are more likely to utilize oral care service because of their higher income and are more likely to benefit from dental insurance coverage. There is a positive relationship between insurance coverage and dental care services, so individuals with dental insurance coverage are more likely to come in for periodic dental check-ups (21).

This study showed that the mean values of the DMFT index, decayed, and missing teeth are lower in people with high school and university degrees compared with illiterate and elementary school educations, but the difference is not significant. Soares et al. studied the relationship between the DMFT index and decayed teeth against education and yielded similar results, but it revealed that the mean value of missing teeth was significantly higher in less-educated people (11). In the study by Santo et al. the value of their DMFT index was significantly high in HIV-positive patients with less than 9 years of educational background (12). Generally, highly educated people have a job and use more oral care services, while less-educated people lack knowledge about oral hygiene issues, show weaker health performance, and are thus less likely to use health care services (18, 22). The results from Soares et al. showed no relationship between the mean values of the DMFT index and missing teeth in regards to smoking and the length of time someone has been smoking (11). This agrees with our study. Unlike our results, however, Soares et al. showed that the rate of caries is higher in HIV-positive patients with greater than 20 years of active smoking (11). Santo et al. showed that the DMFT index of HIV-positive patients with smoking backgrounds is significantly higher than non-smokers, while smoking had no significant effect on caries in these patients (12). It should be noted, however, that there are some contradictions between studies. On the one hand, Voelker et al. showed that there is a significant relationship between smoking, a decreased pH of stimulated saliva as well as its buffering capability, and an increased risk of caries, where smoking has no effect on the *Streptococcus mutans* bacteria (main cavity-forming bacteria) (23). On the other hand, Heintze et al. showed that the number of lactobacillus and *S. mutans* are higher in smokers' saliva than non-smokers (24). Different studies have introduced smoking as a cause for tooth loss (17, 18, 25, 26). In addition to caries, periodontal problems which are three times more prevalent in smokers than non-smokers are a cause of tooth loss (17, 27). It has been shown that the odds of tooth loss in people who are currently smoking is 20 percent greater than for people who have never smoked, or for those who have quit smoking. These odds decrease the longer someone has ceased smoking (28). This study also showed no relationship between smokeless tobacco and the DMFT index, decayed, or missing teeth.

This finding conflicts with other studies (29-31). Vellappally et al. and Nagarajappa and Prasad considered smokeless tobacco as a positive contributing factor to the increased likelihood of caries (29, 30). The nicotine content of tobacco promotes *S. mutan* biofilm formation and its metabolic activity (32). Tobacco in any form immediately increases salivary flow rate but its long-term effects have not yet been determined (33). It has been suggested, however, that gingival recession, deeper periodontal pockets, clinical attachment loss, tooth mobility, and engagement of furcation regions are significantly higher in patients who use smokeless tobacco like pan and chewing to-

bacco; all the aforementioned problems can result in tooth loss (31). This study showed that individuals who wash their teeth with water alone (not brushing with a special instrument) and those who rarely brush their teeth (once a week) have a higher mean value in the DMFT index, caries, and missing teeth compared with other groups. Santo et al. studied oral hygiene using a tooth plaque index and observed a direct and significant relationship between the DMFT index and tooth plaque. They observed no relationship between the former and caries (12). Another study on a healthy population showed that more frequent tooth brushing is associated with lower decayed and missing teeth (34). It is apparent that observing oral hygiene, i.e. eliminating cavity-forming foods and decreasing microbe levels in the mouth, causes improved dental health. The encouragement of HIV-positive patients to observe oral hygiene issues should be always considered as health priorities for this group of people. Unlike the study by Santo et al. that reported no relationship between the DMFT index, decayed teeth, and the duration of HIV involvement (12), our results showed a positive correlation between the duration of HIV involvement, the DMFT index, decayed, and missing teeth. The reason may be traced to the fact that as HIV progresses over time, the number of CD4 cells decreases. It has been suggested that this decrease results in increased caries (5). On the other hand, no matter the length of time that passes for HIV infection, the viral load rises consequently and this high viral load is associated with more periodontal destruction and extensive caries (35). Rezaei-Soufi et al. and Aleixo et al. observed no relationship between the DMFT index, extracted teeth, and ART use (9, 36). Aleixo et al. reported lower rates of dental caries in individuals who receive ART (9). Unlike their results, ours showed that the mean value of the DMFT index, decayed, and missing teeth is higher in individuals who receive ART compared to those who receive no ART, but the difference was not significant. Some ARTs are considered important risk factors for decreased salivary rates and saliva gland enlargement in HIV-positive patients (37). Also, it has been observed that most ARTs have higher sugar concentrations and some types are even in syrup form with a pH value below critical, which makes the mouth cavity susceptible to dental caries, tooth loss, and an increased DMFT index (8). This study showed no correlation between the DMFT index, decayed, and missing teeth with BMI. In contrast, some studies have reported a significant relationship between tooth loss and BMI (17, 18, 38). Obesity has been introduced as a predictor factor for periodontal diseases, so it associates with higher levels of TNFα and its soluble receptors, and consequently associates with increased inflammation and risk of periodontal diseases, which is a cause for tooth loss (39). In a systemic review, 50 percent of studies observed no relationship between BMI and tooth caries. There are some etiologic factors that may play a role in the obtained results: 1, the failure in initial decay involvement and its assessment due to the ratio of initial caries to former ones may differ between overweight and underweight cases; 2, the failure in assessing all BMI score ranges indicating underweight, normal, and overweight people; 3, stating only the mean value and not dividing BMI into a given range, and; 4, conducting no statistical analysis on the linear relationship of the variables (40).

It should be noted that other studies have not covered the relationship between contamination mode and weight loss in the last 6 months in regard to the dental health status of HIV-positive patients. One of the strengths of this study is that it has investigated different social, behavioral, and medical factors that others have yet to investigate. Studies about relationships between different demographic variables and dental health statuses in HIV-positive patients are very limited. Consequently, we have to use papers from healthy individuals that had similar variables to our study. However, the results showed no significant relationship between many social, behavioral, and medical factors with the mean value of the DMFT index, decayed, and missing teeth. This can be attributed to the lower sample population in this study. Therefore, conducting studies on larger populations and comparing findings with a control group is recommended. It is suggested for future studies to unify conditions and dismiss confounding variables and then study different factors. They can study, for example, the effects of cigarette smoking or smokeless tobacco on HIV-positive patients who receive no ART.

5.1. Conclusion

The dental health status of HIV-positive patients in southeast Iran was almost inappropriate. There was only one case with filled teeth, which implies that serious attempts must be made to prepare a proper context in which the people of this region can benefit from dentistry services. The investigation of social, behavioral, and medical factors showed a relationship between dental health with age and length of time an individual has been HIV-positive only; many other factors were deemed not influential.

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Footnotes

Authors' Contribution: Study concept and design: Shirin Saravani, Tahereh Nosrat Zehi, Hamideh Kadeh and Sarvar Mir; acquisition of data: Shirin Saravani, Tahereh Nosrat Zehi and Sarvar Mir; analysis and interpretation of data: Shirin Saravani, Tahereh Nosratzehi and Hamideh Kadeh; drafting of the manuscript: Shirin Saravani, Tahereh Nosratzehi, Hamideh Kadeh and Sarvar Mir; Critical revision of the manuscript for important intellectual content: Shirin Saravani, Tahereh Nosratzehi and Hamideh Kadeh; statistical analysis: Shirin Saravani, Tahereh Nosrat Zehi and Hamideh Kadeh; administrative, technical, and Material support: Shirin Saravani, Tahereh Nosrat Zehi, Hamideh Kadeh and Sarvar Mir; study supervision: Shirin Saravani.

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Table 1. Relationship Between DMFT and Various Factors in HIV-Positive Patients in Southeast Iran

Related Factors	Number	DMFT				P Value
		Mean	Median	SD	Interquartile Range	
Sex						0.69[a]
Male	83	12.07	10	8.65	12	
Female	36	11.42	11	6.65	8.75	
Marital Status						0.219[a]
Single	72	12.61	11	7.96	9.75	
Married	47	10.74	8	8.21	12	
Residence						0.210[a]
City	59	12.81	12	7.89	9	
Village	60	10.95	9.5	8.22	10.75	
Employment						0.868[a]
Employed	15	12.2	9	10.06	13	
Unemployed	104	11.83	11	7.81	10.75	
Education Level						0.474[b]
Uneducated	43	11.91	10	8.02	13	
Elementary School Degree	69	12.22	11	8.38	10	
Diploma and Academic Degree	7	8.29	9	4.54	8	
Smoking Habits						0.582[a]
Smoker	44	12.41	11	8.11	10.5	
Non-smoker	75	11.56	10	8.09	11	
Pan and/or Smokeless Tobacco Use						0.502[a]
User	43	11.21	9	8.99	13	
Non-user	76	12.25	11	7.54	9	
Tools of Oral Hygiene						0.253[b]
Toothbrush and Paste	42	11.81	10.5	7.42	9	
Chewing Sticks	58	11.03	10	7.68	11.5	
Rinsing with Water after Meals	19	14.58	10	10.26	18	
Oral Hygiene Frequency						0.341[b]
More than Once a Day	18	9.94	9.5	7.24	11.5	
Once a Day	74	11.74	10	7.82	10	
Once a Week	27	13.52	13	9.19	14	
Contamination Mode						0.100[b]
Blood	61	10.69	9	8.02	11	
Sexual Contact	52	13.62	12	8.22	11.75	
Vertical Transmission	6	8.83	9.5	4.17	8	
Weight Loss in the Last 6 Months						0.221[a]
Yes	20	9.85	8	7.41	7.75	
No	99	12.28	11	8.18	11	
ART						0.380[a]
Yes	45	12.71	11	8.59	12.5	

No	74	11.36	10	7.76	9.5

[a] Student t-test.
[b] One-way ANOVA.

Table 2. Relationship of Decayed Teeth With Different Factors in HIV-Positive Patients in Southeast Iran

Related Factors	Number	Decayed Teeth				P Value
		Mean	Median	SD	Interquartile Range	
Sex						0.909[a]
Male	83	8.46	7	5.54	8	
Female	36	8.33	7	5.30	7	
Marital Status						0.050[a]
Single	72	9.21	9	5.32	7	
Married	47	7.21	5	5.46	8	
Residence						0.457[a]
City	59	8.80	7	5.23	7	
Village	60	8.05	7	5.67	8	
Employment						0.535[a]
Employed	15	7.6	7	5.75	10	
Unemployed	104	8.54	8	5.42	7	
Education Level						0.363[b]
Uneducated	43	8.53	7	5.56	10	
Elementary School Degree	69	8.64	8	5.55	6	
Diploma and Academic Degree	7	5.57	6	2.64	5	
Smoking Habit						0.289[a]
Smoker	44	9.11	8.5	5.53	6.75	
Non-Smoker	75	8.01	7	5.39	8	
Pan and/or Smokeless Tobacco Use						0.263[a]
User	43	7.67	6	5.96	8	
Non-user	76	8.84	8.5	5.12	7.75	
Tools of Oral Hygiene						0.294[b]
Toothbrush and Paste	42	8.81	9	5.58	7	
Chewing Sticks	58	7.69	7	5.10	8	
Rinsing with Water after Meals	19	9.79	7	6.09	10	
Oral Hygiene Frequency						0.428[b]
More than Once a Day	18	7.17	7	5.22	7.25	
Once a Day	74	8.39	7	5.39	7	
Once a Week	27	9.33	10	5.75	9	
Contamination Mode						0.455[b]
Blood	61	7.82	7	5.38	7.5	
Sexual Contact	52	9.12	8.5	5.66	8	
Vertical Transmission	6	8.5	9.5	3.94	6.5	
Weight Loss in the Last 6 Months						0.360[a]
Yes	20	7.40	6	4.58	7	
No	99	8.63	8	5.60	8	
ART						0.888[a]
Yes	45	8.51	7	5.80	8	

No	74	8.36	8	5.26	7

[a] t-test.
[b] One-way ANOVA.

Table 3. Relationship of Missing Teeth With Different Factors in HIV-Positive Patients in Southeast Iran

Related Factors	Number	Missing Teeth				P Value
		Mean	Median	SD	Interquartile Range	
Sex						0.822[a]
Male	83	3.61	2	4.50	6	
Female	36	3	3	2.84	3.75	
Marital Status						0.969[a]
Single	72	3.40	2.5	3.91	5.75	
Married	47	3.47	2	4.34	4	
Residence						0.083[a]
City	59	3.97	3	4.35	5	
Village	60	2.9	2	3.73	4	
Employment						0.411[a]
Employed	15	4.6	3	5.53	6	
Unemployed	104	3.26	2	3.82	5	
Education Level						0.975[b]
Uneducated	43	3.37	2	3.91	4	
Elementary School Degree	69	3.54	2	4.30	5	
Diploma and Academic Degree	7	2.71	3	2.81	5	
Smoking Habit						0.732[b]
Smoker	44	3.30	2	4.19	4.75	
Non-smoker	75	3.51	3	4.02	5	
Pan and/or Smokeless Tobacco Use						0.874[a]
User	43	3.53	2	4.42	5	
Non-user	76	3.37	3	3.89	5	
Tools of Oral Hygiene						0.907[b]
Toothbrush and Paste	42	2.93	2.5	3.07	4	
Chewing Sticks	58	3.34	2.5	4.05	5	
Rinsing with Water after Meals	19	4.79	2	5.71	9	
Oral Hygiene Frequency						0.657[b]
More than Once a Day	18	2.61	1.5	3.09	4.25	
Once a Day	74	3.35	2.5	3.90	4	
Once a Week	27	4.19	3	5.01	6	
Contamination Mode						0.004[b]
Blood	61	2.87	1	4.01	4	
Sexual Contact	52	4.44	3	4.10	4	
Vertical Transmission	6	0.33	0	0.82	0.5	
Weight Loss in the Last 6 Months						0.117[a]
Yes	20	2.45	1	3.99	3.75	
No	99	3.63	3	4.07	5	
ART						0.097[a]
Yes	45	4.20	3	4.51	6	

No	74	2.96	2	3.73	4

[a] t-test.
[b] One-way ANOVA.