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PERMANYER

Gac Med Mex. 2015;151:567-72

GACETA MÉDICA DE MÉXICO

ORIGINAL ARTICLE

Prevalence of severe periodontal disease and its association with respiratory disease in hospitalized adult patients in a tertiary care center

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Abstract

Background: *Severe periodontal disease is a chronic inflammatory gingival process associated with systemic diseases.* **Objective:** *To determine the prevalence of severe periodontal disease and its association with respiratory diseases among hospitalized patients at the Institute of Respiratory Diseases "Ismael Cosio Villegas" (INER) in 2011.* **Material and Methods:** *A cross-sectional study was developed. The severe periodontal disease was diagnosed by the Department of Stomatology. The International Classification of Diseases 10th revision was used. A multinomial logistic was fit to estimate relative-risk.* **Results:** *Three thousand and fifty-nine patients were included; 772/3,059 (25.2%) had severe periodontal disease. After controlling for age, sex, inpatient days, death, and socioeconomic status, the infectious respiratory diseases that were significantly associated with severe periodontal disease were: HIV/AIDS (RR: 10.6; 95% CI: 9.1-23.3; p < 0.0001); pneumonia (RR: 2.6; 95% CI: 2.2-5.7; p < 0.0001); pulmonary tuberculosis and its sequels (RR: 2.1; 95% CI: 1.6-4.9; p < 0.0001); and lung abscess (RR: 2.6; 95% CI: 1.6-7.8; p = 0.002). Lung cancer and pleural diseases were also significantly associated with severe periodontal disease.* **Conclusions:** *High prevalence of severe periodontal disease was observed in the different respiratory diseases. Severe periodontal disease was associated with both infectious and non-infectious respiratory diseases. It is important to study an oral health intervention.* (Gac Med Mex. 2015;151:567-72)

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KEY WORDS: *Prevalence. Periodontal disease. Respiratory illness. Hospitalization. Third level.*

Introduction

Periodontal disease (PD) is a chronic gingival inflammatory process that leads to the destruction of the structures that give support to the teeth, as well as the alveolar bone, and subsequently to the loss of teeth due to bacterial infection. PD increases the risk for systemic diseases[1-3], and specifically respiratory infections. Tha association between respiratory infection and PD has been explained in terms that PD involves chronic aspiration of bacteria from the oropharynx to the

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Date of modified version reception: 11-09-2014
Date of acceptance: 13-01-2015

lower respiratory tract. In addition, several studies have already been reported where direct evidence between pulmonary infections and oral diseases is shown[4].

As for studies on PD prevalence, there are several in the world with different types of study populations, although actually only a few have been conducted in hospitalized patients, including one carried out in a psychiatric hospital in India, where a moderate PD prevalence of 47% was found[5]. In a study conducted in the United States, PD prevalence in Cuban-origin adults was 40%, and in Central America immigrants it was 37%[6]. In a Brazilian population, a prevalence of moderate to severe periodontitis of 15% was found, highlighting that income inequity was associated with severe periodontitis (RR = 3.0, $p < 0.05$)[7]. In Mexico, a 78% PD prevalence was found in people aged 60 years or older covered by social security[8].

Studies on the association between PD and respiratory diseases have been mainly focused from the clinical point of view[9]. For that reason, in this study we want to find out if there is any association between each of the respiratory diseases and the prevalence of severe PD (SPD) and the patients' socioeconomic level. In this context, the goals of the study were: (a) to determine the prevalence of SPD in patients hospitalized in the National Institute of Respiratory Diseases (INER – *Instituto Nacional de Enfermedades Respiratorias)*; (b) to determine the association between the prevalence of SPD and the patient's economic level, and (c) to identify the association magnitude between SPD and different respiratory conditions.

Material and methods

A cross-sectional, hospital-based study was conducted. All adult patients (≥ 18 years of age) were included, with sedated or intubated patients being excluded due to the impossibility to perform an oral examination.

This study was conducted at the INER and was carried out from January 1st to December 31st 2011. The protocol was approved by the Committee of Research and Ethics for Research of the INER (E06-13).

A bucodental rehabilitation specialist physician, member of the Stomatology Department staff, visited everyday each one of the patients admitted at the hospitalization areas of the INER in order to make a visual examination of the oral cavity and corroborate if there was SPD or not. A patient was regarded as having SPD if on examination the following signs were found: inflammation, necrosis of the interdental papilla, spontaneous bleeding, pain, ulceration and halitosis. Mild or moderate PD was considered in the presence of: slight color change and little change of texture without bleeding, moderate inflammation not completely surrounding the tooth. All this was classified according to the odontologist's criteria, who was the only observer in the study.

The main discharge diagnosis was identified for each patient according to the ICD-10 of the World Health Organization (WHO). The ICD-10 codes regrouping proposed by Pérez Padilla in 2008, which includes respiratory conditions not contained within the "J" codes was used[10]. The analyzed groups were: respiratory conditions in patients with HIV infection/AIDS (B20-B24); malignant tumors (C00-C97, D00-D09, D37-D48); pneumonia and influenza (J09-J18); tuberculosis and tuberculosis sequels (A15-A19, B90, A31); chronic obstructive pulmonary disease (COPD) (J40-J44); bronchiectasis (J47); asthma (J45-J46); interstitial diseases (J60-J80, J82-J84, J99.1, M05-M14, M30-M36); pleural conditions (J86, J90-J92, J94) and lung abscess (J85).

The socioeconomic level was classiffied based on the weighted income per each economic dependent; housing characteristics (construction material, public services and rural, suburban or urban location); if the family owns or rents the house they inhabit, and presence of other ill relatives; depending on the above, a level is assigned from 0, which is the lowest and where the patient doesn't have to pay at all, followed by levels 1 to 4, where fees are assigned in an increasing manner and where the INER covers the subsidy corresponding to each level; then, there is level 5, which corresponds to the real cost that would be payed without subsidy and, finally, levels 6, 7, 8 and 9, where the fee involves an adittional profit for the Institute and corresponds to those patients who have a private insurance or some type of agreement. This analysis did not include socioeconomic levels 5 to 9, since patients in our study were distributed between levels 0 to 4.

Statistical analysis of the study

PD prevalences were calculated by respiratory condition and socioeconomic level. A multinomial logistic model was created considering the regrouping of the 10 above-mentioned respiratory conditions as the dependent variable, taking patients with asthma, which was the condition with the lowest SPD global prevalence (5%), as the reference category, and controlling for age, sex, days of hospital stay, deaths and socioeconomic level. For statistical analysis, the Stata program, version 12, was used.

Table 1. Severe periodontal disease prevalence by respiratory condition and socioeconomic level, INER, 2011 (%)

Respiratory condition*	0	1	2	3	4
HIV/AIDS (n = 432)	70	62	67	55	68
Malignant Tumors (n = 567)	24	28	24	26	15
Pneumonia and influenza (n = 415)	44	35	18	12	9
Tuberculosis and sequels (n = 182)	19	34	39	4	0
COPD (n = 241)	5	11	15	13	5
Bronchiectases (n = 71)	6	16	25	0	0
Asthma (n = 506)	10	8	4	5	0
Interstitial (n = 346)	5	24	11	9	25
Pleural (n = 255)	27	30	17	14	10
Abscess of the lung (n = 44)	35	39	30	0	0

*The groups of diseases correspond to the ICD-10 diagnoses grouping proposed by Pérez Padilla in 2008. Socioeconomic level 0 is the lowest.

Results

A total of 3,059 patients of ≥ 18 years of age who were hospitalized for any respiratory problem were identified during the year of study. Of all 3,059 patients, 772 (25%) had SPD. Of the patients with SPD, 76% were males with an average age (±SD) of 45 years (16.9) and 56 (18.0) for females.

PD prevalences by respiratory condition and socioeconomic level are presented in table 1. Overall, the highest SPD prevalences were observed in patients with HIV/AIDS, with 55 to 70%. The conditions that showed the highest SPD prevalence in the lowest socioeconomic level (0) were: patients with HIV/AIDS, 70%; pneumonia, 44% and asthma with 10%. In the socioeconomic level (1), where the minimum fee is to be payed, the highest prevalences occurred in patients with malignant tumors (28%), pleural conditions (30%) and abscesses of the lung (39%). The highest SPD prevalences in socioeconomic level (2) were observed in: tuberculosis and sequels with 39%, COPD with 15% and bronchiecteses with 25%. The highest SPD prevalences were concentrated on socioeconomic levels 0 to 2, while the lowest did on socioeconomic levels 4 and 5. The only respiratory condition where a SPD prevalence clear descending trend is observed was pneumonia and influenza, which ranges from 44% in socioeconomic level (0) to 9% in socioeconomic level (4).

The results of the multinomial logistic model, using patients with asthma as the reference group, are shown in table 2. The respiratory conditions with significant risk for SPD were: HIV infection/AIDS (RR = 10.6. 95% CI: 6.4-17.4, p < 0.0001); pneumonias and influenza (RR = 2.6, 95% CI: 1.6-4.3, p < 0.0001); pulmonary abscesses (RR = 2.6, 95% CI: 1.1-5.8, p = 0.002). Of the non-infectious chronic diseases, the conditions that were significantly associated with

Table 2. Relative risk (RR) for severe periodontal disease in each one of the respiratory conditions. Results of the multivariate analysis by means of multinomial logistic regression

Respiratory condition	RR	95% CI
Asthma*	1.0	
HIV/AIDS	10.6†	6.4-17.4
Malignant tumors	2.7†	1.6-4.3
Tuberculosis and sequels	2.1†	1.2-3.7
Pneumonias and influenza	2.6†	1.6-4.3
Bronchiectases	1.5	0.7-3.5
COPD	1.2	0.6-2.2
Interstitial conditions	1.7	0.9-2.8
Pleural conditions	1.9†	1.1-3.3
Pulmonary abscess	2.6†	1.1-5.8

The model was controlled for age, sex, days of hospital stay, deaths and socioeconomic level.
*Reference group
†p-value < 0.005

SPD were: malignant tumors (RR = 2.7, 95% CI: 1.6-4.3, p < 0.0001) and pleural conditions (RR = 1.9. 95% CI: 1.1-3.3, p = 0.002).

Discussion

The main findings of this study were: (a) at the INER, PD prevalence is high, 25% in hospitalized, non-intubated adult patients (≥ 18 years of age); (b) the highest PD prevalences were observed in the lowest socioeconomic level for patients with infectious diseases such as HIV/AIDS and pneumonia and influenza, and (c) after controlling for confounders, SPD showed a positive and significant association with respiratory infectious diseases: HIV infection/AIDS, pneumonia and influenza, pulmonary tuberculosis and pulmonary abscesses. Of the non-infectious chronic diseases, the conditions that were significantly associated with SPD were: malignant tumors and pleural conditions. Although the endpoint reported in this study was SPD prevalence in hospitalized patients, most patients had some mild or moderate PD damage. In Mexico, a cross-sectional study conducted in population covered by the National Institute of Social Security and Social Services for Workers at the Service of the State (ISSSTE – *Instituto Nacional de Seguridad Social y Servicios Sociales para los Trabajadores al Servicio del Estado)* and the Mexican Institute of Social Security (IMSS – *Instituto Nacional del Seguro Social)* included 336 patients aged 60 years or older; out of these patients, 78% had PD[8]. The prevalence in this study was much higher than that found in our study, perhaps because 60-year-old or older patients, who have more deterioration of the oral cavity, were considered, while we included 18-year-old or older patients. As a matter of fact, a study conducted in India confirms that the older the age, the higher the frequency of PD[11].

We found that patients with the lowest socioeconomic levels had a higher SPD prevalence, which is consistent with a population-based study in Brazil, which found income inequity to be significantly associated with SPD (RR = 3.0, 95% CI: 1.5-5.9)[7].

The contribution of HIV infection/AIDS to PD in infected patients is not adequately established. A recent study conducted in patients with HIV infection/AIDS showed that the clinical stage of the HIV infection as assessed by CD4 count, antiretroviral therapy and age is not a risk factor for the subjects' periodontal status, but smoking and hygiene habits are the determinants of susceptibility to PD[12,13]. Diagnosis and treatment of these patients requires a multidisciplinary approach that is already being carried out at the INER; however, the results of this study show elevated SPD prevalences among HIV-infected patients in all socioeconomic level groups managed by the INER (Table 1).

As for the increased risk for infectious respiratory diseases in patients with PD, it has already been described for bacterial pneumonia[14], aspiration pneumonia[15], and nosocomial pneumonia[16,17], and bacterial pneumonia in adults has been suggested to result from oropharyngeal flora aspiration into the lower respiratory tract and failure of the defense mechanisms of the host to eliminate contaminating bacteria, which are multiplied in the lungs. Community-acquired pneumonia and pulmonary abscesses are known to possibly be the result of anaerobic bacteria infection, and dental plaque appears to be the source of these bacteria, especially in patients with PD. Bacterial pneumonia has also been suggested to likely result from hospitalization of patients at high risk for pneumonia or patients in rest homes, who are likely to be less careful with personal hygiene[18].

In our study, the main infectious disease that was associated with SPD, except for HIV infection/AIDS, were pneumonias (RR = 2.6, p < 0.0001). These data are consistent with those found in a study conducted in elderly institutionalized patients, which showed a higher risk for pneumonia among patients with poor oral health[19-21]. Even cases of chronic PD-associated recurrent pulmonary infection have been reported. PD treatment allowed for the number of pulmonary infectious episodes to be reduced[22].

We also found PD to be significantly associated with respiratory tuberculosis and its sequels (RR = 2.1, p < 0.001). However, a study conducted in India, where the frequency of PD was compared in patients with and without tuberculosis failed to show any statistically significant difference among the periodontal clinical parameters that were assessed between both groups[23].

With regard to pulmonary abscesses, which in the literature have been attributed to the fact that microorganisms in the oral cavity can cause systemic diseases due to hematogenous dissemination[24], a significant association was observed (RR = 2.6, p = 0.002). In a study, *Bacteroides gingivalis* was found to cause extremely serious pulmonary inflammation that progressed to severe pneumonia and pulmonary abscess[25].

On the other hand, we found SPD to be associated with the presence of pleural conditions (RR = 1.9, p < 0.0001), as well as pulmonary abscesses (RR = 2.6;

$p < 0.0001$). In elderly patients, aspiration pneumonia can lead to the development of abscesses, empyema, or even to death. Two pathophysiological mechanisms have been described for aspiration pneumonia: (a) odontogenic diseases: oral aspiration of microorganisms that reach the pulmonary alveoli, which grow and develop their pathogenicity, and (b) the presence of other risk factors such as alcoholism, diabetes and bed confinement, which reduces cough reflex, airway clearance and phagocytic function[26].

As for the association of SPD with malignant tumors ($RR = 2.7$, $p < 0.0001$), the mechanism that can explain this association is that oral inflammation often has systemic effects that lead to an increased concentration of circulating inflammatory markers, with a high correlation existing between SPD seriousness and serum inflammatory levels. There is documented evidence that PD is significantly associated with lung, kidney and pancreatic cancer, with hematological and oral cancer and that the concept of inflammation is a critical component of tumor progression[27].

The association of SPD with an increased risk for COPD exacerbation has already been documented in several studies that have shown a positive association between PD and chronic bronchitis and COPD[28-31]. However, we found no signifficant association between both conditions ($RR = 1.2$, $p = 0.563$).

We can conclude that: (a) infectious and non-infectious respiratory conditions show a significant association with the presence of SPD; (b) that non-transmittable chronic respiratory conditions can share risk factors with infectious diseases: (c) that SPG is common in patients with respiratory problems, and (d) that the presence of SPD is of huge importance in the pathogenesis of respiratory conditions, especially in developing countries[32].

Limitations of the study

This study was analyzed as a cross-sectional trial, which means that the assessment of PD prevalence and its association with respiratory conditions was made at the same tine and, therefore, we cannot establish if the PD was prior or after the respiratory condition; this is one of the limitations that are intrinsic to a cross-sectional design. In the present study, we controlled for the patients' socioeconomic level in the analysis; however, residual confusion is still posible. The difficulty in observational studies to control for all socioeconomic factors of the population is a known fact[33] and, hence, interventional studies have been proposed where all socioeconomic factors are the same for the entire study population and the only difference would be the investigator's intervention.

Other limitation refers to the way to assess oral health, which was carried out only by visual inpection. In all patients with PD, the signs of the disease were evident, so it is unlikely that the patients were wrongly classified with regard to the disease; it is more likely for patients with less serious signs and symptoms of PD to have been classified as having mild or moderate PD. For all the above reasons, our results may not be comparable with the results of other epidemiological and clinical studies.

Conclusions

PD has a very high prevalence among hospitalized patients with respiratory conditions. Prevalence varies according to the respiratory condition. It would be highly recommendable to develop an oral hygiene interventional program in patients hospitalized for respiratory conditions.

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