ORIGINAL ARTICLE

The Association of Periodontal Disease and Systemic Conditions among Filipino Patients in a University Dental Clinic: A Retrospective Case-control Study

Zen Alfred B. Nemenzo, DDM[1] and Ma. Celina U. Garcia, DDM[2]

[1]*College of Dentistry, University of the Philippines Manila*
[2]*Department of Clinical Dental Health Sciences, College of Dentistry, University of the Philippines Manila*

ABSTRACT

Background and Objective. A growing body of evidence points to a positive association between periodontitis and various systemic diseases, including cardiovascular diseases (CVD), hypertension, and rheumatoid arthritis. However, there is limited data on the prevalence and odds of having systemic conditions among Filipino periodontal patients. Thus, this study aimed to determine the association of periodontal disease with systemic conditions among Filipino patients at a university dental clinic.

Methods. The periodontal and medical charts of all patients who underwent periodontal consult at a university dental clinic within two academic years were reviewed. Periodontal diagnoses which had originally been assigned using the 1999 classification of periodontal diseases were reclassified based on the 2018 European Federation of Periodontology-American Academy of Periodontology classification. Listed medical conditions in the patients' charts were self-reported. The prevalence of various systemic conditions in 715 periodontitis cases was compared to that of 834 control patients without periodontitis. Fisher's exact test was performed to evaluate the difference in the prevalence of comorbidities between groups, while adjusted odds ratios (AOR) were computed using logistic regression analysis, accounting for age, sex, educational attainment, and smoking status.

Results. The prevalence of having at least one systemic condition was significantly higher among periodontitis patients (44.5%) compared to non-periodontitis patients (36.3%). Compared to controls, a significantly higher number of periodontitis cases had two systemic comorbidities (P=0.001). The prevalence of hypertension (18.6% versus 5.04%), CVD including hypertension (20.42% versus 6.95%), arthritis (9.37% versus 3.0%), and diabetes mellitus (5.73% versus 0.84%) were all significantly higher in patients with periodontitis compared to non-periodontitis controls. The odds of having CVD (AOR=1.81), hypertension (AOR=2.14) and diabetes (AOR=3.05) were higher in periodontitis cases. Meanwhile, the prevalence of asthma (9.23% versus 5.31%), respiratory diseases including asthma (12.95% versus 8.25%), and allergies (18.82% versus 13.71%) were significantly higher in non-periodontitis patients compared to periodontitis cases.

Conclusion. Periodontitis patients were more likely to present with CVD, hypertension, and diabetes mellitus. On the other hand, no association was found between periodontitis and respiratory diseases, as well as between periodontitis and asthma.

Keywords: periodontal diseases, periodontitis, comorbidity, Philippines, association, prevalence

Paper presentation – 2021 International Association for Dental Research General Session, July 21-24, 2021 (Virtual).

Corresponding author: Ma. Celina U. Garcia, DDM
Department of Clinical Dental Health Sciences
College of Dentistry
University of the Philippines Manila
Pedro Gil St., cor. Taft Avenue, Ermita,
Manila 1000, Philippines
Email: mugarcia2@up.edu.ph
ORCiD: https://orcid.org/0000-0003-0654-356X

INTRODUCTION

Periodontal disease has been cited as one of the most prevalent noncommunicable chronic, inflammatory human conditions worldwide, with more than one billion cases reported in 2019.[1] Similarly, the 2018 Philippine National Survey on Oral Health also reported a high prevalence, with 49.94% of Filipinos having some form of periodontal disease as demonstrated by gingival bleeding or periodontal pockets.[2]

While periodontal disease is generally regarded as a local inflammation of the periodontium, studies have established a biologic basis that periodontal disease induces systemic inflammation and vice versa. This is evidenced by elevated C-reactive protein, white blood cell counts, and pro-inflammatory cytokines in patients with periodontal disease.[3,4] Furthermore, periodontal disease and other systemic conditions share risk factors such as smoking, socio-economic factors, and age among others.[5]

The proportion of global mortality attributed to non-communicable or chronic diseases (NCDs) has seen a sharp rise in recent years, with seven out of the 10 leading causes of global mortality in 2021 being NCDs, as reported by the World Health Organization.[6] This rise in the global prevalence of NCDs and periodontal disease has fueled more studies investigating associations and biologic plausibility between periodontal disease and individual and multiple systemic comorbidities.

Among the most prevalent systemic conditions, diabetes mellitus has long been accepted as a risk factor for periodontitis and the reverse relationship has also been established.[7] Moreover, cardiovascular diseases accounted for 32% of global deaths in 2019. In the Philippines, ischemic heart disease, stroke, and hypertensive heart disease are listed among the 10 leading causes of mortality in the Philippines.[6] A consensus report examining evidence related to CVD has shown positive associations between periodontitis and coronary heart disease, strokes, and hypertension.[8] Meanwhile, respiratory diseases are another class of systemic disorders with increasing association to periodontitis in different studies.[8,9] On the other hand, other systemic conditions such as allergies, osteoporosis, arthritis, and kidney disorders have reported mixed associations with periodontitis.[10-14]

There is limited data from the Philippines describing the prevalence of systemic conditions and its association with periodontal disease. In a study by Vergel de Dios et al. in 2008, the researchers looked into the prevalence of cardiovascular diseases and diabetes mellitus among periodontitis patients treated at a university dental clinic and in two private periodontal practices. Based on chart review, hypertension was reported in 14.7% of patients while 3.5% were diabetic.[15] In a more recent investigation on Filipino elderly with periodontitis, hypertension was also the top comorbidity, which was noted in 62.4% and 80% of those with moderate and severe periodontal destruction, respectively. Moreover, among those with severe periodontitis, obesity (30%), diabetes (18.5%), and rheumatoid arthritis (4.6%) were also observed.[16] Our research group has also previously reported on the association between periodontitis and diabetes, with significantly higher prevalence of diabetes among periodontitis cases (5.73%) versus gingivitis controls (0.84%).[17] To the authors' knowledge, all previous local research on the association between periodontal disease and multiple systemic comorbidities has focused on periodontitis patients, without any comparison to individuals with either healthy periodontium or gingivitis. Given the paucity of case-control studies in the Philippine setting, the aim of this present study was to determine the association of systemic conditions with gingivitis and periodontitis among Filipino periodontal patients who underwent treatment at a university dental clinic. The study tests the hypothesis that periodontitis patients have increased odds of having certain systemic conditions such as cardiovascular diseases, respiratory diseases, and diabetes mellitus.

MATERIALS AND METHODS

Study Population and Data Collection

A retrospective case-control study through a review of periodontal charts and self-reported medical conditions was performed. The records of all 1,937 patients who underwent consultation for various periodontal chief complaints at the Oral Medicine Section Clinic of the College of Dentistry, University of the Philippines Manila for two academic years (2016-2017 and 2017-2018) were evaluated.

Inclusion criteria were the following: (1) Filipino, (2) ≥18 years old, (3) periodontal chart with diagnosis approved by a faculty member, (4) Admitting Section (AS) chart contained an updated medical history, and (5) AS chart was signed by a faculty member.

After an initial review of the 1,937 patient records within the study period, the final number of included charts for data analysis was 1,549, after exclusion of 388 patients due to the following reasons: patients under the age of 18 (n=151), patients with missing AS charts (n=136), patients whose medical histories were not updated within the study period (n=100), and one patient whose chart was not signed by an attending faculty member (n=1) (Figure 1).

During the patients' initial visits, periodontal statuses had been determined using the 1999 classification of periodontal diseases and conditions. Therefore, all included periodontal charts were analyzed for reclassification of periodontal status based on the 2018 European Federation of Periodontology-American Academy of Periodontology classification of periodontal and peri-implant diseases and conditions.[18,19] Out of the 1,549 patients managed at the university clinic, 715 were diagnosed with periodontitis and served as the study cases, while the remaining 834 without periodontitis were designated as controls. All non-periodontitis control patients received a diagnosis of gingivitis. Data extracted from each periodontal patient's AS chart included age, sex, highest level

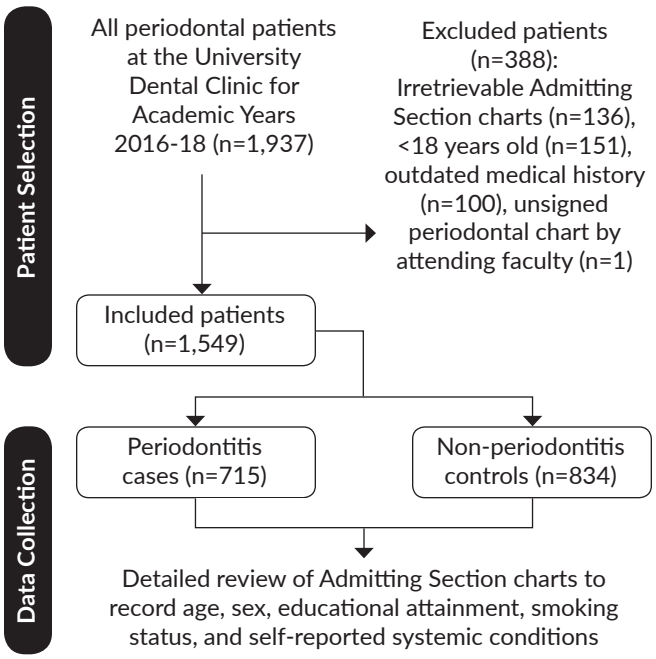

Figure 1. Flow diagram of Admitting Section chart and periodontal chart screening for inclusion in the study's data collection and analysis.

of education, smoking history, and self-reported systemic conditions (Figure 1). For smoking status, patients were classified as non-smokers if they indicated never smoking or had previously smoked but stopped for ≥ 5 years from the time of initial periodontal consult. Conversely, patients designated as smokers were those who either smoked regularly or occasionally, or had quit the habit for less than five years from the time of consult. The systemic conditions reviewed for the present study included allergy, arthritis, asthma, cancer, cardiovascular diseases including hypertension, dermatologic disorders, hypertension (considered as a separate condition and not grouped under CVD), nephrological disorders, osteoporosis, and respiratory diseases.

Sample Size Computation

Sample size was computed using G power 3.1.9.2, based on the reported association between periodontitis and diabetes in the study of Marjanovic and Buhlin.[20] The probability that the systemic comorbidity was present among periodontitis cases was 0.5, with 80% power and 0.5 level of significance. A minimum sample size of 610 each for cases and controls was determined.

Data Analysis

The frequency and prevalence of each systemic condition among periodontitis cases and among patients without periodontitis (controls) were calculated. Significant differences between the prevalences of systemic conditions among cases and controls were determined through Fisher's exact test. Odds ratio (OR) analysis (unadjusted) was carried out to initially determine if there is any association between each systemic condition and periodontitis. Afterwards, identified confounding variables (age, sex, educational attainment, and smoking status) were controlled by means of a logistic regression model for multivariate analysis, set at 95% confidence interval. This yielded the adjusted odds ratios for the association between periodontitis and each systemic condition. Statistical analysis was done using STATA version 14 with significance level set at 0.05.

Ethics Approval

Technical approval was obtained from a College Technical Review Panel while ethical clearance was granted by the University of the Philippines Manila Research Ethics Board (UPMREB 2018-602-UND). The study was conducted in compliance with the Philippine Data Privacy Act of 2012. Personal information that may identify patients were not collected for this study.

RESULTS

Demographic Characteristics of the Study Population

A total of 1,549 patients were included in this study. Of that total, 715 patients had periodontitis and were designated as cases, while 834 patients did not have periodontitis and were designated as controls. The background characteristics of the patients are presented in our research group's previously published report on the association between periodontitis and diabetes mellitus among Filipino dental school patients, and the reader is referred to the publication for a detailed description.[17] Information on the educational attainment was missing for 137 participants while smoking status was not indicated on the charts of two participants. The frequency and percentage for these two demographic characteristics were based only on the number of participants with available data. Patient characteristics are summarized in Table 1.

Number of Systemic Conditions Per Patient

The number of self-reported comorbidities per patient is presented in Table 2. Majority of the patients (cases, controls, and in total) claimed not to have any systemic conditions, with a statistically significantly higher percentage of controls (63.7%) being systemically healthy compared with periodontitis cases (55.5%). Among the patients with at least one self-reported systemic condition, the highest percentage was observed in those who were afflicted with two comorbidities. Moreover, the prevalence of two systemic conditions was significantly higher among periodontitis patients compared with control patients without periodontitis (26.7% versus 19.4%; P=0.001). On the other hand, percentages of cases and controls with one, three, four and greater than or equal to five systemic conditions were comparable.

Table 1. Comparison of Demographic Characteristics between Periodontitis Cases and Control Patients without Periodontitis[17]

Characteristic	Periodontitis Cases (n=715)	Non-periodontitis Controls (n=834)	*P*-value
	Frequency (%)		
Age			
18-20	24 (3.4%)	204 (24.5%)	<0.001
21-30	106 (14.8%)	430 (51.6%)	
31-40	158 (22.1%)	96 (11.5%)	
41-50	189 (26.4%)	55 (6.6%)	
51-60	133 (18.6%)	34 (4.1%)	
61-70	91 (12.7%)	13 (1.6%)	
>70	14 (2.0%)	2 (0.2%)	
Sex			
Male	281 (39.3%)	300 (35.7%)	0.19
Female	434 (60.7%)	534 (64.3%)	
Educational attainment*			
No schooling	2 (0.3%)	0 (0.0%)	<0.001
Elementary	44 (6.7%)	17 (2.2%)	
High school	237 (36.2%)	208 (27.5%)	
Vocational	6 (0.9%)	7 (0.9%)	
College	363 (55.4%)	513 (67.8%)	
Postgraduate	3 (0.5%)	12 (1.6%)	
***Smoking status**†*			
Smokers	162 (22.7%)	131 (15.8%)	0.001
Non-smokers	553 (77.3%)	701 (84.2%)	

**Cases = 655, Controls = 757; †Controls = 832*

Table 2. Number of Self-reported Systemic Conditions among Cases and Controls

Number of Systemic Conditions	Total (n=1,549)	Periodontitis Cases (n=715)	Non-periodontitis Controls (n=834)	*P*-value
	Frequency (%)			
0	928 (59.9%)	397 (55.5%)	531 (63.7%)	0.001
1	68 (4.4%)	27 (3.8%)	41 (4.9%)	0.28
2	353 (22.8%)	191 (26.7%)	162 (19.4%)	0.001
3	63 (4.1%)	27 (3.8%)	36 (4.3%)	0.59
4	86 (5.6%)	46 (6.4%)	40 (4.8%)	0.16
≥5	51 (3.3%)	27 (3.8%)	24 (2.9%)	0.32

Prevalence of Systemic Conditions among Cases and Controls

Among the 1549 included patients, allergies had the highest overall prevalence at 16.5%, followed by cardiovascular disease (13.2%), which includes hypertension, angina pectoris, heart failure, arrythmia, arteriovenous malformation, and mitral valve prolapse. Hypertension, when considered separately from other CVD, was found to affect 11.3% of all patients.

A comparison of the prevalence of various systemic conditions among cases and controls is summarized in Table 3. Cardiovascular diseases including hypertension (20.4%), hypertension alone (18.6%), and allergies (13.7%) had the highest prevalence among periodontitis patients. Meanwhile, allergies (18.8%), respiratory diseases (13.0%), and asthma (9.2%) were the top comorbidities among non-periodontitis controls.

The prevalence of hypertension, cardiovascular diseases, arthritis, and diabetes mellitus were significantly higher (P<0.001) among periodontitis patients compared to non-periodontitis patients. On the other hand, the prevalence of allergies (P=0.007), respiratory diseases including asthma (P=0.003), and asthma alone (P=0.003), were significantly higher in the control group. No significant differences between groups were seen in the prevalences of cancer, nephrological disorders, and osteoporosis.

Odds Ratios between Periodontitis and Systemic Conditions

Crude odds ratio analysis pointed to positive associations between periodontitis and arthritis (OR=3.35), cancer (OR=3.52), CVD (OR=3.43), diabetes mellitus (OR=7.19), hypertension (OR=4.31), nephrological disorders (OR=1.17), and osteoporosis (OR= 3.51), as seen in Table 4. After

Table 3. Frequency and Prevalence of Systemic Conditions among Cases and Controls

Systemic Condition	Periodontitis Cases	Non-periodontitis Controls	*P*-value
	Frequency (%)		
Allergies	98 (13.71%)	157 (18.82%)	0.007
Arthritis	67 (9.37%)	25 (3.0%)	<0.001
Asthma	38 (5.31%)	77 (9.23%)	0.003
Cancer	6 (0.84%)	2 (0.24%)	0.15
Cardiovascular Diseases	146 (20.42%)	58 (6.95%)	<0.001
Diabetes Mellitus	41 (5.73%)	7 (0.84%)	<0.001
Hypertension	133 (18.6%)	42 (5.04%)	<0.001
Nephrological Disorders	7 (0.98%)	7 (0.84%)	0.79
Osteoporosis	3 (0.42%)	1 (0.12%)	0.34
Respiratory Diseases	59 (8.25%)	108 (12.95%)	0.003

Table 4. Unadjusted Odds Ratios and Adjusted Odds Ratios for the Association of Periodontitis with Different Systemic Conditions

Systemic Condition	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	*P*-value (AOR)
Allergies	0.68 (0.52-0.90)	0.77 (0.57-1.05)	0.10
Arthritis	3.35 (2.09-5.36)	1.18 (0.68-2.07)	0.56
Asthma	0.55 (0.37-0.83)	0.50 (0.31-0.82)	0.01
Cancer	3.52 (0.71-17.05)	1.78 (0.17-18.30)	0.63
Cardiovascular Diseases	3.43 (2.49-4.74)	1.81 (1.23-2.68)	0.003
Diabetes Mellitus	7.19 (3.16-19.08)	3.05 (1.27-7.31)	0.01
Hypertension	4.31 (3.00-6.20)	2.14 (1.39-3.31)	0.001
Nephrological Disorders	1.17 (0.41-3.35)	0.74 (0.21-2.63)	0.64
Osteoporosis	3.51 (0.36-33.82)	0.63 (0.06-6.32)	0.08
Respiratory Diseases	0.60 (0.43-0.84)	0.55 (0.37-0.82)	0.003

OR – odds ratio; AOR – adjusted odds ratio

logistic regression analysis to control age, sex, educational attainment and smoking status, a significant association was still identified between periodontitis and CVD, with an adjusted odds ratio of 1.81. Moreover, periodontitis was associated with diabetes mellitus (AOR= 3.05) and hypertension (AOR= 2.14).

DISCUSSION

The present study aims to determine the association of periodontal disease with different systemic conditions among Filipino periodontal patients, through a representative population comprised of patients who sought periodontal treatment at a university dental clinic in the Philippines.

The prevalence of Filipino periodontitis patients who had one or more systemic conditions stood at 44.5% compared to 36.3% among patients without periodontitis. This finding is consistent with a Dutch university clinic study, which reported that 46.3% of Dutch periodontitis patients had at least one systemic comorbidity, and that they had an increased odds of having comorbidity (AOR= 1.36) and multimorbidity (AOR= 1.18).[21] Likewise, a study on an Austrian population showed a higher comorbidity prevalence of 68.5% among their periodontitis patients but found no association between the severity of periodontitis and number of comorbidities.[22]

In the present study, the most frequent self-reported systemic comorbidities among periodontitis patients were cardiovascular diseases including hypertension, hypertension alone, and allergies. CVD including hypertension, and hypertension alone were significantly higher among periodontitis cases. Meanwhile, the prevalence of allergies was significantly higher among non-periodontitis controls.

The high prevalence of CVD among periodontitis patients in this study is in line with a meta-analysis by Leng et al. Based on evaluation of 26 studies, the authors concluded that CVD is relatively frequent among periodontitis patients (7.2%).[23] Moreover, in a case-control study on Swedish dental school patients by Marjanovic and Buhlin, CVD was reported as the top comorbidity among periodontitis patients, with the 44.3% prevalence of CVD among periodontitis cases being significantly higher compared to the control group (30.9%).[20] On the contrary, Sperr et al. found that the prevalence of CVD among Austrian periodontitis patients

(1.8%) was lower than that of non-periodontitis patients (10.6%) in an age and sex-matched case-control study.[22] The much higher prevalence of CVD noted in the present study and among the Swedish dental school patients in the study by Marjanovic and Buhlin may be attributed to the fact that hypertension was counted as a cardiovascular disease diagnosis.[20] In contrast, Sperr et al. considered hypertension as a separate disease entity, and did not lump the condition with other CVD diagnoses.[22]

On the other hand, when the odds of having CVD was determined among the study participants, a significant association was observed, with periodontitis cases having almost twice the likelihood of being afflicted with some form of CVD (AOR= 1.81), which is comparable to the odds ratio of 1.79 that was reported by Marjanovic and Buhlin.[20]

Hypertension is another systemic condition consistently cited in previous research as highly prevalent among periodontitis patients. In this present study, we also investigated the association of periodontitis with hypertension as a separate systemic condition that was not grouped under cardiovascular diseases. Periodontitis cases were two times more likely to have hypertension compared with controls (AOR= 2.14). Moreover, among the periodontitis cases, 18.6% self-reported their diagnosis of hypertension. This is comparable with the findings of the earlier cited Dutch study where hypertension (16.9%) was the top comorbidity among patients with periodontitis.[21] In another recent study examining Filipino older adults with moderate to severe periodontitis, a much higher prevalence of hypertension was reported (63.4%). It is important to note that the Philippine study was designed to investigate a geriatric population and majority of the participants belonged to the 60 to 69-year-old age bracket.[16] In contrast, majority of periodontitis patients (63.3%) in the present study were 21 to 50 years of age. This age disparity may explain the difference in the reported prevalence of hypertension, given that older age increases the risk for high blood pressure and studies have found greater prevalence of hypertension among the elderly.[24,25]

The prevalence of allergies among patients with periodontitis in this study (13.71%) is comparable with that of the Dutch cohort (12.6%). However, it is important to note that allergies as recorded in this present research included all types and forms of known allergies (food, non-food, and animal allergies), whereas the Dutch study limited their scope of allergies to drugs and medical or dental materials.[21]

A relatively higher prevalence of allergies (29.2%) was observed among Austrian periodontitis patients in the study by Sperr et al. (2018). Moreover, periodontitis patients had a significantly higher prevalence of allergies compared to non-periodontitis controls and were more likely to have allergies with an AOR=1.73.[22] The reverse is true in the current study with the non-periodontitis controls having a significantly higher prevalence of allergies compared with periodontitis cases (18.8% versus 13.7%, P=0.007). This disparity further adds to the mixed results reported in available literature investigating the association between periodontitis and allergies (including allergic rhinitis) with some studies identifying a positive association while others report an inverse association.[10-12]

Arthritis is another systemic condition that was identified in this study to have a significantly higher prevalence among periodontitis (9.4%) versus non-periodontitis patients (3%). Both rheumatoid arthritis and osteoarthritis have been linked to periodontitis.[26-28] A long-term cohort study has suggested a bidirectional relationship between osteoarthritis and periodontal disease.[27]

Diabetes mellitus has long been recognized as a risk and modifying factor for periodontitis.[29] Mounting evidence also points to a bidirectional relationship between periodontitis and diabetes.[30] Our research group has previously reported on the significantly higher prevalence (5.73%) and odds (AOR=3.05) of being afflicted with diabetes among periodontitis cases by analyzing the same population that was used in this current study. The reader is referred to the previously published research for a comprehensive discussion on the association between periodontitis and diabetes.[17]

In contrast to the higher prevalence of CVD, hypertension, arthritis, and diabetes among periodontitis cases in this present study, respiratory diseases were noted to be significantly more prevalent among control patients without periodontitis (12.95%) compared with periodontitis patients (8.25%). This result is comparable to that of the Swedish study, where non-periodontitis patients also registered a higher prevalence of respiratory diseases at 23.5% versus 18.8% of patients with periodontitis.[20] Moreover, when asthma was analyzed as a separate disease entity and not grouped together with other respiratory conditions, non-periodontitis controls still had a higher prevalence compared to periodontitis patients (9.23% versus 5.31%), which is similar to the findings of the Austrian population study (5.6% versus 1.5%).[22] Moreover, based on logistic regression analysis, periodontitis cases in this present study were less likely to present with asthma (AOR= 0.5) and respiratory diseases (AOR= 0.55). Similarly, Marjanovic and Buhlin did not find any association between respiratory diseases (OR= 0.88) and periodontitis.[20] In contrast, a recent systematic review and meta-analysis conducted by Molina et al. revealed positive associations between periodontitis and certain respiratory diseases including chronic obstructive pulmonary disorders (COPD), obstructive sleep apnea (OSA), and COVID-19, but not with asthma.[9]

This study had a relatively large population that exceeded minimum statistical requirements to draw associations and determine significant differences between periodontitis cases and non-periodontitis controls. However, caution should be exercised before drawing generalizations to the entire Philippine population, due to the sampling being limited to patients at a university dental clinic. It is recommended that future studies explore the association between periodontitis and various systemic comorbidities among patients in private dental practices and the general Filipino population.

The inherent limitations of self-reporting, which include recall bias and underreporting also apply to this study. Moreover, given that different student clinicians verified the patients' health status through interview, the clinicians' ability to elicit pertinent medical information and patients' health-seeking behavior and awareness of their conditions should also be factored in assessing the quality of data collected. Nonetheless, the validity of self-reported medical status has been appraised and confirmed by several studies with sensitivity of different medical conditions ranging from 59-83%.[31-33] Studies that examine records of physician-diagnosed conditions of periodontal patients would be advantageous and are therefore recommended.

CONCLUSION

This study found a significantly higher odds of having CVD, hypertension, and diabetes among periodontitis cases. On the contrary, no association was found between periodontitis and respiratory diseases, including asthma. Future studies using a more representative sample of the national Filipino population and coverage of more systemic conditions with standardized case definitions are recommended.

Acknowledgments

The authors would like to thank Drs. Maricar Lachica, Jessica Rebueno-Santos, and Michelle Sunico-Segarra for their technical advice in developing the protocol of the study. Gratitude is also extended to their research assistants, Mr. Richard Alipasa, Mr. Alecks Hernandez, Mr. Jhun Perona, and Drs. Khim Flores, Jazmine Hugo, Seleena Lim, Nica Salazar, and Micol Picornell. Lastly, the authors would like to thank Ms. Caren Bacsid for performing the statistical analysis.

Statement of Authorship

Both authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

Both authors declared no conflicts of interest.

Funding Source

This study received a grant from the National Institutes of Health, University of the Philippines Manila.

REFERENCES

1. Zhang X, Wang X, Wu J, Wang M, Hu B, Qu H, et al. The global burden of periodontal diseases in 204 countries and territories from 1990 to 2019. Oral Dis. 2024 Mar;30(2):754-68. doi: 10.1111/odi.14436. PMID: 36367304.
2. Asian Social Project Services, Inc. National survey on oral health in the Philippines 2018: Final report. Department of Health-Disease Prevention and Control Bureau; 2019.
3. Paraskevas S, Huizinga JD, Loos BG. A systematic review and meta-analyses on C-reactive protein in relation to periodontitis. J Clin Periodontol. 2008 Apr;35(4):277-90. doi: 10.1111/j.1600-051X.2007.01173.x. PMID: 18294231.
4. Schenkein HA, Loos BG. Inflammatory mechanisms linking periodontal diseases to cardiovascular diseases. J Clin Periodontol. 2013 Apr;40 Suppl 14(0 14):S51-69. doi: 10.1111/jcpe.12060. PMID: 23627334; PMCID: PMC4554326.
5. Loos BG, Van Dyke TE. The role of inflammation and genetics in periodontal disease. Periodontol 2000. 2020 Jun;83(1):26-39. doi: 10.1111/prd.12297. PMID: 32385877; PMCID: PMC7319430.
6. Global Health Estimates 2021: Deaths by Cause, Age, Sex, by Country and by Region [Internet]. Geneva: World Health Organization. 2000-2021 [cited 2024 Dec 30]. Available from: https://www.who.int/data/gho/data/themes/ mortality-and-global-health-estimates/ghe-leading-causes-of-death
7. Genco RJ, Borgnakke WS. Diabetes as a potential risk for periodontitis: association studies. Periodontol 2000. 2020 Jun;83(1):40-5. doi: 10.1111/prd.12270. PMID: 32385881.
8. Herrera D, Sanz M, Shapira L, Brotons C, Chapple I, Frese T, et al. Association between periodontal diseases and cardiovascular diseases, diabetes and respiratory diseases: Consensus report of the Joint Workshop by the European Federation of Periodontology (EFP) and the European arm of the World Organization of Family Doctors (WONCA Europe). J Clin Periodontol. 2023 Jun;50(6):819-41. doi: 10.1111/jcpe.13807. PMID: 36935200.
9. Molina A, Huck O, Herrera D, Montero E. The association between respiratory diseases and periodontitis: A systematic review and meta-analysis. J Clin Periodontol. 2023 Jun;50(6):842-87. doi: 10.1111/jcpe.13767. PMID: 36606394.
10. Hung SH, Tsai MC, Lin HC, Chung SD. Allergic rhinitis is associated with periodontitis: a population-based study. J Periodontol. 2016 Jul;87(7):749-55. doi: 10.1902/jop.2016.150539. PMID: 27043256.
11. Friedrich N, Völzke H, Schwahn C, Kramer A, Jünger M, Schäfer T, et al. Inverse association between periodontitis and respiratory allergies. Clin Exp Allergy. 2006 Apr;36(4):495-502. doi: 10.1111/j.1365-2222.2006.02455.x. PMID: 16630155.
12. Kim DY, Lee JK, Pang EK, Choi SH, Lee JB. Unique inverse association between allergic rhinitis and periodontitis: a nationwide population-based study. Sci Rep. 2023 May 8;13(1):7444. doi: 10.1038/s41598-022-23543-9. PMID: 37156820; PMCID: PMC10167224.
13. Yu B, Wang CY. Osteoporosis and periodontal diseases - An update on their association and mechanistic links. Periodontol 2000. 2022 Jun;89(1):99-113. doi: 10.1111/prd.12422. PMID: 35244945; PMCID: PMC9067601.
14. Zhao D, Khawaja AT, Jin L, Li KY, Tonetti M, Pelekos G. The directional and non-directional associations of periodontitis with chronic kidney disease: A systematic review and meta-analysis of observational studies. J Periodontal Res. 2018 Oct;53(5):682-704. doi: 10.1111/jre.12565. PMID: 29777531.
15. Vergel de Dios NV, Murjani BV, Garcia MCU. Prevalence of systemic diseases among periodontal patients at the State University clinic and two private periodontal practices in the Philippines. In: Bartold PM, Ishikawa I, Zhang J, editors. A perspective of periodontal systemic relationships for the Asian Pacific region. Adelaide: Asian Pacific Society of Periodontology; 2008. pp.69-76.
16. Garcia MC, de la Vega SA. Prevalence of systemic conditions among Filipino older adults with periodontitis. J Dent Res 2021; 100 (Spec Iss B):95.
17. Garcia MCU, Nemenzo ZAB. The association between periodontitis and diabetes among Filipino dental school patients: a retrospective case-control study. Acta Medica Philipp. 2022 Jul 15;56(12):50-7. doi:10.47895/amp.vi0.2332.
18. Chapple ILC, Mealey BL, Van Dyke TE, Bartold PM, Dommisch H, Eickholz P, et al. Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: Consensus report of workgroup 1 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Clin

Periodontol. 2018 Jun;45 Suppl 20:S68-S77. doi: 10.1111/jcpe.12940. PMID: 29926499.
19. Papapanou PN, Sanz M, Buduneli N, Dietrich T, Feres M, Fine DH, et al. Periodontitis: Consensus report of workgroup 2 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Clin Periodontol. 2018 Jun;45 Suppl 20:S162-S170. doi: 10.1111/jcpe.12946. PMID: 29926490.
20. Marjanovic M, Buhlin K. Periodontal and systemic diseases among Swedish dental school patients - a retrospective register study. Oral Health Prev Dent. 2013;11(1):49-55. doi: 10.3290/j.ohpd.a29375. PMID: 23507681.
21. Beukers NGFM, Su N, van der Heijden GJMG, Loos BG. Periodontitis is associated with multimorbidity in a large dental school population. J Clin Periodontol. 2023 Dec;50(12):1621-32. doi: 10.1111/jcpe.13870. PMID: 37658672.
22. Sperr M, Kundi M, Tursic V, Bristela M, Moritz A, Andrukhov O, et al. Prevalence of comorbidities in periodontitis patients compared with the general Austrian population. J Periodontol. 2018 Jan;89(1):19-27. doi: 10.1902/jop.2017.170333. PMID: 28844189.
23. Leng Y, Hu Q, Ling Q, Yao X, Liu M, Chen J, et al. Periodontal disease is associated with the risk of cardiovascular disease independent of sex: A meta-analysis. Front Cardiovasc Med. 2023 Feb 27;10:1114927. doi: 10.3389/fcvm.2023.1114927. PMID: 36923959; PMCID: PMC10010192.
24. Sun Z. Aging, arterial stiffness, and hypertension. Hypertension. 2015 Feb;65(2):252-6. doi: 10.1161/HYPERTENSIONAHA.114.03617. PMID: 25368028; PMCID: PMC4288978.
25. Wu J, Han X, Sun D, Zhang J, Li J, Qin G, et al . Age-specific association of stage of hypertension at diagnosis with cardiovascular and all-cause mortality among elderly patients with hypertension: a cohort study. BMC Cardiovasc Disord. 2023 May 23;23(1):270. doi: 10.1186/s12872-023-03250-7. PMID: 37221473; PMCID: PMC10207764.
26. Jung ES, Choi YY, Lee KH. Relationship between rheumatoid arthritis and periodontal disease in Korean adults: Data from the Sixth Korea National Health and Nutrition Examination Survey, 2013 to 2015. J Periodontol. 2019 Apr;90(4):350-7. doi: 10.1002/JPER.18-0290. Epub 2018 Nov 26. PMID: 30380152.
27. Ma KS, Lai JN, Thota E, Yip HT, Chin NC, Wei JC, et al. Bidirectional relationship between osteoarthritis and periodontitis: a population-based cohort study over a 15-year follow-up. Front Immunol. 2022 Jul 25;13:909783. doi: 10.3389/fimmu.2022.909783. PMID: 35958545; PMCID: PMC9358960.
28. Jepsen S, Caton JG, Albandar JM, Bissada NF, Bouchard P, Cortellini P, et al. Periodontal manifestations of systemic diseases and developmental and acquired conditions: Consensus report of workgroup 3 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. J Periodontol. 2018 Jun;89 Suppl 1:S237-S248. doi: 10.1002/JPER.17-0733. PMID: 29926943.
29. Chapple IL, Genco R; working group 2 of the joint EFP/AAP workshop. Diabetes and periodontal diseases: consensus report of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases. J Periodontol. 2013 Apr;84(4 Suppl):S106-12. doi: 10.1902/jop.2013.1340011. PMID: 23631572.
30. Graziani F, Gennai S, Solini A, Petrini M. A systematic review and meta-analysis of epidemiologic observational evidence on the effect of periodontitis on diabetes An update of the EFP-AAP review. J Clin Periodontol. 2018 Feb;45(2):167-87. doi: 10.1111/jcpe.12837. PMID: 29277926.
31. Martin LM, Leff M, Calonge N, Garrett C, Nelson DE. Validation of self-reported chronic conditions and health services in a managed care population. Am J Prev Med. 2000 Apr;18(3):215-8. doi: 10.1016/s0749-3797(99)00158-0. PMID: 10722987.
32. Steinkirchner AB, Zimmermann ME, Donhauser FJ, Dietl A, Brandl C, Koller M, et al. Self-report of chronic diseases in old-aged individuals: extent of agreement with general practitioner medical records in the German AugUR study. J Epidemiol Community Health. 2022 Aug 26;76(11):931–8. doi: 10.1136/jech-2022-219096. PMID: 36028306; PMCID: PMC9554083.
33. Mose J, Jensen KH, Scheel-Hincke LL, Andersen-Ranberg K. Are self-reported medical conditions and medicine use from middle-aged and older adults credible? A validation study comparing Danish SHARE-data with National Health Register data. Ann Epidemiol. 2023 Nov;87:100-6. doi: 10.1016/j.annepidem.2023.09.009. PMID: 37903678.