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REVIEW ARTICLE

Effectiveness of School Dental Health Programs: A Review with Insights from India

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Abstract

Schools provide a vital platform for dental health promotion since children spend a large amount of time there, which shapes their habits and overall health. Oral health initiatives in schools are designed to reduce the burden of dental problems including dental caries and gingival disease, which have an impact on their oral health and general well- being. These worldwide initiatives encompass dental hygiene instructions, fluoride application, and preventative measures. With an emphasis on India's experience, this review addresses the school dental health programmes worldwide influence.

Keywords: School dental health programs, Oral health, India

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Graphical Abstract



Introduction

Dental caries, periodontal diseases, and tooth loss are examples of oral disorders that are major global public health concerns because of their extensive effects on general health and quality of life [1]. Approximately 60–90% of school-age children globally experienced dental caries, with over 531 million children experiencing caries of the deciduous teeth [2-3]. Dental caries is the most common multifactorial preventable disease [4]. Gingivitis symptoms were present in the majority of children and adolescents and adverse periodontitis, which can result in early tooth loss, affected about 2% of children [2]. In addition to causing pain and limiting oral functions, oral illnesses can also impede nutrition, induce emotional stress, lower self-esteem. poor attendance. and substandard academic achievement [5-8]. Schools are the best places to promote health because they can reach the majority of school-age children and act as vital support systems for their families and

communities [9-10]. While there are significant differences between nations and genders, 60% of children worldwide finish at least four years of schooling, and 80% of children attend primary schools [11]. Overall, school-based initiatives can improve children's access to dental care, particularly for those from low-income families [12].

Historical background of school dental health program in India

- In 1909 the beginning of school dental health in India was started when for the first time medical examination of school children was carried out in Baroda city of Gujarat.
- In 1946 Bhore committee stated that school health services were practically non-existent in India, and if existed they were in underdeveloped state.
- In 1957, WHO and Nutrition Education Committee assisted set up of school health education project.

- In 1960 the, government of India constituted a school health committee, and submitted its report in 1961.
- In 1977 centrally sponsored National School Health Scheme was started. In January 1982, the task force constituted by the government of India to accomplish the School Health Survey Project, submitted its report. Only 14 states had shown some progress with their own health department budgets.
- The Tokyo declaration was made on July 19th, 2001 at the 1st Asian conference of oral health promotion for school children, held in Tokyo.
- Ayutthaya Declaration (2003) and Bangalore Declaration (2005) also stressed on oral health promotion among school children [13].

School Dental Health Programs

1. Fit for school programmes

The **"Fit for School"** program is a schoolbased initiative focused on improving water, sanitation, and hygiene (WASH) to enhance child health in Southeast Asia, particularly in countries like Cambodia, Indonesia, and Lao PDR. The program was launched in 2009. As part of its oral health component, this program promotes regular teeth brushing with fluoride toothpaste (0.3 ml, 1450 ppm). The results of this program was promising in terms of decrease in dental caries prevalence compare to the children of control school [14].

2. Fluoride 'mouth rinse' programme

In 1974, FDA had given official recognition of safety for fluoride mouth rinsing program followed by ADA in 1975. Fluoride mouth rinse was most widely used in-school fluoride program in the US. Apart from the United States, 7 other nations-Denmark, Finland, New Zealand,

Netherlands. Norway. Thailand and Sweden also supported the mouth rinse programmes. It is usually supervised by classroom teachers or other adult volunteers. Several research conducted in schools have shown that administering fluoride tablets daily or rinsing the mouth with fluoride solution once a week resulted in reduction of dental caries incidence by 30 to 40 percent in areas lacking fluoride [15]. In fluoride deficient places, it is advised to rinse once a week with 0.2% neutral NaF solution [16].

3. Fluoride tablet programme

The fluoride tablet program was first initiated in 1960. This program was developed as part of efforts to provide fluoride supplementation to children, particularly in areas where the drinking water supply lacked adequate fluoride levels. This self-applied fluoride regimen has been utilized for more than 40 years in the US and other countries. In places with low fluoride levels, swallowing a neutral 2.2 mg NaF tablet (1.0 mg F) every day was advised. The main drawback of this program was it has to be done daily in low fluoride areas [15,17].

4. Fluoridated milk (milk fluoridation)

The use of fluoridated milk for dental caries prevention was first proposed by Zeigler in 1953 [18]. In the late 1950's, this approach was tested in several nations, including Australia, Germany, Japan, Switzerland, and the United States. Through this preventive program, children were guaranteed daily access to milk and the extra benefit of fluoride exposure, which guards against tooth cavities [19]. In 1984 Stephen et al. reported on a 5-year school based double blind randomized controlled trial, which resulted in a statistically significant 31% reduction in dmft and a 43% reduction in dmfs in the test group [20].

5. School water fluoridation

In 1954, a school water fluoridation pilot study was initiated at St. Thomas V.S. Virgin Islands, by the U.S Public Health Service division of dental health. Fluoridating the school's water was comparable to fluoridating public water systems as it required no personal effort from the public other than drinking the water or eating food made with it [17]. For school water supply, a fluoride content of 4.5 parts per million was recommended. The school water fluoridation was developed and tested in 1950s and 1960s and after 12 years, researchers found a 40% decrease in dental caries levels [21]. The major limitations of this program was that only few schools were able to bear the cost of installation, supply and maintenance. Also, the children do not receive benefits until they begin school [13].

6. School oral health program Kuwait

The School Oral Health Program (SOHP), Kuwait. probably the is only comprehensive oral health program for school children in the Middle East. The program was started in 1983 and now it's present in all the 6 governorates of Kuwait. In Kuwait, the SOHP provides treatment, prevention, and oral health education to about 280,000 school-age children. Improvements in positive consents, a decrease in composite fillings, and an increase in pit and fissure sealants had all been found as an outcome of this program [22].

7. Sealants placement

Sealants of various types were used to prevent pit and fissure dental caries. Pit and fissure sealant placement was best suited for a school programs [23]. It would be ideal to selectively intervene in the first, second, sixth, and seventh grades to prevent pit and fissure lesions (1st and 2nd graders, because- First permanent molars are sufficiently erupted to place the sealant. 6th and 7th graders for 2nd molars) [13]. One of the studies had found 78% effectiveness of pit and fissure sealant placement as a caries preventive program. The study formed the basis for a policy decision to introduce fissure sealants for selected children in the school dental service [24].

8. Trinity Care Foundation – Bengaluru

Trinity care foundation is a charitable trust registered under the Indian trust act which carries out school health programs in Bengaluru and nearby areas of it. It focuses on teacher training and increasing the awareness about health issues, ill effects of tobacco and tooth brushing techniques to students in government schools [25].

9. Incremental dental care

One method of delivering priority dental care to a group of school children was the incremental care. George Cunningham in England proposed this system in 1907.

When dental illness developed, they were addressed as soon as possible with accurate diagnosis and efficient treatment. This approach prevented dental problems from building up unnecessarily [26]. The basic process was to provide the lowest priority age group with the essential dental treatment in a single year, then each year add a new age group to the group getting care. Specific attention to only deciduous teeth, financial burden and drop out of children were major drawbacks of this program [13].

10. Tattle Tooth Program

The Tattle Tooth Program was developed in 1974-76 as a co-operative effort between health professional organizations, the Texas department of health and Texas education agency. In 1989 the bureau of dental health developed a new programme - "Tattle Tooth II, a new generation" for kindergarten to 6^{th} grade. Three videotapes were produced as a part of 'Teacher - Training Package'. The videotape familiarizes the teacher with the lesson format and content. Brushing and flossing - for dual purpose of teacher training and as educational unit and a third video tape provided teachers with additional background. Program evaluation was as follows: 1) 80% of teacher judge the program to be helpful. 2) 88% of teachers spent 4.5 - 6.5 hrs teaching the "Tattle Tooth Program". 3) Students were brushing 4-5 times and the teachers were teaching at least 8 out of 10 "Tattle Tooth Program". 4) 1989 Tattle Tooth II- curriculum showed positive effect and 94% of the teachers felt that teaching oral health can have a positive effect [13].

11. Askov dental demonstration

The Minnesota department of health's supervised dental health branch а school dental health demonstration program in Askov from 1949 to 1957. The program included dental care, dental health education, and caries prevention and control. Findings from a 10-year period showed: 28% reduction in dental caries in deciduous teeth of children aged 3 to 5 years. 34% reduction in caries in permanent teeth of children 6 to 12 years and 14% reduction in children 13 to 17 years old. The major limitation was that the cost of program was greater and the caries reductions smaller when compared to water fluoridation [13].

12.North Carolina statewide dental public health programme development

In 1970, resolutions were passed by the North Carolina dental society in support of a comprehensive program to prevent dental diseases. This program included fluoridation of schools and communities,

fluoride treatments for school-age children, continuing education for dental professionals on prevention, and plaque education in schools control and communities. According to 1986 - 1987 North Carolina school oral health survey, 53% of children 5-17 years of age have never had a cavity in their permanent teeth [13].

13. Healthy Teeth, Happy Smiles

In an effort to promote better oral health from infancy, Leicester launched the Healthy Teeth, Happy Smiles program in 2014 as part of the city's first Oral Health Promotion Strategy for preschoolers. The included initiative supervised tooth brushing and the distribution of oral health packs with toothbrushes and fluoride toothpaste in order to address the high rates of dental decay among youngsters in Leicester. As of April 2017, approximately 780 members of staff have been trained to deliver supervised tooth brushing with 6,300 children benefiting from daily supervised brushing [1]. Between 2011/2012 and 2014/2015, there was a statistically significant 8% decrease in the percentage of 5-year-old children in Leicester who had dental decay [27].

14.MaliMali program

The MaliMali program, named after the Tongan word for "smile," was a schoolbased program designed and managed by south pacific medical team (SPMT) to improve children's oral health in 1998. The MaliMali program consisted of the following three main programs in addition to extracurricular activities: a program that teaches students in kindergarten and primary school how to prevent cavities (by giving out leaflets, giving lectures, and suggesting foods to eat in between meals), a project that encourages the use of fluoride toothpaste and provides toothbrushing tips, and a fluoride mouthwash delivery program. At the time of evaluation, the mean DMFT score and the DMF person rate among both boys and girls showed significant reduction in 2011 compared with 2001. The MaliMali Program's primary limitation was the need to go to the schools in order to provide fluoride for the school-based program [28].

15. Love Teeth Day

The minister of health in China initiated the signing of a joint declaration on July 14, 1989, and nine government and nongovernment organizations declared September 20 to be "love teeth day" (LTD). The objectives were to encourage individual awareness of and engagement in dental self-care as well as community participation in oral health education programs. Newspapers, radio, and television were among the mass media that provided information to the public regarding oral health issues. After 3 surveys 12-year-old children demonstrated near to 62% reduction in caries incidence in year 2005 [29].

16. Childsmile

The Childsmile program was sparked by the Scottish executive's 2005 policy statement. A strategy for advancing oral health and improving dentistry services in Scotland. The Childsmile nursery and school programmes had provided 28,000 fluoride varnish treatments to nursery and primary school children. Daily supervised toothbrushing and distribution of oral health packs covered almost 100% of nursery schools and P1 and P2 classes in primary schools in the most deprived areas of Scotland. By the end of the 2008-2009 school year more than 95% of school children have participated in supervised school brushing program [30]. Over two third of children aged five years have not reported significant tooth decay, indicating a significant improvement in oral health (dmf = 0, 2016). The mean DMFT among 11-year-olds dropped from 1.29 in 2005 to 0.49 in 2017. Since it does not target the fundamental causes of disease, there will always be a new emergence of fresh cases [31-32].

17. Colgate's "Young India" Bright Smiles, Bright Futures

Colgate-Palmolive and IDA collaborated in 1976 to impart dental health education to students, and launched a campaign to promote oral health in schools in 2001. Children between the ages of 6 and 14 of elementary school were taught proper dental hygiene techniques, the importance of night brushing, and the proper brushing techniques using a toothbrush and tooth model. More than 162 million schoolchildren between the ages of 6 and 14 have benefited from the program in India [33].

18. Neev school dental health program

The government of the NCT of Delhi is currently operating the school dental program "Neev" from September 2014 in government schools throughout Delhi state as a pilot project. The program covered all public schools in Delhi state (at least 50 schools), involving parents, teachers, and school administrators as team members and providing instruction for all students in classes 6 to 10. The program was expected to cover around 80,000 school children in one district of the state and cost a total of Rs. 2,00,00,000 each year [34]. The Neev program has demonstrated a significant long-term reduction in dental caries among Statistical data children. indicates a decrease in caries prevalence by approximately 22.2% to 46.2% among children aged 7 to 11 years who participated in the program [35].

19. Chacha Nehru Sehat Yojna School Health Scheme

The government of Delhi Directorate of Health Services established SHS in 1979 with the goal of providing comprehensive health services to school-age children through the establishment of six school health clinics. It was announced by Hon'ble Chief Minister of Delhi, in her budget speech on 22nd march 2011 and launched on 14th November, 2011. The dental component of the school health program managed by two government was organizations, the Maulana Azad Institute of Dental Sciences and DDU hospital, both conducted regular screening programs and served as the referral centers. Program expansion and the opening of 64 school clinics were carried out under the seventh five-year plan [36].

20.Pit and Fissure Sealant Pilot Project – National Oral Health Program (NOHP), AIIMS, New Delhi

It was started on May 1st 2017 and representatives from 12 dental colleges received training for the pit and fissure sealant project, which was a major component of NOHP. By sealing 53,750 permanent molars, it aimed to prevent dental cavities in kids between 6 to 14 age group [37].

21. Save our smiles – Fluoride mouth rinse program for new jersey schools

New Jersey's voluntary fluoride mouth rinse program, "SAVE OUR SMILES" which began in 1981 has historically served more than 30,000 children each year. The fluoride mouth rinse program was for students in grades one to six only, also conducted in grades 7-8 under special circumstances. Students rinse with 10 milliliters, or around two teaspoonfuls, of a 0.2% neutral sodium fluoride solution once a week. The kids are supposed to swish the solution between their teeth for a minute. Therefore, during the course of the school year, it required less than five minutes of classroom time per week. Every week, mouth rinsing performed on the same day and at the same time [38].

22. Learning about Your Oral Health

This program was a prevention-based school programme. This program was developed by American dental association (ADA) and their consultants in coordination with the 1971 ADA House of delegates and is presently available to school systems throughout the United States of America. The main objective of this program was to create the attitudes, skills, and knowledge necessary for oral disease prevention. The program's primary goal was to give school children the necessary knowledge and abilities for plaque control [13].

23. Preschool dental health programme (Head Start and Smiling for life)

Under the economic opportunity act of 1964, **Head Start**, a nationwide preschool program, was launched in the United States in 1965 to give poor and underprivileged kids access to early learning experiences.

Smiling for life - In 1995, a nutritional assessment of preschool British children revealed that the consumption of non-milk extrinsic sugars (NMES) was substantially higher than the recommended threshold of 10% of total energy. The program successfully promoted the sustained behaviour changes in oral hygiene practices, emphasizing regular tooth brushing and healthy eating habits [13].

24.School health additional referral programme

The SHARP program was instituted in Philadelphia in year 1967. This program aimed to enhance the effectiveness of school health services by providing intensive health counselling and referral services to students with identified health defects, particularly in low-income areas. During the day, the nurses visited the households. Improved communication between the home and school is achieved through one-to-one basis of health advising between a health provider and the parent [13]. The program significantly increased the rate of improvement in health status among children. Prior to SHARP, only about 30% of children with identified received health issues necessary corrections. This percentage rose up to 54% in the first year of SHARP and further increased to 63% in the second year, demonstrating a substantial improvement in addressing health needs through intensive counselling and follow-up by school nurses [39].

25.Intensive Dental Health Care Program – Punjab

Punjab introduced its Intensive Dental Health Care Program in 1989–1990. Schools are covered under the present program according to subdivision. Apart from providing tooth Health Education to schoolchildren and conducting comprehensive oral health examinations, every kid receives a fluoride mouthwash to halt the onset and advancement of tooth caries. This procedure was repeated every six months. The current status of this program is not known [40].

26.**St. David's Dental Program - A Mobile** School- Based Dental Program for Children

The program's inception was in 2000. The primary goal of the program was to remove barriers to dental care, such as cost and transportation. By providing services directly at schools, the program ensured that children receive necessary dental care

without requiring parents to take time off work or arrange transportation. St. David's Mobile Dental Program offered free dental care to children at Title 1 elementary schools in Central Texas, as well as adults referred by area clinics. From August to May, the mobile dental program treated elementary school children who attended title I and charter schools in Austin, Del Valle, Hays, Manor, Pflugerville, and Round Rock ISDs. Beyond addressing urgent needs, this program also educated students about dental hygiene habits that will last a lifetime. In 2005, the program provided \$2.1 million worth of services at a cost of \$1.2 million. The program provided a range of services including exams, Xrays, fillings, cleanings, sealants, and oral health education. It had placed over 93,000 sealants, which help prevent tooth decay [41].

27.**THETA program**

In the spring of 1974, 181 students from Nokomis Elementary School and high school students took part in a THETA program. In the THETA program, high school students have to learn the proper oral hygiene procedures for themselves and teach the elementary school children. First, the THETA students and elementary school teachers are trained in preventive care. Then the THETA students developed a classroom plan of instruction and work with the children [42].

Impact on Current School Dental Health in India

Historical developments have led to several key outcomes in India's current state of school dental health:

Increased awareness - School dental health programs incorporate targeted educational interventions that enhance children's understanding of oral hygiene. These initiatives promote effective brushing and flossing techniques, emphasize the importance of regular dental visits, and address dietary choices that affect dental health, fostering positive habits from an early age [43].

Reduction in dental issues - The introduction of fluoride application programs and sealants in some regions had aimed to reduce dental caries among children. This has been particularly important in areas with high levels of dental caries [34].

Holistic Health Approach- School health programs are increasingly incorporating oral health as a fundamental component of overall health education. This integration helps to address the interconnection between oral health and general health issues, such as nutrition and chronic diseases [44].

By learning from past programs and integrating modern approaches like technology and community involvement, India aims to improve the effectiveness of its school oral health initiatives.

Discussion

Educational interventions through games and shows have proven more effective in enhancing oral hygiene knowledge and skills among children compared to traditional verbal instructions [45]. Specifically children engaged in roleplaying or drama-based health education demonstrated superior oral hygiene outcomes compared to those receiving conventional education from a dentist or trained teacher, or those without any intervention [46-47]. Furthermore, incorporating educational programs for parents, teachers, and children alongside preventive measures, such as sodium fluoride application and supervised tooth brushing with fluoride, has led to notable improvements in oral health indicators. This approach significantly reduced gingival and plaque index scores, while there were no changes observed in decayed, missing, and filled teeth (dmft) and decayed, missing, and filled surfaces (dmfs) scores. Conversely, in the absence of such educational support, there were significant increases in both gingival and plaque index scores, as well as dmft and dmfs scores [48].

In studies evaluating school-based dental health programs, various interventions have demonstrated significant benefits over control groups. One comprehensive program that included oral health education (OHE) for children, teachers, and parents, along with supervised tooth brushing and the provision of fluoridated toothpaste and toothbrushes, resulted in a 30.6% reduction in the increment of decayed, missing, and filled surfaces (dmfs) and a higher percentage of children brushing their teeth twice daily [49]. Another program, which featured OHE for children and teachers, supervised tooth brushing, and the use of 1100 ppm fluoride toothpaste, also achieved a significant reduction in dmfs increment compared to the control group [50]. Additionally, among boys, a school-based supervised tooth brushing initiative that included professional cross-brushing of the first permanent molar surfaces led to a 50% lower caries incidence density compared to a conventional tooth brushing program [51].

Incorporating oral health education (OHE) into the school curriculum has been shown to reduce the risk of new carious lesions by 35% [52]. This effect varies with parental socioeconomic status (SES), as children from high SES backgrounds in the intervention group experienced a 94% reduction in incidence rate ratios (IRR) [53]. Programs that included OHE, teacher support, and competitive elements significantly enhanced oral health knowledge (OHK) and improved oral health-related quality of life (OHRQoL) [54].

Significant improvements in oral hygiene, gingival health, and oral health knowledge were observed when OHE was implemented over a six-month period, regardless of the educator [55]. Individual tooth-brushing training also markedly enhanced children's brushing skills compared to a control group [56]. However, a quasi-experimental study conducted in Burma indicated that a school-based toothbrushing program did not significantly affect plaque or bleeding scores [57]. Additionally, children who participated in a two-month sense of coherence (SOC) intervention led by trained teachers reported significantly better OHRQoL and improvements in their sense of coherence compared to the control group [58]. Another study confirmed that the soc intervention group exhibited better OHRQoL, SOC, oral health beliefs, and gingival health compared to those who did not receive the intervention [59].

A two-week display of educational posters on dental trauma notably increased children's understanding of how to manage such injuries [60]. Additionally, children who received a loss-framed pamphlet intervention demonstrated improved oral health behaviours, attitudes, and intentions to brush their teeth after two weeks. At a 24week follow-up, this group also had lower dental plaque levels, better oral healthrelated quality of life (OHRQoL), and enhanced gingival health compared to other participants [61]. Furthermore, frequent

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teacher-led oral health education (OHE) sessions, combined with the provision of oral hygiene aids, resulted in significant decreases in simplified oral hygiene index (OHI-S), plaque index (PI), and gingival index (GI) scores. In contrast, children who received infrequent dentist-led OHE or no intervention at all experienced increases in these scores [62]. Dental hygienists delivering OHE and preventive measures, such as fluoride varnish, in schools effectively reduced the incidence of enamel caries, though there was no significant effect on dentin caries. This intervention also improved children's oral health knowledge and hygiene practices, but it did not influence their attitudes toward tobacco use [63]. The children who participated in motivational interviewing sessions had fewer new carious teeth, reduced their snacking habits, and increased their toothbrushing frequency compared to those who received conventional OHE [64].

Conclusion

In conclusion, this narrative review summarizes the evolution of school dental health programs worldwide, with a particular focus on India. Historically, the majority of these programs focused on school dental health education, but recently focus have been shifted toward preventive strategies, including use of pit and fissure sealants, fluoride mouth rinses, fluoride toothpaste, school water fluoridation, and improved brushing techniques. The findings reveal that these educational efforts have led to significant reductions in dental caries among children. However, it is concerning that less attention has been given to critical areas such as gingivitis, periodontitis, dental trauma prevention, and tooth loss management. Many schools' dental health education programs in India

have shown promising results in reducing caries incidence and improving oral health knowledge among children, while several others are still underway, with their results awaited. This underscores the need for long-term studies to comprehensively assess their effectiveness. Additionally, the potential integration of artificial intelligence in school dental health education presents an exciting opportunity for enhancing awareness and improving outcomes.

Future Recommendation

Policymakers and public health officials should prioritize integrating oral health education into schools by encouraging collaboration among healthcare professionals, teachers, parents, and students. It is crucial to incorporate oral health within broader health initiatives and allocate funding for comprehensive training programs including oral health education and preventive strategies. These measures will promote overall well-being and lifelong healthy habits among students.

Statements and Declarations Conflicts of interest

The authors declares that they do not have conflict of interest.

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