

## THE ROLE OF ORAL MICROFLORA AND OXIDATIVE STRESS IN THE DEVELOPMENT OF DENTAL CARIES IN YOUNG ADULTS

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**Abstract:** *Dental caries remains one of the most prevalent chronic diseases affecting the oral cavity worldwide. The condition develops as a result of complex interactions between pathogenic microorganisms, dietary factors, saliva composition, and host immune response. The present study aimed to evaluate the role of oral microflora and oxidative stress in the development of dental caries among young adults. The study included 48 patients with clinically confirmed dental caries who underwent dental, microbiological, and biochemical examination. Increased colonization by cariogenic bacteria and elevated oxidative stress markers were significantly associated with caries severity and enamel destruction. Statistical analysis demonstrated a strong positive correlation between *Streptococcus mutans* colonization and caries index values ( $r = 0.76$ ;  $p < 0.001$ ). The findings confirm the important role of microbial imbalance and oxidative stress in dental caries progression.*

**Keywords:** *dental caries, oral microflora, oxidative stress, *Streptococcus mutans*, saliva, oral diseases*

### **Introduction**

Dental caries is one of the most widespread oral diseases and represents a major global health burden. According to the World Health Organization, approximately 2 billion people worldwide suffer from permanent tooth caries, while the disease affects nearly 60–90% of school-age children and young adults [1]. The development of dental caries is closely associated with the activity of cariogenic microorganisms within dental biofilm. Among these microorganisms, *Streptococcus mutans* and *Lactobacillus* species play a central role due to their acidogenic and aciduric properties. These bacteria metabolize fermentable carbohydrates, resulting in acid production and progressive demineralization of tooth enamel [2]. Recent studies emphasize the importance of oxidative stress in the pathogenesis of oral diseases. Increased production of reactive oxygen species contributes to tissue damage, salivary dysfunction, and impaired remineralization processes. Altered salivary composition and reduced antioxidant defense mechanisms may accelerate progression of dental caries and periodontal destruction. Understanding the relationship between microbial activity, oxidative

stress, and caries severity is essential for improving preventive and therapeutic strategies in modern dentistry.

### **Materials and Methods**

This study was conducted at a dental clinical center and included 48 patients diagnosed with dental caries. The mean age of participants was  $22.8 \pm 3.6$  years. Men accounted for 27 patients (56.3%), while women represented 21 patients (43.7%).

Clinical dental examination included assessment of DMFT index (Decayed, Missing, Filled Teeth), oral hygiene index, and severity of enamel destruction. Saliva samples were collected for microbiological and biochemical analysis. Microbiological examination was performed to identify cariogenic bacteria, including *Streptococcus mutans* and *Lactobacillus* species. Biochemical analysis included measurement of salivary pH and oxidative stress markers such as malondialdehyde (MDA).

Patients with severe systemic diseases and recent antibiotic therapy were excluded from the study. Statistical analysis was performed using variation statistics and Pearson correlation analysis. Quantitative variables were expressed as mean  $\pm$  standard deviation (M $\pm$ SD). Statistical significance was accepted at  $p < 0.05$ .

### **Results**

The study demonstrated significant microbiological and oxidative stress alterations in patients with dental caries. The mean DMFT index was  $7.2 \pm 2.1$ , indicating moderate to severe caries activity. Poor oral hygiene was identified in 68.7% of participants. Microbiological analysis revealed elevated *Streptococcus mutans* colonization in 72.9% of patients, while increased *Lactobacillus* counts were detected in 58.3%. Patients with advanced enamel destruction showed significantly higher bacterial colonization compared to individuals with mild caries lesions. Salivary pH values decreased to  $5.9 \pm 0.4$  in patients with severe caries, indicating increased oral acidity. Oxidative stress marker levels were also significantly elevated. Mean malondialdehyde concentration reached  $4.8 \pm 1.1$  nmol/mL, exceeding normal reference values approximately twofold.

Correlation analysis demonstrated a strong positive relationship between *Streptococcus mutans* colonization and DMFT index values ( $r = 0.76$ ;  $p < 0.001$ ). Additionally, oxidative stress marker levels positively correlated with enamel destruction severity ( $r = 0.63$ ;  $p < 0.01$ ).

Men demonstrated slightly higher DMFT scores than women, while women reported increased tooth sensitivity and gingival discomfort. Frequent sugary food consumption was identified in 64.5% of patients and significantly associated with higher bacterial activity. Patients with inadequate oral hygiene habits exhibited caries progression approximately 2.1 times more frequently than individuals practicing regular preventive dental care.

### **Discussion**

The findings of this study confirm the major role of cariogenic microorganisms in dental caries progression. Elevated colonization by *Streptococcus mutans* and *Lactobacillus* species significantly contributed to acid production and enamel demineralization. The observed decrease in salivary pH created favorable conditions for bacterial proliferation and

progression of tooth destruction. Similar findings have been reported in previous international studies investigating oral microbiological ecology [3].

Oxidative stress appears to be an additional pathogenic factor contributing to tissue damage and impaired remineralization. Elevated malondialdehyde levels indicate increased lipid peroxidation and reduced antioxidant defense within the oral cavity. Dietary habits and oral hygiene quality strongly influenced disease severity. High sugar intake and inadequate oral care promoted bacterial biofilm formation and accelerated progression of dental lesions.

These findings highlight the importance of preventive oral hygiene, dietary correction, and early microbiological monitoring in reducing the prevalence and severity of dental caries.

### **Conclusion**

Dental caries is strongly associated with microbial imbalance, acidic salivary environment, and oxidative stress activation. Increased *Streptococcus mutans* colonization and elevated oxidative stress markers significantly correlate with caries severity and enamel destruction. The findings demonstrate that preventive oral hygiene measures, dietary control, and early microbiological assessment are essential for reducing caries progression and improving oral health outcomes.

### **References**

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