


FLUORIDE'S SOCIOECONOMIC IMPACT ON HEALTH EDUCATION: A GLOBAL PERSPECTIVE

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ABSTRACT

Preventive oral healthcare is a crucial lesson learned with dental health education, significantly impacting both individual well-being and societal economic burden. By empowering individuals with knowledge and skills to maintain optimal oral health, dental education programs can reduce the prevalence of oral diseases, lower treatment costs, and ultimately contribute to a healthier and more economically sustainable future. This article delves into the multifaceted benefits of dental health education, examining its impact on quality of life, healthcare costs, and global economic sustainability. Drawing on recent research, public policies, and community health initiatives from Brazil, Europe, and the United States, we highlight the critical role of dental education in addressing oral health disparities and improving overall population health. As healthcare systems worldwide grapple with rising costs, dental education emerges as a cost-effective strategy. By preventing oral diseases and promoting early intervention, these programs can reduce the need for costly treatments, such as dental extractions and restorations. Moreover, improved oral health can enhance individuals' quality of life, leading to increased productivity and reduced absenteeism. In conclusion, investing in dental health education is not merely a public health imperative but also a sound economic decision. By promoting oral health literacy and empowering individuals to take control of their oral health, we can create a healthier, more prosperous, and sustainable future.

Keywords: Dental health education. Quality of life. Cost reduction. Global economic sustainability.

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INTRODUCTION

Oral health has a major impact to the general health and well-being of populations, directly impacting nutrition, speech, self-esteem, and even the management of chronic diseases such as diabetes and cardiovascular disease. The World Dental Federation (FDI) estimates that global spending on dental care exceeds US\$540 billion annually, including treatments, prosthetics, and emergency interventions (FDI World Dental Federation , 2022). Oral health expenditures can represent a significant burden on health systems, especially in countries where the predominant approach is curative rather than preventive (Petersen & Ogawa , 2012). In contrast, countries that prioritize education and prevention, such as several European nations, have achieved remarkable results in terms of cost reduction and improved quality of life for their populations (Schwendicke et al., 2023).

There is a significant difference when comparing oral health expenditures in Brazil, Europe, and the United States. Oral health expenditures vary significantly across different regions of the world, reflecting differences in public health policies, access to preventive care, and investment in educational programs. In Brazil, approximately 8% of total health expenditures in the Unified Health System (SUS) are directed to dental care, ranging from emergency treatments to preventive and restorative procedures (Ministry of Health, 2023). Studies indicate that approximately 60% of dental consultations in the SUS are for treating cavities and performing tooth extractions, procedures that could be largely avoided through preventive interventions (Oliveira et al., 2022).

In Europe, countries such as Germany, Sweden, and Norway have adopted robust oral health prevention policies, including school-based education programs and awareness campaigns. In Germany, annual spending on oral health is approximately 12 billion euros, but the strong emphasis on preventive measures has resulted in a population with lower rates of caries and periodontal disease (Schwendicke et al., 2023). In contrast, Eastern European countries such as Bulgaria and Romania face challenges in implementing comprehensive educational programs, resulting in a higher prevalence of oral diseases and a greater reliance on curative treatments (European Federation of Periodontology , 2022).

In the United States, the oral health scenario is marked by high costs and a significant disparity in access to dental care, influenced by the predominantly private structure of the health system. According to the American Dental Association (ADA), dental care spending in the United States exceeded 155 billion dollars in 2022, of which a considerable portion is allocated to restorative and emergency treatments (American Dental Association , 2023). Local initiatives, such as " Smiles Across America " and school-based oral health programs have been shown to be effective in reducing the prevalence of cavities



and gum disease, especially in underserved communities, resulting in decreased visits to dental emergencies and the costs associated with these services (Jones et al., 2021).

Studies show that lack of access to information and education about dental health contributes to the deterioration of oral health in the population, resulting in a cycle of treatment that could be avoided. In this context, educational initiatives are essential to promote prevention and ensure more efficient and economical care.

LITERATURE REVIEW

The literature on the impact of oral health education on cost reduction and public health improvement has grown significantly in recent years. In a study by Sheiham et al. (2020), the introduction of oral health education programs in schools in developing countries resulted in a reduction of up to 50% in dental caries rates among children aged 6 to 12 years. This study highlights that early education on oral hygiene is a key strategy for reducing health inequalities.

Longitudinal studies conducted in Sweden (Lindberg et al., 2019) followed groups of children for 10 years, demonstrating that those who participated in oral health education programs had a significantly lower need for restorative treatments. Another study conducted in Norway, by Marthaler et al. (2022), reinforces these findings by showing that the inclusion of prevention and nutritional guidance programs in schools can reduce the incidence of cavities by up to 70% over a decade.

In the United States, a study by Milgrom et al. (2021) analyzed the costs of dental treatments in communities with different levels of access to oral health education, concluding that each dollar invested in preventive programs resulted in savings of \$2.50 in emergency and restorative treatments. This study highlights the relevance of oral health education as a cost control strategy for predominantly private health systems.

In Brazil, the impact of programs such as "Smiling Brazil" has been widely discussed. According to Soares et al. (2023), the inclusion of educational activities in public schools resulted in a 35% reduction in the rates of cavities and periodontal diseases in children and adolescents. Another study by Santos et al. (2022) shows that oral health education for pregnant women and low-income families can significantly improve children's oral health, reducing cases of cavities in infants and young children.

The long-term economic impact of preventing oral diseases not only reduces direct treatment costs, but also improves economic productivity by reducing absenteeism related to dental problems. According to Sheiham and Watt (2020), every dollar invested in prevention can result in significant savings in future treatments.



There is also the role of digital technologies, which can be powerful tools in promoting oral health. Studies show that health apps and social media campaigns can increase awareness and adherence to oral hygiene practices. For example, a study by Gil-Montoya et al. (2015) highlighted the positive impact of digital technologies on dental health education.

Not forgetting dental health education in rural and indigenous communities. The inclusion of oral health education programs in rural and indigenous communities is essential. Initiatives such as the "Alliance for a Smiling Brazil" have shown success in reducing health inequalities. Lima et al. (2021) emphasize the importance of dental health education in hard-to-reach areas.

And also carrying out professional training with continuing education, investing in the continuing education of health professionals is crucial for quality care. According to Souza and Sousa (2019), continuing education programs for dentists result in better preventive practices and more effective treatments.

METHODOLOGY

To understand the economic impact of oral health education, a systematic review of studies published in the last ten years was conducted using databases such as PubMed, Scopus and Google Scholar. Articles that investigated the correlation between oral health education and cost reduction in different geographic and demographic contexts were analyzed. In addition, reports from international organizations such as the World Health Organization (WHO) and the American Dental Association (ADA) were included, focusing on economic analyses of health systems.

RESULTS

The results of the review indicate that oral health education can generate significant savings. For example, Lee et al. (2022) showed that every dollar invested in oral health education programs in underserved communities in the United States generated savings of up to \$6 in emergency treatments. In Europe, countries such as Switzerland, which have robust dental health education policies, report an average savings of 25% in costs associated with corrective dental treatments (FDI World Dental Federation, 2023).

In Brazil, studies such as that by Oliveira et al. (2022) indicate that implementing educational programs in schools could reduce tooth decay rates among children by up to 50%, saving millions of reais in treatments. These savings would allow resources to be



redirected to other areas of health. In a country with large regional disparities, such as Brazil, oral health education has the potential to significantly reduce the burden of oral diseases in vulnerable communities, improving quality of life and reducing school absenteeism and loss of productivity at work.

The importance of dental health education is immense, as it involves raising awareness among the population about the importance of oral hygiene, disease prevention, and access to dental care. Education programs have been shown to be effective in reducing the prevalence of caries and periodontal diseases, especially in low-income communities (Bennett et al., 2016; Bittencourt et al., 2020). When people are informed about oral hygiene practices and the importance of regular dental visits, the demand for complex and costly treatments decreases, resulting in significant savings for the health system.

The economic impact of dental health is very relevant and the relationship between oral health and the economy is evident. Untreated dental conditions can lead to complications that require more expensive interventions, increasing public and private health expenditures. Estimates suggest that for every real invested in prevention, there is a considerable saving in subsequent treatments (Righolt et al., 2018; Lamberts et al., 2016). According to the World Health Organization (WHO), dental caries is one of the most prevalent conditions worldwide, mainly affecting low-income populations (World Health Organization , 2020). Effective prevention could drastically reduce the incidence of caries, resulting in savings of billions of reais annually.

When comparing the Brazilian economy with that of Latin America, the Brazilian economy faces unique challenges, including significant inequalities in access to health services. According to the World Bank in 2021, Brazil invests a lower percentage of its GDP in health compared to countries such as Chile and Argentina, where more robust public health policies have resulted in better oral health indicators (González et al., 2019; Salazar et al., 2020). These differences reflect the urgent need to strengthen dental health education in Brazil, especially in vulnerable communities.

Studies show that Latin American countries that have implemented dental health education programs, such as Chile, have been able to reduce rates of tooth decay and periodontal disease, resulting in lower treatment costs and higher productivity (Peres et al., 2019). The relationship between oral health and economic productivity is clear: healthy workers have fewer absences and contribute more to the economy. According to a WHO study, lost productivity due to dental problems can cost the economy up to 5% of GDP (World Health Organization , 2021).



DISCUSSION

A comparative analysis of different countries reveals that oral health education is an essential strategy for the economic sustainability of health systems. Countries that prioritize prevention, such as Sweden and Germany, have lower rates of oral diseases and, consequently, a reduced demand for expensive curative treatments (Matsumoto et al., 2023). The inclusion of oral health programs in public policies has been effective in reducing regional health disparities, promoting a positive impact on the quality of life of populations.

In the United States, despite the high cost of dental care, there is a growing awareness of the importance of preventive programs. Hansen et al. (2022) argue that expanding oral health education programs to low-income areas could reduce the financial burden on public and private health care systems and improve the quality of life for millions of Americans. These educational interventions not only prevent oral problems but also have positive effects on overall health by reducing systemic inflammation associated with periodontal disease (Huang et al., 2023).

Inequality in access to health care is a challenge in Brazil, especially in the North and Northeast regions. The lack of preventive programs in these areas has resulted in high rates of tooth decay and tooth loss among the most vulnerable populations. Initiatives such as “Brasil Sorridente” have shown that the inclusion of oral health education programs in schools and communities can significantly reduce these rates, while promoting greater awareness of the importance of oral hygiene (Alves et al., 2022). However, continued efforts to expand these programs to rural and indigenous areas, where access to health care is even more limited, are essential.

Popular participation is essential for the effectiveness of health policies. Involving the community in the formulation and implementation of health education programs allows identifying local needs and adapting strategies to the social context (Crisp et al., 2014; Oliveira et al., 2021). Social mobilization in recent decades has allowed the population to influence political decisions, resulting in more inclusive and effective policies.

Comparisons between different countries reveal that oral health education is essential for the economic sustainability of health systems. Countries such as Sweden and Germany have lower rates of oral diseases and, therefore, a lower demand for expensive curative treatments (Matsumoto et al., 2023). In the United States, Hansen et al. (2022) argue that expanding preventive programs could alleviate financial pressure on health systems, especially in low-income areas. In Brazil, despite regional inequalities, initiatives



such as “Smiling Brazil” demonstrate the potential of health education to improve oral health and reduce system costs (Alves et al., 2022).

Furthermore, the literature indicates that integrating oral health education into broader public health policies can result in significant resource savings. According to Wang et al. (2022), in an analysis that used economic modeling to estimate the long-term benefits of oral health education, it was identified that each dollar invested can generate savings of up to \$4 in general medical expenses, due to the prevention of complications related to periodontal diseases that affect systemic health, such as cardiovascular disease and diabetes.

There are several successful examples of dental health education programs, such as those implemented in schools and communities, that have shown positive results. One example is the Children's Oral Health Program, implemented in several regions of Brazil, which promotes education and awareness from childhood. These programs not only improve children's dental health and quality of life, but also reduce future costs with dental treatments (Pereira et al., 2019; Azevedo et al., 2018).

Even so, there is much to improve throughout the healthcare chain, in general health as well as in oral health, especially in Brazil, where we have a very large amount of financial resources allocated to public policies that are diverted from their intended purpose, where much better results could be achieved and a much larger number of people could be helped, if it were not for the government's political unpreparedness .

CONCLUSION

Oral health education is a strategic investment that can result in substantial savings for health systems and promote healthier lives for populations. The implementation of educational programs and raising awareness among the population about the importance of oral hygiene have proven effective in reducing oral diseases, providing improvements in quality of life and economic productivity. In a global scenario where oral health care costs are high, investing in oral health education represents a viable and sustainable approach to building a healthier society with a higher quality of life and economically efficient.



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