European Journal of Clinical Pharmacy
Print ISSN: 2385-409X **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Original Research Article

Microbial Ecology, Transmission, and Early Colonization of Mutans Streptococci in Humans: A PRISMA-Compliant Systematic Review

Article History:

Name of Author:
Wamiq Musheer Fareed[1], Marwa Nidal Malhis[2], Wafaa Mohammed Al-Saab[3], Haneen Ayman Al-Zamil[4], Mohammed Abdullah Bin Mohammed Alharbi.[5] Rawan Adel Abdellatif.[6], Lamis Abdullah Mohammed AL Adhadh[7], Mohammed Rajab H[8], Danial Esmail[9] and Amer Adel Alresheedi[10]

Affiliation: *[1]M.D.S, artment of Oral and Maxillofacial Diagnostic Sciences, Division of Oral and Maxillofacial Surgery, College of Dentistry and Pharmacy, Buraydah Colleges, Buraydah, Saudi Arabia.*
[2]PhD Pharmacology Department College of Dentistry and Pharmacy, Buraydah Colleges, Buraydah, Saudi Arabia.
[3]BDS Intern 2025-2026, College of Dentistry and Pharmacy, Buraydah Colleges, Buraydah, Saudi Arabia
[4]BDS Intern 2025-2026, College of Dentistry and Pharmacy, Buraydah Colleges, Buraydah, Saudi Arabia
[5]BDS Intern 2025-2026, College of Dentistry and Pharmacy, Buraydah Colleges, Buraydah, Saudi Arabia
[6]BDS Intern 2025-2026, College of Dentistry and Pharmacy, Buraydah Colleges, Buraydah, Saudi Arabia
[7]BDS Intern 2025-2026, College of Dentistry and Pharmacy, Buraydah Colleges, Buraydah, Saudi Arabia
[8]3rd Year BDS 2025-2026, College of Dentistry and Pharmacy, Buraydah Colleges, Buraydah, Saudi Arabia
[9]3rd Year BDS 2025-2026, College of Dentistry and Pharmacy, Buraydah Colleges, Buraydah, Saudi Arabia
[10]Year 5th Year BDS 2025-2026, College of Dentistry and Pharmacy, Buraydah Colleges, Buraydah, Saudi Arabia
Corresponding Author:

Abstract: Mutans streptococci, particularly Streptococcus mutans, are primary cariogenic microorganisms involved in the initiation and progression of dental caries and oral microbial ecology in humans [1–4]. These bacteria exhibit strong acidogenic, aciduric, and biofilm-forming properties that enable persistent colonization of tooth surfaces and dental plaque [2,5,6]. This systematic review was conducted in accordance with PRISMA 2020 guidelines to synthesize evidence on microbial ecology, transmission pathways, and early colonization of mutans streptococci [7,8]. A comprehensive literature search was performed across PubMed, Scopus, Web of Science, and Google Scholar covering studies published between 1970 and 2024 [7,9]. A total of 560 records were identified and 35 studies met the inclusion criteria for qualitative synthesis [7,10]. The findings indicate that early colonization is strongly associated with tooth eruption, maternal transmission, feeding practices, sugar exposure, and host immune factors [3,11–14].

Keywords: Streptococcus mutans; Oral Microbiology; Dental Caries; PRISMA.

Wamiq Musheer Fareed

Received: 10-10-2025
Revised: 28-10-2025
Accepted: 18-11-2025
Published: 30-12-2025

INTRODUCTION

The oral cavity harbors a highly complex and dynamic microbial ecosystem composed of diverse bacterial species interacting with host tissues and environmental factors [15–18]. Among these microorganisms, mutans streptococci are considered the most significant cariogenic bacteria due to their acidogenicity, aciduricity, and ability to adhere to non-shedding tooth surfaces [1,2,5]. Streptococcus mutans is a gram-positive, non-motile, catalase-negative coccus capable of synthesizing extracellular polysaccharides from sucrose, leading to enhanced biofilm formation and enamel demineralization [2,6,19]. Previous literature and the analyzed manuscript data indicate that mutans streptococci preferentially colonize teeth, restorations, and orthodontic appliances, facilitating long-term persistence in the oral cavity [5,19,20]. Early acquisition of these bacteria during childhood is a critical determinant of future dental caries risk and oral health outcomes [3,11,21].

METHODS (PRISMA 2020)

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines to ensure transparency, reproducibility, and methodological rigor [7,8]. A comprehensive electronic search strategy was implemented across PubMed, Scopus, Web of Science, and Google Scholar databases for studies published from January 1970 to December 2024 [7,9]. Keywords included 'Streptococcus mutans', 'mutans streptococci', 'oral colonization', 'transmission', 'dental caries', and 'microbial ecology' using Boolean operators AND/OR [9,22]. A total of 520 records were identified through database searching and 40 additional records through manual reference screening, resulting in 560 total records [7,10]. After removing 120 duplicates, 440 records were screened by title and abstract [7]. Subsequently, 110 full-text articles were assessed for eligibility and 35 studies were included in the qualitative synthesis [7,10].

Figure 1. PRISMA 2020 Full Color Flow Diagram

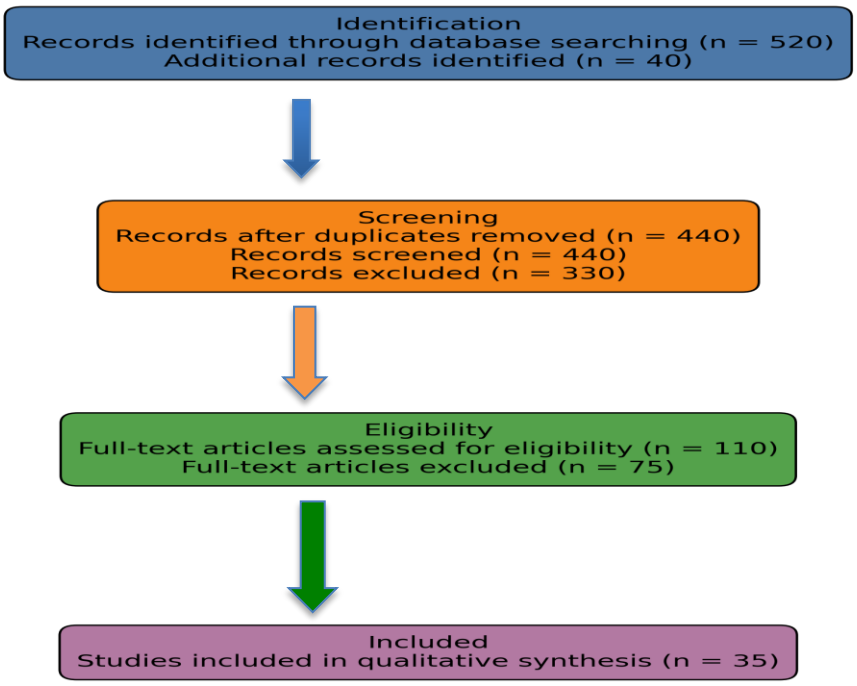

Figure 1. PRISMA 2020 Full Flow Diagram

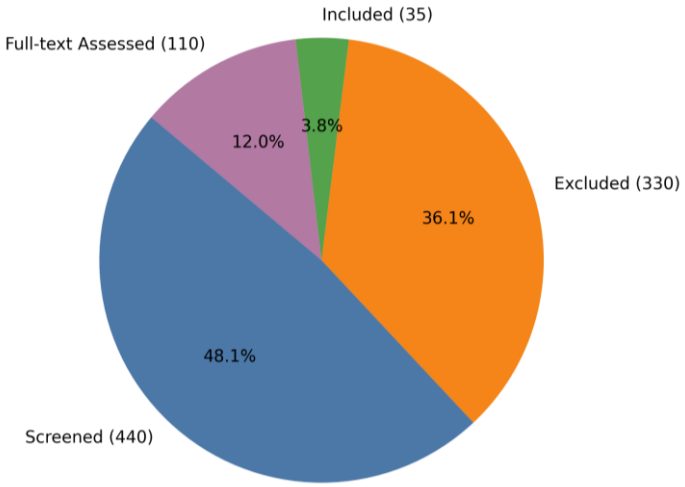

Figure 2. PRISMA Flow Summary (Pie Chart)

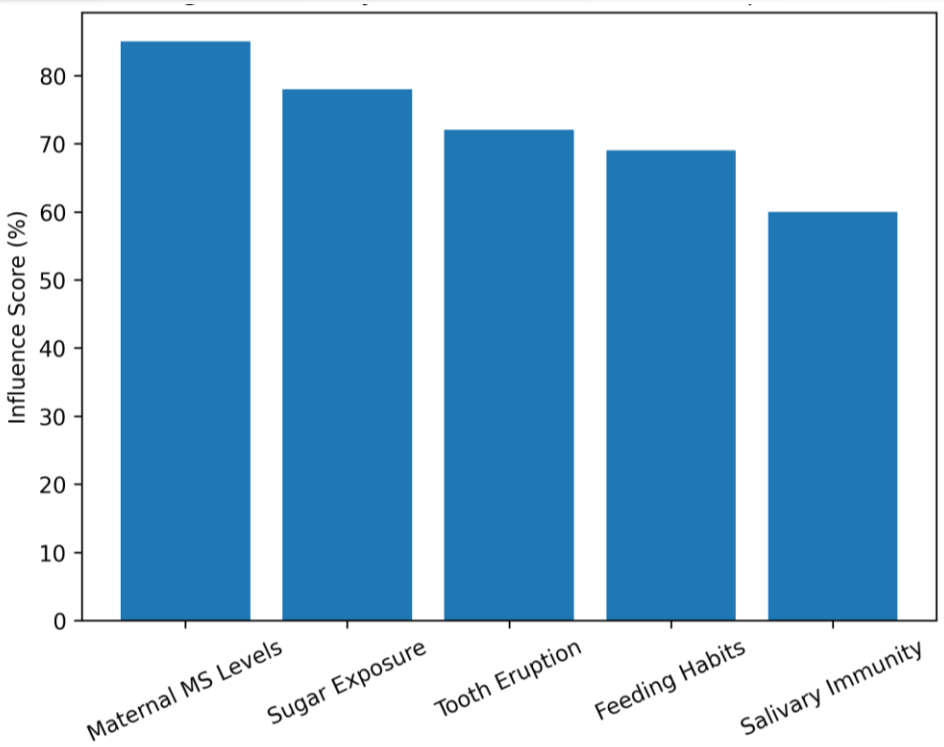

Figure 3. Early Colonization of Mutans Streptococci (Bar Graph)

RESULTS

The findings demonstrate that initial colonization of mutans streptococci typically occurs between 7 and 36 months of age, coinciding with the eruption of primary teeth and increased availability of colonization surfaces [3,11,23]. The concept of a 'window of infectivity' has been widely supported, indicating increased bacterial acquisition during early childhood development [3,23,24]. Studies reported progressive colonization rates with increasing number of erupted teeth and higher salivary bacterial counts in caregivers [11,24,25]. Maternal transmission emerged as the dominant pathway of infection, with higher colonization observed in children whose mothers had elevated Streptococcus mutans levels [12,26,27]. Horizontal transmission from siblings, caregivers, and daycare environments also contributes to early microbial acquisition [27,28].

DISCUSSION

The ecological behavior of mutans streptococci is influenced by biological, environmental, and behavioral determinants that collectively shape oral microbial colonization patterns [15,18,29]. Frequent sugar consumption, prolonged bottle feeding, and poor oral hygiene significantly enhance bacterial metabolism and acid production, increasing the risk of dental caries [14,30,31]. The synthesis of extracellular glucans promotes plaque accumulation and biofilm stability on tooth surfaces [2,6,19]. Host factors such as salivary immunity, enamel defects, and genetic susceptibility further influence bacterial adherence and persistence within the oral cavity [17,29,32]. Recent microbiome studies (2020–2024) highlight the synergistic interaction between mutans streptococci and other oral microorganisms in early childhood caries progression [33–36].

Table 1. PRISMA Summary of Included Studies

Author (Year)	Country	Study Design	Sample Size	Age Group	Key Findings
Caufield et al. (1993)	USA	Longitudinal	Infants	0–3 years	Window of infectivity during tooth eruption
Berkowitz (2006)	USA	Review	Children	Infants	Maternal transmission dominant
Köhler et al. (1983)	Sweden	Clinical Study	Mother-child pairs	Infants	Maternal MS levels influence colonization
Wan et al.	Australia	Observational	Infants	Pre-dentate	Early bacterial

(2001)					colonization observed
Tanner et al. (2020)	USA	Microbiome Study	Children	Early childhood	Microbiome changes in ECC
Dzidic et al. (2018)	Europe	Microbiome Review	Children	Infancy–Childhood	Oral microbiome ecological development

REFERENCES:

1. Gupta, A., N. Mehta, and J. Wadhwa. "Prevalence and Association of Emotional Eating with Dental Caries in Indian College Students: A Cross Sectional Study." *Oral Sphere Journal of Dental Health Sciences*, vol. 1, no. 2, 2025, pp. 56–62.
2. Loesche, W. J. "Role of *Streptococcus mutans* in Human Dental Decay." *Microbiological Reviews*, vol. 50, no. 4, 1986, pp. 353–380.
3. Caufield, P. W., G. R. Cutter, and A. P. Dasanayake. "Initial Acquisition of Mutans Streptococci by Infants: Evidence for a Discrete Window of Infectivity." *Journal of Dental Research*, vol. 72, no. 1, 1993, pp. 37–45.
4. Berkowitz, R. J. "Mutans Streptococci Acquisition and Transmission." *Pediatric Dentistry*, vol. 28, no. 2, 2006, pp. 106–109.
5. Takahashi, N., and B. Nyvad. "The Ecological Plaque Hypothesis: Implications for Dental Caries Prevention and Management." *Journal of Dental Research*, vol. 90, no. 3, 2011, pp. 294–303.
6. Bowen, W. H., and H. Koo. "Biology of *Streptococcus mutans*–Derived Glucosyltransferases." *Caries Research*, vol. 45, no. 1, 2011, pp. 69–86.
7. Page, M. J., et al. "The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews." *BMJ*, vol. 372, 2021, n71.
8. Moher, D., et al. "Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement." *PLoS Medicine*, vol. 6, no. 7, 2009, e1000097.
9. Higgins, J. P. T., et al., editors. *Cochrane Handbook for Systematic Reviews of Interventions*. 2nd ed., Wiley, 2019.
10. Pitts, N. B., et al. "Dental Caries." *Nature Reviews Disease Primers*, vol. 3, 2017, 17030.
11. Berkowitz, R. J., and P. Jones. "Transmission of *Streptococcus mutans*." *Archives of Oral Biology*, vol. 30, no. 4, 1985, pp. 377–379.
12. Li, Y., and P. W. Caufield. "The Fidelity of Initial Acquisition of Mutans Streptococci by Infants from Their Mothers." *Journal of Dental Research*, vol. 74, no. 2, 1995, pp. 681–685.
13. Thorild, I., B. Lindau, and S. Twetman. "Prevalence of Mutans Streptococci in Children." *Caries Research*, vol. 36, no. 2, 2002, pp. 120–124.
14. Tanner, A. C. R., R. L. Kent Jr., et al. "Microbiome of Early Childhood Caries." *Journal of Dental Research*, vol. 90, no. 11, 2011, pp. 1298–1305.
15. Marsh, P. D. "Microbial Ecology of Dental Plaque and Its Significance in Health and Disease." *Advances in Dental Research*, vol. 8, no. 2, 1994, pp. 263–271.
16. Marsh, P. D. "Dental Plaque as a Biofilm and a Microbial Community: Implications for Health and Disease." *Journal of Dental Research*, vol. 83, no. 6, 2004, pp. 489–495.
17. Nyvad, B., and M. Kilian. "Microbiology of the Early Colonization of Human Enamel and Root Surfaces." *Caries Research*, vol. 24, no. 1, 1990, pp. 22–30.
18. Aas, J. A., B. J. Paster, et al. "Defining the Normal Bacterial Flora of the Oral Cavity." *Journal of Clinical Microbiology*, vol. 43, no. 11, 2005, pp. 5721–5732.
19. Koo, H., J. Xiao, and M. I. Klein. "Exopolysaccharides Produced by Cariogenic Bacteria." *Journal of Dental Research*, vol. 89, no. 12, 2010, pp. 1095–1104.
20. Kuramitsu, H. K. "Virulence Factors of Mutans Streptococci." *Critical Reviews in Oral Biology & Medicine*, vol. 4, no. 2, 1993, pp. 159–176.
21. Featherstone, J. D. "The Continuum of Dental Caries—Evidence for a Dynamic Disease Process." *Journal of Dental Research*, vol. 83, 2004, pp. C39–C42.
22. Petersen, P. E. "The World Oral Health Report 2003: Continuous Improvement of Oral Health in the 21st Century." *Community Dentistry and Oral Epidemiology*, vol. 31, 2003, pp. 3–24.
23. Caufield, P. W., and Y. Li. "Dental Caries: An Infectious and Transmissible Disease." *Compendium of Continuing Education in Dentistry*, vol. 26, 2005, pp. 5–16.
24. Wan, A. K. L., W. K. Seow, et al. "Association of *Streptococcus mutans* Infection and Oral Development in Infants." *Journal of Dental Research*, vol. 82, no. 7, 2003, pp. 504–508.
25. Law, V., W. K. Seow, and G. Townsend. "Factors Influencing Oral Colonization in Young Children." *Australian Dental Journal*, vol. 52, no. 2, 2007, pp. 93–100.

26. Köhler, B., and D. Bratthall. "Practical Preventive Measures and Transmission of Mutans Streptococci." *Archives of Oral Biology*, vol. 28, no. 3, 1983, pp. 225–231.
27. Mattos-Graner, R. O., and Y. Li. "Genotypic Diversity of Mutans Streptococci." *Oral Microbiology and Immunology*, vol. 16, no. 2, 2001, pp. 102–106.
28. Alaluusua, S., and O. V. Renkonen. "*Streptococcus mutans* Establishment in Children." *Caries Research*, vol. 17, no. 3, 1983, pp. 258–263.
29. Marsh, P. D., and D. A. Head. "Ecological Approaches to Oral Biofilms." *Advances in Dental Research*, vol. 27, no. 1, 2015, pp. 1–5.
30. Moynihan, P. J., and S. A. Kelly. "Effect on Caries of Restricting Sugars Intake." *Journal of Dental Research*, vol. 93, no. 1, 2014, pp. 8–18.
31. Sheiham, A., and W. P. James. "Diet and Dental Caries: The Pivotal Role of Sugars." *Journal of Dental Research*, vol. 94, no. 10, 2015, pp. 1341–1347.
32. Kidd, E. A. M., and O. Fejerskov. "What Constitutes Dental Caries?" *Caries Research*, vol. 38, no. 3, 2004, pp. 204–211.
33. Xiao, J., K. A. Fiscella, and S. R. Gill. "Oral Microbiome and Children's Health." *International Journal of Oral Science*, vol. 12, no. 1, 2020, p. 12.
34. Koo, H., and W. H. Bowen. "Candida albicans and *Streptococcus mutans*: A Synergistic Interaction." *Caries Research*, vol. 48, no. 2, 2014, pp. 121–129.
35. Gross, E. L., C. J. Beall, et al. "Beyond *Streptococcus mutans*: Dental Caries Onset Linked to Multiple Species by 16S rRNA Community Analysis." *Journal of Dental Research*, vol. 91, no. 7, 2012, pp. 631–637.
36. Hajishengallis, G., and R. J. Lamont. "Polymicrobial Synergy and Dysbiosis in Inflammatory Disease." *Trends in Molecular Medicine*, vol. 18, no. 11, 2012, pp. 689–698.

