ORIGINAL RESEARCH

Indicators of oral health in older adults with and without the presence of multimorbidity: a cross-sectional study

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Purpose: The aim of this study was to determine whether there are differences in the distribution of various indicators of oral health among elderly people with and without multimorbidity (ie, two or more chronic diseases).

Subjects and methods: A cross-sectional, comparative study was conducted using a sample of Mexican elderly individuals aged ≥60 years. The average age of the cohort was 79.06±9.78 years, and 69.1% were women. The variables indicating oral health were as follows: functional dentition, edentulism, hyposalivation, xerostomia, root caries and periodontitis. The multimorbidity variable was operationally categorized as follows: 0= subjects with no chronic disease or one chronic disease and 1= subjects with two or more chronic diseases. Questionnaires were used to collect information on various variables regarding general health. Likewise, the participants underwent a clinical oral examination. The analysis was performed using Stata 11.0.

Results: The overall prevalence of multimorbidity was 27.3%. The prevalences of various oral health indicators were as follows: without functional dentition 89.9%; hyposalivation 59.7%; edentulism 38.9% and self-reported xerostomia 25.2%. Dental caries were observed in 95.3% of the subjects, and the prevalence of severe periodontitis was 80%. We found a significant difference only in edentulism; its prevalence was higher among subjects with multimorbidity (55.3% vs 32.7%, *P*=0.015) than among those without multimorbidity.

Conclusion: The presence of edentulism in this sample of Mexican older adults was higher in subjects with multimorbidity. Multimorbidity and oral diseases constitute a true challenge in elderly people, because they affect quality of life and are associated with high health care costs.

Keywords: older adults, multimorbidity, oral health, edentulism, tooth loss

Introduction

According to WHO, oral health can be defined as the absence of orofacial pain, cancer of the mouth or throat, infections and mouth sores, periodontal diseases, tooth decay, tooth loss and other diseases and disorders that limit the ability of the affected person to bite, chew, smile and talk or impact their psychosocial well-being.[1] Oral diseases and disorders such as dental caries in primary and permanent dentition, periodontal diseases and severe tooth loss affect a large number of people in Mexico and around the world. According to the report "Global Burden of Oral Conditions in 1990–2010" derived from "The Global Burden of Disease (GBD) 2010 Study," they collectively affect roughly 3.9 billion people around the world. Therefore, they represent a serious oral health problem for health systems.[2–5]

On the other hand, multimorbidity refers to the coexistence of two or more chronic diseases or medical conditions simultaneously in the same person.[6,7] Multimorbidity

has spread widely through the third phase of the epidemiological transition, which is characterized by a decrease in mortality rates combined with the aging of a population. Therefore, aging and chronic diseases represent one of the greatest challenges for health systems in the world. In several countries, the prevalence of multimorbidity in the elderly population and its impact on health care spending have led health agencies to begin to address the problem and explore ways to improve health and function.[7]

As a population ages, the prevalence of multimorbidity and oral diseases increases. In this way, poor oral health compromises healthy aging because it affects the quality of life and health in general, causes pain, is costly and results in poor nutrition, all of which worsen chronic conditions in elderly patients.[8] The oral health of the elderly has garnered considerable attention in research in recent years, mainly in developed countries. Much of this research has been clinical in nature, but a large number of epidemiological studies have also been carried out and reported. The primary conditions of interest when considering oral diseases among the elderly are partial or total tooth loss, coronal and radicular tooth decay, periodontitis, xerostomia and precancer/oral cancer. These conditions are considered to be chronic diseases that strongly impact the health of this population group.[9] In Mexico, the oral health of older adults has not received sufficient attention to aid in the decision making and planning of health services.[10–14] In addition, it is unknown which oral health indicators are correlated with multimorbidity.

The aim of this study was to determine whether there are differences in the distribution of various indicators of oral health among elderly people with and without multimorbidity.

Subjects and methods
Design and study sample
This comparative cross-sectional study was conducted by recruiting adults aged ≥60 years living in long-term care facilities or living independently and participating in adult day care services in the city of Pachuca, Mexico. We measured several oral health indicators. This secondary analysis is part of a larger study, some of whose results have been previously published.[15–20] Inclusion criteria were as follows: 1) aged at least 60 years and 2) willingness to participate in the research (permission granted from either the participant or their relatives). Exclusion criteria were as follows: 1) an auditory or language defect that made interviewing difficult or 2) a physical disability that prevented the participants from engaging in the oral examination. The initial total population

consisted of 151 subjects. Twelve refused to participate in the study or did not meet the inclusion criteria or triggered the exclusion criteria. We accordingly studied 139 subjects. The average age of the cohort was 79.06±9.78 years, and 69.1% were women.

Variables and data collection
To determine the variables included in the study, questionnaires addressed to the elderly were used as well as a clinical oral examination was conducted. The oral health indicators included in the study were as follows: functional dentition, edentulism, hyposalivation, xerostomia, root caries and periodontitis. The variable "multimorbidity" was operationally categorized as follows: 0= subjects with no chronic disease or one chronic disease/condition and 1= subjects with two or more chronic diseases/conditions. Table 1 lists the chronic diseases/health conditions included in the present analysis.

Table 1 Distribution of chronic diseases/conditions in a sample of Mexican elderly people aged ≥60 years

	Frequency	Percentage
Cardiovascular diseases		
No	103	74.1
Yes	36	25.9
Hypertension		
No	111	79.9
Yes	28	20.1
Musculoskeletal disorders		
No	112	80.6
Yes	27	19.4
Diabetes		
No	120	86.3
Yes	19	13.7
Neurodegenerative disorders		
No	123	88.5
Yes	16	11.5
Kidney diseases		
No	134	96.4
Yes	5	3.6
Mental disorders		
No	134	96.4
Yes	5	3.6
COPD/asthma		
No	136	97.8
Yes	3	2.2
Visual impairment		
No	137	98.6
Yes	2	1.4
Hearing disorders		
No	137	98.6
Yes	2	1.4
Hypothyroidism		
No	138	99.3
Yes	1	0.7

The oral examinations were performed according to WHO standards by a capacitated dentist. The clinical examinations were conducted using a number 5 dental mirror and a WHO-type probe with a 0.5 mm tip under artificial light. The third molars were excluded from the analysis, and the root tips were considered to be lost teeth. The radicular caries index was used to determine root caries.[21] To determine severe periodontitis, the insertion level and pocket depth were measured in contralateral quadrants considering the quadrants with the largest number of teeth. The dentist measured the mesiobuccal and mid-oral sites; a case of severe periodontal disease was considered when a subject presented at least one site with ≥5 mm of insertion loss.

We followed a standardized procedure to obtain stimulated salivary flow.[22] Samples were collected at 7:30 AM; we ensured that the elderly had not eaten, smoked, brushed their teeth, rinsed their mouth or drunk any liquids for at least the previous hour. Each subject was seated in a straight and relaxed posture; the patient was given 1 g of paraffin to chew and therefore to stimulate the production of saliva. The subject was placed with his or her head tilted forward so that saliva collected on the floor of the mouth. Saliva was collected for 5 minutes in sterile calibrated tubes. To calculate the salivary flow (mL/min), we divided the volume of saliva collected by 5. When the stimulated salivary flow was <0.7 mL/minute, the subject was considered to exhibit hyposalivation. The participants were asked to answer a dichotomous question (yes–no) – Do you feel that your mouth is dry? – to evaluate subjective feelings of dry mouth and operationally categorized as follows: 0= subjects without xerostomia who answered "no" to the question and 1= subjects with xerostomia who answered "yes" to the question.

Statistical analyses

The data were analyzed using Stata 11.0 software (StataCorp LP, College Station, TX, USA). First, descriptive analysis of the studied sample was carried out; we reported measures of central tendency and dispersion for the quantitative variables and frequency and percentages for the qualitative variables. We then performed bivariate analysis using the chi-squared statistical test and Fisher's exact test according to the data.

Ethical considerations

This study satisfied the specifications of the general health law on research in Mexico and the scientific principles of the Declaration of Helsinki. All individuals provided written informed consent. The protocol was approved by the Autonomous University of the State of Hidalgo (Mexico).

Results

Table 1 lists the prevalences of chronic diseases that were included to calculate multimorbidity in the study. The most frequent chronic diseases were cardiovascular diseases (25.9%), hypertension (20.1%) and musculoskeletal disorders (19.4%). The overall prevalence of multimorbidity (two or more chronic diseases) was 27.3%. The prevalences of various oral health indicators were as follows: without functional dentition 89.9%; hyposalivation 59.7%; edentulism 38.9% and self-reported xerostomia 25.2%. Root caries were observed in 95.3% of the patients, and the prevalence of severe periodontitis was 80% (Table 2).

In the bivariate analysis as presented in Table 2, one can see that among subjects with multimorbidity, the prevalence of edentulism was 55.3%. Among those without multimorbidity, the prevalence of edentulism was 32.7% (P<0.05). Patients who exhibited multimorbidity had a 2.62-fold higher risk of presenting edentulism (95% CI =1.21–5.68) than those who did not have multimorbidity, after adjusting for age and sex. There were no differences in the distribution of the other oral health indicators and the presence of multimorbidity.

Discussion

This study focused on comparing different oral health indicators between two groups of elderly people, some with multimorbidity and others without multimorbidity. We observed that only the prevalence of edentulism differed in a statistically significant manner between the two groups. Epidemiological studies have shown that multimorbidity is associated with an increased risk of death, disability, poor functional status, poor quality of life, adverse drug events and other unfavorable results.[23] However, there have been no studies comparing oral health status in this group of patients. It is necessary to note that tooth loss and edentulism are irreversible conditions that reflect the final stage of oral diseases.[24] Oral health is a significant health-related aspect in adults; it has been observed in several studies that certain conditions of the oral state, such as tooth loss and edentulism, are related to quality of life.[25,26] Therefore, it is important to perform this type of investigation.

The world's population is aging rapidly. People over the age of 60 years accounted for 11% of the world's population in 2000; this figure is expected to double by 2050. This change can be attributed to longer life expectancies and decreases in fertility rates.[27] The scenario for Mexico is not different. This situation will generate pronounced economic pressure for both families and health systems in Mexico and the world because a large proportion of older adults

Table 2 Distribution of various indicators of oral health in adults aged ≥60 years in Pachuca, Mexico, with and without multimorbidity

	Frequency (%)	Multimorbidity, n (%)		P-value
		No	**Yes**	
Functional dentition				
No	125 (89.9)	90 (89.1)	35 (92.1)	0.758[a]
Yes	14 (10.1)	11 (10.9)	3 (7.9)	
Edentulism				
No	85 (61.1)	68 (67.3)	17 (44.7)	0.015[b]
Yes	54 (38.9)	33 (32.7)	21 (55.3)	
Hyposalivation				
No	56 (40.3)	43 (42.6)	13 (34.2)	0.370[b]
Yes	83 (59.7)	58 (57.4)	25 (65.8)	
Xerostomia				
No	104 (74.8)	76 (75.3)	28 (73.7)	0.850[b]
Yes	35 (25.2)	25 (24.7)	10 (26.3)	
Root caries[c]				
No	4 (4.7)	4 (5.9)	0 (0.0)	0.579[a]
Yes	81 (95.3)	64 (94.1)	17 (100.0)	
Severe periodontitis[c]				
No	17 (20.0)	13 (19.1)	4 (23.5)	0.738[a]
Yes	68 (80.0)	55 (80.9)	13 (76.5)	
Age (years)				
60–79	68 (48.9)	50 (49.5)	18 (47.4)	0.822[b]
80–100	71 (51.1)	51 (50.5)	20 (52.6)	
Sex				
Men	43 (30.9)	34 (33.7)	9 (23.7)	0.257[b]
Women	96 (69.1)	67 (66.3)	29 (76.3)	

Notes: [a]Fisher's exact test. [b]Chi-squared test. [c]Calculated only for n=85 (presented at least one tooth).

have chronic health problems, several of which can occur simultaneously. These problems include buccal health problems such as periodontitis, tooth loss and edentulism, which require a significant amount of resources for treatment.

Certain diseases have been associated with oral health status. For example, diabetes and hypertension are two diseases that can cause tooth loss and finally edentulism.[28] Subjects with diabetes and cardiovascular disease have been reported to exhibit greater tooth loss and periodontal disease than subjects without diabetes.[24,29] Although few studies have linked tooth loss with hypertension, epidemiological studies have observed that hypertension could be an indicator of risk for this event.[28,30,31] Likewise, and similar to diabetes, a bidirectional relationship between chronic kidney disease and periodontitis, one of the primary causes of tooth loss and edentulism, has been proposed in which a higher prevalence of edentulism and periodontal disease is observed in subjects with chronic kidney disease.[32] In a recent systematic review, Carramolino-Cuéllar et al[33] observed that depression increased the risk of tooth decay, tooth loss and edentulism in older adults. The precise relationship between chronic diseases and oral diseases has not been well elucidated, and several theories have been proposed. Most of these theories postulate

the mediation of a local and systemic inflammatory response (inflammaging)[33] due to endothelial dysfunction in addition to microvascular and macrovascular damage.[34] People with chronic systemic diseases/conditions also exhibit diminished immune systems.[32] In addition, there is increasing evidence to suggest an independent association between periodontitis and its consequences and a range of comorbidities (eg, cardiovascular disease, type 2 diabetes, rheumatoid arthritis, osteoporosis, Parkinson's disease, Alzheimer's disease, psoriasis and respiratory infections).[35] However, several authors have also proposed that these relationships may be bidirectional.[28,32,36]

The validity and reliability of the method used to determine a chronic condition affect the accuracy of the prevalence of multimorbidity. Few epidemiological studies have used clinical examinations at the time of measurement; most have been based on self-reported clinical diagnoses.[7] The current definition of the term multimorbidity is simple but also too broad and nonspecific. As a result, achieving a better understanding of this phenomenon is hindered.[37] Although a conceptual framework for measuring multimorbidity has not yet been proposed, it seems obvious that a means of assessing the severity of medical conditions should be included. One could easily agree that a patient suffering from both disease A and

disease B does not have the same burden of disease as a patient suffering from both disease C and disease D; therefore, simply counting the number of conditions appears to be too restrictive. On the other hand, there are, however, important discrepancies in the sources and results of various studies. In general, data featured in previous studies have been obtained from surveys or administrative databases. In addition, these reports tend not to include data pertaining to the prevalence of medical records; some researchers have suggested that this strategy is the best way to collect information on medical diagnoses.[6] Another limitation of previous studies relates to validity problems associated with the measurements. Two primary disadvantages can be noted:[38] first, the measurements are based on reports from the participants themselves. It has been pointed out that when medical examinations are employed, higher prevalences of multimorbidity are noted. Therefore, self-reporting tends to underestimate the prevalences of multimorbidity. A few studies combined self-reporting with a physical examination and information from medical records; this situation is preferable for determining multimorbidity. A second disadvantage pertains to detection bias: subjects with some serious diseases tend to visit health services more frequently, which increases the probability of being diagnosed with other diseases that are less clinically relevant. However, this situation might also persist with clinical reports. Even so, self-reporting is a measure increasingly used in epidemiological studies and is considered to be a valid indicator that includes multiple dimensions of health status.

One of the limitations of this study is its cross-sectional nature, which presents a problem of temporal ambiguity. When we measure cause and effect at the same time, causal relationships cannot be established.

Conclusion

Based on our results, we can conclude that the presence of edentulism in this sample of Mexican older adults was higher in subjects with multimorbidity. Multimorbidity and oral diseases constitute a true challenge in elderly people, because they affect quality of life and are associated with high health care costs. Health prevention programs should begin at an early age in patients' lives to ensure better quality of life during adulthood. Edentulism may represent a health indicator that could be included when multimorbidity is evaluated.

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Author contributions

Horacio Islas-Granillo, Socorro Aida Borges-Yañez and Carlo Eduardo Medina-Solís were involved in the design study, analyzed the data and wrote the first draft of the manuscript. José de Jesús Navarrete-Hernández, Miriam Alejandra Veras-Hernández, Juan Fernando Casanova-Rosado, Mirna Minaya-Sánchez, Alejandro José Casanova-Rosado, and Miguel Ángel Fernández-Barrera were involved in the conception of the paper, analysis, and interpretation of the results. All the authors discussed the methods, summaries, analyses, and results in the study and were involved in the writing of this paper. All authors contributed toward data analysis, drafting and revising the paper, gave final approval of the version to be published and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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