



ORIGINAL ARTICLE

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Relationship between body mass index, bone mineral density, and oral hygiene with periodontal disease in a Mexican elderly group.

Abstract: The aim of this study was to evaluate the relationship of body mass index (BMI), bone mineral density (BMD), and oral hygiene with periodontal disease (PD) in a group of elderly adults in Mexico City. **Material and Methods:** A cross-sectional study with a convenience sample of 151 elderly adults was conducted. Before applying the epidemiological survey, each subject was asked to sign an informed consent. Standardization for measuring Ramfjord's Periodontal Disease Index (PDI), BMI, and Green and Vermilion's OHI-S was carried out. Descriptive statistics and linear regression models were performed. **Results:** The 93.4% of the group had PD, 33.8% showed severe gingivitis and 20.5% mild gingivitis. A 28.5% five percent of the group had osteopenia and 18.5% had osteoporosis, being more common in people over 69 years. The 38.4% percent of the group was underweight and 53.0% had poor oral hygiene. Oral hygiene accounted for 63.1% of the PD variance ($p=0.0001$), figure that did not increase considerably by adding BMD and BMI variables to the regression model. **Conclusion:** The frequency of PD in this group of elderly adults was high and significantly associated with BMD, BMI, and mainly oral hygiene.

Keywords: *Periodontal disease, Osteoporosis, Elderly, Oral hygiene, Body mass index.*

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INTRODUCTION.

Changes in demographic structure and life expectancy are taking place in many countries, and Mexico is no exception. Today it is estimated that 14.4% of its population belongs to the age group of 60 years or older, with life expectancy reaching 78 years. This represents a greater "social risk" because aging increases the prevalence of degenerative diseases and the differences in coverage and quality of social security and health care¹. Periodontal disease (PD) is characterized by the destruction of connective tissue and alveolar bone after an inflammatory response of the host to infection by pathogens that can lead to tooth loss, affecting more than 80% of the population worldwide. Its multifactorial etiologic character

includes different risk factors such as obesity and osteoporosis, which can contribute to its emergence and prevalence²⁻⁶.

Obesity is a chronic disease of multifactorial etiology that affects the general population. It can increase the risk for the emergence of other systemic diseases (cardiovascular, metabolic and neurological) and local, such as PD⁷⁻¹⁰. It is a nutritional disorder and is considered a public health problem because its prevalence has doubled in the last two decades worldwide. Its importance lies in the fact that increased adipocytes increase in turn certain inflammatory mediators leading to a state that tends to systemic inflammation. This causes a localized decrease in blood flow and affects immune response^{2,5,6}. It may be a risk factor for the development of

PD, particularly in older adults, since it is possible to associate PD with low serum levels of micronutrients. The latter can result from dietary factors and lifestyle, as well as from the nutrigenetic characteristics of this age group. However, there is still limited evidence on the relationship between overweight and obesity with PD. Nevertheless, it can be stated that obesity has several harmful biological effects that may be related to the pathogenesis of PD^{8,11-18}.

Alterations in bone mineral density (BMD) are metabolic disorders characterized by decreased bone tissue thickness that increases bone fragility. Factors such as physical inactivity, low weight, alcoholism, smoking, a diet poor in calcium and rich in fiber, excessive coffee consumption and various diseases that affect calcium depletion may influence the onset of osteopenia and osteoporosis. Due to the longer life expectancy for humans, the prevalence of degenerative diseases has increased. In Mexico 16% of the elderly have osteoporosis (OP) and 57% have osteopenia. The prevalence is higher in women mainly due to insufficient estrogen levels after menopause. There are changes that directly affect the support and stability of teeth, causing the loss of crestal bone height, contributing to tooth loss¹⁹⁻²³. OP is considered a risk factor for PD. Subjects with OP have decreased alveolar density that favors conditions for increased susceptibility to resorption under infectious and inflammatory conditions²⁴⁻²⁷. However, authors like Mathur⁷ and Lohana¹⁰ reported no relationship between these two variables, and that is the reason why it is relevant to continue with their study. There are different theories about the relationship between these two pathologies. These theories assume that in PD biofilm causes a localized inflammatory response that, if not controlled, can lead to a more significant and rapid alveolar loss²⁸.

Epidemiological studies in different population groups worldwide have demonstrated the existence of a direct correlation between the amount of biofilm and the severity of PD, showing that good oral hygiene significantly reduces the incidence of PD²⁹⁻³³.

The aim of this study was to evaluate the relationship of body mass index (BMI), BMD, and oral hygiene with perio-

dontal disease in a group of elderly adults in Mexico City.

MATERIALS AND METHODS.

Study design and participants

A cross-sectional study involving a convenience sample comprising 151 elderly adults out of 208 registered in a civil association in the eastern area of Mexico City was carried out. Their average age was 69.03±2.9 years. Fifty-seven people were excluded from the study because they refused to give consent, were under periodontal treatment, had no clinically present any of the index teeth of the Ramfjord's Periodontal Disease Index (PDI), or had a physical or mental disability which prevented clinical examination.

Ethical and legal considerations of the study

The project was approved by the Committee on Bioethics and Biosafety of the Occlusion Dental Research Line (LI-FESZ-230506), Facultad de Estudios Superiores Zaragoza, Universidad Nacional Autónoma de México. Subjects were asked to sign an informed consent to comply with the ethical and legal aspects of the research.

For the epidemiological survey, a dental surgeon was standardized in four working sessions with a specialist in periodontics and implantology, who acted as gold standard for PDI. Cohen's kappa coefficient was 0.927.

Provisions of the technical standard of the Ministry of Health of Mexico (NOM013-SSA2-200635) in order to prevent infection were complied with during standardization and epidemiological survey. The epidemiological fact file was validated through a pilot test during the standardization process.

Variables, measuring and resources

The epidemiological survey was conducted in the premises of the civil association, assisting the procedure with a frontal white light headlamp (XM-L, T6-4, LED 5200LM, Cree®, USA), a flat dental mirror #5 without magnification, and a Michigan periodontal probe (M-6-PO6, HuFriedy®, USA).

PDI was used to measure the frequency and severity of periodontal disease. To assess the quality of oral hygiene

the Simplified Oral Hygiene Index (OHI-S) was applied. To measure BMD, a bone densitometry (Sonost 2000, Osteosys®, Korea) was performed based on the criteria established by the Project-Survey SABE Mexico¹. BMI was classified according to the criteria established by the WHO³¹.

Statistical methods

Statistical analysis was carried out using SPSS v.20.0 (IBM, USA). To assess the frequency and severity of periodontal disease, frequencies and proportions were calculated both by age and by sex. To determine the association of

PD with BMD, BMI, and OHI-S, a multiple linear regression test was used, with the stepwise approach, considering a confidence level of 95%.

RESULTS.

Socio-demographic characterization is shown in Table 1. BMD diagnostic distribution by age and sex is shown in Table 2, BMI distribution in Table 3 and OHI-S in Table 4.

A 93.4% of the sample presented some kind of peri-

Table 1. Sociodemographic characterization.

Sex	Age (years)		Total
	60-69	70 or older	
Male	20.5% (31)	9.3% (14)	29.8% (45)
Female	39.1% (59)	31.1% (47)	70.2% (106)
Total	59.6% (90)	40.4% (61)	100% (151)

Table 2. Diagnostic distribution of BMD by sex and age.

		Diagnosis according to BMD			Total
		Normal	Osteopenia	Osteoporosis	
Age	60-69	47.0% (71)	12.6% (19)	0.0% (0)	59.6% (90)
	70 or older	6.0% (9)	15.9% (24)	18.5% (28)	40.4% (61)
Sex	Men	19.9% (30)	7.4% (11)	2.6% (4)	29.8% (45)
	Women	33.1% (50)	21.1% (32)	15.9% (24)	70.2% (106)
Total		53.0% (80)	28.5% (43)	18.5% (28)	100% (151)

Table 3. BMI distribution by sex and age.

		Body mass index					Total
		Under-weight	Normal	Overweight	Obesity I	Obesity II	
Age	60-69	13.9% (21)	27.2% (41)	12.6% (19)	4.0% (6)	2.0% (3)	59.6% (90)
	70 or older	24.5% (37)	7.9% (12)	5.3% (8)	2.0% (3)	0.6% (1)	40.4% (61)
Sex	Men	9.9% (15)	13.9% (21)	4.6% (7)	1.4% (2)	0.0% (0)	29.8% (45)
	Women	28.5% (43)	21.2% (32)	13.3% (20)	4.6% (7)	2.6% (4)	70.2% (106)
Total		38.4% (58)	35.1% (53)	17.9% (27)	6.0% (9)	2.6% (4)	100% (151)

Table 4. OHI-S distribution by sex and age.

		Oral hygiene			Total
		Good	Fair	Poor	
Age	60-69	6.6% (10)	27.8% (42)	25.2% (38)	59.6% (90)
	70 or older	3.3% (5)	9.3% (14)	27.8% (42)	40.4% (61)
Sex	Men	2.0% (3)	9.3% (14)	18.5% (28)	29.8% (45)
	Women	7.9% (12)	27.8% (42)	34.4% (52)	70.2% (106)
Total		9.9% (15)	37.1% (56)	53.0% (80)	100% (151)

Table 5. Distribution of periodontal diagnosis according to BMI, BMD and OHI-S.

		Healthy	Mild	Gingivitis Moderate	Severe	Gingival Sulcus 3mm or less	Periodontal Pocket from 4 to 6mm	Periodontal Pocket larger than 6mm
BMD	Normal	4.6% (7)	6.0% (9)	17.9% (27)	20.5% (31)	1.3% (2)	2.6% (4)	0.0% (0)
	Osteopenia	0.0% (0)	2.6% (4)	1.3% (2)	11.3% (17)	10.6% (16)	2.6% (4)	0.0% (0)
	Osteoporosis	2.0% (3)	2.0% (3)	1.3% (2)	2.0% (3)	2.0% (3)	5.3% (8)	4.0% (6)
Oral hygiene	Good	5.3% (8)	4.0% (6)	0.7% (1)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)
	Fair	1.3% (2)	6.6% (10)	14.6% (22)	13.3% (20)	0.0% (0)	1.3% (2)	0.0% (0)
	Poor	0.0% (0)	0.0% (0)	5.3% (8)	20.5% (31)	13.9% (21)	9.3% (14)	4.0% (6)
BMI	Underweight	0.0% (0)	0.7% (1)	5.3% (8)	8.6% (13)	12.6% (19)	7.3% (11)	4.0% (6)
	Normoweight	2.6% (4)	5.3% (8)	9.9% (15)	13.3% (20)	1.3% (2)	2.6% (4)	0.0% (0)
	Overweight	3.3% (5)	3.3% (5)	4.0% (6)	6.6% (10)	0.0% (0)	0.7% (1)	0.0% (0)
	Obesity	0.7% (1)	1.3% (2)	1.3% (2)	5.3% (8)	0.0% (0)	0.0% (0)	0.0% (0)

Table 6. Regression models for periodontal disease.

Model	R	F	p	Regression coefficient
OHI-S	0.631	98.776	0.000	1.139
OHI-S + BMD	0.659	9.407	0.003	1.078
OHI-S + BMD + BMI	0.674	5.122	0.025	1.049

odontal alteration, the most common were: severe gingivitis (33.8%) and moderate gingivitis (20.5%), while 10.5% had periodontal pockets between 4 and 6mm and 4% periodontal pockets larger than 6mm.

The distribution of PD severity according to BMD, BMI, and OHI-S is shown in Table 5. The linear regression models for PD are shown in Table 6.

DISCUSSION.

In the study group the frequency of periodontal disorders was high, similar to that reported by Mathur *et al.*⁷, Cornejo *et al.*¹³ and Petelin *et al.*¹⁴, but much higher than that reported by Norderyd *et al.*¹², Konopka *et al.*¹¹, Ramsay *et al.*²⁹ and Cardentey *et al.*³². With aging, the periodontium may suffer clinical changes such as gingival recession, clinical attachment and alveolar support loss, a situation that is aggravated in greater or lesser degree when the elderly adult is exposed to poor oral hygiene, systemic diseases, smoking, alcoholism, among others^{12,29}.

Some studies suggest that PD and OP share risk factors^{9,12,29}; this would explain the association observed in the present study. This finding is consistent with those reported by Aljehani *et al.*⁴, Rosales *et al.*¹⁹ and Pepelassi

*et al.*²³, but contrary to what was observed by Mathur *et al.*⁷ and Lohana *et al.*¹⁰, as they found no association between these variables. This can be explained because OP leads to reduced alveolar ridge, facilitating bacterial damage to the alveolar bone.

It is known that unintentional weight loss and malnutrition in older adults contribute to the progressive decline in health, affecting the functional and cognitive status of this age group^{2,6}. On the other hand, PD can be more severe in obese^{4,6,7,9,15,18} people. However, the exact mechanism associated with both diseases continues under research⁸. Mechanisms that may explain this association would be changes in the inflammatory response that increase susceptibility to infections and delayed healing^{6,15}.

In the present study, poor oral hygiene was associated with the presence of periodontal pockets, in agreement with the findings reported by Mathur *et al.*⁷, Cornejo *et al.*¹³, Ramsay *et al.*²⁹, Lohana *et al.*¹⁰ Cardentey *et al.*³² and Hernandez *et al.*⁹. This confirms that the quality of oral hygiene remains a very important risk factor for the development of PD.

In conclusion, the frequency of PD in this group of elderly adults was high and significantly associated with BMD, BMI, and mainly with oral hygiene.

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Relación del índice de masa corporal, densidad mineral ósea e higiene oral con enfermedad periodontal en un grupo de adultos mayores mexicanos.

Resumen: El objetivo de este estudio fue evaluar la relación del índice de masa corporal (IMC), densidad mineral ósea (DMO) e higiene oral con enfermedad periodontal en un grupo de adultos mayores de la Ciudad de México. Material y métodos: Se llevó a cabo un estudio transversal con una muestra por conveniencia de 151 adultos mayores. Para la encuesta epidemiológica se solicitó el consentimiento informado de cada persona, se llevó a cabo la estandarización para la medición del Índice de Enfermedad Periodontal de Ramjford (IEP), IMC e IHO-S de Green y Vermillion. Se realizó estadística

descriptiva y modelos de regresión lineal. Resultados: El 93,4% del grupo presentó EP, un 33,8% mostró gingivitis severa y el 20,5% moderada. El 28,5% del grupo presentó osteopenia y el 18,5% osteoporosis, siendo más frecuente en personas mayores de 69 años. El 38,4% del grupo presentó bajo peso y el 53,0% mala higiene oral. La higiene oral explicó un 63,1% de varianza de la EP ($p=0,0001$), valor que no se incrementó de manera relevante al agregar las variables DMO e IMC al modelo de regresión. Conclusión: La frecuencia de EP en este grupo de adultos mayores fue alta, asociándose significativamente con la DMO, el IMC y principalmente la higiene oral.

Palabras clave: *Enfermedad periodontal, Osteoporosis, Adulto mayor, Higiene oral, Índice de masa corporal.*

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