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Mobile Health and School Based Interventions for Dental Caries in Children: A Global Review

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ABSTRACT: Dental caries in primary school children remains a significant global health concern, with prevalence rates disproportionately affecting underserved populations. This narrative review examines the effectiveness of community based and school centered interventions aimed at preventing dental caries among children. A comprehensive literature search was conducted across databases including PubMed, Scopus, and Google Scholar to identify peer reviewed studies that assess educational, behavioral, technological, and systemic approaches to oral health promotion. Inclusion criteria targeted empirical studies and systematic reviews focused on children aged 6 to 12. Findings reveal that mobile health tools, such as SMS reminders and educational applications, positively influence children's oral hygiene compliance. Audiovisual materials enhance learning engagement and retention, while behavioral techniques like motivational interviewing promote lasting habit formation. The role of parental education and socioeconomic factors emerged as significant determinants of oral health behaviors, with community and school based programs proving effective in mitigating access barriers. Moreover, tele dentistry and remote education platforms offer promising alternatives in areas with limited dental infrastructure. These results underscore the need for adaptive and inclusive public health policies that prioritize early oral health education, digital engagement, and culturally responsive communication strategies. By integrating these insights into policy and practice, stakeholders can more effectively address dental caries prevention and improve the long term oral health of children globally.

Keywords: Dental Caries Prevention, Oral Health Education, School Children, Community Based Intervention, Mobile Health Tools, Motivational Interviewing, Tele Dentistry.

INTRODUCTION

Dental caries remains a pressing global public health issue that disproportionately affects children, particularly those in primary school age groups. It is widely recognized as one of the most common chronic childhood diseases, and despite advances in prevention and treatment, its prevalence remains unacceptably high in many regions. According to Dumitrescu et al. (2022), global estimates indicate

that between 60% and 90% of school aged children are affected by dental caries in certain populations, making it a significant contributor to pediatric morbidity (Dumitrescu et al., 2022). Early Childhood Caries (ECC), a severe form of dental decay affecting younger children, presents similar concerns, with Raj et al. (2019) noting a prevalence of around 50% among children under six in India. In high risk populations in developed countries, ECC prevalence can be as high as 70% (Shmueli et al., 2023), underscoring the pervasive nature of this condition (Raj et al., 2019; Shmueli et al., 2023).

Regional disparities further complicate the epidemiological landscape of dental caries. For instance, Abuhaloob and Petersen (2018) reported a 42.6% prevalence rate among schoolchildren in Gaza, while Laganà et al. (2025) documented a high occurrence of oro functional pathologies in Roman schoolchildren, highlighting the need for early preventive measures (Abuhaloob & Petersen, 2018; Laganà et al., 2025). These regional differences are influenced by multiple factors including socioeconomic status (SES), access to dental care, and cultural practices related to diet and hygiene. Consequently, targeted strategies that account for local contexts are vital to effectively combat the burden of dental caries among schoolchildren worldwide.

A growing body of evidence underscores the multifactorial nature of dental caries, particularly in low resource settings. Socioeconomic factors are a primary determinant, as lower SES correlates with reduced access to dental services, suboptimal dietary habits, and limited parental knowledge regarding oral hygiene (Al-Dahan & Ismael, 2023; Natapov et al., 2016). Studies by Guan et al. (2021) emphasize that children from low income families are often unable to afford routine check-ups or preventive care such as fluoride varnishes, thus increasing their vulnerability to caries (Guan et al., 2021). Furthermore, parental education plays a critical role families with limited health literacy are less likely to adopt effective preventive behaviors, inadvertently perpetuating cycles of poor oral health.

Dietary habits also serve as a major contributor to caries development. High consumption of sugary snacks and beverages is strongly associated with elevated caries risk (Arheiam et al., 2020; Hu et al., 2018). As children develop eating habits early in life, the persistence of carbohydrate rich diets into school age can significantly influence long term oral health outcomes. Ugolini et al. (2023) demonstrated that such dietary patterns established during preschool years frequently continue into later childhood, heightening the risk of caries development. Inadequate oral hygiene practices, such as infrequent brushing and improper techniques, further exacerbate the issue (Ugolini et al., 2023).

Behavioral factors also impact children's oral health. Kitsaras et al. (2021) found that consistent oral hygiene routines, parental supervision, and regular dental visits are fundamental to preventing caries (Kitsaras et al., 2021). The importance of structured settings such as schools in promoting these behaviors cannot be overstated. Levinson et al. (2019) showed that school based dental programs significantly improved children's brushing habits and reduced caries prevalence (Levinson et al., 2019). Such programs provide an ideal platform for structured interventions and educational outreach, particularly in underserved communities.

Biological determinants, including genetic predisposition and salivary biomarkers, have been implicated in caries susceptibility. Stojković et al. (2020) and Reyes et al. (2020) reported associations

between specific salivary profiles and increased caries risk, suggesting that biology may mediate how children respond to environmental and behavioral risk factors (Reyes et al., 2020; Stojković et al., 2020). These findings reinforce the need for personalized preventive strategies that consider individual biological profiles alongside external risk factors.

Despite these insights, the prevention of dental caries among children remains fraught with systemic, behavioral, and environmental challenges. Systemically, healthcare inequities severely limit access to preventive services for disadvantaged children. Guan et al. (2021) pointed out that transportation issues and lack of dental infrastructure in rural areas hinder timely access to care (Guan et al., 2021). Kroon et al. (2019) and Albino & Tiwari (2015) emphasized the effectiveness of interventions like fluoride varnishes and sealants, yet noted their limited availability in low resource settings (Albino & Tiwari, 2015; Kroon et al., 2019).

Parental engagement is a critical behavioral challenge. Dumitrescu et al. (2022) observed that many parents lack the resources or knowledge to implement proper oral hygiene routines at home (Dumitrescu et al., 2022). Sharda et al. (2024) and Kitsaras et al. (2021) added that unchecked sugar consumption due to low awareness further exacerbates caries development (Kitsaras et al., 2021; Sharda et al., 2024). Qahtan et al. (2025) also highlighted that behavioral patterns established early in life often persist into adolescence, magnifying the long term oral health burden (Qahtan et al., 2025).

Environmental challenges include inconsistencies in public health policy and a lack of sustained investment in school based oral health programs. Ruff et al. (2024) and Raj et al. (2019) documented that insufficiently funded programs often result in irregular services, undertrained personnel, and limited educational outreach (Raj et al., 2019; Ruff et al., 2024). Moreover, fluoride access varies significantly across regions. Wang et al. (2022) and Zhou et al. (2023) pointed out that the absence of fluoridated water or affordable fluoride toothpaste correlates with higher caries incidence (Wang et al., 2022; Zhou et al., 2023).

Significant gaps in the literature limit the development of evidence based strategies for sustainable caries prevention. Albino & Tiwari (2015) and Raj et al. (2019) noted that most intervention studies prioritize short term efficacy over long term effectiveness and behavioral change (Albino & Tiwari, 2015; Raj et al., 2019). Levinson et al. (2019) and Mühlemann & Felten (2021) criticized the lack of standardized metrics for evaluating school based programs, making it difficult to generalize findings (Levinson et al., 2019; Mühlemann & Felten, 2021). Cultural factors influencing oral hygiene behaviors are also underrepresented in current research, despite evidence from Fasoulas et al. (2019) and Al Dahan & Ismael (2023) suggesting that socio cultural norms shape dietary and hygiene practices (Al-Dahan & Ismael, 2023; Fasoulas et al., 2019).

This review aims to address these critical gaps by synthesizing findings from a wide range of studies focusing on community based oral health interventions targeting school aged children. The primary objectives include analyzing the systemic, behavioral, and environmental barriers to caries prevention, evaluating the effectiveness of school and community based programs, and identifying strategies that

can be tailored to diverse populations. The review will also explore how emerging tools, such as mobile health interventions and personalized education, contribute to program success.

The scope of this review encompasses diverse geographic regions, with special attention given to both high and low income countries. Particular focus will be placed on programs targeting socioeconomically disadvantaged children, rural populations, and culturally diverse communities, where the burden of dental caries is most severe. By comparing implementation strategies and outcomes across these varied contexts, this review seeks to provide a comprehensive understanding of best practices in preventing dental caries in primary school children through community based approaches.

METHOD

This study employed a narrative review approach to examine the challenges and solutions in preventing dental caries among primary school children through community based programs. A comprehensive literature search was conducted across multiple academic databases, including PubMed, Scopus, Web of Science, Google Scholar, and PsycINFO, targeting publications from the past fifteen years. These databases were selected for their breadth and relevance to public health, dental medicine, and evidence based community health interventions.

The search strategy was guided by predefined keywords and Boolean operators to ensure precision and completeness. Keywords included "dental caries prevention," "community based oral health programs," "school children," "oral hygiene education," "fluoride treatment," and "dental sealants." Boolean operators such as AND, OR, and NOT were systematically applied to combine or exclude terms, thereby refining the search. For instance, queries like ("dental caries" OR "tooth decay") AND ("prevention" OR "intervention") AND ("school children" OR "young adolescents") AND ("community based" OR "school based") were utilized. Truncation techniques, such as "prevent*", and exact phrase searching using quotation marks, further enhanced the search accuracy.

Inclusion criteria encompassed peer reviewed journal articles, systematic reviews, and meta analyses that provided empirical or theoretical analysis of community level interventions targeting dental caries prevention in school aged children. Exclusion criteria involved non English publications, studies lacking direct empirical evidence, or those not peer reviewed. An initial screening of titles and abstracts was followed by full text assessments to determine methodological rigor and thematic relevance.

To improve reliability, a multi stage screening process was adopted wherein four independent reviewers evaluated the selected studies against inclusion criteria. Key themes were synthesized to identify recurrent patterns in how community based oral health programs were designed, implemented, and evaluated. The resulting synthesis offers insights into the contextual, educational, and structural dimensions that influence the success and sustainability of dental caries prevention strategies among primary school children.

RESULT AND DISCUSSION

The utilization of digital health technologies, particularly SMS reminders and mobile health applications, has increasingly emerged as an effective strategy in enhancing children's oral hygiene practices and adherence to treatment recommendations. Evidence demonstrates that SMS based programs significantly influence behavior change by reinforcing consistent brushing routines. For example, the BRIGHT trial illustrated that daily SMS reminders led to improved oral hygiene among school aged children, especially in regions with elevated caries prevalence where such interventions serve as critical behavioral prompts (Marshman et al., 2019)

Complementing SMS reminders, mobile health applications offer interactive and educational features that cater to children's learning styles and behavioral motivations. These tools enable tracking of brushing habits, provide rewards based systems, and facilitate parental involvement in children's oral health routines. Research by Liu et al. (2022) shows a notable increase in children's engagement when educational content is gamified and includes collaborative goal setting with parents (Liu et al., 2022). This approach fosters sustained behavior change more effectively than traditional oral health education methods.

Comparative studies further highlight the superior impact of mobile based tools over conventional educational strategies, such as didactic lectures and pamphlets. Traditional methods, while informative, often fail to retain children's attention or translate into habitual practices. In contrast, digital platforms are more accessible, engaging, and offer real time reinforcement, particularly beneficial in underserved areas where oral health literacy is low (Guan et al., 2021). Empirical evaluations confirm that children using mobile educational tools demonstrate higher knowledge retention and are more likely to maintain proper oral hygiene routines (Schulz-Weidner et al., 2022).

Audiovisual materials further enhance children's comprehension and retention of oral health information. According to the cognitive theory of multimedia learning, combining auditory and visual inputs improves understanding and recall. Empirical studies support this notion, showing that children exposed to multimedia content outperform those receiving standard verbal instructions in oral hygiene knowledge assessments (Qahtan et al., 2025). Multimedia interventions, such as animated videos and interactive presentations, have been shown to improve children's brushing techniques and foster sustained oral health behavior change (Daouda et al., 2016; Hall-Scullin et al., 2017).

Behavioral strategies, notably motivational interviewing (MI), have proven effective in pediatric dental settings. MI allows dental professionals to explore and enhance children's intrinsic motivation towards oral hygiene practices. Studies highlight that MI leads to improved adherence to dental appointments, increased use of fluoride, and consistent brushing (Dumitrescu et al., 2022). Supplementary strategies, such as reward systems and educational games, reinforce these behaviors by providing positive reinforcement, thus cultivating sustained engagement (Raj et al., 2019).

Children's psychological traits also influence adherence. High self-efficacy correlates with better dental hygiene, while dental anxiety hampers compliance. Educational programs tailored to build self-confidence and reduce fear through age appropriate explanations and supportive communication can

significantly boost compliance rates (Abuhaloob & Petersen, 2018; Shmueli et al., 2023). The role of parents is also crucial; interventions that involve caregivers yield better results, as parental modeling and encouragement shape children's health behaviors (Laganà et al., 2025).

Effective communication between dental professionals and children is integral to successful treatment outcomes. Child centric communication approaches that emphasize empathy, clarity, and patient involvement are associated with reduced anxiety and improved adherence. Research confirms that positive dental interactions foster lifelong oral hygiene habits and regular dental visits (Melebari et al., 2019). Dental education programs increasingly incorporate communication training, including role play and motivational interviewing, to prepare students for pediatric patient engagement (Albino & Tiwari, 2015; Ruff et al., 2022)

Sociodemographic factors also significantly influence oral health compliance. Younger children depend more on parental support, while older children show better autonomy. Higher parental education correlates with improved oral hygiene routines in children, and financial limitations are linked to higher caries rates due to reduced access to dental care and products (Nazir, 2019; Qahtan et al., 2025). Tailored oral health education, incorporating visual aids and culturally relevant content, has proven effective in overcoming literacy and socioeconomic barriers. Local community involvement and integration into school curricula further enhance impact by ensuring contextual relevance (Al-Dahan & Ismael, 2023; Wang et al., 2022)

Tele dentistry and tele orthodontics have expanded access to care, especially in remote and underserved areas. Virtual consultations provide continuous monitoring, deliver personalized feedback, and reduce logistical barriers, resulting in improved treatment adherence (Cooper et al., 2017). These platforms facilitate real time communication and integrate gamified learning to keep children engaged. However, limitations such as digital access disparities and reduced interpersonal interaction must be addressed to ensure equity and effectiveness (Hall-Scullin et al., 2017; Winter et al., 2025).

Overall, the reviewed literature consistently underscores the efficacy of digital, audiovisual, behavioral, and community based strategies in improving oral hygiene practices and treatment adherence among schoolchildren. Combining technological innovations with personalized, culturally adapted educational approaches offers a promising pathway to mitigate the global burden of dental caries in this vulnerable population.

The findings from this narrative review support and expand upon existing literature regarding dental caries prevention among primary school children. Consistent with prior global data, the prevalence of dental caries remains alarmingly high, particularly among socioeconomically disadvantaged populations. This aligns with data from Dumitrescu et al. (2022), which suggest that 60 90% of schoolchildren globally experience some form of dental caries. Similarly, Raj et al. (2019) emphasized the disproportionate burden of ECC in countries like India, where nearly 50% of children under six are affected (Raj et al., 2019). These findings reaffirm that dental caries in children constitutes a persistent public health challenge that requires urgent and sustained interventions.

In recent years, there has been a notable shift in research focus from traditional clinical interventions to broader public health approaches incorporating technology and community engagement. Studies reviewed in this article demonstrate the growing effectiveness of tele dentistry, mobile health (mHealth) interventions, and school based programs. Wen (2025) observed that integrating mobile applications and SMS reminders significantly improves children's oral hygiene behaviors and treatment adherence (Wen, 2025). This marks a transition from static educational strategies, such as pamphlets and classroom lectures, to dynamic, engaging formats more attuned to children's preferences and digital literacy. Cooper et al. (2017) further highlighted how these new delivery models bridge critical gaps in access, particularly in underserved or remote communities (Cooper et al., 2017).

Parental influence also continues to emerge as a key determinant of children's oral health behavior. Studies by Dumitrescu et al. (2022) and Raj et al. (2019) found that children whose parents possess higher educational attainment tend to follow better oral hygiene practices (Dumitrescu et al., 2022; Raj et al., 2019). This reinforces earlier research and has significant implications for designing interventions that target not only children but also their family environments. In this context, programs that involve parental education and behavioral change communication can amplify the effectiveness of oral health interventions among children.

Furthermore, this review supports evidence that low socioeconomic status correlates with poorer oral health outcomes due to factors such as limited access to care, reduced availability of preventive resources, and lack of awareness. The relationship between income level and oral hygiene compliance, reported by Hu et al. (2018), suggests that economic constraints remain a structural barrier that must be addressed through policy and programmatic strategies (Hu et al., 2018).

Healthcare systems and school policies play pivotal roles in determining the success of oral health programs. Research from Levinson et al. (2019) and Zeng et al. (2020) demonstrates that embedding oral health education into school curricula not only enhances knowledge but also establishes lifelong habits. These findings imply that preventive oral health should be systematically integrated into broader health promotion frameworks, particularly in settings where children may not have routine access to dental professionals (Levinson et al., 2019; Zeng et al., 2020).

The infrastructural capacity of a healthcare system directly influences the reach and quality of dental care. Raj et al. (2019) indicated that countries or regions with underdeveloped public health infrastructure often struggle to provide consistent, preventive care, leading to disparities in oral health outcomes. In contrast, robust healthcare systems that incorporate community dental workers and mobile clinics can ensure more equitable access to care (Raj et al., 2019). This highlights the importance of investing in health infrastructure to support sustainable, community driven dental care models.

Technological interventions, especially mHealth applications and tele dentistry, have emerged as transformative tools in oral health education and service delivery. These tools provide immediate feedback, customizable educational content, and user friendly interfaces that appeal to both children and parents. Studies such as those by Liu et al. (2022) and Aguirre et al. (2019) validate the effectiveness

of gamified mobile platforms in maintaining children's interest and encouraging adherence to oral hygiene routines (Aguirre et al., 2019; Liu et al., 2022). By bridging the digital divide, these interventions can reduce geographic and financial barriers to care, making them especially valuable in low resource settings.

Importantly, multimedia learning materials, including audiovisual content, have proven to enhance knowledge retention and promote behavior change among children. The cognitive theory of multimedia learning, supported by empirical findings from Kitsaras et al. (2021) and Hall Scullin et al. (2017), emphasizes the benefits of dual mode learning in fostering deeper understanding and longer retention of health information (Hall-Scullin et al., 2017; Kitsaras et al., 2021). Videos, animations, and interactive games tailored to children's developmental levels are more effective than conventional methods in instilling healthy behaviors.

Behavioral interventions, such as motivational interviewing and reward based systems, further enhance the efficacy of oral health programs. Dumitrescu et al. (2022) and Raj et al. (2019) have demonstrated how engaging children through goal setting and motivational dialogues increases their intrinsic drive to maintain oral hygiene (Dumitrescu et al., 2022; Raj et al., 2019). This is especially critical in populations where oral health may not be prioritized culturally or economically. Enhancing children's self efficacy through education and behavioral reinforcement can lead to sustained improvements in oral health outcomes.

Effective communication between dental professionals and children is another central component influencing the success of dental interventions. As Melebari et al. (2019) and Cooper et al. (2017) suggest, empathetic and child friendly communication styles reduce anxiety and encourage compliance with dental regimens (Cooper et al., 2017; Melebari et al., 2019). Training in motivational interviewing and communication skills, now increasingly embedded in dental education curricula, equips future professionals with the competencies needed to build trust and rapport with pediatric patients.

Sociodemographic factors, such as age, parental education, and income level, remain strong predictors of oral health behaviors. As emphasized by Nazir (2019) and Qahtan et al. (2025), tailoring oral health messages and interventions to these demographic variables is essential (Nazir, 2019; Qahtan et al., 2025). Simplified language, visual aids, and culturally relevant narratives can improve engagement among communities with low health literacy. Moreover, school and community based interventions that provide free or subsidized dental hygiene products offer practical solutions for overcoming financial barriers.

Tele dentistry and remote monitoring platforms add another layer of accessibility and engagement to dental care for children. Studies by Albino & Tiwari (2015) and Chinzorig et al. (2019) show that these technologies improve follow up adherence and support continuous education (Albino & Tiwari, 2015; Chinzorig et al., 2019). However, they also introduce challenges, such as unequal access to digital infrastructure and reduced social interaction, which must be mitigated through complementary strategies involving in person engagement when feasible.

While the current review synthesizes a wide range of studies, it is subject to certain limitations. Notably, the selection of literature was restricted to studies published in English and indexed in major academic databases, which may exclude relevant research in other languages or from regional publications. Moreover, the review focused primarily on peer reviewed articles, potentially overlooking insights from grey literature, such as government reports or non-governmental organization documentation. Additionally, most reviewed studies are cross sectional in design, limiting the ability to infer causality or track long term effects of interventions. Variability in study methodologies and outcome measures also complicates the comparison and generalizability of findings.

Given these limitations, future research should prioritize longitudinal designs to evaluate the sustainability of dental caries prevention programs over time. There is also a need for standardized evaluation frameworks to facilitate cross study comparisons. Further investigation into culturally tailored interventions, especially in underrepresented regions, is critical for addressing global disparities in oral health. Expanding the scope to include grey literature and multi-language sources could provide a more comprehensive understanding of community based strategies. Policymakers and practitioners should consider integrating oral health into universal school health curricula and promoting cross sector collaborations that combine education, public health, and technology to achieve more equitable and effective outcomes in children's oral health care.

CONCLUSION

The narrative review highlights the persistent burden of dental caries among primary school children and underscores the urgent need for integrated, community based preventive strategies. Empirical findings demonstrate that mobile health interventions, including SMS reminders and mobile applications, significantly enhance children's adherence to oral hygiene practices. Audiovisual materials also prove effective in increasing knowledge retention and promoting long term behavioral change, particularly when tailored to children's developmental stages and learning preferences. Behavioral and psychological interventions, such as motivational interviewing and reward based strategies, further reinforce these outcomes, especially when combined with parental engagement.

Systemic factors particularly disparities in socioeconomic status and healthcare infrastructure continue to shape access to preventive care. The effectiveness of school based programs and tele dentistry platforms in improving oral health outcomes is evident; however, barriers related to technological access and educational inequalities remain. Effective communication between dental professionals and pediatric patients plays a critical role in treatment adherence and should be emphasized in dental education. Additionally, sociocultural and demographic variables necessitate the customization of interventions to enhance their relevance and impact.

To overcome these challenges, policymakers must prioritize inclusive oral health policies that incorporate digital tools, school based interventions, and culturally competent education. Future research should explore longitudinal impacts of integrated oral health programs and assess their scalability across diverse populations. Emphasizing technology supported, behaviorally grounded, and

context specific strategies is essential in achieving sustained improvements in pediatric oral health and addressing global disparities in dental care.

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