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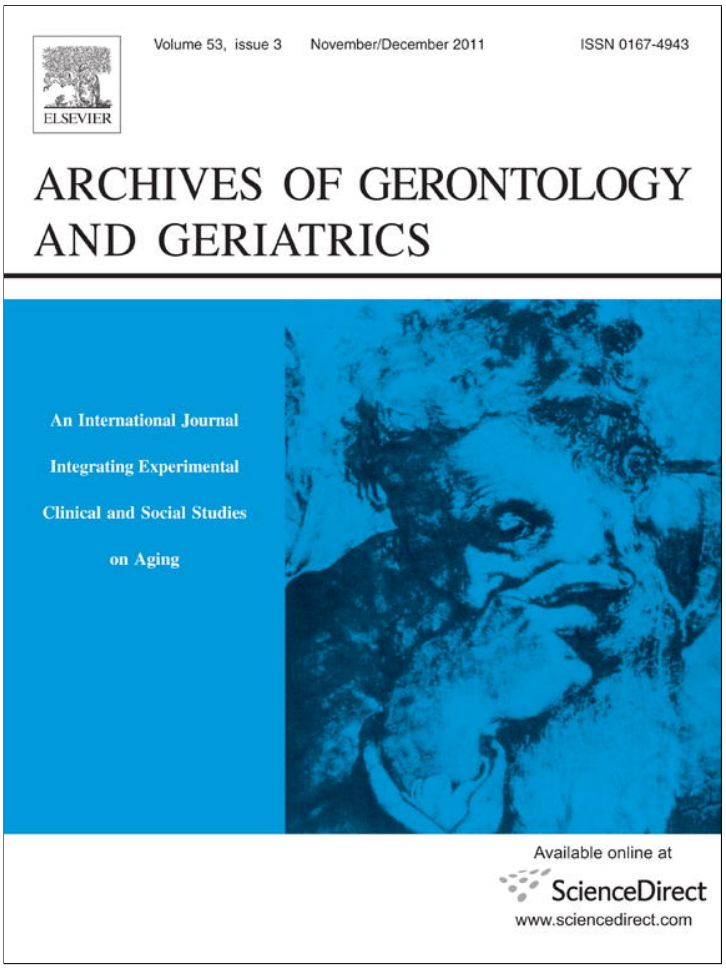

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Edentulism risk indicators among Mexican elders 60-year-old and older

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ABSTRACT

The objective of this study was to determine the prevalence of edentulism in Mexican elders aged 60 years and older, and the associated risk indicators. A cross-sectional study was undertaken in 139 elders living in either of two long-term care (LTC) facilities, or attending an adult day center (ADC) in Pachuca, Mexico. A subject was edentulous when natural teeth were completely absent, determined through a clinical examination. Risk indicators were collected using questionnaires. Analyses were performed using binary logistic regression in STATA 9.0. Mean age was 79.0 ± 9.8 years. Many subjects were women (69.1%). The prevalence of edentulism was 36.7%. In multivariate analysis, after adjusting for age and sex, the variables that were inversely associated ($p < 0.05$) with edentulism were living with a spouse (odds ratio = OR = 0.31), and lacking health insurance (OR = 0.70). Variables associated with higher risk of being edentate were lower educational attainment (OR = 1.61), having received radiation therapy (OR = 4.49), being a smoker (OR = 4.82), and having diabetes (OR = 2.94) or other chronic illnesses (OR = 1.82) (with hypertension approaching significance, $p = 0.067$). In this sample of Mexican elders, diverse variables were associated with edentulism, in particular smoking and past radiotherapy. Oral health programs within and outside LTC/ADC should take into account risk factors specific to the older population.

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1. Introduction

According to the United Nations (2009) report on health, epidemiological shifts and increased demand for health services are closely associated with older ages and higher experience of chronic disorders in populations. Given the current models favoring specialized services, the economic and social costs will continue to pose additional burden for health systems around the world. An increase in life expectancy has been often linked to tooth loss, as a consequence of factors accumulated throughout a lifetime. Tooth loss refers to losing one or more natural teeth; edentulism is the state in which all teeth have been lost (Hanioka et al., 2007; Lawton et al., 2008) through a complex process involving biological and lifestyle factors (Felton, 2009). Tooth loss and edentulism are considered by the WHO as outcomes derived from poor oral health (Lawton et al., 2008).

Besides dental caries and periodontal disease, there are risk indicators that might be associated with tooth loss. Women lose more teeth and are more likely to be edentate than men (Medina-Solís et al., 2006; Nalçaci et al., 2007). A study in Italy found that edentulism was related to different variables in men and women; tobacco smoking was a strong predictor of edentulism (Musacchio et al., 2007). Besides direct effects such as those derived from undergoing radiotherapy (Kaste et al., 2009) (because of its long term effect on saliva production, and consequent impacts on hard and soft tissues in the mouth), indirect effects may be ascribed to markers commonly used to predict health inequalities, such as socioeconomic status (Medina-Solís et al., 2006; Cunha-Cruz et al., 2007; Hugo et al., 2007; Nalçaci et al., 2007).

An important consideration about edentulism regards its consequences. While edentulism has been linked to a wide range of health outcomes (Starr and Hall, 2010), it appears cautious to interpret conservatively any causality assumptions. Partially or completely edentate persons have a higher risk of malnutrition due to dietary adjustments (De Marchi et al., 2008; Quandt et al., 2010). The strength of associations between edentulism and other conditions is less clear but it has nevertheless been documented for

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higher risk of presenting coronary disease (Dietrich et al., 2008), hypertension and stroke (Choe et al., 2009), and some types of cancer (Abnet et al., 2008). Edentulism produces anatomic changes in the upper airways, such as contributing to pharyngeal collapse, a common cause of obstructive apnea (Bucca et al., 2006). Another important impact is its apparent role in modifying quality of life (Hugo et al., 2009; Starr and Hall, 2010). Complete edentulism prior to the age of 65 has been associated with all-cause mortality among American adults (Brown, 2009).

There exists few published reports on edentulism experience for Mexico (Medina-Solís et al., 2006, 2008), in stark contrast with other countries such as Canada, United States of America, Finland, Sweden, United Kingdom, Japan, Thailand, Australia, and China: overall prevalence for the 65+ years old population ranges from 6% to 57% (Petersen and Yamamoto, 2005). The objective of the present study was to determine the prevalence of edentulism among adults 60 years of age and older, as well as to determine risk factors, among Mexican elders, both institutionalized and community-dwelling.

2. Subjects and methods

This study was approved by the Ethical Committee at Universidad Autónoma del Estado de Hidalgo. The board of directors at each one of the participating institutions reviewed the informed consent forms and procedures, and approved them. Each one of the study participants was invited to take part in the study after being informed of its objectives and the confidentiality measures in place; a family member was present while potential participants were being briefed. Participants were also told that they could withdraw from the study at any point. No incentives or monetary compensation were offered.

2.1. Study sample and design

This study is part of a larger project about oral health indicators in elders. The cross sectional design included all elders 60 years of age and older who resided at either one of the two LTC facilities, or attended an ADC. Inclusion criteria were (1) 60+ years old, and (2) willing to participate in the research. Exclusion criteria were (1) people younger than 60 years, (2) people with hearing, cognitive or language disabilities that could interfere with the interview, and (3) people with any physical disability that might prevent an oral exam.

2.2. Data collection and variables

This manuscript presents only data for edentulism. Data collection took place in two stages: clinical examination and questionnaire administration. The clinical exam was performed by one previously trained and standardized dentist; he undertook all exams under artificial light, with a flat dental mirror and a WHO periodontal probe.

Questionnaires directed to the elders were used to collect sociodemographic, socioeconomic, and risk factor information. Questionnaires were administered by previously trained staff, to collect information on age, sex, marital status, availability of publicly funded health insurance, maximum level of schooling, residing in a private or publicly funded LTC or living independently, having received therapeutic radiation, current tobacco smoking status, daily soft drinks intake, and having medically diagnosed chronic diseases.

2.3. Data analysis

The dependent variable was edentulism, categorized as 0 = subject with at least one natural tooth, and 1 = subject with no natural teeth. A person presenting only root tips ($n = 2$) was also considered edentate. The presence of chronic diseases was categorized as 0 = subject with no chronic diseases, 1 = subject with diabetes with or without any other chronic disease (except hypertension), 2 = subject with hypertension with or without any other chronic disease (except diabetes), and 3 = subject with a chronic disease different to diabetes or hypertension (Table 1). A descriptive analysis of the population was first performed: a χ^2-test was used to ascertain if there was a statistically significantly difference between the proportion of the groups who were edentate across independent variable categories.

Bivariate/multivariate analyses were performed using binary logistic regression. The backward method was used for the final model construction. The variance inflation factor was used to identify and avoid multicolinearity among independent variables.

Because of the sample size, interactions were not tested; the significance level $p < 0.10$ was considered as a tendency. For bivariate and multivariate analyses the standard errors were adjusted for the correlation that could have existed among elders from the same LTC/ADC (cluster intra-organization). Hosmer and Lemeshow (2000) goodness of fit was performed for global adjustment of the model (Williams, 2000; Bagley et al., 2001). Data were analyzed using STATA 9.0 program.

Table 1
The distribution of sociodemographic, socioeconomic, and risk factor variables.

	n (%)
Sociodemographic variables	
Sex	
Male	43 (30.9)
Female	96 (69.1)
Age (years)	
60–74	47 (33.8)
75–84	47 (33.8)
85+	45 (32.4)
Marital status	
Single	52 (37.4)
With a spouse	25 (18.0)
Divorced/widowed	62 (44.6)
Socioeconomic variables	
Publicly funded health insurance	
Yes	64 (46.0)
No	75 (54.0)
Schooling	
Illiterate	32 (23.0)
Incomplete elementary	58 (41.7)
Elementary	20 (14.4)
High School	14 (10.1)
College	15 (10.8)
Type of location	
Publicly funded LTC	84 (60.4)
Private LTC	31 (22.3)
Adult day center	24 (17.3)
Other risk factors	
Radiation therapy	
No	133 (95.79)
Yes	6 (4.3)
Current tobacco use	
No	117 (84.2)
Yes	22 (15.8)
Regular soft drink intake	
Yes	46 (33.1)
Sometimes	48 (34.5)
No	45 (32.4)
Chronic diseases	
None	37 (26.6)
Diabetes	
With another disease	18 (12.9)
without another disease	19 (13.7)
Hypertension with another disease	65 (46.8)

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3. Results

3.1. Basic results

A total of 139 subjects were included in the study; no one from the complete rosters at the LTCs or ADC refused to participate when invited. Only 12 elders failed to meet the inclusion criteria.

Average age was 79.0 ± 9.7 years. About two thirds of the subjects were women (69.1%), and about half of the subjects did not have a partner (44.6%). A very high percentage did not finish elementary school or were illiterate (64.7%). Of note is that a substantial proportion of the subjects resided in a publicly funded LTC. About half of the subjects lacked publicly funded health insurance. Only a quarter of the study population (26.6%) had no diagnosed chronic diseases; 16% smoked daily or sometimes. Only 4.3% of the subjects had received radiotherapy at some point in time of their lives. Table 1 shows the variables included in the study.

The prevalence of edentulism was 36.7%. The χ^2-analysis showed similar percentages in men and women (37.1% vs. 36.5%, respectively; $p > 0.05$), and across age groups (29.8% in 60–74, 36.2% in 75–84, and 44.4% in 85+ year-olds, non-parametric test for trend: $p > 0.05$). Table 2 shows the logistic regression bivariate analysis; at this analysis level we found significant differences ($p < 0.05$) for smoking and some chronic diseases. Almost 100% of the subjects who used tobacco had done so for 10 years or longer (data not shown). Having undergone radiation treatment was significantly associated with increased edentulism experience ($p < 0.10$).

3.2. Risk indicators and edentulism

The multivariate regression analysis identified risk indicators for edentulism (Table 3). After adjusting for age and sex, living with a partner was a protective factor against edentulism, compared to being single, widowed, or divorced (OR = 0.31; 95% confidence interval = CI = 0.16–0.62). Not having publicly funded health insurance was also a protective factor (OR = 0.70; 95% CI = 0.63–0.78). When subjects with complete elementary education (and/or higher educational years) were compared against those who had not finalized elementary school, we found that the latter had a 61% higher risk of being edentate.

The subjects who received radiotherapy had markedly incremented odds of being edentulous (OR = 4.49; 95% CI = 1.26–15.98), just as those who used tobacco (OR = 4.82; 95% CI = 3.95–5.86). While hypertension appeared to be marginally associated with the likelihood of being edentate, there was a clear association between suffering from a chronic disease and edentulism, being just diabetes or diabetes combined with another disease. The latter situation led to the stronger, higher association (OR = 2.94; 95% CI = 2.08–4.16).

Table 2
Bivariate analysis of edentulism across independent variables.

	Odds ratio (CI 95%)	p
Sex		
Male	1[a]	
Female	0.97 (0.35–2.69)	<0.951
Age (years)		
60–74	1[a]	
75–84	1.34 (0.55–3.22)	<0.519
85+	1.89 (0.53–6.66)	<0.325
Marital status		
Single	1[a]	
With a spouse	0.51 (0.13–2.09)	<0.353
Divorced/widowed	1.81 (0.67–4.89)	<0.242
Publicly funded health insurance		
Yes	1[a]	
No	0.83 (0.52–1.31)	<0.419
Schooling		
Completed elementary or higher	1[a]	
Incomplete elementary or lower	1.00 (0.60–1.65)	<0.991
Radiation therapy		
No	1[a]	
Yes	3.66 (0.93–14.35)	<0.063
Current tobacco use		
No	1[a]	
Yes	3.78 (2.62–5.46)	<0.001
Regular soft drink intake		
Yes	1[a]	
Sometimes/no	1.02 (0.90–1.15)	<0.784
Chronic diseases		
None	1[a]	
Diabetes with/without another	2.49 (1.77–3.50)	<0.001
Hypertension with/without another	1.26 (0.61–8.36)	<0.221
Other chronic diseases	2.07 (1.32–3.25)	<0.001

Notes: CIs were calculated with standard errors taking into account intra-organization (LTC, ADC) cluster.
[a] Reference category.

Table 3
Multivariate analysis using binary logistic regression for edentulism.

	Odds ratio (CI 95%)	p
Marital status		
Single	1[a]	
With a spouse	0.31 (0.16–0.62)	<0.001
Divorced/widowed	1.56 (0.44–5.55)	<0.491
Publicly funded health insurance		
Yes	1[a]	
No	0.70 (0.63–0.78)	<0.001
Schooling		
Completed elementary or higher	1[a]	
Incomplete elementary or lower	1.61 (1.11–2.35)	<0.013
Radiation therapy		
No	1[a]	
Yes	4.49 (1.26–15.98)	<0.020
Current tobacco use		
No	1[a]	
Yes	4.82 (3.95–5.86)	<0.001
Chronic diseases		
None	1[a]	
Diabetes with/without another	2.94 (2.08–4.16)	<0.001
Hypertension with/without another	2.53 (0.94–6.87)	<0.067
Other chronic diseases	1.82 (1.29–2.59)	<0.001

Notes: Model was adjusted for those variables in Table 3, as well as age and sex. CIs were calculated with standard errors taking into account intra-organization (LTC, ADC) cluster; goodness of fit: Hosmer–Lemeshow: χ^2 (8) = 10.16; p = 0.2541. Linktest (specification error): predictor = 0.0001; predictor^2 = 0.166.
[a] Reference category.

4. Discussion

The present research explored one oral health indicator among Mexican elders. We identified the strength of associations between some lifestyle and socio-demographic variables and edentulism. A prevalence of 36.7% of edentate elders is within the range of the highly variable figures from around the world; they vary widely, even within the same country (Petersen and Yamamoto, 2005; Medina-Solís et al., 2008; Brown, 2009).

Oral health diseases are related to social determinants of health and also to certain aspects of lifestyle (Masalu et al., 2009). The variable that turned out to be more strongly related to edentulism in our study population was tobacco smoking. Tobacco use has been associated with tooth loss and to edentulism in other studies (Medina-Solís et al., 2006; Musacchio et al., 2007; Griffin et al., 2009). The links between these variables operate at multiple levels, such as periodontal disease mechanisms, treatment undertaken in response to oral disorders, and health-related behaviors. At the more basic interpretation of pathophysiologic changes, inflammatory responses are altered jointly with vascular and immune reactions, leading to bone loss, pocket formation, and eventually

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tooth loss (Bergström, 2004). Since periodontitis, or some of the treatment options implemented in response to periodontal breakdown, could be an important cause for tooth loss among adults, tooth loss has often been used as a proxy indicator for periodontal disease in the epidemiological literature. Such interpretation must be cautious because teeth are lost usually with the intervention of dentists: the specific type of dental services received may have a strong modulating effect. The fact that not having publicly funded health insurance was a protective factor against edentulism substantiates this notion. This type of health insurance in Mexico is commonly limited to tooth extractions and basic restorations, without affording more sophisticated options to preserve teeth. A prior study on edentulism in another area of Mexico we undertook hinted at this trend as well (Medina-Solís et al., 2006).

Consistent with other studies, we observed that chronic diseases such as diabetes or hypertension were associated with oral disorders. Griffin et al. (2009) hypothesized that such link may be (1) attributed to common risk factors such as tobacco smoking, low socioeconomic level, or poor nutrition, or (2) imply a direct association between chronic diseases and dental diseases through biological or pharmacologic mechanisms. There are multiple examples of past research focused on both explanations but the exact mechanisms still are a matter of debate.

We found that having a partner was associated with a decline in the risk of being edentulous. Because we controlled for the effects of age and sex, the model allowed us to conclude that it is not simply a relationship predicated on being older, or surviving for longer (a universal trend for women). There are measurable impacts of quality of life related to work and having a partner, and oral health status (Marcenes and Sheiham, 1992, 1996; Abegg et al., 1999).

The sequels of radiation therapy and chemotherapy on oral tissues are well established; both are independent risk factors for tooth loss and edentulism (Roos et al., 1996; Kielbassa et al., 2006; Kaste et al., 2009), as well as aggravation of periodontal breakdown (Epstein et al., 1998). While our findings agree with such general trend, it is worthwhile pointing out that many of the studies have been carried out in survivors of face and/or neck cancer. Our study was not limited to such high risk population but rather used a population-based approach; unfortunately this interpretation was limited because we could not ascertain the reasons for the treatment, or the body part that had been irradiated, due to the absence of relevant medical records.

There is ample evidence that the position in the social structure is a strong mortality and morbidity predictor, substantiating an association between health status and social status: in general individuals with a better socioeconomic level have better health (Kawachi, 2000; Lynch and Kaplan, 2000). In the present study and in our past research with Mexican populations we have confirmed such gradient, suggesting that oral health is a good indicator to gage health inequalities, just as in other parts of the world (Villalobos-Rodelo et al., 2007a,b; Herrera et al., 2009). A variable that has been commonly used as proxy for socioeconomic status, maximum level of schooling, stayed in the final model. Nevertheless, the exact mechanism by which health and socioeconomic position are related is not completely characterized, mainly because of multidimensionality of the constructs (Laaksonen et al., 2005).

The present study has limitations that must be taken into consideration to correctly interpret the results. For example, the cross sectional design implies temporary ambiguity; therefore it is not possible to accurately establish a cause–effect relationship. Another limitation was the type of population studied: just like in many other studies, a large proportion of our study population (82.7%) was institutionalized. Results may be different among elders living independently. Of course, then other considerations might apply to a younger group of elders, perhaps less frail or less dependent. The fact that our study subjects did not suffer from major cognitive, hearing, or physical impairments as a precondition to participating was also a feature that must be kept in mind when contrasting results across study populations.

5. Conclusions

About one third of this array of Mexican elders living under different residential arrangements was edentate. The vast majority of the epidemiologic data for Mexico has been circumscribed to children and teenagers. Together with the need to address the oral health needs and well being of both dentate and edentate elders, the present results highlight the need to bring older populations into the policy planning and services' delivery focus for the country. Risk factors for edentulism identified through the present research constitute a starting point to design and implement health education, health promotion, and proactive preventive programs that introduce tobacco cessation efforts, and highlight the links between systemic diseases and oral well being.

Conflict of interest statement

None.

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