Article

Total Edentulism and Its Epidemiological Surveillance in Oaxaca, Mexico from 2009–2019.

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Abstract: Total edentulism is the loss of all teeth for any cause by a multifactorial process that involves biological and patient-related factors. Studies on edentulism and risk factors in Mexico are limited, and the epidemiological surveillance data is scarce and controversial since official governmental reports are not statistically representative of the country. We estimate the distribution for edentulism according to sociodemographic and socioeconomic variables in adults from a low-income state in 2003 and its progress in Mexico. We analyzed data from the National Performance Evaluation Survey in Oaxaca, Mexico, and the annual reports of the Epidemiological Surveillance System of Oral Pathologies in 2009-2019 using X^2. Oaxacan patients older than 75 y.o (17.9%, $p<0.05$), those with lower schooling (11.2%), and diabetes (14.5%) presented the highest percentage of edentulism. We do not observe differences in edentulism between sex or residence ($p>0.05$). From 2009 to 2019, country data reports the lowest rate of edentulism in adults over 20 y.o (0.32%; 95% CI 0.18%-0.48%) and the most affected population over 79 y.o. (7.29%; 95% CI 5.2%-9.30%). As it is a cumulative phenomenon, it is necessary to establish better surveillance, prevention, and treatment programs to improve the oral health of older thus reducing edentulism.

Keywords: Edentolous; Elderly; Oral Health

1. Introduction

The Global Burden of Diseases, Injuries, and Risk Factors Study GBD reports the oral diseases as the most significant prevalence disorder globally in 2018 [1]. Oral diseases affected almost 3.49 billion people worldwide in 2019 [2]; dental caries and periodontal diseases represent the most significant oral health problems. Dental caries are the leading cause of tooth loss in children and young people, while periodontal diseases are in adults. Severe periodontal disease can cause tooth loss in approximately 10% of the world's population [3]. Although in the world, epidemiological data related to oral health have been directed mainly to the study of these two diseases, both have cumulative chronic character, which leads to tooth loss if they are not treated early to prevent complications.

Total edentulism is the loss of all teeth for any cause through a multifactorial process that involves biological factors and factors related to the patient [4]. Healthy teeth will be maintained with good oral hygiene, avoiding the accumulation of dental plaque, the leading etiological agent of tooth decay and periodontal disease. Unfortunately, dental health in low-income regions is not a priority, and they do not attend constant check-ups or follow up on their treatment.

One of the most critical consequences of edentulism is the nutritional status of the people who suffer from it [5]. Toothless older people modify their diet, avoiding foods that are difficult to chew, such as fruits and vegetables (foods associated with the prevention of chronic diseases), affecting their nutritional status [6]. In addition, some reports

associated edentulism with chronic diseases such as cancer of the digestive tract and cardiovascular diseases [7].

There are only a few studies carried out in Mexico on edentulism and risk factors [8, 9]. For example, Islas-Granillo et al., (2011) studied asylees aged 60 years and over in Pachuca, Hidalgo, to report the prevalence and risk indicators for edentulism; they concluded that variables of diverse nature affected edentulism, with a significant association between smoking and having received radiotherapy [10]. However, official information on the epidemiological surveillance of total edentulism in Mexico is scarce and even more controversial since official reports from Mexican health authorities are not statistically representative of the country.

Oaxaca is the second-lowest income state of Mexico, with 4.13 million inhabitants in 2020, mostly living in rural areas, with no public epidemiological data for oral diseases available. Therefore, the objective of this study was to estimate the distribution of total edentulism according to sociodemographic and socioeconomic variables in adults aged 18 years and over from Oaxaca, Mexico, in the years 2002-2003 and to compare it with the progress reported in the epidemiological surveillance system of oral health in Mexico from 2009 to 2019.

2. Materials and Methods

2.1. Data Collection from the Oaxacan population.

The data for a low-income state (Oaxaca, México) was provided by the National Performance Evaluation Survey (NPES) 2002-2003, part of the technical collaboration between the Ministry of Health of Mexico and the World Health Organization Global Survey project of health. Part of the methodology published for other states of the country [8, 9]. The National Performance Evaluation Survey (NPES) is a cross-sectional, national study in the Oaxacan adult population ≥ 18 years of age. The sample design was probabilistic, multi-stage, stratified, and conglomerates, with a 5% maximum relative error, 95% confidence, non-response rate of 15%, and a design effect of 1.7. Three strata were considered: a) city or metropolitan area (> 100,000 inhabitants); b) urban complement (localities with 2,500 to 99,999 inhabitants), and c) rural area (localities with less than 2,500 inhabitants). With these criteria, the sample size for Oaxaca, México was 1,238 households.

The NPES variables collected were: Edentulism, defined by total loss of teeth for any causes; Age, grouped by range (18-24, 25-34, 35-44, 45-54, >64 years old); Schooling, defined as the total number of school years completed, ranged (<6 years, or primary school; 6 to 8 years, or secondary school; 9 to 11 years, or preparatory school, 12 to 15 years, or superior education, and >16 years or postgraduate studies); Diabetes, as dichotomic presence in individuals; and Place of residence, defined by the type of residence area as rural, or less than 2,500 inhabitants, urban for 2,500 to 99,999 inhabitants, and Metropolitan for more than 100,000 inhabitants.

2.2. Data collection for Mexico from 2009-2019.

The progress in edentulism was measured using data from the annual reports (2009-2019) of the Epidemiological Surveillance System for Oral Pathologies (SIVEPAB) of the General Bureau of Epidemiology of the Ministry of Health, in charge of collecting information on patients who attend at least 355 sentinel epidemiological surveillance units in the 32 states of México, it is a non-probabilistic, for convenience sampling. Therefore, the information collected is not representative and may overestimate the prevalence of oral diseases, minimizing edentulism prevalence in the Mexican population.

2.2. Statistical analysis

The NPES data analysis included the self-report of edentulism as a dependent variable, understanding as a case the people who reported not having any natural teeth in their mouths. The independent variables for this analysis were age, sex, place of residence, education, and diabetes. Due to the design used in the survey sampling, perform the statistical analysis, we use the SVY module (for complex samples) of the STATA 9.0 statistical package. All the variables were qualitative, so the summary measures are frequencies and percentages in the descriptive analysis. We performed bivariate analysis to find the differences in the distribution of the rates of edentulism through the different independent variables included, using X2 tests. A p-value less than 0.05 was considered statistically significant.

2.3. Ethical approval

This study was approved by the Ethic in Research Committee of the Dentistry Faculty of Universidad Autonoma Benito Juarez de Oaxaca, Mexico (CEI01020150804), according to art. 17, fracc I of the Reglamento de la Ley General de Salud en Materia de Investigación para la Salud.

3. Results

3.1. Oaxacan population analysis from National Performance Evaluation Survey.

3.1.1. Edentulism by age.

Data analysis from Oaxaca of the National Performance Evaluation Survey found that the average age for the non-edentulous subjects was 38.45 years old (95% CI 37.55 - 39.35), and for the edentulous, 54.66 years old (95% CI 49.69 - 59.63). Minaya-Sánchez et al., 2010, reported that older people have the highest percentage of subjects with total tooth loss [11]. Our data shows the highest rate of edentulism (17.9%) was presented by those who were 65 years old and older (p <0.05). Regarding the prevalence of edentulism, we estimated a rate of 4.7%, equivalent to 151,507 Oaxacan population aged 18 and over with a complete absence of natural teeth—table 1.

Table 1. Prevalence of edentulism by age in Oaxaca, México according to NPES.

Age	Non-edentulous[1]	Edentolous[1]	p-Value
18-25	555,599 (98.9%)	6,460 (2.2%)	0.0001
25-34	869,556 (98.8%)	10,712 (1.2%)	0.0001
35-44	706.086 (95.5%)	33,337 (4.5%)	0.0001
45-54	446,701 (95.4%)	21,609 (4.6%)	0.0001
55-64	233,201 (88.7%)	29,787 (11.3%)	0.0001
>64	227,505 (82.1%)	49,602 (17.9%)	0.0001
Total	2,038,648 (95.3%)	151,507 (4.7%)	

[1] Weighted population.

3.1.2. Edentulism by schooling.

Analysis of schooling shows that the prevalence of edentulism decreased with higher educational attainment, which indicates inequalities in oral health. Most of the population has completed primary school (58.1%), which, added to the percentage of those who had less than primary school, reaches almost 75%. On the other hand, subjects with the lowest schooling rate constituted those with university studies or more. Some authors also reported in Mexico the same data using various health and socioeconomic position [12]. Table 2.

Table 2. Prevalence of edentulism by schooling, diabetes presence, and residence area in Oaxaca, México according to NPES analysis.

		Non-edentulous[1]	Edentolous[1]	p-Value
Schooling	<6 years	460,695 (88.8%)	58,109 (11.12%)	
	6-8 years	1,788,738 (96.4%)	66,456 (3.6%)	
	9-11 years	434,686 (96.5%)	15,640 (3.5%)	
	12-15 years	225,217 (98%)	4,576 (2%)	
	≧16 years	129,312 (95.1%)	6,726 (4.9%)	0.0015
Diabetes	Diabetic	2,900,037 (95.8%)	128,018 (4.2%)	
	Non-diabetic	138,611 (85.5%)	23,489 (14.5%)	0.0248
Residence	Rural	1,215,463 (94.2%)	75,473 (5.8%)	
	Urban	1,395,892 (95.4%)	67,580 (4.6%)	
	Metropolitan	427,293 (98.1)	8,454 (1.9%)	0.103

[1] Weigthed population.

3.1.3. Edentulism on diabetes patients.

On the other hand, patients with chronic diseases, such as diabetes, have worse oral health states than their counterparts without these diseases (Hugo et al., 2007). We found that people with diabetes present the highest prevalence of edentulism. Diabetic patients have the highest percentage of edentulism (14.5%) compared to non-diabetics (5.7%); these differences were statistically significant (p <0.05)—table 2.

3.1.3. Edentulism by residence area.

The population living in rural areas has the highest percentage of edentulous people (5.8%) compared to people residing in urban (4.6%) and metropolitan regions (1.9%). Although this was higher among rural residents, this difference was not statistically significant (p>0.05) —table 2.

3.2. *Edentulism in México from SISVEPAB*

According to the Oral Pathologies Epidemiological Surveillance System (SISVEPAB), in the 2009-2019 period in Mexico, edentulism in adults over 20 years old was 0.32% (95% CI 0.18% -0.48%), with statistically significant differences (p> 0.05) between age groups. Data show edentulism increases with age groups. (Figure 1).
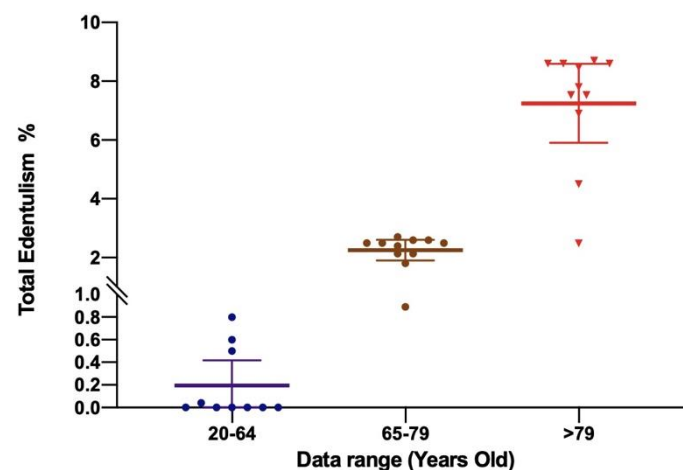
Figure 1. Total edentulism (%) among age groups 20-64, 65-79, and over 79 years old. (Mean +/- 95% CI).

In the country, edentulous people between 65 and 79 years old was 2.52%, with the year 2018 being the lowest reported rate (0.8%); Regarding the population over 79 years old, the average edentulism is 7.25%, the highest data reported for this surveillance system. In 2018, the lowest rate was 2.48%, while the highest was the year 2019 with the year 8.6% (Table 3).

Table 3. Total edentulism in Mexico from 2009 to 2019 by age groups, according to SISVEPAB from the General Bureau of Epidemiology of the Ministry of Health.

Year	Age groups (Years old)			Mean	C.I. 95% Min	C.I. 95% Max
	20-64 (%)	65-79 (%)	>79 (%)			
2009	>1	2.6	4.5	2.1	0.2069	9.057
2010	0	2.14	7.53	2.468	0.0037	45.900
2011	0	2.14	7.53	2.468	0.0037	45.900
2012	0	1.81	8.47	2.67	0.0045	51.750
2013	0	2.5	8.6	2.875	0.0045	61.670
2014	0	2.5	8.6	3.025	0.0056	78.390
2015	0	2.4	6.9	2.575	0.0059	65.940
2016	0.6	2.6	8.7	3.225	0.2951	12.480
2017	0.5	2.5	7.8	2.825	0.1760	12.550
2018	0.04	0.89	2.48	0.8775	0.0148	6.372
2019	0.8	2.7	8.6	3.15	0.2282	13.350

4. Discussion

The only available data for edentulism in a low-income state in Mexico was from the NPES for Oaxaca in 2002-2003, showing that total tooth loss in adults aged 18 years and over has a diverse range depending on sociodemographic and socioeconomic variables.

Regarding age, this study corroborated the observations of several studies [13–17], were observed that older people present the highest percentage of total tooth loss, dental caries, and periodontal disease are considered chronic of a cumulative nature; when age increases, the possibility that both conditions will worsen (if they are not restricted with adequate treatments or even prevented), the tooth loss increases.

The schooling often is used to determine socioeconomic position [13]; in Oaxaca, the prevalence of edentulism decreased with higher educational attainment, indicating the existence of inequalities in oral health; this data supported other studies carried out in low-income regions using various indicators of both health and socioeconomic position [12, 18–21]. In addition, health evidence suggests an association between health and social status: individuals with better socioeconomic status enjoy better health [22–24].

Patients with chronic diseases, such as diabetes, have worse oral health status than their counterparts without these diseases [25–28]. In this study, we found that diabetic patients from Oaxaca presented the highest prevalence of edentulism. Although, from a traditional perspective, the importance of keeping teeth in good functional condition lies in its positive impact on a better quality of life [24] and the fact that association of edentulism with chronic diseases, in addition, other studies have documented the negative impact of edentulism on people's nutritional status [29, 30].

Regarding the epidemiological surveillance of edentulism in Mexico, a lack of planning is evidenced in the SISVEPAB yearly publications, based on the theory that a large part of the Mexican population mainly seeks dental care only when there is pain. As a result, the official reports may overestimate the prevalence of oral diseases in different age groups. Similarly, people who have lost their teeth do not seek dental care as often as those who still have them. For this reason, the study can minimize the prevalence of total tooth loss in the population.

Data from SISVEPAB show that total edentulism of 7.25% for older people (>79 y.o.) differs from other studies in Mexico. Padilla-Sánchez et al. (2017) report 12% of total

edentulism in a population of older adults in Mexico City [31], while Fernández-Barrera et al. (2016) report 15.7% for the city of Pachuca, Mexico [32]. Menchaca-Díaz et al. Report 10.6% for a population in the north of the country [33].

5. Conclusions

In Oaxaca, Mexico, the prevalence of total tooth loss was related to sociodemographic variables (age, sex, and residence), showing a trend towards older age a higher percentage of edentulism. Moreover, edentulism depends on education; the higher the level of education, the lower the edentulous rate. Likewise, diabetes plays an essential role in the prevalence of edentulism; adults 18 years of age and older who suffer from the pathology have a higher percentage of edentulism than the healthy population.

According to reported by the SIVEPAV, from 2009-2019, the cases of edentulism have not decreased. As it is a cumulative phenomenon, it is necessary to establish cost-effective prevention and treatment programs for oral diseases that seek to improve the oral health of adults and adults. Older adults that allow reducing the percentages of edentulism among this population.

Limitation and strength

This study has some limitations, and the first limitation is on the age of populations; from Oaxaca (NPES), we have data from 18 years old, and for country data, we have from 20 years old. The second limitation comes from official data collected from SIVEPAB, where between 2009 and 2015, data only has one digit, depreciating values lower than 1.0 on prevalence. Finally, the third limitation comes from the SIVEPAB data from 2018, where data presented over the lower limits of the table, suggesting an error on official data; however, we could not control those secondary data. Otherwise, this study is the first one regarding edentulism distribution in Oaxaca, Mexico, one of the few studies in open population in Mexico.

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