



Original Article

Prevalence of Pathogenic Microbes in Patients with Dental Caries

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ABSTRACT

Introduction: The preservation of oral health and prevention of dental diseases such as caries and gingivitis remain fundamental objectives in dental medicine. These conditions originate primarily from the formation and maturation of oral biofilms that accumulate on various surfaces within the oral cavity. **AIM:** The aim of this study was to determine the prevalence of pathogenic oral microorganisms in patients with dental caries and to evaluate their distribution and frequency among affected individuals. **Methodology:** This cross-sectional observational study was conducted in the Department of Dentistry at a tertiary care teaching hospital in north-west Rajasthan, between 2023 - 2024. The study population consisted of 74 patients clinically diagnosed with dental caries who attended the outpatient department during the study period. **Result:** The study revealed that *Streptococcus mutans* was the most prevalent microorganism (81.1%), followed by *Lactobacillus* (70.3%), with mixed microbial infections observed in 70.3% of patients, confirming the polymicrobial nature of dental caries. An increasing trend in microbial prevalence was noted with advancing severity of lesions, and significant associations were observed with risk factors such as poor oral hygiene and frequent sweet consumption. **Conclusion:** Dental caries was found to be a polymicrobial disease predominantly associated with *Streptococcus mutans*, with microbial prevalence increasing as lesion severity progressed. Behavioral factors such as poor oral hygiene and frequent sweet consumption significantly contributed to higher microbial load, highlighting the importance of preventive and early diagnostic strategies.

Keywords: Dental caries, microbial infection, Risk Factors.

INTRODUCTION

The preservation of oral health and prevention of dental diseases such as caries and gingivitis remain fundamental objectives in dental medicine¹. These conditions originate primarily from the formation and maturation of oral biofilms that accumulate on various surfaces within the oral cavity^{2,3}. Alterations in the balance of the oral microbiome can create an environment that favors the proliferation of pathogenic microorganisms, ultimately leading to disease initiation and progression². Dental caries is a multifactorial disease influenced by microbial activity, dietary practices, and host-related factors. Frequent carbohydrate consumption, acidic oral pH, and the retention of sticky food debris enhance bacterial metabolism⁴. Acidogenic bacteria metabolize fermentable carbohydrates and produce organic acids that demineralize the tooth structure, resulting in progressive enamel and dentin destruction. If untreated, advancing carious lesions may extend toward the pulp, triggering inflammatory responses such as pulpitis and potentially progressing to periapical pathology^{5,6}. In contrast, gingivitis develops due to persistent plaque accumulation along the gingival margin, provoking localized inflammatory reactions characterized by gingival swelling, increased gingival crevicular fluid flow, and pocket formation⁷. While caries-associated microbiota are predominantly Gram-positive and carbohydrate-fermenting, periodontal conditions are more commonly linked to Gram-negative anaerobic species. Importantly, the host immune response plays a decisive role in determining disease susceptibility and severity⁸. Individuals exposed to similar plaque accumulation may demonstrate varying inflammatory responses, highlighting the significance of host-related factors in disease progression⁹. Early pathogenic alterations in the oral cavity may therefore be identified through molecular evaluation of immune-related biomarkers. Inflammatory processes associated with both gingivitis and caries stimulate the release of cytokines,

chemokines, enzymes, and other mediators that can be detected in oral fluids¹⁰. Saliva, constantly bathing all oral tissues, serves as a readily accessible biological medium containing host-derived molecules and microbial components reflective of ongoing pathological processes. The multifactorial aetiology of caries and periodontal diseases underscores the need for comprehensive and personalised diagnostic strategies¹¹. The assessment of combined salivary biomarkers and microbial indicators offers potential for distinguishing between healthy individuals and those at risk for disease¹². Although salivary diagnostics have gained attention, the identification of specific biomarker patterns predictive of caries remains comparatively underexplored. The close interaction between saliva and oral lesions makes it a promising, non-invasive diagnostic tool for early disease detection and patient monitoring.¹³

AIM

To determine the prevalence of pathogenic oral microorganisms in patients with dental caries and to evaluate their distribution and frequency among affected individuals.

METHODOLOGY:

This cross-sectional observational study was conducted in the Department of Dentistry at a tertiary care teaching hospital in Rajasthan, between 2023 – 2024. The study population consisted of 74 patients clinically diagnosed with dental caries who attended the outpatient department during the study period. A detailed clinical examination was performed using a mouth mirror and explorer under adequate illumination. Dental caries were diagnosed based on visual–tactile criteria. Unstimulated saliva samples were collected from each participant in sterile containers following standard infection control protocols. The samples were transported to the microbiology laboratory for analysis of pathogenic microorganisms using appropriate culture and identification techniques. The prevalence of specific cariogenic microbes was recorded and analyzed. Antimicrobial susceptibility testing of the isolated microorganisms was performed using the Kirby–Bauer disk diffusion method in accordance with the Clinical and Laboratory Standards Institute (CLSI) guidelines to ensure standardized and reliable interpretation of results. The inclusion criteria comprised patients aged 18–60 years with clinically confirmed dental caries who were willing to participate in the study and provide saliva samples. Both male and female patients were included. The exclusion criteria included patients who had received antibiotics within the past four weeks, individuals undergoing periodontal therapy, patients with systemic diseases affecting salivary flow (such as uncontrolled diabetes or autoimmune disorders), pregnant or lactating women, tobacco users, and individuals with a history of recent oral prophylaxis within the previous one month. These criteria were applied to minimize confounding factors that could influence the oral microbial load and salivary composition.

RESULT

Table 1: Demographic Distribution of Study Participants (n = 74)

Age group	Number	Percentage
18-30	24	32.4%
31-45	21	28.4%
46-60	29	39.2%

The majority of participants belonged to the 46–60 years age group (39.2%), followed by 18-30 years (32.4%) and 31-45 years (28.4%). This indicates that middle-aged adults constituted the largest proportion of dental caries cases in the present study.

Table 2: Gender distribution

Gender	Number	Percentage
Male	31	41.9%
Female	43	58.1%

Among the 74 participants, females constituted the majority with 43 cases (58.1%), while males accounted for 31 cases (41.9%). This indicates a higher representation of female patients with dental caries in the present study.

Table 3: Overall Prevalence of Pathogenic Microbes in Dental Caries Patients (n = 74)

Microorganism	Number	Percentage
Streptococcus mutans	60	81.1%
Lactobacillus species	52	70.3%

Actinomyces species	34	45.9%
Candida albicans	18	24.3%

Among the isolated microorganisms, *Streptococcus mutans* showed the highest prevalence (81.1%), followed by *Lactobacillus* species (70.3%) and *Actinomyces* species (45.9%). *Candida albicans* was detected in 24.3% of patients, indicating a comparatively lower prevalence.

Table 4: Risk Factors Associated with High Microbial Load (n = 74)

Risk Factor	Number	Percentage
Frequent sweet consumption	38	51.4%
Poor oral hygiene	41	55.4%
White spot lesions	26	35.1%
Toothache	33	44.6%

Frequent sweet consumption was observed in 38 patients (51.4%), while poor oral hygiene was noted in 41 patients (55.4%), making it the most common associated risk factor in the study population. White spot lesions were present in 26 patients (35.1%) and toothache was reported by 33 patients (44.6%), indicating a substantial association between clinical symptoms and increased microbial load.

Table 5: Distribution of Single vs. Mixed Microbial Infection (n = 74)

Type of Infection	Number	Percentage
Single Microbial Growth	22	29.7%
Mixed Microbial Growth	52	70.3%

Mixed microbial growth was observed in the majority of patients (70.3%), while single microbial growth was detected in 29.7% of cases. This indicates that dental caries in the present study predominantly exhibited a polymicrobial pattern.

Table 6: Frequency of Common Microbial Combinations (n = 74)

Combinations	Number	Percentage
<i>S. mutans</i> + <i>Lactobacillus</i>	24	46.2%
<i>S. mutans</i> + <i>Actinomyces</i>	10	19.2%
<i>S. mutans</i> + <i>Candida</i>	6	11.5%
Multiple (>2 species)	12	23.1%

Among the mixed infections, the most common combination was *S. mutans* with *Lactobacillus* (46.2%), followed by the presence of multiple (>2) organisms (23.1%). The combinations of *S. mutans* with *Actinomyces* (19.2%) and *S. mutans* with *Candida* (11.5%) were comparatively less frequent.

Table 7: Microbial Prevalence According to Severity of Dental Caries (n = 74)

Severity of Caries	Total Cases (n)	<i>S. mutans</i> n (%)	<i>Lactobacillus</i> n (%)	<i>Actinomyces</i> n (%)
Mild (Enamel)	18	12(66.7%)	9(50.0%)	6(33.3%)
Moderate (Dentin)	30	28(83.3%)	22(73.3%)	14(46.7%)
Severe (Deep caries)	26	23(88.5%)	21(80.8%)	14(53.8%)

The prevalence of *S. mutans*, *Lactobacillus*, and *Actinomyces* increased with the severity of caries, showing the highest occurrence in severe (deep) caries cases.

DISCUSSION

The age distribution of the study participants showed that the majority of participants belonged to the 46–60 years age group (39.2%), followed by 18–30 years (32.4%) and 31–45 years (28.4%). The youngest age group, 18–30 years, accounted for 21 patients (28.4%). The findings indicate that extremities represented the largest proportion of dental caries cases in the present study.

Out of the total 74 participants included in the study, 31 were males (41.9%) and 43 were females (58.1%). Females constituted more than half of the total cases of dental caries examined during the study period. This difference reflects greater healthcare-seeking behavior among females compared to males. A similar trend was observed in the study by Sakeenabi B et al¹⁴ where a higher proportion of dental caries was noted among females (57.58%) compared to males (42.42%). However, in contrast to our findings, their study did not show a statistically significant difference between genders ($p = 0.086$).

In our study The microbiological analysis revealed that *Streptococcus mutans* was the most prevalent organism, detected in 60 patients (81.1%), indicating its strong association with dental caries. *Lactobacillus* species were identified in 52 patients (70.3%), suggesting their important role in the progression of carious lesions. *Actinomyces* species were present in 34 cases (45.9%), showing moderate prevalence among the study population. *Candida albicans* was detected in 18 patients (24.3%), representing the least prevalent microorganism. The findings highlight the predominance of acidogenic and aciduric bacteria in caries patients. Our study is consistent with the study conducted by Kiros A et al¹⁵ who also reported that 196 (46.4%) samples were culture positive. Out of 327 bacterial isolates, 196 (46.4%) were identified as *Streptococcus mutans* and 69 (35.2%) were identified to be *Staphylococcus aureus*. From the isolated bacteria, 311 (95.1%) organisms were identified as positive for biofilm formation.

In our study Frequent sweet consumption was reported in 38 patients (51.4%), indicating a strong dietary contribution to increased cariogenic microbial activity. Poor oral hygiene was observed in 41 patients (55.4%), making it the most prevalent risk factor identified in the study. White spot lesions, an early clinical indicator of enamel demineralization, were present in 26 patients (35.1%). Toothache was reported by 33 patients (44.6%), suggesting progression of carious lesions to deeper tooth structures. The findings highlight the significant role of behavioral and clinical factors in the development of dental caries. These findings are in agreement with the study conducted by , Kiros A et al¹⁵ who reported a statistically significant association between dental caries and factors such as , the white spot [AOR = 3.885, 95% CI 1.282-11.767, $P = 0.016$], gum bleeding [AOR (Adjusted Odds Ratio)= 2.820, 95% CI (Confidence Interval) 1.006-7.907, P (Probability value) = 0.049], toothache (AOR (Adjusted Odds Ratio) = 2.27, 95% CI(Confidence Interval) 0.58-0.885, $P = 0.033$), and chocolate consumption [AOR (Adjusted Odds Ratio)= 5.314, 95% CI(Confidence Interval) 1.760-16.040, P (Probability value) = 0.003] were statically associated with dental caries bacterial infection. Thus, both studies collectively emphasize that dietary habits, oral hygiene practices, and early clinical signs play a crucial role in the development and progression of dental caries.

In our study The analysis of infection type showed that mixed microbial growth was predominant among the study participants. A total of 52 patients (70.3%) exhibited mixed microbial infections, indicating the presence of more than one pathogenic organism in saliva. In contrast, single microbial growth was observed in 22 patients (29.7%). The higher proportion of mixed infections reflects the complex interaction among cariogenic microorganisms in lesion development. In our study The analysis of mixed microbial infections revealed that the most frequent combination was *S. mutans* with *Lactobacillus*, observed in 46.2% of cases. This was followed by the presence of multiple organisms (>2 species), accounting for 23.1% of the mixed infections. The combination of *S. mutans* with *Actinomyces* was detected in 19.2% of patients. The least common combination was *S. mutans* with *Candida*, seen in 11.5% of cases. These findings indicate that *S. mutans* play a central role in polymicrobial interactions associated with dental caries.

In our study the distribution of microorganisms varied according to the severity of dental caries. In mild (enamel) caries, *S. mutans* was detected in 66.7% of cases, followed by *Lactobacillus* (50.0%) and *Actinomyces* (33.3%). In moderate (dentin) caries, the prevalence increased, with *S. mutans* present in 83.3%, *Lactobacillus* in 73.3%, and *Actinomyces* in 46.7% of patients. Similarly, in severe (deep) caries, the highest microbial prevalence was observed, with *S. mutans* detected in 88.5%, *Lactobacillus* in 80.8%, and *Actinomyces* in 53.8% of cases. These findings are consistent with the study conducted by Chokshi A et al.,¹⁶ who reported a significant positive correlation between DMFT scores and the presence of *S. mutans*, *Lactobacilli*, and *Actinomyces* ($P < 0.001$) in both mixed and permanent dentition groups.

CONCLUSION

The present study demonstrated that dental caries was most prevalent among middle-aged adults (31–45 years), with a slight female predominance in the study population. Microbiological analysis revealed that *Streptococcus mutans* was the most predominant cariogenic organism, followed by *Lactobacillus* and *Actinomyces* species, confirming the central role of acidogenic and aciduric bacteria in caries development. Mixed microbial growth was observed in the majority of cases, emphasizing the polymicrobial nature of dental caries. An increasing trend in microbial prevalence was noted with advancing severity of lesions, indicating a strong association between microbial load and disease progression, similar to

the positive correlation between DMFT scores and cariogenic bacteria reported in previous studies. Furthermore, behavioral and clinical risk factors such as poor oral hygiene, frequent sweet consumption, white spot lesions, and toothache showed a notable association with increased microbial prevalence. The predominance of combined microbial infections, particularly *S. mutans* with *Lactobacillus*, highlights the synergistic interaction among pathogens in lesion progression. The findings reinforce that dental caries is a multifactorial and polymicrobial disease influenced by microbial load, host factors, and lifestyle behaviors, underscoring the need for early microbial assessment and preventive strategies.

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