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ARTIGO

CRITERIA FOR RADIOGRAPHIC DIAGNOSIS OF PERIODONTITIS IN EPIDEMIOLOGICAL STUDIES

CRITÉRIOS PARA DIAGNÓSTICO RADIOGRÁFICO DE PERIODONTITE EM ESTUDOS EPIDEMIOLÓGICOS

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RESUMO

Objetivo: Comparar quatro métodos radiográficos para a interpretação de periodontite em estudos epidemiológicos de associação com condições sistêmicas. Método: banco de dados de estudo caso-controle sobre associação entre periodontite e osteoporose foi empregado e quatro diferentes critérios radiográficos (CR) comparados ao critério clinico (CC) para interpretar a presença de periodontite (DP): CR-1, um dente; CR-2, no mínimo dois dentes; CR-3, no mínimo três dentes; CR-4, no mínimo quarto dentes, com um ou mais sítios apresentando perda óssea ≥ 3 mm em relação à junção cemento-esmalte, na face mesial ou distal. Valores de frequência e diagnóstico da DP foram calculados, junto com as medidas de associação (*odds ratios*) para os dois critérios que apresentaram as especificidades mais altas. Resultados: A frequência da DP variou de acordo com o CR usado, de 76,6% a 95,6%. CR-4 e CR-3 apresentaram as especificidades mais altas (30,5% e 21,0%, respectivamente). A sensibilidade foi de 100% para todos os critérios testados. As *odds ratios* não ajustadas e ajustadas para CR-3 e CR-4 variaram de 1,13 a 1,52, sem significância estatística. Conclusões: Achados mostraram que a frequência da DP pode ser influenciada por diferentes CR e indicaram uma variação na força de associação entre osteoporose e periodontite.

Palavras-chave: Doença periodontal, radiologia em periodontia, osteoporose, epidemiologia.

ABSTRACT

Objective: This study aimed to compare four radiographic methods for interpreting the periodontitis in epidemiological studies on associations with systemic conditions. Methods: A database from a case-control study evaluating the association between osteoporosis and periodontitis was used to compare four different radiographic criteria (RC) with the clinical criteria (CC) for interpreting the presence of periodontal disease (PD): RC-1, one tooth; RC-2, at least two teeth; RC-3, at least three teeth; RC-4, at least four teeth, with one or more sites on the mesial or distal face presenting bone loss ≥ 3 mm, in relation to the cement-enamel junction. PD frequency and diagnostic values were calculated, along with the main association measurements (odds ratios), for the two criteria presenting highest specificity. Results: PD frequency varied according to the RC used, from 76.6% to 95.6%. RC-4 and RC-3 presented the highest specificity (30.5% and 21.0%, respectively). The sensitivity was 100% for all criteria tested. The unadjusted and adjusted odds ratios for RC-3 and RC-4 ranged from 1.13 to 1.52, without statistical significance. Conclusions: The findings showed that PD frequency may be influenced by different RCs, as well as indicating variation in the strength of the association between osteoporosis and periodontitis.

Keywords: Periodontal disease, radiology in periodontics, osteoporosis, epidemiology.

INTRODUCTION

Healthcare research is going through a time of great importance in the search for factors associated with the health-disease process, given that multifactorial models have been found to provide the best explanation for the causal trail of a large proportion of systemic abnormalities. Within this context, oral conditions have emerged as a possible factor relating to illnesses that become established beyond the oral cavity.

Currently, periodontal disease (a bacterial oral infection) is under discussion as a pathological condition with distant repercussions in the human organism. It seems to be capable of causing the appearance and development of certain diseases and systemic conditions that are considered to be serious public health problems, such as myocardial infarct, diabetes mellitus, respiratory infections, premature birth and/or low birth weight.

Epidemiological studies have shown that the prevalence of periodontal disease worldwide is around 10% to 15%, and that it can reach 80% in certain regions[1]. Furthermore, it is considered to be the greatest cause of tooth loss and edentulism among adults. It has been observed more frequently among older groups than among younger groups, and it is forecast to become a serious health problem in the near future, especially from the current perspective of increasing longevity among the population.

Many studies have sought evidence for a two-way relationship between periodontal disease and systemic diseases[2,3,4]. Although epidemiological evidence exists, there is still much controversy given that while some investigations have favored such an association, others have not corroborated the findings of this relationship[5,6].

It is important to emphasize that for investigations correlating periodontal disease and systemic diseases, the epidemiological method needs to be used carefully in order to obtain reliable findings. Among other points, this includes defining both the exposure measurements and the outcome measurements.

With regard to myocardial infarct, osteoporosis, diabetes, premature birth and/or low birth weight, criteria with worldwide acceptance exist. These were established by the World Health Organization (WHO) or by medical associations, and they clearly characterize individuals with diagnoses of these conditions through making the criteria uniform at the international level of scientific investigation.

In relation to periodontal disease, no such criteria have yet been clearly defined. On the one hand, this relates to the characteristics of this oral disease, in that it is locally specific; there are periods of disease activity with collapse of periodontal support and others of quiescence; the disease does not present clear clinical characteristics compatible with the histopathological conditions; and there are local and systemic factors that accelerate the progression of the disease, among other characteristics. On the other hand, this relates to the fact that few studies investigating associations between periodontal disease and systemic conditions have evaluated the criteria for defining this disease at both clinical and radiographic level in order to make these criteria uniform and compatible for research[4,7].

In addition, although the criteria suggested by WHO for defining periodontal disease are appropriate for prevalence studies, they may not be adequate for other types of investigation. For studies on associations between two diseases, it is a condition *sine qua non* that both the exposure measurement and the outcome measurement should be robust. This means that the clinical or radiographic diagnosis for periodontitis needs to be made accurately, in order to avoid including false positive individuals in the sample, *i.e.* individuals who in reality do not have periodontal disease, which would change the final association measurement.

Given the variety of criteria in the literature for defining the radiographic appearance of periodontitis, this study aimed to compare four methods for interpreting this disease, by using a database from a case-control study that included, among other information, clinical measurements of periodontal condition and panoramic radiographic data. For this, the comparison used measurements of sensitivity, specificity, positive predictive values and negative predictive values, in order to contribute towards increasing the knowledge of tools for diagnosing periodontal disease in analytical epidemiological studies.

MATERIAL AND METHODS

Sample

To make up the sample for this study, information from 87 individuals selected from the database of a case-control investigation[4] was combined with data on 50 individuals in a study on osteoporosis and periodontal disease that is currently in progress.

For all of the individuals selected, a panoramic radiograph of the face, obtained from the Dental Radiology Service of Feira de Santana State University, was available. These examinations had been performed in a standardized manner on the radiographic apparatus (Rotograph Plus; Villa Sistemi Medicali, Milan, Italy). The energy factors for the machine (kV and length of exposure) were determined according to the patient's age and weight, ranging from 60 to 90 kV and 14 to 17 sec; the milliamperage of the machine (10 mA) was not adjustable. The radiographic film (T-MAT G; 12 x 30 cm; Kodak Company, New York, USA) was used in conjunction with intensifier plates (Lanex Regular; Kodak Company, New York, USA) that were inserted in a specific frame for this model of radiographic apparatus. The patient was properly protected using a lead vest during the radiographic exposure. After exposure, the films were processed automatically (Level 360; J. Morita Corp., Osaka, Japan), always using new processing solutions (Kodak Company, New York, USA).

As soon as the radiographs were ready, they were properly identified using self-adhesive labels. It should be noted that the radiographic machine produces an average enlargement of 20%, according to its manufacturer.

The calculation for the size of the sample to validate the diagnostic test (i.e. the radiographic examination) was based on the formula for evaluating the sensitivity and specificity of diagnostic tests[8]: N = Z x Z (P(1-P))/(D/D). The value of P was based on a sensitivity of 94%[9] for diagnosing periodontitis by means of radiographic examinations. The value of D (half-amplitude of the confidence interval, CI) was defined as 5% and the value of Z was defined as 1.96 (for a = 0.05 and CI = 95%). The minimum sample was thus estimated to be 87 individuals.

On the other hand, the calculation for the size of the sample to evaluate the association between osteoporosis and periodontal disease indicated that 130 individuals would be needed to carry out the study with a confidence interval of 95% and power of 80%, with two controls for each case. The parameters for the prevalence of osteoporosis that were used for this calculation were 17% among the controls and 39% among the cases. The Epi-Info software (version 6.0) was used[10].

Since the minimum sample for the association was greater than the sample calculated for validating the radiographic examination, it was decided that for this study, a sample corresponding to the minimum needed for evaluating the association (N = 130) would be used.

The postmenopausal women who formed the subjects for this study, with a minimum age of 50 years, had come to the Human Reproduction Assistance Center (CEPARH), in Feira de Santana, Bahia, Brazil, in order to undergo bone densitometry examinations. There, they were approached and invited to undergo an assessment of their oral condition, with any dental treatment that might be necessary, at the Dental Clinic of Feira de Santana State University (UEFS), Bahia, Brazil. The women who showed interest in this invitation were sent to the UEFS clinic with an arranged appointment, and they received further information about the study protocol and aims, at that location. If they agreed to participate, they signed a free and informed consent statement to authorize their inclusion in the study. This study was approved by the Ethics Committee of the Foundation for Science Development of Bahia, in Salvador, Bahia, Brazil (protocol 047/2005).

The comparison groups were formed in accordance with the following definition. The case group was composed of postmenopausal women who had periodontal disease, while the control group was composed of postmenopausal women without periodontal disease.

Data gathering procedures

The women who agreed to participate in the study answered a questionnaire that sought data relating to sociodemographic, biological and lifestyle factors such as age, skin color, income, schooling level, physical activity practice, calcium intake, smoking habit, alcohol consumption, age at menopause, length of time since menopause, parity, medical history, medications used and oral habits. They underwent a clinical dental examination and were sent to have panoramic radiography performed, as a complementary assessment of their oral condition. The participants' densitometry reports were requested and any diagnoses of osteoporosis were then also recorded.

All of the clinical measurements made in the two groups were made by a single examiner who, at the time of the examination, was unaware of the bone mineral density of the woman under evaluation. The reproducibility and concordance of the clinical measurements were calculated by means of the within-examiner kappa index for probing depth (0.6017) and recession/hyperplasia (0.6863) and the between-examiner kappa index (experienced periodontist versus examiner) for probing depth (0.6080) and recession/hyperplasia (0.6671).

The probing depth procedures were performed and recorded at six sites per tooth. They consisted of four proximal measurements (mesiovestibular, mesiolingual, distovestibular and distolingual), one measurement in the mid-vestibular region and one measurement in the mid-lingual region. All of the measurements were made using a Williams-type probe graduated in millimeters (Hu-Friedy, USA), indicating the distance from the gingival margin to the most apical extent of probe penetration. Measurements for gingival recession and clinical attachment loss were also made at these sites. The recession measurement consisted of the distance from the gingival margin to the cement-enamel junction, while the clinical attachment loss was taken to be the sum of the probing depth and gingival recession.

In addition to this, the rate of bleeding on probing was determined at the same six sites, by observing whether bleeding was present within ten seconds after removing the graduated probe from the pocket or sulcus.

Clinical diagnosis of periodontal disease

Each participant was classified in accordance with the following clinical diagnosis for periodontitis: a minimum of four teeth with one or more sites presenting probing depth ≥ 4 mm and clinical attachment loss ≥ 3 mm at the same site, with bleeding on probing[4].

Radiographic evaluation of periodontal disease

Each participant was reclassified using diagnoses of periodontal disease according to four criteria of radiographic interpretation that were found in the literature[11] and/or determined for the present study. In this way, the four radiographic criteria for interpreting the presence of periodontal disease were defined thus:

Radiographic criteria 1 (RC1): one tooth with at least one site on the mesial or distal face presenting bone loss ≥ 3

mm, in relation to the cement-enamel junction;

Radiographic criteria 2 (RC2): at least two teeth with one or more sites on the mesial or distal face presenting bone loss ≥ 3 mm, in relation to the cement-enamel junction;

Radiographic criteria 3 (RC3): at least three teeth with one or more sites on the mesial or distal face presenting bone loss ≥ 3 mm, in relation to the cement-enamel junction;

Radiographic criteria 4 (RC4): at least four teeth with one or more sites on the mesial or distal face presenting bone loss ≥ 3 mm, in relation to the cement-enamel junction.

For this, the radiographic interpretation was made by three professionals: two radiologists and one specialist in periodontics and radiology. The interpretation was made in an appropriate environment, using a magnifying glass with 2x magnification, in a negatoscope (Firefly no. 4, Hitco, Hiltrade Co. Ltd., Hong Kong), with a ruler graduated in millimeters with enlargement of 25%[12]. The examiners described the presence of periodontal disease in accordance with the four radiographic criteria defined above. In the event of divergence in the results between the examiners, the majority diagnosis prevailed.

At the end of the data-gathering process, with all the information and clinical-radiographic data at hand, the case and control groups were determined. Thus, to make up the comparison groups, the cases were taken to be the individuals presenting clinical periodontitis (gold standard) or radiographic periodontitis (RC1, RC2, RC3 and RC4), while the controls were taken to be the individuals without these findings.

Data analysis procedures

For the data analysis, the occurrences of periodontal disease were distributed according to each of the radiographic criteria. Initially, the clinical criteria for diagnosing periodontal disease were taken as the gold standard for comparisons with the radiographic criteria, using the diagnostic values of sensitivity, specificity, positive predictive value and negative predictive value.

After estimating the accuracy of the criteria under investigation, those with higher specificity were selected to define the outcome and perform multivariate analysis on the association between osteoporosis and periodontal disease.

To investigate statistical interactions in the stratified analysis, the separate stratum-specific measurements were observed in relation to the confidence intervals of the other strata. The Mantel-Haenszel homogeneity test was also applied, to investigate whether there were any possible effect modifiers (alpha of 20%). The potential confounding variables were selected on both a theoretical and an empirical basis, taking into account a relative difference of more than 10% between the measurements of each covariable adjusted using the Mantel-Haenszel method and the measurements of the unadjusted association.

Multivariate analysis was also performed to evaluate the statistical significance, by means of unconditional logistic regression using backward procedures, with a 95% confidence interval. Possible effect modifiers were evaluated by means of the maximum likelihood ratio test ($p<0.05$), comparing models with and without the product terms. For variables for which the presence of effect modification could not be identified empirically, the role of the confounding variable was evaluated by means of the backward strategy, in unconditional logistic regression analysis. Both theoretical and empirical bases were considered in selecting the potential confounding variables. Variables were considered to be confounders if they produced a change of at least 10% in the association measurement. From the theoretical basis, classical confounders were kept in the model regardless of any empirical evidence in this study.

The Stata software (version 8.0, Lakeway Drive, Texas, USA, 2003) and Epi-Info software (version 6.0) were used for data processing and analysis.

Table 1. Some sociodemographic and lifestyle characteristics (number and percentage). Feira de Santana, Bahia, Brazil, 2009 (n = 137).

Characteristics	N	%
Age (years)		
≤ 57	77	56.2
> 57	60	43.8
Age at menopause*		
> 48 years	58	43.3
≤ 48 years	79	57.7
Skin color***		
White/Asian	26	19.7
Black/mixed	106	80.3
Conjugal situation		
With partner	68	49.6
Without partner	69	50.4
Family income*		
≥ 1 minimum salary	115	84.6
< 1 minimum salary	21	15.4
Schooling level*		
> 4 years	32	23.5
≤ 4 years	104	76.5
Number of children		
≤ 3 children	54	39.4
> 3 children	83	60.6
Number of people living in the home		
≤ 3 people	76	55.5
> 3 people	61	44.5
Smoking habit*		
Never smoked	87	64.0
Smoker	13	9.6
Former smoker	36	26.4
Alcohol consumption*		
Never consumed	70	51.5
Consumed	38	27.9
Consumed in the past	28	20.6
Physical activity practice*		
Never practiced	42	30.9
Practiced	52	38.2
Practiced in the past	42	30.9
Regular consultation with dentist**		
No	118	87.4
Yes	17	12.6

* Data on one patient lost; ** Data on two patients lost;
*** Data on five patients lost.

RESULTS

To construct Table 1, only some of the general characteristics were considered, out of the whole database, in order to characterize the sample studied. These data showed, among other features, that in the study group, just over half of the subjects were women aged ≤ 57 years (56.2%), and the menopause had occurred at an age ≤ 48 years (57.66%). Likewise, it was found that majorities of the subjects were women living without a partner (51.47%), with ≤ three children (60.6%) and living with ≤ three people in the sane household (55.5%).

Furthermore, it was observed that most of the subjects had black/mixed skin color (80.3%), had a family income ≥ one minimum salary (84.6%), had a schooling level of ≤ four years (76.5%), were nonsmokers (former smokers plus never smoked, 90.44%), practiced or previously practiced physical activity (69.12%) and did not regularly consult a dentist (87.4%).

With regard to periodontal condition, it was observed that the prevalence of periodontal disease varied according to the radiographic criteria (RC) used, from 76.6% to 95.6%. Table 2 shows that the highest frequency was obtained with RC-1, while the lowest frequency occurred with RC-4. It is important note that, in taking the clinical criteria for diagnosing periodontal disease to be the gold standard, RC-4 presented the highest specificity, followed by RC-3, RC-2 and lastly RC-1. Thus, RC-4 was the set of criteria with the best capacity for correctly identifying individuals who did not present periodontal disease (30.5%). In other words, out of 100 individuals who were found not to present periodontitis using the clinical examination, RC-4 was able to negatively identify only 30 individuals. Conversely, all the radiographic criteria presented 100% sensitivity, i.e. a capacity to detect all individuals diagnosed with periodontal disease.

Thus, the specificity and positive predictive value decreased from RC-4 to RC-1, which is the same as saying that the capacity of the radiographic criteria to identify individuals without periodontitis who had received this diagnosis clinically (gold standard) became lower, and the likelihood of correctly identifying individuals with clinical periodontal disease also became lower. Consequently, the number of false positives increased. Regarding the likelihood that an individual might really be free from clinical periodontal disease, given the negative result from the radiographic criteria (negative predictive value), a proportion of 100% was observed for all of the four criteria investigated, due to the absence of false negative results.

Table 3 presents the association measurements between osteoporosis and periodontal disease, adjusted for skin color, age and smoking habit, along with the distribution of periodontal disease between cases and controls, for the radiographic criteria RC-3 and RC-4 only, since these produced the highest specificity results. It can be noted that the strength of the association varied depending on the radiographic criteria used to define the outcome. This variation ranged from 1.13 to 1.52, although there was no statistical significance for the association. Hence, it is emphasized that the stricter the radiographic interpretation criteria were, the lower the occurrence of the disease was and consequently, the more precise the association measurement was, as represented by the confidence intervals.

Table 2. Distribution of periodontal disease (PD; n and %) and diagnostic values according to radiographic criteria 1, 2, 3 and 4, in comparison with the clinical criteria [α] (gold standard). Feira de Santana, Bahia, Brazil, 2009 (n = 137).

Criterion	Absolute frequency of PD DP (n)	Frequency of DP (%)	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	Positive predictive value (%)	Negative predictive value (%)
RC 1 [*]	132	95.6	100.0 [93.3 - 100.0]	8.7 [3.6 -18.6]	51.9 [43.0 - 60.7]	100.0 [51.7 - 100.0]
RC 2 [†]	129	94.2	100 [93.3 - 100.0]	11.6 [5.5 - 22.1]	52.7 [43.8 - 61.5]	100.0 [59.8 - 100.0]
RC 3 [‡]	114	83.9	100 [86.7 - 100.0]	21 [13.9 - 30.2]	27.8 [20.1 - 37.1]	100 [81.5 - 100.0]
RC 4 [§]	106	76.6	100 [86.7 - 100.0]	30.5 [22.1 - 40.3]	30.5 [22.1 - 40.3]	100 [86.7 - 100.00]
CC [α]	32	23.4				

* RADIOGRAPHIC CRITERIA 1 (**RC1**) – one tooth with at least one site on the mesial or distal face presenting bone loss ≥ 3 mm, in relation to the cement-enamel junction.

† RADIOGRAPHIC CRITERIA 2 **(RC2):** at least two teeth with one or more sites on the mesial or distal face presenting bone loss ≥ 3 mm, in relation to the cement-enamel junction.

‡ RADIOGRAPHIC CRITERIA 3 **(RC3)**: at least three teeth with one or more sites on the mesial or distal face presenting bone loss ≥ 3 mm, in relation to the cement-enamel junction.

§ RADIOGRAPHIC CRITERIA 4 **(RC4):** at least four teeth with one or more sites on the mesial or distal face presenting bone loss ≥ 3 mm, in relation to the cement-enamel junction.

α CLINICAL CRITERIA (**CC**): at least four teeth with one or more sites presenting probing depth ≥ 4 mm, clinical attachment loss ≥ 3 mm and bleeding on probing at the same site.

Table 3. Distribution of periodontal disease between case and control groups, unadjusted and adjusted* odds ratios (OR) and confidence intervals (CI) for the association between osteoporosis and periodontal disease (radiographic criteria 3 and 4). Feira de Santana, Bahia, Brazil, 2009 (n= 137).

Outcome measurement	Cases† N (%)	Controls‡ N (%)	Unadjusted OR	IC 95%	Adjusted OR	95% CI
RC3	115 (83.9)	22 (16.0)	1.52	[0.56 -4.11]	1.36*	[0.46 - 4.05]
RC4	105 (76.6)	32 (23.4)	1.25	[0.51- 3.05]	1.13*	[0.43 - 2.98]

* adjusted for skin color, age and smoking habit.
RADIOGRAPHIC CRITERIA 3 **(RC3)**: at least three teeth with one or more sites on the mesial or distal face presenting bone loss ≥ 3 mm, in relation to the cement-enamel junction.
RADIOGRAPHIC CRITERIA 4 **(RC4):** at least four teeth with one or more sites on the mesial or distal face presenting bone loss ≥ 3 mm, in relation to the cement-enamel junction.
† Case group: composed of postmenopausal women who had periodontal disease.
‡ Control group: composed of postmenopausal women without periodontal disease.

It should be highlighted that, in the stratified analysis using RC-4, only the number of people living in the household and skin color were potential effect modifiers in the homogeneity test ($\alpha = 0.20$), and there were no confounders. In the logistic regression analysis, the potential effect modifiers that had been suggested in the stratified analysis (number of residents and skin color in RC-4 analysis; schooling level in RC-3 analysis) were not confirmed. The covariables of skin color and age were confounders for the association under analysis. Nonetheless, smoking habit was assumed to be a classic confounding covariable and was included in the model for the appropriate adjustments.

DISCUSSION

The present study sought to validate different radiographic interpretation criteria in relation to a set of clinical criteria that are frequently used and validated in studies on associations between periodontal disease and systemic conditions/abnormalities. The findings showed that the frequency of periodontal disease could be influenced by these different criteria and indicated variations in the strength of the association between osteoporosis and periodontal disease. Another important finding was that the criteria used in the multivariate analysis were shown to be fragile, given the low specificity value and absence of statistically significant association that were found.

These results require cautious interpretation, given that there are limitations and advances in the study that need to be presented. Firstly, it is important to highlight the choice of the clinical criteria suggested by Gomes-Filho et al.[12], as the gold standard. This method for diagnosing periodontal disease associated three clinical descriptors of the disease: probing depth (≥ 4 mm), clinical attachment loss (≥ 3 mm) and bleeding on probing (present). In addition, this method defines periodontitis as present only when four or more teeth present this condition in at least one site. Thus, there is rigor in defining the diagnosis of periodontal disease: an essential condition for studies on associations between periodontitis and systemic conditions/abnormalities.

Moreover, the proposed criteria have already been used in investigations on associations, in which periodontitis was considered to be either an exposure factor[4] or an outcome measurement[12]. These presented good diagnostic values for specificity, which is an essential condition for reducing the numbers of false positive diagnoses among participants in groups with periodontal disease, in the respective studies.

With regard to the radiographic criteria used, it is emphasized that these were identified in other studies on this topic in the literature[4] or were defined for the present investigation. Panoramic radiography is a routine examination within clinical dentistry. Although it presents limitations, such as the magnification of the image and the fact that it is not the best recommended radiographic examination for interpreting periodontal conditions, it is greatly used in population-based epidemiological studies. It is used in such studies because of its low cost, compared with complete periapical radiographic examination. Moreover, it is easy and fast to perform, and it allows all the structures of the maxillomandibular complex to be viewed, thereby also serving as a means of screening for dental treatment requirements.

In the light of these points, panoramic radiographic examinations need to be further assessed as an additional tool in population-based epidemiological studies. The present investigation use four criteria representing increasing bone loss (1, 2, 3 and 4 sites) on the proximal faces, to make comparisons with the clinical criteria, or gold standard. In order to take greater care, given the limitations of panoramic radiographs, a ruler graduated in millimeters with 25% enlargement was used. In addition, the radiographic interpretation was made by three examiners. Through this, it was sought to diminish the possibilities of errors in the radiographic findings. Since the present study used an epidemiological strategy for the association and the clinical criteria (gold standard) suggests a minimum of four teeth as a condition for the presence of periodontitis, the radiographic criteria were limited to four teeth with bone loss. It is possible that adding more teeth to the radiographic criteria might include a large proportion of the individuals with periodontitis in groups that are considered not to present periodontal disease.

Thus, from the results presented, the present investigation proposes that panoramic radiography may be an important complementary tool in epidemiological studies on associations, as a means of screening participants, thereby avoiding the complex logistics of complete periodontal clinical examinations in large-sized samples.

Although the findings may not be categorical in this respect, panoramic radiographic examinations could still be used as an additional tool for confirmation of the presence or absence of periodontitis[4], because of the large number of advantages cited earlier. For example, clinical examination on an individual might show that the criteria are at the borderline, but there may be clinical reasons why appropriate examination of the teeth is impossible, such as the presence of severe calculi, tooth pinning or excessive tooth filling material. In such cases, a positive clinical diagnosis of periodontitis would not be achieved using the proposed robust criteria.

Among the four radiographic criteria for identifying individuals with periodontal disease in relation to the clinical examination, RC-1 and RC-2 identified the disease in practically all of the women evaluated. Thus, these criteria did not discriminate between the case group (with periodontal disease) and the control group (without periodontal disease). In other words, these radiographic criteria for periodontitis had poor specificity and included many false positives with radiographic signs of periodontal infection in the case groups. On the other hand, RC-3 and RC-4 presented greater specificity and thus could be used for better discrimination between the comparison groups.

With the purpose of further reinforcing the objectives of this investigation, association measurements were estimated for the criteria RC-3 and RC-4. The findings indicated the presence of an weak association that was not statistically significant. Nonetheless, the association measurement had epidemiological significance. It was also evident that, depending on the radiographic criteria used, and on the adjustments and controls used for confounding covariables and interactions, there was variation in the strength of association between osteoporosis and periodontal disease. Among other reasons, the absence of statistical significance may be explained by the insufficient sample size, especially regarding controls, which led to reduced power for this study. The criteria in the radiographic evaluation may also form an explanation, and this can be taken into consideration in future studies. Such studies might also use digitized image resources, which might make the diagnosis more robust[11].

From this perspective, the present investigation has the role of bringing panoramic radiographic examinations into debate as a tool to be considered in population-based epidemiological strategies, particularly with the use of radiographic image banks. Through this, the body of evidence regarding associations with periodontal infection can be expanded, for example in relation to the topic presented here, i.e. osteoporosis and periodontitis, which still presents great controversy[4,13-18].

CONCLUSION

From the results of this investigation, it is plausible to conclude that the frequency of periodontal disease may be estimated differently according to the criteria used. The use of the radiographic criteria for interpreting periodontal disease constitutes an important complementary tool for association studies, even with its limitations and indications, provided that the analysis characteristics and interpretational rigor are observed. Furthermore, this investigation indicates the need for additional studies within this field of knowledge.

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