USE OF DENTIFRICE AND OCCURRENCE OF DENTAL CARIES AMONG SCHOOL CHILDREN IN NEMBE, BAYELSA STATE.

BY

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CERTIFICATION

This thesis study on "Use of Dentifrices and occurrence of dental caries among school children in Nembe LGA, Bayelsa State" was written by Wilfred Idubamo, (Reg.No:20134874168) of the Department of public Health Technology under the effective supervision of Dr. C.C Iwula and has been evaluated, accepted and approved as have meeting the requirements for the award of master Degree in public Health.

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DEDICATION

This study is dedicated to almighty God, whose inspiration and love brought to the accomplishment of this research work and to my beloved daughters Anthonia, Treasure and Ayebakarinate I. Wilfred who is always a source of my joy and Iduwils foundation, which stresses the importance of education and excellence.

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ABSTRACT

This study aims at determining the pattern of the use of oral dentifrices, dental caries occurrence and the impact of age and sex on the use of dentifrice as oral self-care measures by secondary school children in Nembe, Bayelsa State. One of the goals of the World Health Organization is to ensure increased uptake of preventive oral self-care. This would require the design public health programmes that will ensure children place premium on preventive oral health care uptake. One effort in that direction is the need for countries to define baseline measures on use of preventive oral self-care measures by their population as well as identify factors that impact on its use. Pupils age 8 to 21 years in two Secondary Schools in Nembe completed a questionnaire about dentifrice oral self-care (use of fluoridated toothpaste, flossing, regularity of consuming sugary snacks between main meals), time of the last dental check-up. 350 students were selected from the two schools as sample size using Taro Yamane formula. With the administration of self-administered questions to gather the information and SPSS version 27 was used to analysis the data. Pearson Chi square was used to test association between age (8-12years, 13–16 years and 17 above), sex, and to determine the effect on the use of dentifrice and caries occurrence. Result shows that the age brackets, 13 – 16 years constituted 154(44%), Male genders 180(51.4%) which had the largest proportion, gender-based. Result also shows that there is a high proportion on the usage of dentifrice (73.2%), rate of occurrence of dental caries among the Secondary school students in Nembe LGA of Bayelsa state. Only 169(48.3%) the study population practiced the recommended oral self-care, and 95(27%) always visited the dental clinic for a check-up in the last one year. This study also shows a significant level (X^2 = 611.057, P<0.001) on the pattern of use of oral dentifrice among secondary school students. This study shows a significant level (X^2 = 199.87, P<0.000) timing and duration of on the pattern of use of oral dentifrice among secondary school students. The results showed a level of statistically significant on the rate of occurrence on dental caries among the students (X^2 =243.64, P<0.000, X^2 =50.13, P<0.001, X^2 =97.31, P<0.001) The results also showed a level of statistically significant on the effects of the use of dentifrice on dental caries occurrence among the respondent (P<0.001). Dental caries is a common public health problem in school children associated with poor oral hygiene, dietary and lack of dental visit habits. Therefore, prevention measures such as health education on oral hygiene, dietary habits and importance of dental visit are obligatory for children. The Level of utilization of dental care and the use of dentifrice should be kept standard in a way the school oral health programs should be implemented in other to promote oral health awareness and encourage routine dental check-up among these students.

Keywords; Oral health, **H**ealth literacy, **E**pidemiology, **P**reventive programs, **D**ental plaque, **S**ocio-behavioural risk factors.

CHAPTER ONE

INTRODUCTION

BACKGROUND TO THE STUDY

Dental caries continues to be one of the most common chronic diseases in the Nigeria and globally, with individuals living in poverty and minorities being affected more than their more affluent peers. Dental caries (commonly referred to as “cavities”) is a complex multifactorial disease mediated by factors that protect teeth (fluoride, salivary flow, buffering capacity, and host immunity) and patient-specific factors that put teeth at increased risk (frequent exposure to dietary carbohydrates, poor oral hygiene, and a cariogenic biofilm containing bacteria capable of fermenting carbohydrates and producing a decrease in pH). As Fontana and Wolff (2011) note, it is critical to develop effective tools for prevention and management that are risk based and patient centred Investing in effective nonsurgical (medical) management of dental caries will pay off by reducing the need for dental surgery to remove some or all of the tooth structure. Effective nonsurgical (medical) management of dental caries, including disease prevention and interventions in its earlier stages, requires early assessment to identify individuals at risk prior to visual indications of disease occurrence (dental cavities) combined with person- and/or family– centred education about the importance of oral health and its link to overall health. We believe a person’s health literacy is especially important to consider because their understanding of the factors related to the promotion of oral health and prevention of disease will impact their ability to take action and incorporate appropriate home care as a standard routine. Health literacy as practiced is a shared responsibility of the health care provider, clinical setting, and patient/caregiver. The dental team can enhance a patient’s self-efficacy by incorporating basic health literacy principles, such as the use of clear language and the use of the “teach back” method in clinical practice.

Dental caries continues to pose an important public health problem across the world. The World Health Organization (WHO) emphasizes that the disease affects about 60–90% of schoolchildren, the vast majority of adults and that dental caries contributes to an extensive loss of natural teeth in older people globally (Petersen, 2008a; WHO, 2016). Meanwhile, in most westernized high income countries, an improvement in dental health has taken place over the past three decades in parallel with the introduction of prevention-oriented oral health systems. A decline in the prevalence and the severity of dental caries is particularly observed in countries having established public health programmes using fluoride for dental caries prevention, coupled with changing living conditions, healthier lifestyles, and improved self-care practices. In Eastern Europe and Central Asia dental caries levels are high and with health systems in transition the exposure of the population to fluoride for disease prevention has diminished dramatically. In low and middle income countries of Africa, Asia, and Latin America the lack of preventive programmes is further complicated by the fact that these countries have a shortage of oral health personnel and the capacity of health systems is mostly limited to treatment of symptoms or emergency care. In children and adults suffering from severe tooth decay, teeth are often left untreated or they are extracted to relieve oral pain or discomfort. In the future, tooth loss and impaired quality of life are therefore expected to increase as a public health problem in many developing countries. The current global and regional patterns of dental caries largely reflect distinct risk profiles of countries which relate to structure of society, living conditions, lifestyles, and the existence of preventive oral health systems (Kwan and Petersen, 2010). The socio-behavioural risk factors in dental caries are found universally and they play significant roles in children, adults and older people. The disease level is relatively high among underprivileged population groups, i.e. people with low education background, poor living conditions, people with poor dietary habits and high consumption of sugars, and people with limited tradition of dental care. Unless serious efforts

are made to tackle the social inequity by modifying risk factors and by establishing effective caries prevention programmes, the level of dental caries in disadvantaged populations and countries will unduly increase (Kwan and Petersen, 2010). Evidently, substantial population groups in low and middle-income countries have not yet obtained the health benefit from fluoride in community prevention programmes. The reasons for not having been able to implement prevention programmes varies in nature ranging from lack of national policy for oral health to low awareness of the importance of oral health.

STATEMENT OF THE PROBLEM

Good oral health behaviour and attitude plays a fundamental role for general wellbeing by preventing common oral diseases, such as dental caries and periodontal diseases. This behaviour/attitude includes regular tooth brushing and flossing, preventive measures such as fluoridation and sealants, healthy nutritional habits, and regular visits to the dentists (Sa'adu et al., 2012). Ogundele and Ogunsile (2008) reported that secondary school students and adolescents in Nigeria face challenges regarding their oral health because of the daily high consumption of sugary foods and drinks, which predisposes them to dental caries and periodontal disease. According to Akpata (2004), dental cavities constitute one of the major oral health problems with its prevalence as high as 30 to 45% among young children and adolescents in Nigeria, between the ages of 12 and 15 years respectively. The epidemiological studies of dental caries on some subsections of the Nigerian population were presented by Sofola (2010) who put the prevalence at about 20% with mean decayed, missing, filled teeth (DMFT) of less than 2-6. Okoye and Ekwueme (2011) also reported that dental caries was low among secondary school students in a rural community in Enugu State Nigeria (30%; DMFT 0.85-1.50); this figure may be low, but Okoye and Okwueme concluded that this figure is higher than the prevalence rate reported in urban areas in Enugu state. According to Sofola (2010), chronic periodontal disease has been found to be highly prevalent among Nigerians,

right from the 1960s until today; over 75% of Nigerians suffer from gingivitis and periodontitis due to accumulation of dental plaque on their teeth and gum. Significant prevalence and the severity of periodontal disease has been reported with increasing age among secondary school children in Nigeria (Bayelsa State to be precise; Maduakor et al., n.d). Ogundele and Ogunsile (2008) also reported that the prevalence of destructive periodontal disease among Nigerians aged 15 to 19 years ranges between 15% in Northern Nigeria and 10% in Western Nigeria. Akpata (2004) also explained that the curriculum used in most schools in Nigeria does not accommodate oral health education; therefore, the awareness of level on the negative effects of poor oral health among Nigerian students is low (Petersen, 2004). The negative impacts of poor oral health itemized by Peterson (2004) included pain and suffering, functional impairments, and reduced quality of life. A review of the literature on the use of oral dentifrice in prevention of dental caries among secondary school's students in Nembe, Bayelsa State of Nigeria demonstrates poor results on the topic; thus, there was a literature gap that this research intended to fill.

AIM AND OBJECTIVES OF THE STUDY

In Nembe, Bayelsa state, schoolchildren's usage of dentifrice and occurrence of dental caries are the subjects of the study. The study's goals are as follows:

1. To determine pattern of the use of oral dentifrices among secondary school children in Nembe, Bayelsa state
2. To determine rate of occurrence of dental caries among secondary school children in Nembe, Bayelsa state
3. To determine the effect on the use of dentifrice on the occurrence of dental care among secondary school children in Nembe, Bayelsa state

RESEARCH QUESTIONS

The following research questions guide the objectives of the study:

1. What is the pattern of the use of oral dentifrices among secondary school children in Nembe, Bayelsa state?
2. What is the rate of occurrence of dental caries among secondary school children in Nembe, Bayelsa state?
3. What is the Effect of pattern of the use of oral dentifrices and occurrence of dental caries among secondary school children in Nembe, Bayelsa state?

SIGNIFICANCE OF THE STUDY

Nembe, the state of Bayelsa, and other health institutions can greatly benefit from the study on dentifrice usage and dental caries incidence among schoolchildren in increasing the utilization of dentifrice to reduce dental caries in children. The study's findings will also show a connection between dental caries and the environments in which kids in Nembe, Bayelsa state, learn. The study will add to our understanding of the prevalence of dental caries among children in Nembe, Bayelsa state, as well as the usage of dentifrice, and it will be useful for Nembe, Bayelsa state.

SCOPE OF THE STUDY

The study covers on the use of dentifrice and occurrence of dental caries among school children in Nembe, Bayelsa state

DEFINITION OF TERMS

Caries: meaning rotten or decay.

Dental Caries: This is a gradual, permanent bacterial infection that affects exposed teeth or the calcified tissues around them. Cavities (holes) and discomfort are caused by demineralization of the calcified tissue.

Dental Cavities: It is holes in the two layers of the teeth called the enamel and dentine.

Dentifrice: Any tool or substance that works well for tooth cleaning (oral hygiene aids). Are substances made to be used in conjunction with a toothbrush to remove dental stains and to give the mouth a feeling of freshness, coolness, pleasure, and cleanliness.

Dental Floss: A type of thread that is used for cleaning between the teeth.

DMFT (decayed, missing and filled teeth): It is used to contribute deteriorated, missing, and filled teeth, as well as the Index, which is a count of the number of teeth per individual that are impacted by decay at the tooth or tooth surface level.

DMFT/dmft index: This is the cumulative caries attack index for a population. The DMFT is used to represent decaying, missing, and filled permanent teeth and consequently accounts for the number of surfaces affected on each tooth. Some other similar index for primary teeth (dmft) for representing the number of deteriorated, signalling for extraction or removed owing to caries (to distinguish from loss due to spontaneous exfoliation), and filled teeth.

Dental Plaque: This mathematical indicator represents the total number of caries attacks within a population. The dmf, that is used to represent decayed, missing, and filled permanent teeth, takes into cognisance the number of surfaces on every tooth that have been affected by decay. The primary dentition employs a comparable index to identify the number of teeth that are decayed, need to be pulled or removed due to caries (to differentiate loss from spontaneous exfoliation), or need to be filled.

Dental Calculus: Dental calculus is mineralized or calcified dental plaque. It forms on teeth and other oral appliances and resembles a stone.

Gingivitis: It is the infection and inflammation of the gum.

Halitosis: Bad odour coming out from the mouth.

Oral Cavity: The opening space within the mouth.

Teeth: This is a calcified matrix tissue that burst through any part of the jaw bone and into the mouth's floor. In a typical adult mouth, there are 32 teeth, but a typical toddler mouth has 20 teeth. Each tooth has a base, a neck, and a crown with one or more cusps (points)

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

This chapter includes the analysis of essential literature and studies carried out by eminent researchers in addition to offering definitions of key terms linked to the usage of dentifrice and the incidence of dental caries among pupils in Nembe, Bayelsa State. A brief summary of current research on subjects that are directly relevant to the background and state of the issue is also provided in this chapter.

2.2 DENTAL CARIES

Dental caries involves interactions between the tooth structure, the microbial biofilm formed on the tooth surface and sugars, as well as salivary and genetic influences (Pitts et al., 2016). The dynamic caries process consists of rapidly alternating periods of tooth demineralization and remineralisation, which, if net demineralization occurs over sufficient time, results in the initiation of specific caries lesions at certain anatomical predilection sites on the teeth. It is important to balance the pathological and protective factors that influence the initiation and progression of dental caries. Protective factors promote remineralisation and lesion arrest, whereas pathological factors shift the balance in the direction of dental caries and disease progression. The daily use of fluoride (dentifrices) toothpaste is seen by many authorities as the main reason for the overall decline of caries worldwide over recent decades; the mode of action of such toothpastes is concerned with shifting the balance of the oral biofilm towards health. There is not a direct correlation between the extent of a caries lesion and whether pain and discomfort are felt. However, severe toothache, when it occurs, can be disabling, and infection and sepsis arising owing to caries that spreads to involve the dental pulp can occasionally lead to serious systemic consequences, such as spreading local infection

and, very rarely, treatment-related death (as a complication of anaesthesia), as well as to tooth loss. The clinical detection of caries is traditionally made by detailed visual inspection of clean teeth by trained examiners. Although sharp pointed dental probes (or explorers) are still often used, they provide little additional diagnostic benefit and can do some damage. Dental radiographs or other supportive diagnostic methods are also needed in clinical practice to detect lesions that are hidden to visual assessment, particularly those situated on the interproximal tooth surfaces (that is, surfaces that form contacts between adjacent teeth). Although the ravages of caries can make teeth appear to be highly vulnerable to destruction by disease, from an evolutionary biology perspective, human teeth are a high-valued organ system involved in the prehension and processing of food, and can also function in defence, sexual attraction and phonetic articulation (Koussoulakou et al., 2009). The outer surface of the tooth crown is composed of enamel, the hardest substance in the body, with saliva, a specialized fluid, being secreted throughout the day to preserve its integrity. The morphology of the modern dentition has evolved mainly based on our dietary preferences, which have changed over the millennia (Koussoulakou et al., 2009).

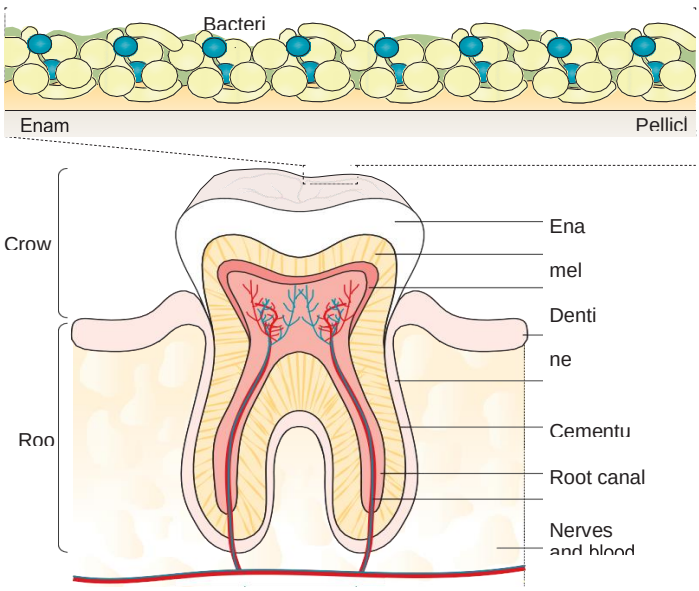


Figure 1. normal anatomy

Source: Nature.com and Dentalcare.com

Figure 1 Normal tooth anatomy and developing dental biofilm. The hard tissue of the tooth consists of enamel, dentine and cementum. Enamel is a hard material composed almost exclusively of mineral — which is mainly composed of hydroxyapatite ($Ca10(PO_4)\ 6(OH)_2$) — and covers the dentine on the crown of the tooth. Cementum is a bone-matrix-like substance, composed of mineral and collagen; it covers the root of the tooth. The dental pulp forms the central part and contains connective tissue, blood vessels and nerves. Teeth are covered by a salivary pellicle layer, consisting of proteins and glycoproteins, which facilitate binding of the oral microbiota to the teeth; this structure is called the dental biofilm (also known as dental plaque). The biofilm shuts off the surface enamel from the saliva and oral cavity and produces a protected microenvironment at the tooth surface. Gums (also known as gingiva) surround the teeth. In humans, primary teeth erupt around 6 months of age; these are gradually replaced by permanent teeth from ~6 years of age.

2.2.1 Epidemiology

There have been several epidemiological studies conducted on dental caries throughout the years, and some numbers from the World Health Organization and other organisations create the idea that there is a plethora of similar data on a worldwide scale. The burden of illness (prevalence), the rate at which a disease develops (incidence), and disease trends over time must be provided by epidemiology for key age groups in a timely, accurate, and accessible manner. Aside from estimates and trends in health inequities, data on variations in disease prevalence across and within nations is also required (differences in health status among populations or groups). However, data that meets these requirements (global representation, timeliness, and clinical applicability) is not currently available. Even though the World Health Organization has recognised dental caries as a severe health issue, which affects 60-90% of children and the great majority of adults in industrialised nations, the topic is still largely ignored (Petersen et al., 2005). Caries has traditionally been associated with children, however

it is now known that people of any age may be affected (Broadbent et al., 2008). Dental caries occurs more often in youngsters than in adults (Pitts, N. et al., 2011). Given the recent increase in the suspected worldwide frequency of dental caries among children aged 2–5, this age range has been declared a global priority action area. 6-8. Caries in the primary teeth of 2-5-year-old children in the United States grew from about 24% to 28% between 1988-1994 and 1999-2004, according to statistics from the 2007 census. Prevalence was greatest among children of colour and children of low-income families. The most recent National Health and Nutrition Examination Survey (NHANES), conducted in 2011 and 2012, found that over 23% of American children between the ages of 2 and 5 have dental caries in their primary teeth. Further, 10% of American children between the ages of 2 and 5 have untreated dental caries. Dental caries are much more or less frequent in certain regions of the United States. New analysis of NHANES data from 1999–2004 reveals that one of the largest counties in the United States, Los Angeles County, has a higher frequency of dental caries than the country as a whole. Over forty percent of pre-schoolers in LA County had dental caries in their primary teeth, compared to just 28 percent of children of the same age in the United States. From 1999 to 2004, children of colour in Los Angeles County had the worst oral health of any demographic in the country, ranking dead last nationally. Some people believe that early childhood caries (ECC) may be transmitted from carers to their children, but it is entirely preventable. ECC is a severe form of caries in children and is a common, bacterially mediated, multifactorial condition characterised by severe tooth decay in children under the age of 6. Very little reliable international data on ECC exist since most nations only record caries in children aged 5 or 6. By and large, poor countries have had a lower incidence of dental caries than industrialised ones. This geographical scenario has gotten more difficult as a result of rapid economic growth and changes in lifestyle and eating in different nations. While racial and ethnic disparities are possible, they likely pale in comparison to variations in lifestyle, socioeconomic status, and

sugar consumption. The DMF (Decayed, Missing, and Filled) Index is a numerical count of impacted teeth per person acquired at either the Tooth (DMFT) or tooth Surface level, and it has been used traditionally over the globe as an indication of caries in epidemiological research but not in clinical practise (DMFS). The severity of caries in a person or population may be gauged by measuring their DMFT (that is, the total of both current and past caries). The median DMFT and the proportion of patients who have DMFTs alter the relevance of the index at different diagnostic cut offs (Pitts et al., 1994). Depending on the cut off point for detection, the estimated percentage of 15-year-olds that are afflicted ranges between 11-52%14. Improvements are being made on a global basis to ensure interoperability between systems used in a fully-equipped dental clinic and those used in epidemiological fieldwork. The prevalence of dental caries may then be studied in more depth. Numerous nations have begun using the more current simplified merging codes option 16 in their epidemiological research, in addition to the "epi-modifications" of the International Caries Detection and Assessment System (ICDAS), which complement the WHO basic reporting standards. The unified ICDAS codes are more in line with those used in clinical practise, because they take into account both healthy surfaces and the three phases of caries (as opposed to sound surfaces and six stages of caries in the full codes ICDAS option). Caries prevalence may also be estimated with the use of clinical and radiographic data (Agustsdottir, H. et al, 2017). Recent studies conducted by many European organisations have used a worldwide example to demonstrate that the existing national caries data for DMFT levels in 12-year-old children are not consistent throughout Europe. Since apparently similar data from numerous nations were obtained at different periods with dramatically different degrees of training and calibration, this resulted in the recording of caries at different thresholds, exemplifying the fundamental issues epidemiological investigations of caries confront. When oral health themes were included in the ongoing Global Burden of Disease Study, Marcenes, W. et al. (2018) discovered that they affected around 3.9

billion people throughout the globe. The method utilised in this extensive study is innovative in caries epidemiology since it does not rely on the DMF Index, which is the standard method for assessing caries load (which has been used globally for the past 60 years). Caries in permanent teeth, when left untreated, were shown to be the most prevalent health issue, impacting 2.4 billion individuals globally and having a global incidence of 35% for all ages combined. Always remember that some of these permanent teeth had their beginnings in the course of your infancy and adolescence. The prevalence of untreated caries in children's primary teeth, which affects 621 million kids worldwide, was rated ninth.

2.2.2 Mechanisms/Pathophysiology

Dental caries is a disease that affects calcified dental tissues, so it's helpful to examine its mechanisms and pathophysiology from a hard tissue perspective first, and then from a microbiology perspective, since the latter describes the driver of the caries process if homeostatic inequity is maintained. However, due to the multifaceted nature of illness, these contributors cannot be considered in isolation. Caries disease affects the dental hard tissues that are constantly exposed to the oral environment, making all tooth surfaces vulnerable at any moment in a person's life (crowns and, later, roots following gingival recession). Caries must be seen as a dietary-microbial illness since it can only develop in the presence of a cariogenic (i.e., pathogenic) dental biofilm and the regular ingestion of dietary carbohydrates, mostly free sugars. In today's understanding of dental caries, not only do biological factors play a role, but also behavioural, social, and psychological factors.

Fluoride's impact on the course of disease cannot be overstated. Dental caries may be best understood as a biofilm-mediated illness caused by poor oral hygiene, frequent consumption of fermentable carbohydrates (sugars including glucose, fructose, sucrose, and maltose), and inadequate fluoride exposure.

2.2.3 Demineralization and Remineralization

Demineralization of the crystalline mineral structure of teeth, known as dental caries, is caused by organic acids produced by biofilm bacteria as a by-product of their fermentation of fermentable, mostly sugars. These changes often begin at and beneath the enamel surfaces (the initial demineralization is subsurface). Lactic acid, a result of sugar metabolism, is thought to be the major acid responsible for caries formation, however dental biofilm bacteria may create a range of organic acids. Under saturation of the environment at the biofilm-enamel interface leads to demineralization of the tooth's surface when acids build in the fluid phase of the biofilm (Zero, D. T., 2013).

Increased porosity, larger gaps between enamel crystals, and surface softness from mineral loss may all allow acids to enter deeper into the tooth. The underlying mineral gets depleted of its minerals as a result (subsurface demineralization). The surface layer is somewhat shielded from further demineralization due to the build-up of reaction products, mostly calcium and phosphate, from the breakdown of the surface and subsurface. In addition, fluoride prevents the demineralization of the 28th surface layer. When carbohydrates are no longer present in the mouth due to ingesting and saliva diluting them, biofilm acids may be neutralised by saliva's buffering abilities. When the biofilm fluid's pH returns to neutral and it becomes appropriately saturated with calcium, phosphate, and fluoride ions, demineralization is prevented and remineralization is encouraged. Subclinical (early) caries may be halted or reversed due to the dynamic nature of the disease process, especially in the presence of fluoride. As the acid challenge and pH drop continue, demineralization moves deeper into the enamel and dentine, causing a subsurface lesion to develop in the case of root caries. The result is a higher rate of mineral loss below ground than above. After enough mineral is removed, the lesion fades to a white patch of skin. Even though the healing process in caries is often limited to the surface layer, this stage of the caries process is therapeutically relevant because the lesion may be

avoided or reversed by modifying the underlying causes or instituting preventive measures. Demineralization of early caries is well advanced. Lesions can either arrest and remain as inactive, non-progressing lesions that can be seen as a scar due to changes in the optical properties of the enamel, demineralize and effectively heal, causing reprecipitation of mineral in the lesion and possibly some superficial surface wear, or remain active and progress to a more severe stage of caries depending on the local ecology, dietary practises, and availability of fluoride. Enamel microcavities or, in the case of root caries, a slow reduction in the thickness of the dentine surface layer lead to an increase in surface porosity if the caries process continues. Cavitation, or the collapse of the surface layer, may occur in the crown caries of the long term. It is possible for a lesion to heal at this late stage of caries, but the cavity that holds the biofilm will remain permanently. Once the lesion has progressed to an irreparable stage, symptoms and/or the patient's requirements for functioning or aesthetics need surgical intervention in most industrialised nations. Allowing the caries process to progress will cause damage to the dental pulp, requiring either a root canal or the removal of the affected tooth. In order to keep teeth in good condition, it's crucial to keep their mineral balance in check. The capacity to remineralize is critical for maintaining dental health since teeth are often exposed to acidic environments, whether through biofilm or dietary acids. Because it includes the minerals needed for remineralization, saliva is essential for preserving tooth health. This is a fundamental explanation for the widespread efficacy of fluoride in preventing tooth decay, regardless of the manner of administration. Demineralization and remineralization occur in cycles throughout the day, contributing to the development of dental caries. Caries are more common in newly erupted teeth, although teeth gradually harden over time to withstand acid attacks. The therapeutic implication is that during the eruptive stages of teeth, caries status should be monitored and prophylactic treatment should be provided.

2.3 MICROBIOLOGY AND DENTAL BIOFILMS

Oral bacteria and health: much like other body surfaces, the mouth is colonised by a wide variety of germs right from birth (collectively known as the oral microbiota). Bacteria are the most prevalent sort of microorganisms; however, yeast, viruses, mycoplasmas, protozoa, and Archaea may also be present. The link between the host and the microorganisms in the mouth is mutualistic, or symbiotic. In exchange for the host's provision of a warm, nutrient-rich environment, resident oral microorganisms defend the host by fighting off intruders, bolstering its defences, and interacting with it to perhaps inhibit excessive pro-inflammatory responses to commensal bacteria (Pitts et al., 2009). Saliva plays a critical role in conserving these beneficial bacteria by maintaining a neutral pH in the mouth (which is optimal for the growth and metabolism of the majority of the oral microbiota) and by providing proteins and glycoproteins as nutrients.

Oral microbiota produces dental plaque by colonising surfaces with a functionally and physically organised community of interacting organisms (Pitts et al., 2009). Biofilms, like dental plaque, need many steps to develop. Gingival crevicular fluid, which seeps from the gum-tooth contact, contributes to the acquired pellicle, a conditioning layer of proteins and glycoproteins that coats tooth surfaces. Other components of this layer include food debris, blood, bacteria, and their byproducts (Figure 1). The acquired pellicle protects the tooth and provides binding sites for the first bacteria to colonise the tooth's surface, a process known as dental biofilm formation.

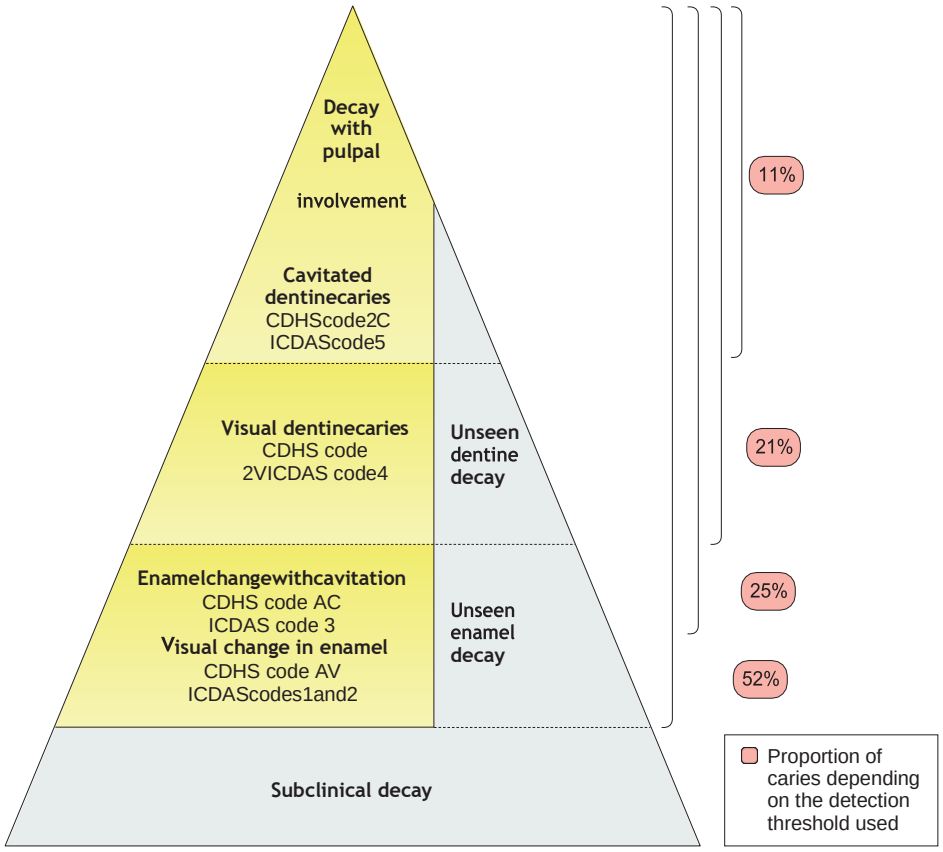


Figure 2

This illustrates the influence of various illness detection thresholds on epidemiological studies. Whether or not a categorization system is adopted, the detection threshold has a significant impact on the findings of an epidemiological study of dental caries. It is a perfect example of the iceberg analogy for tooth decay. Only 11% of kids have obvious cavitated dentine injury, yet this is only the tip of the iceberg (which is the WHO Basic Surveys convention). When lesions characterised by clinical cavitated decay in enamel, clinical visual decay in enamel, and evident visual decay in dentine are taken into account, the percentage of children with dental caries increases from 21% to 25% to 52%.

In 2013, 15-year-olds were polled as part of the National Child Dental Health Survey (CDHS) in England, Wales, and Northern Ireland. Ideally, radiographs would show a lot more of the illness's entire breadth. Also known as ICDAS, this is the International Caries Detection and Evaluation System.

Long-range van der Waal forces (forces that do not need covalent or ionic interactions) between the outer layers of bacteria and this conditioning coating may weakly but irrevocably hold them close to the surface. Molecular interactions between adhesins on the bacteria and their corresponding receptors in the conditioning film increase and stabilise adhesion (Pitts et al., 2009). The complexity of a biofilm increases as secondary colonising organisms co-adhere to the original colonisers. Numerous microbial interactions, both beneficial and harmful, occur during biofilm development. Manipulating the DNA, polysaccharides from sugar metabolism, and bacterial exopolymers (polymers discharged to the external environment) that make up the biofilm matrix may affect the penetration and mobility of molecules inside the biofilm. The biofilm serves as a barrier between the microorganisms and the bacteria. Because of subtle differences in the local environment, the composition of these biofilms differs across different tooth surfaces. Microorganisms like this may lead to dental cavities.

These alterations may increase the susceptibility of a certain area to disease. Frequent ingestion of fermentable dietary carbohydrates (particularly sucrose) and/or reduced saliva flow, both increase the risk of dental caries. Numerous epidemiological investigations, both longitudinal and cross-sectional, have shown that the composition of the microbiota differs between caries-affected and healthy surfaces. It was possible to isolate lactobacilli from advanced caries lesions (Pitts et al., 2009). These results provide credence to the assumption (called the "specific plaque theory") that only a subset of the numerous organisms present in dental biofilms cause caries. Though the bacteria continued to survive on other surfaces that were in fine condition, subsequent epidemiological investigations showed cavities even though they were invisible to the naked eye. Lab studies conducted later confirmed that other bacteria in dental biofilms could also use sugars to lower the pH, while others could mitigate the negative effects of lactic acid by using it as a food source and converting it to weaker acids, or by

producing alkali through the metabolism of arginine or urea in saliva. These findings supported the "nonspecific plaque theory," which proposes that caries are caused by the biofilm's net metabolic activity (Pitts et al., 2009). Many species of Bifidobacterium, Actinomyces, Propionibacterium, and Scardovia wigdiae, as well as others, have all been linked to caries in recent research using either conventional culture or genetic approaches because of their ability to create and withstand acid. In general, these ecological plaque hypotheses are recognised as the most credible explanations for the microbial aetiology of caries (Figure. 1). The original "ecological plaque hypothesis" recognised the need for a caries-promoting environment (a sugar-rich diet and/or low saliva flow) and highlighted the consistency of bacterial function (rapid acid production and tolerance of the acidic conditions generated) despite the lack of a specific bacterial name. Cariogenic bacteria may be present in biofilms on healthy enamel, but only at levels too low to cause any noticeable damage. Caries develops when the native microbiota in the mouth undergo an unfavourable shift in balance due to changes in the oral environment. Plaque that is constantly exposed to fermentable carbohydrates in the diet creates biofilms with persistently low pH, which promotes the development and metabolism of species that do well in neutral pH environments while suppressing the growth of acid-tolerant bacteria. This hypothesis is based on the idea that controlling the conditions that lead to pathogenic changes in the microbiota is just as important as eliminating the offending bacteria themselves in the fight against disease (that is, reducing the amount and frequency of sugar intake to prevent acidic conditions or promoting the use of snacks containing alternative sweeteners that cannot be metabolised to acid by oral bacteria). The extended caries ecological hypothesis is an expansion of the ecological plaque theory that accounts for the ability of certain dental bacteria to adapt to acid stress in chronically low pH conditions. Again, the acidity of the plaque is the deciding element in favouring the growth of bacteria that produce and are resistant to acid, thereby raising the risk of caries. Therefore, dental caries is not an infectious illness in

the traditional sense; rather, it is the result of a shift in lifestyle and oral environment that has altered the ecological balance of the normally helpful oral microbiota. The more you learn about these concepts, the more options you'll have for preventing tooth decay.

2.4 ENVIRONMENT AND DENTAL CARIES

The presence of a biofilm does not necessarily indicate the prevalence of illness, despite the fact that biofilm production on a tooth surface is a common occurrence and an essential step in the development of caries. It takes a complex combination of host variables, such as the tooth surface, gained pellicle plus saliva, and free sugars in the diet for dental biofilm to cause illness. Caries is a highly localised and intricate process that may arise on one part of a tooth surface but not another, even though both surfaces seem to be coated with biofilm. This is due to the different environmental conditions that exist at each tooth location. Tooth-related factors include tooth composition (such as imperfectly formed structure as in hypoplasias), tooth structure, pre- and post-eruptive fluoride exposure, and post-eruptive age, as well as tooth morphology, arch form, occlusion, and tooth position, all of which influence biofilm thickness and pathogenicity by producing areas of plaque stagnation (Pendrys DG, 2000). Increased acid solubility and loss of surface structure due to developmental abnormalities may lead to plaque stagnation sites and an increased risk of caries in primary teeth. Enamel hypoplasia is an example of a developmental disorder that causes enamel to become abnormally thin. A person's susceptibility to developing caries may be affected by factors such as the distance from the mouth's orifices to the teeth, as well as the thickness and velocity of the salivary film at various tooth sites. As a result of the stagnant zones they create, inadequate restorations and dental equipment (such as dentures and orthodontic appliances) may enhance the susceptibility to caries at some tooth locations.

2.5 CARIES LESION DETECTION

Dental caries may be diagnosed by first locating the affected area (caries lesion detection) and then determining if the disease is active, advancing slowly, or has halted altogether. Without this knowledge, a treatment choice cannot be made (Fontana et al., 2018). Visual and radiographic examinations are the standard methods of detection for dental cavities. We believe that new devices that detect early lesions can help monitor early stages of the disease process and, by extension, the effect of nonsurgical interventions over time, as opposed to simply beginning early surgical care. These devices use technologies that contrast areas of tooth mineral loss with healthy tooth structure. The American Dental Association (ADA) has developed a system for classifying caries lesions based on their activity, severity, and location (Young et al., 2015). Decisions about lesion treatment are enhanced by using this strategy, in our view. The need for therapy of lesions is determined by their level of activity (surgical or nonsurgical). As a real "cavity" development enables germs to penetrate the deeper layers of the tooth, its severity is a significant consideration when considering whether to surgically intervene with a restoration or filling. Occlusal (chewing) surfaces of teeth and spaces between teeth may make lesions hard to see, highlighting the significance of location. By stopping the progression of the caries lesion or permitting remineralization, successful caries prevention measures may help preserve tooth structure and reduce the need for future surgical operations. Clinical assessment of the risk of carrying a pregnancy to term and delivery Clinically, assessing a patient's susceptibility to developing new carious lesions or experiencing the progression of existing lesions is called caries risk assessment (CRA) (Fontana and Zero, 2006). Because dental caries is a chronic and multifaceted illness, it has far-reaching consequences for individuals, families, and communities. The caries risk assessment (CRA) considers disease indicators (such as caries experience), biological risk factors (such as nutrition, saliva, plaque, genetics), other risk factors (such as social capital and economic

variables), and preventive factors (such as dental hygiene, fluoride exposure) (Featherstone, 2003). Then, a caries risk profile (low, moderate, or high) is created based on these factors. Several of these risk factors not only affect the development of dental caries, but also have considerable implications on overall health and well-being (Fontana, 2015). Tools from the American Dental Association, the American Academy of Pediatrics, the American Academy of Pediatric Dentistry, and the California Dental Association are just a few examples of the many age-specific strategies and instruments that may be used for CRA (e.g., Cariogram). Even while a dentist's overall subjective assessment of a patient may predict caries risk relatively well, we believe that more precise, user-friendly, and proven CRA instruments are required (Disney et al., 1992). Since most studies have been conducted on young people, scientists have shown that multivariate CRA models are more accurate than those that utilise few or a single component. Prior caries experience remained one of the biggest predictors of future caries development in adults, and the integration of other risk factors does not seem to considerably boost the prediction, despite the lack of data to evaluate CRA models in this population at now (Twetman and Fontana, 2009). Tools for caries risk assessment (CRA) are increasingly important in modern caries care because they may provide the basis for individualised approaches to prevention, diagnosis, and treatment.

2.6 CARRY OVER MANAGEMENT

We believe that decisions regarding therapeutic nonsurgical or services must be based on caries lesion activity and the possibility that the lesion will involve a "cavity" that exposes the deeper levels of the tooth to bacteria after a thorough clinical and radiographic examination and evaluation of a patient's caries risk. Lesions caused by caries may not occur or may cease spreading via a process called "remineralization" if the risk of caries is reduced and the illness is well managed. The term "active surveillance" is used in the field of dentistry to describe methods by which mild caries lesions may be monitored while the patient and dentist choose

the best course of action for disease management. Patients at high risk of developing caries may benefit from using fluoride toothpaste at least twice daily, reducing their sugar diet, and/or taking more effective medicines. We understand that altering people's habits may not be easy. There has been some success and some failure with efforts to boost participation that focus on education and training at the local, household, and individual levels (Albina and Tiwari, 2016). Motivational interviewing, a nonjudgmental method that focuses on the individual's driving forces, is now widely used in a wide range of research settings. Dentists utilise a variety of methods to prevent caries lesions or to halt the advancement of early caries lesions on tooth fissures, including dental sealants, professional topical fluoride treatments, regular reassessments of caries risk, and appropriate follow-up, recare, and recall procedures.

2.7 DENTIFRICES

Dentifrices are products designed to be applied with a toothbrush. Dentifrices' two main goals are to remove stains from teeth and to leave the mouth feeling cool, fresh, and clean.

Fluoride toothpastes have been shown to be effective anticariogenic agents in several clinical studies, and they have been cited as a key contributor to the dramatic decline in caries prevalence in many industrialised countries (Jenkins GN, 2009). Around the world, dentifrices have gained widespread acceptance as the main means of delivering topical fluoride and achieving caries-preventive benefits. More than 95% of all dental goods

Table 1: U.S.P. Fluoride Dentifrice Reference Standards

Sodium Fluoride/Calcium
Sodium Fluoride/Silica
Pyrophosphate (high beta-phase) (discontinued)
Sodium Fluoride/Sodium Bicarbonate
Sodium Monofluorophosphate/Dicalcium Phosphate
Sodium Monofluorophosphate/Calcium Carbonate
Sodium Monofluorophosphate (1,500 ppm F)/Silica
Sodium Monofluorophosphate (1000 ppm F)/Silica
Stannous Fluoride/Silica

sold in the U.S. contain fluoride. Recent extensive quantitative study by Marinho et al. provides the best evidence for the efficacy of fluoride dentifrice (Cochrane Database of Systematic Reviews). In a meta-analysis of 70 studies evaluating the efficacy of fluoride dentifrice with placebo in preventing dental caries in children, the use of fluoride dentifrice was shown to have a caries-inhibiting impact on the permanent dentition (average decrease in DMFS of 24%). Furthermore, the efficacy of fluoride toothpaste may be maximised in those with more caries owing to the higher fluoride content, increased usage frequency, and monitoring of brushing. No correlation between prior exposure to fluoride and impact size was found. There was no mention of whether or not the use of fluoride toothpaste reduced the incidence of caries in baby teeth. Twetman et al. (2003) conducted a more extensive analysis, and they and the CDC's Fluoride Recommendations Work Group came to the same results (2001).

2.8 FLUORIDE DENTURE REGULATORY PROCEDURES

To prevent abuse, fluoride toothpastes sold in the United States must follow the same regulations as other OTC medicines. In its continuous examination of OTC pharmaceutical products, the Federal Drug Administration (FDA) published the final monograph "Anticaries Drug Products for Over-the-Counter Human Use" in the Federal Register (21 CFR Parts 310, 355, and 369) on October 6, 1995. In this research, the criteria for determining whether or not an over-the-counter malaria treatment is safe and effective were created. Before becoming legislation or the final rule, the document was subject to a year of public review and comment. The deadline for conforming to the monograph was then extended by a further year to provide the industry additional time to respond to the monograph and review their fluoride-containing dental care products. In order to get approval for a new medicine whose formulation deviates from the monograph's, the manufacturer must submit a New Drug Application (NDA), which must include the results of two clinical trials to evaluate the drug's efficacy and safety. In order to be considered equivalent to the relevant United States Pharmacopeia (USP.) fluoride reference standard (Table 1) for the animal caries test, all OTC fluoride dentifrice products must meet or exceed the soluble fluoride ion (F- and PO3F=) level specified in the anticaries monograph for each fluoride compound (Table 1). The Biological Testing Procedures for Fluoride Dentifrices is cited in the monograph for information on the approved testing procedures (Federal Register Docket No. 80N-0042). The Standard for Fluoride Dentifrices was written by the Proprietary Association Subgroup on Fluoride Dentifrices and published on March 11, 1978; it specifies Laboratory Testing Profiles for these products (LTPs). Several companies have taken advantage of the clause in the anti caries monograph that allows them to petition the FDA for clearance to undertake alternative testing employing intraoral appliance (IOA) models in order to satisfy the biological (animal testing) requirement. The Food and Drug Administration (FDA) has requested comments and information on IOA (in situ) models

as an alternative to the animal caries reduction test by January 14, 2002 (Federal Register/Vol. 66, No. 199). The Consumer Healthcare Products Association's Anticaries Task Group asked for a deadline extension to July 12, 2002.

The American Dental Association's Evaluation Program 2.11 Through its Acceptance Program, the American Dental Association gives dentists and consumers more confidence that fluoride dentifrice products are safe and effective. The American Dental Association (ADA) Acceptance Program receives several applications for fluoride dentifrice products each year; those that match the requirements are awarded the ADA Seal of Acceptance, a symbol of a dental product's trustworthiness and efficacy. There are presently 47 fluoride toothpastes from 12 manufacturers that have the ADA Seal. Since their implementation in May 1998, the current standards include clinical caries studies for novel dentifrice formulations that significantly alter their chemical makeup, for as by using a new fluoride source or abrasive mechanism. Dentifrices that are chemically identical to or similar to previously ADA-accepted products are required to provide data for total fluoride in fresh and aged samples, available fluoride in fresh and aged samples, the release rate of fluoride in one minute, and the bioavailability of fluoride in enamel. The ADA, like the FDA, allows for certain leeway in the ways tests must be conducted. The ADA standards are the same as the FDA rules with the following exceptions. The ADA does not require caries testing in rats, and the FDA does not need data on fluoride release beyond one minute. The FDA might surprise enterprises with regulatory audits to see whether they are following the antiticaries monograph without giving advance warning. All fluoride dentifrice products that apply for the ADA Seal are subjected to in-house laboratory testing to assess the amount of accessible fluoride and the amount of fluoride emitted within a minute.

2.9 IMPACT OF REGULATORY AND MARKET PLACE FORCES

There are a few things about today's market that aren't ideal for developing ground-breaking goods. To begin, the FDA can only ensure that OTC medical products are successful and safe in clinical trials, not that they are as successful as is physically feasible. Except in cases where a corporation makes false claims about a product's efficacy, the FDA usually doesn't care about differences in quality between competing products. Dentifrice producers in today's consumer-driven market are more interested in pursuing non-therapeutic aesthetic claims than in developing whole new product categories. Colgate Total, the first completely new formulation to obtain FDA approval, was just released. It was finally given the go light in 1996. Marketing gives a far bigger return on investment than research and development for new treatments, thus the focus has turned from anticancer efficacy to aesthetic claims. As discussed before, getting new products approved requires signing a nondisclosure agreement. The high price tag of conducting clinical caries studies over a period of two to three years has been a major roadblock in the development of novel fluoride dentifrice formulations. Costs have been linked to factors such as the need for a bigger sample size, participant accrual fees, more stringent regulatory and scientific criteria, and more expensive infrastructure. There is now a great deal of interest in the creation and validation of models that include the early diagnosis of non-cavitated lesions using optical and technical means, with the goal of decreasing the duration and expense of caries trials. Third, there is a time-dependent decline in the correlation between the anti caries monograph and real clinical efficacy. More than 25 years have passed since the completion of the clinical studies upon which the anti caries monograph is based. Current guidelines for the design and execution of randomised controlled trials (RCTs), as defined in the CONSORT (Consolidated Standards of Reporting Trials) declaration, would render many of this research invalid. Only three dentifrices on the market today, Colgate Total, Crest Cavity Protection Toothpaste, and Colgate Cavity Protection, have never been subjected to clinical caries testing.

Every other drug on the market now follows the FDA's product monograph. Manufacturers often adjust formulations to back up new advertising claims in response to fluctuating ingredient availability and costs. Dentifrice products have undergone the requisite in vitro and animal trials, so we may have some faith in them. However, we should be vigilant since true clinical proof of the advantages of fluoride treatments is becoming farther and further away. Numerous restrictions are placed on the kind of tests that must be conducted in accordance with the anti caries monograph. We now know that many LTPs' use of outmoded methodologies from the 1970s and earlier is not reflective of our knowledge of fluoride's mechanism of action. Most professionals in the area believe that fluoride's ability to stimulate remineralization is its primary mechanism of action. However, this process is not considered in the monograph testing standards. The enamel solubility reduction test is utilised as part of the marketing strategy for a variety of goods despite the fact that it is not generally considered as a trustworthy procedure. Certain procedures call for substances that are becoming hard to come by. Petitioning the government to make changes to established procedures or to institute new ones may be a time-consuming and resource-intensive endeavour. This hinders research towards developing cutting-edge testing methods. Most LTPs have not been subjected to the rigorous testing necessary to determine whether or not they exhibit the fluoride dosage response necessary for in situ demin/remin models. Prerequisites for doing statistical analysis are also not discussed. The FDA has recognised this issue and provided statistical methods in response to a request for information and opinions on the use of intraoral appliance models (mentioned above). Future laboratory procedures should focus on performance criteria rather than rigid cookbook methods in order to meet these problems. It is recommended that model systems demonstrate a dose response to fluoride (0, 250, 550, and 1100 ppm F), include internal controls for all tests (0, 250, and gold standard), have sufficient samples to achieve statistical power for

demonstrating equivalence, and employ a specified statistical methodology to establish equivalence ("as good as") with an appropriate clinical gold standard.

2.10 DENTIFRICE INGREDIENTS

It is now both an art and a science to formulate effective therapeutic fluoride dentifrices for current use. Active fluoride component, water, abrasive system, surfactants, binder, humectants, flavours, colourants and preservatives are the usual ingredients in fluoride dentifrice products. In the last 20 years, dentifrices have become increasingly used as a vehicle for the delivery of a wide variety of additives, including calculus inhibitory agents (tartar control), anti-plaque/anti-gingivitis representatives, tooth desensitisers, anti-oral malodor/breath fresheners, whitening/stain removal systems, and remineralizing agents. The author argues that the assertion that fluoride has anti caries effects should be prioritised since it is the only one that has been linked to a long-term health benefit. There is room for debate on this point of view. It has been known for quite some time that fluoride's efficacy in dentifrice formulations is highly dependent on how effectively it interacts with other substances. During the first clinical trials of fluoride dentifrice, as described by Bibby (1945), it became clear that NaF's incompatibility with the abrasive was reducing the formulation's efficiency (dicalcium phosphate). In 1954, Muhler et al. combined SnF2 with a calcium pyrophosphate abrasive activity to create the first dentifrice formulation that was clinically effective, which ultimately led to the launch of Crest in 1956. This original formulation, which was subsequently superseded by the modern NaF/silica combination, had a short shelf life due to the interaction between the fluoride component and the abrasive. The fluoride sources included in the FDAanticaries monograph are stannous fluoride (SnF2), sodium monofluorophosphate (Na2PO3F), and sodium fluoride (NaF) (Table 1). Due to the high stakes in the market, it is almost impossible to study the research on these agents and know with any degree of confidence how effective they are. Various studies have compared NaF to MPF, with

contrasting perspectives reaching essentially different conclusions. NaF seems to distribute fluoride in a manner that is most consistent with the present understanding of the mechanism of action of fluoride when included in a well-made dentifrice, however all three fluoride compounds have been demonstrated to be therapeutically beneficial. Dentifrices containing amine fluoride sold in Europe, despite their proven efficacy in clinical trials, are banned in the United States. Table 1 of the FDA's OTC anti caries monograph details the active components, including their concentration and dosage form. All currently available US dentifrices include a minimum of 1000 ppm fluoride, often in the forms of sodium fluoride (NaF) and mono fluorophosphate (MFP). Several clinical studies using various formulations, examiners, and participants have shown that the anticancer effects of MFP and NaF are enhanced with greater F concentrations. Extra Strength Aim, an MFP dentifrice with a greater concentration of 1500 ppm F, was approved by the FDA via the NDA procedure, but only under the condition that the labelling state "use toothpastes with a total fluorine content of 1,500 ppm. This extra-strength fluoride dentifrice may be beneficial for adults and children over the age of six who live in non-fluoridated areas or who are at a higher risk of acquiring cavities." No longer advertised or sold in the United States is a line of extra-strength over-the-counter (OTC) fluoride dentifrices. Most fluoride dentifrice products in Europe, where they are controlled by the European Union as cosmetics, contain 1,500 ppm F, which is worth noting. To prevent the build-up of natural stains that most people experience on their teeth, abrasive ingredients are utilised in toothpastes. Silica, sodium bicarbonate, dicalcium phosphate, calcium carbonate (chalk), and dicalcium phosphate were the most common abrasives in dentifrices. It's well knowledge that abrasives drastically alter the pace and extent of fluoride release. Since most people don't spend more than a minute brushing their teeth, the dentifrice's fluoride must be able to escape its packaging within that time limit for it to be clinically effective. Although the ADA calls for a specific test, the FDA's anti caries monograph uses biological test techniques

(reduction in rat caries and/or enamel solubility, fluoride absorption) to prove that fluoride is present. The effectiveness of fluoride may also be influenced by the other components included in dentifrice formulations. The most often used anionic surfactant in dentifrices is sodium lauryl sulphate, which has some antiplaque effect but may also reduce fluoride uptake by enamel. Overstimulating the salivary glands with highly flavoured dentifrice products might speed up the process by which fluoride is washed away from the mouth. Some research suggests that chemicals like pyrophosphate, which prevent calculi from developing, may also slow down the remineralization process. Research, largely based on in vitro and animal tests, disproves this concept by showing that adding pyrophosphate to a fluoride dentifrice does not interfere with the anti caries effects of fluoride. Despite the success of tartar control fluoride dentifrice in clinical caries research, there is no conclusive proof that these products are better than conventional fluoride dentifrice. Marketing claims provide an intriguing case against more frequent use of fluoride dentifrice solutions. Even if a dentifrice ingredient, such a whitening agent, diminishes the efficiency of a fluoride dentifrice compared to a standard dentifrice product, the desire to have whiter teeth may lead to increased frequency and length of tooth brushing, which may counterbalance a potentially negative impact. It would be fantastic if there were dentifrices on the market that were both very effective at avoiding caries and appealing to consumers.

2.11 FACTORS AFFECTING DENTIFRICE EFFECTIVENESS

The anti-caries effectiveness of a fluoride dentifrice may be affected by factors outside the product's inherent qualities. This interaction takes place during the "application" phase, when relatively high concentrations of fluoride first reach the tooth surface and plaque. This happens both before and after the "retention" phase (plaque and plaque fluid, the fluoride in the mouth after brushing that got retained in saliva, the tooth surface, and oral soft tissue reservoirs). The frequency of use, the length of time spent brushing, the method used to rinse after brushing,

the time of day used, and the quantity of dentifrice used are all behavioural drivers of dentifrice use. It is generally known that the effectiveness is greatly influenced by the frequency of use. An increased preventative impact may be achieved by bushing more often than twice daily. How long you brush affects how much of the comparatively high fluoride content in the dentifrice slurry is in contact with the teeth and plaque and is potentially absorbed (the application phase). The force that drives fluoride diffusion through plaque and onto the tooth surface is increased as fluoride concentration increases. Evidence suggests that rinse habits influence both the quantity of fluoride retained in the mouth after brushing and the occurrence of caries. Clearance rates of fluoride are affected by physiological (biological) parameters, particularly salivary flow rate, both during and after fluoridation. Since saliva production is drastically reduced when sleeping, using a fluoride dentifrice at night resulted in much more fluoride retention than using the product during the day. Fluoride added to toothbrushes is not as effective as the fluoride found in toothpaste (dose). Higher concentrations of fluoride in toothpaste are more effective than lesser quantities. Young children (those under the age of six) are particularly susceptible to developing enamel fluorosis from using toothpaste with too much fluoride. The reduction of fluoride treatments is thus preferable to the reduction of the dose of goods marketed toward children

2.13.1 Safety

Although there is much historical evidence that dentifrices are safe, there is ongoing worry about dental fluorosis in children younger than six. A recent study found that toddlers aged 1-3 years consumed between 30 and 75 percent of the dentifrice, whereas children aged 4-7 years consumed between 14 and 48 percent. To prevent overdosing, use the same safety measures you would with any other OTC medication. All fluoride dentifrice products must have the following warning, mandated by the FDA: "To minimise swallowing use a pea-size amount in children under six." It has been suggested that child-resistant lids be used on fluoride dentifrices

for kids. Alternatively, young children may be given metered dentifrice delivery systems that, depending on the child's weight, would dispense the proper quantity of fluoride for their teeth.

2.14 DENTIFRICES(FLUORIDE) AND PREVENTION OF DENTAL CARIES

Too much sugar in the diet and not enough fluoride in the water are the leading causes of tooth decay worldwide (WHO, 2010; 2015). The use of fluoride has greatly benefited public health. Extensive studies have demonstrated a positive reduction in dental cavities in numerous countries since the controlled addition of fluoride to drinking water supplies started in the 1940s in areas where the fluoride content is below the recommended limits to have a cariostatic effect. Switzerland was the first country to begin commercial production of fluoridated salt in 1955. With the same level of effectiveness as water fluoridation, its use rapidly spread to other nations and regions. Plans have been formed in nations all over the world that include milk fluoride with school health and nutrition initiatives due to its demonstrated usefulness in preventing dental cavities, particularly in youngsters (Jürgensen and Petersen, 2013). Since drinking fluoridated milk, salt, or water requires no user intervention, these products have been dubbed "automatic techniques" for preventing tooth decay. The high cost of toothpastes has hindered low-income communities from benefiting from this preventative approach, despite the fact that fluoride has been used in toothpaste for decades and is thought to play a major influence in the drop in dental cavities observed among individuals in industrialised nations. Products containing fluoride are now on the market for commercial use, joining previously available gels, varnishes, and repair supplies. Fluoride mouthwash has long been a part of school health programmes, despite its mixed track record of success in lowering cavity rates. The World Health Organization's position on fluoride for cavity prevention The World Health Organization (WHO) has supported widespread use of fluoride for cavity prevention since the late 1960s. World Health Assembly (WHA) Resolutions like WHA22.30 (1969), WHA28.64 (1975), and WHA31.50 (1978) emphasise the use of automatic fluoridation because of its

positive effects on oral health and the avoidance of dental cavities. The need of fluoridating public water supplies has been emphasised in the preceding comments. The WHO Oral Health Programs at the global and regional levels are supported by the most recent WHA resolution (WHA60.17, 2007). Treatment of oral health problems is emphasised as an important step in reducing the risk of developing chronic illnesses. The right use of fluoride is emphasised in the Resolution titled "Oral Health: Action Plan for Promotion and Integrated Disease Prevention," which requests that Member States guarantee their citizens get its benefits (Petersen, 2008b). Here's what the item says: Countries without access to optimal levels of fluoride and which have not yet established systematic fluoridation programmes should be encouraged to develop and implement such programmes, with a focus on equitable measures such as the automatic administration of fluoride, for example, in drinking water, salt, or milk, and the provision of affordably priced fluoride toothpaste. Some nations are introducing new fluoridation initiatives, while others are adjusting their current ones. The World Health Organization (WHO) is available to give technical assistance and guidance to Member States at the international and regional levels in order to facilitate the creation of appropriate fluoridation programmes that take into account sociocultural factors. In response to the WHA60.17, the World Health Organization (WHO) produced a report in 2010 titled "Inadequate or excess fluoride: a severe public health concern" (WHO, 2010). Keeping a modest level of fluoride in the oral cavity on a daily basis is the most effective way to prevent tooth decay. However, there are certain drawbacks to being exposed to too much fluoride. In spite of efforts to limit oral fluoride exposure, it seems that mild to severe enamel fluorosis is inevitable if fluoride-based caries prevention is to be successful. Thus, public health workers should work on reducing both caries and enamel fluorosis. Identifying fluoride exposure and informing health administrators about exposure is crucial before initiating any fluoridation or supplementation programmes for the prevention of dental caries (WHO, 2014). The World Health Organization (WHO) has

released Technical Report Series 846 (TRS846) titled "Fluorides and Oral Health" to provide guidance and technical assistance to nations (WHO, 1994). When creating fluoride programmes, public health officials and oral health programme directors often consult the TRS846. Researchers, universities, and dental professionals all make heavy use of the guide. In 1994, you could buy the first TRS846s. Implementing effective public health treatments and enhancing policy via the use of evidence has been more important during the last two decades. In addition to addressing a pressing need, this effort is also connected to the lack of up-to-date data on fluoride intake.

2.14.1 Evidence-based public health

For all its importance in clinical research, the Randomized Controlled Trial (RCT) is insufficient for evaluating the efficacy of public health programmes (Rychetnik et al., 2002). Since the causal chain from the agent to the outcome is generally short and straightforward, the RCT design may be applicable to assessing the efficacy of therapeutic interventions. Because of the complexity of the causal chains involved in public health initiatives, RCT data cannot be used to comprehensively evaluate the effectiveness and consequences of widespread efforts. Given the limitations of traditional research methods in community trials, which include groups of people in their natural environments, these non-experimental approaches may provide reliable and generalizable findings. To keep up with the growing body of data in their sector, health care practitioners, researchers, patients, and policymakers all need access to systematic reviews. Because of this, evaluations like this are crucial for proving that fluoride is useful.

2.14.2 Tooth Decay and Fluoride: A New Perspective

The most current edition of Community Dental Health includes a significant update to the research that backs fluoride's effectiveness in preventing tooth cavities. Fluoride's impacts on biology, medicine, and public health are studied in depth. This article primarily focuses on the following themes: environmental fluoride, fluoride metabolism and metabolite, fluoride in

teeth and bone, biochemical markers of fluoride exposure, attempts to reduce dental caries through fluoride intake, fluoridation of salt and milk, attempts to apply a fluoride topical application, and fluoride-containing toothpaste. The report highlights the efficacy and acceptability of various community fluoride administration types and explores the practical consequences of adopting combined fluoride administration based on the most current understanding of the evidence for public health. The purpose of this publication is to collect data on how much fluoride is used in different parts of the world. Such up-to-date information is essential for countries beginning fluoride programmes or modifying existing ones.

2.15 EMPIRICAL REVIEW

Several studies have looked at the correlation between the usage of oral dentifrices and the rate of caries in different parts of the globe. In 2010, Adeniyi, Abiola, Ogunbodede, Eyitope, Sonny, O, and Sofola, Oyinkansola investigated the incidence of dental caries and related oral hygiene behaviours among preschool-aged children in both rural and urban Nigeria. Mothers of 404 children between the ages of 18 months and 5 years were interviewed and their children's teeth were inspected to learn more about the children and their families. We drew our sample from the primary care clinics and hospitals in Lagos State where young children generally go to obtain their immunisations. Dental caries was observed in the sample population 10.9% of the time. Caries was more common in youngsters older than three than in younger ones. (p 0.001). Supervised tooth-cleaning by an adult ($p = 0.106$), kind of toothpaste used ($p = 0.657$), and number of times a day a kid brushes their teeth ($p = 0.774$) had no statistically significant effect on the prevalence of caries. Relationship between oral hygiene score and caries incidence was statistically significant (p 0.000). Though caries was uncommon among the study population, researchers found that factors such as a child's age and oral hygiene score contributed to the risk of cavities.

Akinyamoju CA, Dairo DM, Adeoye IA, and AO conducted a survey of students' oral health and hygiene practises in rural areas of Southwest Nigeria. This was a cross-sectional research, and it included 778 students from 12 different public elementary schools. Data on socioeconomic status and dental hygiene routines were collected using a semi-structured interviewer-administered questionnaire that had been pilot-tested beforehand. The degree of dental caries was quantified using the decayed, missing, and filled (DMFT) index, and the quality of oral hygiene was evaluated using the gingival and oral hygiene indices. Dental caries affected 12.2% of the children, who were on average 1.0 1.8 years old and had mean DMFT/dmFT of 0.2 0.7. Ten- to twelve-year-olds had a threefold increased risk of having caries on at least one tooth (P = 0.01, 95% CI = 1.3-6.7). Over a third of respondents (35.3% to be exact) turned to natural remedies to deal with tooth pain. The mean total scores for both oral hygiene and gingival health were 1.7 and 0.9, respectively.

One study by Obichi and Chibuzo is titled "Prevalence of Dental Caries among Female Adolescents in Umuahia Metropolis". Determining the frequency of dental caries among adolescent females was the major motivation for this research, which aimed to assess participants' awareness of and adherence to best practises in oral health. Umuahia's female high school seniors took part in the study. With the use of a multistage sampling method, 251 pupils were chosen. Self-administered questionnaires and dental examinations with mirrors and probes were also used to collect information. Microsoft Excel was used for both hand- and programmatically-generated data analysis. On average, respondents were 15.12 years old. Dental caries affected 62 people out of 251 respondents (24.7%). There were 94 teeth in all that were compromised. There was a DMF index of 1.52. There are 235 students who use fluoride toothpaste, or 93.6%, and 12 students who don't, or 4.8%. One hundred twenty-five individuals (49.8%) were found to often wipe their lips, whereas the remaining eighty people (32%) were only found to do so once a day. Eighty-six (34.6%) people have a sweet treat at

least once a day, and 148 (59.6%) have more than one. Dental caries may be affected by a number of factors, including the use of fluoride dentifrices, the intake of sugary foods, and the use of mouthwash. Teens need to be encouraged to adopt better oral hygiene habits since dental caries is so common.

Secondary schools in the Ihiala local government area of Anambra State took part in epidemiological research on dental caries. Eighty girls from Uli Girls Secondary School and sixty-four boys from Abbot Boys were among the 144 kids who were checked out. Each student completed a pre-test questionnaire measuring their familiarity with, and willingness to take action about, dental caries. Each pupil had a clinical examination to look for evidence of dental caries. From an examination of 144 pupils, we found that 45.8 percent had dental caries and 54.2 percent did not. For secondary schools, the frequency of dental caries ranged from 22 for Abbott Boys to 44 (55%) for Uli Girls. Female students outnumbered male pupils by a ratio of 55 to 44 (or 55%) and 34.4% to 36.2%. Of all age groups, those aged 16–18 had the greatest incidence (12, 54.5%), followed by those aged 10–12 (4, 18.2%). While decaying teeth were more common (4 out of 100) in secondary schools for Abbot boys and Uli girls, extractions were more common (12 out of 100), representing 54.5% of all cases of dental caries. Students at Ihiala's secondary schools have good access to dental care, according to the results of the survey. This emphasises the need of providing dental care and encouraging better hygiene practises for children living in remote areas. To determine the prevalence of dental fluorosis among secondary school students in the Oloibiri Community, Ephraim et al. (2016) carried out cross-sectional research of students enrolled in the Government Secondary School, Oloibiri between the ages of 11 and 19. (JSS 1 - SS 3). They were all sitting in chairs in direct sunshine before the fluorosis test, and none of the individuals had entirely dry teeth. After confirming the existence and severity of dental fluorosis, we assigned a grade using the Dean's index. Community fluorosis index and prevalence were determined. The prevalence of dental

fluorosis was high amongst our research population, with an oral incidence of 18% and a community fluorosis score of 0.42. Very moderate dental fluorosis (n = 12) was the most common kind. All research participants were found to have modest levels of dental caries at the time of examination. Fluorosis and tooth decay are not major threats to public health in the Oloibiri neighbourhood. Effectively conveying the public health goal of promoting excellent oral health for all individuals globally encourages increasing fluoride knowledge and educating the public about its usage.

Folayan et al. 2022 conducted the research to learn more about caries and gingivitis in children in Nigeria between the ages of 6 and 11. Ile-Ife, Nigeria was the site of a cross-sectional survey that relied on questionnaires. Gingivitis and dental caries were the study's dependent variables. Dental caries severity and history (of having caries or not) were evaluated using the dmft/DMFT index. To determine if gingivitis was present and, if so, how severe it was, researchers employed a tool called the gingival index. Preventive practises pertaining to oral health served as the independent variable (frequency of daily tooth brushing, frequency of consumption of refined carbohydrates in-between-meals, use of fluoridated toothpaste, and use of dental floss, history of dental service utilization). Many logistic regression analysis models were built, once confounders were considered, to establish the relationships between the dependent and independent variables (age, sex, and socioeconomic status).

There were 69 cases of caries (5.2% of the total) among the children. Standard deviation for the mean DMFT was 0.08, whereas the mean DMFT itself was 0.02. (0.457). (0.159). 839 (or 63.3% of the sample) of the kids had gingivitis, with a mean (SD) gingival index score of 0.503. (0.453). Children from middle-class families were less likely to develop moderate to severe gingivitis than children from lower-income families (AOR: 0.573; 95% CI: 0.330-0.994; p = 0.048). However, no dental caries risk signs were identified.

Ingle et al. set out in 2014 to determine how common dental caries were among students aged 12 to 15 attending public and private schools in the city of Bharatpur. A total of 1400 pupils from both public and private schools took part in this cross-sectional analysis. The sample was selected using a straightforward random sampling method. Participants' teeth were checked for cavities using a 1997 WHO evaluation form. Dental caries prevalence was measured using both the Frequency Index and the Significant Caries Index.

A statistically significant increase in dental caries was seen between the ages of 5 and 19 among students attending government schools (53%) compared to those attending private schools (47%). On average, pupils attending public schools had 7.61 more decaying, missing, or filled teeth than those attending private schools (2.86). (4.76 2.42).

During the years 2016-2019, students in the Bau District of Kuching, Sarawak's Form 2 secondary school were surveyed by Chia et alstudies. to determine the prevalence of dental caries and the subsequent need for treatment. Students in Form 2 at secondary schools run by the Ministry of Education (MOE) between the years 2016 and 2019 participated in this cross-sectional research. The Health Records and Information Network were mined for information (HIMS). When reporting cases of dental caries, the WHO recommends using the DMFT index. Dental caries prevalence declined from 67.0% (2016) to 60.1% (2018) across four separate cohorts of Form 2 students over a four-year period. (2019). The average number of cavities per patient's teeth (mean DMFT) also fell from 2.56 in 2016 to 1.82 in 2019. Based on the mean number of decaying teeth, the demand for dental caries treatment decreased from 0.88 in 2016 to 0.45 in 2017. (mean D). (2019).

The Harish & Bhavani study from 2022, titled "Prevalence of dental caries among government elementary school kids," used a sample size of 200 students to assess the prevalence of dental caries in this population. The DMFT/DMFS indices were calculated to be 76 (38.0%), with mean DMFT scores of 2.222.402 and mean DMFS scores of 5.467.242. Children's DMFT

scores range from 2.22 to 2.4 on a gender scale. Dental caries was most common among children aged 10 (48.8%, mean dmft 2.27), then those aged 6 (37.0%, mean dmft 2.3), then those aged 8 (31.4%, mean dmft 2.26) and lastly those aged 9 (27.9%, mean dmft 2.49). (mean dmft 2.15). To better the oral health of students in public elementary schools, it is crucial to shift from restorative dental care to preventative dental services.

Schoolchildren's oral hygiene and the prevalence of dental caries were investigated in 2013 by Thippeswamy et al. in Sullia Taluk, Karnataka, South India. There were a total of 1800 pupils included in the study's sample. Two thousand youngsters comprised each age bracket. A survey was conducted to learn about people's dental hygiene routines. The prevalence of dental caries was measured using dft/DMFT, per WHO guidelines from 1997. Results: In 33.6% of patients examined, dental caries was found to be pervasive in Sulliataluk. The prevalence of dental caries was greatest among children ages 5 to 12, and then again among adolescents ages 12 to 15 (37.0%). It has been shown that toothbrushes are responsible for 32.6% of all dental caries and fingers for 42.8%. The p-value for this result was 0.05. (P0.05). The prevalence of caries was lower among children who used toothpaste (30.5%) and who cleaned their teeth twice daily (10.6%). In comparison to rural regions (33.3%) and vegetarian diet groups (32.9%), the incidence of dental caries was found to be somewhat higher in urban settings (34.2%) and mixed diet groups (34.9%). The prevalence of tooth decay was highest in the permanent dentition but was widespread across age groups. The majority of the people in the research needed just a single surface repaired.

The purpose of Chi and Tham's research in 2020 at Tan Binh Secondary School in Hai Duong city was to assess the prevalence of dental caries and gingivitis. Tan Binh Secondary School in Hai Duong Province had 390 teenagers take part in a cross-sectional survey between September 2014 and June 2015. Based on World Health Organization standards, cases of tooth decay and gum disease were recorded. SMT index was 1.03 and dental caries was diagnosed in 63.3% of

patients (tooth decay, fractured tooth, dental filling). Caries in the teeth were more common among adolescents aged 14 and 15 than among those aged 12 and 13 (OR: 2,7; 95%CI: 1,7-4,2). Forty-eight percent of people had some kind of gingivitis, with 1.8% having severe instances and 34.6% having moderate forms. As a result, it's safe to say that dental caries and gingivitis are quite common among school-aged children. Appropriate lessons stressing dental capacity development and school-family partnerships are needed to bolster the school's dental education programme.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter's goal is to describe the procedures followed for this investigation. Research design, study population, sample size and sampling techniques, instruments, instrument validation, instrument administration, and data processing techniques are among the processes.

3.1 RESEARCH DESIGN

The study design adopted for this research work is descriptive cross-sectional study design. It is a design that can be used to study a phenomenon at one time to gather information or data from several groups at the same time. This design also collects data using questionnaire. According to Charan and Biswas (2013), Therefore, the cross-sectional design is appropriate for this study as it deals with healthcare professionals or providers from different category of health facility.

3.2 AREA OF STUDY

The study on the use of dentifrice and occurrence of dental caries among secondary school children in Nembe, Bayelsa State was carried out in two selected secondary schools due to the population, out of the seven secondary schools of which three government owns and four privates' schools. Nembe National Grammar School (NNGS) and Community Girls Secondary Schools (CGSS) in Nembe City, Bayelsa State.

The Nembe City is a traditional state in Niger Delta. Nembe city is geographical with 40 32', 60 24" N latitude and 40 22", 60 01" E longitudinal points, at Nembe Local Government Area of Bayelsa State, Nigeria. It has an Area of 760km2 and a population of 130,931 at the 2006 census.

Source: National Population Commission of Nigeria (web). National Bureau of Statistics (web).

The postal code of the Area is 562102. Much of the Area of the Local Government Area is occupied by water at the Edumanon national forest.

It lies along the opposite community called Bassanbiri, and serves as host community.

Nembe community has about seven primary health care facilities (Comprehensive Health Centre (PHC) with one cottage hospitals and one general hospital. It is a rural community whose original occupants are peasant fishing, palm oil milling, trading, business and public servants, the young adults of the community are not left out in the aquatic practice.

Nembe is a major oil and gas producing Area of about 155 oil wells and 4 major flow stations along the creek of the Niger Delta, contributing over 30% of Nigerian oil production. Nembe has a heavy rainfall record with a short period of dry season that last from November to March. Nambe people are mostly endorsed with the practice of Christianity and traditional worshipper which was left by their forefather to them. Christianity is the basic religion practiced, and they speak the Ijaw (Nembe) language.

Development seems to have met with Nembe city due to influx of government and its affiliate foreigners, for accommodation.

This has encouraged investors to both living, dwelling with the people of that land. Most of the inhabitant of this community are young both indigenes and foreigners of all ages.

This was a choice community for this study because it contains lots of people of the age interest for the study and also has necessary features that can fuel risky health behaviours among young adults.

3.3 STUDY POPULATION

The total number of registered students at Nembe National Grammar School and Community Secondary School (NNS and CGSS), in Nembe, Bayelsa state, was 2770 .A sample size of 350 respondents were selected of which a total of 235 students from Nembe National Grammar School and 115 students from Nembe Community Girls Secondary School.

The study population consisted of children within the age range of 8–21 years which was recruited from two secondary schools in Nembe metropolis. The minimum age for study participation was fixed at age 8 years so as to ensure appropriate responses for each of the items in the study questionnaire could be generated. Informed consent for study participation was sought from the school principal.

3.4 METHODS OF DATA COLLECTION

To learn more about their personal characteristics and oral hygiene routines, a well-structured questionnaire was used to extract data from the respondents which was administered by a Dentist. The dentist examined their mouths while the subjects sat comfortably on plastic chairs. The examination was performed in an area with enough natural light by three dental professionals using a standard mouth mirror and a blunt probe (CPITN periodontal probe). Multiple clinical assessments were used as the foundation for calculating intra- and inter-examiner reliability.

Participants' caries experience was evaluated using the DMFT/dmft index, which measures dental caries prevalence. Caries prevalence is measured by determining how many teeth have been lost, filled, or deteriorated as a result of caries using diagnostic criteria established by the World Health Organization. The DMFT/dmft value is calculated by adding the three numbers obtained. Carious lesions were defined as those located in a pit or fissure, on a smooth tooth surface, and characterised by a weakening wall or floor. The term "filled without decay" is used

to describe teeth that have had permanent fillings placed and are devoid of cavities in the surrounding regions, even those with primary caries. Failure to remove carious teeth has been linked to missed extractions. The DMFT demonstrates the higher frequency of caries in the permanent dentition compared to the deciduous dentition.

3.4.1 Sampling Size Determination

The sample size for this study was computed from the following formula;

n = $\frac{N}{1+N(e)^2}$ (Taro Yamane)

Where;

n = sample size, N = population size in each class, e = margin of error (0.05).

For the purpose of this study, 350 students were selected from the two schools.

Therefore, from the above formula the sample size is 350 respondents where N = 2770 and margin of error = 0.05.

Therefore;

n = $\frac{2770}{1+2770(0.05)^2}$

n = $\frac{2770}{1+2770\ X\ 0.0025}$

= 349.52

$n \cong 350$

Sample size of 350 was used in this study.

3.4.2 Sampling Methods.

The sampling method employed in this study was Stratified random sampling technique which was used to select 350 students, 235 students from Community Government Secondary School (CGSS), and 115 students are from Nembe National Grammar School (NNGS).

In each class, simple random sampling techniques was used to select 70 students from Junior Secondary School (JSS 2, 3, and Senior Secondary School 1, 2 and 3). With an average of about 35 students in each class (30-35 students in each stream).

INSTRUMENTS OF DATA COLLECTION

The study adopted the use of questionnaire for the assessment of preventive oral self-care on secondary school students. Questionnaires were self-administered and had fixed responses. A team of two trained Dental nurses' researchers administer the questionnaire in each of the classrooms where students were recruited. The researchers served as guide to the pupils and answered any clarifying questions: they went through the questionnaire with the class and gave expounded explanations for each of the five questions and their options.

The questions asked for specific information on frequency of tooth brushing, use of dental floss, consumption of sugar-containing snacks or drinks between main meals, and time of last dental check-up. Researchers provided specific guide on the use of fluoride dentifrice containing toothpaste by highlighting the various types of fluoride and non-fluoride containing toothpastes in the market. Where alternatives to toothpastes were used for tooth cleansing, respondents were asked to tick the option that reflected.

The purpose of the study and issues of confidentiality were highlighted on each questionnaire. Instructions on how to complete the questionnaires were also clearly stated. Pupils were asked to refrain from recording their names on the questionnaire for reasons of confidentiality. They were however asked to indicate their sex (male or female) and age. The questionnaire requested information on respondents' oral health behaviour. The questionnaire assessed: (Appendix 1).

1. **Oral Self-Care**: Recommended oral self-care was defined as a composite score derived from indications of brushing teeth at more than once a day, use of fluoridated toothpaste, and consumption of sugary snacks between main meals less frequently than once a day.

   Each respondent needs to have met the three criteria to be categorised as practicing recommended oral self-care

2. **Tooth-brushing**: Respondents were also asked to indicate the frequency of tooth brushing using the following alternatives – irregularly or never, once a week, a few (2–3) times a week; once a day, and more than once a day. Respondents who chose the options 'irregularly or never, once a week, a few (2–3) times a week; once a day' were classified as not having undertaken preventive dental care.

3. **Use of fluoridated toothpaste**: Respondents were also asked to indicate the frequency of use of fluoridated toothpaste when tooth brushing using the following alternatives – Always, quite often, seldom, not at all. Respondents who chose the options 'quite often, seldom, not at all' were classified as not having undertaken preventive dental care.

4. **Use of tooth sticks**: Respondents were also asked to indicate how often tooth pick was used for to clean the teeth using the following alternatives – Not at all, occasionally, a few (2–3) times a week, once in a day, more than one time in a day. Respondents, who chose the options 'Not at all, occasionally, a few (2–3) times a week', were classified as not having undertaken preventive dental care.

5. **Dental service utilization**: Respondents were also asked to indicate the time of the last check-up using the following alternatives - within the last 6 months, more than 6 months to one year ago, more than 1 to 2 years ago, more than 2 to 5 years ago, more than 5 years, never, do not remember. Attending a dental check-up within the last year was defined as preventive care use. Respondents who chose the options 'more than 1 to 2 years ago, more

than 2 to 5 years ago, more than 5 years, never, do not remember' were classified as not having undertaken preventive dental care.

3.6 VALIDITY / RELIABITY OF INSTRUMENT

The design and construction of the questions asked was intended to provide a reflection of the phenomenon being studied. The supervisor read through the questionnaire to make sure it was clear, and then 5% of the study's sample size was pretested. The researcher effected all the necessary corrections and approved as adequate, before final distribution to respondents.

Intra examiner reliability was assessed using Pearson chi square correlation which was 0.90 suggesting an excellent agreement.

3.7 DATA ANALYSIS METHODS

Data collected from the distributed questionnaires were analysed using the Statistical product for service solution (SPSS) version 27. statistical Methods such as frequency distribution tables, percentage and mean were employed. as well as the Pearson chi square technique were used to analyse the data and the established connections between the study questions and the patterns of responses. The value of <0.05 was used as the threshold for statistical significance.

3.8 LIMITATION OF THE STUDY

Since the participants of the study were students of a selected secondary schools in Nembe Bayelsa State, the generalization of the results to student populations from different cultural and ethnic background was made with caution. However, the study findings provided useful information for adolescents with similar demographic characteristics. The research design was a cross sectional survey, which is an economical and relatively easy to conduct design to obtain some information on several issues of the oral health of the population. The main disadvantages of this design are its inability to attribute causality, that is, whether an exposure precedes or follows an outcome and those data were collected only at one point in time, rather than

longitudinally. The use of a questionnaire made it difficult to access the reliability of oral health variables in the survey because of recall bias, especially in the area of practice of oral health. The issue of nonresponse bias also occurred, especially as far as 6 students from the mixed schools (NNGS) are concerned because they were not familiar with some of the terms that were presented in the given questionnaire, although an explanation was given prior to and during the study.

3.9 ETHICS AND INFORMED CONSENT

Every research subject must provide their informed consent. Participant names are replaced with codes as personal identifiers, privacy and secrecy are guaranteed, and data is kept on a computer that is only accessible by the lead investigator. Written permission forms were supplied by the Department of Public Health, School of Health Technology, Federal University of Technology Owerri, duly signed by the Head of Department which was then approved by the principal and administrative workforce of the schools under investigations (Appendix B). The students informed consent was also considered before copies of the questionnaires were administered.

CHAPTER FOUR

DATA ANALYSIS, RESULT AND DISCUSSION

4.1 INTRODUCTION

The presentation and analysis of the survey results are covered in this chapter. The information was presented in the order that the research questions had structured the data. The demographic data of the respondents were analysed using sample percentage, and the study hypothesis was tested using Pearson correlation.

Table 4.1, The table expresses the respondents' socio-demographic variables in frequencies and percentages. The ages in the distribution were grouped into the brackets of 8-12, 13-16, and 17 years and above; among the age brackets, 13 – 16 years constituted 154(44%) and had the largest proportion, followed by 8-12 constituted 137(39.1%), 17 years and above constituted 59(16.9%).

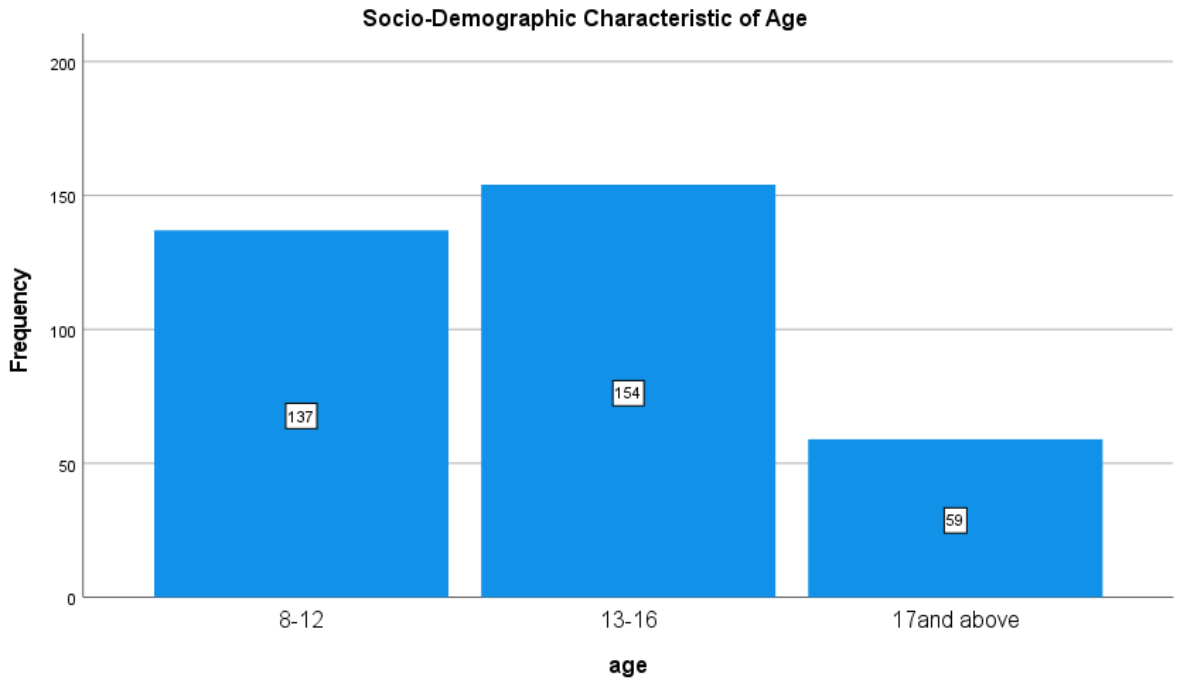
4.2 Results

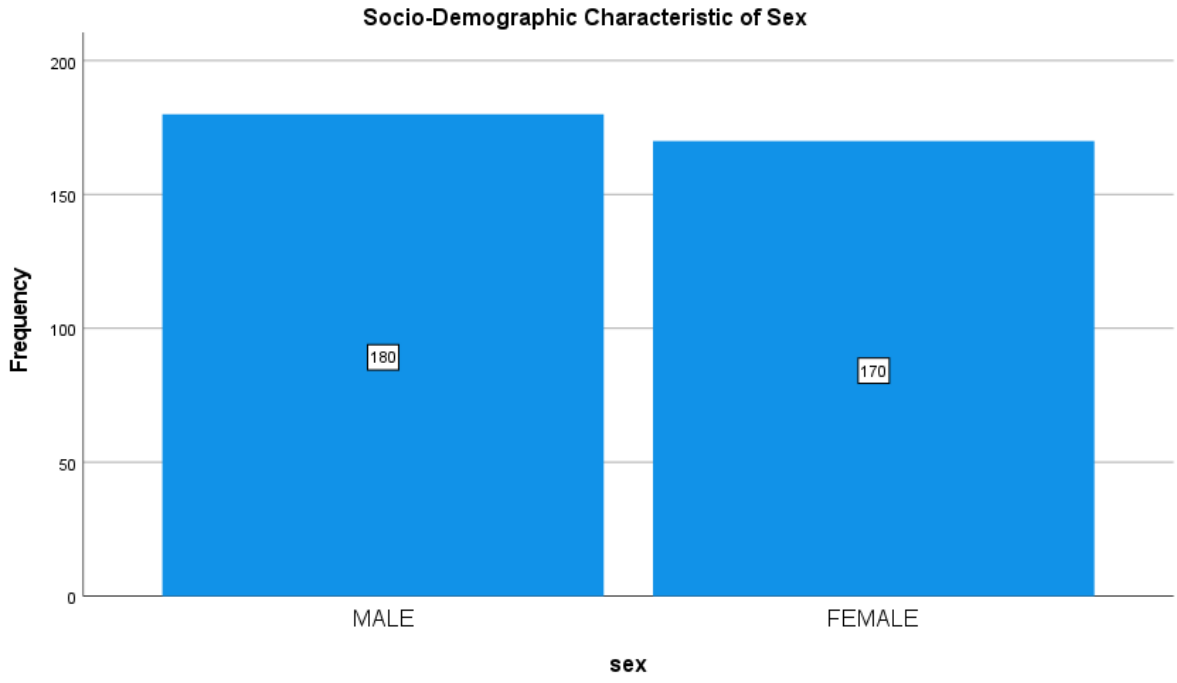
Section 1: Socio-Demographic Characteristic of Respondents

Table 4.1 Shows the Distribution of respondents by socio-demographic variables

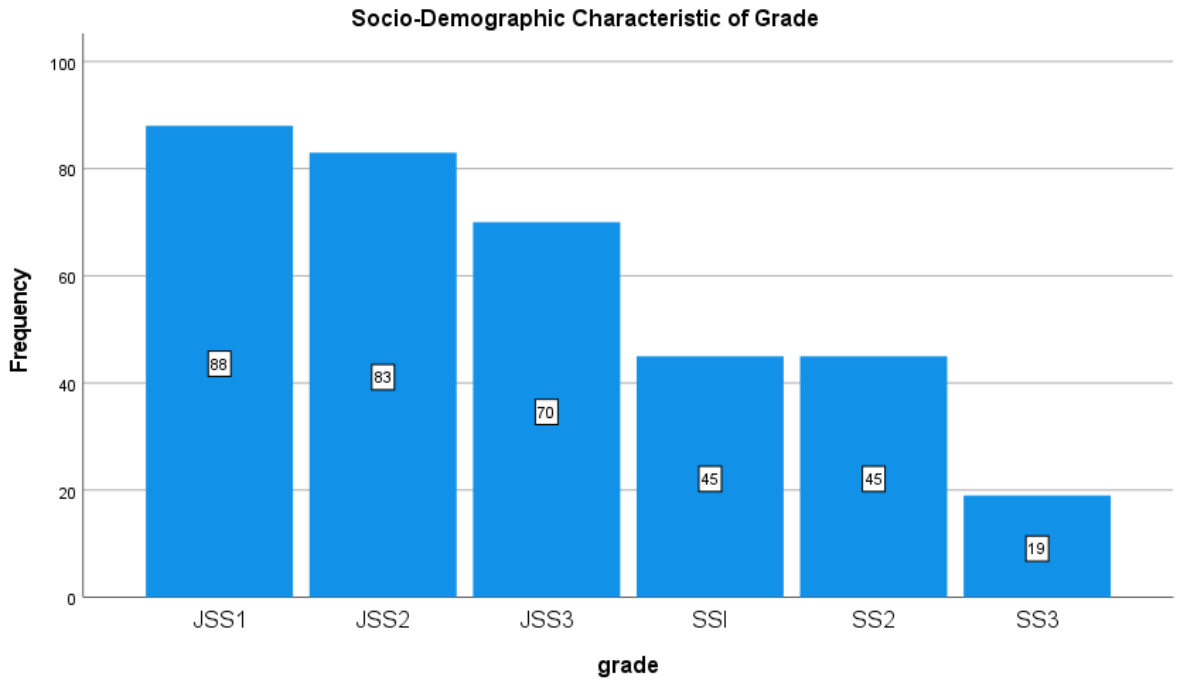
Socio-Demographic Variables	Frequency = 350	Percentage = 100
Age		
8–12	137	39.1
13–16	154	44.0
17– And above	59	16.9
Gender		
Male	180	51.4
Female	170	48.6
Grade		
JSS1	88	25.1
JSS2	83	23.7
JSS3	70	20.0
SS1	45	12.9
SS2	45	12.9
SS3	19	5.4

Source: SPSS version 27, output extraction 2024





In the gender-based distributions, 170(48.6%) of the respondents were female while 180(51.4%) of the respondents were male.



However, in the Grade ranking, students in JSS1 constitute the largest proportion of 88(65%) followed by JSS2 83(17%), followed by JSS3 which constitute 70(9%), followed by SS1 45 and SS2 45(6%) and the least in the Grade range is SS3 which constitute 19(4%). This indicates that majority respondents in the sample were Junior Secondary Student as at the time of this study.

SECTION 2: PATTERN OF USE OF ORAL DENTIFRICE

Table 4.2. shows the Frequency and Percentages of Children with Various Patterns of use of oral dentifrices among secondary school children in Nembe, Bayelsa State.

Response	Number of respondents (N = 350), n(%)	Statistical Test (X^2)	p-value
Teeth Cleaning Patterns.			
Tooth Sticks	20(5.7%)		
Tooth Brush without Paste	49(14.0%)		
Tooth Brush with Paste	253(72.3%)		
Charcoal	8(2.3%)		
Rinse with Water	20(5.7%)	611.057	<0.000
Total	350(100%)		
Cleaning Teeth			
Yes	229(65.4%)		
No	32(9.1%)		
Sometimes	89(25.4%)		
Total	350(100%)		
Time of Teeth Cleaning			
Before Meal	201(57.4%)	176.166	<0.000
After Meal	62(17.7%)		
Before and After Meal	37(10.6%)		
No Fixed time	50(14.3%)		
Total	350(100%)	199.874	<0.000

Source: SPSS version 27, output extraction 2024

SECTION 3: RATE OF OCCURRENCE OF DENTAL CARE

Table 4.3. shows the rate of occurrence of dental cares (Oral Hygiene) among secondary school children in Nembe, Bayelsa State.

	N= 350				
Variables	**Frequency Distribution (%)**			**Statistical Test**	**p-value**
Types of hygiene, duration and timing	**Yes**	**No**	**Sometimes**	**(X^2)**	
I always use a toothbrush and toothpaste	253(72.3%)	32(9.1%)	65(18.6%)	243.64	<0.000
I always store my toothbrush in the bathroom other than someplace.	256(73.1%)	49(14%)	45(12.9%)	249.674	
I always visit the dentist every six months	95(27.1%)	182(52%)	73(20.9%)	56.95	<0.001
I always brush my teeth twice daily	169(48.3%)	120(34.3%)	61(17.4%)	50.13	<0.001
I always brush after meal in the morning	201(57.4%)	93(26.6%)	56(16.0%)	97.31	<0.001

Source: SPSS version 27, output extraction 2024

SECTION 3: EFFECT ON THE USE OF DENTIFRICE ON DENTAL CARE OCCURRENCE

Table 4.4 Shows effect on the use of dentifrice on the occurrence of dental cares (Oral Hygiene) among secondary school children in Nembe, Bayelsa State.

	N= 350				
Variables	**Use of Dentifrice**			**Statistical Test**	**p-value**
Dental Care	**yes**	**No**	**Sometimes**	**(X^2)**	
I always brush my teeth twice daily	169(48.3%)	120(34.3%)	61(17.4%)	226.03	<0.001
I always brush before meal in the morning	201(57.4%)	93(26.6%)	56(16.0%)	334.82	<0.001
I always visit the dentist every six months	182(52%)	95(27.1%)	73(20.9%)	89.06	<0.001
I always store my toothbrush in the bathroom other than someplace.	256(73.1%)	49(14.0%)	45(12.9%)	473.600	<0.001

Source: SPSS version 27, output extraction 2024

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 DISCUSSION OF FINDINGS

A total of 350 Secondary School Children participated in the study. Of these, 170 (48.6%) were female and 180(51.4%) were male. The majority of respondents (44.0%) were from 13 to 16 years of age. More than half of the study participants were from the Junior Secondary School 68.8% (Table 4.1).

Table 4.2 Results addresses research Question 1 and Objective 1: What is the pattern of the use of oral dentifrices among secondary school children in Nembe, Bayelsa State, it also shows that respondent that uses dentifrice on dental care occurrence have a hight proportion of 72.3% which has led to a high proportion of respondents with cleaned teeth (65%) and a moderate respond of the students visiting a dentist. The results showed a level of statistically significant on the effects of the use of dentifrice on dental care occurrence among the respondent ($P<0.001$).

The Study reveals that 253 (72.3%) of the respondents maintain the use of toothbrush with paste while 49(14.0%) of the respondent uses toothbrush without paste and 20(5.7%) of the respondent uses water to rinse the mouth, this can be due lack of time management in the early hours before school time, 20(5.7%) uses tooth sticks and 8(2,3%) of the respondents uses charcoal. The studies of (Wondemagegn et al., 2014) shows that children use more of dentifrice with toothbrush than any other pattern of oral hygiene (more of toothbrush with paste. This study also shows a significant level ($X2 = 611.057$, $P<0.001$) on the pattern of use of oral dentifrice among secondary school students in Nembe LGA.

This study also observed a high performance of respondents on the duration and timing of oral dentifrice use in the study environment. A majority of the respondents perform or carry out teeth brushing before taken their meal 201(57.4%) while 62(17.7%) carry out teeth brushing after taken their meal. 50(14.3%) of the students have to fixed time of oral hygiene and 37(10.6%) carry out teeth brushing before and after meal. This study also shows a significant level (X^2 = 199.87, P<0.000) timing and duration of on the pattern of use of oral dentifrice among secondary school students in Nembe LGA. Table 4.2

Table 4.3 Results addresses research Question 2 and Objective 2: What is the rate of occurrence of dental caries among secondary school children in Nembe, Bayelsa state?

The results show a high proportion of respondents with dental care occurrence on the use of toothbrush and paste of 253(72.3%), 256(73.1%) of respondent who also maintained a proper way of keep their toothbrushes, also the respondent showed a moderate rate of brushing teeth twice daily (169(48.3%) and 201(57.4%) respondents who always brush after meal in the morning. The results showed a level of statistically significant on the above-mentioned rate of occurrence on dental care among the respondent (X^2 =243.64, P<0.000, X^2 =50.13, P<0.001, X^2 =97.31, P<0.001). research conducted by Chi & Tham (2020). Titled "Situation of dental caries and gingivitis among school children in Tan Binh Secondary School in Hai Duong city" also showed similar results of my research findings. Ephraim-Emmanuel et al, (2016). Showed similar finds in confirmation of this studies, in their research titled "Prevalence of Dental Fluorosis among Secondary School Children in Oloibiri Community".

This study reported that 253(72.3%) of the respondent cleaned their teeth using toothbrush and paste for maintaining dental care (oral hygiene) shown in Table 4.2 and Table 4.3. In contrast, other studies showed that tooth sticks, rinse with water were the most common means of maintaining oral hygiene (Joshi et al., 2005, Ayele et al. 2013). In this study, a moderate proportion of the students 182(52%) had never visited a dentist. Similar finding was reported

in Ethiopia Ayele et al. 2023, Nepal (Dexit et al. 2013) and Sirilanka (Perpera et al. 2013). Table 4.3

5.2 CONCLUSION

Dental caries is a common public health problem in school children associated with poor oral hygiene, dietary and poor dental visit habits. Therefore, prevention measures such as health education on oral hygiene, dietary habits and importance of dental visit are obligatory for children. The Level of utilization of dental care and the use of dentifrice should be kept standard in a way the school oral health programs should be implemented in other to promote oral health awareness and encourage routine dental check-up among these students.

5.3 RECOMMENDATION

Adequate knowledge of the way an individual utilizes health care services and factors predicating the behaviour help to improve health outcomes. Oral health, an essential and integral part of the overall heath and quality of the life across the life span needs to be closely monitored for appropriate advice and early treatment where necessary. This study was able to highlight that the use of dentifrices containing toothpaste was wide spread among the study the population. However, the practice of twice daily tooth brushing and use of dental floss were low. The study was carried out with three hundred and fifty (350) participants in total from two secondary schools. A total of one hundred and fifteen (115) and two hundred and thirty-five (235) from Community Secondary School Nembe and Nembe National Grammar School Nembe, respectively. from among the population of two thousand seven hundred and seventy (2770) registered students in all, 350 students were selected from the two schools as sample size using Taro Yamane formular. This study revealed 51.4% of the respondents' males while 48.6% are female in the study. Most of the respondents in the study were within the age brackets of 13 to 16 years as was reported from both schools. The study revealed a high

proportion of dental caries occurrence and patterns in the use of dentifrice among the respondents.

This study also reveals that there is a high proportion on the usage of dentifrice, rate of occurrence of dental care and effects on the use of dentifrice on the occurrence of dental caries among the Secondary school students in Nembe LGA of Bayelsa state.

Therefore, the analysis suggests the following

• To prevent oral diseases, general education on good oral health should be conducted and taught in high schools.

• The business on sales of dental products requires assistance in creating incentives to encourage the development of more efficient products that meet both the requirements and desires of customers.

• Activities that promote oral health, such as using fluoride-containing toothpaste and brushes, teaching and reinforcing proper brushing techniques and frequency, displaying the removal of a plague using revealing agents, and reducing the availability of sugar-free (tooth-friendly) sweets, should be encouraged and reinforced.

• Demonstrating proper technique for brushing and cleaning teeth, the cultural practise of brushing teeth at least once a day by the professionals may be used to promote oral health.

• Additionally, it's important to teach the youngsters how to avoid oral health issues like bleeding gums at home. This will boost their commitment to maintaining proper oral hygiene, which will reduce the incidence of dental problems.

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APPENDIX A

QUESTIONNAIRE ON USE OF DENTIFRICES AND OCCURRENCE OF DENTAL CARIES AMONG SCHOOL CHILDREN IN NEMBE, BAYELSA STATE

S/N	DEMOGRAPHICS	RESPONSE PATTERN					
1	Gender	Male	Female				
2	Age range	8-12	13-15	16-18	19-21		
3	Class in school	JSS1	JSS2	JSS3	SS1	SS2	SS3

1	Have you used a tooth paste before?	Yes	No
2	Have you used a tooth powder before?	Yes	No
3	Have you used a mouth wash before?	Yes	No

S/N	QUESTION ITEM	Sometime	no	yes
	Process and ideals	[ ]	[ ]	[ ]
4	I always make sure that my angle of brushing is always at 45°	[ ]	[ ]	[ ]
5	While brushing, I move the brush back and forth using short, tooth-wide strokes	[ ]	[ ]	[ ]

6	I always start with the outer surfaces of my teeth	[ ]	[ ]	[ ]
7	I always brush against my gumline	[ ]	[ ]	[ ]
8	I always brush the inner surface of my teeth	[ ]	[ ]	[ ]
9	I always clean the chewing surfaces of my teeth	[ ]	[ ]	[ ]
10	I always brush your tongue	[ ]	[ ]	[ ]
11	I always only spit out any excess toothpaste after brushing	[ ]	[ ]	[ ]
12	I don't always rinse my mouth immediately after brushing	[ ]	[ ]	[ ]
13	I don’t always use mouthwash straight after brushing my teeth	[ ]	[ ]	[ ]
14	I always choose a different time to use mouthwash, such as after lunch	[ ]	[ ]	[ ]
15	I always don't eat or drink for 30 minutes after using a fluoride mouthwash	[ ]	[ ]	[ ]
16	I always floss before brushing your teeth.	[ ]	[ ]	[ ]
	Duration and timing	[ ]	[ ]	[ ]
17	I always brush my teeth for about 2 minutes at any given instance	[ ]	[ ]	[ ]
18	I always brush my teeth the last thing before I go to bed every day	[ ]	[ ]	[ ]
	Types and hygiene	[ ]	[ ]	[ ]
19	I always use a toothbrush with a small head and a compact, angled arrangement of long and short round-end bristles	[ ]	[ ]	[ ]
20	I always use a toothpaste that contains at least 1,350 parts per million (ppm) fluoride	[ ]	[ ]	[ ]
21	1 always use my toothbrush for only three months	[ ]	[ ]	[ ]

22	I always store my toothbrush someplace other than your bathroom	[ ]	[ ]	[ ]

APPENDIX B

LETTER OF INTRODUCTION

Federal University of Technology Owerri,

School of Health Technology,

Department of Public Health

7th July, 2018.

Dear Sir/Madam,

USE OF DENTIFRICES AND OCCURRENCE OF DENTAL CARIES AMONG SCHOOL CHILDREN IN NEMBE, BAYELSA STATE

I am a postgraduate student at the Federal University of Technology, Owerri.

I wish to request you to allow me to use some of your students in your school in a study that will form part of my degree work. The study involves filling out a questionnaire and only the students who present will participate in the study. There will be no material gain upon participation in the study and the results will be used for research purposes only and no invasive procedure will be undertaken on the students. Your permit and their participation will be highly appreciated.

Thanks.

WILFRED IDUBAMO

```
FREQUENCIES VARIABLES=age sex grade use_of_oral_dentifrice TIme_of_Cleaning
Teeth_cleaning q1 q2 q3
    q4 q5
  /BARCHART FREQ
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		18-MAR-2024 20:47:05
Comments		
Input	Data	C:\Users\GESI-TECH\OneDrive\Desktop\RESEARCH WORK\research questions.sav
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	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	350
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=age sex grade use_of_oral_dentifrice TIme_of_Cleaning Teeth_cleaning q1 q2 q3 q4 q5 /BARCHART FREQ /ORDER=ANALYSIS.
Resources	Processor Time	00:00:02.11
	Elapsed Time	00:00:02.40

Statistics

	Age	sex	grade	Teeth Cleaning Patterns	Time of Teeth Cleaning	Teetj Cleaning

N	Valid	350	350	350	350	350	350
	Missing	0	0	0	0	0	0

Frequency Table

sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MALE	180	51.4	51.4	51.4
	FEMALE	170	48.6	48.6	100.0
	Total	350	100.0	100.0	

grade

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	JSS1	88	25.1	25.1	25.1
	JSS2	83	23.7	23.7	48.9
	JSS3	70	20.0	20.0	68.9
	SSI	45	12.9	12.9	81.7
	SS2	45	12.9	12.9	94.6
	SS3	19	5.4	5.4	100.0
	Total	350	100.0	100.0	

Teeth Cleaning Patterns

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	tooth sticks	20	5.7	5.7	5.7
	Tooth Brush without paste	49	14.0	14.0	19.7
	Tooth brush with Paste	253	72.3	72.3	92.0
	Charcoal	8	2.3	2.3	94.3
	Rinse with Water	20	5.7	5.7	100.0
	Total	350	100.0	100.0	

Time of Teeth Cleaning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Before Meal	201	57.4	57.4	57.4
	After Meal	62	17.7	17.7	75.1
	Before and After Meal	37	10.6	10.6	85.7
	No fixed time	50	14.3	14.3	100.0
	Total	350	100.0	100.0	

Teetj Cleaning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	229	65.4	65.4	65.4
	No	32	9.1	9.1	74.6
	Sometime	89	25.4	25.4	100.0
	Total	350	100.0	100.0	

I always use a toothbrush and toothpaste

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	253	72.3	72.3	72.3
	No	32	9.1	9.1	81.4
	Sometime	65	18.6	18.6	100.0
	Total	350	100.0	100.0	

I always store my toothbrush in the bathroom other than someplace.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	256	73.1	73.1	73.1
	No	49	14.0	14.0	87.1
	Sometime	45	12.9	12.9	100.0
	Total	350	100.0	100.0	

I always visit the dentist every six months

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	No	182	52.0	52.0	52.0
	Yes	95	27.1	27.1	79.1
	Sometimes	73	20.9	20.9	100.0
	Total	350	100.0	100.0	

i always brush my teeth twice daily

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	169	48.3	48.3	48.3
	No	120	34.3	34.3	82.6
	Sometime	61	17.4	17.4	100.0
	Total	350	100.0	100.0	

I always brush my before meal in the morning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	201	57.4	57.4	57.4
	No	93	26.6	26.6	84.0
	Sometime	56	16.0	16.0	100.0
	Total	350	100.0	100.0	

Bar Chart

A**PPENDIX C**

LETTER OF CONSENT FROM PRINCIPAL OF SCHOOL

I do hereby freely consent to allow the above student to carry out the study in my school. The procedure has been explained to me and I understand that no harm will be caused to the participants and there will be no material gain from the study. Also, any participating student can withdraw participation at any time without any harm. I am informed and understand that all the information gathered from the students will be treated with utmost confidentiality.

Signed…… Date……..

PRINCIPAL