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Original Article

Medical conditions associated with tooth loss among Saudi adults

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Abstract Upon reviewing the literature, the prevalence of many systemic conditions such as diabetes, hypertension, asthma and rheumatoid arthritis were reported to be high in Saudi Arabia. The relationship of these conditions with tooth loss among Saudi population was not investigated. Therefore, the aim of the present study is to explore the relationship between tooth loss and most common medical conditions among Saudi dental patient. The study participants were 250 patients who were randomly selected from the College of Dentistry database of King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) in Riyadh, Saudi Arabia. Participants were requested to answer self-administered questionnaires related to their demographic as well as general health questions concerned to the presence of systemic medical conditions. Missing teeth were determined after examining the orthopantogram radiographs and reviewing the Romexis and SALUD databases. Descriptive statistics, independent *t*-test and linear multiple regression model were performed using SPSS software. The mean number of missing teeth among the study population was 5.8 teeth per person. The mean number of missing teeth was higher among subjects with diabetes, hypertension, rheumatoid arthritis, cardiovascular diseases, or osteoporosis compared to healthy individuals. A multiple linear regression analysis model revealed that diabetes, hypertension and rheumatoid were significant predictors of missing teeth among Saudi population. These results highlight the importance of the effect of medical conditions on oral health.

Keywords: Medical conditions; oral health; Saudi; systemic conditions; tooth loss.

Introduction

Teeth play a crucial role in the oral cavity. They contribute in the process of mastication, speech, and maintaining the facial aesthetic (Fiske *et al.*, 2001). Missing teeth, on the other hand will lead to disruption of such functions. Factors contributed to tooth loss could be local, systemic or both. The role of poor oral hygiene in initiating dental caries and periodontal disease leading to the loss of teeth was reported (Fure and Zickert, 1997).

Systemic diseases such as diabetes, hypertension, asthma, rheumatoid arthritis and osteoporosis might promote the susceptibility of teeth to missing (Hämäläinen *et al*., 2003; Tavares *et al.*, 2014; Lee *et al.*, 2010; Joshipura *et al*., 2003). In a study conducted among Hispanic adults, tooth loss was found to be twice as higher in diabetic adults as in other adults (Greenblatt *et al.*, 2016). Tooth loss was found to be associated with hypertension and osteoporosis even after controlling for smoking (Lee *et al.*, 2010). Women with osteoporosis in the lumbar spine were reported to be at a higher risk of losing eight or more teeth than were women with a normal bone mineral density in the lumbar spine (Ji *et al*., 2016). The mean numbers of missing teeth were significantly higher among those who had a history of atherosclerotic vascular disease, heart failure, ischemic heart disease, and joint

disease according to one American study on the elderly (Hamasha *et al.,* 1998).

Systemic conditions among Saudi population were previously studied and it was reported that the prevalence of diabetes was 34.1% in males and 27.6% in females (Alqurashi *et al.,* 2011) while the prevalence of hypertension was about 26% (Al-Nozha *et al.*, 2007). One study reported that 34% of healthy Saudi women, and 31% of men, 50-79 years of age are osteoporotic (Sadat-Ali *et al.*, 2012). The prevalence of rheumatoid arthritis in one province of Saudi Arabia was 0.22% (Al-Dalaan *et al.*, 1998). The data on tooth loss among Saudi adolescents showed a high prevalence of tooth loss compared with studies conducted in a similar age group in other countries (Atieh, 2008). However, no other study found to address the reasons for tooth loss among adults in Saudi Arabia population. Therefore, the aim of this study is to investigate the relationship between tooth loss and common systemic conditions among patients attending College of Dentistry Clinics, King Saud bin Abdulaziz University for Health Science.

Materials and methods

The present study is an observational cross-sectional study that was conducted at the Comprehensive Care Clinics in College of Dentistry (COD) at King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) in Riyadh, Saudi Arabia. This study was granted an ethical approval from the IRB committee of King Abdullah International Medical Research Center of National Guard Health Affairs, Saudi Arabia (H-01-R-005). Before commencement, a complete review of dental records of the COD patients was conducted using SALUD software from the years 2017 to 2018. Based on the records, patients with a complete dentition were excluded. Next, patients reported with tooth loss, were randomly selected using the COD Romexis database linked to the OPG. In this study, four examiners were calibrated by an oral and maxillofacial radiology specialist to verify on the criteria of missing teeth. After samples determination, they were invited via phone to participate in this study. A self-administered questionnaire was distributed among consented participants comprise of two components: (1) Demographic factors of the patient including age, gender, level of education, occupation, and monthly income. (2) General health including patient's systemic conditions. Information about number and type of tooth loss was recorded based on OPG assessment from Romexis and SALUD databases. Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) software version 22.0 (IBM Inc., Chicago, IL, USA). Frequency distributions were conducted for participants' characteristics and systemic conditions. Independent samples *t*-test and ANOVA was conducted to compare mean number of missing teeth among different medical conditions. The level of significance of this study was set at $p \leq 0.05$. A final multiple linear regression models was conducted to explore the systemic conditions that might be associated with missing teeth among the Saudi samples. A stepwise regression was performed to indicate significant factors. The primary model set for this model was identifying the association between medical conditions and tooth loss. Thus, variable with significant p-value were retained in the model and those with $p > 0.05$ were forced out. The best fit multiple regression model for systemic conditions that explain the difference in missing teeth is presented in table 4. Interactions and multicollinearity between significant variables were also checked. The level of significance was set at $p < 0.05$.

Results

Of the 277 subjects who agree to participate and attended interview, 27 subjects did not meet the inclusion criteria. The final study sample consisted of 250 dental patients aged 18 years and older resulted in a response rate of 90%.

Table 1 shows distribution of the participants by age, gender, level of education and monthly income. Majority of the participants were below 45 years of age and females represented 66% of the sample. It was found that participants with college degree were around 45% and only 20% of the sample had no formal schooling. About 60% of the participants had a monthly income less than SR10000.

Table 2 shows the frequency distribution of medical conditions of participants in this study. The most commonly reported medical conditions were hypertension and diabetes (14%) followed by asthma (11%). Cardiovascular diseases, rheumatoid arthritis, gastrointestinal diseases and osteoporosis were relatively uncommon among study subjects.

Table 3 shows the mean number of missing teeth among different systemic diseases of the study sample. The mean number of missing teeth was 5.84 teeth per person. Patients who reported diabetes, hypertension and rheumatoid arthritis have significantly higher mean number of missing teeth compared with the subjects who are healthy (Table 3). Moreover, the mean number of missing teeth in patients with asthma, cardiovascular diseases, and osteoporosis is higher though it is not statistically significant.

Table 4 shows the medical conditions that were associated with tooth loss among Saudi's after controlling for other factors. Diabetes, hypertension and rheumatoid arthritis were significantly associated with mean number of missing teeth. Patients who diagnosed with diabetes, hypertension and rheumatoid arthritis have higher mean number of missing teeth. The model was explained about 13% of the variance in the number of missing teeth.

Discussion

This study aimed to investigate the relationship between tooth loss and common systemic conditions among about 3000 adult patients attending College of Dentistry, KSAU-HS clinics. Several studies have investigated the relation between oral health status and general health conditions among elderly (Hämäläinen *et al*., 2003; Fure and Zickert, 1997; Hamasha *et al*., 1998; Natto *et al*., 2014). However, the association between medical conditions and oral health among other age groups is not well described. Some studies in Saudi Arabia addressed the relation between tooth loss and other risk factors; however this is the first study to address the relationship between tooth loss and systemic conditions.

Dental records and OPG radiographs were used to evaluate missing teeth, which give us more confidence in assessing tooth loss compared to clinical examination that might have miscalculations of crowned or unerupted teeth. Most of reported studies in the literature were addressing the association of tooth loss with other factors among elderly population (Natto *et al.,* 2014; Lee *et al.,* 2010). However, in the present study, we included all ages of adults and geriatric patients represented only 15% of the sample.

Table 1 Demographic and behavioral characteristics of study participants

Variable	Category	No.	%
Age	18-24 years	41	16.4
	25-34 years	52	20.8
	35-44 years	70	28.0
	45-54 years	49	19.6
	55-64 years	31	12.4
	65+ years	7	2.8
Gender	Male	84	33.6
	Female	166	66.4
Level of education	Less than high school	50	20.0
	High school	88	35.2
	College education	112	44.8
Monthly income	Less than SR5000	80	32.0
	SR5000-10000	67	26.8
	SR11000-20000	41	16.4
	SR21000-30000	29	11.6
	SR30000 and more	33	13.2

Table 2 Frequency distribution tables for reported systemic diseases

Variable	Category	No.	%
Hypertension	Yes	35	14.0
	No	215	86.0
Diabetes	Yes	34	13.6
	No	216	86.4
Asthma	Yes	27	10.8
	No	223	89.2
Rheumatoid arthritis	Yes	9	3.6
	No	241	96.4
Gastrointestinal diseases	Yes	8	3.2
	No	242	96.8
Cardiovascular diseases	Yes	8	3.2
	No	242	96.8
Osteoporosis	Yes	3	1.2
	No	247	98.8

Table 3 Comparisons of the mean number of missing teeth among different systemic diseases of the sample

Variables	Category	Mean	SD	*p* value*
Diabetes	Yes	10.94	9.085	0.000
	No	5.93	5.020	
Hypertension	Yes	9.23	7.203	0.000
	No	5.28	5.693	
Asthma	Yes	6.41	6.145	0.605
	No	5.77	6.065	
Rheumatoid arthritis	Yes	11.22	9.985	0.006
	No	5.63	5.809	
Gastrointestinal diseases	Yes	5.88	5.515	0.985
	No	5.83	6.096	
Cardiovascular diseases	Yes	9.00	7.461	0.162
	No	5.74	6.017	
Osteoporosis	Yes	8.33	0.577	0.474
	No	5.81	6.098	

* Independent samples *t*-tests.

Table 4 Final linear multiple regression model for systemic factors influencing the number of missing teeth

Variable(s)	β (95% CI)	p-value	¥Adjusted β (95% CI)	*p*-value
Diabetes	-1.471	0.000	-1.246	0.002
Hypertension	-1.102	0.003	-0.767	0.055
Rheumatoid arthritis	-1.971	0.015	-1.774	0.036
Age	1.932	0.062	1.653	0.078
Gender	0.484	0.098	0.730	0.063

* Total variance explained (R^2) = 0.129
¥ Adjusted for: age, gender, level of education and monthly income.
The model is fit, and the assumption is met. There are no interaction and multicollinearity.

The most commonly reported medical conditions in the present study were hypertension (14%), diabetes (13.6%) asthma (10.8%). However, diabetes was previously reported as the most common systemic conditions followed by hypertension (Natto *et al.*, 2014).

Hypertension in the present study is significantly associated with tooth loss which is similar to other studies. Lee *et al.* (2010) reported that more tooth loss was associated with higher hypertension in both males and females after controlling age and smoking in the elderly population. Additionally, Singh *et al.* (2016) found that individuals with partial tooth loss had 1.62 times higher odds of being hypertensive after adjustment of confounders including age, sex, marital status, area of residence, educational attainment, tobacco use, alcohol use, physical activity, and self-reported diabetes.

The present finding showed that diabetes is significantly associated with missing teeth. In the present study, diabetic subjects had almost double the mean number of missing teeth compared to non-diabetic subjects. The present results are in accordance with others which concluded that adults with diabetes had about twice the tooth loss as did those without diabetes (Greenblatt *et al*., 2016; Luo *et al.,* 2015). On the other hand, periodontal disease is considered as the sixth complication of diabetes which is a major risk factor for tooth loss (Löe, 1993). Moreover, research had demonstrated the association between tooth loss, diabetes and periodontal diseases (Taylor and Borgnakke, 2008). However, the present result is in contrast with the results as reported by Hamasha *et al.* (1998) for elderly population which showed no significant association between tooth loss and diabetes.

In this study, rheumatoid arthritis was found to be significantly associated with missing teeth. Individuals who reported rheumatoid arthritis had increased number of missing teeth compared to those who did not report rheumatoid arthritis. The results of the present study are consistent with Hamasha *et al.* (1998) who reported that mean numbers of missing teeth were significantly higher among those who had a history of joint disease.

This study revealed that the mean number of missing teeth was higher among those who had history of cardiovascular diseases; however, the difference was not statistically significant. On the contrary, Natto *et al*. (2014) found that cardiovascular diseases had a positive relation to tooth loss. Furthermore, it has been previously reported that mean numbers of missing teeth were significantly higher among those who had a history of atherosclerotic vascular disease, heart failure and ischemic heart disease (Hamasha *et al*., 1998; Natto *et al.*, 2014). This could be explained by the sample size that is relatively young and has less prevalence of cardiovascular.

The present study showed that individual with osteoporosis had a mean number of missing teeth higher than normal individual; however, this was not statistically significant. A previous study reported that reduced bone stiffness was associated with both clinical attachment loss and tooth loss in women (Silveira *et al.,* 2016).

Conclusion

Diabetes, hypertension, and rheumatoid arthritis were significant predictors for number of missing teeth. Individuals who reported diabetes, hypertension and rheumatoid arthritis had significantly higher mean numbers of missing teeth. These results highlight the importance of the effect of medical conditions on oral health.

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