

RELATIONSHIP BETWEEN GINGIVITIS, PERIODONTITIS AND SYSTEMIC HEALTH; A RETROSPECTIVE STUDY IN A UNIVERSITY SETTING

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AIM

The aim of the present study was to perform a large-scale retrospective epidemiological analysis of the role of age, gender, and various local and systemic conditions in the prevalence of gingivitis and periodontitis (using case definitions proposed by the 2018 classification) in patients attending university dental clinics. The rationale behind this approach was the greater number of self-referred patients who likely to present with periodontal diseases, and therefore, there is a higher probability to examine their prevalence with local and systemic conditions.

METHODS

Study design: This was a large-scale retrospective study. The Institutional Review Board of the University of Texas Health Science Center at Houston (UTHealth, Houston, TX, USA) has granted the approval to conduct the proposed study (protocol #HSC-DB-18-0663).

Study population: De-identified data of patients attending dental clinics at the UTHealth School of Dentistry were extracted from the University's axiUm® database (Henry Schein, Melville, NY, USA) and exported in standardized extraction spreadsheets.

Inclusion criteria: (i) self-referred patients who visited dental clinics at the UTHealth School of Dentistry between January 1, 2007 and July 1, 2020 (ii) ≥ 18 years old; (iii) women and men; (iv) all reported races and ethnicities (African-American, Asian, Caucasian, and Hispanic); (iii) American Society of Anesthesiologists (ASA) physical *status* I, II, and III; (iv) dentate with ≥ 2 remaining non-adjacent teeth; and (v) patients with the completed D0180 code (comprehensive periodontal evaluation - new or established patient, according to the Code on Dental Procedures and Nomenclature) with completed medical and dental history and full-mouth periodontal chart.

Exclusion criteria: individuals who do not meet the above-mentioned inclusion criteria.

Variables: The following variables were extracted from the axiUm® database: demographics characteristics (patient's age, gender, race, BMI), periodontal (maximum and minimum, values of PD and CAL (PD_{max}, PD_{min}, CAL_{max}, and CAL_{min}, respectively), the percentage of BOP, and FGM-CEJ values), the presence and absence of local factors (root-canal therapy (RCT), caries, partial fixed dentures, and fillings), and the presence and absence of systemic conditions (ASA status, hypertension, smoking, infective endocarditis, coronary heart disease, heart attack, pacemaker, RA, stroke, bronchitis, asthma, pneumonia, renal failure, kidney stones, dialysis, hepatitis, Crohn's disease, gastrointestinal disease, DM, thyroid disease, steroids intake, adrenal disease, hemophilia A and B, von Willebrand disease, iron-deficient and sickle-cell types of anemia, blood transfusion, osteoporosis, osteoarthritis (OA), gout, epilepsy, intellectual disability, autism, Parkinson's disease, Alzheimer disease, organ transplantation, pregnancy, history of intake of systemic antibiotics (amoxicillin, clindamycin, azithromycin, minocycline, and metronidazole), history of intake of medications commonly associated with gingival overgrowth (phenytoin, cyclosporin A, nifedipine, and verapamil).

RESULTS

A total of 7,965 self-referred patients (60.1% women and 39.9% men; age range 11 to 92 years; mean age 49.1 ± 16.4 years) met the inclusion criteria. When stratified based on the self-reported race, 22.8% of patients were African Americans, 8.7% Asians, 37.5% Caucasians, and 31.0% Hispanic.

The overall prevalence of **clinical gingival health** was 4.9%, with markedly higher prevalence in women as compared to men (65.3 vs. 34.7%, respectively). When stratified based on race, this diagnosis was most common in the Caucasians (51%), followed by the Hispanics (22.4%), African Americans (18.4%) and Asians (8.2%). When stratified based on both gender and race, clinical gingival health was most commonly diagnosed in the Caucasian women (32.6%) and least commonly in Asian women and Caucasian men (4.1% in both groups). Among men, the highest prevalence was observed in Caucasian men (18.4%), whereas the other races showed similar but much lower prevalence (4.1-6.1%).

The overall prevalence of **biofilm-induced gingivitis** was 6.2%, with markedly higher prevalence in women as compared to men (71 vs. 29%, respectively). When stratified based on race, this diagnosis was most common in the Caucasians (43.5%) followed by the Hispanics (25.8%), African Americans (17.8%), and Asians (12.9%). When stratified based on both gender and race, the diagnosis of biofilm-induced gingivitis was most commonly assigned to the Caucasian women (29%) and least commonly to Asian and Hispanic men (3.2 and 4.8%, respectively). The highest women-to-men ratio was observed for Hispanics and Asians (4.33 and 3.5, respectively) and the lowest in the Caucasians (2.0).

the overall prevalence of periodontitis (stages I-IV) was 88.9% with markedly higher prevalence in women as compared to men (60.4 vs. 39.6%, respectively). When stratified based on race, the diagnosis of periodontitis (stages I-IV) was most common in the Caucasians (36.4%) followed by the Hispanics (31.7%), African Americans (23.4%), and Asians (8.5%). **Table 2** presents that when stratified based on both gender and race, the diagnosis of periodontitis (stages I-IV) was most commonly assigned to Caucasian women (21.1%) and least commonly to Asian men (4.1%) and Asian women (4.5%).

The diagnosis of **periodontitis** was further stratified based on the stages. Our results showed that 5.2, 19.4, and 64.3% of patients had periodontitis stage I, II, and III/IV, respectively. When it was stratified based on gender, all stages were more prevalent in women as compared to men (65.3 vs. 34.7% for stage I, 67.5 vs. 32.5 for stage II, and 57.9 vs. 42.1% for stages III/IV, respectively).

When it was stratified based on races, stage I was most prevalent in the Caucasians followed by Hispanics, African Americans, and Asians (32.7, 30.1, 26.9, and 10.3%, respectively). When it was stratified based on both gender and race, stage I was most prevalent in Hispanic and African American women (21.2 and 19.2%, respectively) and least prevalent in Asian men and women (3.8 and 5.8%, respectively). Stage II was most prevalent in the Hispanics, followed by Caucasians, African Americans, and Asians (36.1, 35.1, 21.6, and 7.2%, respectively). When stratified based on both gender and race, stage II was most prevalent in Hispanic women (26.3%) and least prevalent in Asian men and women (3.1 and 4.1%, respectively). Stages III/IV were diagnosed most commonly in the Caucasians followed by Hispanics, African Americans, and Asians (37.2, 30.3, 23.6, and 8.9%, respectively). When stratified based on both gender and race, stages III/IV were most prevalent in the Caucasian and Hispanic women (19.4% for both groups) and least prevalent in Asian men and women (4.4 and 4.5%, respectively).

As periodontitis stage III/IV was defined as the presence of CAL $\geq$ 5mm and PD $\geq$ 6mm, the next step was to determine the factors, which were significantly associated with **CAL_{max}** and **PD_{max}** in patients with periodontitis stage III/IV. **CAL_{max}** was significantly associated with various factors; among them, the most significant association was observed with age, male gender, ASA status (combined, I, and II), hypertension, OA, coronary artery disease, history of heart attack, and DM. **PD_{max}** was also significantly associated with various factors; among them, the most significant association was observed with age, male gender, pregnancy, OA, ASA (I-III combined and II), and heart attack.

To gain further insight into the association between age, gender, and race and periodontitis stages III/IV, several models describing one-, two, and three-way interactions between age, gender, and race were constructed. Hypertension and the presence of fixed dental prostheses were significantly associated with the three-way interaction among age, gender, and race (**Model 1**). DM, iron deficiency anemia, osteoporosis, and smoking were associated with two-way interaction between age and race (**Model 2**). Finally, analysis of one-way interactions (**Model 3**) showed that coronary artery disease, history of heart attack, pneumonia, history of metronidazole use, and thyroid disease were significantly associated with gender and age; hepatitis and OA were significantly associated with age and race; Parkinson's disease, pacemaker, stroke, and history of steroid use in the past 6 months were significantly associated with age; asthma was significantly associated with gender; and epilepsy, bronchitis, and history of nifedipine use were significantly associated with race.

Factor	Variables	P-value	Patient information
Model 1 (three-way interaction)			
Hypertension	Age:Gender:Race	≤0.02639	Hispanic F, ≥45 y.o.
			Hispanic M, ≥41 y.o.
			Black F, ≥20 y.o.
			Black M, ≥42 y.o.
			White F, ≥38 y.o.
			White M, ≥35 y.o.
			Asian F, ≥49 y.o.
			Asian M, ≥38 y.o.
Fixed dental prostheses	Age:Gender:Race	≤0.0386	Black M, ≥50 y.o.
			Hispanic F, ≥20 y.o.
			Asian F, ≥20 y.o.
Model 2 (two-way interaction)			
Diabetes mellitus	Age:Caucasian race	≤0.036777	≥20 y.o.
Iron deficiency anemia	Age:Male gender	0.025260	≥20 y.o.
Osteoporosis	Age:Race	0.03888	Hispanic, ≥61 y.o.
Smoking	Age:Caucasian race	0.0176	≥20 y.o.
	Gender:Race	0.008186	Caucasian F
	Age:Race	0.22256	African American M
			Caucasian M
Model 3 (one-way interaction)			
Coronary artery disease	Gender	0.000265	M
	Age	9.7×10^{-8}	≥50 y.o.
Heart attack	Gender	0.00239	M
	Age	3.37×10^{-6}	≥43 y.o.
Pneumonia	Gender	0.0388	M
	Age	0.0149	≥54 y.o.
Metronidazole	Gender	0.003799	M
	Age	2.177×10^{-5}	≥20 y.o.
Thyroid disease	Gender	2.11×10^{-7}	M
	Age	6.63×10^{-7}	≥50 y.o.
Hepatitis	Age	0.02146	≥20 y.o.
	Race	0.03610	Caucasian race
Osteoarthritis	Age	1.33×10^{-15}	≥61 y.o.
	Race	0.0232	African American race
	Race	0.0045	Caucasian race
Parkinson’s disease	Age	0.008762	≥67 y.o.
Pacemaker	Age	0.0004432	≥70 y.o.
Stroke	Age	0.00310	≥79 y.o.
Steroid use in the past 6 months	Age	3.82×10^{-5}	≥20 y.o.
Asthma	Gender	0.01621	M
Epilepsy	Race	7.671×10^{-5}	Asian race, African American race
Bronchitis	Race	0.002806	Caucasian race
Nifedipine	Race	0.03449	African American race

CONCLUSIONS

In academic settings, the prevalence of periodontal diseases reached 95.3%. Although gingivitis was not significantly associated with the examined factors, periodontitis was associated with the patient’s age, male gender, Caucasian and Hispanic races, and compromised systemic conditions. The prevalence of Stage III periodontitis in the population of the present study was 64.3%. Gender- and age differences in oral health and periodontal conditions appear to be influenced by both biological and environmental factors