ORAL HEALTH IN BANGLADESH

An Overview of People's Perception, Knowledge and Priority towards Their Oral Health and Hygiene

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Submitted by

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Declaration

I acknowledged the works of other researchers, retrieved from the internet, in printed copies or other sources and have referenced accordingly in line with the institution's requirements.

The thesis on the oral health of Bangladesh, an overview of people's perception, knowledge and priority towards their oral health and hygiene is my individual work.

Amin Hasmine

Signature

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List of Abbreviations

ADA	American Dental Association
AN	Areca nut
BQ	Betel quid
DMFT	Decayed, Missing, and Filled Permanent Teeth
ECC	Early Childhood Caries
GATS	Global Adult Tobacco Survey
HBM	Health Belief Model
LBW	low birth weight
LMIC	Low and Middle Income countries
NCD	Non-communicable diseases
PHC	Primary healthcare
PTB	preterm birth
PTD	premature delivery
SLT	Smokeless tobacco
WHO	World Health Organization

Definition of key terms:

The WHO defines oral health as the state of the mouth, teeth and orofacial structures that enables individuals to perform essential functions, such as eating, breathing and speaking, and encompasses psychosocial dimensions, such as self-confidence, wellbeing and the ability to socialize and work without pain, discomfort and embarrassment. Oral health varies over the life course from early life to old age, is integral to general health and supports individuals in participating in society and achieving their potential.

Source: https://iris.who.int/bitstream/handle/10665/375771/9789240070806-eng.pdf?sequence=1

Dental caries:

Dental caries is a gradual loss and breakdown of tooth hard tissues that results when free sugars contained in food or drink are converted by bacteria into acids that causes tooth cavities which may destroy the tooth over time. Dental caries can affect all age groups, from infants to the elders. Consumption of free sugars very regularly and the absence of cleaning teeth adequately are the main factors in the development of dental caries. Dental cavities are the most common NCD worldwide, with more than one third of the global population, young and old, living with untreated dental caries.

Source: https://iris.who.int/bitstream/handle/10665/375771/9789240070806-eng.pdf?sequence=1

Periodontal disease:

Periodontal disease is a chronic inflammation of the soft and hard tissues that support and anchor the teeth. Severe periodontal disease, defined as the presence of a tooth pocket of more than 6 mm depth, is a condition of public health concern. Poor oral hygiene is a major behavioural risk factor for periodontal disease, in addition to common NCD risk factors like tobacco use.

Source: https://iris.who.int/bitstream/handle/10665/375771/9789240070806-eng.pdf?sequence=1

Edentulism:

Losing teeth is generally the end point of a lifelong history of oral diseases, primarily advanced dental caries and severe periodontal disease, but tooth loss can also result from trauma; all can possibly lead to tooth extraction. Edentulism is a stark indicator of social and economic inequalities, with disadvantaged populations disproportionately experiencing total tooth loss.

Source: https://iris.who.int/bitstream/handle/10665/375771/9789240070806-eng.pdf?sequence=1

Oral cancer:

The Eastern Mediterranean Region had an estimated 23,749 new cases of oral (lip and oral cavity) cancers in 2020, accounting for 6.3% of the total estimated number of new cases globally. The Region had more than 14 000 deaths from oral cancers in 2020. Within the Region, country incidence rates of oral cancer vary from low to high, with a range between 1.1 and 10.1 per 100 000 people. Differences largely follow patterns of the main risk factors, including tobacco use, cultural habits and alcohol consumption. Incidence is highest in Pakistan, where areca nut and betel leaf consumption is very high.

Source: https://iris.who.int/bitstream/handle/10665/375771/9789240070806-eng.pdf?sequence=1

Early Childhood Caries:

Early Childhood Caries (ECC) refers to tooth decay on any surface of primary teeth up to the age of 6-years. The overall global prevalence percentage of 48 in the primary dentition of 1- to 6-year olds is very high.

Source: Kazeminia M, Abdi A, Shohaimi S, Jalali R, Vaisi-Raygani A, Salari N, Mohammadi M. Dental caries in primary and permanent teeth in children's worldwide, 1995 to 2019: a systematic review and meta-analysis. Head Face Med. 2020 Oct 6;16(1):22. doi: 10.1186/s13005-020-00237-z. PMID: 33023617; PMCID: PMC7541284.

Smokeless tobacco:

The term "smokeless tobacco" (SLT) implies the use of any unburned tobacco in the finished product that can be consumed orally or nasally. There is a great diversity of SLT products and their use patterns across the globe, and it refers to more than thirty different products, broadly categorized as "spit tobacco" or "chewing tobacco. Tobacco is being chewed in multiple forms and modes in South Asia such as betel leaf with areca nut, betel leaf alone, Zarda and Gul, and the pattern of consumption varies across countries by different sociocultural norms.

Source: Huque R, Zaman MM, Huq SM, Sinha DN. Smokeless tobacco and public health in Bangladesh. Indian J Public Health. 2017;61(Suppl 1):S18-S24. doi:10.4103/ijph.IJPH_233_17

Abstract

Background:
In Bangladesh, Oral health is a significant public health problem. The high prevalence of oral diseases impacts both children and adults. The situation is worsened by challenges such as limited dental care, lack of awareness, socio-economic issues, and lack of governmental healthcare strategy.

Objective:
This research aimed to evaluate how Bangladeshi individuals perceive, understand, and prioritize their oral health and hygiene. Simultaneously, the research aimed to investigate the obstacles that prevent people from accessing oral health care services. The study sought to examine various demographic factors and how they influence individuals' behavior. The research also aimed to create suggestions for enhancing the current scenario.

Methodology:
An extensive exploration of academic sources was conducted utilizing online databases such as Scopus, Web of Science, Google Scholar, PubMed, and ResearchGate. The research concentrated on investigating Bangladeshi individuals' beliefs, attitudes, and knowledge about health, as well as the current state of oral health. The Health Belief Model (HBM) and the Dahlgren-Whitehead model were utilized to analyze the information and provide a comprehensive understanding of the influences on oral health behaviors and outcomes.

Findings:
The report highlighted numerous instances of gingivitis, untreated cavities, and periodontal diseases among people living in urban and rural areas of Bangladesh. Certain key challenges encompassed a dearth of information, societal and financial constraints, and a scarcity of skilled dental professionals. The study also discovered a notable connection between socioeconomic status, educational attainment, and oral health outcomes. Additionally, it was identified that the lack of a well-defined oral health strategy and its enforcement hindered the delivery of efficient health care services.

Conclusion:
Targeted public health interventions are urgently required in Bangladesh to tackle the identified deficiencies in oral health knowledge and care accessibility. Increasing awareness about oral health, improving the availability of dental services, and introducing preventative measures are essential to reduce the overall oral health scenario.

Total word count: 11279

Introduction

Oral diseases represent a significant global public health challenge (1). Low socio-economic countries experience a high prevalence of oral diseases (2). Recent findings indicate that oral infections, particularly periodontitis, may impact the development and progression of various systemic conditions like cardiovascular disease, bacterial pneumonia, and diabetes mellitus (3, 4). Regrettably, in many Low and Middle-Income countries (LMICs), oral health and hygiene have largely been neglected and not recognized as a significant social issue, resulting in a growing burden on public health (5). In Bangladesh, nearly half of the 12-year-old children in a rural-based study reported experiencing severe bleeding gums and calculus build-up on their teeth (6). The importance of oral health cannot be overstated, as this issue can impact quality of life, growth, and development, and lead to tooth pain or loss (7). Tooth decay and periodontal disease are very common oral conditions that can impact the oral health of a majority of the population (8, 9) Not only in Bangladesh but also many where dental caries is a major problem for the children and a study revealed that overall, 50% children have one or more decay in their primary teeth by the end of their toddler age (10). Even though both dental cavities and gum diseases can be easily prevented and controlled by maintaining regular oral hygiene; they are prevalent among all oral ailments (8).

A few random research works on oral health found a high rate of cavities in both city and countryside residents in Bangladesh (6, 11). However, significant occurrence of dental plaque, gingival bleeding, and extensive periodontal pockets was observed in central and western Bangladesh (11). In addition, the study revealed that, apart from the 6-year-olds, fewer than 10% of individuals across all age categories had a healthy periodontium (11, 12). Various researches have shown significant evidence of high occurrence of oral illnesses in Bangladesh (10, 11, 12). Multiple studies on oral health in Bangladesh demonstrated a link between sugar intake and the occurrence of dental cavities (13, 14). Insufficient knowledge about behaviors such as the common use of tobacco, especially when combined with pan chewing, among Bangladeshis could lead to periodontal diseases and oral cancer (15,16). Various research studies have indicated a lack of awareness about oral health and disease among Bangladeshis (17, 18). It is widely acknowledged that having a good understanding of oral health and maintaining oral cleanness is closely linked to the behavior and utilization of health services related to oral health (17,19).

Maintaining good oral health relies heavily on high standards of oral hygiene (20). The Department of Health and Human Services in the United States declared that a person cannot be considered truly healthy if they are still affected by oral and craniofacial diseases and conditions (21). Maintaining oral hygiene involves keeping the mouth and teeth clean to avoid dental issues like cavities, gingivitis, periodontal

diseases, and bad breath (22). Insufficient understanding leads to poor oral hygienic conditions, which pose a significant public health issue due to their widespread occurrence and impact on people's well-being (23).

Knowledge and beliefs about oral health play a significant role in determining oral health behaviors (24). Maintaining good oral health depends on the combined effect of both the dental provider and the patients (25). Bangladesh needs more awareness to prevent various oral and dental problems (26). The nation has a low number of skilled dental professionals (100,000:6) (27) and a high occurrence of tooth decay in kids aged 2 to 5 years (28). Parents have little understanding about the importance of oral care for their young children, leading to development of early childhood caries (ECC), which typically occurs within the first 3 years of life (29). Mothers' level of education is linked to children's oral health behaviors, such as not brushing their teeth properly, consuming excessive sugar, and eating refined carbs before sleeping (30, 31). Identifying the combination of socio-demographic and behavioral risk factors that make children susceptible in places like Bangladesh is crucial for de`veloping successful strategies to control ECC.

Maintenance of oral hygiene and seeking oral health care are determined by several factors. Patients are more likely to follow oral health care routines when they are educated and given positive encouragement. Raising awareness about oral health and educating children during this stage of life is highly significant. Consistent oral hygiene, including brushing and flossing, can help prevent and halt dental issues from worsening (32). Simply knowing about oral health practices doesn't guarantee a change in future attitudes and behaviors, as they are typically developed after these practices are understood. Seeking knowledge, accurate treatment, patient availability, and willingness are all essential for sustainable prevention and development of oral health challenges. There have been few literature reviews on Bangladeshi people's perceptions, knowledge, attitudes, beliefs, practices, and priorities regarding oral health and hygiene. Identification of knowledge gaps can point towards the necessity of further research focusing on specific areas for interventions.

1. Background

1.1 Oral health and oral diseases:

Oral health refers to the condition of the mouth, teeth, and oro-facial structures which allow people to carry out important tasks like eating, breathing, and talking, including emotional aspects like self-assurance, happiness, and the capacity to interact and work without pain, unease, and shame (33). Oral diseases consist of various diseases and conditions like dental caries, gum disease, tooth loss, oral cancer, dental injuries, tooth erosion, and birth defects like cleft lip and palate (33). Dental conditions are prevalent non-communicable diseases globally, impacting around 3.5 billion individuals (33). The increasing global burden of oral health issues, especially in low- and middle-income countries, is expected to continue rising due to population growth and aging, resulting in a higher demand for oral health services (33). Education and awareness both are very important to avoid dental diseases as these dental diseases are always preventable. Inadequate oral health knowledge and awareness is more likely to cause oral diseases among all age groups, including children (34). Oral diseases have a greater impact on the populations that are most vulnerable and disadvantaged (33). Individuals with lower economic status are more affected by oral diseases throughout their lifespan, from childhood to old age, regardless of the overall income level of the country (33).

1.2 Burden of Oral Health in Bangladesh:

Prevalence of oral diseases (2019):

43.5% of kids between 1 and 9 years old have cavities in their baby teeth that have not been treated, while 30.4% of people aged 5 and up have cavities in their permanent teeth that have not been treated. These large percentages indicate a significant lack of dental services access, particularly for children (27).

Severe periodontal disease affects 23.4% of individuals aged 15 years and older. If periodontal disease is not addressed and treated timely and appropriately, it can lead to various systematic and oral consequences which ultimately results in loss of teeth. (27) Edentulism, which is complete tooth loss, affects 1.2% of individuals aged 20 and above. Despite being lower than other oral health indicators, this rate still indicates a significant number of individuals at a young age who have lost all of their natural teeth. (27).

In 2020, it was reported that approximately 13,985 new cases of lip and oral cavity cancer were identified in Bangladesh, with an incidence rate of 9.5 per 100,000 people (27).

Males had a higher incidence rate (12.4 per 100,000) compared to females (6.5 per 100,000). Timely identification and medical intervention are crucial for enhancing results in Bangladesh, where oral cancer poses a significant public health concern. (27)

1.3 The consequences of weak oral health:

High rates of dental diseases and the resulting pain greatly impact the quality of life and limit daily functions for individuals (35). In the end, these results in a substantial decrease in the amount of time people can work in the community. (35) Oral diseases are impacted by poor oral health (35) Missing, discolored, or damaged teeth affect people's daily lives and well-being, causing pain and issues with eating, chewing, smiling, and communication (36). Oral health issues can also limit performance in school, work, and domestic settings. (36) The negative impacts of oral disease include hindering

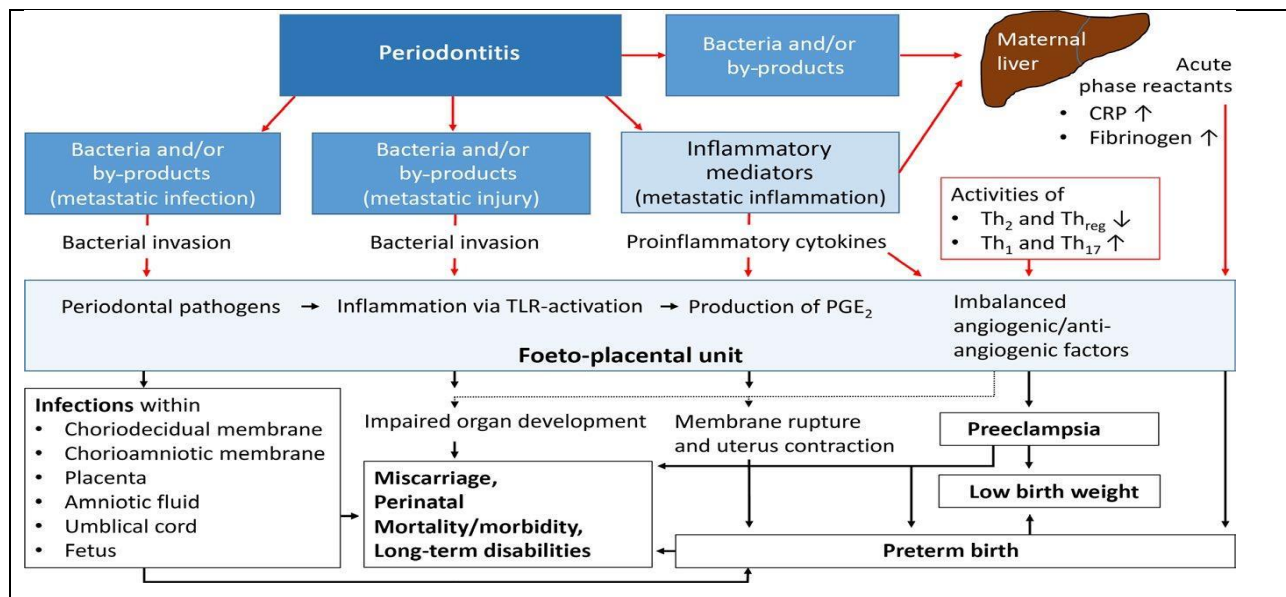Figure 1: Proposed mechanisms/pathways linking periodontal diseases to adverse pregnancy outcomes. CRP, C-reactive protein; PGE2, prostaglandin E2; Th, T helper cells; TLR, toll-like receptor

masticatory function, blocking nutrient intake, and impeding the growth of permanent teeth. It may also harm the lining of the mouth and affect overall health and quality of life (37). Gingivitis and periodontitis

are not only known to impact the tissues that support teeth but are also linked to various systemic diseases and conditions (38). According to the 2013 consensus report from the American Academy of Periodontology and the European Federation of Periodontology, periodontal infections may raise the likelihood of negative pregnancy results in certain groups (39). If left untreated, periodontitis and dental cavities result in the eventual extraction of teeth (35). Premature tooth loss results in decreased chewing function, which can lead to digestion issues, nutrient malabsorption, and overall poor health in an individual (40). The great number of dental diseases and the pain they cause greatly interfere with their daily activities (35). In the end, this leads to a notable decrease in productivity and the subsequent financial burden on the low-income neighborhood. (35) The effects of bad oral health extend beyond just the mouth to impact overall health (41). Inadequate dental care is also viewed as a significant risk element for long-term illnesses like heart disease (42).

Adverse pregnancy outcomes, such as Preterm birth (PTB) and Low birth weight (LBW), are linked to gingivitis and periodontal diseases (43). Many studies since 1996 have pointed out the link between dental health and negative pregnancy outcomes, with periodontal disease being identified as a possible risk factor for premature delivery (PTD) (43, 44). PTB rates were found to increase alongside the seriousness of gingivitis and periodontitis (45). Likewise, periodontitis has been found to have a significant association with LBW/PTB in infants (46). Periodontitis has also been associated with uterine leiomyoma, gestational hypertension, preterm birth, preterm delivery, and small gestational age (47).

2.0 The problem statement, Justification, and Research Objective

2.1 Problem Statement:

Even though it is considered important for general well-being, there is a lack of research focusing on the oral health knowledge, beliefs, and behaviors of the Bangladeshi population. Previous research frequently offered limited information and tends to concentrate on particular community or condition samples instead of taking into account the complete population. Precise interventions are crucial in Bangladesh because of the country's diverse socio-economic and cultural differences, highlighting the significance of the lack of knowledge. Finally, a lack of comprehension regarding how socioeconomic aspects and demographics influence oral health habits hinders the creation of effective strategies. Closing these gaps is crucial to improving policy and practice, and promoting more effective and fair oral health interventions.

2.2 Justification of the Study:

The primary benefit of this research is its relevance to public health in Bangladesh, as it assesses oral health awareness holistically by considering perception, cognition, affect, and behavior equally. Examining individuals' perceptions of disease threats and their methods of coping, the Health Belief Model (HBM) aided in comprehending voluntary health behaviors. These models will help policymakers develop the best intervention plans by considering the considerable differences in the human population, thereby improving the effectiveness and fairness of oral health policies put in place. By incorporating socio-economic factors as predictors, the research will aid in mitigating bias when identifying and reaching out to target groups for intervention. Implementing this research in healthcare settings will provide important information about patients' behaviors and challenges, helping policymakers develop better patient education and engagement strategies. Ultimately, the aim of this research is to improve oral hygiene and cleanliness of the mouth in Bangladesh, promoting a healthier society conducive to productivity.

2.3 Research objectives

2.3.1 General Objective:

To assess the current oral health status - Evaluate the prevalence and severity of common oral health issues among different age groups and socio-economic strata.

2.3.2 Specific Objectives:

To explore oral health knowledge and practices - Evaluate the awareness levels and oral hygiene practices prevalent in diverse communities.

To analyze the socio-economic determinants - Understand how socio-economic factors impact oral health outcomes and access to dental services.

To identify barriers to accessing oral healthcare services - Investigate the factors hindering individuals from seeking timely and adequate dental care.

To establish a baseline for future development - Discover effective activities for the health policymakers of the government to improve health seeking behavior of the individual

3.0 Methodology

An electronic literature review was established to address the objectives. The studies had to focus on the oral health and oral hygiene of Bangladeshi individuals, as well as their knowledge, practices, behaviors, attitudes, beliefs, or understandings related to oral health, to meet the inclusion criteria. Few studies were conducted on gray literature published in the past two decades focusing on oral health and hygiene practices among the population of Bangladesh. Electronic databases like Scopus, Web of Science, Google Scholar, PubMed, and ResearchGate were used to search. The search was conducted using the keywords (LMIC, Bangladesh, Oral Health, Dental Health, Oral Hygiene, Dental Hygiene, Oral Care, Dental Care, Knowledge, Attitude, Practice, Belief, Behavior, and Habit). Only literature that was published in English was taken into account. Dahlgren and Whitehead model (48) was used to analyze the collected data. This model addressed different factors that impact health and was connected to achieving the first 2 specific objectives. Dahlgren and Whitehead's model emphasized one unchangeable factor, such as age, sex, or constitutional factor, along with four other factors: individual lifestyle, social connections, living and work environments, and general socio-economic, cultural, and environmental conditions. The Health Belief Model (49) examined the personal and cultural characteristics of Bangladeshi individuals and pinpointed specific areas where behavior modifications were necessary. It was also linked to recognizing the drawbacks and constraints to develop effective strategies for last 2 specific objectives (Specific objectives 3, 4).

3.1 Conceptual Framework:

This study is based on the Health Belief Model and employed the Dahlgren and Whitehead model for explanation. Becker and Rosenstock developed the Health Belief Model (HBM), focusing on the psychological factors that influence health behaviors. The main components of the Health Belief Model include perceived susceptibility, perceived severity, perceived benefit, perceived barrier, cues to action n, and self-efficacy. These structures were used to comprehend how the local Bangladeshi community viewed oral health issues and the factors that impacted preventative actions. The Dahlgren-Whitehead model broadened the scope to include social, economic, and environmental factors that impacted health. It included fixed factors like age, gender, and genetic characteristics, as well as variables like lifestyle choices, social relationships, residential and occupational settings, as well as broader socioeconomic, cultural, and environmental circumstances. This model helped in examining the complex interplay of various factors that was impacting oral health in Bangladesh. Use of these 2 frameworks resulted in better understanding of how belief systems, socio-cultural factors, and health system components impacted oral health in Bangladesh.

4.0 Results

Factors contributing to poor oral health status (4.1-4.5)

4.1 Age, sex, and constitutional factors:

4.1.1 Age:

Tooth decay is the prevailing illness that impacts 60-90% of children globally (50). In Bangladesh, dental caries is prevalent among pediatric patients (51-55). A study on 330 children aged 6–24 months found that 25.8% had ECC, which was linked to lower maternal education and advanced maternal age (56). Research carried out at Mymensingh Medical College Hospital on 362 children aged 4 to 10 found that dental caries had an overall prevalence of 82.7% (36). More than 40% of children under the age of 5 experience tooth decay (57-59). According to studies, caries was substantially more common among children aged 8-10 years (36). Research on 631 children revealed that 44.3% of 12-year-old students had inadequate oral hygiene and bleeding gums. (60) A different research on 1,820 elementary school pupils aged between 6 and 13 years in the areas of Dhaka and Chittagong found that 17.5% had gingivitis and 56.0% had plaque (61). Research conducted in Narayanganj observed a 53.97% prevalence of caries among 252 children aged 10-17 (62). Certain major risk factors linked to tooth decay in children included living near a rural area, low monthly income of parents, mother's lack of education, short duration of teeth brushing (≤1 min), lack of brushing before bedtime, spoon-feeding method, sticky sugary cereals, extended breastfeeding (37-48 months), and family history of oral issues (36).

When looked at the older age group, around 88% of individuals aged 13-22 had lost one or more permanent teeth as a result of tooth decay or associated issues (63, 64). In these situations, the primary risk factors were lack of knowledge about brushing teeth, insufficient oral hygiene habits, dietary elements like sweetener consumption, absence of fluoride in water, and socioeconomic issues (65). Many parents ignore the maintenance of baby teeth since they were temporary and would eventually be replaced by permanent teeth (66). Age was determined to be a contributing factor in the development of arsenical tongue lesions in a particular arsenic study. According to the study, younger individuals are more resilient to arsenic exposure's health impacts compared to older individuals, (67). A large research project involving 3904 slum residents from twelve slum areas in Tongi Municipality found a high occurrence of gingivitis in both younger and older individuals due to inadequate oral care practices (68).

As per a research study, the prevalence of SLT (smokeless tobacco) use steadily rises as individuals age, starting at 6.6% in the 15–24 age group and reaching 56.4% in those aged 65 and older (69). The mean age when individuals started using SLT was determined to be 31.5 years (70). Between the ages of 55 and 64, the use of SLT was most common among men (44%) and women (42.5%) (71).
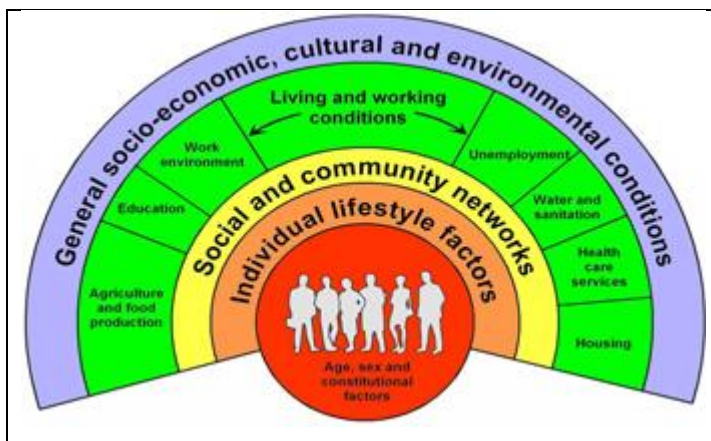
Fig 2: The Dahlgren-Whitehead model of health determinants

4.1.2 Sex:

In 2014, research conducted on 251 madrasa-going children aged 6-12 in Tongi found a higher incidence of dental caries in girls compared to boys (72). According to clinical observations, the prevalence of periodontal diseases in pregnant women ranges from 35% to 100% (73). Research showed that pregnant women had a 1.97 higher risk of experiencing dental caries and a 1.81 higher risk of gingivitis compared to non-pregnant women (74). Increased carbohydrate consumption, heightened acid levels in the mouth due to vomiting, decreased salivary production, and/or elevated saliva acidity during pregnancy are common major risk factors (75). Based on a study about SLE use, 7.1% of boys aged (13-15) years and 3.7% of girls aged 15 years used SLT (76). The occurrence rose to 20.2%–23% among individuals aged 15–49 years (77). Men aged 55-64 years had a slightly higher percentage (44%) compared to women (42.5%) in that same age group (78). When it comes to arsenic-related oral diseases (arsenicosis), men had a higher rate of occurrence compared to women (67). Women had a lower risk of developing arsenical lesions in their gums due to their superior ability to methylate arsenic compared to men (79, 80). In particular, women of reproductive age showed a much greater ability to methylate arsenic compared to men (81).

4.1.3 Physiological factor:

Pregnancy is a normal bodily function that involves temporary alterations in women's physical structure, hormone levels, metabolism, and immune systems (82, 83). Fluctuations in estrogen and progesterone levels lead to changes in the mouth, causing increased permeability of oral blood vessels and a weakened immune system (84). This occurrence results in higher vulnerability to oral infections (85). Included in these modifications are pregnancy gingivitis, harmless oral gingival lesions, tooth mobility, enamel erosion, tooth decay, and periodontitis (86-88). A temporary increase in these sex hormones during pregnancy has been associated with distinctive localized inflammatory growths known as pregnancy granuloma, observed in 0.2%-9.6% of expectant mothers (89). A larger and more widespread inflammation issue known as "pregnancy gingivitis" is prevalent among over 33% of expectant mothers (90, 91). This form of gingivitis is almost identical to plaque-induced gingivitis, except that there is a more noticeable level of gum inflammation even with lower levels of plaque present (92, 93). Periodontitis can also be observed in pregnant women, with rates ranging from 0% to 61% (94, 95).

4.2 Individual lifestyle factors:

4.2.1 Financial capability:

A research carried out at Dhaka Dental College with 385 participants shows that the primary cause (63.9%) of not seeking dental care (66) was cited as insufficient financial resources. 26.49% lacked the desire for treatment while 9.61% did not have enough information about dental treatment options (66).

4.2.2 Food habits:

Consuming sugary and sticky foods can result in dental decay, bleeding gums, gum disease, tartar build-up, and various other oral health issues (96-98). The average daily sugar intake per person is 16.9 grams, posing a notable threat to dental health despite not being excessively high (27). A study carried out in 2022 in Trishal involved 532 mothers, with 231 (43.4%) supporting giving their child sweets daily, while 233 (43.8%) saw offering sweets and biscuits as a way to promote positive behavior (99). Once more, a research study done on 115 children at the Dhaka Dental College and Hospital, Mirpur-14 revealed that children had a preference for sugary and carbohydrate-rich foods and beverages, consuming them on a daily basis. After consuming sugary and carbohydrate-rich foods and beverages, they did not rinse their mouth with water (100). The World Health Organization (WHO) stated that elderly people's oral health

problems can be linked to certain controllable factors like drinking sugary tea, consuming too many carbohydrates, smoking, having a poor diet, and their socio-demographic background (101).

4.2.3 Drinking water:

In Bangladesh, levels of arsenic contamination in groundwater were reported to be as much as 100 times greater than the World Health Organization's recommended limit of 10μg/L (102,103). Approximately 35 to 77 million individuals in Bangladesh have supposedly come into contact with arsenic by consuming water (104,105). Increased levels of arsenic exposure correlated positively with a higher risk of arsenic lesions on the gums and tongue (106). Arsenic can be harmful to the important nerves and blood vessels in the tooth, resulting in serious harm from jaw infections called osteomyelitis (107). In a region in Bangladesh affected by arsenic, 75.5% of individuals displayed enlarged vallate papillae on their tongues, indicating arsenicosis (108). Exposure to arsenic could also result in melanosis of the buccal mucous membrane (109) and could potentially cause the onset of cancer (110).

4.2.4 Smoking:

39.1% of individuals aged 15 and older currently use tobacco, with males having a higher prevalence at 60.6% compared to females at 17.7% (111). The role of chemicals in cigarettes is important in the occurrence of oral cancer and periodontal diseases (106). Smoking is a significant lifestyle factor that affects the health of the gums, lips, and tongue, as well as being linked to reduced ability to metabolize arsenic (106). Earlier research found that cigarettes contain numerous chemical carcinogens, such as arsenic, that can cause damage to lip tissues (112).

4.2.5. Use of Smokeless Tobacco (SLT):

Smokeless tobacco (SLT) consumption is considered a socially and culturally approved practice in Bangladesh (113). SLT includes tobacco products that are not burned (114). According to a recent Global Adult Tobacco Survey (GATS), tobacco use is prevalent in Bangladesh, with 18% of the population being smokers and 20.6% using smokeless tobacco (SLT) (115). In Bangladesh, 43.3% of individuals aged 15 and older were found to use tobacco, with 27.2% using SLT, which was higher than the 23% prevalence of smoking (69). Even though males had a higher smoking rate (26.4%) compared to females (1.5%), females exhibited slightly higher use of SLT than males (69, 116-118).

4.2.6 Habit of betel quid (BQ) and Areca nut (AN):

Research utilized data from the Bangladesh Demographic Health Survey revealed that 17.5% of men were found to consume BQ with tobacco/zarda, with no data available for women (119). In a study of dental health in rural areas of Bangladesh's Kishoreganj District, it was discovered that 40% of the adult villagers used areca nut with slaked lime and tobacco in different mixtures (120). The International Agency for Cancer Research has classified Betel quid (BQ) and Areca nut as carcinogenic to humans, ranking them as the fourth most common addictive agents worldwide after tobacco, alcohol, and caffeine (121). BQ, mixed with smokeless tobacco (SLT), is a known factor in the development of oral and esophageal cancers, as well as pharyngeal cancer (122). As per the 2009 survey conducted by the WHO & Ministry of Health & Family Welfare, the rate of BQ chewing among individuals aged 15 and above in Bangladesh was 23.5% for men and 25.2% for women (123).

4.2.7 Soft drinks consumption:

A survey of 385 people revealed that approximately 39.48% were classified as heavy consumers, while 40% were categorized as moderate consumers of soft drinks. Only a small percentage of consumers, specifically 8.57%, were identified as occasionally consuming soft drinks (66). Almost 90% of the participants in the study were accustomed to drinking soft drinks, potentially leading to dental issues such as cavities (66).

4.2.8 Tooth brushing habit:

Some research suggests that the majority of children brush their teeth once a day, typically before breakfast (124,125). In a study conducted in 2016 in Chittagong, 62.5% of 160 respondents reported that they only brushed their teeth in the morning before breakfast (126). The American Dental Association recommends brushing your teeth for 2 minutes, twice a day - once after breakfast and once after dinner (100). For adults, it was discovered that the majority of participants did not brush their teeth post-dinner. The research involved 385 participants and showed that 48.83% used toothbrushes, 25.71% used a chewing stick, and 25.45% used a finger for oral hygiene (66). The same research indicated that 83.12% of participants brushed their teeth regularly, 11.69% brushed 2 to 6 times weekly, and 5.19% rarely brushed (66). In rural areas, communities typically use Neem sticks and ash to brush their teeth in the morning (66).

4.2.9 Mouthwash and fluoride use:

Research on 160 participants found that 43.1% of them occasionally used mouthwash (126). The study also reported that 54.4% of participants used dental floss for interdental cleaning (126). In a separate study of 90 students aged 12 to 16 in a rural area of Sylhet district, approximately 80% were unaware of the benefits of fluoride in preventing cavities (127). Another study from 2019 involving 115 children aged 4 to 14 found that only 40% of respondents gurgled after dinner (100).

4.2.10 Behavioral factors:

A study in Trishal with 532 children under 5 years old showed that 96.2% had never had a dental check-up, and 96.8% had never seen a dentist (99). Information gathered from research done in Dhaka indicated that approximately 90.65% of the 385 participants had sought dental care for an urgent issue, with the remaining 9.35% going for a routine checkup (66). Furthermore, it was discovered that 48.57% of the participants did not go to the dentist on a regularly (66). The study also found that 51.69% of participants returned for their dental appointment within 2 years, while 48.31% either returned after 2 years or never returned (66). In Chittagong 2016, separate research with 160 participants revealed that 94.4% visited the dentist solely to assess their issue severity (126). In Bangladesh, many parents neglect their baby's milk teeth as they are temporary and will be replaced eventually (66).

4.2.11 Ritual practice:

Oral hygiene practices vary based on religious guidelines (128). Hindu Brahmins and priests spend an hour cleaning their teeth with cherry wood while positioned towards the sun as it rises. Traditional Jains use their fingers to clean their teeth instead of using a brush. This could adversely affect their dental well-being (128). Muslims pray five times a day through the act of Salat. In each Salat, they incorporate miswak sticks and toothpicks and engage in gum massaging as part of the ritual. This could improve the overall health of the mouth (129).

4.2.12 Diabetes:

Bangladesh shows a significant occurrence of diabetes among adults, with a rate of 8.1% (130). The International Diabetes Federation stated that in Bangladesh, there are 7.1 million individuals diagnosed with diabetes and similar amounts have diabetes that has not been detected (131). Individuals with diabetes have a higher susceptibility to specific oral conditions (132). A study found that there is a greater occurrence of oral mucosal issues among individuals with diabetes (45–88%) in comparison to those without diabetes (38–45%) (133). Periodontitis is ranked as the sixth most frequent complication of

diabetes (134). It is indicated by evidence that there is a reciprocal relationship between periodontal disease and diabetes mellitus (135-138). In 2014, a research done in Dhaka with 598 diabetic individuals found that 34% of them were tobacco users (139). Therefore, in Bangladesh, oral health issues were prevalent among individuals with diabetes (140).

4.3 Social and community networks:

4.3.1 People living in the slum areas:

As stated in a report by UN-Habitat (2006), 79% of people in urban areas in Bangladesh reside in slums (141). A few occasional research projects on dental wellness in these impoverished neighborhoods found a high incidence of caries with DMFT scores varying from 1.0 to 4.7 among urban and rural residents in Bangladesh (142, 143). The majority of the kids in the slums saw the dentist for severe tooth or gum pain, swelling, or tooth extraction (100). Most of the subjects showed significant plaque buildup, indicating a lack of good oral hygiene within the group being studied (68). Research in the central and western regions of Bangladesh found that fewer than 10% of individuals across all age groups had healthy gums (143,144).

4.3.2 Use of indigenous medicines:

Roughly 20-25% of rural Bangladeshis use modern healthcare, while the rest rely on traditional medical practitioners for healthcare services (145). Numerous traditional remedies for oral conditions incorporate volatile oils like Clove oil (146). In traditional medicine, Datura and belladonna are utilized as pain-relieving medications (146).

4.3.3 Religious views:

For female patients, getting dental care from a male dentist could be uncomfortable because of the religious significance of receiving treatment from dentists of the opposite gender, potentially leading to reluctance in seeking care from male dentists (147). Taking into account Islamic beliefs on interactions between genders, it is understandable why some Muslims may find dental procedures uncomfortable. Patients might hesitant to interact closely with the dentist due to challenges such as exposing their oral cavity, being physically examined, or being alone with a member of the opposite sex, which could lead to reluctance (148).

4.3.4 Family belief:

Family pressure and traditional beliefs from ancestors prevent family members from turning to modern science-based treatment, leading them to use home remedies or seek advice from traditional healers like pir and hakim (149). In Bangladesh, the majority of households follow a joint family structure, with decisions commonly guided by peers and elder family members who draw on their beliefs and experiences (149).

4.4 Living and working conditions:

4.4.1 Education:

In 2023, the functional literacy rate for individuals aged 11-45 years is 73.69%, compared to 53.70% in 2011 (150). Though the literacy rate was high but lack of knowledge about tooth brushing techniques, using fluoridated toothpaste, frequency of brushing, choosing sugar-free foods, and rinsing mouth properly after eating; made people more vulnerable to infection (125,151-153). Inadequate knowledge of dental issues and limited access to quality treatment were the major factors leading to subpar dental health (125,154). Maternal education level is linked to oral health habits in children with Early Childhood Caries (ECC) (155,156).

4.4.2 Knowledge:

A study carried out in Trishal with 532 mother-child pairs found that 93.2% of mothers were uninformed about the role of fluoride in preventing dental caries, while 97% were unaware of the significance of using fluoridated toothpaste while brushing teeth. In addition, 374 individuals (70.3%) were not knowledgeable about the connection between soda and tooth decay, and 511 people (96%) did not know the importance of routine dental exams (99). In the same research, it was discovered that 97.7% of mothers were unaware of how to brush their child's teeth properly, and 71.8% believed they should not force their child to brush their teeth if they resisted (99). Mothers of young children from low-income families had limited knowledge of how to prevent cavities and did not have the best oral hygiene habits for their kids (99).

4.4.3 Housing:

There is a significant disparity in dental care access between urban and rural areas. A large number of rural areas do not have any dental clinics, depending instead on sporadic visits from volunteer programs.

On the other hand, cities have a more significant number of dentists and private dental practices. The Global Adult Tobacco Survey (2009) indicates that the use of SLT was higher in rural areas (28.8%) compared to urban areas (22.5%) (69). Other researchers found that rural residents were 1.5 times more likely to use SLT (157). Urban areas are typically seen as centers for a variety of activities and have a higher number of healthcare facilities compared to towns or villages, where only limited healthcare services and facilities are available (158,159). In rural areas, there were no properly equipped dental clinics or routine dental care available, except for occasional volunteer tooth camps in certain locations (66).

4.4.4 Health care service:

Bangladesh has a small number of oral health professionals for every 10,000 people (27). In 2019, there were a total of 9,608 dentists, which equates to only 0.6 dentists per 10,000 people (27). In 2019, the nation also employed 23 dental prosthetic technicians (27). There was a lack of information on the quantity of dental assistants and therapists. Access to oral health screenings, urgent care for emergency dental needs and pain relief, basic restorative dental procedures, and general oral support in primary care settings was restricted (27).

4.4.5 Living environment:

The circumstances in which people live affect how they seek out healthcare. Individuals residing in slums had limited access to oral healthcare services and no preventative measures were in place to stop the advancement of oral illnesses (35). A large survey of 3904 individuals in twelve slum neighborhoods of Tongi found that residents in the slum region did not have access to any basic interventions or preventive measures for oral health issues (35). For tribal populations, their healthcare needs, attitudes, and healthcare-seeking behaviors varied from those of Bengalis due to sociocultural, political, and economic factors (160). The tribal communities are particularly susceptible to different oral health issues due to their isolation from mainstream development activities, high poverty rates, and limited access to healthcare facilities (160).

4.4.6 Work environment:

A large number of people participate in the manufacturing and distribution of processed SLT products, such as farmers, raw tobacco sellers, producers, wholesalers, and retailers (161). The supply chain was complex due to numerous interconnected actors (161). A study found that 88% of all SLT products sold by vendors were made locally (161).

4.5 General socio-economic, cultural, and environmental conditions:

4.5.1 Economic Impact:

In 2019, Bangladesh spent 13 million US dollars on dental healthcare, equating to a per capita expenditure of 0.1 US dollars. The minimal amount of money being spent on dental care indicates that a large number of Bangladeshis may have restricted access to affordable dental services (27).

In 2019, it was estimated that the combined productivity losses from five oral diseases equaled 637 million US dollars, including untreated cavities in baby and adult teeth, advanced gum disease, tooth loss, and other oral conditions. These losses emphasize the substantial financial impact of oral health issues on individuals, families, and society overall (27).

In Bangladesh, fluoride toothpaste, which is crucial for preventing tooth decay, is seen as too expensive, requiring approximately 2.8 days of work to purchase enough for one person for a year. The cost of preventive oral health services poses a major obstacle to their utilization (27).

4.5.2 National Health System Response:

Bangladesh lacks a national policy, strategy, or action plan for oral health. Bangladesh's Ministry of Health has a committed team focusing on non-communicable diseases (NCDs), such as oral health. However, Noma (cancrum oris), a serious type of necrotizing stomatitis, is not acknowledged as a significant public health issue at a national level in the country (27).

4.5.3 Oral health interventions as part of health benefit packages (2021):

In the health benefit packages for oral health interventions in 2021, it was discovered that the policy did not cover regular and preventive oral health care (27). The outcome was identical when it came to essential curative oral health care, which includes non-surgical extraction and abscess drainage. An additional two significant concerns are complex restorative dental treatments (such as resin composite and dental amalgam fillings, x-rays, and root canals) and reconstructive dental procedures (including crowns, bridges, dentures, braces, and dental implants) were also identified as having unfavorable outcomes (27). Many health benefit packages were discovered, however, none of them were put into action. The oral health interventions did not benefit the Bangladeshi population (27).

4.5.4 Cultural influence:

In Bangladesh, while there was not a cultural taboo against smokeless tobacco use among the youth or women, traditional values and social norms still discourage smoking (162). Incorporated into traditional values, spirituality, and beliefs, SLT is utilized extensively in festivals, daily life, and rituals like marriage and popular entertainment (163, 164). Approximately 20%–30% of females living in rural regions consume SLT as a custom (165), offer it to visitors during traditional festivities (164), and regard it as a sweet treat (163). Numerous myths and misunderstandings surround the use of SLT, particularly prevalent in rural communities (76). Interest, social influences, and invitations from peers and acquaintances all play a role in the beginning of SLT use (166). Certain parents go as far as to actively support their children in utilizing SLT (163). This fact is mirrored in the findings of the Global Youth Tobacco Survey, showing why SLT usage is so common among 13-15 year-olds in Bangladesh (167).

4.5.5 Weak implementation of the law:

Even though many adults in Bangladesh used smokeless tobacco (SLT) frequently, it was not officially addressed in the Tobacco Control Law until 2013 (76). There was not enough information on the use of SLT among Bangladeshi individuals to make effective policies and implement control measures (76). More than one-quarter (27%) of adults in Bangladesh who are 15 years old and above use SLT in various ways (76). In Bangladesh, taxation on SLT is still lower than that on cigarettes (76). In 2013, changes were made to the Tobacco Control Law which mandates that half of SLT packaging must display graphic health warnings, advertising of SLT products is prohibited, and sales to minors are restricted (76). Yet, the enforcement of the law is ineffective.

4.6 Health belief model

The health belief model was among the initial models to incorporate behavioral science theories into the health domain for addressing health issues (49). This model assists in recognizing behaviors, pinpointing areas for behavioral adjustments, and simplifying decision-making processes (49).

4.6.1 Perceived Susceptibility:

Perceived susceptibility refers to an individual's perception of their susceptibility to a specific risk (49). One research study revealed that around 90.65% of participants in Bangladesh only sought dental care from a dentist in emergencies due to the widespread occurrence of oral diseases (66). Over 80% of the people in Bangladesh drink soft drinks without knowing the negative impact of carbonated drinks. While 48.83% of participants utilized toothbrushes but the percentage was not satisfactory (66). 25.71% of

participants utilized a chewing stick, while 25.45% used their fingers, which was not an appropriate teeth-cleaning method. 48.31% of respondents did not return for their dental checkup within 2 years after treatment, while 51.69% did (66). It was also discovered that a total of 27.53% of the study participants did not visit any dental specialists, showing a lack of knowledge about oral care services (66). Taking all these factors into account, it can be inferred that the citizens of Bangladesh had a low level of perceived susceptibility regarding their oral health problems.
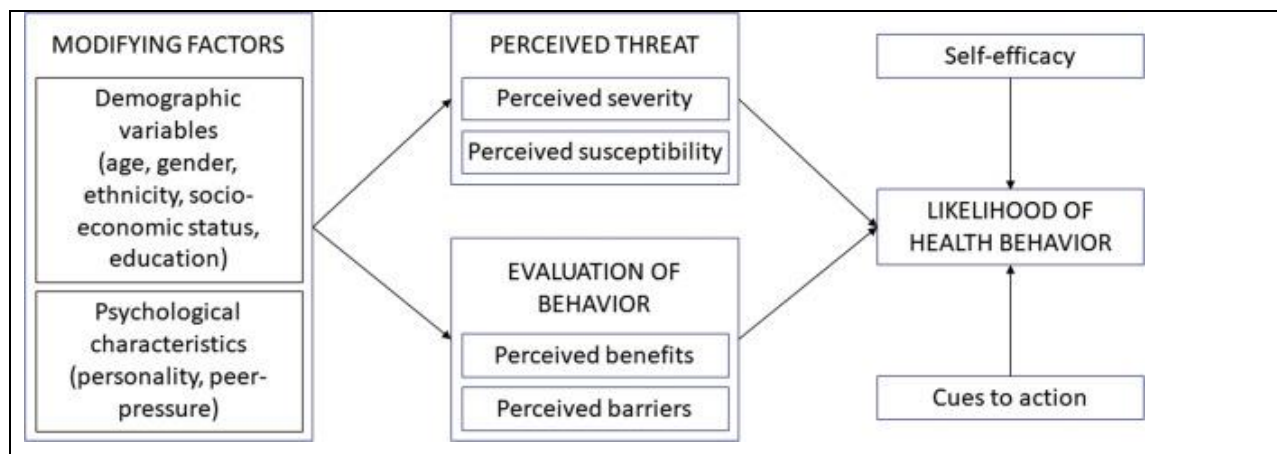
Figure 3: The Health Belief Model.

Education and awareness about health are key factors in shaping an individual's perception of susceptibility. Statistics showed that education levels were increasing in Bangladesh (150). However, overall health education remains low among the population. Health education and health promotion activities were not established in the schools (125,154). Due to a lack of understanding about oral health problems and their effects, individuals were hesitant to practice proper healthcare habits. Due to the absence of health insurance and a national oral health policy, strategy, or action plan, individuals simply chose to ignore the matter (27). Again, since they were not financially stable (66) and had to pay for all treatment expenses themselves; individuals were hesitant to go to dental clinics for checkups and services. Due to the low perceived susceptibility of the general population to their oral health and hygiene, they lacked motivation to change their behavior towards oral health.

4.6.2 Perceived Severity:

Perceived severity is the personal evaluation of how serious a health issue is and what it could lead to (49). Studies have shown that 48.57% of respondents did not frequently see dental surgeons (66). Despite experiencing issues with their mouths, 48.31% of individuals did not return to their dentist for a follow-up within 2 years (66). This suggests that they did not consider the oral problems important. A study on children under the age of 5 found that over 40% of participants had dental cavities (57-59). Further research on children between the ages of 8 and 10 showed a similarly high prevalence of caries (36). It suggests that the parents did not view the potential impacts of the dental treatment as serious and did not respond positively. The occurrence of tooth decay was significant among children under 5 years old and this high occurrence persisted as they got older as well (27). About 88% of individuals aged 13-22 years old have lost one or more permanent teeth because of tooth decay or associated issues (63,64).

A study found that 7.1% of boys aged 13-15 used SLT, while 3.7% of girls in the same age group used it (76). Between 20.2% and 23% of men aged 15-49 years were affected, according to a study (77). Among individuals aged 55-64, the prevalence was higher among both males (44%) and females (42.5%) (78).

A common and peculiar belief among Bangladeshi people is that they should prioritize the treatment of heart disease because they only have one heart. They need to be extra careful about their kidneys or eyes as they only have a pair of each. However, when it comes to teeth, they believe there were a total of 32 teeth. If there is an issue with one or more teeth, they can be removed and the problem can be easily resolved (based on personal experience). They believed that they could still eat and perform other important tasks even with a few missing teeth. So it was not necessary to keep all the teeth in the mouth (Personal Experience). While not all people had the same mindset, the majority of the population shared a similar thought process. The suggested mindset indicated that individuals in Bangladesh did not perceive themselves to be prone to oral and dental problems. The majority of people were not concerned about the potential consequences of neglecting their oral hygiene.

Perceived severity includes views on the disease and its effects on work and social roles (49). Due to the lack of education on oral health and hygiene at the primary level, people had very limited understanding of the impacts of oral and dental problems as literacy level regarding oral health was very poor (125,154). Due to the high cost and lengthy nature of dental and oral treatments, they chose not to invest money and time in addressing their dental issues. If there was an issue with the teeth, they would opt to extract it instead. Restorative procedures were costly, while tooth extractions were comparatively more affordable

and quicker. All of these behaviors showed that the perceived seriousness of the Bangladeshi community was also extremely low.

4.6.3 Perceived Benefits:

The perceived advantages of acting also impact health-related behaviors (49). Perceived benefits are how a person views the worth or effectiveness of taking part in a behavior that promotes health in order to reduce the chances of getting sick (49). Several behaviors that promote oral health include visiting the dentist regularly, brushing teeth and rinsing with clean water, changing eating habits, increasing knowledge about oral health, receiving preventive treatment to prevent severe issues, health education, having more healthcare providers, addressing cultural behaviors, etc. Research found that 51.69% of participants had a dental checkup within 2 years (66). It suggests that over half of the population would go to the dentist when they had dental problems. Research also indicated that most participants (48.83%) utilized toothbrushes, with 25.71% opting for a chewing stick and 25.45% using their fingers to clean their teeth (66). Even though not all methods were ideal for brushing teeth, the majority of participants still practiced some form of oral hygiene to keep their mouths clean. In terms of how often they brushed their teeth, 83.12% of participants brushed regularly, while 11.69% brushed 2 to 6 times per week (66). A study also revealed that 40% of the participants had a routine of softly gargling before bed after their evening meal (100). Education is closely linked to awareness and understanding. In the past 15 years, there has been a significant increase in the proportion of individuals with formal education (150). The government also knew about growing the number of dentists and expanding government employment opportunities. Currently, there are 9 Public Dental Colleges and 26 Private dental colleges situated in various regions nationwide, with 23 of them founded post-2000 to produce additional dental graduates and deploy them across the country (168). Big corporations and trading groups have their own dental professionals located in the workplace (66). Health education has the potential to increase awareness among families and communities, leading to long-lasting sustainable development in the health industry and preventing significant economic losses, such as the 637 million US dollars lost in total productivity in 2019 due to five oral diseases (27).

4.6.4 Perceived Barriers:

Perceived barriers are how someone views the hindrances to changing their behavior (49). According to Bangladesh, the biggest obstacle to preventive oral health services was seen as affordability (66). Bangladesh is classified as a low and middle-income country (LMIC). A study with 385 participants in

Dhaka found that the primary reason (63.9% of participants) for not seeking dental treatment was due to insufficient financial resources (66).

Insufficient knowledge about tooth brushing methods, fluoridated toothpaste, brushing frequency, sugar-free food selection, or rinsing the mouth after eating were seen as significant obstacles to maintaining good health and hygiene (125, 151-153). According to a study, a lack of knowledge about dental treatment was observed in 9.61% of the study participants (66). Insufficient knowledge about dental issues and available treatment options may also be viewed as a barrier to seeking care (125,154).

Around 35 to 77 million individuals in Bangladesh have been said to have come into contact with arsenic by drinking contaminated water (104,105). Arsenic has been detected in varying levels across all 64 districts of Bangladesh. The entire population was unable to relocate from the region with high arsenic levels to an area with lower arsenic concentrations. Simultaneously, it is not always possible to purchase arsenic-free mineral water for drinking and household uses. Relocating to an area without arsenic may be desired for its advantages, but it is not feasible for a large population, posing a barrier to accessing clean, fresh water.

In Bangladesh, people have a strong liking for sweet foods due to their culture. The World Health Organization states that elderly individuals' inadequate oral health is due to certain controllable factors such as consuming sweetened tea, excessive carbohydrate intake, and poor nutritional status (101). In Bangladesh, the average daily sugar consumption per person is 16.9 grams, posing a substantial threat to dental health (27). Having the right mindset about avoiding sugar is seen as a barrier in this situation.

Research conducted on the tribal communities residing in the Rangpur area indicated that they consistently utilized traditional practices for maintaining oral cleanliness (169). Out of them, 43.9% exclusively utilized traditional tooth cleaning techniques, such as charcoal combined with salt (128). Their common habits such as regularly consuming betel leaf, slaked lime, areca nut, and catechu are known to increase the risk of periodontal diseases (170), oral submucous fibrosis (171), and oral malignancies (172). The enduring indigenous cultural influences were seen as a hindrance to changing harmful eating habits.

It appears that individuals in Bangladesh have a strong reliance on cold beverages. A study involving 385 participants found that due to the extremely hot and humid weather, 39.48% of the respondents were frequent consumers of soft drinks, 40% consumed them daily, and 8.57% drank them occasionally (66).

About 90% of Bangladeshi residents are reliant on soft drinks, leading to issues like cavities (66). Bangladeshi people saw their environmental and long-standing daily habits as a barrier.

In a decade-long literature review, it was discovered that 43.3% of adults (15 years and older) in Bangladesh used tobacco, with smokeless tobacco (SLT) being more prevalent at 27.2% compared to smoking at 23% (69). Quitting smoking has always been difficult and was seen as a hurdle by 43.3% of participants in the study.

Residents of slums had limited access to oral care and preventive services, leading to a generally low level of periodontal and oral hygiene among them (35). The location of residence is important because different amenities are tied to different locations. Residing in impoverished neighborhoods was also seen as a hindrance.

Likewise, individuals residing in tribal regions, particularly the elderly were a highly at-risk group due to their remote location and limited healthcare resources (173). A study conducted on 255 tribal individuals in Bangladesh revealed that 25.35% of the elderly tribal population had extremely poor oral health (173). Due to the severe lack of healthcare access, they relied on traditional healers to address their health issues. These traditional healers did not receive formal education or institutional training. However, tribal elders, aware of their constraints with no alternatives, still seek out dental care, possibly seen as a hurdle to accessing adequate oral treatment.

Bangladesh lacks a national oral health policy, strategy, or action plan (27). It was discovered that the policy did not include regular and preventative oral health care (27). In 2019, Bangladesh spent a total of 13 million US dollars on dental healthcare, amounting to a per capita expenditure of 0.1 US dollars. These minimal expenditures on dental care indicate that a large number of Bangladeshis may have restricted access to affordable dental services. In Bangladesh, there were only 27 oral health professionals for every 10,000 people, which is considered low. In the year 2019, there were just 0.6 dentists for every 10,000 people (27). In 2019, the nation also employed 23 dental prosthetic technicians (27) as registered professionals. Thus, the general population viewed seeking appropriate oral health care services as a hindrance as well.

In Bangladesh, while smoking is not encouraged among the youth or females due to traditional values and social norms, SLT did not face the same restrictions (162). SLT was widely utilized in festivals, daily routines, and ceremonies like marriage and entertainment due to its integration with traditional values, spirituality, and beliefs (163,164). Around 20% to 30% of females living in rural regions consume SLT as

a custom, offer it to visitors during traditional festivals (163-165), and view it as a form of sweets. Numerous myths and misunderstandings surround the use of SLT, particularly in rural areas, where it was believed to aid in digestion after a meal, provide pain relief, cure toothaches, headaches, and stomach aches, alleviate boredom and frustration, promote mental relaxation, reduce tension, enhance concentration, and be less harmful than smoking (174-177). These long-standing cultural practices and societal norms serve as an obstacle for the illiterate population.

Female patients might found it uncomfortable to receive dental treatment from male dentists because of religious beliefs regarding interactions between genders, leading to reluctance among some women, particularly in rural areas, to seek care from male dentists (147).

4.6.5 Cues to action:

Cues for action are considered the most influential aspect of the health belief model in encouraging individuals to modify their behavior. The Health Belief Model states that a stimulus, such as a cue, is needed to encourage participation in behaviors that promote health (49). Internal or external factors can serve as cues to action (49). Physical signals (such as pain and discomfort) serve as internal prompts for action (49). Internal cues are personal reactions. Research discovered that approximately 90.65% of participants sought dental care solely for emergencies, with only 9.35% going for routine checkups (66). An additional research found that 48.57% of participants did not make regular visits to a dentist (66). The inner signals must be powerful for Bangladeshi individuals who are naturally hesitant about their health. External cues come from close others, the media, or healthcare providers and encourage involvement in health-related actions. External stimuli may be as basic as receiving a reminder postcard from a dentist or hearing news of a friend or family member falling ill. Possible options may include expanding public education efforts, improving access to dental services, increasing affordability of dental care, and changes to national oral health policies (49). In countries such as Bangladesh which are still developing, educational programs can emphasize the significance of maintaining oral health and scheduling regular dental examinations. Institutional or individual efforts could create programs to raise social awareness and promote oral health consciousness among people. A dental camp organized by a toothpaste company took place for one month in 30 districts of Bangladesh, Dhaka included (178). The dental camp, which was free of charge, ran from February 2023 until March 2023. Being a no-cost service, it managed to draw in 765,800 individuals seeking advice from expert dentists for their oral health issues (178). 3,574 dentists with BDS certification put in hard work at 330 camps across the nation. (178). The participants were also

given complimentary toothpaste and toothbrushes by the organizers. The complimentary consultations and medications served as external incentives to draw people in.

Government initiatives such as mobile clinics or educating local healthcare workers in remote regions were closing the gaps in delivering dental services. Providing financial assistance or insurance coverage could increase the affordability of dental care for people with low incomes. A holistic plan bundle might focus on dental wellness, tackle potential dangers, and enhance the dental workforce. All of these actions can create triggers to improve the oral health of Bangladeshi people.

4.6.6 Self-efficacy:

Self-efficacy was incorporated into the Health belief model in 1988 (49). Self-efficacy is the belief of a person in their ability to effectively carry out a task (49). When individuals feel they can control a certain danger, they are more inclined to take the necessary steps to avoid it. This is why accurate information is crucial for fostering this belief. Because of monetary constraints and a lack of knowledge about healthcare, the population of Bangladesh hesitated to prioritize their dental health (66). The self-efficacy was extremely minimal.

To increase a person's ability to resist oral diseases, it is necessary to enhance their health knowledge, promote good health habits, provide health education, and motivate them to take care of their oral health. In 2023, the rate of functional literacy among Bangladeshi individuals aged 11-45 years was 73.69%, an increase from 53.70% in 2011 (150). It shows that literacy rates are on the rise in Bangladesh. With various efforts from the government, NGOs, school health campaigns, doctors, and national awareness, it is hoped that Bangladeshis will develop strong self-efficacy against oral diseases in the future, leading to healthier behaviors and overcoming barriers.

5.0 Discussion

Overall oral health refers to the overall state of the mouth, including the oral cavity, teeth, and related structures. In Bangladesh, over 80% of the population experienced oral and dental issues like periodontitis, gingivitis, dental caries, pulpitis, alveolar abscesses, dental cysts, and oral cavity carcinoma (179). The oral health profile of Bangladesh indicated that 43.5% of children aged 1-9 years had oral diseases in 2019 and 30.4% of individuals aged 5 years and older had untreated caries in their permanent teeth. 23.4% of people who are at least 15 years old experienced severe periodontal disease (27). In 2020,

there were about 13,985 new cases of lip and oral cavity cancer in Bangladesh, with an incidence rate of 9.5 per 100,000 people (27).

In Mymensingh district, 82.7% of children were found to have dental caries, with varying prevalence among urban (68.9%), suburban (83.9%), and rural (96.3%) areas (36). China and Saudi Arabia had a similar high prevalence of dental caries at 85% and 89%, respectively (180,181). In contrast, lower prevalence rates were reported in Palestine (76%), Israel (64.7%), and India (51.9%) (182-184). Nonetheless, in developed countries, the occurrence of tooth decay was significantly less ranging from 30% to 50% (185-187). The higher level of education, increased awareness, and improved dental accessibility in developed countries likely caused this discrepancy.

Research conducted with 251 children aged between 6 and 12 revealed that girls had a notably higher prevalence of dental cavities compared to boys (72). It was suggested that dental caries exhibited a preference for a specific gender (72). A 2012 study on 1000 children revealed that girls in the age range of 6 to 18 had higher rates of caries compared to boys. This was attributed to parental neglect and discrimination (188) towards girls, although Bullappa's findings (189) contradicted this. Some studies showed more males than females (190-192) while other studies showed more females than males (193,194). Therefore, it can be concluded that gender discrepancy is not a significant issue when it comes to dental cavities (36).

Factors related to income, like a low family income, can greatly raise the risk of developing dental caries. Many studies have shown that parents are unable to pay for their children's dental care because of the expenses related to dental materials, the dentist, and medication (36). As family income goes up, there is a drop in the number of dental cavities due to regular visits to dentists (195).

As per WHO 2013, around 80% of the sick population in developing nations like Bangladesh rely on traditional healing for their Primary Healthcare (PHC) needs (196). These traditional healers lacked education and training. Incorrect treatment was widespread due to their experience being the determining factor in how they were treated. These indigenous healers utilized various tree roots for treatment, but they were not always successful. Because the medications were inexpensive and the tribal community lacked adequate access to doctors, they opted to seek treatment from traditional healers. The Unani and Ayurvedic systems of traditional medicine were widely acknowledged and embraced as viable alternative forms of healthcare in both rural and urban regions of Bangladesh (197,198).

Hygiene knowledge, education, and social environment greatly influence dietary and oral hygiene behaviors (199). Basic preventative measures can help keep oral and dental health in good condition (100). Individuals with a higher educational background are more inclined to be knowledgeable about oral health care, leading them to make more frequent visits to the dentist compared to those with a lower level of education (200). Education is linked to the type of job one has and impacts how much money they earn. Typically, individuals with more advanced education tend to have higher incomes, allowing them to access superior healthcare options (201). Mothers with higher education levels were more diligent about oral hygiene (202-204). Infants who consume sugar-containing milk from a bottle, particularly at night, often experience widespread tooth decay, meaning the majority of their teeth are affected by cavities. Many parents in Bangladesh neglected to properly care for and treat milk or baby teeth because they believed these teeth were temporary and would eventually be replaced by permanent ones. Insufficient management of plaque and excessive sugar intake is linked to negative maternal oral health practices (205).

Residents of rural areas often have to travel far to access oral healthcare in cities, leading to a decrease in how often they see a dentist or oral health professional compared to city dwellers (206). The analysis of risk factors also showed that children living in rural areas have a 7.3 times higher risk of dental caries compared to those in urban areas, a finding consistent with prior research (207-211). There were no regular dental facilities in rural areas except for occasional voluntary dental camps in certain locations (66). Minor extractions, scaling, and temporary restoration were the typical procedures performed in temporary camps.

Due to the limited availability of dental services in villages, dental patients had to travel to nearby health complexes for urgent treatment (158,159). Providing conservative and prosthetic dental treatment to the villagers was a major challenge due to the limited treatment facilities available. So, following the loss of teeth, they primarily live without dentures. Once more, residents in slums lacked access to oral health interventions or preventive programs, with minimal surveys conducted to assess their oral health status (68). The residents of slum areas lack access to oral treatment and there is no preventive program to stop the advancement of oral diseases (68). Surveys from various sources indicate that slum residents generally have inadequate periodontal and oral hygiene (68).

90.65% of a study respondents visited the dentist only in emergencies (66), indicating a reactive rather than proactive mindset towards oral health. Approximately 27.53% of participants in a study had never been to a dental care specialist, showing their lack of knowledge about dental services (66). According to

the study, 51.69% of respondents visited the dentist for a checkup within 2 years, while the remaining 48.31% did not return for the checkup (66).

Numerous myths and misunderstandings exist regarding the use of SLT, particularly in rural areas (76), where it is believed to aid digestion after meals, provide pain relief for toothaches, headaches, and stomachaches, combat boredom and frustration, promote mental relaxation, reduce tension, improve concentration, freshen breath, offer protection from snake and scorpion bites, and be less harmful than smoking (174-177). Because of its attractive low cost (212), it persuaded individuals to consume substantial quantities of SLT. An appropriate public awareness program is needed in Bangladesh to reduce the use of SLT, along with higher taxes and cessation services, given the cultural acceptance of SLT in the country (76). The rise in tobacco consumption in Bangladesh is due to easy access, cheap cost, widespread misconceptions about its health benefits, growing population, absence of tobacco control laws, and inadequate enforcement of current regulations (76).

Most of the school kids utilized toothbrushes along with toothpaste for their dental hygiene. Nearly every child brushes their teeth at least once daily, typically in the morning before eating. The same results were found for inconsistent dental care practices among schoolchildren in Jordan (213). It is advised by the American Dental Association (ADA) to brush teeth twice daily and incorporate floss or inter-dental cleaners into their routine to properly eliminate microbial plaque (214). In a study, 62% of students were not aware of how often they should change their toothbrushes. The American Dental Association suggests changing toothbrushes every 3-4 months to prevent damage to oral tissue from worn bristles (215). Approximately half of the participants lacked knowledge about the components of toothpaste. The majority of the students were casually brushing their teeth (215). The horizontal stroke that was most frequently used had the greatest negative impact on teeth, leading to loss of surface enamel, abrasions on the enamel, damage to the gums and surrounding soft tissue, gingival recession (2), and sensitivity (216-218) in teeth. Effective oral health education programs in secondary schools have the potential to make a significant impact on tooth brushing behavior (219).

The elevated rate of ECC in young children aged 6 to 24 months matches the data from India (35.44%) (220) and Sri Lanka (32.2%) (221), but is less than the results from Thailand (58.4%) (222). In contrast to these results, a significantly lower percentage was documented in Europe (2.9%) (223). A systematic review and meta-analysis from 2020 found that the prevalence of dental caries in primary teeth was 46.2% in children, while in permanent teeth it was 53.8% (224).

It is believed that in Bangladesh, Smokeless Tobacco Products vary in form from raw to finished items like Sada Pata, Zarda, Gul, and Khoinee. More than a quarter of Bangladeshi individuals who are 15 years old and above consume SLT in some form. It was calculated that SLT has over 30 cancer-causing substances (225). The likelihood of developing these conditions was discovered to rise as the dosage and frequency of SLT usage increased. According to reports, consuming it has been linked to a rise in heart diseases, stroke, and oral cancer and resulted in approximately 320,000 disability-adjusted life years lost in Bangladesh in 2010 (76). There is no stoppage assistance provided to SLT users at public establishments (76).

6.0 Limitations

The range of research methodologies and study quality reviewed varied, which could impact the trustworthiness of the results. Many studies lack adequate details on validated questionnaires and confounding factors, which could potentially affect the findings. The research was carried out over an extended period, and in some cases, the results differed greatly from earlier studies, possibly due to the passage of time. This review specifically focused on studies published in English, leading to a lack of representation of many studies in the field. Time constraints also played a role in the completion of this research.

7.0 Conclusion

The study revealed that Bangladeshi people have low awareness and understanding of their oral health and hygiene. The occurrence of tooth decay, gum inflammation, and gum disease was elevated. There was also a lack of good oral hygiene practices. Both the absence of education and financial resources, as well as the lack of awareness regarding their oral health, contributed to this situation. To tackle this issue, it was crucial to include strategies such as integrating oral health education in school curricula and community programs, addressing economic barriers to dental care, promoting oral health awareness initiatives, and conducting further research to identify and change cultural habits. The collaboration between these joint efforts would enhance people's well-being and drive the overall health and productivity of the country.

8.0 Recommendation

Parents need to be careful to watch over their children as they brush their teeth to make sure they are doing it properly. Scheduled parent/teacher meetings should inform parents about the significance of maintaining good hygiene for preventing dental diseases.

It is crucial to integrate oral health education into the school's usual activities. Emphasizing 'School Dental Public Health Awareness Programs' is gaining prominence and should be promoted.

Ensure to evaluate and uphold the dental well-being of children starting at a young age and regularly track their development.

Plan and maintain regular monthly seminars or workshops to promote healthy habits like proper brushing techniques, and brushing teeth two times daily. Additionally, behavioral modification like limiting sticky food intake, avoiding sugary foods, rinsing mouth well, and booking regular dental check-ups will be helpful.

A comprehensive initiative is needed to prevent and address oral diseases among the poor residents of slums.

The government must set up specialized educational institutions to boost the quantity of dental graduates.

Government actions are required to guarantee that dental health services are available throughout the country to enhance dental health in Bangladesh.

To meet the goals of the WHO, it is essential to consistently carry out dental health initiatives for the community's benefit.

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