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The Effect of Probiotic on Oral Health in Children : A Narrative Review

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Abstract

Introduction: Oral health problems, particularly dental caries, continue to be a significant global health challenge for children. Caries leads to pain, infection, impaired nutrition, and affect overall well-being. Probiotics, live microorganisms with potential health benefits, have emerged as a preventive measure in pediatric dentistry, particularly in managing oral microbiota. **Purpose:** This review evaluates the impact of probiotics on oral health in children, focusing on caries prevention, microbiota composition, plaque, gingival health, and salivary parameters. **Methods:** A narrative review was conducted, analyzing randomized controlled trials, clinical trials, and quasi-experimental studies published between 2010 and 2025. Data was synthesized qualitatively to identify trends and outcomes across various probiotic interventions. **Results:** Studies generally show that probiotics reduce cariogenic bacteria like *Streptococcus mutans*, improve plaque control, and enhance gingival health. However, long-term benefits for caries prevention remain inconsistent. The effectiveness of probiotics varies by strain, dosage, and delivery method. **Conclusion:** Probiotics hold promise as adjunctive agents in pediatric oral health care but are not a substitute for traditional oral hygiene practices. Further research, particularly long-term studies with standardized protocols, is essential to establish clear guidelines for their use in preventing caries in children.

Keywords: Children; dental caries; gingivitis; microbiota; oral health; probiotic

Introduction

Oral health problems in children remain a major global health concern, with dental caries recognized as the most common chronic disease in childhood.[1] These conditions can cause pain, infection, and impaired nutrition, negatively affecting growth, general health, quality of life, and school performance. Early childhood is a critical period for establishing oral habits and microbiota composition, which may have long-term implications for oral and systemic health.[2]

The oral microbiota plays a central role in pediatric oral health, as its composition determines susceptibility to caries and other oral diseases. A predominance of cariogenic bacteria, such as *Streptococcus mutans*, is strongly associated with caries development. Salivary pH, buffering capacity, plaque accumulation, and gingival inflammation are closely linked to the balance of oral microbiota. In children, the oral microbial ecosystem is more modifiable than in adults, providing opportunities for early preventive interventions.[3]

Probiotics, defined as live or inactivated microorganisms that confer health benefits when administered in adequate amounts, have emerged as a potential preventive approach in dentistry. In pediatric oral health, probiotics are proposed to compete with cariogenic bacteria, produce antimicrobial substances, and modulate host immune and inflammatory responses. Various probiotic delivery methods, including milk, lozenges, tablets, drops, curd, ice cream, and mouthwash, have been studied to optimize effectiveness and compliance in children.[4]

Despite their promise, evidence on the efficacy of probiotics in preventing dental diseases is inconsistent. Some studies demonstrate reductions in *S. mutans* levels, plaque accumulation, gingivitis, and caries incidence, while others report minimal or no long-term benefits. These discrepancies may result from differences in probiotic strains, dosage, duration, age groups, and outcome measures, complicating clinical decision-making.[5]

This narrative review aims to synthesize current evidence on the effect of probiotics on oral health in children. Specifically, it evaluates outcomes related to dental caries, oral microbiota, plaque, gingival health, and salivary parameters, providing insights relevant for preventive pediatric dentistry. Understanding the potential benefits and limitations of probiotics may inform strategies to improve oral health outcomes in children.[6]

Methods

Study Design

This study employs a narrative review approach to synthesize evidence on the effects of probiotics on oral health in children. The review focuses on experimental studies, primarily randomized controlled trials (RCTs), clinical trials, and quasi-experimental studies conducted in human subjects.

Search Strategy

Relevant literature was identified through structured searches of electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar, using combinations of keywords and Medical Subject Headings (MeSH) terms such as:

- “probiotics”
- “oral health” OR “dental caries” OR “gingivitis”
- “children” OR “pediatric”

Boolean operators and truncation were applied to refine the search (e.g., *probiotic* AND *oral health* AND *children*). Only studies published in English between 2010 and 2025 were considered to ensure contemporary relevance.

Inclusion criteria

The inclusion criteria for this review were established based on the PICOS framework. The target population (P) consisted of children aged 0 to 18 years. The evaluated interventions (I) included the administration of probiotics in any form, such as milk, tablets, candies, drops, toothpaste, or mouthwash, with or without comparison groups receiving a placebo or no intervention (C). The primary outcomes (O) focused on any oral health-related parameters. Regarding study design (S), randomized controlled trials, clinical trials, and quasi-experimental studies conducted in humans and published within the last 15 years (2010–2025) were considered eligible

Data Extraction

A standardized data extraction form was utilized to gather relevant details from each included study. The extracted data elements comprised the author(s) and publication year, study design, sample size, population characteristics, details of the probiotic intervention (type, dosage, and duration), comparison conditions, oral health outcomes, and the main findings.

Results

A total of 18 studies fulfilled the inclusion criteria and were subsequently included in this review. Most of the selected articles were randomized controlled trials investigating the effects of different probiotic strains on oral health outcomes among children. Considerable variation was observed across studies regarding the probiotic strains administered, methods of delivery, duration of intervention, and outcome parameters evaluated. The majority of studies focused on the impact of probiotics on cariogenic microorganisms, plaque accumulation, gingival condition, and salivary characteristics. A detailed summary of the studies included is presented in Table 1.

Table 1. Summary of Articles Examining the Effect of Probiotic on Oral Health in Children

Author, Year	Country	Sample Size (N)	Population	Age (Years)	Intervention	Control	Key Results	Follow-up (Months)
Hasslöf P et al.[1] 2013	Sweden	N=118 (56 probiotic, 62 placebo)	Children	4 months – 9 years (starting at 4–13 months)	Cereal enriched with *Lactobacillus paracasei F19* (1 x 10^8 CFU) daily for 9 months	Placebo cereal (without probiotic)	No significant long-term effects on caries frequency (dmfs/DMFS), *S. mutans*, or *lactobacilli* levels at age 9	108 months
Stensson M et al.[2] 2014	Sweden	N=113 (60 probiotic, 53 placebo)	Children	9 years	Drops with Lactobacillus reuteri ATCC 55730 (10^8 CFU daily) for 12 months (first year of life)	Placebo drops (oil without bacteria)	Significant reduction in primary caries prevalence at age 9 (82% caries-free in probiotic vs. 58% in control); also reduced gingivitis	108 months
Burton JP et al.[3] 2013	New Zealand	N=83 (40 probiotic, 43 placebo)	Schoolchildren	5 – 10 years	Sucrose-free lozenges with *S. salivarius* M18 (twice daily)	Placebo lozenges	Significant reduction in plaque accumulation (OHI-S) at 3 months, especially in high-plaque subjects; reduced *S. mutans* in colonized subgroups	7 months (3 months intervention + 4 months post intervention
Campus G et al.[4] 2014	Italy	N=191 registered (91 test, 90 control)	High-caries-risk schoolchildren	6–8 years	Sucrose-free lozenges with *Lactobacillus brevis* CD2 (2 × 10^8 CFU, twice daily) for 6 weeks	Placebo lozenges	Significant reduction in *S. mutans* concentration in saliva and plaque acidity (AUC 5.7 and 6.2)	2 months
Mishra R et al.[5] 2014	India	N=60 (20 per group)	Children	6–14 years	Probiotic mint tablets (Probiora3) dissolved in 5 mL water as rinse (twice daily) for 7 days	0.2% chlorhexidine or herbal mouthwash	Probiotics least effective for plaque index (PI) and *Streptococcus viridans* counts compared to active controls	0.25 months
Teanpaisan R et al.[6] 2015	Thailand	N=110	Adolescents	12–14 years	Powdered milk with *Lactobacillus paracasei* SD1 (daily) for 6 months	Placebo milk	Reduced salivary mutans streptococci (MS) levels and	12 months (6 months intervention

				(mean: 13.19)			caries risk, especially in high-risk groups	+ 6 months observation)
Ashwin D et al.[7] 2015	India	N=60 (30 per group)	Children	6–12 years	Probiotic ice cream with *Bifidobacterium lactis* Bb-12 and *Lactobacillus acidophilus* La-5 daily for 7 days	Placebo ice cream	Significant reduction in salivary *Streptococcus mutans* (SMS) levels	6 months
Tehrani MH et al.[8] 2016	Iran	N=53 (30 probiotic, 23 placebo)	Children with early childhood caries	3–6 years	Pedilact probiotic drops (*L. rhamnosus*, *L. reuteri*, and *Bifidobacterium lonqum* subsp) 5 drops nightly for 2 weeks	Placebo drops	Significant reduction in salivary *Streptococcus mutans* (SM); lactobacilli reduced in probiotic group but no intergroup difference	0.5 months
Pahumunto N et al.[9] 2018	Thailand	N=124 randomized, 103 completed	Preschool children	1.5–5 years	Milk with *Lactobacillus paracasei* SD1 (10^7 CFU/g), daily for 3 months	Standard non-probiotic milk	Significant reduction in salivary MS and delayed new caries development	6 months
Alamoudi N et al.[10] 2018	Saudi Arabia	N=178 (90 experimental, 88 control)	Preschool childreen	3–6 years	Probiotic lozenges *L. reuteri* DSM 17938 and ATCC PTA 5289, twice daily for 28 days	Placebo lozenges	Significant reductions in salivary mutans streptococci and lactobacilli; reduced plaque (OHI-S)	1 months
Villavicencio J et al.[11] 2018	Colombia	N=363 (119 intervention, 202 control)	Preschool children	3–4 years	Fortified milk with (*Lactobacillus rhamnosus* and *Bifidobacterium lonqum*), 200 mL, for 9 months (weekday)	Standard control milk	Significant reduction in salivary *Lactobacillus spp.* (p=0.002) and increased saliva buffer capacity (p=0.000). no differences in *S. mutans* or ICDAS caries	9 months
Manmontri C et al.[12] 2019	Thailand	N=487 recruited, 268 analyzed	Preschool children	1–5 years	Probiotic milk (*Lactobacillus paracasei* SD1) daily or triweekly for 6 months	Daily placebo milk	Significant reductions in salivary and plaque *S. mutans* (both doses) increased total lactobacilli	12 months (6 months intervention + 6 months post intervention)
Manikandan S et al.[13] 2020	India	N=40 (20 probiotic, 20 green tea)	Schoolchildren	6–8 years	Probiotic mouthwash powder (10 mL, 1 min) for 1 month	Green tea mouthwash	Significant salivary pH increase in probiotic group (5.60–7.20)	1 month

Borrell García C et al.[14] 2021	Spain	N=27 (12 experimental, 15 control)	Adolescents	12–18 years	Probiotic tablets (*L. reuteri* DSM 17938/ATCC PTA 5289) $1x10^8$ CFU/tablet, daily for 28 days	Placebo tablets	Reductions in *S. mutans*, plaque, gingivitis, and bleeding (not statistically significant); attenuated *S. mutans* increase	1.5 month
Duraisamy V et al.[15] 2021	India	N=40 (20 probiotic, 20 synbiotic)	Schoolchildren	6–12 years	Nilgiris probiotic curd (100 mL daily) for 15 days	Synbiotic curd (probiotic powder + oats)	Significant salivary *Streptococcus mutans* reduction in both groups (p=0.001); greater inhibition in probiotic group	0.5 month
Sakhare S et al.[16] 2021	India	N=57 (31 study, 26 control)	Schoolchildren	6–12 years	Amul probiotic curd *L.acidophilus* (La5) and *B. lactis* (Bb12)), 100g, twice daily for 21 days	No intervention	Significant salivary *Streptococcus mutans* reduction after 24 days (p=0.05); no pH change	0.8 month
Krupa NC et al.[17] 2022	India	N=30 (10 probiotic, 10 CHX, 10 xylitol)	High-caries-risk schoolchildren	5–12 years	Probiotic mouthwash (5-strain mix; 15 mL daily) for 14 days	0.2% chlorhexidine or 10% xylitol mouthwash	Plaque *Streptococcus mutans* reduction lowest in probiotics vs. active controls	0.5 month
Staszczyk M et al.[18] 2022	Poland	N=140 (127 completed: 57 probiotic, 70 control)	Preschool children	3–6 years	Chewable tablets with heat-inactivated *Lactobacillus salivarius*, daily for 2 weeks	Usual care	Significant reductions in caries incidence and prevalence at 12 months (p=0.001)	12 months

Discussions

Most studies examining the effects of probiotics on oral health in children have demonstrated positive outcomes, particularly in microbiological parameters. The reduction of harmful oral bacteria, such as *Streptococcus mutans*, is the most consistently reported effect across studies.[2] However, while probiotics show promising results for microbial balance, the long-term benefits for caries prevention remain inconsistent. The evidence suggests that probiotics may act as adjunctive preventive agents, complementing conventional oral care measures, rather than replacing them.[6] Furthermore, the benefits of probiotics are generally more evident in short- to medium-term interventions, with more limited evidence for their effectiveness in the long term.[9]

Effect of Probiotics on Cariogenic Bacteria

One of the most consistent findings in studies involving probiotics is the reduction of *Streptococcus mutans*, a major contributor to dental caries.[4] This effect is particularly noticeable in preschool-aged children and those at high risk for caries.[8] Additionally, the reduction of lactobacilli has been observed in some studies, while others report an increase. This variation can be attributed to the strain-specific effects of probiotics, as different strains interact with the oral microbiota in distinct ways.[11] Probiotics are believed to work through mechanisms such as competitive adhesion to the tooth surface, the production of bacteriocins that inhibit harmful bacteria, and the modification of local pH to create a less favorable environment for cariogenic bacteria.[5]

Impact on Dental Caries and Plaque Accumulation

Long-term studies investigating the impact of probiotics on dental caries have shown mixed results. Some studies reported a reduction in caries prevalence or a delay in caries development.[10] In contrast, short-term studies have more consistently demonstrated reductions in plaque accumulation and improvements in oral hygiene indices.[12] However, it is important to note that microbiological changes, such as the reduction of cariogenic bacteria, do not always immediately translate into a decrease in caries development. This suggests that while probiotics may help improve the oral microbiota, other factors, including dietary habits and oral hygiene practices, play a significant role in caries prevention.[2]

Effects on Gingival Health and Salivary Parameters

Several studies have highlighted the positive impact of probiotics on gingival health, with reductions in gingivitis and bleeding observed in probiotic-treated groups.[8,9] Additionally, improvements in salivary parameters, such as increased salivary pH and buffering capacity, have been noted.[13] These effects suggest that probiotics not only target harmful bacteria but also contribute to a healthier oral environment overall. By enhancing the buffering capacity and pH of saliva, probiotics may help protect teeth from acid erosion and support the neutralization of harmful acids in the mouth.[15]

Influence of Strain, Delivery Method, and Duration

The effectiveness of probiotics in improving oral health varies significantly depending on the strain used. Different probiotic strains, such as *Lactobacillus reuteri*, *L. paracasei*, *S. salivarius*, and *Bifidobacterium*, have shown varying degrees of efficacy in reducing cariogenic bacteria and improving oral health parameters.[1] The method of delivery, including milk, lozenges, tablets, or drops, also influences compliance and exposure. Milk and curd, for example, promote good compliance with daily exposure, while lozenges and tablets provide direct oral contact.[12] Dairy-based delivery vehicles may also provide additional oral health benefits because they naturally contain calcium, phosphate, and casein, which support enamel remineralization and enhance salivary buffering capacity.[11] Furthermore, the semisolid consistency of curd may prolong oral retention time, potentially increasing probiotic interaction with the dental biofilm. These properties may create a synergistic effect between probiotics and the dairy matrix in reducing cariogenic activity and supporting oral homeostasis.[16] Mouthwash, on the other hand, offers a shorter contact time. Short interventions may temporarily alter bacterial counts, but their effects often do not persist after discontinuation. Continuous or early-life administration of probiotics may provide more lasting benefits, suggesting that probiotics may be more effective when used as part of a long-term strategy.[3]

Comparison with Conventional Agents

Several studies have compared probiotics with traditional agents, such as chlorhexidine and xylitol, in the prevention of oral health issues. While probiotics are generally considered safer and better accepted by children, they tend to be less potent than chlorhexidine, especially in terms of bacterial reduction.[17] The main advantage of probiotics over chlorhexidine is their lower risk of side effects, such as staining of the teeth or altered taste perception, which can

affect children's acceptance of the treatment. Additionally, probiotics are well-tolerated, with fewer reported adverse effects, making them a viable alternative or adjunct to traditional oral health measures.[17]

Limitations of Current Evidence

Despite the promising findings, several limitations exist within the current body of evidence. Some studies report no significant long-term effects of probiotics on oral health.[10] Potential reasons for these inconsistencies include short follow-up periods, small sample sizes, low probiotic dosages, and differences in outcome measurement methods. These factors contribute to heterogeneity in study results, complicating the interpretation of the effectiveness of probiotics in oral health.[18] Furthermore, there is a lack of standardized protocols across studies, and most studies have been of relatively short duration, with limited long-term randomized controlled trials available.

Implications and Future Research

To better understand the role of probiotics in pediatric oral health, there is a clear need for well-designed, long-term randomized controlled trials. Standardization of probiotic strains, dosages, and outcome assessment methods will also be crucial for comparing results across studies. Future research should explore the potential of probiotics as part of comprehensive preventive oral health programs, particularly for high-risk pediatric populations.[12] Given the promising effects of probiotics on oral microbiota, future studies should focus on their role in preventing caries and supporting oral health in vulnerable groups, with a focus on developing effective and accessible delivery methods.[9] Current evidence suggests that probiotics may provide supportive benefits in maintaining oral health. However, their long-term effectiveness in caries prevention remains inconclusive. Therefore, probiotics should be considered adjunctive preventive agents that complement conventional oral hygiene practices rather than substitutes for proper toothbrushing and established caries prevention measures.

Conclusion

Based on the evidence summarized in this review, probiotics have demonstrated positive effects on oral health in children, particularly in reducing cariogenic bacteria such as *Streptococcus mutans* and improving plaque control, gingival health, and salivary parameters.

The effects are more consistent in short-to medium-term interventions and appear to be strain-specific and influenced by delivery method, dosage, and duration of administration. Although probiotics show promise as adjunctive preventive agents, their impact on long-term caries prevention remains variable, and they cannot replace conventional oral hygiene measures. Future research should focus on well-designed, long-term randomized controlled trials with standardized protocols to establish the optimal use of probiotics in pediatric oral health, especially for high-risk populations.

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