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Oral Health Knowledge, Attitudes, and Practices Among Secondary School Students in Nigeria

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2014

Abstract

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

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Abstract

Secondary school students in Nigeria face challenges regarding their oral health. Few researchers have investigated oral health knowledge, attitudes, and behaviors in Nigerian populations. The purpose of this study was to assess the level of oral health knowledge, behaviors, and practices among secondary school students in Enugu State, Nigeria, in relation to their oral health status. The theoretical framework of this study was based on the health belief model. A cross-sectional study was conducted to collect data from 12 secondary schools in Enugu State, using a close-ended questionnaire as well as oral examination (dental caries and periodontal diseases) of the students who attended junior secondary (JSS) I, II, and III classes. A total stratified sample of 671 students was included in the study. Bivariate nonparametric tests and logistic regression were used to analyze the data. According to the results of the study, the levels of dental caries and periodontal diseases were relatively low. However, only one fourth of the students had received professional fluoridation, and almost 50% of the participants had never visited a dentist. Students from a missionary school had lower levels of periodontal diseases than those from public schools, with an odds ratio of 0.612 (95% CI [0.402, 0.934]). Students from JSS III class tended to have a lower level of periodontal diseases than those of JSS I class (OR: 0.567, 95% CI [0.363, 0.886]). The social change implications of this study can be the development and incorporation of oral health promotion programs into the school curriculum. These programs may increase the adoption of preventive oral health strategies by students, such as regular dental attendance, to maintain their good oral health for a life time.

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Dedication

This dissertation is dedicated to God Almighty for His grace and mercies over me, and to my parents Mr. Sule Peter Omale and Mrs. Ashamawo Juliana Omale for the sacrifices they made for their children and for their continual support for me.

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Chapter 1: Introduction to the Study

Introduction

The mouth is the major gateway to the body; whatever affects oral health may also affect general health (Nyamuryekung'e, 2012). Oral health can be defined as a

> Being free of chronic mouth and facial pain, oral and throat cancer, oral sores, birth defects such as cleft lip and palate, periodontal (gum) disease, tooth decay and tooth loss and other diseases and disorders that affect the mouth and oral cavity. (World Health Organization [WHO], 2009, p. 1)

The oral tissue forms an integral part of every human being and is extremely vulnerable to disease as it is in an intimate relationship with the external environment, and it is also subjected to mechanical, chemical, and bacterial interactions (Dilip, 2005). According to Petersen (2004), oral diseases may be considered a public health problem due to their high prevalence and significant social impact. Singh et al. (2012) explained that the most common oral health issues across the world are tooth decay, periodontal disease, and halitosis.

There are various environmental and life style factors such as nutritional status, tobacco smoking, alcohol, poor oral hygiene, stress, and systemic conditions linked to the oral diseases (Sheiham & Watt, 2000). Singh et al. (2012) explained that a lot of people suffer from poor oral health without being aware of their situation; therefore, chewing and digestion of food as well as quality of life are negatively affected. Singh et al. further reported that the oral health care of an individual depends on his or her oral health

attitude and behavior, which reflect one's experiences, cultural perception, familial beliefs, and other life style situations.

Oral health is an essential aspect of general health, as such, oral health knowledge is considered to be an essential prerequisite for health related practices (Carneiro, Kabulwa, Makyao, Mrosso, & Choum, 2011). Carneiro et al. (2011) also explained that there is an association between increased knowledge and better oral health because people who assimilate oral health knowledge most probably have a sense of personal control over their oral health, and they are more likely to adopt self-care practice. According to Symth et al. (2007), there is strong evidence between oral health knowledge and better oral health practice by giving adequate information, motivation, and practice of oral health measures to individuals. Cheah, Tay, Chai, Lagmanul, and Zhuleikha (2000) also explained that people with more positive attitudes towards their oral health are influenced by better knowledge in taking care of their teeth.

The aim of this study was to assess the level of oral health knowledge, behavior, attitudes, and practices of students in Enugu State, Nigeria, in relation to their oral health status. Social change may be promoted in such a way that schools will be encouraged to inculcate oral health education in the existing school curriculum in order to improve the level of awareness among students. The Federal Dental School in Enugu State will be encouraged to carry out regular oral health education in schools and communities to sensitize people on the need to maintain good oral health, and students will also benefit from free dental check-ups and oral health education.

Detailed information on the background of the study, the research problem, the nature of the study, the research questions and aims of the study, and the significance of the study, mostly focusing on possible social change emerging from the study, is included in this chapter.

Background

According to the WHO General Assembly (2009), there is need to develop a "mechanism to provide coverage of the population with essential oral health care and to promote the availability of oral health services that should be directed towards diseases prevention and health promotion for poor and disadvantage countries" (Petersen, 2009, p.120). The development and implementation of preventive programs is necessary to introduce healthy lifestyle and self-care practices, especially for the children of these countries (Petersen, 2008, 2009).

Several studies have already been conducted in developing countries to assess oral health knowledge, attitudes, and behaviors of secondary school students for determining their individual or collective alertness to the existence and prevention of oral diseases and for taking the necessary steps to obtain appropriate treatment for oral diseases such as dental caries and periodontal diseases (Sofola, 2010). Carneiro et al. (2011) studied the oral health knowledge and practices of secondary school students in Tanzania showed that the majority of students (84%) had an adequate level of knowledge on oral health but had a low level of oral health practices. It was concluded that the high level of oral health knowledge among the students was because oral health education has

been part of the primary school curriculum in Tanzania since 1982, and it was implemented by teachers at primary schools (Carneiro et al., 2011).

Lian et al. (2010) conducted a similar study among secondary school students in Kuching, Sarawak. According to their results, only 43.5% of the students had a high level of oral health awareness. Although the students had a positive attitude towards dental services, dental attendance was low, mostly due to a fear of needles and hand pieces; their knowledge about oral diseases was also poor (Lian et al., 2010).

Humagain (2011) performed a descriptive cross sectional study evaluating the knowledge, attitude, and practice (KAP) about oral health among secondary school level students of rural Nepal. The result showed that only 35.1% of the study participants actually had knowledge of oral hygiene, and only 20% reported that they were regular dental attendees for check-ups. Humagain concluded that the oral health knowledge, attitudes, and practice of the students was poor..

Mehta and Kaur (2012) assessed the oral health related knowledge and practices among 12-year-old school children studying in rural areas of Punchkula, India. A low level of knowledge and practices among the children was observed, as only 25% of the participants cleaned their mouth more than once a day; 45.5% of the children had some problem with their teeth and/or gums, and only 35.9% visited the dentist for treatment (Mehta & Kaur, 2012). Ogundele and Ogunsile (2008) carried out a cross sectional survey among adolescents in Oyo State, Nigeria, to assess their dental health knowledge, attitude, and practice on the occurrence of dental caries, and a low level of dental health knowledge was found. Ogundele and Ogunsile observed that secondary school students

and adolescents in Nigeria regularly consumed sugary foods and drinks, which are widely identified as risk factors for dental caries.

There are no data about oral health knowledge, attitudes, and practices in Enugu State, Nigeria, and there is a lack of researchers who investigated this particular topic regarding most of the states in Nigeria. I aimed to provide baseline national data regarding this specific age group that will be compared to the only available correspondent data provided by Ogundele and Ogunsile (2008) in Oyo state and Sa'adu, Musa, Abu-Saeed, and Abu-Saeed (2012) in Ilorin, Kwara State, Nigeria.

Problem Statement

Good oral health behavior and attitude plays a fundamental role for general wellbeing by preventing common oral diseases, such as dental caries and periodontal diseases. This behavior/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 (Enugu 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 oral health knowledge, attitudes, and behaviors among students in Nigeria demonstrates poor results on the topic; thus, there was a literature gap that this research intended to fill.

Purpose of the Study

A quantitative cross sectional survey design was used to collect data from secondary school students in Enugu State, Nigeria. Data collection included the administration of a self-structured close-ended questionnaire as well as an oral examination of the participants. The purpose of the study was to assess the level of oral disease knowledge and oral health behaviors and attitudes of the students in relation to their oral health status. The dependent variable was the oral health status of the students (recorded with specific indices; please see the next section for more details), while the independent variables were the level of oral disease knowledge as well as oral health behaviors and attitudes of the students. Additionally, demographic variables were examined as moderating variables.

Research Questions and Hypotheses

Descriptive Questions

RQ 1: What is the oral health status (dental caries and periodontal diseases) of secondary school students in Enugu State, Nigeria?

RQ 2: What is the level of knowledge on the causes and preventive measures of oral diseases among secondary school students in Enugu State?

RQ 3: What are the behaviors/attitudes (e.g., frequency and reason of dental visit, brushing and flossing frequency, consumption of food with sugar content) of secondary school students in Enugu State towards dental health?

Inferential Question

RQ4: What are the relationships between demographic variables (age, gender, class, and type of institution), level of oral health knowledge, as well as oral health behavior and attitudes of secondary school students in Enugu State and their oral health status?

$H1_0$: There is no significant relationship between demographic variables (age, gender, class, and type of institution) and students' oral health status, as measured by the survey instrument located in Appendix A (Section A), which I developed.

$H1_a$: There is a significant relationship between demographic variables (age, gender, class, and type of institution) and students' oral health status, as measured by the survey instrument located in Appendix A (Section A), which I developed.

$H2_0$: There is no significant relationship between the students' level of oral health knowledge and students' oral health status, as measured by the survey instrument located in Appendix A (Section B), which I developed.

$H2_a$: There is a significant relationship between the students' level of oral health knowledge and students' oral health status, as measured by the survey instrument located in Appendix A (Section B), which I developed.

$H3_0$: There is no significant relationship between the students' oral health behavior and attitudes and their oral health status, as measured by the survey instrument located in Appendix A (Sections C, D), which I developed.

$H3_a$: There is a significant relationship between the students' oral health behavior and attitudes and their oral health status, as measured by the survey instrument located in Appendix A (Sections C, D), which I developed.

Theoretical Framework for the Study

The theoretical background for this study was drawn from the health belief model (HBM). This is the most widely used psychological approach to explain health related behaviors in response to diagnosed illness, particularly compliance with a medical regimen (Stretcher & Rosenstock, 1997). The HBM demonstrates how individuals weigh up the advantages and disadvantages of health behavior before taking action (Stokes, Ashcroft, & Platt, 2006).

The HBM was developed in the 1950s by social psychologists Hockbaum, Rosenstock, and Kegels working in the U.S Public Health Services (Rosenstock, 1974). The model was adapted to explore a variety of long term and short term health behaviors; it focuses on the attitudes and beliefs of individuals (Rosenstock, 1974).The core assumption of the HBM is based on the understanding that a person will take a health related action if that person feels that a negative health condition can be avoided or has a positive expectation that by taking a recommended action, he or she will avoid a negative health condition (Rosenstock, 1974).

The HBM is one of the most frequently used tools in health seeking behavior research. A link between this model and the research topic is that it will be used to interpret the obtained information on what is known, believed, and done in relation to oral health as far as the population under study is concerned (Haq et al., 2012). This

model is usually used to seek how far individual and community knowledge corresponds with a biomedical concept (Haq et al., 2012), and more analysis is provided in Chapter 2.

Peoples' reported knowledge that deviates from biomedical concepts is usually termed as a belief (Haq et al., 2012); attitude was defined by Allport (1954) as a learned disposition to think and act in a specific way toward an object. As such, attitude is a product of a complex interaction of belief, feelings, and values (Haq et al., 2012). Practices in KAP surveys usually inquire about the use of preventive measures or different health care options; this is because prevention against any disease is proportional to KAP of the population (Haq et al., 2012).

Nature of the Study

The research design that was adopted is a quantitative cross sectional survey design. The study identified and described the extent of knowledge, behavior, and attitudes of students in Enugu State, in relation to oral health status. Twelve secondary schools were involved in the study out of over 35 secondary schools in Enugu East L. G. A. A stratified random sampling technique was used in selecting the schools because the schools were divided into the strata of public schools, private schools, and missionary/faith-based schools; four schools were drawn from each stratum. Sixty students were selected from each school through a stratified sampling technique by dividing the classes into strata of junior secondary school (J.S.S.) I, II, and III, respectively.

The instrument for data collection included a dental examination of the participants and a close-ended questionnaire. The self-structured, closed-ended

questionnaire was administered to the participants in the classrooms; the questionnaire contained questions such as demographic profile, oral health knowledge and attitudes, self-care practices, and utilization of dental services. The questionnaire was divided into four sections: Section A–demographic profiles of participants, Section B–information on health knowledge, Section C–questions related to dental health attitudes, and Section D–information on practices toward dental health. The instrument was administered with the help of three dental therapists working at the Federal School of Dental Technology and Therapy.

Oral epidemiological data were collected by clinical examinations in the various schools. The Decay Missing and Filled Teeth Index (DMFT; WHO, 1987) and the Periodontal Disease Index (PDI; Ramfjord, 1967) were adopted in determining dental caries and periodontal disease prevalence among the participants. All examiners were trained and calibrated accordingly (WHO standards), prior to the data collection.

The data were analyzed using the Statistical Package for Social Science (SPSS) for Windows version 21.0 to determine possible relationships between the dependent and independent variables. The dependent variable was the oral health status of the students (as measured with the use of DMFT and PD index), while the independent variables were the demographic variables, level of oral disease knowledge, and oral health behaviors and attitudes of the students.

Definitions

Attitude: This is a relatively enduring organization of belief around an object, subject, or concept, which predisposes one to respond in some preferential manner (Shardra, & Shetty, 2008).

Cross-sectional design: These are studies carried out at one point or over a short period of time. They are usually conducted to estimate the prevalence of the outcome of interest in a given population, commonly for the purpose of public health planning (Levin, 2006).

Curriculum: This term is used to refer to the existing contact between society, the state, and educational professionals with regard to the educational experiences that learners should undergo during a certain phase of their lives. The curriculum defines why, what, when, where, how, and with whom to learn (Braslavskey, 1999).

Decayed, missing, filled teeth (DMFT): This is an index used to describe the prevalence of dental caries in an individual (WHO, 1987).

Demographic variables: For the present study, these include age and gender of students, class, and type of institution.

Dental plaque: The sticky colorless film of bacteria that forms on the teeth. It makes teeth "feel fuzzy" to the tongue and is most noticeable when teeth are not brushed (Web MD, 2013).

Health education: Any combination of learning experiences designed to help individuals and communities improve their health by increasing their knowledge or influencing their attitude (WHO, 2013).

Knowledge: This is defined as the expertise and skills acquired by a person through experience or education with the ability to use it for a particular purpose (Sharda, & Shetty, 2008).

Oral practice: This is an activity undertaken by people in order to protect, promote, or maintain oral health and prevent dental diseases. The practices include tooth brushing and sugar consumption practice among others (Taiwo, Ibiyemi, & Bankole, 2012).

Oral health status: For the present study, oral health status will be assessed with a clinical examination of the students, using two indices, DMFT for dental caries and PDI for periodontal diseases (see the detailed definitions of these indices in this section and Appendix B).

Oral hygiene: This is the practice of keeping the mouth clean to prevent oral diseases and bad breath (Akpata, 2004).

Periodontal disease index (PDI): An index for estimating the degree of periodontal disease based on the measurement of six representative teeth for gingival inflammation, pocket depth, calculus and plaque, attrition, mobility, and lack of contact (Ramfjord, 1967).

Risk factor: Any attitude characteristic or exposure of an individual that increases the likelihood of developing a disease or injury (WHO, 2013).

Secondary school: A school that is intermediate in level between elementary school and college that usually offers general, technical, vocational, or college preparatory curricula (The Free Dictionary, 2013).

Assumptions

It is assumed that children with higher socioeconomic status (SES) who attend private schools also have a higher level of knowledge regarding oral health than students with low SES who attend public schools. It is also assumed that female students have higher oral health knowledge and practice better oral hygiene than the male students, while according to Ogundele and Ogunsile (2008), females normally display more positive dental health attitudes and practices than their male counterparts.

This assumption was attributed to the fact that children who attend private and missionary/faith-based schools in Nigeria are widely considered to receive a more qualitative education than their counterparts attending public schools, even though oral health education is not inculcated into the existing school curriculum in Nigeria. Most private schools also benefit from community oral health education because most private schools can afford and organize community health programs for their students (Akpata, 2004).

Scope and Delimitations

Enugu State is in southeastern Nigeria. It is inhibited mostly by the Igbo tribe. Though there are immigrants from other ethnic groups such as the Hausas, Yorubas, and other minority groups in the country, the Igbos are the dominant tribe in the state. The students' population in the Enugu East local government area is dominated by the Igbos. Some of the schools may not have students from other ethnic groups in Nigeria. The state is rural-urban in nature and is less rich compared to the Nigeria mean GDP; the state was

ranked 25 out of the 36 states (Nigerian Watch, 2013). The commonest occupations of the people include civil service and trading.

The study was confined to 12 secondary schools (four private, four missionary/faith-based, and four public schools) in the Enugu East local government area of Enugu state, Nigeria. Approximately 60 students were selected from each school. The study participants were in the JSS cadre, that is, I, II, and III respectively. Twenty students were selected from each of the three classes.

Limitations

Since the participants of the study were students of a specific State in Nigeria, the generalization of the results to student populations from different cultural and ethnic background was made with caution. However, the study findings may provide useful information for adolescents with similar demographic characteristics, especially for those who live in developing countries.

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 a population (Nyamuryekung'e, 2012). The main disadvantages of this design are its inability to attribute causality, that is, whether an exposure precedes or follows an outcome (Nyamuryekung'e, 2012), 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 attitudes and practice of oral health. The issue of nonresponse bias also occurred, especially as far as

students from the public schools 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.

Significance

The study had a significant impact since I investigated and revealed students' level of knowledge of oral health attitudes and behaviors in relation to their oral health status. Findings of the study will serve as national baseline data for the Enugu state Ministry of Health and Enugu state Ministry of Education, for policy making in the area of inculcating oral health education into the existing school curriculum and for assessing the need for regular school visits by dental professionals. The results may also help the Enugu state Ministry of Health and dental schools in the state to organize schools/community oral health education programs in all the local government areas in Enugu state; this will provide students access to oral health information and free dental check-ups, and thus the significant goal of social change will be accomplished.

Summary

The mouth is the major gateway to the body; as such, whatever affects oral health also affects general health. The practice of keeping the mouth clean to prevent common oral health diseases is necessary, especially in children who live in developing countries (Sa'adu et al., 2012). Children should adopt a healthy life style, such as regular tooth brushing and flossing, preventive measures like fluoridation, and sealants, healthy nutrition, and regular visits to dentist. Because there are no data about oral health

knowledge, behaviors, attitudes, and practice among students in Enugu state Nigeria, there was a literature gap that this study will fill.

To facilitate this study, a detailed literature review follows (Chapter 2), mostly focusing on other topics such as the concept of health and oral health, common oral diseases and their etiology, oral health education and its dissemination in secondary schools, various oral hygiene practices among secondary school students, policy guidelines for oral health care in Nigeria, and oral health quality of life and the use of oral health care services among students in Nigeria. In Chapter 3, the methodology, sampling strategy and instruments which were used in the study will be described. Finally, in Chapters 4 and 5, results and conclusion of the study will be discussed.

Chapter 2: Literature Review

Introduction

The purpose of the study was to assess the level of oral disease knowledge and oral health behaviors and attitudes of secondary school students, in relation to their oral health status. The study adopted a quantitative cross sectional survey design to collect primary data from selected secondary school students in Enugu State, Nigeria. Data collection included the administration of a self-structure close-ended questionnaire as well as an oral examination of the participants.

Oral health is an essential aspect of general health, as such, appropriate oral health attitudes and behavior are considered to be an essential pre-requisite for health related practices (Carneiro et al., 2011). In order to prevent common oral diseases, specific measures such as regular tooth brushing and flossing, fluoridation, sealants, healthy nutritional habits and regular dental attendance must be promoted and encouraged (Sa'adu et al., 2012).

Ogundele and Ogunsile (2008) reported that secondary school students and adolescents in Nigeria face challenges regarding their oral heath, because of the daily high consumption of sugary foods and drinks and because of poor oral hygiene, which predispose them to dental caries and periodontal disease. According to Sofola (2010), chronic periodontal disease was found highly prevalent among Nigerians, right from the 1960 to date; over 75% of Nigerian suffers from periodontal diseases, due to poor oral hygiene. Akpata (2004) reported that deep periodontal pockets occur in a relatively high proportion among young adolescents in Nigeria; the prevalence increases with age, being

51-58% in children aged above 15years. Singh (2012) also reported that dental caries constitute one of the major oral health problems among young children and adolescents in Nigeria, aged 12 and 15 years old, while its prevalence ranges between 30 and 45%, respectively.

The negative impacts of poor oral heath described by Petersen (2004) include pain and suffering, functional impairment, and reduced quality of life. Petersen explained further that the level of awareness on the negative effects of poor oral health among students in Nigeria is low. A review of literature on the oral heath knowledge, attitudes and behaviors among students in Nigeria demonstrates poor results on the topic, thus, there was a literature gap which this study intends to fill.

The literature was reviewed under the following su-headings: The concept of health and oral health, common oral diseases and their etiology, oral health education and it dissemination in secondary schools, various oral hygiene practices among secondary school students, policy guidelines for oral health care in Nigeria and oral health quality of life, and the use of oral health care services among students in Nigeria.

Literature Search Strategy

The accessed library databases and research engines used for the literature are:

1. Health Science Databases such as CINAHL Plus with full text; Medline with full text and PubMed.
2. ProQuest Dissertations and Theses Database.
3. Google Scholar.

Each of the articles/paper chosen for the study was selected based on the use of key terms that were directly related to the topic. The key terms used were *oral health and Nigeria, dental caries and Nigeria, health knowledge, periodontal diseases and Nigeria, quality of life, oral health attitude and behavior, adolescents, and secondary students*. This method yielded more results from Google scholar. CINAHL Plus with Full Text, yielded 23 results for oral health in Nigeria, but only three articles were relevant to the study. But when the search for peer-reviewed articles was extended beyond Nigeria, there were more articles in oral health, but not on oral health knowledge, attitudes and practice of secondary school students. The majority of the articles gotten were from 2003 to 2013, with the exception of few articles that were written in the 1960s. Most of the articles were within the 10years of research period.

The Concept of Health and Oral Health

The word *health* was derived from the old English word *hoelth*, which meant a state of being sound (Ustun & Jakob, 2005). Several definitions of health are available, but the most commonly quoted definition is the one adopted by the World Health Organization, over half a century ago, "complete state of physical, mental and social wellbeing, and not merely the absence of disease or infirmity" (WHO, 1948). On the other hand, Bhatia (n.d.) explained that this first definition of health is not very accurate, while health is an elusive word, and people who consider themselves healthy may have some disease, and many people who are suffering from some known disease, may be relatively healthy. Bhatia further explained that health is a holistic concept, this is because health is a concept which does not merely relate to the absence of disease of

healthy organs, or having good thoughts; but health is a tri-une of three parts: emotional health, mental health, and physical health which cannot be separated from each other.

In humans, mouth is the major gateway to the body, thus, whatever affects the mouth (oral cavity) also affects the general health. WHO (2013), defined oral health as "a state of being free from chronic mouth and facial pain, oral and throat cancer, oral sores, birth defects such as cleft lip and palate, periodontal (gum) disease, tooth decay and tooth loss, and other diseases and disorders that affect the oral cavity". Dilip (2005) explained that the oral tissues are vulnerable to disease because of their intimate relationship with external environment, and they are also subject to mechanical, chemical and bacteria interaction. Dilip concluded that whatever affects the oral cavity will also affect the general health. As such, the oral cavity must be always healthy in order to prevent the occurrence of common oral diseases such as caries and periodontal disease.

Common Oral Diseases and Their Etiology

The most common oral diseases are dental caries and periodontal diseases (Akpata, 2004). According to Okoye and Ekwueme (2011), dental caries is a complex chronic oral disease and it is the most prevalent chronic disease of childhood. Sa'adu et al. (2012) explained that caries is five times more common than asthma, and seven times more common than hay fever.

Dental caries is defined "as a localized, post-eruptive, pathological process of external origin involving softening of the hard tooth tissue and preceding to the formation of a cavity" (WHO Technical Report Series, 1962). Dental caries proceeds from a microscopic lesion, which cannot be positively diagnosed by present chemical methods,

to a cavity which can be diagnosed by a clinical examination (WHO Technical Report Series, 1962).

Caries is very common among children worldwide and it develops when bacteria stick to the surface of the tooth, forming plaque. When a person eats food containing simple sugar, the bacteria use this sugar for their own metabolic needs and produce acid as by-products; the acid demineralizes the enamel surface of the tooth, forming a cavity (Levin, 2007). Caries in Nigeria varies between very low in rural areas to moderate in urban communities. The prevalence of the disease appears to be on the increase more in the urban communities more than the rural area (Akpata, 2004). Factors that increase an individual's risk of dental caries include: eating sweet and sticky food and drink, poor oral hygiene, tobacco, smoking, and dry mouth due to low level of saliva in their mouth (NHS Choices, n.d.). Levin (2007) explained that untreated caries in children may be painful and can affect diet, school attendance, and sleep; likewise, unresolved oral health problems can affect child's speech and language, as well as appearance, self-image and even social functioning.

Chronic periodontal diseases are found to be highly prevalent in Nigeria right from the 1960s to date (Sofola, 2010). "Periodontal diseases are those pathological processes of an inflammatory and degenerative type that involve the periodontium, they are clinically characterized as gingivitis, pocket formation, loss of alveolar bone and eventually tooth loss" (WHO Technical Report Series, 1962). Enwonwu (1966) observed and reported the prevalence of destructive periodontal disease as evaluated by Russell's criteria, to range between 15% in Northern Nigeria, and 40% in Western Nigerians aged

15-19 years. Adegbembo and El-Nadeef (1995) reported a national wide study carried out in both rural and urban Nigeria; the prevalence of periodontal pockets 4-5mm deep was 39% at 15 years of age and this increased to 57% among those aged 25-29 years. Akpata (2004) also reported that deep periodontal pockets occur in a relatively high proportion among young adolescents in Nigeria; the prevalence increases with age, being 51-58% in children aged above 15years. Akpata further explained that occurrence of periodontal disease is related to oral hygiene status and socioeconomic class. National Institute of Dental and Craniofacial Research (NIDCR; 2012) identified the following risk factors for periodontal disease; smoking, hormonal changes in girls/women, diabetes, medications, genetic susceptibility, and poor oral hygiene.

Oral Health Education

Stillman-Lowe (n.d.), defined oral health education as "any learning activity which aims to improve individuals' knowledge, attitudes and skills relevant to their oral health". It is important that everyone has a right to be educated regarding the prevention of oral diseases; this can be achieved through school-based oral health education programs, with the assistance of dental health professionals (Stuart, 2013).

Although oral health education is an integral part of professional responsibility, simply passing across information does not by itself lead to desirable action. Personal involvement is necessary (Stuart, 2013). There are different methods of disseminating information, such as through mass media, one-to-one instruction and meetings with small groups. Stuart suggested that small groups and mass approaches should be used during oral health education programs.

Rustvold (2012) explained that it is necessary for dental professionals to know that there are differences between technical problems (understanding the oral environment, adopting ideal tooth brushing pattern and flossing, and the rationale for cleaning) and adaptive challenges (multiple system of beliefs, knowledge, motivation and behavior that do not lend themselves easily to technical analysis), when encouraging people to take action. Rustvold further explained that technical problems can be solved with established knowledge and procedures, that is, if information or a roadmap is given, the action can be taken, but adaptive challenges on the other hand require innovation, new learning, and adoption of new patterns of behavior. It is necessary for dental professionals to know that information by itself is not sufficient to bring about change in behavior, if this behavior requires that the individual go beyond familiar patterns, beliefs and understanding. As such, the principle of adaptive challenges must be slightly adhered to (Rustvold, 2012).

Oral Health and Quality of Life

Oral health means more than healthy teeth; oral health means being free of diseases and conditions that affect all oral, dental and craniofacial tissues, collectively called as the craniofacial complex (Macek, 2003). According to Langha (2004), oral health was associated with self-reported wellbeing and quality of life as measured along functional, psychosocial, and economic dimension. For instance, impaired oral health, adversely affect diet, nutrition, sleep patterns, psychological status, social interaction, and school and work related activities among some individuals (Langha, 2004). Macek (2003) also reported that oral and craniofacial conditions may have social functioning

effect on an individual, in the areas of limitation of verbal and nonverbal communication and social interaction.

Theoretical Foundation

HBM was the theoretical framework for this study. HBM is a psychological model designed to help explain and predict health behaviors (Rustvold, 2012). The model was developed by social psychologists Hochbaum, Rosenstock, and Kegels in the 1950s (Rosenstock, 1974). The HBM was developed in response to lack of participation in a United State Public Health Services free screening program for tuberculosis (Rosenstock, 1974). Since then, the HBM has been adopted to explore a variety of long and short term behavior.

According to Janz and Becker (1984), the basic components of the HBM were derived from a well-established body of psychological and behavioral theory, according to which health behavior depends mainly upon two variables:

1. The value placed by an individual on a particular goal; and
2. The individual's estimate of the likelihood that a given action will achieve that goal (Janz & Becker, 1984).

According to this model, a negative health consequence can be avoided, expecting that recommended health behavior will prevent the negative consequence and believing that it is possible to do the recommended action (Health at Fact Expert, 2013). The key emphasis of the model is to motivate the public to follow recommended health behavior, which will therefore prevent negative consequences and improve overall public health (Health at Fact Expert, 2013).

The original six constructions of HBM as presented by Rustvold (2012) include: Perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cue to action, and demographics or psychological structures. Rustvold (2012) further explained the HBM constructs as follow: a person will take a-health-related action if that person (a) believe that he or she is susceptible to a health problem, (b) feels that a negative health condition can be avoided, and (c) has a positive expectation that by taking a recommended action, he/she will avoid negative health condition, and believes that he or she can successfully take a recommended health action. These concepts constitute readiness to act.

The HBM have been applied in many studies regarding oral health education. Solhi, Zadeh, Serj, and Zadeh (2010) investigated the application of the HBM in oral health education for 12years-old children and its effect on oral health behavior and status; the researchers observed that after educating the participants based on HBM, all the oral health perceptions increased, and this influenced correct brushing and flossing, and limited intake of sugary food. Solhi et al. concluded that it is possible to use the HBM in oral health education for increasing the likelihood of taking preventive oral health behaviors.

The HBM was relevant to this study because I engaged participants in such a way that they embraced the idea that oral diseases can be prevented or mitigated by individual action and encourage participants that they can be successful in their action (Rustvold, 2012).

Data Regarding Oral Health Attitudes, Behavior, and Knowledge in the Nigerian Population

There was a literature gap on oral health attitudes, behavior and knowledge of secondary school students in Nigeria especially in Enugu State, while they are some data regarding some populations in this country. Ehizele, Chiwuzie, and Ofili (2010) conducted a comparative descriptive cross sectional study on oral health knowledge, attitudes and practices among Nigerian primary school teachers in Benin City, Edo State, Nigeria. According to the results, many of the teachers had positive oral health attitudes, but many teachers had poor oral health practices. For instance, about 87.6% of the teachers still use potentially traumatic materials such as wooden toothpicks, plastic toothpicks, brooms stick and pin for interdental cleaning and 60% consumed regularly, various forms of refined sugar.

Nosayaba (2010) presented a critical review of the level of primary oral health care in Nigeria, three decades after the Alma-Ata declaration of primary health care. Nosayaba came to the conclusion that oral health awareness remains low in Nigeria; the school curriculum, from primary to secondary still lacks a primary oral health education programs. He illustrated that as in 1994, the number of kids in primary school in Nigeria was 16,190,947 in 54,434 pubic primary schools; and 3,266,780 students in 7129 junior secondary schools. If oral health education and counseling have been incorporated into the curriculum of these schools (e.g., appropriate oral hygiene, topical fluoridation, and regular dental visits), there would have been a lot of improvement regarding oral health attitudes and behaviors of these children (Nosayaba, 2010).

Kolawole, Oziegbe, and Bamidele (2010), investigated the relationship between oral hygiene practices, socioeconomic status and gingival health in a group of Nigerian children aged 11-14 years in Ile-Ife, Osun state, Nigeria. Kolawole et al. concluded that tooth brushing once daily was the most common practice among the children; 20.2% of the children had moderate and severe gingivitis. On the other hand, socioeconomic status had no relationship with tooth brushing frequency, but it had low significant correlation (mild positive relationship) with oral hygiene index and gingival index.

Ogundele and Ogunsile (2008) conducted a quantitative study on dental health knowledge, attitudes and practices in relation to dental caries among adolescents in a local government area (LGA) of Oyo State, Nigeria. A descriptive survey research design was adopted for the study. A total number of 637 students were drawn from ten schools; the schools were selected using sampling with replacement method. Each of the schools selected had representatives from strata of six classes: junior secondary school I, II, III and senior secondary I, II and III, respectively (Ogundele & Ogunsile, 2008). The instruments for data collection were a self-structured questionnaire and dental examination. The questionnaire was organized into sections, in such a way that information such as demographic attributes of respondents, dental health knowledge, attitudes towards dental health, and practices towards dental health, were well covered. The findings from the study revealed a significant high knowledge of positive dental health among the participants; this knowledge was not significantly influenced by demographic attributes of respondents; the attitude of the respondents was also positive towards brushing after eating in the morning, and going for dental check-up (whether in

pain or not); female respondents attending private schools displayed more positive attitudes than their counterparts; the practice of oral hygiene among the participants, especially brushing twice a day, using toothbrush and toothpaste and adopting up, down and sideways technique for brushing was also significantly sound. Female students from private schools had better dental health practice than their counterparts (Ogundele & Ogunsile, 2008). Oral examination revealed that few students 6.1% had dental caries. Among those with dental caries, females were more than males, and those affected were more from the public schools (Ogundele & Ogunsile, 2008). The researchers concluded that when healthful knowledge is allowed to influence attitude and practice of dental health, occurrence of common dental disease will be reduced (Ogundele & Ogunsile, 2008). The research goal was well articulated, but the authors failed to explain whether there were more private schools than public schools, selected for the study; whether the participants have ever had access to dental health education; and the issue of dental caries occurrence was carried out without using the appropriate index such as the DMFT index. The strength of the study is that all the variables were addressed in the instrument for data collection, and the issue of validity and reliability of the instrument was well managed.

Oral Hygiene Practices in Nigeria

Good oral health habits are measures that people may learn and practice regularly in order to maintain good oral health and, or prevent oral diseases (Langha, 2004). Traditionally, two sets of behavior are the main components of good oral health practice; these include: self-care habits (maintenance of dental hygiene, use of fluoride products, and restriction of sugar products) and utilization of dental services (regular dental visits,

oral health education and professionally applied preventive measures, such as fluoridation) (Langha, 2004).

There are different types of oral hygiene measures that can be adopted for the maintenance of the oral health; according to Langha (2004) most researchers recommend tooth brushing twice a day and agreed that when performed with fluoridated toothpaste, it could prevent the occurrence of common dental diseases. Also, Langha (2004) pointed out that tooth brushing alone plays a limited role in preventing dental diseases such as caries, because brushing alone is not sufficient in cleaning the proximal surfaces of teeth. As such, the use of dental floss is also recommended to help in preventing both dental caries and periodontal diseases.

Tilliss et al. (2003) also explained that individuals can avoid oral diseases by brushing and flossing once a day. The use of dental floss or tape, a toothpick, a small brush that fits between the teeth, an oral irrigator or other special device is necessary in order to clean between the teeth, an oral irrigator or other special device is necessary in order to clean between the teeth.

In Nigeria and most African countries, chewing stick is traditionally used for cleaning and strengthening the teeth (Oguntola, 2013).About 80-90% of Nigerians use chewing sticks mainly because they are readily available, cheap and efficacious (Rotimi & Mosadomi, 1987). The choice of chewing sticks to be used in most cases depends on its cleansing action on the teeth, the therapeutic value, or preferred taste or flavor (Ogundiya, Okunade, &Kolapo, 2006). Chewing sticks may be stem or root obtained from the following plants: *Garcinamanni, Masulariaaccuminita, Terminaliaglaucescens,*

Anogeissusleiocarpus, Pseudocedrelakotschyi, Xanthoxyllumgilletti and Azadiractaindica (Ogundiya et al., 2006). Rotimi and Mosadomi (1987) explained that the medicinal properties associated with these chewing stick ranges from gum healing, analgesia, anti-sickling, haemostasis and antimicrobial and plaque inhibiting effects.

The literature review regarding oral health knowledge, attitudes and practices among adolescents and specifically secondary students if possible, mostly focused on Nigerian populations, since this review demonstrates poor results on the topic; thus, there was a literature gap which this study intended to fill. Nigerian students have different cultural, economical and ritual backgrounds compared to students of developed countries; therefore this study's main aim was to explore the oral health data of Nigerian students. Nevertheless, several recent studies which have been conducted worldwide and especially in developed countries (Areai et al., 2011; Hedman et al., 2006, Markowitz et al., 2012; Oulis et al., 2011) have also been reviewed in order to examine if surveys used in these studies to assess knowledge, attitudes and practice are also suitable for the present study. According to this literature review and to additional Nigerian studies of Sa'adu et al (2012) and Ogundele and Ogunsile (2008) several instruments have been already used to assess oral health knowledge, attitudes and practices among students therefore the questionnaire that was used for the present research is based on these similar surveys. However, as none of the above instruments adequately covers all the needed aspects of Nigerian students in order to answer the research questions of the study, the survey used in this project combined questions/parameters from all the existing instruments, therefore content and construct validity of the new instrument was re-

confirmed. This confirmation was explained in detail in Chapter 3 (e.g. pilot testing, internal consistency confirmation etc.).

Policy Guidelines for Oral Health Care in Nigeria

Until recently there was no structured oral health policy in Nigeria, although the Nigerian government decided to recognize oral heath as a component of primary oral health care (POHC) (Sofola, 2010).

On Tuesday, November 13, 2013, the National Oral Health Policy (NOHP) was formally launched by the Minister for Health, Prof. C.O. Onyebuchi Chukwu (Anonymous, n.d.), in the Honorable Minister for Health's address, the policy was meant to address the following:

1. Low oral health awareness
2. Increased needs for oral health care.
3. Misconceptions among Nigerians about oral health as not being live threatening and therefore not important.
4. Absence of a coordinated system for collecting oral health data in the country.
5. Problematic availability of oral available oral health facilities.

The minister concluded that the goal of the National Oral Health Policy is to improve oral health status of Nigerians through sustainable awareness creation, strategic research, workforce development and coordination of oral health activities.

Use of Oral Health Care Services Among Students in Nigeria

In Nigeria, oral health has not been taken seriously as part of the general health but recent studies have shown that oral health is essential to the general health. According to Olusile (2010), medical researchers have begun to understand the complexity of the relationship between poor oral health and its effects on other bodily systems. For instance, poor oral health have been linked to cardiovascular disease, poorly controlled diabetes, and difficulties during pregnancy and delivery. Olusile (2010) further explained that certain factors militate against good oral health care delivery in Nigeria, and these include: culture, myth and fallacies, poverty, fear of the dental clinics, ignorance or low level of oral health awareness, and lack of access to oral health facilities.

There was a literature gap on the use of oral health facilities among students in Nigeria. According to Varenne et al. (2006), the availability and accessibility of oral health services are seriously constrained in sub-Sahara Africa, and the provision of essential oral health care is limited. Varenne et al. (2006) also reported that utilization of oral health care services (where available) is very low; and visit to dental facilities is mostly undertaken for symptomatic reasons; that is, dentists are usually consulted when children and adults suffers pain and discomforts which may lead to tooth extraction. Olusile (2006) concluded that self-medication with herbal medicines or modern drugs seem to be a common practice in many African countries.

Summary

Oral health is a fundamental component of general health, and there have been evidence that poor oral health always has negative impacts on the general health and

quality of life of school children (Petersen, 2004). A survey investigating Nigerian adolescents' oral health behavior, might offer valuable insight into the oral health status of the students population and into individual determinants of oral health in terms of oral health knowledge, attitudes and practices. Unfortunately, very few studies were found to address oral health knowledge, attitudes and behaviors towards oral health in Nigerian populations. The HBM, as a theory of choice for this study was also discussed. Comparing the results obtained from the present study with the ones from other studies outside Nigeria enabled culture comparisons of students' oral health.

A detailed research methodology was presented in Chapter 3, mostly focusing on research design, description of the study area, target population, sample size and sampling technique, data collection and measurements, data analysis plan and ethical concerns.

Chapter 3: Research Method

Introduction

Oral health is an essential aspect of general health, as such, oral health knowledge is considered to be an essential prerequisite for health related practices (Carneiro et al., 2011). In Nigeria, there was a literature gap on the oral health knowledge, attitudes and practices of secondary students in Enugu State and most of the states in the country. The purpose of this study was to adopt a quantitative cross sectional approach to assess the level of oral disease, knowledge and oral health behaviors and attitudes of students in Enugu State, Nigeria, in relation to their oral health status. A detailed discussion on how cross sectional survey design was used for the purpose of this study was included in this chapter. Also, the sample and sampling procedures, data collection, pilot study, instrumentation, data analysis plan, threats to validity, ethical procedures, and summary was described in this Chapter.

Research Questions and Hypotheses

RQ 1: What is the oral health status (dental caries and periodontal diseases) of secondary school students in Enugu State, Nigeria?

RQ 2: What is the level of knowledge on the causes and preventive measures of oral diseases among secondary school students in Enugu State?

RQ 3: What are the behaviors/attitudes (e.g., frequency and reason of dental visit, brushing and flossing frequency, consumption of food with sugar content) of secondary school students in Enugu State towards dental health?

Inferential Question

RQ4: What are the relationships between demographic variables (age, gender, class, and type of institution), level of oral health knowledge, as well as oral health behavior and attitudes of secondary school students in Enugu State and their oral health status?

$H1_0$: There is no significant relationship between demographic variables (age, gender, class, and type of institution) and students' oral health status, as measured by the survey instrument located in Appendix A (Section A), which I developed.

$H1_a$: There is a significant relationship between demographic variables (age, gender, class, and type of institution) and students' oral health status, as measured by the survey instrument located in Appendix A (Section A), which I developed.

$H2_0$: There is no significant relationship between the students' level of oral health knowledge and students' oral health status, as measured by the survey instrument located in Appendix A (Section B), which I developed.

$H2_a$: There is a significant relationship between the students' level of oral health knowledge and students' oral health status, as measured by the survey instrument located in Appendix A (Section B), which I developed.

$H3_0$: There is no significant relationship between the students' oral health behavior and attitudes and their oral health status, as measured by the survey instrument located in Appendix A (Sections C, D), which I developed.

$H3_a$: There is a significant relationship between the students' oral health behavior and attitudes and their oral health status, as measured by the survey instrument located in Appendix A (Sections C, D), which I developed.

Research Design and Rationale

A quantitative cross sectional design was used to collect data from selected secondary schools in Enugu State, Nigeria through the administration of a close-ended questionnaire, as well as oral examination of the participants (Appendices A & B). The main aim was to assess the level of oral disease, knowledge and oral health behaviors and attitudes of the students, in relation to their oral health status. The independent variables were the level of oral disease knowledge as well as oral health attitudes and behaviors of the students. The dependent variable was the oral health status of the students, recorded with specific indices, such as the decayed missing filled teeth (DMFT) and the periodontal disease index (PDI). The moderating variables were demographic variables such as age, gender, class and type of institution.

Cross-sectional design was appropriate for this study, because it was easy and economical to be conducted, and it was very useful for investigating a variety of characteristics of individuals, such as socio economic status, gender and ethnicity (Nyamuryekung'e, 2012). Crosby et al (2006, explained that cross sectional designs can be used to estimate levels of knowledge about a given health threat or health protective behavior, and health related attitudes, beliefs, opinions, and behaviors. The main disadvantage of this design is its inability to attribute causality whether an exposure precedes or follows the outcome (Salkind, 2009). Due to constraint of time, resources and

the relatively large sample size requirement, a self-structured questionnaire and oral examination was considered appropriate for data collection, as all the students were at the same level of education and were able to read and write. The usage of the questionnaire ensured complete anonymity, and the clinical examination function as an objective assessment of the outcome of various variables from the questionnaire.

Population

The target population for this study was 270,889 students aged 11-16 years old (133,371 senior secondary students and 137,518 junior secondary students) attending public schools, private schools, and missionary/faith-based schools in Enugu State, Nigeria (Mba Mike, Planning Officer, Enugu State Ministry of Education, Personal Communication). Twelve secondary schools were involved in the study out of over 35 secondary schools in Enugu East local government area. Sixty students were selected from each of the selected schools through stratified sampling technique; this was described in detail in the following sections.

Sample and Sampling Procedure

A stratified random sampling technique was used in selecting 12 schools out of over 35 secondary schools in Enugu East local government area, Enugu State, Nigeria, considering the fact that the schools were divided into strata of public schools, private schools and missionary/faith-based schools respectively; four schools were drawn from each stratum, and 60 students were selected from each school through stratified sampling technique by dividing the classes into strata of JSS I, II and III respectively. Twenty students who met the inclusion criteria were selected from each of the classes using a

table of random sampling numbers. Approximately 720 students were selected for the study. It is important that the sample selected within each stratum reflected proportionately the population proportions (Crosby et al. 2006). Sampling with replacement was adopted if any participant randomly selected, refuse to participate in the study

Sample Size analysis

Statistical power is defined as the probability that a given statistical test will detect a real treatment effect or real relationship between variables (Salkind, 2009). In order to reduce sampling error, statistical power, alpha, and effect size should be determined when calculating sampling size. For my study, proportionate stratified random sampling was adopted; this is because the sample size of each of the selected institution was proportionate to the population size, when viewed against the entire population (Stattrek.Com, 2013). Effect size (Cohen's *d*) was obtained from the study of Oulis et al, (2011). In this study, the effect size of dental caries (DMFT) regarding a similar study population group (students aged 12 years-old) was found at least 0.46, pertaining to the impact of various demographic variables (e.g., gender, educational level of parents, rural or urban location) on dental caries onset: thus, a total sample of approximately 720 participants was appropriate for my study (achieved statistical power > 0.90 with the use of G* Power Calculator).

Inclusion/Exclusion Criteria

The secondary schools included in the study were public schools, private schools and missionary/faith-based schools (these are the types of secondary schools in Nigeria).

The schools had both boys and girls or with one sex only, and either boarding or day schools. The students were in JSS I, II or III classes respectively, and aged 11-16 years-old. Eligible participants were made to sign an informed assent form shown in Appendix E and the parents signed an informed consent form shown in Appendix F. Students with serious medical conditions or experiencing cognitive impairment such as Alzheimer were excluded from the study; this information were provided by the parents when receiving parental consent forms.

Recruitment and Participation

After obtaining approval from Walden University's Institution Review Board (IRB), permission from the Enugu State Ministry of Education, principals and administrators of the selected secondary schools and Federal School of Dental Technology and Therapy, Enugu, I scheduled an appointment with each of the schools in order to give the students oral health lecture, with the help of three dental therapists working at Federal School of Dental Technology and Therapy, Trans-Ekulu, Enugu, Nigeria. During the oral health lecture, the nature of the study was explained in detail to the students; the details regard the duration of the study, informed consent, confidentiality concerns, and possibly compensation (tube of close-up toothpaste) after the completion of the study. I and the teacher of each class especially explained that this study was voluntary and that everyone will respect children's decision of whether or not they should participate in the study. It was pointed out that no one at school would treat students differently if they decided that they should not participate in the study, and that they could have stopped at any time. Finally, adequate time (1 week) was given to the students

to decide their participation and the teacher's made them clear that if they or their parents decline participation this is totally acceptable.

Though students were selected randomly from each of the stratum of classes, a letter was sent to the children's parents informing them of the study and asked for their consent. Students were asked to fill an assent form, before they are eligible to participate in the study. Students with serious medical conditions and experiencing cognitive impairment were excluded from the study.

Pilot Testing

A pilot study was conducted prior to the start of cross sectional study, in order to reveal potential problems in the structure or comprehensibility of the questionnaire that were used. First, a preliminary draft of the survey that was used in the main research has been distributed to a panel of colleagues (dental therapists who are also lecturers at Federal School of Dental Technology and Therapy, Enugu, Nigeria) by also providing the study's guiding/research questions. Next, based on their comments and feedback, the survey was revised accordingly (Appendix A). The questionnaire was pilot tested and distributed to a small group of respondents similar to those in the target population (20 students) at the same schools where the main research took place. According to the results of the pilot study, the appropriate corrections/adjustments were made for content and clarity.

In order to confirm the construct validity of the survey that was used in this study, the questionnaire was based on similar surveys which were used and standardized in previous studies (Areai et al., 2011; Hedman et al., 2011, Markowitz et al., 2012; Sa'adu

et al, 2012; Oulis et al, 2011; Ogundele &Ogunsile, 2008) regarding students of secondary schools.

Instrument

The instrument required for data collection for this study was a closed-ended questionnaire and dental examination (see Appendices A, B, C and table 1).

Questionnaire Survey

Several recent studies have been conducted worldwide and especially in developed countries (Areai et al., 2011; Hedman et al., 2011, Markowitz et al., 2012; Oulis, et al, 2011) and they have been reviewed in order to examine if surveys used in these studies to assess knowledge, attitudes and practices were suitable for the present study. According to this literature review and to additional Nigerian studies of Sa'adu et al (2012) and Ogundele and Ogunsile (2008) several instruments have been already used to assess oral health knowledge, attitudes and practices among students; therefore, the questionnaire which was used for the present research was based on these similar surveys. However, as none of the above instruments adequately covers all the cultural, ethnic and other needed aspects of Nigerian students to answer the research questions of the study, the survey used in this project combined questions/parameters from all the existing instruments, therefore content and construct validity of the new instrument was reconfirmed. The questionnaire was organized into four sections (Appendix A): Section A regarded information on demographic variables of respondents (gender, age, name of school, type of school and class). More specifically, these variables was recorded as follow: gender: male/female; age: (a) 11-12, 13-14, 15-16, >16; (b) class, JSS, JSS II,

JSS III, type of school; and (c) public, private, missionary. Section B included information on dental health knowledge. Six questions were used to elicit knowledge and the response followed a four way Likert scale format, for example "Foods and drinks with sugar such as sweets, chewing gums, and soft drinks destroy your teeth.1-*strongly disagree* 2-*disagree* 3-*agree* 4-*strongly agree*. Section C had five questions related to attitude towards dental health, for example "When was your last dental visit? (a) 0-6 months, (b) 7-12 months, (c) more than a year, and (d) never", "Why do you usually visit the dentist? (a) pain/treatment (b) check-up/tooth cleaning". Section D had six questions that elicit information on practices towards dental health, for example "How often do you brush your teeth? (a) Once a day (b) twice a day (c) sometimes a week (d) never", "Do you use toothbrush and fluoride toothpaste for tooth brushing? (a) Once a day (b) twice a day (c) sometimes a week (d) never".

Dental/Clinical Examination

Oral epidemiological data was collected after obtaining the IRB approval from the Federal School of Dental Technology and Therapy, Enugu and from Walden University; clinical examinations in the various schools were carried out by three trained and calibrated examiners (dental therapists) using disposable dental mirror, caries probes, WHO community periodontal index probes and college tweezers. Prior to the study, a meeting was organized in the aforementioned Dental School to train and calibrate the examiners and each one of them has the responsibility to examine 240 students. This training first included a one day oral presentation regarding the indexes (e.g., detailed

description of criteria and indications of each index) which were used in the clinical examination.

This presentation also included some photos and potential challenging clinical cases that the examiners may face during the study, such as the accurate differential diagnosis between similar dental diseases. The next day, all the examiners examined 10 patients of the Dental School, in order to assess inter-examiner reliability; inter-examiner reliability and agreement (kappa coefficient) was assessed with the author of this dissertation (J.O.) as gold standard. After the completion of this training/calibration process, all the examiners received a guide which includes the detailed description of each clinical index, in order to have it during the conduction of the study. The result of the calibration procedure is provided in Chapter 4. Diagnosis of dental caries and periodontal disease was according to the criteria recommended by the WHO (1987), i.e. when a lesion in a pit or fissure, or on a smooth surface, had an unmistakable cavity, undermined enamel or a detectably soften floor or wall; and when there is a marked depth around the attached gingiva.

The DMFT index (WHO, 1987) was used to determine dental caries and the PDI (Ramfjord, 1967) was used to determined prevalence of periodontal disease among the participants. Both indices were presented in detail in (Appendices B & C), and they are continuous variables. In brief, in order to compute DMFT score at individual level, total of D+M+F teeth was calculated, for example if D = 3, M = 2, F = 5, then DMF = 3+2+5 = 10. In order to compute group average, total DMFT scores of all the participants was

divided by the number of individuals in the group. Also, for PDI score, a calculation example for an individual is:

Tooth // Periodontal Disease Score	
No 3(16):	4
No 9(21):	0
No 12(24):	5
No 19(36):	6
No 25(41)	4
No 28(44)	2
Total	21

For PDI Group Score, the total of individual PDI Scores was computed and then divided by the number of individuals examined. The average ranges from 0 to 6. (Wilkins, 1989). The variables, the research questions, in relation to the surveys are presented in Table 1.

Table 1

Variables, Research Questions, and Sections on Surveys

Variable category	Research question	Sections of survey/clinical examination
Independent Variable: Oral health status (dental caries and periodontal disease) as measured by DMFT and PDI indices	RQ1	Clinical Examination (Appendices B, C)
Independent Variable: Level of knowledge on the causes and preventive measures	RQ2	Section B of the survey (Appendix A)
Independent Variable: Behaviors/attitudes of students towards dental health	RQ3	Sections C , D of the survey (Appendix A)
Dependent variables: oral health status of the students (DMFT and PDI), Independent variables: level of oral diseases knowledge as well as oral health behaviors and attitudes of the students. Moderating variables: Demographics	RQ4	DV: Clinical Examination (Appendices B, C). IV: Sections A, B, C , D of the survey (Appendix A)

Data Analysis Plan

All data were imported into statistical program for SPSS, version 21.0 for analysis. First, descriptive statistics (e.g., mean, median, mode and standard deviations) were computed for all the variables of the study (Table 2). Second, the possible relationships between the independent (oral health knowledge, attitudes and behaviors, Sections B, C, and D of the survey, demographic data, Section A), and dependent variables (DMFT and PDI data) were explored (Table 2). Examination of bivariate statistical associations was conducted with the use of t-test and ANOVA or Mann Whitney test and Kruskall – Wallis test depending on the outcome's nature (DMFT and PDI scores normally distributed or not, respectively). The linear regression (Pearson Product Moment Correlation) was also suggested to be used for data analysis. This is the simplest form of linear regression used to calculate an equation that determines the Y-intercept and the best fitting line (Crosby et al, 2006). The purpose for adopting this basic regression is that it was used to test the nature of the linear relationship between X variable(s) (independent and mediating variables) and a given outcome Y (dependent variables); it was also used to test the strength of the relationship; it can also be used to formulate prediction equations based on sample data that can be applied to the population (Crosby et al, 2006). However, as the assumptions of linear regression were not met, for example normal distribution of data, linearity and homoscedasticity, dependent variables were transformed from continuous to categorical variables in order to use logistic regression (binary) instead of linear regression.

Table 2.

Statistical Procedures per Research Question and Hypothesis

Research question	Hypothesis (Ha)	Variables	Statistical procedure/analysis
Descriptive RQ 1: What is the oral health status (dental caries and periodontal disease) of secondary school students in Enugu State, Nigeria? RQ 2: What is the level of knowledge on the causes and preventive measures of oral diseases among secondary school students in Enugu State? RQ 3: What are the behaviors/attitudes (e.g. frequency and reason of dental visit, brushing and flossing frequency, consumption of food with sugar content) of secondary school students in Enugu State towards dental health?	NA	Oral health status (dental caries and periodontal disease) as measured by DMFT and PD indices. Level of knowledge on the causes and preventive measures. Behaviors/attitudes of students towards dental health.	Univariate: mean, sd, median and interquartile range for continuous variables; frequencies for categorical variables.
Inferential RQ 4: What are the relationships between demographic variables, level of oral health knowledge, as well as oral health behavior and attitudes of secondary school students in Enugu State and their oral health status?	1.H_0: There is no significant relationship between demographic variables and students' oral health status. Ha: There is a significant relationship between demographic variables and students' oral health status 2.H_0: There is no significant relationship between the students' level of oral health knowledge and students' oral health status. Ha: There is a significant relationship between the students' level of oral health knowledge and students' oral health status. 3.H_0: There is no significant relationship between the students' oral health behavior and, attitudes and their oral health status. Ha: There is a significant relationship between the students' oral health behavior and attitudes and their oral health status.	DV: Oral health status (dental caries and periodontal disease) as measured by DMFT and PDI indices. IV: Level of knowledge on the causes and preventive measures. Behaviors/attitudes of students towards dental health. MV:Demographics.	Bivariate:If each IV/MVcategorical *and* DV normal distributed ($H_{1,2,3,}$)→ t-test or ANOVA If each IV/MVcategorical *and* DV not normal distributed ($H_{1,2,3,}$)→ Mann-Whitney U test or KruskalWallis Multivariate: If DV normal distributed($H_{3,}$) : linear regression, using as predictors IV and MV. If DV not normal distributed (H_3)→ transformation to binary categorical variable, using median as the cut point: logistic regression, using as predictors IV and MV.

Threats to Validity

Cross sectional survey is an economical and relatively easy to conduct design in order to obtain some information on several issues of oral health of a population (Nyamuryekung'e, 2012). For this particular study, the design was subjected to internal and external validity:

Internal Validity Threats

Recall bias and social desirability bias was the two most important threats for internal validity. Recall bias in a survey setting refers to selective and differential recall of information as a result of the subjects being different with respect to demographic variables or exposure (Crosby et al, 2006). In order to minimize recall bias in this study, questions that inquired on past experiences was framed within a specific time period that is not too long. Social desirability bias is that differential in the presentation of information as a result of social pressure to conform to expected modes of behaviors (Nyamurykung'e, 2012). Self-reported events tend to be distorted in a socially desirable direction and behaviors which are associated with a social stigma or are perceived to be personally threatening are often under-reported (Nyamurykung'e, 2012). In order to minimize this bias, there was need to stress on anonymity of participants, prior to distribution of the questionnaire; encourage the participants to fill the questionnaires as independently as possible and emphasize on the importance of true information, elaborating that there is no single "correct" answer to any of the items. The issue of

selection threat was ruled out since the researcher aimed to recruit equal sample from the selected schools.

External Validity Threats

Non response bias especially from students attending public schools posed a threat because they were not familiar with some of the terms that was presented in the given questionnaire, although explanation was given prior and during the study. Ecological validity (that is the degree to which the study results can be generalized to different settings) could be confirmed by the adequate control of confounding, using the appropriate data analysis plan and multivariate analysis in particular.

Ethical Concerns

Initially, I submitted approval applications to the Institutional Review Board (IRB) at Walden University, Federal School of Dental Technology and Therapy, Enugu, Enugu State Ministry of Education (Post Primary School Management Board, PPSMB), and the various schools involved in the study (Appendix D). The IRB may identify conflicts within the study that may not be visible to the research team, and there is need to get an approval from the participants/administrators of each of the schools before the involvement of the research subjects in the study. After the approval of all the relevant documents, parents of potential participants were asked to sign an informed consent form and the participants signed a assent form respectively (provided at Appendices E & F) in which it was clearly stated that their participation is voluntary and that they have the right to withdraw at any moment during the study. However, they would surrender their eligibility to receive compensation. After the receipt of the completed informed consent

assent forms, the questionnaire was distributed to all the participants respectively. The same participants that filled the questionnaire participated in the clinical examination of oral cavity. Participants were assured that their responses, names and contact information will be confidential and prohibited to be used for other circumstances that do not pertain to the study. Data were stored in a locked file cabinet and in a password protected computer only accessible to the researcher and kept for a period of five years. Respondents and the selected institutions that desired copies of the results received a summarized copy which excluded any identifiable codes. The students benefitted from the study in such a way that they have access to oral health education and free dental check-up.

Summary

Cross sectional design was chosen for this study because it is economical and relatively easy to conduct in order to obtain information on several issues related to oral health of a population. The participants were registered students in JSS I, II and III classes of selected public, private and missionary/faith-based schools in Enugu State, Nigeria. Informed assent forms from students and informed consent forms from parents were received prior to the inclusion of each student in the study. A pilot study was conducted prior to the start of the study in order to reveal potential problems in the structure/comprehensibility of the questionnaire that was used. Three calibrated dental therapists working at Federal School of Dental Technology and Therapy, Enugu, Nigeria, helped with the administration of questionnaire, and with clinical examination of the participants. Data was analyzed using the statistical package for social science (SPSS)

version 21.0. Chapter 4 includes the statistical analysis of the obtained data as well as the presentation of the findings of the study, mostly focusing on the potential relationship between the dependent and the independent variables.

Chapter 4: Results

Introduction

The purpose of the study was to assess the oral health knowledge, attitudes and practice of secondary students in relation to their oral health status, in Enugu East Local Government, Enugu state, Nigeria..

The first three research questions were descriptive questions:

RQ 1: What is the oral health status (dental caries and periodontal diseases) of secondary school students in Enugu State, Nigeria?

RQ 2: What is the level of knowledge on the causes and preventive measures of oral diseases among secondary school students in Enugu State?

RQ 3: What are the behaviors/attitudes (e.g., frequency and reason of dental visit, brushing and flossing frequency, consumption of food with sugar content) of secondary school students in Enugu State towards dental health?

The fourth question was an inferential question:

RQ4: What are the relationships between demographic variables (age, gender, class, and type of institution), level of oral health knowledge, as well as oral health behavior and attitudes of secondary school students in Enugu State and their oral health status?

$H1_0$: There is no significant relationship between demographic variables (age, gender, class, and type of institution) and students' oral health status, as measured by the survey instrument located in Appendix A (Section A), which I developed.

$H1_a$: There is a significant relationship between demographic variables (age, gender, class, and type of institution) and students' oral health status, as measured by the survey instrument located in Appendix A (Section A), which I developed.

$H2_0$: There is no significant relationship between the students' level of oral health knowledge and students' oral health status, as measured by the survey instrument located in Appendix A (Section B), which I developed.

$H2_a$: There is a significant relationship between the students' level of oral health knowledge and students' oral health status, as measured by the survey instrument located in Appendix A (Section B), which I developed.

$H3_0$: There is no significant relationship between the students' oral health behavior and attitudes and their oral health status, as measured by the survey instrument located in Appendix A (Sections C, D), which I developed.

$H3_a$: There is a significant relationship between the students' oral health behavior and attitudes and their oral health status, as measured by the survey instrument located in Appendix A (Sections C, D), which I developed.

The results of the study, including the calibration process of the examiners, the findings of the pilot study, and a description of the data collection methods are discussed in this chapter.

The instrument used for data collection was a self-structured closed-ended questionnaire and dental examination. For clinical examination, three dental therapists working at Federal School of Dental Technology and Therapy, Enugu, Nigeria, were trained and calibrated on how to diagnose dental caries and periodontal diseases

according to the criteria recommended by the WHO (1987) prior to the start of the study. For this purpose, a 1 day oral presentation regarding the DMFT index and PDI was carried out. The presentation included photos and potential challenging clinical cases that examiners may face during the study. In order to assess the inter-examiner reliability and agreement (Kappa Coefficient), the researcher (J.O.) was used as gold standard. The results of the calibration process (4/18/2014) in 10 patients are the following:

DMFT:

Agreement between examiner 1 vs. gold standard: 0.97, very good

Agreement between examiner 2 vs. gold standard: 0.766, good

Agreement between examiner 3 vs. gold standard: 0.766, good

PDI:

Agreement between examiner 1 vs. gold standard: 0.702, good

Agreement between examiner 2 vs. gold standard: 0.702, good

Agreement between examiner 3 vs. gold standard: 0.702, good

Data Collection

Twelve schools were involved in the study: four mission/faith-based schools, four private schools, and four public schools in Enugu East Local Government, Enugu state, Nigeria. After obtaining approval from Walden University's IRB, introductory letters were sent from the Post Primary School Management Board (PPSMB) to the principals of the schools for permission. Twenty students were randomly selected from the JSSI, II and III classes of each school to make up for the 60 students earlier suggested for each of the schools. The selected students were given 1 week to decide their participation. From

them, 20 students were selected to provide any feedback regarding the surveys (pilot study), but no suggestions were provided. Within the period of one week, they were given consent forms for their parents and assent forms that they completed, indicating their willingness to participate in the study. Eventually, 671 students indicated their willingness to participate in the study, after two weeks of selection. The data collection process (recruitment and administration of questionnaire and clinical examination), was carried-out within nine weeks instead of the 4 weeks originally planned. This delay was mostly attributed to the fact that there was some waiting time to receive all the needed consent and assent forms. Also, two of the schools initially selected for the study (one mission/faith-based school and one public school) declined participation, but with the consent of the PPSMB, the two schools were replaced.

There were no major discrepancies observed during the data collection as presented in chapter 3, besides that each of the three examiners were meant to examine 240 students, but each of them examined 224 students, 224 students and 223 students, respectively.

Demographic and Descriptive Statistics of the Sample

The demographic characteristics of the sample are presented in Table 4. Among the 671 students who completed the survey, 226 respondents were in public school (33.7%), 213 were in private school (31.9%) and 231 were in missionary/faith-based schools (34.4%). Three hundred and sixty one were males (53.8%) and 310 were females (46.2%). There were 211 students between 11-12 years old (31.4%), 331 were between 13-14 years old (49.3%), 112 were between 15-16 years old (16.7%), and 17 were above

16 years (2.5%). For the different classes involved in the study, 202 were in JSS I Class (30.1%), 236 were in JSS II (35.2%) and 233 were in JSS III class (34.7%).

Among the 671 students, 98 visited the dental clinic between 0-6 months ago (14.6%), 121 visited between 7-12 months ago (18.5%), 128 visited over one year ago (19.2%) and 320 had never visited the dental clinic (47.7%). One hundred and sixty seven students visited the dentist because of pain/treatment (24.9%), and 497 visited for check-up/cleaning (74.1%). One hundred and seventy one students claimed to have received professional fluoridation in a dental clinic (25.5%), 272 had never received professional fluoridation in a dental clinic (40.5%) and 223 do not know whether they received it or not (34%). One hundred and eighty five brushed their teeth once a day (27.2%), 465 brushed twice a day (69.6%), 14 brushed sometimes in a week (2.1%) and seven claimed never to have brushed their teeth (1.1%). One hundred and thirty five students rinse their mouth once a day after each meal (20.1%), 425 rinse twice after each meal (63.4%), 66 rinse sometimes (9.9%) and 44 never rinse their mouth after each meal (6.6%). One hundred and eighty two brushed their teeth with toothbrush and fluoride toothpaste once a day (27.1%), 418 brushed twice a day (62.2%), 35 brushed sometimes a week (5.2%) and 35 never used toothbrush and fluoride toothpaste (5.2%). One hundred and eighty six brushed their teeth using up, down and sideways technique once a day (27.8%), 427 brushed twice a day (63.6%), 32 sometimes brushed using up, down and sideways technique (4.8%) and 25 never used this technique (3.8%). One hundred and thirty nine used dental floss to clean their teeth once a day (20.7%), 231 used dental floss twice a day (34.5%), 90 sometimes used dental floss (13.5%) and 210 never used dental

floss (31.3%). Sixty seven students also used chewing stick once a day to clean their teeth (10.0%), 56 used chewing stick twice a day (8.4%), 121 sometimes used it (18.2%) and 422 claimed never to have used it (63.4%).

Table 3

Descriptive Statistics of the Participants of the Study

When was your last dental visit?	*N*	%
0-6 months	98	14.6
7-12 months	121	18.5
More than a year	128	19.2
Never	320	47.7
Why do you usually visit the dentist?		
Pain/treatment	167	24.9
Check-up/tooth cleaning	497	74.1
Did you ever receive a professional fluoridation in a dental office?		
Yes	171	25.5
No	272	40.5
Do not know	223	34
How often do you brush your teeth?		
Once a day	185	27.2
Twice a day	465	69.6
Sometimes a week	14	2.1
Never	7	1.1
Do you rinse your mouth with water after each meal?		
Once a day	135	20.1
Twice a day	425	63.4
Sometimes a week	66	9.9
Never	44	6.6

Table continues

Do you use toothbrush and fluoride toothpaste for tooth brushing?	*N*	%
Once a day	182	27.1
Twice a day	418	62.2
Sometimes a week	35	5.2
Never	35	5.2
Do you brush your teeth using up, down and sideways technique?		
Once a day	186	27.8
Twice a day	427	63.6
Sometimes a week	32	4.8
Never	25	3.8
How often do you use dental floss to clean your teeth?		
Once a day	139	20.7
Twice a day	231	34.5
Sometimes a week	90	13.5
Never	210	31.3
Do you use chewing stick to clean your teeth?		
Once a day	67	10
Twice a day	56	8.4
Sometimes a week	121	18.2
Never	422	63.4

Test of Normality

Prior to hypothesis testing for research question 4, Shapiro-Wilk tests were performed with each independent variable and the dependent variables mean DMFT and mean PDI to determine normality. The results of the Shapiro-Wilk tests were that the all variables were not normally distributed; therefore non parametric tests (Mann-Whitney U and Kruskall Wallis) were used, according to the data analysis plan of Chapter 3. Also, the dependent variable (PDI) did not meet the assumptions of normal distribution and homoscedasticity for linear regression, so binary logistic regression was used instead (see RQ 4 results for more details).

Research Question 1 Results

What is the oral health status (dental caries and periodontal diseases) of secondary school students in Enugu state, Nigeria (Table 4)?

Male respondents had a mean DMFT of 0.67 (SD I.32) and mean PDI 1.16 (SD 4.33), female respondents had a mean DMFT 0.58 (SD 1.01) and mean PDI 1.13(SD 4.68).

Students in public schools had a mean DMFT of 0.71 (SD 1.10) and mean PDI 0.98 (SD 0.28) private schools mean DMFT was 0.57 (SD 1.21) and mean PDI 1.65 (SD 7.93) and students in missionary/faith-based schools had mean DMFT 0.61 (SD 1.16) and mean PDI 0.85(SD 0.36).

Students in the age group 11-12 years had a mean DMFT 0.59 (SD 1.12) and mean PDI 1.27 (SD 5.67). Those in age group 13-14 had mean DMFT 0.61 (SD 1.10) and mean PDI 1.16 (SD 4.52). Those between 15-16 years had mean DMFT 0.79 (SD

1.49) and mean PDI 0.92 (SD 0.33). Students that were 17 years and above had mean DMFT 0.47 (SD 1.46) and mean PDI 0.95 (SD 0.41).

Students in JSS I class had a mean DMFT of 0.64 (SD 1.15) and mean PDI 1.33 (SD 5.79). Those in JSS II class had a mean DMFT of 0.57 (SD 1.08) and PDI 0.94 (SD 0.34). Those in JSS III class had a mean DMFT of 0.67 (SD 1.32) and mean PDI 1.20 (SD 5.39).

Table 4

Differences of DMFT and PDI indices in Students by Demographic Parameters (Section A of the Survey). Mean Scores and Standard Deviations in Parenthesis.

Demographic factor	*N*	DMFT[1]	PDI[2]
Sex			
Male	361	0.67 (1.32)	1.16 (4.33)
Female	310	0.58 (1.01)	1.13 (4.68)
Mann-Whitney u test, $p<0.812^1$, $<0.165^2$			
School type			
Public	226	0.71 (1.19)	0.98 (0.28)
Private	214	0.57 (1.21)	1.65 (7.93)
Missionary	231	0.61 (1.16)	0.85 (0.36)
Kruskal Wallis test, $p<0.172^1$,$<0.001^2$			
Age group			
11-12	211	0.59 (1.12)	1.27 (5.67)
13-14	331	0.61 (1.10)	1.16 (4.52)
15-16	112	0.79 (1.49)	0.92 (0.33)
17 and above	17	0.47 (1.46)	0.95 (0.41)
Kruskal Wallis test, $p<0.618^1$, $<0.717^2$			
Class			
JSS I	202	0.64 (1.15)	1.33 (5.79)
JSS II	236	0.57 (1.08)	0.94 (0.34)
JSS III	233	0.67 (1.32)	1.20 (5.39)
Kruskal Wallis test, $p<0.752^1$, <0.002			
Total	671	0.63 (1.19)	1.15 (4.49)

Research Question 2 Results

What is the level of knowledge on the causes and preventive measures of oral diseases among secondary school students in Enugu State (Table 5)?

According to the results of the study, those who strongly disagreed that in order to keep the teeth healthy, it is necessary to brush after breakfast in the morning and last thing at night had a mean DMFT 0.88 (SD 1.58) and mean PDI 3.45(SD 14.28), those who disagreed had mean DMFT 0.70 (SD 1.24) and mean PDI 0.90 (SD 0.31), those who agreed had mean DMFT 0.66 (1.19) and mean PD1 0.94 (SD 0.32), and those who strongly agreed had mean DMFT 0.59 (SD 1.14) and mean PD1 1.08 (SD 4.06).

Those who strongly disagreed that it is necessary to always rinse their mouth with water after each meal in order to remove food debris trapped between teeth had a mean DMFT 0.83 (SD 1.29) and mean PDI 5.56(SD 19.33), those who disagreed had mean DMFT 0.71 (SD 1.37) and mean PDI 0.83 (SD 0.34), those who agreed had mean DMFT 0.59(SD 1.09) and mean PDI 0.93 (SD 0.30), those who strongly agreed had a mean DMFT 0.63(SD 1.22) and mean PD1 1.08 (SD 3.94).

Those who strongly disagreed that food and drink with sugar such as sweet chewing gums and soft drink destroy the teeth had a mean DMFT 1.04 (SD 1.83) and mean PDI 0.86 (0.31), those who disagreed had mean DMFT 0.60 (SD 1.10) and PDI 1.00(SD 0.30), those who agreed had mean DMFT 0.57 (SD 1.06) and mean PDI

0.91(SD 0.31), those who strongly agreed had mean DMFT 0.64(SD 1.21) and mean PDI 1.30(SD 5.77).

Those who strongly disagreed that poor oral health causes periodontal diseases such as swollen and bleeding gum had a mean DMFT 0.50 (SD 0.92) and mean PD1 5.62 (SD 19.31), those who disagreed had a mean DMFT 0.65 (SD 1.38) and mean PD1 1.03 (SD 0.20), those who agreed had mean 0.54(SD 1.08) and mean PD1 0.92 (SD 0.32), those who strongly agree had mean DMFT 0.69(SD 1.25) and mean PD1 1.08(SD 4.11).

Those who strongly disagreed that it is necessary to go for dental check-up at least once in a year had a mean DMFT 0.60 (SD 1.13) and mean PD1 3.70 (SD 14.98), those who disagreed had mean DMFT 0.93 (SD 1.19) and mean PD1 3.67 (SD 15.26), those who agreed had a mean DMFT 0.61(SD 1.19) and mean PD1 0.88.(SD 0.34), those who strongly agreed had mean DMFT 0.62(SD 1.20) and mean PD1 0.92 (SD 0.34).

Those who strongly disagreed that it is possible to prevent oral diseases by brushing, flossing and avoiding sugar had a mean DMFT 0.95 (SD 1.39) and mean PD1 5.25(SD 18.83), those who disagreed had mean DMFT 0.46 (SD 0.92) and PD1 0.96 (SD 15.26), those who agreed had mean DMFT 0.50 (SD1.04) and mean PD1 0.50 (SD 1.04), those who strongly agreed had mean DMFT 0.69 (SD 1.26) and mean PD1 1.09 (SD 4.06).

Table 5

Differences of DMFT and PDI Indices in Students by Knowledge of Dental Health Parameters (Section B of the Survey). Mean Scores and Standard Deviations in Parenthesis.

Question	*N*	DMFT[1]	PDI[2]
In order to keep the teeth healthy it is necessary to brush after breakfast in the morning and last thing at night			
Strongly disagree	33	0.88 (1.58)	3.45 (14.28)
Disagree	70	0.70 (1.24)	0.90 (0.31)
Agree	155	0.66 (1.19)	0.94 (0.32)
Strongly agree	413	0.59 (1.14)	1.08 (4.06)
Kruskall Wallis test, p< 0.712[1], <0.588[2]			
It is necessary to always rinse our mouth with water after each meal to remove food debris trapped between teeth			
Strongly disagree	18	0.83 (1.29)	5.56 (19.33)
Disagree	24	0.71 (1.37)	0.83 (0.34)
Agree	192	0.59 (1.09)	0.93 (0.30)
Strongly agree	437	0.63 (1.22)	1.08 (3.94)
Kruskal Wallis test, p<0.848[1], <0.178[2]			
Foods and drinks with sugar such as sweets, chewing gums, and soft drinks destroy your teeth			
Strongly disagree	24	1.04 (1.83)	0.86 (0.31)
Disagree	40	0.60 (1.10)	1.00 (0.30)
Agree	201	0.57 (1.06)	0.91 (0.31)
Strongly agree	406	0.64 (1.21)	1.30 (5.77)
Kruskal Wallis test, p<0.865[1], <0.336[2]			
Poor oral health causes periodontal disease such as swollen and bleeding gum.			
Strongly disagree	18	0.50 (0.92)	5.62 (19.31)
Disagree	26	0.65 (1.38)	1.03 (0.20)

Table continues

Agree	223	0.54 (1.08)	0.92 (0.32)
Strongly agree	402	0.69 (1.25)	1.08 (4.11)
Kruskal Wallis test, p<0.610[1], <0.040[2]			
It is necessary to go for dental check-up at least once in a year			
Strongly disagree	30	0.60 (1.13)	3.70 (14.98)
Disagree	29	0.93 (1.19)	3.67 (15.26)
Agree	239	0.61 (1.19)	0.88 (0.34)
Strongly agree	373	0.62 (1.20)	0.92 (0.34)
Kruskal Wallis test, p<0.409[1], <0.218[2]			
It is possible to prevent oral diseases by brushing, flossing and avoiding sugar.			
Strongly disagree	19	0.95 (1.39)	5.25 (18.83)
Disagree	28	0.46 (0.92)	0.96 (0.34)
Agree	211	0.50 (1.04)	0.92 (0.29)
Strongly agree	412	0.69 (1.26)	1.09 (4.06)
Kruskal Wallis test, p<0.144[1], <0.669[2]			
Total	671	0.63 (1.19)	1.15 (4.49)

Research Question 3 Results

What are the behaviors/attitudes (e.g., frequency and reason of dental visit, brushing and flossing frequency, consumption of food with sugar content) of secondary school students in Enugu State towards dental health (Table 6 & 7)?

According to the study's findings, those who strongly disagreed that caring for the mouth is as important as caring for other parts of the body had a mean DMFT 0.31(SD 0.60) and mean PDI 6.12 (SD 20.5), those who disagreed had mean DMFT 0.69 (SD 1.36) and mean PDI 6.12 (SD 20.5), those who disagreed had mean DMFT 0.69 (SD 1.36) and mean PDI 0.99 (SD 0.34), those who agreed had mean DMFT 0.51(SD 0.94) and mean PDI 1.39 (SD 6.06), those who strongly agreed had mean DMFT 0.69(SD1.25) and mean PDI 0.88 (SD 0.35).

Those who strongly disagreed that it is important to brush the teeth in the morning after breakfast and last thing before sleep had a mean of DMFT 0.40 (SD 0.91) and mean PDI 3.21(SD 13.88), those who disagreed had mean DMFT 0.53(1.08) and mean PDI 0.92(SD 0.37), those who agreed had mean DMFT 0.61(SD 1.23) and PDI 0.94 (SD 0.30), those who strongly agreed had mean DMFT 0.61(SD 1.23) and mean PDI 1.10(SD 4.22).

Those who claimed to had visited the dental clinic between 0-6 months ago had a mean DMFT 0.69 (SD1.20) and mean PDI 0.98 (SD 0.32), those who visited between 7-12months ago had mean DMFT 0.63 (SD 1.14) and mean PDI 0.88 (SD 0.38), those who had visited for more than a year had mean DMFT 0.70 (SD 1.18) and mean PDI 1.59 (SD 7.26), those who had never visited the dental clinic had mean DMFT 0.57 (SD 1.19) and mean PDI 1.14 (SD 4.60).

Those who claimed to visit the dentist for pain/treatment had mean DMFT 0.60 (SD 1.10) and mean PDI 1.38 (SD 6.36), those who visited for check-up/tooth cleaning had mean DMFT 0.64 (SD 1.21) and mean PDI 1.08 (SD 3.70)

Those who claimed to have received professional fluoridation in a dental office had a mean DMFT 0.69 (SD 1.17) and mean PDI 1.40 (SD 6.29), those who said no, had mean DMFT 0.69 (SD 1.21) and mean PDI 1.19(SD 4.99), those who did not know had mean DMFT 0.60 (SD 1.15) and mean PDI 0.93 (SD 0.33).

Table 6

Differences of DMFT and PDI Indices in Students by Attitudes Toward Dental Health Parameters (Section B of the Survey). Mean Scores and Standard Deviations in Parenthesis.

Question	*N*	DMFT[1]	PDI[2]
Caring for your mouth is as important as caring for other parts of the body			
Strongly disagree	16	0.31 (0.60)	6.12 (20.5)
Disagree	29	0.69 (1.36)	0.99 (0.34)
Agree	184	0.51 (0.94)	1.39 (6.06)
Strongly agree	441	0.69 (1.25)	0.88 (0.35)
Kruskall Wallis test, $p<0.765^{1}$, $<0.230^{2}$			
It is important to brush the teeth in the morning after your breakfast and last thing before you sleep teeth			
Strongly disagree	35	0.40 (0.91)	3.21 (13.88)
Disagree	60	0.53 (1.08)	0.92 (0.37)
Agree	194	0.61 (1.18)	0.94 (0.30)
Strongly agree	381	0.67 (1.23)	1.10 (4.22)
Kruskal Wallis test, $p<0.612^{1}$, $<0.503^{2}$			
When was your last dental visit?			
0-6 months	98	0.69 (1.20)	0.98 (0.32)
7-12 months	121	0.63 (1.14)	0.88 (0.38)
More than a year	128	0.70 (1.18)	1.59 (7.26)
Never	320	0.57 (1.19)	1.14 (4.60)
Kruskal Wallis test, $p<0.471^{1}$, $<0.016^{2}$			
Why do you usually visit the dentist?			
Pain/treatment	167	0.60 (1.10)	1.38 (6.36)
Check-up/tooth cleaning	497	0.64 (1.21)	1.08 (3.70)
Mann Whitney U test, $p<0.980^{1}$, $<0.805^{2}$			
Did you ever receive a professional fluoridation in a dental office?			
Yes	171	0.69 (1.17)	1.40 (6.29)
No	272	0.60 (1.21)	1.19 (4.99)
Do not know	223	0.60 (1.15)	0.93 (0.33)
Kruskal Wallis test, $p<0.677^{1}$, $<0.449^{2}$			
Total	671	0.63 (1.19)	1.15 (4.49)

Also, students who brushed their teeth once a day had a mean DMFT 0.55 (SD 1.06) and mean PDI 0.89 (SD 0.35), those who brushed twice a day had mean DMFT 0.65 (SD 1.21) and mean PDI 1.26 (SD 5.39), those who brushed sometimes a week had mean DMFT 0.50 (SD 1.09) and mean PDI 0.90 (SD 0.35), those who had never brush their teeth had DMFT 1.86 (SD 2.55%) and mean PDI 0.95 (SD 0.49).

Those who claimed to rinse their mouth once a day with water, after each meal had a mean DMFT 0.69 (1.15) and mean PDI 0.95 (SD 0.35), those who rinsed twice a day had mean DMFT 0.64 (1.24) and mean PDI 1.28 (SD 5.64), sometimes a week had mean DMFT 0.64 (SD 1.08) and mean PDI 0.86 (SD 0.36), those that had never, had mean DMFT 0.32 (SD 0.91) and mean PDI 0.91 (0.32).

Those who used toothbrush and fluoride toothpaste for cleaning their teeth once a day had a mean DMFT 0.53 (SD 1.00) and mean PDI 0.91(SD 0.36), those who used it twice a day had mean DMFT 0.63(DS 1.21) and PDI 1.30(SD 5.68), those who used it sometimes a week had mean DMFT 0.83 (SD 1.34) and mean PDI 0.91(SD 0.30), those who had never, had mean DMFT 0.77 (SD 1.44) and mean PDI 0.85 (SD 0.38).

Those who brushed their teeth using up, down and sideways technique once a day had a mean DMFT 0.46 (SD 0.88) and mean PDI 0.91 (SD 0.33), twice a day had mean DMFT 0.69 (SD 1.31) and mean PDI 1.28 (SD 5.62), sometimes a week had mean DMFT 0.50 (SD 1.11) and mean PDI 0.97 (SD 0.32), and never, had mean DMFT 0.96 (SD 1.06) and mean PDI 0.93 (SD 0.36).

Students who reported to use dental floss to clean their teeth once a day had a mean DMFT 0.60 (SD 1.07) and mean PDI 0.91 (SD 0.33), twice a day had mean DMFT 0.66 (SD 1.23) and mean PDI 1.25 (SD 5.41), sometimes a week had mean DMFT 0.73 (SD 1.26) and mean PDI 0.87 (SD 0.32), and never, had mean DMFT 0.57 (SD 1.19) and mean PDI 1.32 (SD 567).

Students who claimed to use chewing stick once a day had mean DMFT 0.61(SD 1.15) and mean PDI 2.21(SD 10.02), twice a day had mean DMFT 0.95 (SD 1.66) and mean PDI 0.95 (SD 0.29), sometimes had mean DMFT 0.69 (SD 1.28) and mean PDI 0.90 (SD 0.34), and never, had mean DMFT 0.58 (SD 1.09) and mean PDI 1.08 (SD 4.01).

Table 7

Differences of DMFT and PDI Indices in Students by Practice of Oral Hygiene Parameters (Section D of the Survey). Mean Scores and Standard Deviations in Parenthesis.

Question	*N*	DMFT[1]	PDI[2]
How often do you brush your teeth?			
Once a day	185	0.55 (1.06)	0.89 (0.35)
Twice a day	465	0.65 (1.21)	1.26 (5.39)
Sometimes a week	14	0.50 (1.09)	0.91 (0.35)
Never	7	1.86 (2.55)	0.95 (0.49)
Kruskall Wallis test, $p<0.260^{1}$, $<0.964^{2}$			
Do you rinse your mouth with water after each meal?			
Once a day	135	0.69 (1.15)	0.95 (0.35)
Twice a day	425	0.64 (1.24)	1.28 (5.64)
Sometimes a week	66	0.64 (1.08)	0.86 (0.36)
Never	44	0.32 (0.91)	0.91 (0.32)
Kruskal Wallis test, $p<0.71^{1}$, $<0.426^{2}$			
Do you use toothbrush and fluoride toothpaste for tooth brushing?			
Once a day	182	0.53 (1.00)	0.91 (0.36)
Twice a day	418	0.63 (1.21)	1.30 (5.68)
Sometimes a week	35	0.83 (1.34)	0.91 (0.30)
Never	35	0.77 (1.44)	0.85 (0.38)
Kruskal Wallis test, $p<0.621^{1}$, $< 0.594^{2}$			

Table continues

Do you brush your teeth using up, down and sideways technique?			
Once a day	186	0.46 (0.88)	0.91 (0.33)
Twice a day	427	0.69 (1.31)	1.28 (5.62)
Sometimes a week	32	0.50 (1.11)	0.97 (0.32)
Never	25	0.96 (1.06)	0.93 (0.36)
Kruskal Wallis test, $p<0.014^1$, $<0.500^2$			
How often do you use dental floss to clean your teeth?			
Once a day	139	0.60 (1.07)	0.91 (0.33)
Twice a day	231	0.66 (1.23)	1.25 (5.41)
Sometimes a week	90	0.73 (1.26)	0.87 (0.32)
Never	210	0.57(1.19)	1.32 (5.67)
Kruskal Wallis test, $p<0.523^1$, $<0.475^2$			
Do you use chewing stick to clean your teeth?			
Once a day	67	0.61 (1.15)	2.21 (10.02)
Twice a day	56	0.95 (1.66)	0.95 (0.29)
Sometimes a week	121	0.69 (1.28)	0.90 (0.34)
Never	422	0.58 (1.09)	1.08 (4.01)
Kruskal Wallis test, $p<0.819^1$, $<0.358^2$			
Total	671	0.63 (1.19)	1.15 (4.49)

Research Question 4 Results

What are the relationships between demographic variables (age, gender, class and type of institution), level of oral health knowledge, as well as oral health behavior and attitudes of secondary school students in Enugu State and their oral health status (Tables 4-8)?

The first null hypothesis is that there is no significant relationship between demographic and students' oral health status, and the alternative one is that there is a significant relationship between demographic variables and students' oral health status.

According to the results of Mann-Whitney U and Kruskal Wallis tests, null hypothesis was accepted for dental caries (DMFT scores). On the contrary, Kruskal-Wallis test revealed that school type (p<0.001) and class (p<0.002) appeared to have a significant impact on the periodontal status of the students (alternative hypothesis accepted). More specifically, according to Mann-Whitney U post-hoc tests, students of public schools had significantly lower PDI scores than students of private schools (0.98 ±0.28 vs. 1.65 ±7.93, U=21249.5, p<0.024), and significantly higher PDI scores than students of missionary schools (0.98 ±0.28 vs. 0.85 ±0.36, U=20787.5, p<0.0001). Also, students of JSS III class had significantly lower PDI scores than students of JSS I class (1.20 ±5.39 vs. 1.33 ±5.99, U=20099.5, p<0.007), and significantly higher PDI scores than students of JSS II class (1.20 ±5.39 vs. 0.94 ±0.34, U=22725, p<0.001).

The second null hypothesis is that there is no significant relationship between the students' level of oral health knowledge and students' oral health status, and the alternative hypothesis is that there is a significant relationship between the students' level of oral health knowledge and students' oral health status.

According to our results, null hypothesis was accepted for dental caries, but rejected for periodontal diseases. More specifically, students who strongly disagreed with the statement "poor oral health causes periodontal disease such as swollen and bleeding gum" had significantly higher PDI scores (5.62 ±19.31), compared to those who agreed (0.92 ±0.32,U=1438.5, p<0.041) and disagreed with this statement (1.08 ±4.11,U=2527.5, p<0.027).

The third null hypothesis about this research question is that there is no significant relationship between the students' oral health behavior and attitudes and their oral health status, and the alternative one is that there is a significant relationship between the students' oral health behavior and attitudes and their oral health status.

Null hypothesis was rejected for both dental caries and periodontal diseases. More specifically, the students that brushed their teeth using up, down and sideways technique once a day had a significantly lower mean DMFT (0.46 ±0.88) compared to those who did this technique twice a day (0.69 ±1.31, U=1592, p<0.002), sometimes a week (0.50 ±1.11, U=4046.5, p<0.014), and never (0.96 ±1.06, U=264.5, p<0.011). Also, students who claimed to have visited the dental clinic between 0-6 months ago had a significantly lower mean (PDI 0.98 ±0.32), compared to those that had never visited the dental clinic (PDI 1.14 ± 4.60, U=12928, p<0.007).

In order to test a relationship between PDI scores and demographic information, oral health knowledge, behaviors and practices, binary logistic regression was conducted using a new binary PDI variable as the dependent variable, and covariates (predictors) as those variables that were found significant from the bivariate tests. Please note that as only one variable was found significantly associated with dental caries, no multivariate analysis was needed for this dependent variable. Mean PDI scores was re-coded into categorical variable low and high PDI score--where low score was all data below and at the median cut off point of PDI distribution and high score was all data above the median level of PDI scores.

The logistic regression model was statistically significant, $\chi^2(6) = 14.876$, $p < .021$, and explained 3.2% (Nagelkerke R^2) of the variance in PDI scores and correctly classified 72.8% of cases. The Hosmer and Lemeshow test supports the model (p=.187). Of the four predictor variables, only two were statistically significant: school type (p<.023) and work setting (p<.016) (Table 8).

School type appeared to be the strongest predictor of periodontal diseases, with an odds ratio of .612 (95% CI [.402, .934]), pointing out that the students from a missionary school were less likely to show a higher mean level of PDI scores than those from public schools. Class was another predictor with an odds ratio of .567 (95% CI [.363, .886]), indicating that students from JSS III class were less likely to have a higher mean level of PDI scores than those of JSS I class.

Table 8

Binary Logistic Regression Between Independent and Mediating Variables vs. Low and High PDI Score (Dependent Variable).

							95% CI	
Predictor	*B*	*S.E.*	*Wald*	*df*	*p*	*OR*	*LL*	*UL*
School type (missionary, ref: public)	-.490	.215	5.180	2	**.023**	.612	.402	.934
Class (JSS III, ref: JSS I)	-.507	.227	6.206	1	**.013**	.567	.363	.886
Poor oral health causes periodontal disease such as swollen and bleeding gum.								
When was your last dental visit? Constant	-.050	.125	.158	1	.691	.952	.745	1.215
	-.033	.078	.182	1	.670	.967	.830	1.128
	-.299	.506	.348	1	.555	.742		

Note. B = B coefficients; *S.E.* = standard error; *Wald* = Wald test, *df* = degrees of freedom, *p* = probability value, *OR* = odds ratio, CI = confidence interval for odds ratio, *LL* = lower level, *UL* = upper level

Summary

The purpose of the study was to assess the oral health knowledge, attitudes and practice of secondary students in relation to their oral health status, in Enugu State, Nigeria. Descriptive and inferential statistics were conducted to answer the research questions and hypotheses.

Shapiro-Wilk tests were conducted to determine normality among the variables. Non-parametric bivariate testing with Kruskal Wallis and Mann-Whitney tests were performed to determine if there were differences in dental caries and periodontal diseases scores among 671 secondary students in Enugu state, Nigeria. Binary logistic regression was used to determine if independent and mediating variables affected oral diseases levels.

The mean DMFT and PDI score of the students was .63 ±1.19 and 1.15 ±4.49, respectively. School type appeared to be the strongest predictor of periodontal diseases, with an odds ratio of .612 (95% CI [.402, .934]), pointing out that the students from a missionary school were less likely to show a higher mean level of PDI scores than those from public schools. Class was another predictor with an odds ratio of .567 (95% CI [.363, .886]), indicating that students from JSS III class were less likely to have a higher mean level of PDI scores than those of JSS I class.

The findings of the study will be discussed in chapter 5, including limitations, generalizability of the results, and recommendations for practice and for further research.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of the study was to assess the oral health knowledge, attitudes, and practices of secondary school students, in relation to their oral health status, in Enugu State, Nigeria. A closed-ended questionnaire and dental examination was used for data collection. The self-structured closed-ended questionnaire was used to collect data on demographic profiles, knowledge, attitudes and practices of the students, and dental examinations was used to determine the oral health status (dental caries and periodontal diseases) of the students.

Key Findings of the Study

The mean DMFT and PDI score of the students were found .63 ±1.19 and 1.15 ±4.49, respectively, which are considered as relatively low disease levels (Shirazi et. al., 2013; Wilkins, 1999). Low DMFT levels can be partly attributed to the fluoridated water in this specific state in Nigeria. More specifically, a study was conducted by Ogbu, Okoro and Ugwuja (2012) in order to determine the mean fluoride concentration of water collected from five zones in Enugu State, Nigeria. The results revealed that Abakpa-Nike had 0.60mg/L, Achara Layout had 0.70mg/L, Obiagu/Ogui had 0.62mg/L, Trans-Ekulu had 0.62mg/L, and Uwani had 0.63mg/L. The overall mean concentration of fluoride was 0.63mg/L in the whole state. The authors concluded that the overall mean concentration of fluoride recorded in the study were lower than the permissible limit of WHO (1.5 mg/L).

Also, the great majority of the students declared that they visited the dentist for check/up and cleaning. However, only one fourth of the sample reported the receipt of professional fluoridation, which is one of the most significant dental preventive measures, and almost 50% of the students had never visited a dentist. Further, most of the participants responded that brushed their teeth at least twice a day, but the flossing frequency was relatively low. Bivariate analysis revealed that school type and class appeared to have a significant impact on the periodontal status of the students. Students of public schools had significantly lower PDI scores than students of private schools and significantly higher PDI scores than students of missionary schools. Also, students of JSS III class had significantly lower PDI scores than students of JSS I class, and significantly higher PDI scores than students of JSS II class. Additionally, students who strongly disagreed with the statement "poor oral health causes periodontal disease such as swollen and bleeding gum" had significantly higher PDI scores compared to those who agreed, and disagreed with this statement. Students who claimed to have visited the dental clinic between 0-6 months ago had a significantly lower mean, compared to those that had never visited the dental clinic.

In order to test the relationship between PDI scores and demographic information, oral health knowledge, behaviors and practices, binary logistic regression was conducted using a new two level PDI variable as the dependent variable and covariates (predictors) as those variables that were found significant from the bivariate tests. School type appeared to be the strongest predictor of periodontal diseases, with an odds ratio of .612 (95% CI [.402, .934]), pointing out that the students from a missionary school were less

likely to show a higher mean level of PDI scores than those from public schools. Class was another predictor with an odds ratio of .567 (95% CI [.363, .886]), indicating that students from JSS III class were less likely to have a higher mean level of PDI scores than those of JSS I class.

Interpretation of the Findings

According to the results of the study, a low occurrence of dental caries and periodontal diseases was recorded among the students. This interpretation was in agreement with Shirazi, et al. (2013) who explained that DMFT value between 0-4 is considered low caries status; and Wilkins (1999) who also explained that PDI value between 0-3 indicated gingival involvement only. Male had higher mean DMFT and PDI scores than the female students. This result is not in accordance with the findings from the similar study conducted by Ogundele and Ogunsile (2008) who found that dental caries was prevalent among the female students. Public schools had higher mean DMFT score than the private and missionary/faith-based school, and students between age group 15-16 years old had higher mean DMFT score. This is similar to the findings of Ogundele and Ogunsile (2008) which revealed that majority of dental caries observed among the junior secondary school students was among those aged 14-16 years.

Most of the students had satisfactory knowledge on the causes on various preventive measures of oral diseases, such as, knowing that it is necessary to brush the teeth after breakfast in the morning and last thing at night, to avoid intakes of foods and drinks that contain sugar, to go for dental check-up at least once in a year, and that it is possible to prevent oral diseases by brushing, flossing and avoiding sugar. These findings

are also supported by the studies conducted by Ogunsile and Ogundele (2008), Emmanuel and Chang'endo (2009), Carneiro et al. (2011), and Mehta and Kaur (2012).

Most students had positive attitudes towards their oral health status, as the majority of them either strongly agreed or agreed that caring for the mouth is as important as caring for other parts of the body, and that it is important to brush the teeth in the morning after breakfast and last thing in the night. Emmanuel and Chang'endo (2009) explained that maintaining positive attitudes will go a long way in preventing dental health problems. Although the majority of the students claimed to visit the dentist for check-up and tooth cleaning, only few of them claimed to have received professional fluoridation in a dental clinic. The response of the students could be justified by the fact that professional fluoridation is not a common preventive dental treatment for children in the Eastern part of Nigeria.

The practice of oral hygiene among the students was significantly sound as most of them brushed their teeth once or twice a day, with toothpaste and fluoride toothpaste, and rinse their mouth with water once or twice a day after each meal. These practices were also in agreement with the findings from Ogundele and Ogunsile (2008), Emmanuel and Chang'endo (2009), Carneiro et al. (2011), and Sa'adu et al. (2012). Very few students used chewing stick once or twice a day for cleaning their teeth. The reason for the choice of plastic toothbrush may not be far from the fact that toothbrush is preferred in the urban areas to the wooden toothbrush (Mswaki; Carneiro et al., 2011).

A significantly high knowledge, positive attitudes and sound practices of oral health were detected among the examined students. This may likely be the reason for the

low levels of dental caries and periodontal diseases observed in this study, and it is in accordance the study conducted by Ogundele and Ogunsile (2008) in Oyo State, Nigeria, among adolescents of the same age groups.

Results from binary logistic regression revealed that school type was the strongest demographic predictor of periodontal diseases, as measured with the PDI scale. Students from public schools demonstrated a higher mean level of PDI score than those from the missionary/faith-based schools. This result was somehow expected because most of the students attending public schools have low socioeconomic status (SES), and therefore their level of awareness on oral health and practice could be lower compared to the one of students attending private and missionary schools. According to Akpata (2004), students attending private and missionary schools in Nigeria are widely considered to receive an education of better quality than their counterparts attending public schools, even though oral health education is not inculcated into existing school curriculum in Nigeria.

Class type as another significant predictor of having low or high PDI score, indicated that the youngest students (JSS I) were more likely to have higher mean level PDI score than the oldest students (JSS III). No previous studies from the literature had really established a relationship between class type and prevalence of periodontal diseases in populations similar to the study sample. Possible explanations for this finding may be that the JSS III students were found to brush their teeth more frequently compared to JSS I students, they may have had more visits to dentists, and they usually give more attention to their appearance as adolescents.

Limitations of the Study

One of the limitations of the study was that there was the possibility of some of the students reported a desirable behavior (e.g., increased brushing frequency) due to potential social pressure. In order to minimize this, the investigator, prior to distribution of the questionnaire, highlighted the anonymity of the participants, informed the participants that there was no grade attached to the questionnaire filled; as such, participants were advised to fill the questionnaire as independently as possible and emphasized on the importance of true information (Nyamuryekunge, 2012).

Another limitation of the study was that participants of the students were from a specific state in Nigeria. As such, generalization of the results to students' population from different cultural and ethnic background should be done with caution. However, the study findings may provide useful information for students with similar demographic characteristic in the country.

Using a cross sectional design to obtain some information on several issues of oral health of a population is another limitation of this study because of its inability to attribute causality; that is, whether an exposure precedes or follows an outcome (Nyamaryekung'e, 2012).

The non use of radiographs to detect interproximal caries was also a limitation for this study, as there was the possibility of overlooking caries in between the teeth. Furthermore, the DMFT value did not show the number of teeth at risk of developing caries. Despite these limitations, DMFT score has been found to be a universally applicable instrument for measuring dental caries (Udoye et al., 2009).

The use of a questionnaire was difficult to access the reliability of oral health variables in the survey because of recall bias, especially in the area of attitudes and practice of oral health. The issue of non-response bias also occurred especially as far as students from the public schools are concern, because they were not familiar with some of the terms that were presented in the given questionnaire, although explanation was given prior and during the study.

Recommendations for Future Research and Practice

This study has contributed to the literature by providing baseline information on the knowledge, attitudes and practice of secondary school students in relation to their oral health status in this specific region of Nigeria. However, additional studies investigating this issue can be conducted, among students from different cultural and ethnic backgrounds in Nigeria, in order to make the results more generalizable.

The findings of this study revealed that the students expressed high knowledge, positive attitudes and sound practices of oral health, but the level of dental attendance and the use of dental floss were found relatively low. There is need to inculcate oral health education into the school curriculum, especially for public schools; this will go a long way in providing relevant information on the need to maintain good oral health, by adopting appropriate oral hygiene measures.

The rate of attendance to dental clinic at least once in a year was low, despite the high levels of knowledge regarding the importance of dental visits. There is need to carry out further studies in order to find out whether the low dental visits was due to non-availability of dental services or just negative attitude towards preventive measures.

Another recommendation may be to expand this study to be longitudinal in nature in order to follow participants over time.

It should be also noted that dental problems constitute one of the reasons for students' absenteeism from school (Ogundele & Ogunsile, 2008). It is necessary for schools whether private, public or missionary, to make effort, in making arrangement for periodic visit by dental professionals in their localities to give oral health education and carryout clinical examination, in order to detect oral diseases among the students.

Social Change Implications

The findings of this research have contributed to the literature by providing a national base line data for Enugu State Ministry of Education and Ministry of Health, on the relationship between oral health knowledge, attitudes and practice of secondary school students in relation to their oral health status.

One of the major findings of this research was that despite the significantly high level of knowledge by the students, almost half of the students had never visited the dentist. Therefore schools' and local dental school's authorities should schedule periodic visits by dental professionals, in order to give both students and teachers oral health education, and to conduct free dental check-up.

Enugu State Ministry of Education will be encouraged to incorporate oral health education into the existing school curriculum; as such, students will have access to information on how to prevent common oral diseases such as dental caries and periodontal diseases. Also, Federal School of Dental Technology and Therapy, Enugu may organize oral health intervention program for schools. This program may include the

promotion of oral hygiene practices, such as the brushing and especially flossing, but also the application of preventive dental treatment, such as professional fluoridation and sealants. This will lead to positive social change in the sense that students will be more informed on how to prevent dental problem by practicing good oral hygiene, and also will receive beneficial preventive measures.

Conclusion

The mouth is the major gateway to the body, as such, whatever affects the oral health will also affect the general health. Good oral health behavior and attitude plays a fundamental role for general wellbeing by preventing common oral diseases, such as dental caries and periodontal disease, especially in children who live in developing countries (Sa'adu et al., 2012). The behavior/attitude include regular tooth brushing and flossing, preventive measures such as fluoridation and sealants, healthy nutritional habits and regular visit to the dentists (Sa'adu et al., 2012).

Secondary school students and adolescents in Nigeria face challenges regarding their oral health, because of the daily high consumptions of sugary foods and drinks and because of poor oral hygiene, which predispose them to dental caries and periodontal diseases (Ogundele & Ogunsile, 2008). The negative impacts of poor oral health include pain and suffering, functional impairment and reduced quality of life (Petersen, 2004).

Oral health knowledge is considered to be an essential pre-requisite for health related practices. According to Carneiro et al. (2011), there is an association between increased knowledge and better oral health due to the fact that people who assimilate oral health knowledge, most probably have a sense of personal control over their oral health,

and they are more likely to adopt self-care practice. A review of literature on the oral health knowledge, attitudes and behavior among students in Nigeria demonstrated poor results on the topic; thus, there was a literature gap.

The purpose of this study was to fill the literature gap by identifying and describing the extent of knowledge, behavior and attitudes of students in secondary schools in Enugu East Local Government Area, Enugu state, Nigeria, in relationship to their oral health status, through cross-sectional survey. Descriptive and inferential statistics were conducted to answer the research questions and hypotheses. Binary logistic regression was conducted to see if any relationship exists between PDI scores and demographic information, oral health knowledge, behaviors and practices. According to the results of the study, there was a low level of dental attendance and use of flossing and professional fluoridation, although there was a high knowledge, positive attitude and sound practices of dental health in general. Also, students from public schools and lower class (JSS I) appeared to had significantly higher levels of periodontal diseases, as measured with the PDI scale. Therefore, the Enugu State Ministry of Education may incorporate oral health education and promotion programs into the existing school curriculum, in order to more inform both students and teachers about the beneficial oral health behaviors, and also to provide free dental check-up. The social change aspect of these programs may increase the adoption of preventive oral health strategies by the students, such as regular dental attendance and professional fluoridation, and thus good oral health of students could be maintained for a life time.

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Appendix A: Oral Health Knowledge, Attitudes, and Practice for Secondary School Students.

Section A: Demographic Account

1. Name of School_____
2. Type of school (a) Public (b) Private (c) Missionary
3. Gender (a) Male (b) Female
4. Age group (years) (a) 11-12 (b) 13-14 (c) 15-16 (d) 17 and above
5. Class (a) JSS I (b) JSS II (c) JSS III

Section B: Knowledge of Dental Health

6. In order to keep the teeth healthy it is necessary to brush after breakfast in the morning and last thing at night.1=strongly disagree 2-disagree 3-agree4=strongly agree
7. It is necessary to always rinse our mouth with water after each meal to remove food debris trapped between teeth.1=strongly disagree 2-disagree 3-agree 4=strongly agree
8. Foods and drinks with sugar such as sweets, chewing gums, and soft drinks destroy your teeth.1=strongly disagree 2-disagree 3-agree 4=strongly agree
9. Poor oral health causes periodontal disease such as swollen and bleeding gum.1=strongly disagree 2-disagree 3-agree 4=strongly agree
10. It is necessary to go for dental check-up at least once in a year.1=strongly disagree 2-disagree 3-agree 4=strongly agree
11. It is possible to prevent oral diseases by brushing, flossing and avoiding sugar.1=strongly disagree 2-disagree 3-agree 4=strongly agree

Section C: Attitudes toward dental health

12. Caring for your mouth is as important as caring for other parts of the body.1=strongly disagree 2-disagree 3-agree 4=strongly agree

13. It is important to brush the teeth in the morning after your breakfast and last thing before you sleep.1=strongly disagree 2-disagree 3-agree,4=strongly agree

14. When was your last dental visit?

(a) 0-6 months (b) 7-12 months (c) more than a year (d) never

15. Why do you usually visit the dentist?

(a) pain/treatment (b) check-up/tooth cleaning

16. Did you ever receive a professional fluoridation in a dental office?

(a) Yes (b) no (c) do not know

Section D: Practice of Oral hygiene

17. How often do you brush your teeth?

(a) Once a day (b) twice a day (c) sometimes a week (d) never

18. Do you rinse your mouth with water after each meal?

(a) Once a day (b) twice a day (c) sometimes a week (d) never

19. Do you use toothbrush and fluoride toothpaste for tooth brushing?

(a) Once a day (b) twice a day (c) sometimes a week (d) never

20. Do you brush your teeth using up, down and sideways technique?

(a) Once a day (b) twice a day (c) sometimes a week (d) never

21. How often do you use dental floss to clean your teeth?

(a) Once a day (b) twice a day (c) sometimes a week (d) never

22. Do you use chewing stick to clean your teeth?

(a) Once a day (b) twice a day (c) sometimes a week (d) never

Appendix B: Clinical Examination

Decayed, Missing and Filled Teeth (DMFT) Index

1. Selection of Teeth
    a. DMFT is based on 28 Teeth
    b. Teeth not counted
        - Third molars
        - Unerupted teeth
        - Congenitally missing and supernumerary teeth
        - Teeth removed for reasons other than dental caries
        - Teeth restored for reasons other than dental caries, such as trauma (fracture) cosmetic purposes or for use as a bridge abutment.
        - Primary tooth retained with the permanent successor erupted.
2. Scoring
    a. Individual DMFT
        i. Total each component separately
        ii. Total D+M+F = DMF

        Example: D = 3, M = 2, F = 5

        DMF = 3+2+5 = 10 (A DMF of I0 may have different deviations. An individual who had regular dental care may have a distribution: D = 0, M = 0, F = 10).
    b. Group Average
        i. Total to the DMFs for each individual examined
        ii. Divide the total DMFs by the number of individuals in the group.

        Example: 30 individuals with a total DMF of 210

        $\frac{210}{30}$ = 7.0 average DMF for the 30 group
        iii. This DMF average represents accumulated dental caries experience. It can be presented by age groups.
3. Specific Treatment Needs of a Group

a. To calculate the percentage of DMF teeth needing restorations, divide the total D component by the total DMFT.

   Example: D = 175, M = 55, F = 18

   Total DMFT = 248

   D =175= .70 or 70% of the teeth need restorations
   DMF 248

b. Tooth mortality in a group of 20 individuals

   i. To calculate the percentage of teeth lost by extraction, divide the total M component by the total DMFT.

      Example: D = 175, M = 55, F = 18

      Total DMFT = 248

      M =55 = .22 or 22% of the DMF teeth are accounted for by extraction
      DMF 248

   ii. To calculate the percentage of all teeth lost by extraction because of dental caries; twenty individuals have 28 x 20 = 560 teeth.

      M= 55 = .09 or 9% of all their teeth lost because of dental caries
      Total teeth 560

   iii. The same calculation is used to determine the percentage of filled teeth (Adapted from Wilkins, 1989).

Appendix C: Clinical Examination (PDI) as Specified by Ramfjord 1967.

The Periodontal Disease Index (PDI)

1. Selection of Teeth and Surface

i. Six teeth are used to represent the six segments of the definition, starting from the posterior of the right maxillary jaw
(FDI system tooth numbers are in parenthesis)

Maxillary	Mandibular
No 3 (16) right first molar	No 19 (36) left first molar
No 9 (21) left central incisor	No 25 (41) right central incisor
No 12 (24) left first premolar	No 28 (44) right first premolars

ii. Only fully erupted teeth are used

iii. Substitutions are not made for missing teeth; scores are derived from the teeth present.

2. Criteria for Scoring

0 = Absence of signs of inflammation

1 = Mild to moderate inflammatory gingival changes, not extending all around the tooth.

2 = Mild to moderately severe gingivitis extending all around the tooth.

3 = Severe gingivitis characterized by marked redness, swelling, tendency to bleed and ulceration, not necessarily extending around the tooth.

4 = Pockets of any 2 or 4 recorded areas extend-appically to thecemento enamel junction not more than, but including, 3mm.

5 = When the pockets of any 2 or 4 recorded areas extend apically to the cemento enamel junction from 3mm to 6mm.

6 = When the pockets extend more than 6mm

3. Suggest Normal Scale for Evaluation of Scores

i. Gingivitis - Number 0 to 3 indicate gingival involvement only with increase severity from 0 (no disease) through 3-9 (severe gingivitis).

ii. Periodontitis – Number 4 through 6 indicate periodontal involvement with migration of the functional epithelium and bone loss of increase degree of severity from 4 (early disease) through 6 (advanced disease).

4. Calculation Example for an individual

Tooth	**Periodontal Disease Score**
No 3(16)	4
No 9(21)	0
No 12(24)	5
No 19(36)	6
No 25(41)	4
No 28(44)	2
Total	**21**

PDI = Total Scores / Number of teeth = 21 / 6 = 3.5 (By nominal scale representation; represent severe gingivitis)

5.

Total the individual PDI Scores and divide by the number of individuals examined. The average ranges from 0 to 6.

(Adapted from Wilkins, 1989).

Appendix D: Permission Letter to Institutions

Johnson John Omale

_____
_____
_____
_____

Sir/Madam,

My name is Johnson John Omale, I am a post graduate student at the Walden University, Minnesota, USA, pursuing a Doctorate Degree in Public Health (Community Health Education). I am conducting a study to determine the oral health knowledge, attitudes and practice of secondary school students in Enugu East Local Government Area, Enugu State.

I am requesting for your kind permission to use your institution for the study. The target audience is students in JSSI, II and III respectively. The participation is voluntary; the students are expected to fill an assent form and their parents fill a consent form before they can be allowed to participate in the study. The study will be in two phase: Filling of a self-structured questionnaire which will last between 10-15 minutes (all answers will be kept anonymous); and clinical examination of their oral health, within the school premises.

I will be very grateful if my request is given favorable consideration.

Sincerely,

Johnson .J. Omale

Curriculum Vitae

Johnson John Omale

Education

Walden University, Minneapolis, Minnesota
Ph. D. Public Health (Community Health Education), Expected November 2014
Usmanu Danfodio University, Sokoto, Nigeria

Post Graduate Diploma in Education (PGDE), November 2005
Lagos State University, Lagos, Nigeria

MSc Social Works, June 2001
Nigerian Army School of Medical Sciences, Lagos, Nigeria

Higher National Diploma (HND) Dental Therapy, December 1994

Professional Experience
Chief Lecturer/Deputy Rector--- Federal School of Dental Technology and Therapy, Trans-Ekulu, Enugu, October 2008 to date.
I work in a higher institution training dental therapists and technologists as a lecturer and an academic administrator. I also supervise students' project work at HND level and ND II seminar presentations.

Students Industrial Work Experience Scheme (SIWES) coordinator, 2006-2008.
I was in-charge of students' placement for four months industrial work experience for ND 1 students and one year mandatory internship programs after the award of Higher National Diploma (HND) in either Dental Therapy or Technology.

Head of Department Dental Therapy, 2002-2006.
I was in charge of day to day administration of the department in the areas of academic and students' clinical experience.
I was an instructor at the Nigerian Army School of Medical Sciences in the year 1999-2001. I was involved in teaching courses such as Dental Radiography, and Clinical Practice. I supervised students' clinical practice and community dental health education.

Community Service
Organized Community Dental Health Education Programs (CODHE) in Enugu state in collaboration with GlaxoSmithKline (GSK), Nigeria, Enugu zonal office, 2010-2012

Licenses and Certification

Registered Dental Therapist--- Dental Therapists Registration Board of Nigeria (DTRBN), March, 1999

Professional Affiliation
Member, Academic Staff Union of Polytechnics (ASUP), FSDT&T chapter
Member, Nigeria Dental Therapists Association
Associate Member, National Institute of Management (NIM)
Fellow, Institute of Corporate Administration