Scientific Research Report

+Risk Indicators of Tooth Loss Among Mexican Adult Population: A Cross-Sectional Study

Aguilar-Díaz Fatima del Carmen [a*], *Borges-Yáñez Socorro Aída* [b], *de la Fuente-Hernández Javier* [a]

[a] *National School of Higher Education, National Autonomous University of Mexico, León, Guanajuato, Mexico*
[b] *Dentistry School, National Autonomous University of Mexico, Mexico City, Mexico*

ARTICLE INFO

Article history:
Available online 26 February 2021

Key words:
Missing teeth
Oral hygiene
Smoke
Diabetes
Mexico
Cross-sectional study

ABSTRACT

Objective: This study aimed to assess the factors associated with tooth loss in an adult population in Guanajuato, Mexico.

Methods: This cross-sectional study included individuals enrolled in a community program (2014-2016). Data were gathered through closed-ended questions about sociodemographic characteristics such as sex, age, and schooling. Oral hygiene practices, self-perceived oral health, dental visits during the last 12 months, smoking habits, and diabetes status of the participants were also recorded. A clinical evaluation was performed for each person to register decayed, missing, and filled teeth (DMF-t). Descriptive statistics, bivariate analysis, and negative binomial models were used to identify variables associated with the number of missing teeth.

Results: A total of 1640 persons were included in the study. The mean age was 41.6 (±15.4) years; 63.6% were female; and 52.7% had at least 1 missing tooth, with a mean of 2.9 (+4.6) missing teeth. The mean number of missing teeth increased by 5% per year relative to age. Females (relative ratio [RR] = 1.40), smokers (RR = 1.56), people with diabetes who smoke (RR = 3.62), and people who rated their oral health as fair or poor (RR = 1.2) had higher mean values of missing teeth. In contrast, individuals who achieved a high school degree (or above) (RR = 0.81), practiced daily toothbrushing (RR = 0.63), or practiced regular toothbrushing and flossing (RR = 0.65) had fewer missing teeth.

Conclusions: More than half of the population has at least 1 missing tooth. The number of missing teeth is higher in individuals with diabetes and unhealthy habits such as smoking. Good oral hygiene practices play an essential role in preventing tooth loss.

Introduction

Although tooth retention has increased in most countries during the last few decades, tooth loss is a critical health problem worldwide[1] that negatively impacts the daily lives of many individuals.[2] Oral functions such as speaking, eating, and swallowing may be impaired as a result of tooth loss, leading to a change in the diet and nutrition of the individual. Moreover, tooth loss also affects the person's aesthetic, self-perception, and decreases the health-related quality of life.[3-6]

Tooth loss is mainly linked to oral conditions such as caries and periodontal disease.[7] However, this alteration has also been associated with other traits, such as socioeconomic factors (eg, age and educational qualifications),[8–9] use of health services, lifestyle, and unhealthy behaviours (eg, smoking habits).[10] Additionally, some oral hygiene habits have been positively associated with the number of teeth an individual retains. For example, it has been reported that the use of multiple hygiene devices (eg, dental floss and mouthwash) fosters higher tooth retention indices.[11–12] Additionally, some systemic diseases, such as diabetes, have been associated with tooth loss.[13–14]

* *Corresponding author*. National School of Higher Education, National Autonomous University of Mexico, Blv. UNAM #2011, Predio El Saucillo y, Comunidad de los Tepetates, El Potrero, 37684 León, GJ, Mexico.
E-mail address: faguilar@enes.unam.mx (A.-D. Fatima del Carmen).

https://doi.org/10.1016/j.identj.2020.12.016

The World Health Organization (WHO) uses the tooth loss indicator as a marker of oral health. A target of the World Health Organization is to reduce the number of missing teeth at the ages 18, 35-44, and 65-74 years by 2020. Every country specifies the percentage reduction.[15] In Mexico, the goal for 2018 was to reduce decayed, missing, and filled teeth to <3.[16] Tooth loss is a marker of current health and represents the history of dental diseases. Given the cumulative nature of missing teeth, it reflects the dental treatment provided throughout an individual's life.[17-18]

In recent years, in Mexico, research has been performed to evaluate the link between certain risk factors for tooth loss;[15] however, these studies mainly have focused on systemic conditions without considering behavioural patterns. Hence, this study aims to identify variables associated with tooth loss in an adult population in Mexico, such as sociodemographic traits, oral hygiene patterns, self-perceived oral health, oral symptoms, and caries experience.

Methods

Participants enrolled in Community Oral Health Program from 2014 to 2016 were included in this cross-sectional study. This program was designed to supply coverage to rural and periurban areas in municipalities within the State of Guanajuato, central Mexico, providing free dental treatment to anyone who requested it. Patients were treated by operator-assistant pairs of undergraduate and postgraduate students under the surveillance of a coordinator. Although the program provided coverage to citizens of all ages, only patients older than age 18 years were considered for this study.

The number of missing teeth was obtained from the tooth loss counting carried out by the clinical examiner and according to the decayed, missing, and filled teeth (DMF-t) index. Third molars were excluded. The independent variables were age, sex, self-perceived oral health, dentist attendance, oral hygiene patterns, use of oral cleaning devices, and oral symptoms such as gingival bleeding, halitosis, and oral pain (Table 1).

In the statistical analysis, toothbrushing frequency and dental floss use were combined to create a single variable that encompasses oral hygiene as a local risk factor. Smoking and diabetes were merged to create another variable that represents the general health risk factor.

Descriptive data analyses were carried out according to the scale of the variables: Proportions were considered for the nominal variables, whereas central tendency measures and dispersion were applied in the case of the quantitative variables. A bivariate analysis was carried out using the Mann-Whitney or Kruskal-Wallis tests and the Spearman correlation test depending on the nature of the variable. Finally, the variables with a P value <.20 in the bivariate test were

Table 1 – Studied variables.

	Age		
	Sex		Male
			Female
	Schooling	The maximum completed degree studied	No formal education
			Elementary
			Middle school
			High school
	Self-rated OH appearance	In general, how would you rate the appearance of your teeth?	Excellent-good
			Fair-poor
	Self-rated OH status	In general, how would you rate your oral health?	Excellent-good
			Fair-poor
	Dentist attendance	Dental attendance in the last 12 months	Yes
			No
Oral hygiene patterns	Toothbrushing frequency	Do you brush your teeth every day?	Yes
			No
	Use of oral devices	Dental floss	Yes
			No
		Mouthwash	Yes
			No
Oral symptoms	Gum bleeding	Gum bleeding in the last 4 weeks	Yes
			No
	Halitosis	Bad breath in the last 4 weeks	Yes
			No
	Oral pain	Pain in teeth/mouth in the last 12 months	Yes
			No
	Oral hygiene instructions	Have you ever received instructions on how to cleanse your mouth?	Yes
			No
	Smoking	Do you smoke?	Yes
			No
	Systemic medical conditions	Diabetes	Yes
			No
	Caries experience	DMFT index	Affected teeth number

DMFT = decayed, missing, and filled teeth; OH = oral hygiene.

included in a negative binomial regression model to obtain relative risk values and 95% CIs. In all analyses, a 2-sided *P* value of less than .05 was considered statistically significant.

This study was approved by the Ethics and Research Committee of the National School of Higher Education of the National Autonomous University of Mexico, León campus.

Results

A total of 1874 persons were evaluated, but 234 profiles were excluded from the study because of the lack of data for 1 or more covariates. Therefore, 1640 persons were included in the analysis. The mean age of the participants was 41.6 (±15.4) years, and 66.3% were female. In terms of education, 23.3% of the participants reported no formal schooling, whereas 29.9% reported having attended elementary school, 29.8% middle school, and 17.0% high school or above (Table 2). Out of the 1640 participants, 52.7% had at least 1 missing tooth, with a mean value of 2.9 (±4.6) missing teeth, and a median value of 1.0. When analysed by age groups, the values were 18-30 years, a mean of 0.23 ± 1.0; 31-59 years, a mean of 2.2 ± 3.8; and 60 years or older, a mean of 6.7 ± 7.5.

Additionally, 10.6% of the participants perceived their oral health to be excellent or good, and the rest (89.4%) rated it as fair or poor (Table 2).

In the bivariate analysis, no differences were observed in the mean of missing teeth among males and females ($P = .916$). Nonetheless, according to the Spearman correlation test, age ($r = 0.441$, $P < .001$), caries ($\rho = 0.090$, $P < .001$), and filled teeth ($\rho = 0.111$, $P < .001$) were positively correlated with missing teeth. In addition, schooling, self-rated oral health, self-rated oral appearance, diabetes, smoking, and toothbrushing patterns were significantly associated ($P < .05$) with tooth loss. Those reporting better self-rated oral health, oral appearance, and better toothbrushing patterns have more teeth, whereas those who smoke and have diabetes have fewer teeth.

However, attending a dentist in the previous 12 months, having been instructed on how to perform oral hygiene, or having had pain in the last 12 months were related to missing teeth ($P > .05$). Similarly, this finding was observed regarding decayed teeth (Table 2).

The multivariate negative binomial regression analysis results showed that the mean number of missing teeth

Table 2 – Bivariate analysis.

			Decayed teeth			Missing teeth			Filled		
	n	%	Mean*	SD	P†	Mean*	SD	P†	Mean*	SD	P†
Men	596	36.3	6.38	5.45	.297	2.83	4.97	.916	0.84	2.02	<.001
Women	1044	63.6	6.62	5.31		3.04	5.65		1.45	2.91	
No formal education	383	23.3	6.59	5.03	.040	5.58	7.52	<.001	1.04	2.62	.333
Elementary	490	29.9	6.74	5.75		2.58	4.29		1.33	2.78	
Middle school	488	29.8	6.75	5.32		1.98	3.71		1.27	2.71	
High school or more	279	17.0	5.58	5.04		0.72	1.74		1.46	2.45	
Self-rated OH excellent-good	174	10.6	5.26	4.94	.003	2.19	4.39	.023	1.56	3.12	.403
Fair-poor	1466	89.4	6.68	5.38		3.85	6.26		1.23	2.62	
Self-rated OH appearance excellent-good	208	12.7	5.97	5.27	.145	2.02	4.08	<.001	1.29	2.37	.303
Fair-poor	1427	89.3	6.61	5.36		3.94	6.35		1.26	2.72	
Diabetes	1526	6.9	5.81	5.01	.119	5.45	6.78	<.001	1.19	2.81	.494
No diabetes	114	93.1	6.62	5.39		2.57	5.05		1.20	2.67	
Smoking	163	9.9	6.64	5.40	.754	3.67	4.98	<.001	1.18	2.69	.191
No smoking	1477	90.1	6.53	5.35		2.86	4.09		1.27	2.68	
Oral pain											
Once or more in the last 12 months	378	23.0	6.68	5.40	.110	2.65	5.58	.222	1.25	2.56	.130
Never	472	28.8	6.11	5.10		2.94	5.24		1.33	3.04	
Gum bleeding	840	51.2	6.63	5.38	.546	1.43	2.94	.218	1.30	2.75	.496
No gum bleeding	700	48.8	6.45	5.34		2.29	4.75		1.22	2.62	
Halitosis	977	59.6	6.85	5.43	.010	1.88	3.97	.481	1.32	2.80	.442
No halitosis	663	40.4	6.10	5.22		1.84	3.96		1.18	2.53	
Daily toothbrushing	1573	4.1	4.42	4.42	.042	2.48	4.7	<.001	1.30	2.73	.065
No daily toothbrushing	67	95.9	6.57	6.57		6.01	7.70		0.57	1.55	
DA last 12 months	830	50.6	6.42	5.29	.111	2.61	4.67	.905	1.21	2.65	<.001
No DA in the last 12 months	810	49.4	6.78	5.10		2.85	5.57		1.67	2.95	
Flossing	174	11.6	6.69	5.23	.590	0.96	1.64	.079	1.78	2.84	<.001
Not flossing	1119	88.4	6.53	5.38		3.03	5.47		1.21	2.68	
OHI	1056	64.4	6.32	5.24	.098	2.41	4.64	.318	1.53	2.94	<.001
No OHI	584	35.6	6.86	5.50		3.25	5.70		0.90	2.26	

DA = dental attendance; DMF = decayed, missing, and filled teeth; OH = oral hygiene; OHI = oral hygiene instructions; SD = standard deviation.

* DMF mean according to sociodemographic, behavioural characteristics, and oral symptoms of the studied sample ($n = 1640$).

† Based on Kruskal-Wallis/Mann-Whitney tests

Table 3 – Associated factors to tooth-loss for the studied population (*n* = 1640).

			95% CI	
	IRR	*P*	Lower	Upper
Age	**1.051**	**<.001**	**1.048**	**1.054**
Male	—	—	—	—
Females	**1.401**	**.048**	**1.01**	**1.95**
No schooling	—	—	—	—
Elementary	0.913	.140	0.810	1.029
Middle school	1.002	.970	0.880	1.140
High school or more	**0.813**	**.024**	**0.680**	**0.972**
Local risk-factors	—	—	—	—
No daily TB/No flossing				
No daily TB/Flossing	NC*	NC*	NC*	NC*
Once or more a day TB/No flossing	0.847	.06	0.714	1.006
Once or more a day TB/Flossing	**0.654**	**<.001**	**0.520**	**0.822**
General risk factors	—	—	—	—
No Diabetes/No smoker				
No diabetes/Smoker	**1.567**	**<.001**	**1.328**	**1.850**
Diabetes/No smoker	0.965	.603	0.847	1.101
Diabetes/Smoker	**3.621**	**<.001**	**2.867**	**4.574**
Self-perceived oral health	—	—	—	—
Excellent-Good				
Fair-Poor	**1.283**	**.001**	**1.101**	**1.496**
Self-perceive oral appearance				
Excellent-Good	—	—	—	—
Fair-Poor	**1.327**	**.003**	**1.098**	**1.603**
Decayed	**0.967**	**<.001**	**0.957**	**0.977**
Filled	**0.963**		**0.945**	**0.982**
_cons	0.203	<.001	0.148	0.277

Negative binomial regression for number of teeth loss.
CI = confidence interval; IRR = incidence rate ratio; NC = no cases; TB = toothbrushing.

increased 40% in females and increased by 0.5% ($P < .001$) per year increase in age. Individuals who have a higher schooling level (high school or above) have, on average, 18% fewer missing teeth compared to individuals with no schooling ($P = .024$). According to oral hygiene patterns, people who brush their teeth daily have 16% fewer missing teeth, and those that brush their teeth daily and floss them have 35% fewer missing teeth than those who do not participate in these practices $P < .001$) (Table 3).

The mean number of missing teeth is 56% higher in smokers than in nonsmokers, and it is 260% higher in people who smoke and have diabetes than in those who do not ($P < .001$) (Table 3).

In addition, the mean number of missing teeth among people who perceive their oral health to be fair or poor is 28% greater than among those who recognized it as excellent or good. Lastly, for every decayed and filled tooth, the mean number of missing teeth diminished by almost 0.4% ($P < .001$) (Table 3).

Discussion

This study evaluated factors associated with tooth loss in an adult population of Guanajuato, Mexico. The findings showed that more than half of the population had at least 1 missing tooth, and the number of missing teeth was significantly higher in those who were smokers and had diabetes. Age and educational level were also correlated with missing teeth. The number of missing teeth increased per yearly increase in age. People with better educational qualifications had fewer missing teeth. Additionally it was shown that good oral hygiene plays an essential role in preventing tooth loss.

Although, Mexico is considered an upper-middle-income country, the prevalence of tooth loss in our study was 57.2%, which is similar to that reported in low-middle income countries.[19] Kassebaum[1] reported similar results in the global burden of severe tooth loss. In that report, the prevalence of severe tooth loss for Mexico was significantly higher than the global mean. This situation may be multifactorial. In Mexico, dental preventative treatments are not widely received by certain income groups. People generally go to the dentist when there are severe problems such as dental pain and tooth mobility, so when seeking treatment, only tooth removal is possible because theproblem is advanced. Additionally, the prevalence of dental visits in this population also depends on the type of communities that the dental school serves; many served communities are low income and with a low to middle education level.[20]

Similar to other studies,[21-23] we observed that, on average, women had more missing teeth than men. The reasons for this are unclear but may be linked to the fact that women are more likely to seek dental care.[24] Perera[25] observed that health services use was associated with more missing teeth; thus, women might have received dental extractions more often. Besides, in some places in Mexico, people might ask dentists to remove 1 or several teeth as a short–term solution to teeth-related problems, probably because of the economic burden of having to pay for other treatments. This situation is similar to that observed by Petersen[26] in many developing countries, where access to oral health care is limited, and teeth often remain untreated or are extracted.

Regarding age and tooth loss, we found an association between age and tooth loss, consistent with that reported before[27–29] derived from studies focused mainly on elderly populations. Nonetheless, we included a large sample with a wide range of ages and observed that the average number of missing teeth increased by 5% for each year of the patient's age, suggesting that in this population tooth loss is a problem that affects people of all age groups.

In line with previous findings, in developed and developing countries, educational level was related to missing teeth, showing that people with higher educational qualifications have fewer missing teeth.[8,30-32] Perhaps, people with better education have better oral hygiene practices, which promotes better oral health and leads to better retention of natural teeth. In this sense, our results support and reinforce the idea that the combination of hygiene practices is associated with tooth retention. Those who brush their teeth daily have fewer missing teeth, and if this practice is complemented with flossing, the number of missing teeth decreases considerably. Additionally, there is enough evidence showing positive associations between healthy behaviours and a reduction in the risk of oral cancer, a decrease in the average decayed, missing, and filled teeth, and a lower prevalence of periodontal disease. The latter 2 conditions are the core causes of tooth loss.[33]

Smoking and diabetes

We observed that the mean value of missing teeth in a person who smokes and has diabetes is almost three times higher compared to healthy nonsmokers. In the same way, reports indicate an increase in the risk of having oral problems related to smoking or diabetes in developed and developing countries.[13,32-36] Smoking is a risk factor for several types of cancer, including oral cancer. Furthermore, smoking is an important risk factor for periodontal disease and tooth loss, and it has been suggested that it also promotes modifications in the oral environment, resulting in a high incidence of caries, which eventually leads to tooth loss.[32] Therefore, oral health professionals should educate patients with chronic diseases, such as diabetes, about the risks of this condition to their oral health. Specifically, dentists in Mexico should reinforce strategies to promote smoking cessation among their patients, following the stipulation in the Official Mexican Standard NOM-013-SSA2-2015 for the prevention and control of oral disease.[35]

One of the strengths of the study is to have included a large sample of the general population, evaluating not only general health factors but also behavioural ones; also, diabetes and smoking were analysed as variables that interact and not as separate factors. On the other hand, some limitations of this study should be mentioned. First, results must be taken cautiously because of the cross-sectional design; no causality could be identified. In addition, we did not evaluate the socioeconomic position per se. Instead, we used the educational level as the sole indicator of this variable, based on the idea that a given socioeconomic status is related to a given academic level.

Another limitation is the lack of assessment of periodontitis, which is linked to the number of missing teeth. Nonetheless, diabetes and smoking are the main risk factors associated with periodontitis, and these 2 factors were included in the study. These 2 factors, separately, are associated with tooth loss. Specifically, smoking is 1 of the 2 leading causes of tooth loss. It might be an indicator of an unhealthy lifestyle that includes poor oral hygiene, poor diet, and a sedentary lifestyle.

Finally, our results indicate that the conventional oral health approach is neither sufficient nor efficient to prevent tooth loss; tooth loss should be urgently addressed through the implementation of community preventive programs under the common risk factor approach that focuses on risk factors that are common to many chronic health conditions within the context of the broader socioenvironmental setting.[37] It is vital that all health care workers focus their efforts on common risk factors, in this case, unhealthy personal habits. In doing so, they would contribute to the reduction of chronic diseases and, at the same time, mitigate unhealthy oral conditions that lead to tooth loss and its consequences.

Conclusions

More than half of the population has at least 1 missing tooth. The number of missing teeth is higher in those with diabetes and unhealthy habits such as smoking. Increased preventive practices lead to tooth retention.

Conflict of interest

None disclose.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Kassebaum NJ, Bernabé E, Dahiya M, et al. Global burden of severe tooth loss: a systematic review and meta-analysis. J Dent Res 2014;93:20S–8S. doi: 10.1177/0022034514537828.
2. Chauncey HH, Muench ME, Kapur KK, et al. The effect of the loss of teeth on diet and nutrition. Int Dent J 1984;34(2):98–104.
3. Okamoto N, Morikawa M, Yanagi M, et al. Association of tooth loss with development of swallowing problems in community-dwelling independent elderly population: The Fujiwara-kyo study. J Gerontol A Biol Sci Med Sci 2015;70(12):1548–54.
4. Naito M, Yuasa H, Nomura Y, et al. Oral health status and health-related quality of life: a systematic Review. J Oral Sci 2006;48:1–7.
5. Batista MJ, Lawrence HP, de Sousa Mda L. Impact of tooth loss related to number and position on oral health quality of life among adults. Health Qual Life Outcomes 2014;12:165. doi: 10.1186/s12955-014-0165-5.
6. Gerritsen AE, Allen PF, Witter DJ, et al. Tooth loss and oral health-related quality of life: a systematic review and meta-analysis. Health Qual Life Outcomes 2010;8:126.
7. Medina-Solís CE, Pontigo-Loyola AP, Pérez-Campos E, et al. Principal reasons for extraction of permanent tooth in a sample of Mexicans adults [in Spanish]. Rev Invest Clin 2013;65:141–9.
8. Rodriguez FR, Paganoni N, Weiger R, et al. Lower educational level is a risk factor for tooth loss - analysis of a Swiss population (KREBS Project). Oral Health Prev Dent 2017;15(2):139–45. doi: 10.3290/j.ohpd.a38097.
9. Lahti S, Suominen-Taipale L, Hausen H. Oral health impacts among adults in Finland: Competing effects of age, number of teeth, and removable dentures. Eur J Oral Sci 2008;116(3):260–6. doi: 10.1111/j.1600-0722.2008.00540.x.
10. Ando A, Ohsawa M, Yaegashi Y, et al. Factors related to tooth loss among community-dwelling middle-aged and elderly Japanese men. J Epidemiol 2013;23:301–6. doi: 10.2188/jea.JE20120180.
11. Hsu KJ, Yen YY, Lan SJ, et al. Impact of oral health behaviours and oral habits on the number of remaining teeth in older Taiwanese dentate adults. Oral Health Prev Dent 2013;11 (2):121–30. doi: 10.3290/j.ohpd.a29360.
12. Kressin NR, Boehmer U, Nunn ME, et al. Increased preventive practices lead to greater tooth retention. J Dent Res 2003;82 (3):223–7. doi: 10.1177/154405910308200314.
13. D'Aiuto F, Gable D, Syed Z, et al. Evidence summary: the relationship between oral diseases and diabetes. Br Dent J 2017;222(12):944–8. doi: 10.1038/sj.bdj.2017.544.
14. Wiener RC, Shen C, Findley PA, et al. The association between diabetes mellitus, sugar-sweetened beverages, and tooth loss in adults: Evidence from 18 states. J Am Dent Assoc 2017;148 (7) 500-9.e4. doi: 10.1016/j.adaj.2017.03.012.
15. Hobdell M, Petersen PE, Clarkson J, Johnson N. Global goals for oral health 2020. Int Dent J 2003;53:285-8.
16. D.R. Secretaría de Salud. Prevención, detección y control de los problemas de salud bucal. Available from: http://www.cenaprece.salud.gob.mx/descargas/pdf/

PAE_PrevencionDeteccionControlProblemasSaludBucal2013_2018.pdf. Accessed 8 February 2020.
17. Petersen PE, Bourgeois D, Ogawa H, et al. The global burden of oral diseases and risks to oral health. Bull World Health Organ 2005;83:661–9.
18. Baelum V, van Palenstein Helderman W, Hugoson A, et al. A global perspective on changes in the burden of caries and periodontitis: implications for dentistry. J Oral Rehabil 2007;34(12):872–906. doi: 10.1111/j.1365-2842.2007.01799.x.
19. Shabana Begum SK, Chandra Sekhara Reddy V, Krishna Kumar RVS, et al. Tooth loss prevalence and risk indicators among adult people visiting community health centers in Nellore district, Andhra Pradesh: a crosssectional study. J Ind Assoc Public Health Dent 2016;14(4):413–8.
20. National Institute of Statistic and Geography. Cuentame. Informaciín por entidad. Available from: http://cuentame.inegi.org.mx/monografias/informacion/gto/poblacion/educacion.aspx?tema=me&e=11#:~:text=Educaci%C3%B3n.,Guanajuato&text=En%20Guanajuato%2C%20el%20grado%20promedio,m%C3%A1s%20de%20la%20secundaria%20concluida. Accessed 20 March 2020.
21. Peres MA, Barbato PR, Reis SCGB, et al. Tooth loss in Brazil: analysis of the 2010 Brazilian Oral Health Survey. Rev Saude Publica 2013;47:78–89. doi: 10.1590/S0034-8910.2013047004226.
22. Moreira RDS, Nico LS, Barrozo LV, et al. Tooth loss in Brazilian middle-aged adults: multilevel effects. Acta Odontol Scand 2010;68(5):269–77. doi: 10.3109/00016357.2010.494617.
23. Lin HC, Corbet EF, Lo ECM, et al. Tooth loss, occluding pairs, and prosthetic status of Chinese adults. J Dent Res 2001;80(5):1491–5. doi: 10.1177/00220345010800052101.
24. Matos DL, Lima-Costa MF. Trends in the use of dental services by elderly Brazilians and related sociodemographic factors based on the National Household Survey (1998 and 2003). Cad Saude Pub 2007;23(11):2740–8.
25. Perera R, Ekanayake L. Tooth loss in Sri Lankan adults. Int Dent J 2011;61(1):7–11. doi: 10.1111/j.1875-595X.2011.00002.x.
26. World Health Organization. WHO releases new report on global problem of oral diseases. Available from: https://www.who.int/mediacentre/news/releases/2004/pr15/en/. Accessed 24 May 2020.
27. Islas-Granillo H, Borges-Yañez A, Medina-Solis CE, et al. Tooth-loss experience and associated variables among adult Mexicans 60 years and older. P R Health Sci J 2016;35(2):88–92.
28. Hayasaka K, Tomata Y, Aida J, et al. Tooth loss and mortality in elderly Japanese adults: effect of oral care. J Am Geriatr Soc 2013;61:815–20.
29. Islas-Granillo H, Borges-Yañez SA, Medina-Solís CE, et al. Socioeconomic, sociodemographic and clinical variables associated with root caries in a group of persons age 60 years and older in Mexico. Geriatr Gerontol Int 2012;12:271–6.
30. Haugejorden O, Klock KS, Astrøm AN, et al. Socioeconomic inequality in the self-reported number of natural teeth among Norwegian adults - An analytical study. Community Dent Oral Epidemiol 2008;36(3):269;78. doi: 10.1111/j.1600-0528.2007.00367.x.
31. Susin C, Oppermann RV, Haugejorden O, et al. Tooth loss and associated risk indicators in an adult urban population from south Brazil. Acta Odontol Scand 2005;63:85–93.
32. Song I, Han K, Choi Y, et al. Influence of oral health behavior and sociodemographic factors on remaining teeth in Korean adults: 2010–2012 Korea national health and nutrition examination survey. Medicine 2016;95(48):e5492. doi: 10.1097/MD.0000000000005492.
33. Gupta B, Bray F, Kumar N, Johnson NW. Associations between oral hygiene habits, diet, tobacco and alcohol and risk of oral cancer: A case-control study from India. Cancer Epidemiol 2017;51:7–14. doi: 10.1016/j.canep.2017.09.003.
35. de Araújo Nobre M, Maló P. Prevalence of periodontitis, dental caries, and peri-implant pathology and their relation with systemic status and smoking habits: results of an open-cohort study with 22009 patients in a private rehabilitation center. J Dent 2017;67:36–42. doi: 10.1016/j.jdent.2017.07.013.
35. Jimenez M, Hu FB, Marino M, et al. Type 2 diabetes mellitus and 20 year incidence of periodontitis and tooth loss. Diabetes Res Clini Pract 2012;98(3):494–500.
36. Sun H, Du M, Tai B, et al. Prevalence and associated factors of periodontal conditions among 55- to 74-year-old adults in China: results from the 4th National Oral Health Survey. Clin Oral Investig 2020;24:4403–12. doi: 10.1007/s00784-020-03306-4.
37. Sheiham A, Watt RG. The common risk factor approach: a rational basis for promoting oral health. Community Dent Oral Epidemiol 2000;28(6):399–406. doi: 10.1034/j.1600-0528.2000.028006399.x.