

Assessment of Knowledge of the Association between Periodontitis and Systemic Conditions among Clinical Medical and Nursing Students.

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Citation: Alade GO, Otakhoigbogie U. Assessment of knowledge of the association between periodontitis and systemic conditions among clinical medical and nursing students. *Nig J Dent Res* 2024; 9(1):22-30.
<https://dx.doi.org/10.4314/njdr.v9i1.4>

ABSTRACT

Background: Periodontitis has been linked to some systemic conditions. The knowledge of this association by qualified health professionals and those in training is very vital in holistic patient care.

Objective: To assess knowledge of the association between periodontitis and systemic condition among clinical medical and nursing students

Method: This was a descriptive cross-sectional study conducted among clinical medical and clinical nursing students of the University of Port Harcourt, Rivers State, Nigeria. A total of 200 questionnaires were administered with 156 properly filled. Section A of the questionnaire had questions on the sociodemographic characteristics of the respondents, while section B included questions on the assessment of participants' awareness and knowledge regarding the possible link between periodontitis and some systemic conditions. Data analysis was done using SPSS version 25.0 with $p \leq 0.05$ considered statistically significant.

Results: A total number of 156 clinical medical and nursing students participated in the study, 99 (63.5%) were females, while the remaining 57 (36.5%) were males. The age range of the participants was 19-35 years with a mean age of 23.31 ± 2.50 years. Of the 156 participants, 85 (54.5%) were clinical medical students while 71 (45.5%) were clinical nursing students. 74.4% of the medical students and 35.7% of the nursing students knew that there was a possible link between periodontitis and diabetes mellitus ($p=0.000$). 54.9% of medical students and 30.0% of nursing students agreed that there is a possible link between periodontitis and cardiovascular disease ($p=0.001$). Using Bloom's concept, 69 (81.2%) of the medical students and 53 (74.6%) of nursing students demonstrated low knowledge about the link between periodontitis and systemic conditions,

Conclusion: There was an inadequate level of knowledge of the possible association between periodontitis and some systemic conditions among the participants. Hence, there is a need to include oral health education in the undergraduate curriculum of both medical and nursing students.

Keywords: Periodontitis, Medical students, Nursing students, Systemic conditions

Received: 30-April, 2023

Revision: 15 Jan, 2024

Accepted: 30 Jan, 2024

INTRODUCTION

Periodontal disease is a chronic inflammatory condition affecting the supporting apparatus of the tooth.¹ It presents initially as gingivitis, which is a mild and reversible form.² However, if untreated, it can progress to periodontitis, which is a severe and irreversible form and impacts significantly on overall general health.³ Periodontitis has been reported as a possible risk factor for some systemic conditions such as low birth weight,⁴ cerebrovascular diseases,⁵ diabetes,^{7, 8} cardiovascular disease,⁹ respiratory diseases,¹⁰ obesity¹¹ and complications of pregnancy.¹² The impact of periodontitis on overall health is via the initiation of systemic inflammation.¹³ This had been linked to the oral microbiota, immune system response and genetic constituent of the host.¹⁴ Inflammatory and immune responses are triggered by the presence of some periodontal microorganisms such as *Porphyromonas gingivalis*.¹⁵ These responses are both from innate immunity and adaptive immunity, resulting in the production and release of pro-inflammatory cytokines such as tumour necrosis factor-alpha (TNF α), interleukin (IL)-17, IL-1, IL-6, and collagenases such as matrix metalloproteinases (MMPs).¹⁶⁻¹⁸ This inflammation can become persistent and deregulated, which may lead to irreversible destruction of the dentogingival epithelial surface, permitting local inflammation into the systemic circulation, hence disrupting systemic health.^{17,18} Disruption of local inflammation produced pro-inflammatory mediators which enter into the systemic circulation and affect distant organs disrupting inflammatory state equilibria.¹⁹ It has also been reported that patients with periodontitis produce higher values of circulating white blood cells as well as other systemic inflammatory parameters such as C-reactive protein (CRP), a protein produced by the liver as a response to external stress. Hence, it can argue that periodontitis-associated local inflammation may become systemic, thus modifying organismal inflammatory loads and conversely, systemic inflammation alters periodontal health.¹⁷ Low-grade inflammation (LGI) induction has also been hypothesized as a mechanism by which periodontitis is causally linked with the progression of chronic diseases such as diabetes and cardiovascular disease since they involve low-grade inflammation, which is also found in periodontitis.²⁰ Periodontitis has been reported as the sixth complication of diabetes mellitus.²¹ There is a two-way connection established between periodontitis and diabetes

mellitus.²² Diabetes mellitus has been reported to worsen periodontal disease, with higher levels of inflammatory mediators in both saliva and gingival crevicular fluid when compared to non-diabetics.²³ Likewise, periodontitis worsens glycaemic control, through increasing insulin resistance, if present in a diabetic patient.²⁴ Periodontal treatments in DM have resulted in reduced HbA1c levels and improvement in glycaemic control.²²

It is therefore imperative for medical students and physicians to be kept abreast of this association between periodontitis and systemic conditions. Alade et al²⁵ reported a limited level of awareness of the association between periodontal disease and systemic conditions among medical doctors at the University of Port Harcourt Teaching Hospital (UPTH). Also, a previous study conducted among resident doctors in Nigeria by Umeizudike et al,²⁶ reported an inadequate knowledge of the link between periodontal disease and systemic diseases. A study conducted among medical students of Bahria University Medical and Dental College, Karachi, reported very limited knowledge regarding periodontal disease and its association with diabetes mellitus.²⁷ There is paucity in the literature of studies on awareness of the link between periodontitis and systemic diseases among medical and nursing students. This study therefore aims to compare the awareness of a possible association between periodontitis and systemic conditions among clinical medical students and clinical nursing students, since these trainees will constitute a significant proportion of the healthcare professionals saddled with the responsibility of patient care and appropriate referral, upon graduation.

MATERIALS AND METHODS

This was a descriptive cross-sectional study conducted among clinical medical and clinical nursing students of the University of Port Harcourt, Rivers State, Nigeria. A non-probability sampling method (convenience sampling) was used to select the participants. Interviewer-administered questionnaires were used for data collection in this study. Clinical medical students were 500 and 600-level undergraduate students studying Medicine and Surgery, who are on clinical rotations with hands experience with patients. Clinical nursing students were undergraduate nursing students on clinical rotations. Nursing students at the University of Port Harcourt start clinical rotation at the 200 level.

Ethical Approval for the study was obtained from the Health Research and Ethics Committee of the

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University of Port Harcourt Teaching Hospital, followed by the participant's consent.

The questionnaire was pretested among 10 dental students of the University of Port Harcourt, Rivers State, to ensure simplicity and ease of understanding by the participants. Section A of the questionnaire had questions on the sociodemographic characteristics of the respondents, while section B included questions on the assessment of participants' awareness and knowledge regarding the possible link between periodontitis and some systemic conditions. Section B consisted of 14 questions to assess the level of awareness between periodontitis and some systemic conditions. A correct answer was assigned 1 point and an incorrect/don't know answer was assigned 0 points (Responses were "Yes", "No" and "Don't know"). The total knowledge score was 14 ranging from 0 to 14, meaning the higher the score, the better the knowledge. The overall awareness of each outcome was summed based on Bloom's cut-off concept.²⁸ Based on the sum scores, the level of knowledge was classified into low-level knowledge (less than 60%; 0-8 scores), moderate-level knowledge (60-80%; 9-11 scores) and high-level knowledge (81-100%; 12-14 scores)

Data analysis was done using Statistical Product and Service Solution, (SPSS) version 25.0 (IBM SPSS Inc. Chicago, Illinois). Results were presented using frequency counts and percentages, descriptive summary was obtained for demographic variables and difference in proportion was tested using Chi-Square at a 95% confidence interval.

A comparison of the medical and nursing student's knowledge of the association between periodontitis and systemic condition was done using the Chi-square test, with $p \leq 0.05$ considered statistically significant.

RESULTS

A total of 156 clinical medical and nursing students participated in the study, 99 (63.5%) were females, while the remaining 57 (36.5%) were males. The age range of the participants was 19-35 years with a mean age of 23.31 ± 2.50 years. (Table 1). Of the 156 participants, 85 (54.5 %) were clinical medical students while 71 (45.5%) were clinical nursing students. The age range of the medical students was 20-29 years, with a mean age of 23.46 ± 1.97 years, while the age range of the nursing students was 19-35 years with a mean age of 23.14 ± 3.01 years.

Comparing the knowledge of the possible link between periodontitis and systemic conditions, 61(74.4%) of medical students and 25 (35.7%) of nursing students knew that there was a possible link between periodontitis and diabetes mellitus. Four (4.9%) of medical students and 16 (22.9%) of nursing students did not agree that there is a link between periodontitis and diabetes mellitus, while 17 (20.7%) of medical students and 29 (41.4%) of nursing students did not know if there is a link between periodontitis and diabetes mellitus. This finding is statistically significant ($p=0.000$). Forty-five (54.9%) of medical students and 21 (30.0%) of the nursing students agreed that there is a possible link between periodontitis and cardiovascular disease, while 33 (40.2%) of the medical students and 34 (48.6%) of the nursing students did not know of a possible link between periodontitis and cardiovascular disease. This finding is statistically significant. ($p<0.001$). Twenty-four (29.6%) of medical students and 20 (45.5%) of nursing students agreed that there is a link between periodontitis and chronic kidney disease, while 46 (56.8%) of medical students and 32 (45.7%) of nursing students did not know of any possible link between periodontitis and chronic kidney disease. This finding, however, is not statistically significant ($p=0.157$). Few 18 (22.2%) of medical students and 18 (25.7%) of nursing students agreed that there is a link between periodontitis and preterm labour/low birth weight, 14 (17.3%) of medical students and 21 (30.0%) of nursing students disagreed that there is a link between periodontitis and preterm labour/low birth weight, while 49(60.5%) of medical students and 31(44.3%) of nursing students did not know about such association. This finding is not statistically significant ($p = 0.98$). This is shown in Table 2.

Regarding awareness of the importance of oral health to general health, 82 (96.5%) of medical students and 69 (97.2%) of nursing students were aware that oral health is important to general health. Concerning the level of knowledge of the possible link between periodontitis and systemic conditions based on Bloom's cut-off concept,²⁸ 69 (81.2%) of the medical students and 53 (74.6%) of nursing students demonstrated low knowledge about the link between periodontitis and systemic conditions, the finding, however, it is not statistically significant ($p=0.095$). More medical students had a low level of knowledge of periodontitis as a risk factor for systemic diseases, compared to nursing students and

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this difference is statistically significant ($p < 0.05$).

This is shown in Table 3.

Table 1: Sociodemographic variables of participants (N=156)

| Sociodemographic Variables | | N | % |
|----------------------------|------------------|--------|------|
| Age group | <20 | 2 | 1.3 |
| | 20-24 | 111 | 71.2 |
| | 25-29 | 38 | 24.4 |
| | 30-34 | 5 | 3.2 |
| Age (Mean \pm SD) | 23.31 \pm 2.50 | | |
| Gender | Female | 99 | 63.5 |
| | Male | 57 | 36.5 |
| Level | 200 | 7 | 4.4 |
| | 300 | 11 | 7.1 |
| | 400 | 15 | 9.6 |
| | 500 | 90 | 57.7 |
| | 600 | 33 | 21.2 |
| | Marital status | Single | 140 |
| | Married | 16 | 10.3 |

Table 2: Comparison of medical and nursing students' knowledge of possible link between periodontitis and specific systemic conditions

| VARIABLES | | GROUPS | | P value |
|--------------------------------|------------|---------------------------|---------------------------|---------|
| | | Medical students N (%) | Nursing students N (%) | |
| Diabetes mellitus | Yes | 61 (74.4) | 25 (35.7) | 0.000* |
| | No | 4 (4.9) | 16 (22.9) | |
| | Don't know | 17 (20.7) | 29 (41.4) | |
| Cardiovascular disease | Yes | 45 (54.9) | 21 (30.0) | 0.001* |
| | No | 4(4.9) | 15 (21.4) | |
| | Don't know | 33 (40.2) | 34 (48.6) | |
| Osteoporosis | Yes | 38 (46.9) | 23 (32.9) | 0.06 |
| | No | 9 (11.1) | 17 (24.3) | |
| | Don't know | 34 (41.9) | 30 (42.8) | |
| Chronic kidney Disease | Yes | 24 (29.6) | 20 (45.5) | 0.157 |
| | No | 11 (13.6) | 18 (25.7) | |
| | Don't know | 46 (56.8) | 32 (45.7) | |
| Cerebral Infarction | Yes | 20 (24.7) | 28 (40.0) | 0.04* |
| | No | 13 (16.0) | 16 (22.9) | |
| | Don't know | 48 (59.2) | 26 (22.9) | |
| Preterm labour/low birthweight | Yes | 18 (22.2) | 18 (25.7) | 0.98 |
| | No | 14 (17.3) | 21 (30.0) | |
| | Don't know | 49 (60.5) | 31 (44.3) | |
| Hospital acquired pneumonia | Yes | 31 (38.3) | 18 (25.7) | 0.022* |
| | No | 11 (13.6) | 22 (31.4) | |
| | Don't know | 39 (48.1) | 30 (42.6) | |
| HIV/AIDS | Yes | 46 (56.1) | 19 (27.1) | 0.000* |
| | No | 9 (11.0) | 21 (30.0) | |
| | Don't know | 27 (32.9) | 30 (42.9) | |
| Smoking | Yes | 50 (61.0) | 25 (35.7) | 0.004* |

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| | | | | |
|-----------------------------|------------|-----------|-----------|--------|
| Erectile dysfunction | No | 7 (8.5) | 16 (22.9) | 0.204 |
| | Don't know | 25 (30.5) | 29 (41.4) | |
| | Yes | 19 (23.2) | 21 (30.0) | |
| Rheumatoid arthritis | No | 16 (19.5) | 19 (27.1) | 0.198 |
| | Don't know | 47 (57.3) | 30 (42.9) | |
| | Yes | 20 (24.4) | 20 (28.6) | |
| Stress | No | 15 (18.3) | 19 (27.1) | 0.481 |
| | Don't know | 47 (57.3) | 31 (44.3) | |
| | Yes | 25 (30.9) | 23 (32.9) | |
| Smoking | No | 15 (18.5) | 17 (24.3) | 0.049* |
| | Don't know | 41 (50.6) | 30 (42.8) | |
| | Yes | 50 (61.0) | 29 (41.4) | |
| Leukaemia | No | 8 (9.8) | 13 (18.6) | 0.174 |
| | Don't know | 24 (29.3) | 28 (40.0) | |
| | Yes | 30 (36.6) | 24 (34.3) | |
| Obesity | No | 10 (12.2) | 16 (22.9) | 0.054 |
| | Don't know | 42 (51.2) | 30 (42.8) | |
| | Yes | 22 (26.8) | 21 (30.0) | |
| | No | 10 (12.2) | 18 (25.7) | |
| | Don't know | 50 (61.0) | 31 (44.3) | |

*- Statistically significant

Table 3: Comparison of the level of knowledge of the possible link between periodontitis and systemic conditions between clinical medical and nursing students

| Variable | Medical students | | Nursing students | | p-value |
|--|------------------|--------|------------------|--------|---------|
| | N | (%) | N | (%) | |
| Oral health is important to general health | | | | | |
| Yes | 82 | (96.5) | 69 | (97.2) | 0.086 |
| No | 0 | (0.0) | 2 | (2.8) | |
| Don't know | 3 | (3.5) | 0 | 0(.0) | |
| Knowledge of link between periodontitis and systemic conditions based on Bloom's cut-off concept | | | | | |
| High knowledge | 13 | (15.3) | 16 | (22.5) | 0.095 |
| Moderate knowledge | 3 | (3.5) | 2 | (2.8) | |
| Low knowledge | 69 | (81.2) | 53 | (74.6) | |
| Knowledge of periodontitis as a risk factor of systemic conditions based on Bloom's cut off concept | | | | | |
| High knowledge | 10 | (11.8) | 22 | (31.0) | 0.012* |
| Moderate knowledge | 4 | (4.7) | 3 | (4.2) | |
| Low knowledge | 71 | (83.5) | 46 | (64.8) | |
| Total | 85 | | 71 | | |

*Statistically significant

DISCUSSION

In this study, we compared the knowledge of the possible link between periodontitis and systemic conditions among clinical medical and nursing

students. As future practitioners, they are expected to have adequate awareness regarding the possible link between oral health and systemic health, as the oral cavity is regarded as the mirror of the body.²⁹

The medical students in this study demonstrated a better level of awareness than nursing students, regarding the possible association between periodontitis and diabetes mellitus. This finding is in tandem with a previous study.²⁷ This finding among the nursing students is comparable to the findings in a previous study, where nursing students in a private medical university, were unaware of the link between periodontitis and systemic conditions.³⁰ The finding calls for a review of the nursing curriculum to include oral health and its association with systemic conditions. This is because the nurses help patients with systemic conditions in the clinic and on the ward with their daily oral and personal hygiene. A better understanding of oral health among the nursing students and the nurses will help improve patients' oral hygiene, which will reduce periodontal disease and its effect on systemic conditions.

More medical students than nursing students agreed that there is a possible association between periodontitis and cardiovascular disease (CVD), HIV/AIDS and smoking. These findings about medical students' awareness follow the trends in previous studies.^{34,32} The reason for the poor knowledge of the possible link between periodontitis and systemic conditions among nursing students could be that dental topics are not included in their curriculum and there might be less interactions between nursing and dental students, while medical students interact more with dental counterparts. Periodontitis and CVDs share numerous common genetic^{33,34} and environmental risk factors (e.g., tobacco smoking).³⁵ The mechanisms supporting the association between periodontitis and CVDs have been explained by the passage of bacteria from periodontitis from daily life activities (tooth brushing, flossing and chewing) and professional intervention (dental prophylaxis, scaling, tooth extraction and periodontal probing) into the vascular system, and increased levels of systemic inflammation resulting from periodontitis.^{36,37} Also, there was an increased production of inflammatory mediators associated with the pathophysiology of atherosclerosis, such as high-sensitivity C-reactive protein (CRP) and fibrinogen, which is also increased in periodontitis patients.³⁸

Patients with HIV/AIDS, presents with oral manifestation such as xerostomia (dry mouth), which can be caused by salivary gland hypofunction by the high number of HIV viruses in the lymph nodes and infiltration of CD8+ in the lymph node close to the parotid gland. Consequently, xerostomia causes a

build-up of plaque and calculus in the oral cavity that leads to periodontal problems. Some HIV- positive patients present with different stages of necrotizing periodontal diseases such as necrotizing ulcerative gingivitis, necrotizing ulcerative periodontitis and necrotizing stomatitis. It has been hypothesized that these necrotizing periodontal diseases may reflect the overall systemic progression of HIV infection to a more severe collapse of the immune system and progression to full-blown AIDS.³⁹

Few of the medical students and nursing students in this study had adequate knowledge of the possible link between periodontitis and other systemic conditions such as cerebral infarction, preterm labour/low birth weight, and stress. It has been reported that periodontal infections are linked with cerebrovascular diseases through the formation of atherosclerosis. Periodontal infections may play a role in atherosclerotic plaque formation, which can cause stroke if the plaques occur in the brain arteries, also periodontal pathogens have been isolated from these atherosclerotic plaques.⁴⁰ Altered cytokine and hormone levels produced in periodontal disease, may lead to complications during pregnancy such as preterm birth and low birth weight.⁴¹

Chronic stress has been linked with periodontitis by indirectly influencing periodontal health by inducing changes in unhealthy coping behaviours such as smoking, excessive alcohol consumption and illicit drug use, improper diet, neglect of oral hygiene and poor compliance with dental care. Also, it influences periodontal health through direct biological impact, mediated through alteration of saliva, changes in gingival blood circulation and by influencing the host immune response.⁴² Stress has been reported as a risk factor for necrotizing ulcerative gingivitis (NUG) also known as "trench mouth", which is a bacterial infection characterized by papillary necrosis, pain and gingival bleeding.⁴³ The association between stress and periodontitis was recently confirmed by the increased number of necrotizing periodontal lesions found during the COVID-19 pandemic (a period characterized by increased levels of stress) compared to the pre-pandemic period.⁴⁴

A large percentage of both medical and nursing students agreed that oral health is important to general health. This finding is in accordance with the documented results in previous studies.^{45,46} However, using Bloom's cut-off concept²⁸ to

estimate the overall level of knowledge, the medical students as well as the nursing students, had a low level of knowledge of the link between periodontitis and systemic conditions and in the knowledge of periodontitis as a risk factor for systemic conditions. Some authors have reported similar findings among medical trainees, practitioners, and nurses.^{30, 47,48} Registered nurses and medical practitioners are in a position of professional autonomy, and most often the initial point of call of health care, consequently, they have a responsibility to provide health education, counselling, and referrals for people. This is particularly important concerning those at high risk of systemic diseases, such as patients with cancers and other systemic diseases like diabetes mellitus, which may manifest first in the mouth. It is encouraging to know that some medical schools in Nigeria have integrated oral health into their undergraduate curriculum. However, some medical schools and nursing schools have yet to do the same. It is therefore recommended that those medical and nursing schools yet to integrate oral health into the undergraduate curriculum, should be encouraged to do so. Also, medical practitioners and nurses should encourage their patients with systemic conditions to visit the dental clinic for periodontal evaluation.

CONCLUSION

In this study, it was observed that medical students have better knowledge about the possible link between periodontitis and diabetes, cardiovascular disease, HIV/AIDS and smoking when compared to nursing students. The majority of medical and nursing students agreed that oral health is important to general health. Overall, using Bloom's cut-off concept, there was an inadequate level of knowledge of the possible association between periodontitis and some systemic conditions as well as its being a risk factor for most. Hence, the undergraduate medical and nursing curricula should be revised to include oral health topics, so they will be better equipped to detect oral diseases and appropriately refer to the relevant oral health professionals.

Source of Support

Nil

Conflict of Interest

None declared

REFERENCES

1. Martínez-García M, Hernández-Lemus E. Periodontal Inflammation and Systemic Diseases: An Overview. *Front*

- Physiol2021;12:709438. <https://doi.org/10.3389/fphys.2021.709438>
2. Research, Science and Therapy Committee of the American Academy of Periodontology. Treatment of Plaque-Induced Gingivitis, Chronic Periodontitis and other Clinical Conditions. *J Periodontol* 2001;72:1790-1800. doi: 10.1902/jop.2001.72.12.1790
3. Könönen E, GURSOY M, GURSOY UK. Periodontitis: A Multifaceted Disease of Tooth-Supporting Tissues. *J Clin Med*. 2019;8:1135. <https://doi.org/10.3390/jcm8081135>
4. Keshava A, Chidambar YS, Zope S, Naduwinmani S, Preetham J. Periodontitis as a risk factor for preterm low birth weight infants: A clinico-epidemiological evaluation. *J Basic Clin Reprod Sci* 2014;3:88-92.
5. Pradeep AR, HADGE P, ARJUN RAJU P, SHETTY SR, SHAREEF K, GURUPRASAD CN. Periodontitis as a risk factor for cerebrovascular accident: a case-control study in the Indian population. *J Periodont Res* 2010;45:223-228. doi: 10.1111/j.1600-0765.2009.01220.x.
6. Hashemipour MA, Afshar AJ, Borna R, Seddighi B, Motamedi A. Gingivitis and periodontitis as a risk factor for stroke: A case-control study in the Iranian population. *Dent Res J (Isfahan)* 2013;10:613-619.
7. Oberoi SS, Harish Y, Hiremath S, Puranik M. A cross-sectional survey to study the relationship of periodontal disease with cardiovascular disease, respiratory disease, and diabetes mellitus. *J Indian Soc Periodontol* 2016;20:446-452. doi:10.4103/0972-124X.186946.
8. Borgnakke WS. Modifiable risk factors for periodontitis and diabetes *Curr Oral Health Rep* 2016;3:254-269. <https://doi.org/10.1007/s40496-016-0099-6>
9. Saini R, Saini S, Saini SR. Periodontal disease: A risk factor to cardiovascular disease. *Ann Card Anaesth* 2010;13:159-161.
10. Sharma N, Shamsuddin H. Association between respiratory disease in hospitalized patients and periodontal disease: a cross-sectional study. *J Periodontol* 2011;82: 1155-1160
11. Francis DL, Raja BK, Chandran CR. Relationship of obesity with periodontitis among patients attending a dental college in Chennai: A cross-sectional survey. *J Indian Asso Public Health Dent* 2017;15:323-326

12. Aqueda A, Ramon JM, Manau C, Guerrero A, Echeverria JJ. Periodontal disease as a risk factor for adverse pregnancy outcomes: a prospective cohort. *J Clin Periodontol* 2008;35:16-22
13. Hirschfeld J, Higham J, Chatzistavrianou D, Blair F, Richards A, Chapple IL. Systemic disease or periodontal disease? Distinguishing causes of gingival inflammation: a guide for dental practitioners. Part 1: immune-mediated, autoinflammatory, and hereditary lesions. *Br Dent J* 2019; 227:961–966. 10.1038/s41415-019-1050-8
14. Kinane DF, Stathopoulou PG, Papapanou PN. Periodontal diseases. *Nat Rev Dis Primers* 2017; 3:1–14. 10.1038/nrdp.2017.38
15. Bartold PM, Van Dyke TE. An appraisal of the role of specific bacteria in the initial pathogenesis of periodontitis. *J Clin. Periodontol* 2019;46:6–11. 10.1111/jcpe.13046
16. Franco C, Patricia HR, Timo S, Claudia B, Marcela H. Matrix metalloproteinases as regulators of periodontal inflammation. *Int J Mol Sci.* 2017; 18:440. 10.3390/ijms1802044
17. Cecoro G, Annunziata M, Iuorio MT, Natri L, Guida L. Periodontitis, low-grade inflammation and systemic health: a scoping review. *Medicina* 2020;56:272. 10.3390/medicina56060272
18. Nascimento GG, Leite FR, Scheutz F, Lopez R. (2017). Periodontitis: from infection to inflammation. *Curr. Oral Health Rep.* 2017;4:301–308. 10.1007/s40496-017-0158-7
19. Hajishengallis G. Periodontitis: from microbial immune subversion to systemic inflammation. *Nat Rev Immunol* 2015;15:30–44. 10.1038/nri3785
20. Moutsopoulos NM, Madianos PN. Low-grade inflammation in chronic infectious diseases: paradigm of periodontal infections. *Ann NY Acad Sci* 2006; 1088: 251–264.
21. Saini R, Saini S, Sugandha R. Periodontal disease: The sixth complication of diabetes. *J. Fam. Community Med* 2011; 18: 31. <https://doi.org/10.4103/1319-1683.78636>
22. Casanova L, Hughes FJ, Preshaw PM. Diabetes and periodontal disease: A two-way relationship. *Br Dent J* 2014; 217:433-7.
23. Patel MH, Kumar JV, Moss ME. Diabetes and tooth loss: An analysis of data from the national health and nutrition examination survey, 2003-2004. *J Am Dent Assoc* 2013; 144:478-85.
24. Preshaw PM, Bissett SM. Periodontitis: Oral complication of diabetes. *Endocrinol Metab Clin North Am* 2013; 42:849-67.
25. Alade GO, Osagbemi BB. Awareness of medical practitioners on the link between periodontitis and systemic diseases in a tertiary hospital. *Nig J Dent Res* 2022; 7:103-109.
26. Umeizudike KA, Iwuala SO, Ozoh OB, Ayanbadejo PO, Fasanmade OA. Association between periodontal disease and systemic illnesses: A survey among internal medicine residents in Nigeria. *Saudi Dent J* 2016;28:24-30
27. Fatima N, Mazhar S, Ahmed M, Aslam U. Awareness of medical students regarding periodontal disease in diabetic patients in a private dental college of Karachi. *JBUMDC* 2019;9:275-280
28. Bloom BS. Taxonomy of Education objectives. Book 1: Cognitive Domain. New York: David MCKay; 1956
29. Kulkarni R. The Mouth is the Mirror to the Body: Oral-Systemic Health. *Del J Public Health* 2023;9(1): 50. <https://doi.org/10.32481/djph.2023.04.011>
30. Kanika V, Deepa D. Assessment of knowledge and awareness among nursing students of a private medical university towards periodontal health and oral-systemic disease link: A cross-sectional study. *Tanta Dental Journal* 2021;18:67-71. DOI: 10.4103/tdj.tdj_12_20
31. Calvi VL, Chalub LO, Carmo AFB do, Levi YL de AS, Prado RL do, Maia LP. Knowledge of senior students concluding the courses of Dentistry and Medicine toward the interrelationship of periodontal diseases and systemic health. *RSD [Internet].* 2020; 9:e19681210967. [cited 2023Jul.6] Available from: <https://rsdjournal.org/index.php/rsd/article/view/10967>
32. Ponugubati CC, Raji V Murthy K, Trinath Kishore D, Ravi R, Kumar SP. Periodontal awareness in medical students of Andhra Pradesh, India – A survey. *IP Int J Periodontol Implantol* 2020;5:68-73
33. Aarabi G, Zeller T, Seedorf H, Reissmann DR, Heydecke G, Schaefer AS, et al. Genetic susceptibility contributing to periodontal and cardiovascular disease. *J Dent Res* 2017; 96(6): 610–617.
34. Loos BG, Van Dyke TE. The role of inflammation and genetics in periodontal disease. *Periodontol* 2000 2020; 83(1): 26–39.

35. Seitz MW, Listl S, Bartols A, Schubert I, Blaschke K, Haux C et al, (2019). Current knowledge on correlations between highly prevalent dental conditions and Chronic Diseases: An umbrella review. *Prev Chronic Dis* 2019;16, E132.
36. Herrera D, Sanz M, Kekschull M, Jepsen S, Sculean A, Berglundh T, et al. EFP Workshop Participants & Methodological Consultant. Treatment of stage IV periodontitis: The EFP S3 level clinical practice guideline. *J Clin Periodontol* 2022;49(Suppl 24):4–71.
37. Reyes L, Herrera D, Kozarov E, Roldan S, Progulske-Fox A. Periodontal bacterial invasion and infection: Contribution to atherosclerotic pathology. *J Clin Periodontol* 2013;40(Suppl 14), S30–S50.
38. Chandy S, Joseph K, Sankaranarayanan A, Issac A, Babu G, Wilson B, et al. Evaluation of C-reactive protein and fibrinogen in patients with Chronic and aggressive periodontitis: A Clinico-biochemical study. *J Clin Diagnostic Res* 2017; 11(3), ZC41-ZC45.
39. Vernon LT, Babineau DC, Demko CA, et al. A prospective cohort study of periodontal disease measures and cardiovascular disease markers in HIV-infected adults. *AIDS Res Hum Retroviruses*. 2011.
40. Khader YS, Albashaireh ZS, Alomari MA. Periodontal diseases and the risk of coronary heart and cerebrovascular diseases: a meta-analysis. *J Periodontol*. 2004 Aug;75(8):1046-53.
41. Sitholimela CS, Shangase LS. The association between periodontitis and pre-term birth and/or low birth weight: a literature review. *SADJ*. 2013 May;68(4):162-6.
42. Goyal S, Gupta G, Thomas B, Bhat KM, Bhat GS. Stress and periodontal disease: The link and logic! *Ind. Psychiatry J*. 2013;22: 4–11.
43. Lindhe J, Lang NP, Karring T. *Clinical Periodontology and Implant Dentistry*; Wiley: Hoboken, NJ, USA, 2009; ISBN 1444313045, 9781444313048.
44. D'Ambrosio F, Caggiano M, Schiavo L, Savarese G, Carpinelli L, Amato A, Iandolo A. Chronic Stress and Depression in Periodontitis and Peri-Implantitis: A Narrative Review on Neurobiological, Neurobehavioral and Immune-Microbiome Interplays and Clinical Management Implications. *Dent. J*. 2022;10:49.
45. Rajkarnikar J, Acharya J, Yadav K. Awareness of Periodontal Medicine among medical students at a tertiary care center. *JNSPOL*. 2019;3:66-9.
46. Pai M, Ribot B, Tane H, Murray J. A study of periodontal disease awareness amongst third-year nursing students. *Contemp nurse*. 2016;52:686-95.
47. Taşdemir Z, Alkan BA. Knowledge of medical doctors in Turkey about the relationship between periodontal disease and systemic health. *Brazilian oral research*. 2015;29:1-8.
48. Oyetola EO, Oyewole T, Adedigba M, Aregbesola ST, Umezudike K, Adewale A. Knowledge and awareness of medical doctors, medical students and nurses about dentistry in Nigeria. *Pan African Medical Journal*. 2016;23:172