# Tooth-Loss Experience and Associated Variables among Adult Mexicans 60 Years and Older

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**Objective:** This study was conducted to determine the experience of tooth loss, as well as its associated variables, in a sample of adult Mexicans, aged 60 years and older.

**Materials and Methods:** This cross-sectional study was part of a larger project to measure diverse oral health indicators in a convenience sample: it included 139 adult Mexican seniors (69.1% of whom were women), ages 60 years and older, either living in long-term care facilities or living independently and participating in adult day care services. Each participant underwent an oral examination to determine the number of missing teeth. Questionnaires were administered to collect sociodemographic, socioeconomic, and behavioral data. Statistical analyses were performed using non-parametric tests and negative binomial regression.

**Results:** The mean age was 79.06 (±9.78 years). The mean number of missing teeth was 20.02 (±8.61; median, 24); 99.3% of the participants had at least 1 missing tooth, and only 14 had 20 teeth or more. Using a negative binomial regression multivariate model, we found that for each year's increase in age, the mean number of teeth lost increased by 1% (p<0.05). In individuals who brushed their teeth fewer than two times a day, who had received radiotherapy, or who were currently smokers, the average tooth loss increased 49.2%, 22.6%, and 19.0%, respectively (p<0.01).

**Conclusion:** Tooth-loss experience in these Mexican seniors was very high (20.02±8.61). Older age (within the range of this group of seniors), tooth-brushing patterns, the receipt of radiation therapy, and (current) tobacco use were associated with higher experience of tooth loss. [*P R Health Sci J 2016;35:88-92*]

*Key words: Oral health, Tooth loss, Epidemiology, Smoking, Mexico*

In recent decades there has been a dramatic change in the population profiles of developed and developing countries. In less than 4 decades, the population growth of Mexico slowed, migration intensified, and the number of older adults increased. Nationally, adults over 59 years old are being reported as having poorer health status, higher proportions of acute and chronic diseases, and greater degrees of disability than their younger counterparts have. In general, the use of health services by these older adults is very low (1). Oral health in the older population group is poorly documented and has received little attention. Elder residents of long-term care facilities often lack basic dental care, potentially leading to poor nutrition, dental pain, medical complications, and tooth loss (2).

In Mexico, oral diseases such as dental caries (3,4) and periodontal diseases (5,6) remain the major dental public health problems in the general population; they are the main causes of teeth being extracted in adults (7). Tooth loss in the elderly may be associated with chronic systemic diseases and malnutrition, besides affecting such activities in daily life as talking, smiling, chewing, and tasting. Preventing tooth loss helps maintain good

overall health and a high quality of life and minimizes other morbidity and mortality issues (8–10).

Several epidemiological studies around the world have observed a number of factors related to the risk of losing teeth. In addition to clinical reasons such as caries and periodontal disease (7,11), other factors/indicators have been associated with tooth loss; among them are age (i.e., being elderly), sex (i.e., being a woman), certain diseases (specifically, diabetes), tobacco use, the receipt of radiation treatment, poor (self-rated) oral health,

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abundant plaque, low levels of schooling, occupation, type of residence, and low socioeconomic position (12–17). Tooth loss could have an impact on general health in the elderly population because tooth loss undermines masticatory function, which is critical for proper nutrition (8). There is little information about these features in Mexico; little information exists as well about the overall experience of tooth loss among the elderly.

The dental health care system in Mexico is a mixed system, with the overwhelming majority of services delivered under a fee-for-item, out-of-pocket scheme that is run by largely unregulated members of the dental profession and similarly unregulated dental market. The public health sector is responsible for a small, essentially undetermined and largely fluid set of services that are almost completely restricted to urban settings.

The aim of the present study was to determine the experience of tooth loss, together with the distribution of variables associated with tooth loss, in a sample of Mexican adults aged 60 and older.

## Subjects and Methods

### Population and Study design

A cross-sectional study was undertaken on people ages 60 and older who were residents of the long-term care (LTC) facilities La Casa Hogar Para Ancianos de Gobierno del Estado (publicly funded) and Fundación Ma. Domínguez viuda de Álvarez (privately funded), or who were non-resident members receiving adult day care services (ADC) in a senior center, En Busca de un Amigo (federally funded). A description of the survey planning and methods has been described elsewhere (18–21). These facilities are in Pachuca, Hidalgo, México.

The original population consisted of 151 participants. Inclusion criteria for the study were that the potential participant be a) a man or a woman, b) 60 years old or older, c) willing to participate in the research, and d) a resident of either of the 2 LTC facilities or a registered member of the day care group. Exclusion criteria were a) having auditory, cognitive, or language disabilities that could interfere with the interview, b) having a physical disability severe enough to prevent an oral examination, c) refusing to take part in the study, and d) having incomplete data with regard to the number of missing teeth. We excluded 12 (7.9%) participants who failed to meet at least one of the inclusion criteria. The final study sample was made up of 139 individuals. We calculated a power of 0.95 (n = 135), based on a 0.65 proportion of teeth lost in the overall population and a 0.50 proportion in our study population.

### Data collection and Measurements

Clinical exams were performed by a trained and standardized dentist under artificial light, with a flat dental mirror and a World Health Organization periodontal probe. Training was undertaken in another group of seniors in a separate pilot study, using identical scales and instruments; the kappa values for the various health indicators were greater than 0.85. Third molars were not taken into account. Root tips were considered as missing teeth. Our dependent variable was the number of teeth lost.

The questionnaires filled out by participants were used to collect sociodemographic and socioeconomic information, and to ascertain their oral health behaviors. Questionnaires were administered by 2 senior dental students who were trained to use appropriate language for lay people in the targeted age group and trained to avoid suggesting any specific answer. Each participant completed or responded to a questionnaire that included questions on age, sex, marital status, tooth brushing frequency, health insurance status, maximum level of schooling, whether participant lived in long term care facilities or received non-residential adult day care services, whether or not the participant had received prior radiation therapy, tobacco use, and soft-drink intake; reported diagnoses of chronic diseases (which had previously been conducted by medical personnel) were also recorded. Questionnaires were administered in Spanish; they were developed by public health staff who had ascertained face validity. No psychometric evaluations of the questionnaire were undertaken. During pilot studies, ambiguities in meaning and problems with comprehension were identified and then addressed for the final version used in the main study. Special attention was paid to the type of language used, to ensure that it would be understandable to the participants.

### Statistical analysis

First, a descriptive data analysis was carried out according to the scale of the variables: proportions for nominal variables and central tendency measures and dispersion for quantitative variables. A bivariate analysis was undertaken using Mann–Whitney, Kruskal–Wallis, and Spearman correlation tests, also taking into account the measurement scale of the contrasted variables. In all analyses, a 2-sided p-value of less than 0.05 was considered to indicate statistical significance.

Because data did not fit the distribution for a Poisson regression model, we chose negative binomial regression (NBR) to model tooth loss. In the NBR multivariate model we included those variables that were found to be statistically significant (p<0.25) in the bivariate analyses, to adequately control for the effect of confounders. An analysis of variance inflation factor (VIF) was undertaken to detect and, if necessary, avoid multicollinearity between independent variables. Interactions were tested but none reached a value sufficient to remain in the model (p<0.15) (22). In multivariate analyses the confidence intervals were calculated with robust standard errors, which allowed for valid estimates even in the case of correlation between groups. This strategy was adopted because data were obtained from individuals from different groups, but assumed that a correlation of scores existed within each one of the 2 LTC and the single ADC locations. Stata (version 9.0) was used for the analyses.

### Ethical considerations

This study was approved by the Ethics and Research Committee of Universidad Autónoma del Estado de Hidalgo. After being informed of its objectives, the potential participants

were invited to take part in the study. They were thoroughly briefed on informed consent, at which time the confidentiality of the collected data was emphasized. The potential participants were assured that they could withdraw from the study at any time and were told that no monetary compensation would be offered.

## Results

The mean age of the 139 participants was 79.06 (±9.78 years); 60 were women (69.1%). The descriptive analysis of variables included in the study is given in Table 1.

**Table 1**. Demographic, socioeconomic, and behavioral characteristics of a sample of Mexican seniors (n = 139).

|  | Frequency (n) | (%) |
|---|---|---|
| Sex |  |  |
|   Male | 43 | (30.9) |
|   Female | 96 | (69.1) |
| Married status |  |  |
|   Single | 52 | (37.4) |
|   Has a spouse | 25 | (18.0) |
|   Divorced/widowed | 62 | (44.6) |
| Current living arrangement |  |  |
|   Publicly funded LTC | 84 | (60.4) |
|   Private LTC | 31 | (22.3) |
|   Adult day care center | 24 | (17.3) |
| Health insurance |  |  |
|   Yes | 64 | (46.0) |
|   No | 75 | (53.0) |
| Schooling |  |  |
|   No formal education | 32 | (23.0) |
|   Some elementary | 58 | (41.7) |
|   Elementary | 20 | (14.4) |
|   High school | 14 | (10.1) |
|   College | 15 | (10.8) |
| Tooth brushing |  |  |
|   At least twice/day | 49 | (35.2) |
|   <2 times/day | 90 | (64.8) |
| Uses tobacco |  |  |
|   No | 117 | (84.2) |
|   Yes | 22 | (15.8) |
| Consumes soft drinks |  |  |
|   Yes | 46 | (33.1) |
|   Only sometimes | 48 | (34.5) |
|   No | 45 | (32.4) |
| Is receiving or has received radiation therapy |  |  |
|   No | 133 | (95.7) |
|   Yes | 6 | (4.3) |
| Chronic diseases |  |  |
|   None | 37 | (26.6) |
|   Diabetes | 18 | (13.0) |
|   Other chronic diseases | 84 | (60.4) |

The average number of missing teeth was 20.02 (±8.61; median, 24). Overall, 10.1% had 20 or more functional teeth. Only 1 person (0.7%) had all his natural teeth.

Table 2 shows the results of the bivariate analysis. Age was positively correlated with the number of missing teeth (r = 0.18; p = 0.02); as age increased, the number of missing teeth also increased. People who brushed less than twice a day had more

missing teeth than did those who brushed at least twice a day (p<0.01). Seniors living in retirement homes presented more missing teeth than did those receiving adult day care services (ADC) (p<0.01). Subjects who were current smokers had lost more teeth than had those who were non-smokers (p<0.05). Differences in the number of missing teeth across sex or marital status were not significant (p<0.10).

**Table 2**. Bivariate analysis. Mean tooth loss in a sample of Mexican seniors (n = 139).

|  | mean±sd (median) | p-value |
|---|---|---|
| Age (n = 139) | 20.02±8.61 (24) | r = 0.1876; 0.0270* |
| Sex (n =139) |  |  |
|   Male (n = 43) | 22.42±6.60 (26) |  |
|   Female (n = 96) | 18.95±9.19 (21) | 0.0615† |
| Married status (n = 139) |  |  |
|   Single (n = 52) | 20.31±8.45 (26) |  |
|   Has a spouse (n = 25) | 16.96±9.47 (17) |  |
|   Divorced/widowed (n = 62) | 21.02±8.23 (26.5) | 0.0789‡ |
| Current living arrangement (n = 139) |  |  |
|   Publicly funded LTC (n = 84) | 21.77±8.04 (27) |  |
|   Private LTC (n = 31) | 19.84±7.91 (20) |  |
|   Adult day care center (n = 24) | 14.12±9.04 (12) | 0.0031‡ |
| Health insurance (n = 139) |  |  |
|   Yes (n = 64) | 19.94±8.69 (25) |  |
|   No (n = 75) | 20.09±8.59 (24) | 0.8857† |
| Schooling (n = 139) |  |  |
|   No formal schooling (n = 32) | 20.47±9.13 (25.5) |  |
|   Some elementary (n = 58) | 19.88±8.20 (21) |  |
|   Elementary (n = 20) | 20.25±7.80 (23) |  |
|   High school (n = 14) | 22.14±8.70 (28) |  |
|   College (n = 15) | 17.33±10.31 (14) | 0.5839‡ |
| Tooth brushing (n = 139) |  |  |
|   At least twice/day (n = 49) | 14.82±7.21 (14) |  |
|   <2 times/day (n = 90) | 22.85±7.98 (28) | <0.0001† |
| Uses tobacco (n = 139) |  |  |
|   No (n = 117) | 19.32±8.81 (21) |  |
|   Yes (n = 22) | 23.77±6.35 (28) | 0.0213† |
| Consumes soft drinks (n = 139) |  |  |
|   Yes (n = 46) | 21.50±7.83 (26) |  |
|   Only sometimes (n = 48) | 18.33±9.32 (16.5) |  |
|   No (n = 45) | 20.31±8.43 (22) | 0.3428‡ |
| Is receiving or has received radiation therapy (n = 139) |  |  |
|   No (n = 133) | 19.84±8.66 (24) |  |
|   Yes (n = 6) | 24.00±6.48 (28) | 0.1748† |
| Chronic diseases (n = 139) |  |  |
|   None (n = 37) | 19.70±8.86 (24) |  |
|   Diabetes (n = 18) | 20.83±9.14 (27.5) |  |
|   Other chronic diseases (n = 84) | 20.00±8.47 (21.5) | 0.7418‡ |

Note: *Spearman's rho, †Mann–Whitney, ‡Kruskall–Wallis

Table 3 shows the results of the multivariate negative binomial regression analysis. The model had 4 main effects. We noted that for each increment of 1 year in age, the mean number of missing teeth increased by 1% (p<0.05). In people who brushed their teeth fewer than two times a day, the mean number of missing teeth increased 49.2%, contrasted to those who brushed their teeth 2 or more times a day (p<0.01). The mean number of missing teeth increased 22.6% in subjects who had received radiotherapy

compared with those who had not (p<0.01). Finally, the subjects who were current smokers had a mean number of missing teeth 19.0% greater than the experience among non-smokers (p<0.01).

**Table 3**. Negative binomial regression for number of teeth lost (n = 139).

|  | Coefficient | % change | p-value |
|---|---|---|---|
| Age | 0.0074 | 1 (0.07 – 1.4) | 0.030 |
| Tooth brushing |  |  |  |
| At least twice/day | 1* |  |  |
| <2 times/day | 0.4003 | 49.2 (32.0 – 68.6) | <0.001 |
| Is receiving or has received radiation therapy |  |  |  |
| No | 1* |  |  |
| Yes | 0.2035 | 22.6 (21.0 – 24.2) | <0.001 |
| Uses tobacco |  |  |  |
| No | 1* |  |  |
| Yes | 0.1739 | 19.0 (9.6 – 29.1) | <0.001 |

*Reference category. Note: The model was adjusted for those variables in the table. Confidence intervals were calculated with standard errors taking into account the intra-location (LTC, ADC) cluster. Interactions were tested but none reached a value of p<0.15, which would have been an indication that it could remain in the model.

## Discussion

Over 99% of the participants in our sample population had lost at least 1 tooth, with the mean number of missing teeth being 20.02 (±8.61). Compared with what has been found by other studies in Mexico (23) and in other countries (12,24), the present study determined that seniors have a high prevalence of missing teeth. Such information may be helpful in the planning of dental care services for the elderly to improve their oral health – in particular at locations such as retirement homes and adult day care centers.

That increasing age is a variable associated with tooth loss has been consistently observed in previous studies (9,13,17), just as we found it to be; when age increases, tooth loss increases too. Diverse changes associated with old age occur in various oral structures; for example, as the vascularity of the alveolar bone decreases, the metabolic cellular activity increases bone resorption and reduces the ability to repair damage (25). While tooth loss is not specifically a side-effect of age, it is derived from the cumulative results of a given patient's caries experience and whether or not he or she has periodontal disease. That being the case, it is common for people to think that with aging, teeth will be lost. Though we found some evidence supporting this belief, it is possible that senior citizens may have simply been more often subject to dental extractions than to restorative care as a method of treating disease.

Tooth brushing is assumed to be one of the most effective methods to maintain good oral health. It is a commonly used tool in prevention programs aimed at the population at large, as tooth brushing mechanically disrupts the dental biofilm. Additionally, tooth brushing exposes dental surfaces to fluoride from toothpaste (26,27). Studies carried out by different authors (14,17) have shown that people with poor oral hygiene are more likely to lose teeth, just as we demonstrated in the present report.

Despite sparse data, there are studies supporting a possible association between tooth loss and radiotherapy to treat head and neck cancer (15,16). In the present study, subjects who had received radiotherapy had lost more teeth. Some possible explanations for this association have been proposed—specifically, changes in the structure and hardness of tooth tissues, apparently because biomechanical properties are affected by radiation. Moreover, the formation of recurrent and atypical patterns of dental caries follows from salivary gland hypofunction (16). After exposure to radiation, periodontal ligament fibroblasts express markers of senescence, as shown by the decrease in type I collagen and the increase of MMP-2 expression. Furthermore, effects on osteoblastic differentiation are likely associated with diminished tissue integrity (28). In addition, improper care and oral hygiene in people receiving radiation therapy may promote coronal and root caries as well as bone resorption.

Tobacco consumption has a negative impact on oral health, besides its harmful effects on general health. Studies in Taiwan by Hsu (14) and in Japan by Ando et al. (13) showed that people who were former or are current smokers are likely to have more missing teeth than non-smokers who have never smoked. Several authors have also suggested that smoking may support caries onset or progression by fostering the increased formation of S. mutans biofilm on tooth surfaces (29). Furthermore, there is sufficient evidence to infer a causal relationship between smoking and periodontitis—with most smokers having negative responses to treatment—and probably with root-surface caries. The most plausible biological connection between substances in tobacco smoke and oral health is that these substances might be responsible for the destruction of tissues that provide support for the teeth (30). The destructive effects of smoking on periodontal tissues appear clinically in several forms. These include inflammation manifested through vascular and immune reactions, and deterioration of the supportive function of bone tissue, leading to bone resorption, pocket formation, and tooth loss (31).

The present study is limited by its cross-sectional design, which precludes confirming causal relationships. In spite of this shortcoming, the findings add to knowledge about elderly Mexicans: less frequent tooth brushing, prior radiotherapy, and current smoking were associated with relatively greater levels of tooth loss. Because the cumulative effects of dental caries and periodontal diseases (which, together with personal and professional decisions about dental treatment, can lead to tooth loss) can be observed more readily in adults and elderly individuals, health promotion programs for young and old adults alike should be implemented to prevent tooth loss and promote healthy aging, in the first place (7). Future studies ought to incorporate variables such as medication use, proxies for socioeconomic status, physical limitations, and cognitive impairment; they might also help explain patterns of tooth loss. A more complete body of knowledge can provide support for a strong case for the oral health programs and preventive/restorative interventions needed for these age groups, if they are to improve their oral health status, dental function, and, ultimately, oral health–related quality of life.

## Resumen

Objetivo: Determinar la experiencia de pérdida de dientes, así como sus variables asociadas, en una muestra de adultos mexicanos mayores de 60 años y más. Materiales y métodos: Este estudio transversal fue realizado en una muestra de conveniencia de 139 adultos mexicanos (69.1% mujeres) de 60 años y más de edad que vivían ya sea en asilos o de forma independiente, o que asistían a un grupo de cuidado diurno. Se realizaron exámenes bucales para determinar el número de dientes perdidos. Se emplearon cuestionarios para recoger datos sociodemográficos, socioeconómicos y conductuales. Los análisis se realizaron utilizando pruebas no paramétricas y regresión binomial negativa. Resultados: La edad media de los participantes fue de 79.06±9.78 años. El promedio de dientes perdidos fue de 20.02±8.61 (mediana de 24); 99.3% tenían por lo menos un diente perdido. Sólo 14 tenían ≥ 20 dientes. En el modelo multivariado de regresión binomial negativa, se encontró que por cada aumento de un año en la edad, la media de pérdida de dientes aumentó 1% (p<0.05). En aquellos que se cepillaban los dientes <2 veces al día, que habían recibido radioterapia, o que actualmente fumaban, el promedio de dientes perdidos aumentó 49.2%, 22.6% y 19,0%, respectivamente (p<0.01). Conclusión: La experiencia de dientes perdidos en estos ancianos mexicanos fue muy alta (20.02±8.61). La edad avanzada, el cepillado dental, el haber recibido radioterapia y el consumo de tabaco se asociaron con la mayor pérdida de dientes.

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