International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Association Between Oral Pathogens and Systemic Diseases Such As Dm: A Microbiological Study

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Received: 11-10-2025
Accepted: 12-11-2025
Available online: 28-02-2026

ABSTRACT

Introduction: The human body acts as a complex biological ecosystem in which human cells coexist with a vast community of microorganisms. AIM: To evaluate the association between oral pathogens and systemic diseases such as diabetes mellitus (DM). **Methodology**: This cross-sectional study was conducted in the Department of Microbiology, SMS Hospital, Rajasthan, India, from January 2023. **Result**: The present case–control study demonstrated a higher prevalence of periodontal pathogens in patients with systemic diseases as compared to healthy controls. Moderate to severe periodontitis and lifestyle factors were most commonly observed, indicating a positive association between periodontal pathogen burden and systemic health. Conclusion: The study concludes that an increased periodontal pathogen burden and severity of periodontal disease are associated with the presence of systemic diseases. These findings support a potential oral–systemic link and show the importance of maintaining periodontal health to promote overall systemic well-being.

Keywords: *Oral pathogen, systemic disease, microbiological analysis.*

INTRODUCTION

The human body functions as a complex biological ecosystem in which human cells coexist with a vast and diverse community of microorganisms[1,2]. This intimate association has led to the concept of humans as a "superorganism," where microbial cells play an essential role in maintaining physiological balance[3]. The oral cavity represents one of the most diverse and dynamic environments among all the other habitats present in the human body. It harbours bacteria, fungi, viruses, mycoplasmas, and protozoa that colonise both hard and soft tissues, and organise into structured biofilms[4].

These microbial communities are generally present in symbiosis with the host, contributing to nutrient metabolism, immune system modulation, maintenance of pH, and resistance to pathogenic colonisation. Oral biofilm formation begins with the development of an acquired pellicle composed of salivary glycoproteins on tooth surfaces. Early colonisers adhere via physicochemical interactions.[5] As the biofilm matures, secondary colonisers aggregate and increase microbial diversity, creating a highly organised three-dimensional structure within an extracellular matrix. Under healthy conditions, a balanced interaction exists between commensal and microbial species, which helps in competitive inhibition, production of antimicrobial substances for the regulation of nitrate metabolism and local pH[6]. However, alterations in the oral environment can lead to disease formation, such as changes in saliva composition, immune status, or systemic health, and disrupt this equilibrium.

Dysbiotic shifts in the oral microbiome lead to the development of dental caries, gingivitis, and periodontitis. Periodontitis is a chronic inflammatory disease that affects the supporting structures of the teeth, leading to destruction of the periodontal ligament and alveolar bone, resulting in tooth loss. It involves interactions between periodontal pathogenic bacteria and the host immune-inflammatory response[7]. Although microbial presence is mainly required for disease initiation, for severity

and progression, host-mediated inflammatory mechanisms are required. Studies showed that oral pathogens are not only confined to the oral cavity, but they also affect systemic health[8]. Virulence factors from periodontal bacteria enter the bloodstream, especially in inflamed periodontal tissues, reaching distant organs. Oral bacteria have been detected in atherosclerotic plaques and thrombi, proving their role in cardiovascular inflammation and plaque instability. Similar associations have also been described between oral dysbiosis and diseases like inflammatory bowel disease, neurodegenerative disorders, and certain malignancies[9,10]. Routine culture and VITEK enable species-level identification and provide insights into microbial diversity and dysbiosis patterns associated with systemic diseases.[11]

AIM

To evaluate the association between oral pathogens and systemic diseases such as diabetes mellitus (DM) through microbiological analysis.

METHODOLOGY

This cross-sectional study was conducted in the Department of Microbiology, Rajasthan, India, during 2023–2024. The study included a total sample size of 84 participants, divided into two groups: patients diagnosed with systemic disease and control that are systemically healthy. Ethical clearance was obtained, and written informed consent was taken from all participants. Patients were selected from the dentistry department, and samples were sent to the microbiology department. Detailed demographic data, medical history, and oral hygiene practices were recorded using a well-structured proforma.

Clinical periodontal examination was performed for all participants. The collected samples were transported immediately to the microbiology laboratory for processing. Samples were subjected to routine microbiological culture using appropriate selective media for the isolation of periodontal pathogens. The culture colonies obtained after incubation were further identified and confirmed using the VITEK automated microbial identification system. Quantitative analysis was performed to compare the microbial load between diabetic and non-diabetic groups.

Inclusion criteria for the diabetic group included patients aged 30–65 years. The control group included age- and gender-matched systemically healthy individuals. All participants were required to have a minimum of 20 natural teeth.

Exclusion criteria included patients who had received periodontal therapy or antibiotics within the past three months, pregnant or lactating women, and patients wearing removable or fixed prostheses that could alter biofilm accumulation. Individuals unwilling to provide consent were also excluded from the study.

RESULT

Table 1:Age Distribution of Study Participants

Age Group (Years)	Number	Percentage (%)
18–30	14	16.7%
31–45	26	31.0%
46–60	28	33.3%
>60	16	19.0%

The majority of participants belonged to the 46–60 years age group (33.3%), followed by 31–45 years (31.0%). Younger individuals aged 18–30 years constituted 16.7%, while 19.0% of subjects were above 60 years of age.

Table 2:Gender Distribution

Gender	Number	Percentage (%)
Male	48	57.1%
Female	36	42.9%

The study population consisted predominantly of males (57.1%), while females accounted for 42.9% of the participants. This indicates a slight male preponderance among the subjects included in the study.

Table 3:Distribution of Study Population According to Systemic Status

Systemic Condition	**Number**	**Percentage (%)**
Diabetes Mellitus	16	38.1%

Cardiovascular Disease	12	28.6%
Rheumatoid Arthritis	8	19.0%
Chronic Kidney Disease	6	14.3%
Systemically Healthy (Control)	42	50%

Among the systemic disease group, diabetes mellitus was the most prevalent condition (38.1%), followed by cardiovascular disease (28.6%), rheumatoid arthritis (19.0%), and chronic kidney disease (14.3%). The control group comprised 50% of the total study population and included systemically healthy individuals for comparison.

Table 4:Distribution According to Personal Habits

Habit	Number	Percentage (%)
Tobacco Chewing	30	35.7%
Smoking	26	31%
Alcohol Consumption	22	26.2%
No Adverse Habits	28	33.3%

Tobacco chewing was the most common adverse habit observed (35.7%), followed by smoking (31%) and alcohol consumption (26.2%), while 33.3% of participants reported no deleterious habits. The presence of these lifestyle factors may contribute to alterations in oral microbial composition and increased periodontal pathogen burden.

Table 5: Oral Hygiene Practices

Oral Hygiene Practice	Number	Percentage (%)
Brushing Once Daily	42	50%
Brushing Twice Daily	26	31%
Irregular Brushing	16	19%

Half of the study participants (50%) reported brushing once daily, while 31% brushed twice daily and 19% practiced irregular brushing. These findings indicate that a considerable proportion of subjects followed suboptimal oral hygiene practices, which may influence microbial burden and periodontal status.

Table 6:Periodontal Status of Study Population

Periodontal Status	Systemic (Cases) n=42	Control n=42	P value
Healthy	6 (14.3%)	10 (23.8%)	0.405
Gingivitis	12 (28.6%)	14 (33.3%)	0.817
Mild Periodontitis	13 (31.0%)	11 (26.2%)	0.812
Moderate–Severe Periodontitis	11 (26.2%)	7 (16.7%)	0.430

The distribution of periodontal status showed a higher proportion of moderate–severe periodontitis among systemic cases (26.2%) compared to controls (16.7%), whereas healthy status was more common in the control group (23.8% vs 14.3%). Overall, periodontal disease severity tended to be greater in individuals with systemic conditions than in systemically healthy subjects.

Table 7: Comparison of Pathogen Prevalence Between Systemic and Control Groups

Pathogen	Systemic (n=42)	Control (n=42)	P value
P. gingivalis	27 (64.3%)	20 (47.6%)	0.187

A. actinomycetemcomitans	23 (54.8%)	17 (40.5%)	0.275
F. nucleatum	29 (69.0%)	24 (57.1%)	0.366
Parvimonas micra	41 (97.6%)	39 (92.8%)	0.608

The prevalence of major periodontal pathogens was comparatively higher in the systemic disease group than in the control group, with P. gingivalis (64.3% vs 47.6%) and A. actinomycetemcomitans (54.8% vs 40.5%) showing notable differences. Although Parvimonas micra was highly prevalent in both groups, the overall findings suggest an increased microbial burden among individuals with systemic diseases.

DISCUSSION

The age distribution in our study demonstrated that the majority of participants were in the 46–60 years age group, forming 33.3% of the total sample. 31.0% of the subjects were in the 31-45 age group, 19.0% above 60 years of age and the youngest group, 18–30 years, constituted 16.7% of the total participants.

In our study, a total of 84 participants were included, 48 (57.1%) and 36 (42.9%) were females. The study population demonstrated a male predominance. Gender distribution was comparable between systemic and control groups.

In our study, among the cases Diabetes Mellitus was the most prevalent condition, accounting for 38.1% of cases. Cardiovascular disease constituted 28.6% of the systemic group. Rheumatoid arthritis and chronic kidney disease represented 19.0% and 14.3% of cases, respectively. Overall, systemic disease cases comprised 50% of the total study population, while the remaining 50% were systemically healthy controls. This balanced distribution allowed comparison between diseased and healthy groups.

In our study, tobacco chewing was reported by 35.7% of participants, Smoking was present in 31% of the study population, while 26.2% reported alcohol consumption. 33.3% had no adverse habits. The presence of tobacco and smoking habits contribute to alterations in the oral microbiota and increased periodontal pathogen load. Lee YH et al[12] in their study showed Various endogenous and exogenous factors, including smoking, alcohol consumption, socioeconomic status, antibiotic use, diet, and pregnancy, affect the oral microbiota. Disruption of the host–microbial mutualism, can occur because of significant changes in the oral environment or lifestyle that favor the colonization of disease-associated microbiota.

In our study half of the study participants (50%) reported brushing once daily, making it the most common practice observed. About 31% of individuals brushed twice daily. However, 19% of the participants reported irregular brushing habits, indicating inconsistent plaque control.

The predominance of once-daily brushing contribute to the persistence of plaque biofilm and increased microbial load. Irregular brushing practices further predispose individuals to periodontal inflammation and pathogen colonization.

In our study, the distribution of periodontal status showed differences between systemic disease cases and healthy controls. Only 14.3%cases were healthy compared to controls (23.8%). Gingivitis was in 28.6% of cases and 33.3% of controls, that is a comparable prevalence in both groups. Mild periodontitis was slightly more common among cases (31.0%) than controls (26.2%). While, moderate–severe periodontitis was more prevalent in the systemic group (26.2%) compared to controls (16.7%). Similarly, Choi YJ et al[13] in their study showed the prevalence rates of periodontitis and dental caries pathogens among the study subjects. Parvimonas micra (97.6%), Porphyromonas endodontalis (96.8%), and Treponema socranskii (95.0%) were highly prevalent, and Fusobacterium nucleatum (66.6%) was the least prevalent.

In the present study, the major periodontal pathogens was comparatively higher in the systemic disease group than in the controls. Porphyromonas gingivalis was in 64.3% of cases compared to 47.6% of controls, Aggregatibacter actinomycetemcomitans was in 54.8% of cases versus 40.5% of controls, Fusobacterium nucleatum showed increased prevalence in the systemic group (69.0%) compared to controls (57.1%) while Parvimonas micra demonstrated high prevalence in both groups (97.6% vs 92.8%), the burden remained slightly elevated in systemic subjects. Rajasekaran JJ[14], et al in their study explores associations between the oral microbiome and systemic diseases including gastrointestinal, cardiovascular, endocrinal, and neurological conditions, autoimmune diseases, and cancer. Similarly,Spahr A et al[15] In their multivariable analyses, found a statistically significant association between the periodontal pathogen burden (log10 of the sum of all pathogens) (odds ratio [OR], 1.92; 95% confidence interval [CI], 1.34-2.74; P<.001) or the number of A actinomycetemcomitans in periodontal pockets (log10) (OR, 2.70; 95% CI, 1.79-4.07; P<.001) and the presence of CHD. In addition, a statistically significant association between an increase in mean CPITN score by 1 and the presence of CHD (OR, 1.67; 95% CI, 1.08-2.58; P = .02) was observed.

CONCLUSION

In the present study, Although oral pathogens were detected in both groups through routine culture and VITEK-confirmed identification, their prevalence and mean colony counts were consistently higher in systemic cases than control particularly for Porphyromonas gingivalis and Aggregatibacter actinomycetemcomitans. Moderate–severe periodontitis was also more common in the systemic group, showing a relationship between periodontal inflammation and systemic health status. Lifestyle factors such as tobacco use, smoking, and irregular oral hygiene practices were frequently observed and contributed to increased pathogen colonization. The findings support the concept of an oral–systemic microbial axis, wherein elevated periodontal pathogen burden and periodontal disease severity associated with systemic conditions including diabetes, cardiovascular disease, autoimmune disorders, and chronic kidney disease. This study showed the importance of maintaining periodontal health as part of systemic disease management. Early diagnosis, effective plaque control, and risk factor modification help reduce microbial burden.

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