School-Based Oral Health Promotion Programs in the Low and Lower-Middle-Income Countries in the WHO Eastern Mediterranean Region

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A thesis submitted in partial fulfillment of the requirement for the degree of Master of Science in Public Health

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List of Abbreviations

ART	Atraumatic Restorative Treatment
ATP	Audio Tactile Performance
EMR	Eastern Mediterranean Region
GHO	Global Health Observatory
HPS	Health Promoting Schools
LLMICs	Low and Lower-Middle-Income Countries
LMICs	Low and Middle-Income Countries
MENA	The Middle East and North Africa
MSP	Minimum Service Package
NGOs	Non-Governmental Organizations
SBOHP	School-based Oral Health Promotion
UHC	Universal Health Coverage
UIS	UNESCO Institute of Statistics
WHA	World Health Assembly
WHO	World Health Organization

Abstract

Background: Oral diseases severely impact the performance and quality of life of all age groups. The cost of treatment is high, and oral care services are not accessible to large parts of the population in EMR. However, those diseases are preventable with good oral hygiene, a healthy diet, and lifestyle. Programs to enhance such preventive measures start in childhood and schools can provide the appropriate environment to conduct such programs.

Objective: This study is among the first to explore the availability and effectiveness of school-based oral health promotion programs in LLMICs in the EMR.

Method: A review of the literature using the keywords was done. Twenty-six articles met the inclusion criteria from EMR, and other fifteen articles for learned lessons from other LLMICs in Africa.

Findings and Discussion: Findings revealed that oral health promotion in schools is rarely performed in LLMICs in EMR. Besides, most retrieved studies focused on oral health education in schools. On the other hand, good experiences were found in LLMICs in Africa, including the oral health education in the curriculum of teacher trainees and provision of oral health education for students as part of syllabus. Moreover, a considerable gap in the literature regarding SBOHP programs exists and must be covered.

Conclusion: SBOHP programs were found effective despite using different evaluation criteria. Recommendations for providing SBOHP programs in LLMICs include teachers, students, institutions, dental, and other medical professionals.

Keywords: Oral health, School-based oral health promotion, Low and lower-middle-income countries, Eastern Mediterranean Region.

Word Count: 9,752

Introduction

After decades of performing oral health-related research, it became known that oral diseases are mostly preventable. Factors that cause these diseases include high and frequent sugar-containing food and drinks, poor oral hygiene, absence of fluoride-containing preventive products, and excessive use of tobacco. These risk factors are modifiable and also risk factors for obesity, lung cancer, and heart and vascular diseases. However, focus on programs to promote oral health is not up to the needs.

Luckily, in 2021 a significant step was taken to change this unfavorable situation. At the 74th World Health Assembly (WHA), a resolution was accepted that called on the Member States:

"(1) to frame oral health policies, plans, and projects for the management of oral health care according to the vision and political agendas in health projected for 2030, in which oral health is considered an integral part of general health, responding to the needs and demands of the public for good oral health.

(2) to strengthen cross-sectoral collaboration across crucial settings, such as schools, communities, and workplaces, to promote habits and healthy lifestyles, integrating teachers and the family.

(3) to enhance oral health professionals' capacities to detect potential cases of neglect and abuse and provide them with the appropriate and effective means to report such cases to the relevant authority according to the national context" (1).

The present thesis will focus on the second recommendation, particularly on implementing oral health promotion programs in schools in LLMICs.

1. Background

1.1. Eastern Mediterranean Region (EMR)

This region includes 22 member states in the Middle East, North Africa, Horn of Africa, and Central Asia. It is estimated that there are nearly 679 million people living in the region in 2022 (2). The countries covering the area are Afghanistan, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, State of Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates and Yemen (3). The highest populations are found in Pakistan, Egypt, and Iran. Currently, ten states face a humanitarian crisis on a large scale, and approximately 43 percent of those in need of humanitarian assistance in the world are situated in this region (4).

The proposed study will focus on LLMICs in the EMR, which are 12 states. These countries are Afghanistan, Somalia, Sudan, Syrian Arab Republic, Yemen, Djibouti, Egypt, Iran, Morocco, Palestine, Pakistan, and Tunisia (5). It is worth mentioning that four countries (Afghanistan, Somalia, Syrian Arab Republic, and Yemen) are crisis-affected nations.

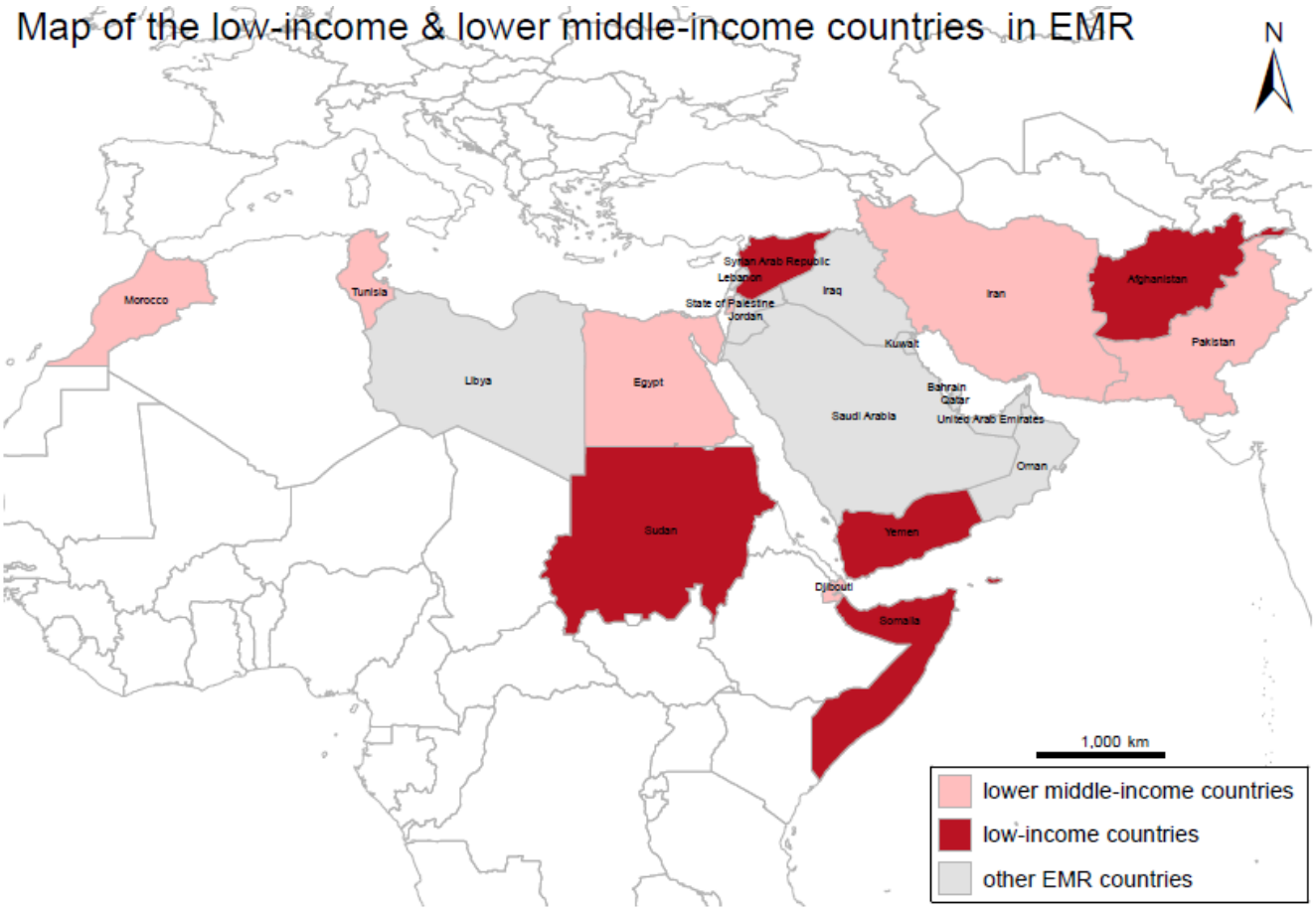

Figure 1: Map of LLMICs in EMR.

Source: This Map was developed using ArcGIS with the data from https://data.worldbank.org/?locations=XM-XN (5)

1.2. Oral Diseases and Risk Factors

The oral cavity is subject to different issues, which include diseases such as dental caries, periodontitis, oral cancers, and injuries to the teeth and jaws. Other oral conditions that can seriously affect a person's wellbeing include crowding teeth, hypo-mineralization of teeth (dental fluorosis), and anomalies such as extra or fewer teeth. From a public health perspective, the focus concerns those that are most prevalent such as tooth cavities, periodontitis, cancers, and dental injuries. Dental cavities are defined as the breakdown of the tooth structure due to acid activity. The acid is produced by bacteria fermenting carbohydrates in food debris and sugars sticking to the teeth' surfaces. Periodontitis is a disease of the gums and bone. It is a chronic inflammatory disease caused by microorganisms that destroy the tooth-supporting structures and can lead to tooth loss.

Understanding that tooth loss results from disease or injury rather than an inevitable consequence of aging is an essential initial step in fighting the two major causes of poor oral health-dental cavities and periodontal disease (6). Various factors that contribute to oral diseases include biological, behavioral, social, socioeconomic, and environmental factors (7). Risk factors for dental cavities are age, sex, mother's education, socioeconomic level, tooth brushing frequency, parents' oral knowledge, and sugar intake (8). Periodontal diseases are linked with tobacco use, comorbidities, and individual and community socioeconomic factors (7). While for oral cancers, low levels of income, education, socioeconomic status, and social deprivation are the highly linked contributing factors (7). Further, sociodemographic, clinical, and environmental factors are all related to an increased risk of traumatic dental injuries (9). Dental fluorosis, dental cavities, and their relationship with naturally fluoridated water are the most prominent oral conditions that have the environment as a positive and negative (fluorosis) risk factor (7).

1.3. Oral Health Status and Burden of Oral Conditions

More than 3.5 billion people have oral diseases and conditions worldwide, the majority of which are preventable. For the last three decades, the global prevalence of dental caries (cavities), periodontal (gum) disease, and tooth loss has remained constant at 45 percent, higher than the prevalence of any other non-communicable disease (10). Dental caries is one of the most common chronic diseases throughout the world. 90% of the world's population has experienced dental problems or toothache because of dental caries, and most cavitated teeth go untreated in low-to-middle income countries. Severe periodontitis also impacts 5-15% of the world's population (11).

Lip and oral cancers are the sixteenth most common cancer worldwide, accounting for over 375 000 newly diagnosed cases and approximately 180 000 deaths in 2020. Noma, a rapidly progressive and often fatal bacterial infection of the mouth and face, is associated with severe poverty, malnutrition, measles, and living in the proximity of livestock. The condition begins in the mouth and kills up to 90% of young individuals without treatment (10). Oral

symptoms like oral fungal, bacterial, or viral infections are present in 40–50% of HIV-positive individuals (11).

Available studies illustrate the high prevalence of oral diseases LLMICs in the EMR. A meta-analysis conducted in 2018 to measure the prevalence of dental caries in children aged 5-15 in the EMR concluded that the pooled prevalence of dental caries in 5-year-old was 65%, with a lower caries prevalence (61%) among 12-year-old children. At the same time, the prevalence of caries among 15-year-old children was found to be higher (70%). It is worth mentioning that the study was limited to only nine countries because they had relevant data, and those countries included LLMICs (12).

At the country level, the prevalence of dental caries was measured at different periods. In Yemen, the percentage of schoolchildren without caries was found to be very low (4.1%) in 2009 (13). In Egypt in 2019, 74% of children experienced dental caries (14), while in another study conducted in 2014 in the same country, the percentage of children who had untreated dental cavities was 70%, and a form of periodontitis was found in 80% of them (15). In Pakistan, dental caries was found in approximately 60% of the population (16), and periodontitis existed in 34.5%, according to a study in 2021 (17). The prevalence of caries in the under 18-year-old population group in Iran was found to be high (72.8%) in 2020 (18). In 2016, the dental caries prevalence among 3-5 years preschool children in Sudan was found to be 52.4% (19). In Somalia, dental cavities, while not directly impacting learning, affected 26% of 4-19-year-old school children in 2019 (20).

In addition to the high prevalence and severity of oral diseases, many children are affected through unintentional injuries. These include playground injuries, accidents from traffic, or other causes. These accidents frequently result in head, mouth, jaw, and neck injuries. In several developing countries, more than half of the children experienced oral trauma (21). Child and adolescent deaths, as well as the disability-adjusted life years due to unintentional injuries in the EMR, are one of the highest globally (22,23).

Despite the fact that oral diseases constitute a significant burden on Arab nations' quality of life and healthcare economics, little attention has been paid to restorative and preventive dental care. Global direct treatment costs for dental diseases were estimated to be around $297.67 billion, with countries accounting for 82 percent of the estimated expenditure ($244.40 billion) and the Middle East and North Africa (MENA) contributing nearly $8.33 billion. Oral injuries, in particular, have a significant economic impact and pose a public health risk, notably in kids and young people (24).

1.4. Health System

In many high and higher-middle-income countries, oral health professionals have applied preventive and symptomatic measures like strengthening the structure of enamel and placing restorations that improved the oral health situation of large parts of their populations.

However, in low and lower-middle-income countries (LLMICs), such measures could not consistently be implemented for various reasons. Among the reasons are the low numbers of trained oral health professionals, materials, and lack of financial resources.

Because the aetiological factors for oral diseases equal those of major non-communicable diseases, the oral health research community developed the common-risk factor approach. This concept implies that oral and general health professionals should not work in isolation if a common risk factor needs to be addressed. For example, programs that emphasize reducing sugary food and drinks intake to reduce obesity in a community should also focus on reducing dental caries, a sugar-intake-related disease, and vice-versa. Unfortunately, attempts from the oral health field have often not been met by general health professionals. It is, therefore, a correct statement that the Oral Health Representative at the World Health Organization (WHO) recently made: "Oral health has been neglected in the global health agenda". This occurred despite the knowledge that more than three billion people suffer from untreated oral diseases and that this situation has not changed over the last 30 years. The combined global prevalence of dental caries, periodontal disease, and tooth loss remained at 45 percent (25). Untreated dental cavities were the most prevalent medical condition in the world. However, the number of people affected increased during 1990-2019 because of the increase in population growth globally (26).

At the 74th World Health Assembly (WHA) landmark resolution on oral health was endorsed. It prompted its member states to address key risk factors for oral diseases that are common with other non-communicable diseases. It also called for strengthening the competencies of oral health professionals and a shift away from the traditional dental curative approach towards a preventive approach. The latter needed to include oral health promotion in the home, schools, and workplaces and prompt, thorough, and comprehensive care within the primary healthcare system (27).

Traditional curative oral care is, generally speaking, based on electrically driven equipment for opening tooth cavities and placing restorations. Such equipment, these days, is often controlled by chips, therefore not easily maintainable and costly. The equipment is not mobile, and the patient must travel to a dental clinic situated in a health center, whether government of privately owned. The dental equipment currently in operation in the primary healthcare setting in most LLMICs in the EMR are mainly in the private sector and mainly in urban areas. As well, maintenance of the basic equipment is lacking in rural areas (28).

According to WHO, the average global dentist per population is one dentist per 7,500 people. The data from WHO Global Health Observatory (GHO) revealed that the ratios of dentists per population in LLMICs in the EMR differ from high in countries like Iran and Syria to low in Afghanistan, Djibouti, and Yemen, as illustrated in (table 1) (29). In addition to the low ratio of dentists to people, most dentists practice in urban areas and big cities. Furthermore, only a tiny percentage of dental professionals are recruited into the public health system.

Table 1: Dentist Per 10,000 population - LLMICs in EMR

Countries	Year						
	2014	2015	2016	2017	2018	2019	2020
Afghanistan	0.033	0.036	0.034		0.24	0.71	
Djibouti	0.21						
Egypt	1.62	1.83	1.86	1.98	2.01		
Iran (Islamic Republic of)	3.59	3.34		3.27	4.47		
Morocco	1.36	1.41		1.36			
Pakistan	0.77	0.84	0.9	0.98	0.96	1.23	
Sudan		2.09					
Syrian Arab Republic	8.86		7.18				
Yemen	0.21						

Source: WHO Global Health Observatory (29)

Although WHA suggested emphasizing preventive oral care over traditional curative oral care, the latter cannot be ignored. The oral health fraternity has developed an alternative curative method that does not rely on electrically driven equipment for curing tooth cavities (30). Instead of the traditional bur and drill, hand instruments are used instead. A study among Egyptian adolescents showed that this alternative method could treat 52% of the diagnosed tooth cavities (31). Cavities with a tiny opening could not be treated with hand instruments but could be treated by sealing over the cavity opening with a restorative material. This alternative curative method was called Atraumatic Restorative Treatment (ART) and was accepted by the WHO in 1994. These methods can be utilized to treat cavities in low resources and hard-to-reach areas and can be functional in schools for treating cavities in schoolchildren. ART was well received by secondary school students (28) and dental practitioners in Egypt (32).

The high cost of dental services is one of the significant barriers facing people's access to dental health services. In most developing countries, over 90% of dental cavities remain with no treatment. Treating cavities with traditional restorative dentistry methods is out of the financial reach of the majority of low-income countries, as three-quarters of these countries do not even have enough resources to cover the cost of an essential package of health care services for their children (33). On the other hand, the absence of treatments is much higher in terms of financial, social, and personal consequences (34).

Oral health is obviously not considered a priority in planning for health policies in low and middle-income countries (LMICs). Policy makers tend to focus on providing treatment, not preventing diseases, including oral diseases. Furthermore, oral health services are not considered a part of the universal health coverage (UHC) package and not even part of the minimum service package (MSP) of health services provided by the United Nations agencies and international and national non-governmental organizations (NGOs) in crisis-affected nations.

2. Problem Statement, Justification, and Objectives

2.1. Problem statement

Good oral health is essential for obtaining good general health and quality of life. The mouth has a vital function in daily life. It enables the person to speak, chew, swallow food, and gives the person a good appearance. Several diseases can affect the different parts of the oral cavity. Oral diseases are a substantial public health problem as they affect almost every single human being during their life (35). These problems can cause pain and suffering, loss of function, and diminished quality of life (36).

Furthermore, oral health problems interfere with activities at different levels in society, including school, work, and even at home, resulting in the waste of millions of study and work hours annually all over the world (37). The impact of poor oral health on children can be high and severely affect their performance over the study period and later in the future. Children suffering from bad oral health have a higher chance of having low performance or miss school (38–40). In fact, oral diseases result in an annual school time loss that exceeds 50 million hours (21).

Most of the burden of oral diseases is found in the poorest and most disadvantaged groups in any population. In contrast, the prevalence and severity of dental caries have declined in children, and the loss of teeth among adolescents and adults is controlled in high-income countries (2).

Caries epidemiological studies amongst children, performed in LLMICs of the EMR, showed a high prevalence and severity. This observation is in line with the caries situation in other LLMICs based on the WHO database (41). In terms of severity, there had been twice the number of dental cavities developed in 5-6-year-olds in these countries compared to the high and higher-middle-income countries. A salient outcome was that almost all, less than 96%, of cavities of these young children in LLMICs had not been treated; on average, four cavities per child. It is opportune to consider how to turn this unfavorable situation into a community with fewer untreated cavities at first and, eventually, no cavities or treated cavities (41).

2.2. Justification

What influenced the decline of dental caries in the more affluent parts of high-income countries? One factor is related to manpower. In addition to sufficiently well-trained oral health professionals that include not only dentists, but also dental hygienists and preventive dental assistants have been trained. The latter cadre primarily deals with communicating preventive related information and assisting the person to keep the teeth and gums clean from debris and dental plaque. The dentist is trained to perform the more complicated procedures for keeping teeth functioning, assisted by the dental hygienists for maintaining the periodontal tissues in good condition. Having this manpower situation requires an extensive network of educational

institutions and a well-functioning primary health care structure and private practice. If unavailable, it takes decades to develop if governments have the means and are willing to do and finance it. In economically disadvantaged countries, such a network is unlikely to develop. Which biological or behavioral factors were responsible for the decline in dental caries in children in affluent countries? The most important single influence in the decline of dental caries in children was the availability and usage of fluoride-containing toothpaste and toothbrush. If applied twice a day, the chance that a dental cavity develops is meager. The second factor concerns the low intake of sugar-containing food and drink. Would it be possible to introduce these two preventive measures in LLMICs? Public health programs that reach children can have a great role in enhancing these two oral health preventive measures (37). Messages encouraging lowering sugar intake, reducing acidic beverage consumption, and brushing and flossing teeth on a regular basis should continuously be disseminated through all forms of media, including dental literature, television, newspapers, magazines, radio, and the Internet, and should be incorporated into education curricula aimed at children, caregivers, and communities. Educational programs focusing on the importance of oral health promotion are also essential (6).

Schools are very appropriate for oral health promotion. 80% of children worldwide go to primary schools, and 60% finish four years of education at the minimum, with geographical and gender variations. In the MENA region, an estimated 7.2 million children are out of school, according to data from the UNESCO Institute of Statistics (UIS) 2012. 4.3 million at primary school age and 2.9 million at low secondary age. Early school leaving comprises a significant problem in the area, and the drop-out is mainly in the low secondary level. Most drop-out children are from low-income families in rural areas, with girls comprising the majority. In the previous decade, most of the countries in the area were able to reduce the percentage of out-of-school children by 50 percent. However, the situation is worsening in conflict-affected countries such as Yemen and Syria, and barriers to schooling have increased, including destroyed schools, insecurity, military use of school buildings, displacement, and poverty (42). Despite the high percentage of out-of-school children in some countries, schools are still a proper setting to connect with over a billion children globally. The duration of school starts at child age and extends to adulthood. Behaviors and attitudes are developed in this crucial period of life which is characterized by receptiveness and resilience to establish habits. Furthermore, continuous enhancement of the messages can be achieved over the schooling period. In schools, children can be provided with the skills necessary for a healthy lifestyle and dealing with unwanted situations like violence. As well, schools can be a favorable environment for enhancing oral health. For instance, safe playgrounds and a safe physical environment everywhere in schools are reducing the risk of oral trauma, in addition to health policies that ensure healthy diets and limit intake of sugars. In fact, the lack of dental health personnel in LMICs leaves schools sometimes the only place for children to access oral health. Further, their children can pass oral health knowledge and skills provided in schools to the families and communities (21).

School-based health promotion was launched at first in 1995 as the WHO Global School Health Initiative. There are key components of the Health Promoting Schools (HPS) that include a healthy school environment, school health education, school health services, nutrition and food services, physical exercise and leisure activities, mental health and wellbeing, health promotion for staff and community relationships and collaboration (43). Integrating oral health into health-promoting schools is promising. Various strategies and approaches to school-based oral health promotion (SBOHP) are applied in different countries. This is usually based on various factors, including the financial and organizational status of the health and education systems, the socioeconomic level, culture, oral diseases burden, availability of health policies, as well as the prioritizing of oral and general health per se (44).

This study aims to present the availability and effectiveness of SBOHP programs in EMR through the following objectives:

2.3. Objectives of the Study

- **General Objective:** To explore the availability and effectiveness of school-based oral health promotion interventions in LLMICs in the EMR.

- **Specific Objectives:**

1. To identify the existing SBOHP interventions in LLMICs in EMR.
2. To discuss the effectiveness of the SBOHP interventions in LLMICs in EMR.
3. To identify lessons learned from existing SBOHP interventions in other LLMICs in Africa.
4. To recommend the most appropriate interventions and best possible ways to conduct them in low resources countries in the EMR.

3. Methodology

3.1. Research Strategy

A literature search has been done to identify relevant publications on the study topic in each of the 12 LLMICs in the EMR (according to the WHO Eastern Mediterranean regional office), in addition to other 17 (English-speaking) LLMICs countries in Africa (according to the WHO regional office for Africa). Databases PubMed, Scopus, and Cochrane, the search engine Google scholar, and oral journals have been consulted. Different Boolean connectors have been utilized with the keywords (ex. “Oral health” OR “Dental health” AND “School” AND “Afghanistan”), as illustrated in (Table 2). The abstracts of the articles were reviewed, and the relevant articles were then selected.

Table 2: Keywords & Boolean connectors

	AND				
OR	Oral health	School-based	Promotion program	Eastern Mediterranean Region	Africa
	Oral	School	Prevention program	Afghanistan	Eritrea
	Dental health	Educational	Awareness	Somalia	Eswatini
	Teeth health	For students	Educational program	Sudan	Ethiopia
	Oral diseases	Primary school	School health environment	Syrian Arab Republic	Gambia
	Dental caries	Secondary school	School oral health education	Yemen	Ghana
		For pupils	School oral health services	Djibouti	Kenya
			Nutrition and food	Egypt	Liberia
			Health promotion for staff	Iran	Malawi
			Mental health and well being	Morrocco	Lesotho
			Community relationships and collaboration	Palestine	Nigeria
				Pakistan	Rwanda
				Tunisia	Sierra Leone
					South Sudan
					Uganda
					Tanzania
					Zambia
					Zimbabwe

Inclusion Criteria:

- Published articles about SBOHP programs in the English language.
- Timeframe for articles and research is limited to 2000-2022.
- Articles from LLMICs in EMR and Africa.

Exclusion Criteria:

- Articles about SBOHP programs in the high middle and high-income countries.
- Articles about the SBOHP programs in languages other than English.
- Articles about the prevalence and incidence of oral diseases.

3.2. Conceptual Framework

The framework to be used in analyzing the topic has been adapted from the key components of integrating oral health into HPS by Kwan et al. (43) and the outcomes in the ecological model (45). It includes two main parts (components of the SBOHP program and outcomes of the program), as illustrated in Figure 4. The key components of an SBOHP program are health school environment, school oral health education, school oral health services, nutrition and food, oral health promotion for staff, mental health and wellbeing, and community relationships and collaboration. The author removed the eighth component of physical activity, which is more related to general health to prevent obesity and other inactivity-related issues. Each component offers various opportunities for tackling oral health issues, either as a separate project or as part of a broader strategy for promoting oral health. In analyzing the retrieved literature, the author utilized the seven components of the oral health promotion program to categorize the available interventions.

Health school environment*:* Oral health can be enhanced through a supportive school environment. Safe playgrounds and premises, combined with a smoke-free and stress-free environment, as well as a nutritious food supply, can all help to improve oral health. Such an environment can be introduced gradually, beginning with restrictions on providing unhealthy snacks (food and drinks) in the schools and selling unhealthy food and tobacco products near schools.

School health education: Oral health education helps children develop personal skills and knowledge about oral health and promotes positive attitudes and healthy behaviors. Oral health education can be taught as a separate subject or part of a more extensive curriculum, addressing the physical, psychological, cultural, and social determinants of oral health. Integrated approaches with active participation promote long-term behavioral changes. Oral health issues can be effectively incorporated into the curriculum. It is critical, as well, that teachers and peer educators receive appropriate training as those play critical roles in enhancing the education of children regarding their oral health.

School health services: The school health team collaborates with the primary health care team to provide oral health education, screening, diagnosis, needs assessment, preventive care, treatment, and regular monitoring, as well as referral to other dental or medical specialists secondary care for more complicated conditions.

Nutrition and food: Healthy eating programs should be designed to ensure that school canteens, tuck shops, kiosks, and vending machines serve nutritious meals and snacks.

Through school health education, pupils can be encouraged to develop healthy eating habits at a young age. Oral health can be incorporated into schemes for promoting general health, such as breakfast clubs set up to encourage healthy eating and the evaluation and surveillance of nutritional status. Outside vendors should be recommended to strengthen school-based healthy eating initiatives.

Health promotion for staff: Staff should be provided with a well-designed oral health training program that is responsive to their needs on a regular basis as part of their in-service development. It should enable employees to learn new skills and maintain healthy lifestyles, as well as incorporate their skills and experience into their teaching. They can identify critical policies and practices that endorse oral health by collaborating with the education health team, parents, and the local community.

Mental health and wellbeing: Stress can lead to unhealthy eating habits, smoking, and violent behavior. School activities that assist children's self-esteem and confidence while also lowering stress and conflict should be included in the curriculum. Children and school personnel should be taught skills to help them avoid and, if necessary, deal with relationship issues, stress, peer pressure, as well as other social forces. Counseling and support services for pupils and faculty would be invaluable.

Community relationships and collaboration: Parents can be trained to reinforce oral health messages at home and act as facilitators in outreach programs for children who do not attend school. Such programs can help promote oral health in these families and may encourage them to become part of the school community. Through the students, other members of the family can benefit from an oral health promotion program initiated by the school. Advocating for a healthy environment, transparent food labeling, and water fluoridation requires community support. The media is an effective medium for communicating oral health messages. The media should be educated to avoid trying to target children and teenagers in tobacco advertising campaigns, as well as promoting foods and beverages high in sugar, salt, and fat (43).

In addition, the effectiveness of the interventions found in the literature is going to be addressed based on the following three outcomes:

- Oral health knowledge and behavior (improved oral hygiene behaviors): by improving the comprehension of factors that affect health and enabling them to make healthy choices and follow health behaviors during their lives.

- Oral health care access (fewer barriers to dental care): schools are suitable for the provision of preventive and curative services.

- Oral health and wellbeing (reduced caries incidence and improvement in healthy gingiva): oral health is crucial to general health and has a huge impact on life quality (45).

It is also worth mentioning that improving oral health knowledge and behaviors and increasing access to oral health care eventually result in enhancing oral health and wellbeing.

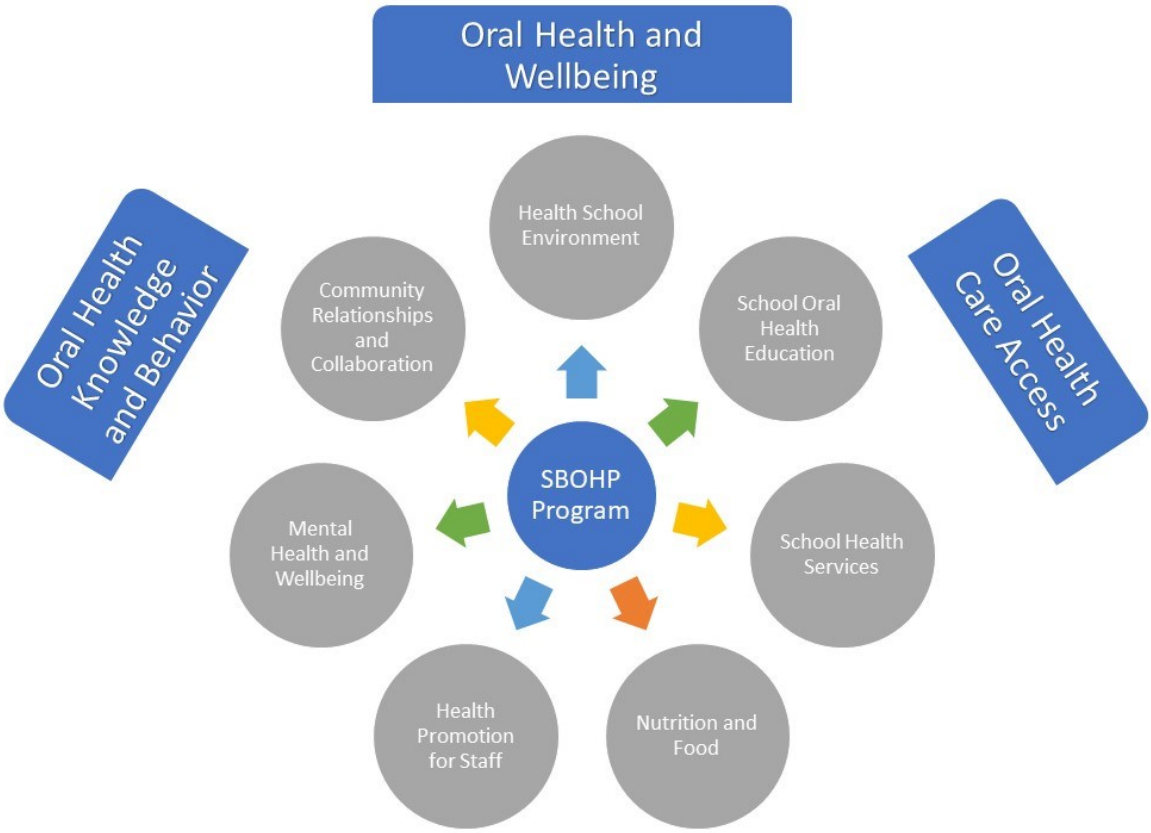

Figure 2: Framework for SBOHP Program and its Outcomes

3.3. Study Limitations

Due to the neglect of oral health and lack of focus on promoting oral health in LLMICs, published articles on the topic are generally limited. This is undoubtedly worsened in the EMR. In addition, using the English language as an inclusion criterion might have caused missing relevant articles, especially in countries like Morrocco and Tunisia, where the French language is more used.

4. Findings

Using the search methodology described earlier, 26 articles about school-based oral health promotion interventions were retrieved in EMR following the inclusion criteria. The articles came from Iran, Egypt, Palestine, Pakistan, and Syria, as shown in (Figure 3).

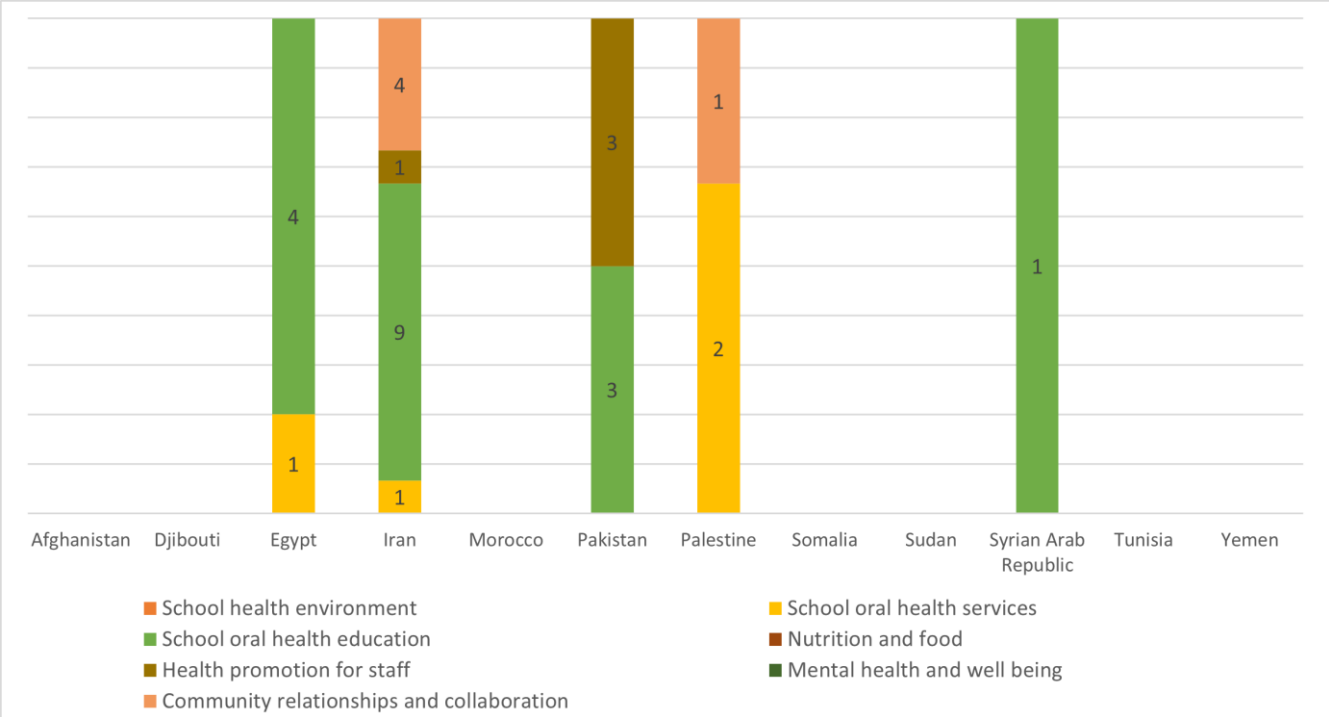

Figure 3: Retrieved articles on SBOHP interventions per country- low and lower middle-income countries- EMRO

Using the same research methodology and limiting the review to other LLMICs African countries with English as the national language (17 countries as previously shown in (Table 2)), 15 articles about SBOHP were found in four countries, as shown in (Figure 4).

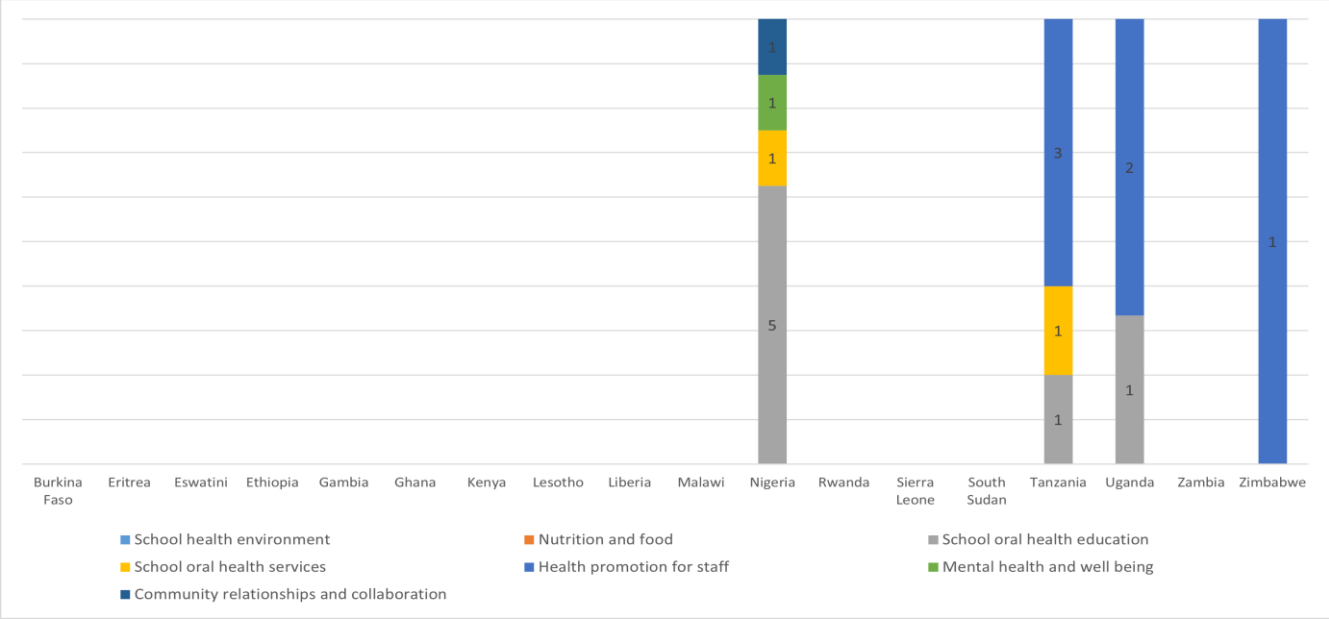

Figure 4: Retrieved articles on SBOHP interventions per country- low and lower middle-income countries- AFRO

Analyzing the literature on school-based oral health promotion programs implemented in LLMICs in EMR, a diverse picture arose. In general, the programs are not identical in implementation and do not include all components described in the SBOHP program. In some countries, like Yemen, Afghanistan, Djibouti, and Somalia, oral health promotion interventions in schools were not mentioned. In these countries, few studies have been conducted about the prevalence of dental caries among school children or their knowledge, attitude, and practices. A number of oral health promotion interventions were found in studies from Iran, Palestine, and Pakistan. However, those interventions were not unified, and no single program covered all the components of the WHO framework. Available programs in the LLMICs in EMR are described in the following paragraphs.

In Palestine, the oral health program started in 1997 by screening the oral cavity, educating the children, and referring them to the Ministry of Health (MoH) oral clinics as a part of the national school health program. The next step was providing prevention procedures on need, like the application of fluoride gel and fissure sealants in selected schools in the 2002-03 and 2003-04 school years (46). In 2017, a cross-sectional survey revealed the necessity to improve children's oral health and hygiene habits in schools in Palestine. Only one in every five children aged 5-6 years brushed their teeth two times a day, and a high number of kids did not use fluoride toothpaste. In addition, the study showed that children consumed a lot of sugary foods and beverages (47).

In Pakistan, the health program in schools was initiated in 17 districts. The program was funded by the Bill and Melinda Gate foundation and implemented by the National Commission for human development in 2005. 1.83 million students benefited from the program that covered

23,266 primary schools. The program included the implementation of oral health education (48). However, evaluating the oral health knowledge, attitudes, and practices among school students in Mastung district showed that the students did not have sufficient knowledge. Especially girls had low knowledge regarding oral hygiene. This study found that the source of knowledge and advice about oral health and hygiene was from parents, not teachers, illustrating a gap in the role of schools in promoting oral health (49).

In Sudan up to 2010, the school health services program included a screening of oral diseases. The national guideline for implementing an effective school health program (developed in collaboration with UNICEF) mentioned oral health and hygiene as a part of nutrition education (50). This illustrates the unavailability of distinct oral health promotion interventions in schools. A study conducted in a primary school in Khartoum state illustrated the effectiveness of a school oral health promotion program in reducing dental caries and gingivitis and recommended implementing the program (51).

On the other hand, good experiences from other LLMICs in Africa were looked for to find lessons learned in a similar socioeconomic state. The first promising finding is the WHO AFRO publication in 2016 titled "Promoting oral health in Africa" which addresses the prevention of oral diseases and promotion of oral health and includes a chapter on School-based oral health promotion. This chapter illustrates the principles of health in school settings and states recommendations on oral health promotion activities in schools as an essential package (52). Oral health education was found to be included in the curriculum of primary schools for more than 40 years and is a part of the syllabus of teachers' trainees in some countries.

The retrieved articles report on the effectiveness of interventions of components in the SBOHP program, mainly consisting of pilot studies or small-scale interventions or evaluations of the implementation of programs conducted at a larger scale in LLMICs in EMR. The retrieved articles from EMR are illustrated in (Table 3). In addition, retrieved articles from other LLMICs in Africa report on the effectiveness of nationwide programs and other intervention. The retrieved articles from other LLMICs in Africa are illustrated in (Table 4) . Then, the findings are presented under each component of the SBOHP program and divided over countries in EMR and other LLMICs in Africa.

Table 3: Retrieved articles on SBOHP interventions from LLMICs in EMR.

#	Author	Country	SBOHP Component	Outcome Criteria	Evaluation of Effectiveness	Comment
1	Shaima F. et al. 2014	Egypt	School oral health education	Oral health Knowledge and Behavior	Effective	Intervention is effective in improving oral health knowledge and habits and among children of 5-6 years old.
2	Rizk Mohammed Abu-Elenen et al. 2015	Egypt	School oral health education	Oral health Knowledge and Behavior	Effective	Positive impact of the program on the knowledge, practice, and self-efficacy regarding the children's oral health
3	Seif El-Nasr E. 2018	Egypt	School oral health education	Oral health Knowledge and Behavior	Effective	Effectiveness in enhancing the knowledge and practice of teeth brushing.
4	AbdAllah et al. 2018	Egypt	School oral health education	Oral health and wellbeing	Effective	Effectiveness of special educational program in improving caries risk factors and reducing the chances to get dental caries for autistic children.
5	Rizk et al. 2021	Egypt	School oral health services		N/A	Unfortunately, the project was stopped at this early level. The pilot second phase was not implemented.
6	Naseri Salahshour et al. 2019	Iran	School oral health education	Oral health Knowledge and Behavior	Effective	Effectiveness of the promotion through education based on TPB.
7	Yazdani et al. 2009	Iran	School oral health education	Oral health and wellbeing	Effective	Improving the oral hygiene and gingival health among adolescents was proven in the short term.

8			School oral health education	Oral health Knowledge and Behavior	Effective	Success of an oral health education program in enhancing the oral health related behaviors of schoolchildren was indicated.
	Yekaninejad et al. 2012	Iran	School oral health services	Oral health Knowledge and Behavior	Effective	Involvement of teachers and staff members is promising in oral health promotion of students.
			Community relationships and collaboration		N/A	Promising role of parents in improving the oral health of their children was concluded when involved to benefit from interventions
9	Sharififard et al. 2020	Iran	School oral health education	Oral health and wellbeing	Effective	ATP technique alone can be an effective method to provide oral health education and improve the oral health status of visually impaired children.
10	Hashemi et al. 2021	Iran	School oral health education	Oral health Knowledge and Behavior	Effective	Good strategy when combined with other oral health self-care education and can enhance the performance of students towards good oral health practices.
11	Nooshin Peyman et al. 2015	Iran	School oral health education	Oral health Knowledge and Behavior	Effective	Intervention was effective in improving behaviors that prevent oral disorders among students.
12	Goodarzi et al. 2019	Iran	School oral health education	Oral health Knowledge and Behavior	Effective	Effectiveness of oral health education based on HBM in enhancing oral hygiene behaviors.
13	Sanaeinasab et al. 2022	Iran	School oral health education	Oral health and wellbeing	Effective	Higher level of effectiveness of the HBM-program compared to traditional methods of education.

14	Pakpour et al. 2014	Iran	School oral health education	Oral health Knowledge and Behavior	Effective	Intervention is more effective in encouraging self-care behaviors towards oral health among adolescents.
15	Memarpour et al. 2011	Iran	School oral health services	Oral health and wellbeing	Effective	Fissure sealant was proven effective in preventing caries in permanent molars.
16	Saied-Moallemi et al. 2012	Iran	Community relationships and collaboration	Oral health and wellbeing	Effective	Mothers' attitudes, beliefs, and behaviours affect the oral health of the children.
17	Saber Azami-Aghdash et al. 2015	Iran	Community relationships and collaboration	Oral health and wellbeing	Effective	Significance of parents in protecting their children from injuries and managing when injuries of teeth exist is stated.
18	Bashirian et al. 2021	Iran	Community relationships and collaboration	Oral health Knowledge and Behavior	Effective	Oral hygiene behaviors among elementary school children can be facilitated by socially supportive home environment provided by the parents.
19		Pakistan	School oral health education	Oral health Knowledge and Behavior	Effective	Repetition and reinforcement of oral health education for schoolchildren was found very effective and a key role in school based oral health education.
	Haleem et al. 2016			Oral health and wellbeing	Effective	Repetition and reinforcement of oral health education for schoolchildren was found very effective and a key role in school based oral health education.
			Health promotion for staff		Effective	The significant role of trained teachers in oral health education is stated.

20	Maaz A et al. 2020	Pakistan	School oral health education	Oral health Knowledge and Behavior	Effective	Intervention was effective in improving the oral health care of the children, especially for those who had practical supervision from an educator.
21	Moin et al. 2021	Pakistan	School oral health education	Oral health and wellbeing	Effective	The use of various oral hygiene education programs such as pictorial and video methods for hearing impaired children is effective in improving oral health.
22	Sajjad et al. 2016	Pakistan	Health promotion for staff		N/A	Positive attitude and willingness of schoolteachers to be part of the oral health education program in school.
23	Sajjad et al. 2015	Pakistan	Health promotion for staff		N/A	Positive attitude and willingness of schoolteachers to be part of the oral health education program in school.
24	Abuhaloob et al. 2021	Palestine	School oral health services		N/A	
			Community relationships and collaboration		N/A	Critical role of parents in improving the oral health of schoolchildren is stated.
25	E Kateeb 2007	Palestine	School oral health services		N/A	
26	Bardaweel et al. 2018	Syria	School oral health education	Oral health Knowledge and Behavior	Effective	Leaflets are an effective educational tool to improve oral health knowledge and oral hygiene of schoolchildren.

Table 4: Retrieved articles on SBOHP interventions from other LLMICs in Africa

#	Author	Country	SBOHP Component	Outcome Criteria	Evaluation of Effectiveness	Comment
1	Melo et al. 2021	Nigeria	School oral health education	Oral health Knowledge and Behavior	Effective	The program was effective in improving the knowledge and behavior of children towards oral health in 21 days and that this result lasts for a minimum of 6 months
2	Melo et al. 2021	Nigeria	School oral health education	Oral health and wellbeing	Effective	Program increased Nigerian children's confidence in their smile by 71% and doubled the proportion of children presenting with good oral hygiene
3	Esan et al. 2015	Nigeria	School oral health education	Oral health Knowledge and Behavior	Effective	The intervention increased the use of fluoridated toothpaste and brushing twice daily among children
			Community relationships and collaboration	Oral health Knowledge and Behavior	Effective	The interventions increased the use of fluoridated toothpaste and brushing twice daily among children
4	Lawal et al. 2014	Nigeria	School oral health education		N/A	Because of lack of baseline data, no evaluation of the effectiveness of the program in enhancing the KAP or improving the oral health and wellbeing was feasible
5	Olubunmi et al. 2013	Nigeria	School oral health education	Oral health and wellbeing	Effective	Using video in local language can significantly promote oral hygiene among this group

6	J O Eigbobo et al. 2015	Nigeria	School oral health services		N/A	Many schools have no clinics or have no suitable equipment to manage dental emergencies
7	Tantawi et al. 2021	Nigeria	Mental health and well being	Oral health and wellbeing	N/A	Possible relationship between high risk of mental problems and high risk of dental cavities
8	MacNab et al. 2012	Uganda	School oral health education	Oral health Knowledge and Behavior	Effective	Effectiveness of oral health education in enhancing health knowledge and healthy practices
9	Akera et al. 2022	Uganda	Health promotion for staff		N/A	Teachers were found to be crucial players in providing oral health promotion and they should be essential part of any governmental intervention for oral health promotion
10	Astrom et al. 2000	Uganda/ Tanzania	Health promotion for staff		N/A	Teachers are prepared to teach and their awareness about oral health behaviors is high
11	Mbawalla et al. 2013	Tanzania	School oral health education	Oral health and wellbeing	Effective	The intervention was found to have a positive impact on oral health status
12	Mashoto et al. 2010	Tanzania	School oral health services	Oral health and wellbeing	Effective	Outcomes of ART resulted in improvements in all aspects of oral health
13	Mwangosi et al. 2002	Tanzania	Health promotion for staff		N/A	Teachers and teacher trainees' knowledge about oral health is moderate to poor

14	Mwangosi et al. 2001	Tanzania	Health promotion for staff		N/A	Oral health education was mainly provided in low grade primary school students and mainly given by the female teachers and those new in the profession
15	Frencken et al. 2001	Zimbabwe	Health promotion for staff	Oral health and wellbeing	Ineffective	Training the teachers one time to provide oral health education was found to be ineffective in reducing plaque level meaning poor oral hygiene among their students

4.1. Health school environment

EMR:

Although no studies discussing the significance of having a healthy environment in schools were found, it is worth noting that many policies to ensure a healthy environment in public places, including schools, exist. One example is smoking restrictions in public places, including schools in EMR countries (53,54).

Other LLMICs in Africa:

No studies were reported on this component.

4.2. School oral health education

EMR:

Most of the interventions found in the literature were regarding oral health education in schools, and these included various perspectives such as studying the effectiveness of education for improving oral health. The studies used, e.g., the application of models and theories such as the Theory Planned Behavior (TPB), the Health Belief Model (HBM), and the effects of different messages, animation and gaming, and repetition and reinforcement in improving oral health. Other studies measured the effectiveness of oral health education for impaired children.

Egypt. A study was conducted on schoolchildren in governmental primary schools at Port-Said City, Egypt, to measure the effectiveness of an educational program on a sample of 203 schoolchildren aged 10-12 years regardless of gender and area of residence. The study concluded that there was a positive impact of the program on the knowledge, practice, and self-efficacy regarding the children's oral health (55). Another study aimed to evaluate the effectiveness of oral health education intervention among 100 primary school children in 5th grade in two language schools in El-Qalyubia Governorate. The study revealed that the oral health education intervention was effective in enhancing the knowledge and practice of teeth brushing (56). However, this study may not be representative as language school students come mainly from families of high socioeconomic status. Further, a study conducted on 442 children in nurseries schools in El-Suez governorate found that oral health education was effective in improving oral health knowledge and habits among children of 5-6 years old (57). Another study included 30 autistic children aged 4-13 years in three academies for autism in the Cairo governorate and assessed the effectiveness of the special education program. The program consisted of educational workshops using games, songs, coloring papers, and models and was found to be effective in improving caries risk factors and reducing the chances of getting dental caries for autistic children (58).

Iran. The effectiveness of an easy-to-implement, cheap school-based oral health intervention in improving oral hygiene and gingival health among 15-years-old adolescents was Assessed in a study in Tehran. The leaflets and videotapes tested in the study were proven effective in the short term (59). Another study in Tehran indicated the success of an oral health education program in enhancing the oral health-related behaviors of 11-12 years old schoolchildren (60). As well, a cluster randomized control trial conducted in the city of Saveh, tested the effectiveness of oral health education using the TPB in promoting the awareness, attitude, perceived behavioral control, intention and behavior among 4th, 5th, and 6th grade elementary school students. The program lasted three times a week of 45-minute training sessions that included both education and practical demonstration of tooth brushing and flossing. The study concluded that a statistically significant difference was observed between the intervention and control groups proving the effectiveness of the promotion through education based on TPB (61). Other studies also discussed the significance of oral health education using the health belief model (HBM), such as the research conducted in Tehran that showed a higher level of effectiveness of the HBM program compared to traditional methods of education (62), and the study in Mashhad city on 5th-grade elementary school girls that concluded the effectiveness of oral health education based on HBM in enhancing oral hygiene behaviors (63). Another study conducted in Khomein City aimed at evaluating the effects of animation and games in improving oral health concluded that it is a good strategy when combined with other oral health self-care education and can enhance the performance of students towards good oral health practices (64). A study conducted in Qazvin compared the loss-framed with the gain-framed messages. It was found that loss-framed messages are more effective in encouraging self-care behaviors toward oral health among adolescents in this city (65). Another study to predict oral health behaviors among female students aged 10-12 years using HBM concluded that perceived self-efficacy was found to be significantly related to improvement in oral health behaviors such as brushing teeth and flossing (66). Furthermore, Audio Tactile Performance (ATP) technique for visually impaired children was found effective in a study in Tehran (67)**.**

Pakistan. A study conducted in a rural community of Pakistan illustrated the improvement in oral hygiene behaviors (tooth brushing) due to educational interventions for children in primary schools. The oral health education was effective in improving the oral health care of the children, especially for those who had practical supervision from an educator (68). In an urban community in Karachi, the effectiveness of repetition and reinforcement of oral health education for schoolchildren was assessed. These measures were found to be very effective and of a key role in school-based oral health education (69). Another study in schools for deaf children in Karachi concluded that using various oral hygiene education programs such as pictorials and videos for hearing impaired children effectively improves oral health (70).

Syria. The effectiveness of educational leaflets in enhancing oral health knowledge and oral hygiene of 10-12 years schoolchildren compared to E-applications. The study concluded

that leaflets are an effective educational tool to improve schoolchildren's oral health knowledge and oral hygiene (71).

Other LLMICs in Africa:

Nigeria. A study was conducted in 2021 in Nigeria and Indonesia to measure the effectiveness of implementing a 21- days Brush day and night program on children's oral health knowledge and behavior. The study targeted students in 1, 2, and 3 grades to ensure most children are between 6-12-years-old. In the intervention group, students were provided with a toothpaste and toothbrush, received brushing instructions, and were supervised when brushing. Also, children were supported with songs about the importance of brushing twice a day and provided with calendars and stickers to track their progress. At 24 weeks, Nigerian children had a 92 percent higher probability of brushing their teeth on a regular basis and a 73 percent higher probability of using fluoride toothpaste. Meaning that the program was effective in improving the knowledge and behavior of children towards oral health in 21 days and that this result lasts for a minimum of six months (72).

Another study aimed to measure the same intervention's impact on children's wellbeing and oral hygiene. The study revealed that the program increased Nigerian children's confidence in their smiles by 71% and doubled the proportion of children presenting with good oral hygiene (73). In Ile-Ife, a study was conducted to measure the effectiveness of the oral health program, consisting of both school-based education and community-based interventions on self-care behaviors toward dental caries. The oral health education in schools was provided using a curriculum developed by the Pediatric Dentistry Working Group and ensures that the schoolchildren from 1-6 grades are provided with five educational sessions on oral health annually for four years. Children were also provided with a toothbrush every year, and fluoridated toothpaste use was encouraged. The study showed that the intervention increased the use of fluoridated toothpaste and brushing twice daily among children (74). Another study measured the effectiveness of using videos in the local language in improving oral hygiene among schoolchildren from the low socioeconomic quintile in the country. The study concluded that this method could significantly promote oral hygiene among this group (75). A health institute conducted a study in 2014 to review Nigeria's school-based oral health education programs. It was found that 104 oral health education interventions were conducted in 104 schools for a total of 16,248 students and teachers. The teams conducting the interventions were led by trained dentists who conducted the education and screening activities with assistance from trained public health nurses. This study illustrated the feasibility of conducting low-budget oral health education programs and the effectiveness of such programs (76).

Tanzania. Oral health education has been included in the primary school curriculum since 1982 with the goal of enhancing the proper oral health behavior of schoolchildren. One study was conducted to measure the oral health outcomes of secondary school students following oral health promotion integrated into a health-promoting school initiative. The oral health intervention consisted of educational sessions for both students and teachers about

brushing with fluoride toothpaste, brushing two times a day, and toothbrush replacement, in addition to the provision of posters of oral health messages for participants. The intervention was found to have a positive impact on oral health status (77).

Uganda. A 4-years oral health education program was established based on key components: teachers include oral health education in the curriculum and delivered in class, supervision of oral health practices (tooth brushing in schools), reinforcing the key messages through visits conducted by dental trainees, and yearly examination of schoolchildren participating in the program. The program was implemented for 1st-grade students in 4 schools. What is interesting about this intervention is the use of local language and including culturally accepted activities such as: acting the process of dental caries formation through playing roles of food, bacteria, tooth paste and brush in relation to caries, singing songs that enhance learning oral hygiene practices, and demonstrating the function of acid in destroying the tooth by using cola to dissolve eggshells. This study illustrated the effectiveness of oral health education in enhancing health knowledge and healthy practices (78).

4.3. School oral health services

EMR:

Palestine. As mentioned earlier, the oral health promotion program in schools in Palestine started with screening the oral cavity, conducting oral health education, and referring students to MOH-run oral clinics. The services provided included prevention procedures like the application of fluoride gel and fissure sealants to schoolchildren in selected schools in the 2002-03 and 2003-04 school years (46). Oral diseases prevention and health promotion is a part of the comprehensive school health program that has been established in the country. The implementation of the program took place in several representative schools and included building healthy lifestyles, addressing risk factors including low intake of sugar, appropriate nutrition, using fluoride effectively, and enhancing oral hygiene in children. Schoolteachers were trained and were responsible for providing health education and supervising toothbrushing activities for school children (47).

Egypt. A pilot health appraisal project for primary school children was implemented in Fayoum governorate with the intention to cover all schools in Egypt. The pilot project took place in October-December 2012 and targeted 50% of the 1st and 4th-grade primary school students. The project included screening for oral diseases and referral of those with needs to dental clinics. Unfortunately, the project was stopped at this early level. The pilot's second phase was not implemented (79).

Iran. A study evaluated the effectiveness of fissure sealants to prevent caries in permanent molars as a part of a school oral health program in 1st-grade students in Shiraz in 2008. The teeth were examined a year and a half after sealant application. The results showed that 13% were entirely lost. Fissure sealant was proven effective in preventing caries in permanent molars (80).

Other LLMICs in Africa:

Tanzania. A study to investigate the evaluative properties of the Child Oral Impact on Daily Performance (Child-OIDP) inventory and changes in estimated treatment-associated changes in the OIDP and self-reported oral health following ART and oral health education was implemented in 2008. It was clear that ART outcomes resulted in improvements in all aspects of oral health (81).

Nigeria. In a study in 2015 to measure the care provided to primary school children who had traumatic dental injuries in the country, findings revealed that many schools have no clinics or suitable equipment to manage dental emergencies (82).

4.4. Nutrition and food

No studies discussing the significance of healthy eating programs in schools were found in this study's countries.

4.5. Health promotion for school staff

EMR:

Iran. It has been concluded that children's performance of desired behaviors improves in relation to getting positive feedback from others such as teachers. Furthermore, significant others such as peers, teachers, or parents are good examples for children (83). Teachers in schools can contribute to promoting oral health for children. Involvement of teachers and staff members is promising in the oral health promotion of students, as the findings of a study suggested (60).

Pakistan. The previously mentioned study in Karachi that clarified the importance of repetition and reinforcement of oral health education in improving oral health also drew attention to the significant role of trained teachers in oral health education (69). Fortunately, schoolteachers from Rawalpindi city had a positive attitude and expressed their willingness to participate in the school oral health education program(84,85).

Other LLMICs in Africa:

Tanzania and Uganda. Oral health education is part of the syllabus of teachers' training programs in Tanzania. Teachers' preparedness to provide knowledge about oral health-related behaviors in Uganda and Tanzania was assessed. The results showed that teachers are prepared to teach, and their awareness of oral health behaviors is high. However, some misconceptions still exist among them and need to be addressed (86). In Gulu district, Uganda, the contribution of primary school teachers in promoting oral health was assessed. Teachers were found to be crucial players in providing oral health promotion, and they should be an essential part of any government intervention for oral health promotion (87).

Tanzania. The oral health knowledge, attitude, behavior of teachers in Rungwe district and revealed that teachers' and teacher trainees' knowledge about oral health is moderate to poor (88). At the same time, another study in the same country revealed that oral health education was mainly provided to low-grade primary school students and mainly given by female teachers and those new to the profession. This ensured the need to encourage teachers to participate more in oral health education (89).

Zimbabwe. The effectiveness of oral health education intervention provided by the schoolteachers over a period of 3.5 years was evaluated. Teachers attended workshops on oral health and were provided with the means to train other teachers to increase the number of trainers. Training the teachers once to provide oral health education was found to be ineffective in reducing plaque levels resulting in poor oral hygiene among their students (90).

4.6. Mental health and wellbeing

EMR:

No studies were reported on this component.

Other LLMICs in Africa:

Nigeria. Only one study was retrieved, and that concerned a cross-sectional survey that was conducted in Osun state. The relationship between mental health issues, dental cavities, and gum inflammation in adolescents was assessed. A possible relationship between high risk of mental problems and a high risk of dental cavities was found, but the pathways for the relationship were vague (91).

4.7. Community relationships and collaboration

EMR:

Iran. The impact of mothers' knowledge of oral health on their children's oral health behaviors was evaluated. The conclusion was that parents are facilitators of the oral health of their children and that their attitudes, beliefs, and behaviors affect the oral health of the children (92). Parents' promising role in improving their children's oral health was also concluded when involved to benefit from interventions (60). The high percentage of injuries in the home sets an example of the significance of parents in protecting their children from injuries and managing injuries to teeth (93)**.** In Hamadan, a study demonstrated that oral hygiene behaviors among elementary school children could be facilitated by a socially supportive home environment provided by the parents. It was also stated that children's low self-efficacy could be compensated for by their parents' social support, encouragement, assessment, and remembrance, which improves their oral hygiene behaviors (94)**.**

Palestine. The previously mentioned survey stated parents' critical role in improving schoolchildren's oral health (47)**.**

Other LLMICs in Africa:

Nigeria. In Ile-Ife, the effectiveness of an oral health program, both the school-based education and the community-based interventions on self-care behaviors towards dental caries was evaluated. The community component was implemented in three parts. The first was the education of pregnant women in antenatal care on different oral health issues that includes addressing local myths and misconceptions about oral health and how to take care of children's oral health. Trained oral health workers provided this part for the duration of 4 weeks. The other part was through oral health education for the parents through public discussions and education on oral health, and this was performed with different community groups, including churches and mosques. The last part targeted schoolteachers with pieces of training on the use of the oral health education curriculum and its integration to classes (74).

5. Discussion

5.1. Summary of the main results

This present study has sought to identify the existing SBOHP interventions in LLMICs in the EMR, evaluate their effectiveness, and look for learned lessons from other African countries with similar socioeconomic status to make appropriate recommendations. Despite the differences between countries, as some are under conflict and some struggle through economic difficulties, it was found that oral health promotion in schools is rarely performed in all 12 countries. Some interventions such as screening for oral diseases were found only in Palestine, Sudan, and Egypt. The programs were suspended in the two latter countries more than ten years ago, and no outcome evaluation was conducted in Palestine. A small intervention was done in Iran to examine the effectiveness of fissure sealants in preventing dental cavities, which proved effective.

It was vivid that the focus of the existing studies is mainly on the effectiveness of oral health education with very limited evidence on the effectiveness of other interventions globally. Existing systematic reviews only focus on oral health education (95,96). Worldwide, no study currently provides a comprehensive picture of the effectiveness of various types of oral health programs in various school settings (96). However, oral health education as a public program was only retrieved in Pakistan. The other studies were limited to presenting the significance and effectiveness of oral health education programs implemented in certain areas and included only some schools in different countries. Some studies drew attention to using different methods in oral health education and stressed the roles of repetition, the inclusion of music, and the special educational methods for impaired children in improving oral health (ATP technique for visually impaired children, and pictorial and video methods for hearing impaired children). Despite differences, all mentioned studies had consensus in representing the effectiveness of oral health education despite their differences. Differences were in the utilized methods, the targeted age groups of school children, the duration of the intervention, and the perspective of the measured outcome.

This present study found that oral health services in schools in LLMICs in EMR were limited to two countries and dealt mainly with a screening of oral diseases and referral. Those public interventions were terminated due to different reasons. Although those programs were not evaluated, school screening of oral health programs was found to be effective in a systematic review conducted in 2019. However, the finding of this review was limited to evaluating the program's effectiveness in enhancing dental attendance over a short period (97). Only one study reported the effectiveness of applying sealants as a preventive measure to dental cavities. At the same time, focus on other aspects such as oral health promotion for school staff, integrating school staff in education on oral health, and increasing the awareness of parents were not available despite the studies revealing the significance of the roles of teachers and parents and their willingness to be involved in the oral health promotion.

Similar conclusions about the focus on oral health education to other program components were also derived from the studies found in other LLMICs in Africa. However, the interventions in Africa were found to be implemented at a large scale and illustrated the feasibility and efficacy of conducting oral health education to cover the majority of schoolchildren. Oral health education was included in the teachers' program syllabus or provided in education sessions for teachers. Oral health education was also included in the curriculum for students in schools. Governments established such programs to subside the low numbers of dentists in the countries and lower the burden on the health system by reducing the prevalence of oral diseases, mainly dental caries and periodontitis. Although some studies revealed unsatisfactory results of those interventions, teachers still play a key role in educating oral health.

In other LLMICs in Africa, studies about school oral health services included other perspectives, such as measuring the effectiveness of ART as a suitable treatment method for low resources areas and evaluating schools' capacities to manage dental trauma. ART was proven to be effective in improving the oral health status of schoolchildren, while schools were proven to have no suitable equipment to deal with dental emergencies in a separate study. Including education of parents to ensure community collaboration was found to be effective.

This present study draws attention to the gap in scientific publications on oral health promotion in schools that specialists and educational institutions need to recognize. Many interventions conducted in different countries targeted school children's oral health. The dental colleges' students executed those. They carried out visits to schools and conducted several activities, mainly oral health education, focusing on oral hygiene habits and the proper way to brush one's teeth, nutrition-related advice, screening for dental and oral health problems, and referral to dental clinics. Those interventions are not documented in articles but seem promising if organized and supervised.

There is also a gap in policy towards oral health promotion in areas of a healthy environment in schools, the ban of sugary drinks on school premises and their surroundings and enhancing healthy dietary habits among schoolchildren. Although no superior experiences were found in the study area, it would be of great interest to learn from the exciting experiences in other low and low-middle-income nations such as India. In India, very respectful entities like the Indian Academy of Pediatrics and the Indian Dental Association focus on the oral health of schoolchildren through developing guidelines. The guidelines for parents developed by the Indian Academy of Pediatrics draw attention to safety in contact sports for schoolchildren. Critical recommendations on using plain water as an alternative of high-sugar drinks in addition to disallowing the sales of those fuzzy drinks and junk foods in schools and within a proximity of 50 meters to schools are also mentioned in the guidelines, which further includes the Mumbai Declaration on sugary drinks and healthy food (98,99). However, disseminating those recommendations to policy makers and the community is crucial and should be enhanced to ensure implementation and reach the desired outcomes.

In addition, the present study showed that oral health specialists conducted the majority of studies regarding the SBOHP program. They are the leading key player, and their efforts are obligatory for planning and implementing the program (100). Furthermore, the role of parents and the influence of the family environment on children's oral health was crystal clear and should be highly considered. Including parents in oral health promotion programs is important to ensure the adaptation and consistency of their children's health behaviors, resulting in high quality of life (101,102).

Evaluating the effectiveness of different SBOHP interventions was found incomparable. Studies used dissimilar criteria. Some focused on evaluating the knowledge and behavior change, while others used the improvement of oral health and wellbeing to evaluate the effectiveness of the intervention. The effectiveness of the SBOHP programs was obvious, especially for those including oral health education for students, teachers, and parents. This observation is in line with findings from two meta-analyses, in which also supervising tooth brushing in schools and provision of fluoridated toothpaste were considered essential (102,103). SBOHP programs can have promising outcomes when all relevant stakeholders, including the ministry of health, the ministry of education, dental colleges, researchers, etc., are involved in the planning. This creates ownership of the program and ensures interest and efforts towards success. Stakeholders need to be empowered with the knowledge and skills to further execute their roles in the program.

5.2. Relevance of the utilized framework

The utilized framework was suitable for identifying the different applicable interventions for oral health promotion. However, it included components that are difficult to be implemented in the LMICs school health environment. High budgets to establish the appropriate reforms to make schools safer for schoolchildren, including safe playgrounds and personal safety supplies for sports in schools, are required. In addition, components like nutrition and food include feasible interventions like encouragement for healthy eating habits. This can be included in the oral health education component as well as the mental health component, which is limited to enhancing self-esteem and lowering stress that should be included in the curriculum. Other components like community collaboration and relationships include outreach activities that are not usually launched from schools and are difficult to be implemented in the educational system. It became clear that evaluating oral health promotion in schools would be best implemented by limiting the framework to evaluating oral health education, oral health services in schools, and oral health for staff.

5.3. Limitation of the study

The present literature review was conducted by one researcher. Because of this, there is a possibility that the process of selecting data from the database and analysing the content of the selected articles is subject to selection bias. Carrying out this process by at least two researchers would diminish the possibility of obtaining biased information.

Retrieved studies were mainly randomized control trials, cross-sectional and quasi-experimental studies limited to certain geographic areas. Most of the studies included small numbers of participants of different ages and were conducted over short periods. They were not representative of a region, state, or country. Some should be considered pilot studies. Although providing evidence of the effectiveness of SBOHP interventions, most of these studies' conclusions were limited by deficiencies like these. Furthermore, different outcome criteria were applied, making comparison difficult.

The low number of retrieved articles and the lack of articles about some components of SBOHP programs hindered the ability to compare the different interventions.

6. Conclusion and Recommendations

6.1. Conclusion

SBOHP interventions were found to be rarely implemented in LLMICs in the EMR. Available information from the retrieved studies illustrated the feasibility and applicability of effective interventions utilizing existing educational systems.

The retrieved studies from LLMICs in Africa illustrated that oral health promotion could be implemented to cover all schoolchildren in low resources countries. Oral health promotion should be included in the curriculum for teachers and medical professionals at educational institutions and provided in practical ways to school students as part of the syllabus.

A realistic framework for evaluating SBOHP in LLMICs in EMR and Africa would be limited to oral health education, school health services, and oral health for staff.

6.2. Recommendations

The following interventions are recommended based on the findings of the present study. Those cover different areas and are prioritized based on feasibility and importance.

- Oral health promotion to be included in the curriculum of teacher trainees in the universities as a subject and provided enthusiastically and practically to ensure application and motivation.
- Oral health promotion to be included in the curriculum of school students using suitable methods and terms appropriate to the different age groups and included in all years to ensure repetition and reinforcement. Key topics should include general oral health, oral hygiene practices, healthy eating habits, and personal safety.
- Dental colleges to include oral health promotion in the syllabus and requirements. Dental colleges plan to cover primary schools through outreach activities by the dental students as part of their requirements. The outreach activities include oral screenings, educational sessions for teachers, students, and parents, supervised tooth brushing, and ART. Those activities should be coordinated with the private sector as part of their community participation to provide the required supplies for the outreach.
- Dental colleges, institutions, and researchers should focus on studying the effectiveness of oral public health and the promotion of oral health.
- Oral health promotion should be included in the curriculum of medical colleges (doctors, nurses, midwives) to provide them with the required knowledge and skills to promote oral health.

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