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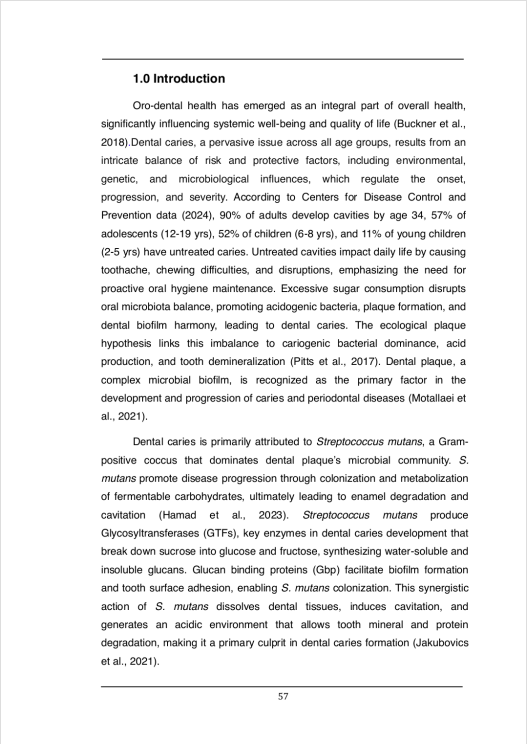

1.0 Introduction

Oro-dental health has emerged as an integral part of overall health, significantly influencing systemic well-being and quality of life (Buckner et al., 2018).Dental caries, a pervasive issue across all age groups, results from an intricate balance of risk and protective factors, including environmental, genetic, and microbiological influences, which regulate the onset, progression, and severity. According to Centers for Disease Control and Prevention data (2024), 90% of adults develop cavities by age 34, 57% of adolescents (12-19 yrs), 52% of children (6-8 yrs), and 11% of young children (2-5 yrs) have untreated caries. Untreated cavities impact daily life by causing toothache, chewing difficulties, and disruptions, emphasizing the need for proactive oral hygiene maintenance. Excessive sugar consumption disrupts oral microbiota balance, promoting acidogenic bacteria, plaque formation, and dental biofilm harmony, leading to dental caries. The ecological plaque hypothesis links this imbalance to cariogenic bacterial dominance, acid production, and tooth demineralization (Pitts et al., 2017). Dental plaque, a complex microbial biofilm, is recognized as the primary factor in the development and progression of caries and periodontal diseases (Motallaei et al., 2021).

Dental caries is primarily attributed to *Streptococcus mutans*, a Gram-positive coccus that dominates dental plaque's microbial community. *S. mutans* promote disease progression through colonization and metabolization of fermentable carbohydrates, ultimately leading to enamel degradation and cavitation (Hamad et al., 2023). *Streptococcus mutans* produce Glycosyltransferases (GTFs), key enzymes in dental caries development that break down sucrose into glucose and fructose, synthesizing water-soluble and insoluble glucans. Glucan binding proteins (Gbp) facilitate biofilm formation and tooth surface adhesion, enabling *S. mutans* colonization. This synergistic action of *S. mutans* dissolves dental tissues, induces cavitation, and generates an acidic environment that allows tooth mineral and protein degradation, making it a primary culprit in dental caries formation (Jakubovics et al., 2021).

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