COMPARISON OF PEER-LED, DENTIST-LED AND TEACHER-LED SCHOOL-BASED ORAL HEALTH PROMOTION STRATEGIES AMONG ADOLESCENTS IN IBADAN, NIGERIA

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CERTIFICATION

This is to certify that the study titled "COMPARISON OF PEER-LED, DENTIST-LED AND TEACHER-LED SCHOOL-BASED ORAL HEALTH PROMOTION STRATEGIES AMONG ADOLESCENTS IN IBADAN, NIGERIA" was carried out by Folake Barakat Lawal (Matriculation Number: **76904**) for her PhD Project in the Department of Periodontology and Community Dentistry, Faculty of Dentistry, University of Ibadan under my supervision.

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DEDICATION

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ABSTRACT

School-based Oral Health Promotion (SbOHPm) programmes largely depend on dentists as resource persons. However, dentists are relatively few in Nigeria, making coverage for SbOHPm difficult. This has contributed to high unmet dental needs among adolescents. A need, therefore arises to explore the feasibility and effectiveness of SbOHPm activities led by non-dentists. The effectiveness of SbOHPm activities conducted by three cadres of Resource Persons (RPs) [peer, dentist and teacher] among adolescents in Ibadan were compared.

Exploratory sequential mixed-method study design was adopted. A convenience sample of 120 adolescents and 52 teachers participated in the qualitative phase that consisted of 12 Focus Group Discussions (FGDs) for students and five for teachers. Information obtained from the FGDs was utilised in designing the Oral Health Promotion Intervention (OHPI). The quantitative phase was a cluster randomised controlled trial of 1800 Senior Secondary School-I students selected by multi-stage sampling from 36 schools in four out of five Local Government Areas (LGAs) in Ibadan Metropolis. The LGAs were randomised into three Intervention Groups (IGs) varied according to RPs delivering SbOHPm activities (peer-led,dentist-led and teacher-led); and a control group. The RPs were trained and they conducted the OHPI bi-monthly for one school-year. A structured pretested validated questionnaire was used to evaluate Oral Health Knowledge (OHK), Attitude (OHA), Practices (OHP) and Oral Health-Related Quality of Life (OHRQoL) while Oral Health Status (OHS) was evaluated using standardised tools before and six months after OHPI. Qualitative data were analysed using thematic approach while quantitative data were analysed with Chi-square, Wilcoxon signed-rank test and generalised estimating equation at $\alpha_{0.05}$.

At baseline, the adolescents displayed different points of view, unfavourable attitude and misconceptions about oral health. The percentage improvements, post-intervention in OHK were 69.3%, 87.1%, 56.0% and 6.9% for peer-led, dentist-led, teacher-led and control groups, respectively. For OHA, improvement according to groups, were 127.4%, 135.1%, 131.5% and 11.5%, respectively and for OHP; 27.3%, 36.2%, 22.4% and 7.3%, respectively. Measures of improvement in OHS according to groups were: gingival health; 62.1%, 68.2%, 46.9% and 10.0%, periodontal treatment needs; 44.7%, 87.2%, 82.9% and 3.7%, decayed teeth; 4.4%, 5.0%, 3.2% and 0.7% and oral hygiene; 34.7%, 83.9%, 42.4% and 2.8% in the peer-led, dentist-led, teacher-led and control groups, respectively. Students in peer-led, dentist-led and teacher-led groups, had better OHK (OR=1.60, 95%CI=1.50–1.70, OR=1.86, 95%CI=1.74–1.99, OR=1.57, 95%CI=1.47–1.68), better OHA (OR=1.86, 95%CI=1.69–2.05, OR=2.02, 95%CI=1.83–2.22, OR=2.03, 95%CI=1.85–2.23) and better OHP (OR=1.22, 95%CI=1.17–1.27, OR=1.31, 95%CI=1.26–1.37, OR=1.18, 95%CI=1.13–1.23) compared to the control group. The OHRQoL also improved in IGs compared to control group: peer-led (OR=1.80, 95%CI=1.13–2.84), dentist-led (OR=1.81, 95%CI=1.14–2.86), teacher-led (OR=1.57, 95%CI=0.98–2.51). Perspective of oral health by adolescents changed positively following the intervention.

The dentist-led oral health promotion strategy was the most effective at improving oral health knowledge, attitude, practices, oral health status and oral health-related quality of life of in-school adolescents. Peer-led and teacher-led interventions were comparable and could effectively support or replace dentist-led method in school-based oral health promotion to reduce burden of unmet dental needs.

Keywords: Adolescent oral health, Oral health promotion, Oral health-related quality of life, School health programme

Word count: 499

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LIST OF ABBREVIATIONS

ANOVA: Analysis of Variance

CI-S: Simplified Calculus Index

COHIP-SF 19: Child Oral Health Impact Profile Short Form 19

CPI: Community Periodontal Index

CPITN: Community Periodontal Index of Treatment Needs

DI-S: Simplified Debris Index

DMFT: Decayed Missing and Filled Teeth

FGD: Focus Group Discussion

GB: Gingival Bleeding

GEE: Generalised Estimating Equation

GI: Gingival Index

HBM: Health Belief Model

HPM: Health Promotion Model

HPS: Health Promoting School

JAS: Joint Advanced Seminar

LGA: Local Government Area

LIC: Low Income Countries

OHA: Oral Health Attitude (Attitude to Oral Health)

OHI-S: Simplified Oral Hygiene Index

OHP: Oral Health Practice

OHPn: Oral Health-Promotion

OHRQoL: OralHealth RelatedQualityofLife

OHK: Oral Health Knowledge

OPCS: Office of Population Censuses and Surveys

QoL: QualityofLife

SBOHPP: School Based Oral Health Promotion Programme

SCT: Social Cognitive Theory

SD: Standard Deviation

SPSS: Statistical Package for the Social Sciences

TPB: Theory of Planned Behaviour

TRA: Theory of Reasoned Action

WHO: World Health Organization

95%CI: 95% Confidence Interval

DEFINITION OF TERMS

Oral health promotion: the equipping of individuals with the appropriate resources to control health determinants for health gains.

Strategy: a plan of action with the goal of achieving the set aim.

Trial arm: a group or subgroup of participants in a clinical trial, which interventions are targeted at.

Intervention: introduction of an action or process to interfere with outcome of a study.

Outcome: end result of a study.

Adolescents: a transitional phase of growth between childhood and adulthood usually between the age 10-19years.

Periodontal disease: a general term used for the inflammatory conditions of the periodontium- the tooth supporting structures.

Dental caries:a post eruptive pathological condition of the tooth and one of the commonest chronic diseases in childhooddue to imbalance in the demineralization and mineralization processes leading to cavitation in the enamel of a tooth.

Determinants of health: are factors that act as a barrier or facilitator of behaviour change. They include social factors, psychosocial factors, physical factors, lifestyle and other personal and environmental factors.

Perspective: the level of understanding, awareness of an individual or group of people about an issue/oral health.

Perception: the views or point of looking at an issue by an individual or group of people about an issue/oral health, which is based on the perspective of that issue/oral health.

Acceptability:the tolerance or satisfaction with an event/ programme. This was assessed in this study as the preference of the students to the SBOHPP.

CHAPTER ONE

INTRODUCTION

1.1 Background

Oral diseases have been described by the World Health Organization (WHO) as a major public health challenge in both industrialized and developing nations (Petersen *et al.*, 2005a). The commonest oral diseases globally; dental caries and periodontal diseases, occur with prevalence rates of 5.7% to 42.7% (Denloye *et al.*, 2005, Adekoya–Sofowora *et al.*, 2006, Umesi-Koleoso *et al.*, 2007, Adeniyi *et al.*, 2012a, Ajayi and Abiodun-Solanke, 2014, Lawal and Oke, 2020) and 56.0% to 97.0%, respectively in Nigerian adolescents (Maduakor *et al.*, 1996, El-Nadeef *et al.*, 2006, Popoola *et al.*, 2015, Lawal and Oke, 2020). The high prevalence of these oral diseases in Nigeria has been associated with poor socio-environmental factors and, more importantly, low level of oral health awareness (Sofola, 2010, Lawal and Oke, 2020). These oral diseases are largely preventable, and prevention has been found to be cost effective when compared to curative measures (Petersen, 2003, Petersen *et al.*, 2005a). However, Nigeria and many other African countries face economic challenges and limited resources with very small percentages of their annual fiscal budgets allocated to the health sector (Adeniyi *et al.*, 2012b). The resultant effect is that many adolescents are left with unmet dental needs from untreated oral diseases (Maduakor *et al.*, 1996a, Denloye *et al.*, 2005, El-Nadeef *et al.*, 2006, Ajayi and Abiodun-Solanke, 2014, Popoola *et al.*, 2015, Lawal and Oke, 2020).

Unmet dental needs in adolescents interfere with their Oral Health Related Quality of Life (OHRQoL); affecting enjoyment of food, speaking and pronouncing words, self-confidence and consciousness, sleeping and relaxing, which result in malnutrition and absenteeism from schools, among other consequences (Chukwumah *et al.*, 2016,Lawal and Ifesanya, 2017, Lawal and Bankole, 2019). The burden of these highly preventable

diseases on adolescents is huge.Promotion of oral health at early stages of life has been found beneficial, as lifestyle during adolescence may influence later stages of life(Jurgensen and Petersen, 2013). One of the avenues for such influences is the school-based oral health programme (Jurgensen and Petersen, 2013).

School-based oral health programmes aim at establishing a foundation of good oral health early in life. These programmes are particularly essential in our environment because of the insufficient awareness of oral health attributable to inadequate education on oral health (Sofola, 2010, Lawal and Oke, 2020). In other countries, the school-based intervention has helped in promoting oral health among the students (Walsh, 1985, Friel *et al.*, 2002, Conrado *et al.*, 2004, Vanobbergen *et al.*, 2004, Goel *et al.*, 2005, Chapman *et al.*, 2006, Chachra *et al.*, 2011, Chandrashekar *et al.*, 2012,Haleem *et al.*, 2012b, Bhardwaj *et al.*, 2013,Gambhir *et al.*, 2013, Chandrashekar *et al.*, 2014, Damle *et al.*, 2014, Blake *et al.*, 2015, Esan *et al.*, 2015, Haleem *et al.*, 2015, Haque *et al.*, 2016, Vangipuram *et al.*, 2016, Villanueva-Vilchis *et al.*, 2019, Dagar *et al.*, 2020), but such programmes do not exist in a formalized way in Nigeria.

In promoting oral health at school level, different strategies have been employed, ranging from dentist-led, teacher-led, peer-led to self-learning methods (van Palenstein Helderman *et al.*, 1997, Vanobbergen *et al.*, 2004, Yazdani *et al.*, 2009, Haleem *et al.*, 2012b,Yekaninejad *et al.*, 2012, Yusof and Jaafar, 2013,Amalia *et al.*, 2014, Haleem *et al.*, 2015, Vangipuram *et al.*, 2016). Of these strategies, the dentist-led strategy was the widely utilized and has been demonstrated to be effective in improving the oral health of pupils (Vanobbergen *et al.*, 2004, Haleem *et al.*, 2012b, Priya *et al.*, 2019, Tsai *et al.*, 2020). From recent studies, the peer-led strategy was found to be comparable to the dentist-led strategy with self-learning strategy being the least effective (Haleem *et al.*, 2012b,Haleem *et al.*, 2015). Different strategies have been employed in various regions in the world and some studies have compared the strategies yielding equivocal results such as in Bangladesh, Belgium, India, Iran, Ireland, Pakistan, Tanzania and Zimbabwe(van Palenstein Helderman *et al.*, 1997, Frencken *et al.*, 2001, Friel *et al.*, 2002, Vanobbergen *et al.*, 2004, Goel *et al.*, 2005,Haleem *et al.*, 2012b, Gambhir *et al.*, 2013, Gauba *et al.*, 2013, Haleem *et al.*, 2015, Srivastava *et al.*, 2016, Vangipuram *et al.*, 2016, Furukawa *et*

al., 2017, Ghaffari *et al.*, 2018, Priya *et al.*, 2019, Villanueva-Vilchis *et al.*, 2019, Sayar *et al.*, 2020, Tsai *et al.*, 2020).

In Nigeria, the dentist-led strategy has been evaluated among primary school children and adjudged to be effective in conferring positive oral health preventive behaviour (Aderinokun, 1997, Bankole and Ibiyemi, 2013, Esan *et al.*, 2015). In addition, these studies, which assessed educational aids in the dentist-led strategy, established that posters and videotapes were effective aids. However, the dentist-led strategy is fraught with problem of sustainability in low resource settings due to the low dentist to population ratio. Examining the possibility of delivering oral health promotion (OHPn) activities by other persons apart from the dentists therefore becomes imperative. Findings from this study should provide the template on which sustainable school-based oral health promotion programmes (SBOHPP) will be anchored in low resource settings like Nigeria.

1.2 Statement of the problem

Oral health is not accorded much importance in many African countries, mainly because of the ignorance arising from poor knowledge, attitude and practices on oral health (Sofola, 2010). This results in highly prevalent common and easily preventable oral diseases witnessed by these countries. In addition, these countries face severe economic challenges and limited resources, thus very little of the country's resources are allocated to the health sector, leaving many, including children with high unmet dental needs and impaired quality of life (QoL)(Umesi-Koleoso *et al.*, 2007, Chukwumah *et al.*, 2016, Lawal and Ifesanya, 2017). Consequently, primary prevention of oral diseases and promotion of oral health during adolescence, especially in school, becomes very important. In countries where the programme has been successfully implemented, significant lowering of the common oral diseases especially in children and adolescents have been reported (Tai *et al.*, 2001, Tai *et al.*, 2009, Shenoy and Sequeira, 2010, Yekaninejad *et al.*, 2012, Bhardwaj *et al.*, 2013, Matsuyama *et al.*, 2016, Qadri *et al.*, 2018, Tashiro *et al.*, 2019, Dagar *et al.*, 2020, Tsai *et al.*, 2020). While it will be of immense benefit to adopt the same school-based programme in Nigeria, appropriate modification to suit the socio-cultural peculiarities is required. More so, the outcome of theSBOHPP varies in different contexts and the most appropriate strategy among

adolescents is yet to be ascertained (Priya *et al.*, 2019). Presently, dentists are the only ones promoting oral health in schools in developing countries. This ought not to be so, particularly in Nigeria where there is a short supply of dentists (Adeniyi *et al.*, 2012b). Exploring other options to OHPn, which may prove equally effective, therefore, becomes important. There is ample literature on peer-led and teacher facilitated educational methods on a variety of subjects, oral health inclusive.There is, however, sparse information on the effect of these delivery strategies on oral health in this environment.

This study, therefore, was aimed at comparing the effectiveness of peer-led, dentist-led and teacher facilitated strategies with a view to determining the most suitable strategy to facilitate oral health education programmes in schools in Ibadan, Nigeria.

1.3 Justification for study

Promotion of oral health among in-school adolescents is imperative in Low- and Middle-Income Countries (LMICs) due to the high unmet dental needs that impact on their QoL(Chukwumah *et al.*, 2016,Lawal and Ifesanya, 2017, Lawal and Bankole, 2019). Under the umbrella of the schools, the dentist-led oral health promotion programmes have been shownto be beneficial in improving the oral health of adolescents (Haleem *et al.*, 2012b). Unfortunately, in Nigeria as in other Low-Income Countries (LICs), this is unsustainable due to dearth of dentists in these regions (Adeniyi *et al.*, 2012b). Recently, a shift from the traditional dentist-led strategy has informed various research efforts to evaluate teacher-led and peer-led programmes in high income countries (Haleem *et al.*, 2012b). Although there are mixed reports about the success of non-dentist-led strategies implemented in High Income Countries (HICs) and in a few LICs (Frencken *et al.*, 2001, Chapman *et al.*, 2006); such information does not exist in Nigeria. The need therefore arises to examine the possibility of promoting oral health among adolescents by other persons apart from the dentists in the local context as well as in other LICs.

Findings from this study is expected to provide the template on which sustainable school-based oral health promotion will be anchored in low resource settings like Nigeria where prevention of oral diseases is accorded little or no attention.

1.4 Aims and objectives

1.5 General aim

To compare the relative effectiveness of three school-based oral health promotion delivery strategies (peer-led, dentist-led and teacher-led) at improving oral health among adolescents aged 14 – 18 years in Ibadan.

1.6 Specific objectives

1. To establish baseline data on the perspective of students on oral health.
2. To establish baseline data on the perspectives of teachers on oral health.
3. To establish baseline data on the oral health of the students.
4. To evaluate the relative effectiveness of school-based oral health promotion strategies on the oral health of students.
5. To evaluate the relative effectiveness of school-based oral health promotion strategies on the OHRQoLof students.
6. To evaluate the acceptability of the three-different school-based oral health promotion strategies by the students.
7. To evaluate the acceptability of the three-different school-based oral health promotion strategies by the teachers.

1.7 Hypotheses

1.7.1 Hypothesis I

H_{0-} No difference exists in the three strategies for promoting knowledge of oral health among in-school adolescents in Ibadan.

H_{A-} Differences exist among the three strategies for promoting knowledge of oral health among in-school adolescents in Ibadan.

1.7.2 Hypothesis II

H_{0-} No difference exists in the three strategies for improving attitude towards oral health among in-school adolescents in Ibadan.

H_{A-} Differences exist among the three strategies for improving attitude towards oral health among in-school adolescents in Ibadan.

1.7.3 Hypothesis III

H_{0-} No difference exists in the three strategies for promoting oral health practices among in-school adolescents in Ibadan.

H_{A-} Differences exist among the three strategies for promoting oral health practices among in-school adolescents in Ibadan.

1.7.4 Hypothesis IV

H_{0-} No difference exists in the three strategies for promoting good oral health status among in-school adolescents in Ibadan.

H_{A-} Differences exist among the three strategies for promoting good oral health status among in-school adolescents in Ibadan.

1.7.5 Hypothesis V

H_{0-} No difference exists among the three strategies on OHRQoL of in-school adolescents in Ibadan.

H_{A-} Differences exist among the three strategies on OHRQoL of in-school adolescents in Ibadan.

1.8 Research questions

1. What is the perspective of students about oral health?
2. What are the perspectives of teachers about oral health?
3. What is the baseline on oral health status, knowledge, attitude and practices among the students?
4. What effect does school-based OHPn have on the oral health status of students?
5. What effects does school-based OHPn have on the OHRQoL of the students?
6. What are the perspectives of students regarding three different school-based oral health education strategies?
7. What are the views of teachers regarding the three different school-based oral health education strategies?

This thesis consists of six chapters; Chapter one introduced the research project by discussing the background, justification for the study, the aims and objectives of the study,

hypotheses and research questions. Chapter two has presented extensive literature review relevant to the research project and the conceptual framework of the study. Chapter three discusses the methodological components of the research project; the study design, study population, study area, intervention procedure, ethical consideration, data collection, data management and analysis. The results obtained from the research project are presented according to the objectives in Chapter four.The findings were discussed and limitations highlighted in Chapter five. Chapter six elucidates the conclusions, recommendations, future and practical implications of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Literature review

The purpose of this literature review is to critically examine previous research to describe the unmet dental needs of adolescents as well as explore at length, the effectiveness of different school-based OHPn strategies towards improving the oral health of adolescents across countries, thereby identifying the research gaps.

2.1 Introduction

This chapter will first take a close look at previous studies to identify the concepts and research gaps associated with oral health promotion strategies. This review also tracks the burden of oral diseases among Nigerian adolescents in order to provide evidence for the need to promote oral health among them. Next, insights into prevention of oral diseases were discussed.

Also, the importance of the school inOHPn was reviewed from both local and international studies. A discourse of the effectiveness of SBOHPP was thereafter conducted. Finally, in order to shed light on appropriate methodologies that would best suit the present study, a comparison of the outcome of the promotion strategies was conducted.

A detailed search of the literature relevant to this study was carried out by first identifying the key words for the research. Using the google search engine, google scholar and PubMed central, databases of peer reviewed English publications were selected. Further exploration of the PubMed database was conducted with mesh terms ’oral health’ and ‘health promotion’. Boolean logic (and/or/and not) were used to refine the searches. Thereafter, relevant articles were downloaded into the Mendeley reference manager. The Hinari database was searched to retrieve articles that were inaccessible through earlier

mentioned search engines. The Hinari search was also used to identify articles based on the subject title. The Cochrane library search yielded review articles, systematic reviews and meta-analysis publications related to the study and from these a comprehensive literature for the study was obtained. References from the identified texts were further retrieved from google scholar, PubMed, Medline and Hinari databases and added to the literature matrix.

This review identified prominent gaps in school-based oral health promotion programmes as well as methodological weaknesses. This has, therefore dictated the design, implementation and evaluation of the intervention in this study.

2.2 Concepts of school oral health promotion

In designing effective School-Based Oral Health Promotion Programmes (SBOHPP), identifying the appropriate interlinked concepts and building framework are critical steps. Concepts are themes and ideas that serve as the building blocks for the phenomenon under study. Concepts of SBOHPP are typically based on concepts of OHPn and include oral health, oral health education, determinants of health and behaviour change (Watt, 2005).

2.3 Oral health of adolescents; definition of oral health and its concepts

Oral health has been defined by many and the origin is from the Disease Model of the presence or absence of disease. Definition of health has become comprehensive as health is now described as not just the absence of disease but holistically as a complete state of well-being (WHO, 1946, Callahan, 1973). This definition has a positive and holistic view of health but has been considered by some (Herzlich, 1973) as being unrealistic and unachievable. This is because any defect or problem affecting an individual makes him/her unhealthy. This criticism led to different modifications in the definition of health, one of which was suggested by Herzlich (1973) who described health as “ability to reach a high state in life without the encumbrance of poor health”. A more recent definition of health by WHO (1984)sees health as a resource for daily life, with emphasis placed on factors thatare indicative of health.

Health has been equally described in relationship to physical functioning intertwined with psychosocial functioning (Reisine, 1981), thus a multi-dimensional entity. The multi-dimensional definition of health was proposed by Ewles and Simnett (2003) who defined

health based on six pillars; physical factors, mental status, emotional well-being, social relationships, spiritual dimensions and societal nature. It was from this modern concept that Locker (1988) developed the conceptual framework of oral health.Heconceptualised it as more than the absence of oral diseasesas it should include functional components, social relationships and psychological factors. This was also described by Dolanand Atchison(1993). The recent definition of health is based on the biomedical model and no longer the disease model, thus leaving out presence or absence of oral diseases.

2.4 Common oral diseases in adolescents

Common oral diseases affecting people globally are dental caries and periodontal diseases (Watt, 2005). Malocclusion is also considered a common oral condition with peculiar prominence among adolescents (Mandall *et al.*, 2000, Onyeaso, 2004,Gelgör *et al.*, 2007). The diseases especially dental caries, occur commonly among adolescents and they are highly preventable (Petersen *et al.*, 2005a).

2.5 Dental caries

Dental caries can be described as a post eruptive pathological process involving the tooth and it is one of the commonest chronic diseases in childhood. It is a consequence of the imbalance between the demineralization and mineralization processes leading to cavitation in the enamel of a tooth (Selwitz *et al.*, 2007). Dental caries is ubiquitous affecting a great number of people in their childhood, which may persist to adolescent age (Watt, 2005). In HICs, for example, the United States of America, it persists asa major chronic disease in childhood (Health and Human Services, 1990). Prevalence of dental caries varies across countries and is found more in the developed countries than the developing (Watt, 2005). However, due to increasing industrialization, recent evidence shows that there is a rise in its prevalence in low income countries (Sofola *et al.*, 2014). Prevalence of dental caries in LICs is higher in urban regions than in rural regions (Maserejian *et al.*, 2008). Although there are mixed reports on this in HICs as higher prevalence was observed in rural areas than urban areas in Sweden (Gaszynska *et al.*, 2014). The severity of the disease among 12-year-olds has been higher in HICs than in LICs with the United States having a mean DMFT of 3.0 while in European countries a value of 2.6 was reported (Watt, 2005, Petersen *et al.*, 2005a). Higher values (4.9%) than these were reported among Tirana

adolescents (Laganà *et al.*, 2015). Over the decades, a downward trend has been reported in HICs (Gaszynska *et al.*, 2014) with converse reports in LICs (Sofola *et al.*, 2014). The divergence in trends has been attributed to increase in westernized diets in LICs and increased public health measures to prevent caries in HICs (Petersen *et al.*, 2005a,Gaszynska *et al.*, 2014).

In Nigeria, the severity of dental caries among adolescents as determined by meanDecayed, Missing and Filled teeth(DMFT) index was recorded at below 3.0 and in the range of 0.4- 1.3 (Akpata, 2004, Adekoya–Sofowora *et al.*, 2006, Umesi-Koleoso *et al.*, 2007, Adeniyi *et al.*, 2012a, Sofola *et al.*, 2014). Although this value is in accordance with the WHO recommendation, many adolescents in Nigeria have high unmet dental needs when compared to those from HICs (Akpata, 2004, Adekoya–Sofowora *et al.*, 2006, Adeniyi *et al.*, 2012a, Sofola *et al.*, 2014). High unmet need due to untreated dental caries among adolescents seen in LICs may be associated with high poverty, poor awareness, limited access to oral health services (Lawal and Oke, 2020) as well as failure to put preventive measures in place in these countries.

The complication of untreated dental caries varies from pain to fascial space infections and tooth loss (Azodo *et al.*, 2012, Olatosi and Sote, 2012). Dental caries and its sequelae have been reported as the commonest cause of dental emergencies in adolescents in Nigeria (Azodo *et al.*, 2012).

Dental caries is highly preventable and major causes include poor oral hygiene, refined carbohydrate, bacteria, and poor oral health knowledge (Petersen *et al.*, 2005a). Poor oral health awareness is prominent in Africa and many adolescents still exhibit poor oral health knowledge, attitude and practices (Lawal and Taiwo, 2018, Lawal and Fagbule, 2020). This is of great concern as poor awareness level is associated with high prevalence of oral diseases (Gaszynska *et al.*, 2014, Sofola *et al.*, 2014). There is, consequently, a dire necessity for oral health education and OHPn among adolescents in Nigeria and other LICs to prevent caries(Lawal and Taiwo, 2018). Well proven prevention methods for dental caries include; fluoride use, dietary modification, good oral hygiene and regular dental checks (Petersen *et al.*, 2005a, Watt, 2005). These preventive programmes and oral

health promotion programmes have been quite helpful in reducing dental caries in HICs (Sarmadi *et al.*, 2009).

Measurement of dental caries severity is performed by using indices, the commonest of which are Decayed, Missing and Filled teeth (DMFT) index, International Caries Detection Assessment System, Significant Caries Index (Bratthall, 2000, Campus *et al.*, 2003) and the Pulpal Ulcerative Fistula and Abscess index (Monse *et al.*, 2010). The DMFT is the most widely used of these indices and will be employed in this study according to the rules set down by WHO (Akpata, 2004, Adeniyi *et al.*, 2012a, WHO, 2013). The DMFT caries index is conducted using a plane mirror and a dental probe (WHO, 2013). It has the strength of being easy to learn and use, being sensitive and amenable to statistical analysis.

2.6 Periodontal diseases

Periodontal disease affects the periodontium – the tooth supporting structures. Periodontal disease occurrence in adolescents varies from gingivitis to Aggressive periodontitis. The prevalence of periodontal disease is high among adolescents in south east Nigeria (Maduakor *et al.*, 1996). Over 80% of adolescents in this region had one form of periodontal treatment need ranging from simple to complex (Maduakor *et al.*, 1996). Similarly, all adolescents in a population-based study in south west Nigeria were noted to have mild to moderate gingivitis (Agbaje *et al.*, 2016). A recent study (Lawal and Oke, 2020) in Ibadan, Southwest Nigeria observed that 73.3% of adolescents had unhealthy periodontium. Gingivitis is seen more often in rural adolescents compared to those resident in the urban regions (Azodo and Agbor, 2015). Lower prevalence rates of periodontal diseases were noted in HICs as reported for Tirana adolescents where 32% had good oral hygiene and 46.9% required simple periodontal treatment in terms of oral hygiene instruction and motivation (Laganà *et al.*, 2015). The higher rates of periodontal disease in LICs has been linked to poor oral hygiene, poor knowledge and bad attitude as well as behaviour common with adolescents from LICs like Nigeria and other African countries (Watt, 2005).

Effect of periodontal disease include halitosis, unsightly tooth appearance, tooth mobility and tooth loss. Periodontal disease was prevalent among children and adolescents presenting at a dental outpatient in Nigeria as reported by Folaranmi*et al.*,(2014).

Assessment of the severity of periodontal disease is conducted using the following indices; Gingival Health Assessment according to standardsurvey methods (WHO, 2013), Oral Hygiene Index-Simplified(Green and Vermillion,1964), Gingival Index (Loe and Silness,1967) and Community Periodontal Index of Treatment Needs (Ainamo *et al.*, 1984). Examination is conducted with mirror and periodontal probes under good illumination (WHO, 2013). These indices are widely accepted because of the ease of use, high sensitivity and being amenable to statistical analysis (Ainamo *et al.*, 1984, Laganà *et al.*, 2015). They are also used in disease monitoring as they are able to determine the treatment needs and severity of the disease (Ainamo *et al.*, 1984, WHO, 2013, Laganà *et al.*, 2015).

2.7 Malocclusion

Malocclusion is a deviation from the normal relationship between maxillary and mandibular teeth when in contact. It is associated with genetic and acquired causes (Corruccini, 1984). Acquired causes are predominantly habits, which can be prevented (Corruccini, 1984). The prevalence of malocclusion and treatment (orthodontics) needs varies from region to region. Severe orthodontic treatment needs in adolescents was reported as 17.4% in Albania, Southeast Europe (Laganà *et al.*, 2015) and 12.6% in Brazil (Silveira *et al.*, 2016). Orthodontic treatment need was reported more in the underprivileged and was further corroborated by report of 39.7% of adolescents in rural Nigeria requiring orthodontic treatment (Lawal and Ifesanya, 2017) although only 7.4% required definite treatment (Lawal and Ifesanya, 2017). Acquired causes of malocclusion such as oral habits and retained deciduous teeth can easily be prevented and can be addressed in oral health promotion programmes.

Effect of malocclusion include psycho social maladjustment, high financial implication and extended treatment period (Lawal and Ifesanya, 2017). Assessment of malocclusion has been based on Angles malocclusion classification, Index of Orthodontic Treatment

Needs and Dental Aesthetic Index. These two indices have been the most widely used and are important in comparative studies (Lawal and Ifesanya, 2017).

2.8 Effect of oral diseases on the OHRQoL of adolescents

The impact on daily performances has been assessed using the OHRQoL measure, whichis a subjective assessment of how oral health affects daily activities (Locker, 1988, Locker, 1997). It complements clinical assessment of oral health and gives weight to how these diseases affect their daily performances (Locker, 1988, Locker, 1997, Sheiham, 2005). The effect of common oral diseases on the daily engagements of adolescents affects social, physical and emotional domains (Lawal and Ifesanya, 2017). A significant relationship betweenunmet dental treatment needs and OHRQoL of in-school adolescents has been documented in Nigeria (Lawal and Ifesanya, 2017). Major activities that are affected in adolescents include eating, speaking, sleeping, being conscious of the oral problem, avoiding social contact with other peers, smiling with embarrassment, doing schoolwork. (Tomazoni *et al.*, 2014, da Silva *et al.*, 2015, Lawal and Ifesanya, 2017,Lawal and Bankole, 2019). The impact of oral diseases and unmet dental treatment needs among adolescents in Nigeria is a source of concern and a public health problem that necessitates OHPn.

2.9 Prevention of oral diseases

The burden of oral diseases and its impact on OHRQoLsignifies an impetus for their prevention. Prevention is hindering oral diseases from occurring or limiting their progression when they have already occurred (Nunn and Steele, 2003, Petersen *et al.*, 2005a, Petersen *et al.*, 2005b, Petersen and Ogawa, 2005, Watt, 2005). Prevention and promotion of health have been used interchangeable by many but there is a thin line of difference. The fact remains that both aim to improve the overall health of the individual or the population. The major difference between the two has been the fact that prevention focuses on the disease process and has been critiqued as favouring more of the Disease Model whereas health promotion focuses on Health Model (WHO, 1984, Nunn and Steele, 2003, Petersen *et al.*, 2005a, Petersen *et al.*, 2005b, Petersen and Ogawa, 2005, Watt, 2005, Srof and Velsor-Friedrich, 2006). In essence, directing prevention activities to

improve oral health must be a well-planned process. Preventive measures can therefore be administered to individuals or populations through planned activities called strategies

2.10 Prevention strategies

Prevention strategies are planned activities to hinder oral disease from occurring and are divided into two; whole population and high-risk approach (Rose, 1992). Risk approach focuses on people at the highest risk of the disease and is sub divided into the targeted population and high risk. The high-risk approach identifies individuals who are at the highest risk through screening tests (Rose, 1992, Watt, 2005). The effectiveness of the approach is dependent on a highly reliable and valid screening tool (Rose, 1992) to identify those that are at risk and to whom prevention activities should be directed. Many of the preventive interventions have been centred on the high-risk approach but are limited in the non-radical involvement of potential risk individuals.

Targeted population or population directed approach involves focusing on groups of individuals or sub population that are at high risk (Rose, 1992). Epidemiological data are used to identify the subpopulation at high risk (Rose, 1992, Watt, 2005). This approach is preferable to high-risk approach though not as radical in prevention of oral diseases as the whole population approach.

The whole population approach focuses on the entire population among whom most of the disease occur. Public health measures favour instituting prevention to reduce risk of disease in the population (Rose, 1992, Watt, 2005). Applying this shifts the whole distribution of disease to the left (near zero) unlike the high-risk approach where the tail end of the disease distribution is shifted to the right (Rose, 1992). The population approach targets the underlying determinants of health and is preferred in public health practice (Rose, 1992, Watt, 2005). Whole population approach involves everybody in the population and includes prevention measures directed at the community as seen in school-based health programmes.

Each of the prevention strategies comes along with its own advantages and limitations and may apply only at particular levels of disease prevention. The whole population approach is radical in its approach, involves those at risk and those not at risk and focuses on the underlying determinant of health. Though more expensive, it is better overall (Rose, 1992,

Petersen *et al.*, 2005b, Watt, 2005). The risk approach involves only those at risk, involves screening, may leave out those who are not at risk at the time of intervention but may be in the future. It is preferred for rare diseases and diseases that occur at very low prevalence (Rose, 1992, Petersen *et al.*, 2005b, Watt, 2005). The whole-population approach, with its inherent advantages of addressing the entire population, may be a more suitable form of prevention strategy in LMICs.

2.11 Levels of prevention of oral diseases

Prevention has been described in three levels: primary, secondary and tertiary. Primary prevention is the process, or any activity aimed at disallowing disease from occurring. It involvesboth personal and community efforts (WHO, 1987). Ways of achieving primary prevention of common oral diseases among adolescents include oral health education, use of fluoride to prevent caries and twice daily tooth brushing (WHO, 1987, Watt, 2005).

Secondary prevention is the prevention level that comes into play at the early stages of the disease process. It is defined as activities and measures undertaken when oral disease has occurred for early detection, prompt response and appropriate intervention to correct deviations from the normal state(WHO, 1987). It halts the disease process early enough. Ways of achieving secondary prevention include restoring decayed teeth, use of fluoride to mineralize enamel at the incipient caries stage. It is treatment based and its cost-effectiveness is less than primary prevention but more than tertiary prevention.

Tertiary prevention level focuses on rehabilitation. It involves all measures undertaken to reduce impairment and disabilities in order to improve the QoL of the affected (WHO, 1987). Ways of tertiary prevention include provision of denture for patients with tooth loss. Tertiary prevention is also treatment-based and clinic-oriented and has greater cost implication than the other two levels of prevention.

Of the three levels of prevention, the most important and least expensive in public health practice is primary prevention. It is totally devoid of curative dental care services. On the other hand, other levels of prevention, as of necessity, include curative dental care as the disease would have occurred before instituting them (Watt, 2005). Primary prevention level is the only level that may be population-based and here, oral health can be easily promoted.

2.12 Limitation of preventive approach

Oral diseases prevention is fraught with limitations not unconnected to its being based on the Disease Model, thus it continues to attract criticism (WHO, 1987, Watt, 2005). Prevention of oral diseases focuses on reducing disease levels and has led to the development of other approaches such as Behaviour Change, Educational Approach, Empowerment and Social Change, all of which have been incorporated into Health Promotion.

Behaviour change targets encouraging individuals to take over the responsibility for their health and adopt healthier lifestyles while educational approach engages in providing knowledge and skills as well as other options from which individuals can choose (WHO, 1984, WHO, 1987, WHO, 1997a, Watt, 2005). Empowerment assists in identifying individual's priorities with the aim of strengthening their capabilities to address these problems at both individual and population level (WHO, 1984, WHO, 1987, Watt, 2005). Social change explains the relevance of the indicators of healthand the need to change these factors in order to promote health (WHO, 1987). All these approaches are now entrenched within health promotion.

2.13 Oral health promotion

Health promotion becomes important as a result of the shift from Disease Model to the more comprehensive Biomedical Model. Health promotion is unique because disease prevention levels and strategies focus on presence or absence of diseases and not on the more important underlying causes of disease and determinants of health (WHO, 1986, WHO, 1987, Srof and Velsor-Friedrich, 2006). The shift from disease model to health model which focuses both on prevention of diseases and promotion of health brought about its development in a WHO assembly (WHO, 1987).

Oral health promotion is defined as the "process of enabling individuals to have control over determinants of health and improve their health" (WHO, 1986). Health promotion involves focusing on the broader determinants of health within settings where people live, work, learn or play through sensitive policies and actions (Watt, 2005).

2.14 History of health promotion

The historical development of health promotion dates to the 19th century. The WHO has been advocating for activities geared at promoting health since 1948 till date (WHO 1986). The activities included legislation, fiscal policies, organizational and community empowerment, all targeted at improving health for all (WHO, 1986).The Lalonde report in 1974 was the first official policy report suggesting that health promotion was related to determinants of health other than health care systems or medical care (Hanock 1986). Within Canada, the Lalonde report enforced the shift of public policies centred on disease treatment to health promotion. Further documentation on health promotion not being a feature of health care sector was made evident by the Alma-Ata declaration in 1978 (WHO, 1986, WHO 2000). It encouraged the need for health promotion, as well as for curative services and rehabilitative services Many recommendations from the Alma-Ata declaration was incorporated into the Ottawa Charter documentations. Health promotion became more prominent after a WHO Assembly - the Ottawa Charter for Health Promotion in 1986 (WHO, 1986, Porter, 2006). It aims at equipping individuals with the skills required to influence their own perspective of oral health and to have control over determinants of health that could modify such perspectives (WHO, 1986, Porter, 2006). Furthermore, the WHO Adelaide recommendations on healthy policy came into existence in 1988 to emphasize the importance of supportive environment in promoting health (WHO, 1986, Porter, 2006). Other works on health promotion included the Jakarta Declaration on health promotion (WHO, 1997b).It reflects the firm commitment of participants at the 4th International Conference on Health Promotion in 1997 to develop the vision to tackle the determinants of health in the 21st century. Further work on health promotion was the Bangkok Charter for Health Promotion; a name of an international agreement reached among participants of the 6th Global Conference convened by WHO on Health Promotion (WHO 2005, Porter, 2006). The conference took place in Bangkok, Thailand in August 2005.The outcome of the conference provided the documentation that explains the need for centralization of policies and partnerships to empower communities so as to improve health and health equality (WHO 2005, Porter, 2006). All the works done on health promotion were targeted at improving health and making it available to all

without inequalities as well as to empower people to have control over the determinants of health.

2.15 Principles ofOHPn

The principles of OHPn include policies targeted at the community, an environment that is supportive, invigorating community-centred action, development of personal skills and refocusing on preventing health care(WHO, 1987, Whitelaw *et al.*, 2001, Watt, 2005, Watt and Marinho, 2005).

Creating supportive environment should involve stakeholders to provide safe and supportive environment in which oral health can be promoted. Examples of this include smoke free environment to discourage smoking among adolescents and adults. Non-sale of cariogenic food within the immediate vicinity of children and adolescents can discourage frequent intake of cariogenic food. The importance of supportive environment for behavioural change has been emphasized (WHO, 1987, Whitelaw *et al.*, 2001, Watt, 2005, Watt and Marinho, 2005).Community particpation in the form of involivng the traget groups; the families, important stakeholders, peer-leaders, market women and the community at large have been associated with successed of oral helath promotion programmes (WHO, 1987, Whitelaw *et al.*, 2001, Watt, 2005, Watt and Marinho, 2005).

Healthy public policies by the government and important stakeholders are important to influence both the individual and the populace in promoting their health (Watt, 2005, Watt and Marinho, 2005). Development of personal skills through regular training, organizing workshops have been shown to empower people with the necessary skills to have control over the determinants of health (Watt, 2005). Emphasis have been placed on reorienting health services from curative to preventive services so as to promote peoples' health. The down stream approach of preventing diseases have been largely encouraged by many and found efective in promoting heatlh(Watt and Marinho, 2005). Recent suggestions have favoured the drive to subsudize prices for preventiive tretament so as to encourge individuals to takre up preventive services to maintain their health as well as to make early diagnosis of chronic disesases (Watt, 2005).

2.16 Benefits of OHPn

Oral health promotion encourages participatory roles of individuals as well as supports individuals to control their lifestyle for optimal health. This is unlike the Disease Model where the dentist is the active component. Oral health promotion equips individuals with the skills required to influence their own perspective of oral health as it focuses on determinants of health in addition to health information provided by health education (Watt, 2005, Srof and Velsor-Friedrich, 2006, Van den Branden *et al.*, 2014,Mendez *et al.*, 2017). Further, it assists individuals to have control over determinants of health that could modify their perspectives (Van den Branden *et al.*, 2014, Mendez *et al.*, 2017). There are numerous benefits in OHPn consequent upon its principles on the health status of individuals and the community.

Oral health promotion differs from mere prevention of oral diseases because unlike prevention that just focuses on reducing the occurrence of diseases, OHPn, also focuses on the underlying causes of oral diseases (WHO, 1986). It is more radical than prevention, this has increased the likelihood of overall success as well as sustainability (WHO, 1986, Watt, 2005).

2.17 Types of OHPn approaches

Oral health promotion can be individual or community health approach. Individual health approach aims at improving individual's health potential so they can cope with demands from the environment, psychological stress and health problems (Noack, 1987). Individual health approach is a replica of the traditional clinic intervention, face to face education and counselling. Community health approach, on the other hand, is directed towards social, cultural, technical and natural environment. The overall aim of community health approach is to improve the health of the community as a whole and has therefore based its actions on public health perspective (Noack, 1987).

2.18Avenues of OHPn for adolescents

The avenues for oral health promotion include the home, religious organizations, the community and the school. This review will focus on schools as the underlying theme of the subject matter.

2.19 The school

Evidence from HICs has shown education to be a structural determinant of health. The school provides a suitable connection of the adolescents and their families with the school with resultant positive health outcome (Resnick *et al.*, 1997, Catalano *et al.*, 2012, Viner *et al.*, 2012). The ability of the school in health promotion and the development of the healthy school programme serves as evidence of the superiority of the school in promoting oral health and general health among adolescents as well as children (Jürgensen and Petersen, 2013, Honkala, 2014). Schools have been fully utilized in HICs and this has reduced the prevalence of common oral diseases. It has also improved the QoL of children and adolescents in those countries (Mcbride *et al.*, 1999, Jürgensen and Petersen, 2013, Honkala, 2014). Similarly, in middle income and LICs there is growing evidence of the school being an effective medium of promoting health (Blum *et al.*, 2000, Control, 2013, Jürgensen and Petersen, 2013, Langford *et al.*, 2014, Yusof and Jaafar, 2013). The intervention by Esan *et al.*, (2015) corroborates this, by the positive outcome of the SBOHPP among elementary school pupils (Esan *et al.*, 2015). The fact that the school is a knowledge seat and the large-scale involvement of adolescents in school-based studies are overwhelming advantages in promoting oral health among them through that platform.

2.20 Health Promoting School (HPS)

The HPS is an initiative of the WHO developed in the 1980's (WHO, 1997a, McNeely *et al.*, 2002, Kwan *et al.*, 2005, Langford *et al.*, 2014). It is an initiative whereby the school is considered as an avenue for healthy living, learning and working (WHO, 1997a, McNeely *et al.*, 2002, Kwan *et al.*, 2005, Langford *et al.*, 2014). The HPS framework was developed to reduce inequities that exist in health among children and adolescents. In addition, it was targeted at shifting attention away from education to promotion due to the various limitations of health education resulting from non-focus on determinant of health (WHO, 1997a, Kwan *et al.*, 2005, Langford *et al.*, 2014). It has a goal of involving the school population, families and the community to achieve a healthy state together. The HPS has been based on strategies that aim at improving SBOHPP by strengthening capacities both locally and at the national level (Langford *et al.*, 2014). It also enables availability of networks and alliances for its success as well as providing opportunities for

researches into the effectiveness of SBOHPP(Kwan *et al.*, 2005). The pillars of HPS include; "healthy school environment, school health education, school health services, nutrition and food services" (WHO, 1997a, Langford *et al.*, 2014). It also includes physical activities, mental health programmes and other health promotional activities for students, staff and the community (Kwan *et al.*, 2005, Langford *et al.*, 2014). Based on the above, the HPS framework was thus, designed with peculiarities to promote health education formally in the curriculum of schools, promote health of students through various school activities with supportive environment and ethos (Kwan *et al.*, 2005, Langford *et al.*, 2014). Furthermore, the school is to engage families, sectors outside the school and other community members to promote health (Kwan *et al.*, 2005, Langford *et al.*, 2014). Although HPS has been instituted in developed countries with encouraging results on various health issues, it has not gained popularity in LICs(Langford *et al.*, 2014). It is non-existent in countries like Nigeria. In view of the successes observed with other health issues, the WHO has proposed the inclusion of oral health into the HPS(Petersen, 2008).

2.21 School oral health programmes

The school is an important avenue to promote oral health among adolescents, providing a large coverage worldwide. The SBOHPP is a combination of different oral health activities with the aim of promoting health among the students in a supportive school environment (Kwan *et al.*, 2005, Lee, 2009). The SBOHPP may be achieved through components suggested by the HPS initiated by the WHO(Petersen, 2008).

2.21.1 Components of SBOHPP

The components of SBOHPP include school oral health education, development of personal skills by training of resource persons; peers, teachers, school staff, formulating school policies, community participation and promoting supportive environment (WHO, 2003, Kwan *et al.*, 2005, Petersen, 2008).

2.21.2 Definition of concepts in SBOHPP

Oral health promotion is a combination of "educational, organizational, social, environmental and economic support for behaviour change to improve oral health" (Green and Kreuter, 2005). It has also been defined as the "process of enabling individuals to

have control over determinants of health and improve their health" (WHO, 1986). The key concepts identified from the various definitions of OHPn include oral health education, behaviour change and determinants of health (Pucher *et al.*, 2015).

Oral health education is a beneficial process of information transfer to individuals for knowledge gain as well as impartation of skills to maintain a healthy oral lifestyle. It has been defined as "any combination of learning experiences designed to facilitate voluntary adaptation of behaviour conducive to oral health" (Griffiths, 1972). It has further been defined as any learning activity aimed at improving the individual's knowledge, attitude and skills in relation to oral health (Kay and Locker, 1996). It provides information required for modifying attitude and changing the individual's behaviour. Although different definitions have been made, they are all in agreement with the fact that oral health education entails provision of information needed for behaviour change. Oral health education revolves around the three domains of learning; cognitive, affective and health behaviour (Gagné, 1972). These domains are also known as the educational KAB model (Knowledge, Attitude and Health Behaviour), which helps the understanding of the process of health education.

The cognitive domain is the acquisition of knowledge and is usually seen as improved awareness from any health educational intervention (Gagné, 1972). Knowledge acquisition results in the defining of the affectional domain and translates to change in attitude and beliefs (Gagné, 1972). Attitudinal changes on the other hand, focus on the perspectives and beliefs that determine the behaviour that a person is likely to adopt after the health education. Behaviour adopted after health education can either be positive or otherwise. Three types of health behaviour recognized in the last domain of health education are Preventive Health Behaviour, Illness Behaviour and Sick Role Behaviour (Kasl and Cobb, 1966).

Preventive health behaviour is any action taken by a healthy individual for the purpose of preventing disease (Glanz *et al.*, 2008). Illness behaviour is regarded as any action taken by a person who is ill to define his/her state of health and identify appropriate treatment (Herzlich, 1973, Glanz *et al.*, 2008). Sick role behaviour entails activities performed to get well and healthy (Kasl and Cobb, 1966, Adekunle *et al.*, 2019). These different types of

behaviour exist in people and are intertwined. The behaviour types provide insight into overt behaviour patterns that result in the restoration of health and maintenance of health. They help in monitoring the behaviour adopted and the specific strategies that may be relevant in refuting inappropriate behaviour or reinforcing appropriate ones. Knowledge of the different behaviour patterns is thus beneficial to the process of oral health education.

The linear sequence of knowledge resulting in changed attitude and eventual positive behaviour in health education has been criticized. The critique of the KAB model of health education has emphasized that the linear sequence of the model is unrealistic and not practical (Gagné, 1972, Herzlich, 1973, Glanz *et al.*, 2008). This is further corroborated by effectiveness and systematic reviews of health education programmes that revealed that the main limitation of oral health education is lack of sustainability in improvement because of failure to address the underlying determinants of health (Watt, 2005). These findings threw more light on the influence of determinants of health in the overall success of oral health education.

2.22 Determinants of health

The determinants of health have enormous influence on behaviour change and on the overall health outcome of a person. The determinants of health were identified in a bid to dissuade individuals from their beliefs that their health primarily depended on intervention by the health worker and the detection of upcoming disease (McKeown, 1978). They include the social, physical, psychosocial and environmental factors that influence health behaviour (McKeown, 1978). The physical determinants are factors such as age, gender and demography (McKeown, 1978).The psychosocial determinants of health behaviour include Self-Efficacy, outcome expectations of the behaviour adopted by an individual, goals of that person which can be proximal or distal and impediments or barriers to adoption of the recommended behaviour (Bandura, 2004). The impediments are factors that hinder the uptake of the recommended behaviour and can either be personal or self-perceived barriers or through health systems. These factors affect behaviour change (McKeown, 1978, Viner *et al.*, 2012). The social determinants have in particular, been identified to strongly influence adolescents' health and behaviour change (Viner *et al.*, 2012). Social determinants of health are defined as the factors associated with

circumstances in which people are born, grow, live, work and age (Petersen, 2008). These factors affect health within the social context and include family, peer, community, societal and cultural influences, poverty, resources and power, amongst others. The factors shape the behaviour of an individual and resultant health status (Viner *et al.*, 2012). This suggests the need to incorporate cues to action when planning interventions to increase the chances of a successful outcome. In addition, bearing in mind the complex web formed by the various factors that determine health, it would seem more appropriate to make it as one of the building blocks of any intervention if success is to be achieved. As the case may be, paying attention to risk factors or protective factors which have potential in shaping Health behaviour of adolescents is critical in health promotion interventions.

2.23 Behaviour change

Behaviour change is the stage preceding improvement in oral health status, the ultimate outcome of any OHPn programme. Behaviour change is "any positive health behaviour that is a personal attribute such as habits or practices that are related to restoration and maintenance of health" (Glanz *et al.*, 2008). For improved oral health through behaviour change; the intervention must be hinged on theories and models of health behaviour change (Glanz *et al.*, 2008). These are helpful in identifying strategies that prevent relapse and enhance maintenance of recommended behaviour (Glanz *et al.*, 2008).

2.24 Concept map for the study

This is the graphic representation of the relationship between the concepts of SBOHPP (Figure 2.1).

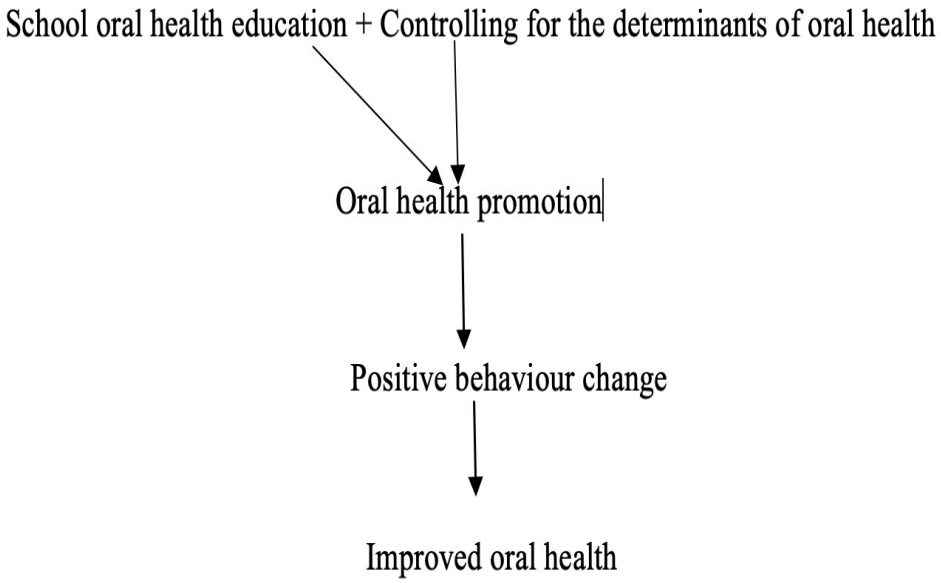

Figure 2.1: Concept map for the study

2.24.1 Different components of the concept map

As shown in the map, the relationship between the concepts is such that information is provided using appropriate educational strategies. The students acquire appropriate knowledge and skills through repeated demonstrations during SBOHPP. In so doing, one is controlling for underlying determinants of health. These determinants include social and environmental factors that will enable the students have control over their lifestyles and make healthy choices (health promotion). These concepts also revolve and are hinged on health behaviour theories and models.

2.25 Health behaviour theories and models

These are theories that guide the design and conduct of oral health or health promoting interventions and help in the understanding of factors that can affect behaviour change. Theories are defined as systematic explanation of observed facts (Reigeluth, 2013). Models are diagrammatic representation of a combination of theories showing the link and association between the theories (Green and Kreuter, 2005). In recent years, there has been emphasis on theoretically driven interventions for positive health related outcome (Patrick and Williams, 2012). They have become important as they identify the underlying factors that may influence the outcome of the instituted process(Patrick and Williams, 2012). The more commonly used theories in literature are the HBM, Social Cognitive Theory (SCT) and Theory of Reasoned Action (TRA). The Health Belief Model, which has been employed in SBOHPP, has been used to explain health related behaviour change and maintenance of such behaviour (Rosenstock, 1974, Glanz *et al.*, 2008, Yekaninejad *et al.*, 2012).

2.25.1 Health Belief Model HBM)

The HBM targets individual perspectives and susceptibility to the disease of interest. It is the earliest theory of behaviour change proposed for preventing diseases (Rosenstock, 1974). The theory was developed in the 1950s to explain why people fail to participate in health promotion programmes (Glanz *et al.*, 2008). The HBM originated from two stimulus response theories and Cognitive Theory. The stimulus response theory is based on the fact that learning results from reinforcement. This was corroborated by Skinner (1953) who hypothesized that positive behaviour is influenced by reinforcement. The

Cognitive Theory is based on the fact that reinforcement is influenced by expectations of an individual and explained by perceived susceptibility and perceived severity of diseases and the likelihood of avoiding these threats through self-action in the HBM (Rosenstock, 1974).

The model has evolved over the decades (Glanz *et al.*, 2008) with some modification to better explain the role of individual perspectives on behaviour change (Glanz *et al.*, 2008). From this, the HBM assumes that value and expectations guide the behaviour of individuals. The modification also explains the domains of health education that impact on interventions in preventing diseases and improving health (Glanz *et al.*, 2008).

The construct of HBM include perceived susceptibility to oral diseases, perceived seriousness of oral diseases while physical expectation outcomes are termed as threat (Rosenstock, 1974, Rosenstock *et al.*, 1988). Other concepts including perceived benefits and barriers to action are categorized as impediments that are personal. These concepts are modified by determinants of health and cues to action (Rosenstock, 1974). Self-Efficacy was later added as a concept after the initial model was developed. From the interrelationship of the concepts within the models, one can explain thus; that for an individual to consider behaviour change, he must believe that there is a likelihood of contracting the disease (perceived susceptibility) and have feelings about the seriousness of the disease if contracted or if untreated and the consequences (perceived severity). The chances of the perceived threat (combination of perceived susceptibility and severity) leading to the final positive behaviour change is dependent on the persons' perceived benefits of adopting the recommended behaviour in reducing or eliminating the disease threat (Bandura, 1997). Furthermore, uptake of the recommended action is only possible if the perceived benefits outweigh the barriers or negative effects of the action (Bandura, 1997, Bandura, 2004). Perceived benefits are enhanced by cues to actions, which are essentially encouraging factors available to the individual to take up the recommended action. These cues are in form of mass media and health education campaigns. The final step of behaviour change is guided by Self-Efficacy, a construct that was later integrated into the HBM to enhance its comprehensiveness. Self-Efficacy is defined as "the conviction that one can successfully execute the behaviour required to produce the outcomes (Bandura, 1997) and with this, final results in positive health outcome is

observed. Many school-based oral health education programmes have utilised HBM as conceptual framework(Yekaninejad *et al.*, 2012, Charkazi *et al.*, 2016).

2.25.2 Social Cognitive Theory

Social Cognitive Theory (SCT) is a theory built on the Interpersonal Model and explains the relationship between environment and health behaviour and how humans learn in the process. The theory took its origin from the research by Rotter in the 1950s (Rotter, 1954) and addresses the socio- structural and personal determinants of health. The SCT was first known as the Social Learning Theory (Bandura, 2004) and later integrated with concepts of cognitive psychology to be renamed the SCT (Bandura 1986). The theory has developed over time with further integration of concepts from sociology, political sciences and human psychology (Bandura, 1997, Bandura, 1998). The concepts of SCT include reciprocal determinism to explain the interaction between people and their environment. It assumes that behaviour is a dynamic interplay of personal behaviour and environment and the individual has control over the environment to suit the positive behaviour (Bandura, 1998). Other concepts include Outcome Expectations, Self-Efficacy, Collective Efficacy, Observational Learning, Incentive Motivation, Facilitation, Self-Regulation and Moral Disengagement (Bandura, 2004).

Outcome Expectations is the psychosocial determinant of health behaviour as identified in the SCT. It is elucidated as beliefs about the outcomes resulting from an individual's behaviour as a result of his choice and perceived value of those outcomes(Bandura, 2004). The SCT focuses on the Social and Self-Evaluative Outcomes. Social Outcomes are perspectives influenced by an individual's thought of others evaluating his behaviour (Bandura, 2004). Self-Evaluative Outcome on the other hand, is a social outcome provided by the individual and not by other people (Bandura 2004). This concept explains the resistance of individuals to peer pressure that could hinder them from positive behaviour change. Self-Efficacy is a concept that gave the SCT popularity (Bandura, 1997). Self-Efficacy is the perspective of a person that he has the capacity to adopt a recommended behaviour (Bandura, 2004). The term Collective Self-Efficacy is applied when it involves more than an individual such as evaluations of how people work in organizations.

Observational Learning is a concept in the SCT based on observations of models of people. It occurs in four stages; attention, retention, production and motivation. It is likened to when individuals observe others as models (Bandura, 2004). Attention is when individuals pick information of perceived importance or value to their well-being and pay attention to it. Cognitive Retention applies to learning by reading or through other aids and the ability to produce the observed skills (Bandura, 2004). This is dependent on communication and physical skills as well as through Self-Efficacy (Bandura, 2004). Motivation results from weighing Outcome Expectations from the risks and benefits of the learnt skills/behaviour (Bandura, 2004). Furthermore, provision of a supportive environment is mandatory for behaviour change through incentives used to reinforce the positive behaviour or punishment for negative behaviour in the SCT (Bandura, 2004). In addition, presence of facilitators such as posters and educational aids help provide a supportive environment (Bandura, 2004).

The other concepts are the Self-Regulation and Moral Disengagement concepts. Self-Regulation is the concept of SCT that enables individuals to endure and have control over the negative short-term challenges for a more distant goal of positive behaviour change (Bandura, 1965, Bandura, 1989, Bandura, 1998, Bandura, 2001, Bandura, 2004). Bandura *et al.*, (1997) reasoned out six ways in which Self-Regulation can be achieved and these include; systematic observations of one's behaviour (self-monitoring), identification of long term benefits (goal setting), information about one's performance and how to improve on it (feedback)(Bandura, 1997). It also involves provision of rewards for oneself, self-instruction during the process of behaviour change and enlistment of social support through others who encourage an individual's effort to exert self-control (Bandura, 1997). Moral Disengagement helps individuals to withdraw from harmful events to aid self-regulation (Bandura, 2004). These concepts operate together to provide insight into the dynamics of behaviour and the environment.

The SCT provides a comprehensive understanding of human behaviour and learning processes as well as the interplay with the environment. There are evidences of its applicability in SBOHPP(Haleem *et al.*, 2012b,Haleem *et al.*, 2016).

2.25.3 Health Promotion Model (HPM)

The HPM is a theoretical representation of variables and associations that contribute to health promoting behaviour and the resultant improved QoL. The HPM was originally developed by Pender in the1980s (Pender, 2011). It a model that serves as a "guide for exploration of the complex biopsychosocial processes that motivate individuals to engage in health behaviour directed towards enhancement of health" (Pender, 2011). The HPM was derived from the SCT of Bandura (1997). The HPM classifies determinant of health as individual characteristics and experiences, behaviour specific cognition and its effects as well as situational and interpersonal influences (Pender, 2011). Individual characteristics are background factors such as age, gender and are unmodifiable, while individual experiences guide future behaviour (Pender 2011). Behaviour specific cognition and its effects include the self-perceived benefits of recommended actions and perceived barriers to adopt the action as well as perceived Self-Efficacy all influenced by cues to action (Pender, 2011). The situational and interpersonal influences are social and environmental factors that influence actual behaviour change (Pender, 2011). Pender (2011) identified Self-Efficacy as the most important factor in behaviour change in adolescents. Although the use of HPM has been evaluated among adolescents especially for physical activity (Wu and Pender, 2002) its role in school-based oral health promotion is still limited.

2.25.4 Theory of Reasoned Action and Theory of Planned Behaviour

Theory of Reasoned Action (TRA) bases the determinant of behaviour on behavioural intentions. The TRA originated from the quest to have a better understanding of the associations that exist between intentions and behaviour (Fishbein, 1967). The critique of the theory in the earlier years was its reduced effectiveness when the behaviour is under volitional control and led to the development of the Theory of Planned Behaviour (TPB) whereby perceived behavioural control was added to the TRA (Ajzen, 1985, Ajzen, 1991).

The TPB considers behaviour that is not under individual control and assumed human behaviour is guided by three factors. These three factors are; Behavioural Beliefs, Normative Beliefs and Control Beliefs (Ajzen, 1985, Ajzen, 1991). Behavioural beliefs are beliefs about the outcomes of one's action, which could result in favourable or

unfavourable attitude (Ajzen, 1985). Normative beliefs on the other hand include beliefs about expectations of others and complying with them. This results in perceived peer pressure and consideration of beliefs as subjective norms, which are Social Expectation Outcomes. Control Beliefs on the other hand are beliefs about facilitating factors or barriers to a certain action and result in Perceived Behavioural Control (Ajzen, 1985). Perceived Behavioural Control corresponds to the Self-Efficacy components of the psycho social determinants (Bandura, 2004). The combination of the three beliefs that is; the more positive or favourable the attitude, subjective norm and perceived behavioural control, the higher the likelihood of the intention to take up the recommended behaviour. This then leads to the actual control, intention and finally behaviour change. Intentions are classified as proximal or short-term goals of psychosocial determinants of health behaviour which precede behaviour change. Although past studies based on TPB resulted in moderate effects in behaviour change (Steinmetz *et al.*, 2016), there is still a lack of evidence of its effect on oral health interventions in schools.

2.26 Comparison of the models

The HBM has limitations in being based on Cognitive Theory. It does not put into consideration the emotional concept of behaviour (Glanz *et al.*, 2008). In addition, the cue to action is an aspect which should be adequately outlined due to its importance in the model during interventional studies (Glanz *et al.*, 2008).The HBM is a theory of behaviour based on individuals and is important in one-on-one health education programmes (Glanz *et al.*, 2008). There is evidence of its applicability in school-based health education with positive outcomes when compared to other individual theories of health behaviour (Yekaninejad *et al.*, 2012, Charkazi *et al.*, 2016).

The TPB is also individual-based theory and has a limitation of not being able to measure the effect of the outcome objectively but as self-reports which serves as a strong source of bias (Armitage and Conner, 2001). Similarly, TPB has higher predictive value for self-reported outcomes than observed outcomes (Armitage and Conner, 2001) and may not be the most desirable when objectivity of outcome is important. In addition, evidence of its applicability in oral health intervention that is school-based is very sparse and may require further investigation to ascertain its suitability.

The SCT on the contrary is an interpersonal theory describing the relation between behaviour, individual and the environment. It predicts both behaviour change and creates an avenue to inform, enable, guide and motivate individuals to adopt positive behaviour that will promote their health (Bandura, 1997). This is not the case for other models as they only assess the outcome expectations in various ways thereby only predicting behaviour change and giving no room to guide how to go about behaviour change (Bandura, 2004). The SCT has been valuable in SBOHPP and resulted in positive outcome (Haleem *et al.*, 2012b).

The comparison of the models is as shown in Table 2.1. Although each is unique in its own way and has led to different evaluations as well as comparison.It has been proposed that no single theory or model is perfect thus a combination of theories and models is recommended to guide the conduct and implementation of health promoting interventions (Glanz *et al.*, 2008). In addition, there should be emphasis on those that focus on the type of behaviour to be changed.

The suitability of the models to different situations aroused investigations and observations about each model and the following were highlighted. The HBM was found to provide more details than SCT with respect to the categorization and measurement of outcome expectations that influence use of preventive services (Bandura, 1997, Glanz *et al.*, 2008). Similarly, the HBM has been found to be better suited for investigating the reasons (Bandura, 1997, Glanz *et al.*, 2008), predicting and evaluating planned actions to change health behaviours. Other theories and conceptual models may be enhanced by incorporating SCT concepts and principles (Bandura, 1997, Glanz *et al.*, 2008). These concepts and principles include peer modelling in observational learning, self-regulation, incentive motivation, and enabling environmental facilitation (Bandura, 1997, Glanz *et al.*, 2008).

In conclusion, in understanding OHPn, the health behaviour theories and models are useful entities on which conceptual frameworks can be based. This should lead to improved health status in SBOHPP.

Table 2.1: Comparison of the models and the components of psycho-social determinants of health behaviour and self-efficacy

Theories	Psychosocial Determinants of Health Behaviour							
	Self Efficacy	Outcome expectations			Goals		Impediments/barriers	
		Physical	Social	Self-evaluative	Proximal	Distal	Personal	Health system
SCT	Rated	Rated	Rated	Rated	Rated	Rated	Rated	Rated
HBM	Rated	Rated	Rated				Rated	Rated
TRA		Rated	Rated		Rated			
TPB	Rated	Rated	Rated		Rated			
HPM	Rated	Rated	Rated				Rated	

Adapted from Bandura, 1997, Armitage and Conner, 2001, Bandura, 2004, Glanz *et al.*, 2008.

2.27Comparison of outcomes from SBOHPP using the different health behaviour theories

Available evidence has shown that the Social Cognitive Theory was able to provide positive outcome on the oral health knowledge, attitude and practices of students in a school-based study in Pakistan (Haleem *et al.*, 2012b). In addition, positive outcome was also noted in the oral health status of the students (Haleem *et al.*, 2012b). Likewise, the Health Belief Model also yielded positive oral health outcomes in School-Based Oral Health Programmes (Yekaninejad *et al.*, 2012, Charkazi *et al.*, 2016). There is, however, limited evidence on the effectiveness of the TPB in SBOHPP.

The use of HBM and SCT may provide an advantage of positive health outcome in SBOHPP in view of the above evidence and as such a conceptual framework utilizing these two theories is used in the study

2.28 Conceptual framework

The framework shows the link between the concepts/constructs of a research project. It may be guided by concepts/theories/models or in other cases may eventually lead to the deduction of theories.

2.28.1 Importance and role of a conceptual framework

Concepts associated with school oral health programmes are themes that serve as the fundamental building blocks for the design, implementation and evaluation of the programme. Conceptual framework is a combination of concepts (constructs) that guide the study in terms of its design and conduct. It shows how the various concepts are linked to each other and result in the final outcome. The research concepts for school oral health promotion revolve around health education, determinants of oral health and behaviour change. Health education provides the required knowledge and enables the students to acquire the recommended skills (WHO, 1987, Green and Kreuter, 2005). Indicators of health such as social, physical and environmental factors as well as school support, among others influence health and they directly or indirectly affect behaviour change (WHO, 1986, WHO, 1987). Behaviour change aims to encourage individuals to adopt the recommended action and skills for healthy lifestyle (Green and Kreuter, 2005).

The concepts are interlinked with theoretical models in the conceptual framework. The health education component of the SBOHPP will be guided by concepts from the SCT(Bandura, 1998) and HBM(Rosenstock, 1974); incorporating active involvement and positive reinforcement to push the knowledge acquired during health education towards the ideal. Health education is the cue to action and will be anchored by the school oral health promotion strategies; viz- a viz dentist-led, teacher-led and peer-led. The final outcome, which is improved oral health, is influenced by perceived susceptibility to oral diseases, perceived benefits of adopting the recommended behaviour, perceived barriers to uptake of the positive behaviour and self-efficacy, which are constructs from the health belief and health promotion theories. The framework also takes into consideration the relationship between the constructs of these theories and the concepts as they relate to sustainability and the process of conduct of the intervention.

A conceptual framework helps to define the objectives of the study. It helps in refining research questions and is important in the constructive design of the methodology (Locker, 1988, Carroll *et al.*, 2007, WHO, 2010). Similarly, the role of the conceptual framework in critical design of data collection tools and in the identification of pitfalls that could arise in the methodology of a study, has been highlighted (Locker, 1988, Carroll *et al.*, 2007, WHO, 2010). In addition, non-evident factors that can contradict the hypothesis being tested are brought into focus in a conceptual framework (Locker, 1988, Carroll *et al.*, 2007, WHO, 2010). Conceptual framework is a useful tool that guides and outlines the processes involved in the planning, implementing and steps towards the outcome of an intervention.

2.28.2 Components of the conceptual framework for the study

The conceptual framework addresses the principles of oral health promotion, health education which is the cue to action and represented by the intervention and the behaviour change model which links the various concepts of school oral health programmes to achieve the ultimate outcome of improved oral health (Figure 2.2).

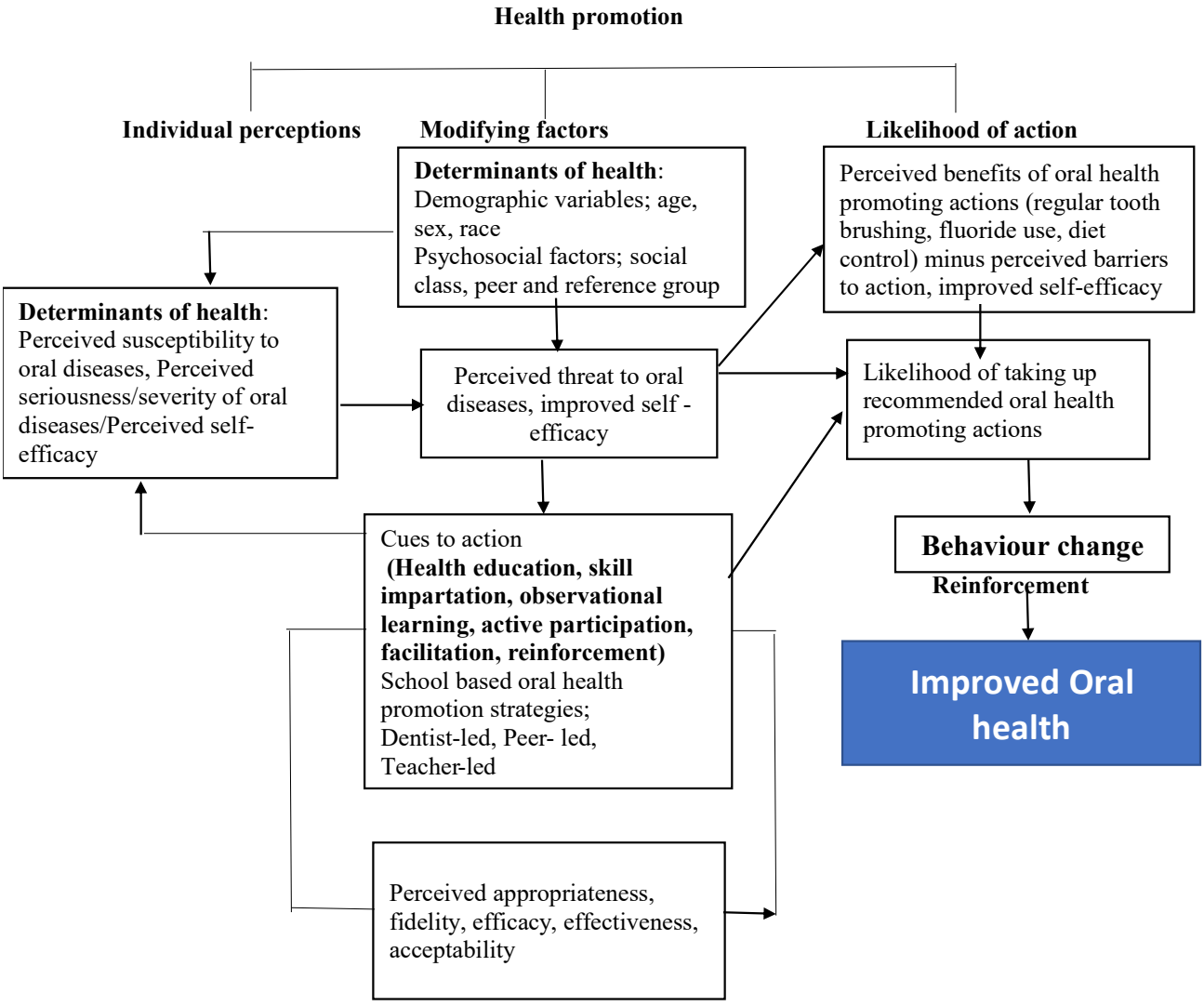

Figure 2.2: Conceptual framework for the study

2.28.3 Description of the links between the components of the conceptual framework

Conceptual framework of this study consists of interaction between the concepts of oral health education and the health behaviour theories; HBM and SCT. Oral health education delivery methods are cues to actions (HBM). The intervention (SBOHPP) delivered to the students affects their susceptibility to oral diseases and severity of these diseases (HBM) (Yekaninejad *et al.*, 2012). The intervention provides information about oral health, aided by appropriate educational aids which are facilitators (SCT) (Haleem *et al.*, 2012b). The process of educating the students will involve observational learning and active participation (SCT) (Haleem *et al.*, 2012b). These will act to modify the perspectives of the students through skills acquisition, through the intervention and supportive environment from the school. Incentives (SCT) minimize the effects of the determinants of health and other modifiers (Yekaninejad *et al.*, 2012). Tooth brushes, tooth paste, oral health education aids, posters and handbills act as reminders as well as facilitators to eliminate social barriers to behaviour change (SCT) (Haleem *et al.*, 2012b), thus increasing the likelihood of taking up recommended behaviour (HBM). Perceived benefits of good oral health behaviour, minus the barriers to taking up positive behaviour, increases the likelihood of positive action and vice versa (HBM) (Rosenstock, 1974). Sustained behaviour change is greatly influenced to a large extent by Intervention Fidelity assessed by adherence, quality, exposure and responsiveness to the intervention (Carroll *et al.*, 2007). Fidelity of SBOHPP relates to how the intervention is being delivered by the various resource persons, its quality and adherence to the design of the intervention (Carroll *et al.*, 2007). Sustainability and efficacy are contributory factors to the Cues to Action construct of this framework and are to be evaluated in the conceptual framework. Future incentive/motivation (SCT) helps to reinforce positive behaviour and overall improved oral health.

2.29 School oral health education

This is the process of passing information on oral health across and skill training for students using appropriate educational aids. The educational message focuses on the causes of oral diseases, ways of preventing oral diseases, types of tooth cleaning aids, tooth brushing programme and demonstration of tooth cleaning (Laiho *et al.*, 1987, Laiho

et al., 1991, Thomas *et al.*, 2000, Sahota *et al.*, 2001, Hartono *et al.*, 2002, Kwan *et al.*, 2005, Chapman *et al.*, 2006, Petersen, 2008,Tai *et al.*, 2009a, Yazdani *et al.*, 2009, Haleem *et al.*, 2012a, Yekaninejad *et al.*, 2012, Yusof and Jaafar, 2013, Langford *et al.*, 2014, Haleem *et al.*, 2015, Lai *et al.*, 2016, Singh *et al.*, 2016, Vangipuram *et al.*, 2016, Hodder *et al.*, 2017). This information ought to yield cognitive changes, which are sustainable when conducted with adequate health education aids (Bankole *et al.*, 2011, Amalia *et al.*, 2012). The appropriateness of the health education aids is according to the study site, age and aim of the intervention (Yusof and Jaafar, 2013, Langford *et al.*, 2014). Conduct of oral health education activities/programmes are guided by the health behaviour theories and the stages (Haleem and Khan, 2006, Bankole *et al.*, 2011, Amalia *et al.*, 2012, Yekaninejad *et al.*, 2012). The efficiency and effectiveness of oral health education in promoting oral health tend to increase in the presence of a supportive environment.

2.30 Creation of supportive environment

Successful oral health promotion entails creating room for a supportive school environment. The school authorities, teachers, parents and the school community are crucial determinants of the success of the SBOHPP (Blum *et al.*, 2000, Center for Disease Control, 2013, Jürgensen and Petersen, 2013, Yusof and Jaafar, 2013, Langford *et al.*, 2014). Formulation of policies to favour the adoption of recommended behaviour, such as non-sale of cariogenic food, mouth inspection, integration of oral health courses into the school curriculum, among others, are helpful. In addition, involvement of the parents and families of the students can enhance and promote the actions needed for the success of SBOHPP (Yekaninejad *et al.*, 2012). The involvement of these stakeholders, to provide safe and supportive environment, should be considered in designing, implementing and evaluating SBOHPP as they are crucial to its success.

2.31 Building public policies

The government and the school authorities are important in building policies that will influence both the students and the staff. This will in turn result in appropriate behaviour and will enhance the other components of health promotion. School policies to influence training of students and the staff as well as supportive environment for behaviour change

such as ban of sales of cariogenic food within and in the immediate vicinity of the school has been advocated (WHO, 2003, Kwan *et al.*, 2005,Petersen, 2008).

2.32 Developing personal skills – training of resource persons (peers, teacher, staff members)

Of great importance to SBOHPP is the training of resource persons that are responsible for the delivery and monitoring of the programme. In this case, resource persons are relevant groups apart from the dentists who should be enlisted to perform as oral health educators. They include teachers, other school staff, peers and school nurse. This may become important in regions where there are very few health personnel as seen in many LMICs and few HICs (Fernando *et al.*, 2013, Jain *et al.*, 2016). Employing teachers as agents of oral health promotion has yielded positive outcome by improving the oral heath KAB as well as reducing oral diseases (Fernando *et al.*, 2013, Naidu and Nandlal, 2017). The use of non-dentist promoters is gaining popularity from the positive outcomes recorded from such studies. This should thus be explored further to examine the appropriateness to LMICs.Oral health promotion through schools involves participation of all stakeholders as a school community ensuring community participation. Involvement of parents, teachers, students in decision making has been recommended (Kwan *et al.*, 2005, Petersen, 2008).

2.33 Effectiveness of SBOHPP

The SBOHPP play crucial roles in providing positive change in knowledge, attitude and practices. A major component of SBOHPP is health education, which addresses the cognitive aspect of learning (Gagné, 1972). Studies have shown that SBOHPP improve oral health knowledge, attitude and practices (Shenoy and Sequeira, 2010, Gambhir *et al.*, 2013, Esan *et al.*, 2015). Although improvement in KAB has been the main aim of many studies, evaluation of the overall health status is more important. This is because change in oral health and attitude does not necessarily translate to behaviour change and by extension overall improved oral health status.

The role of SBOHPP in improving the oral health status of adolescents has generated mixed reports. Reduction in the prevalence of dental caries, malocclusion and periodontal disease has been reported from many studies (Yazdani *et al.*, 2009, Yekaninejad *et al.*, 2012, Haque *et al.*, 2016). While some studies have provided positive improvement in

oral hygiene and invariably periodontal disease status (Azogui-Lévy *et al.*, 2003, Amalia *et al.*, 2012, Gauba *et al.*, 2013, Ariga *et al.*, 2014, Damle *et al.*, 2014, Blake *et al.*, 2015), others have reported contrary findings (Frencken *et al.*, 2001, Hedman *et al.*, 2013). The differences in the recorded outcome of the various studies are attributed to the methodology used on one hand and the fact that some of the studies were not founded on any behaviour change theory or a recognized conceptual framework. Furthermore, non-dentist-led strategies increased the likelihood of failure of the programme (Frencken *et al.*, 2001, Hedman *et al.*, 2013). The major draw-back from many of the SBOHPP studies is the failure to examine underlying determinants of health that are important for behaviour change and improved oral health. This is corroborated by studies demonstrating the role of behaviour theories and determinants of health in sustainable behaviour change and overall improved health (McKeown, 1978, Noack, 1987, Mcbride *et al.*, 1999, Watt, 2002, Martikainen *et al.*, 2002, Marmot, 2005,). These evidences have, however mainly been gathered from HICs and very few LICs. There has been no documentation of the influence of SBOHPP inNigerian adolescents.

2.34 School oral health promotion strategies

Inappropriate use of health promotion strategies is a known contributory factor in the failure of SBOHPP. Different strategies have been identified in the conduct of SBOHPP and include dentist-led, teacher-led, peer-led and self-learning. The various strategies are highly influenced by the environment and social factors, thus should be evaluated for its contextual appropriateness.

2.34.1 Dentist-led strategy

Dentist-led SBOHPP are programmes that are anchored, delivered and monitored by the dentist. Dentists play important roles in providing the required information and skills about oral health and this has been justified by many authors (Chapman *et al.*, 2006, Tai *et al.*, 2009, Bankole *et al.*, 2011, Bhardwaj *et al.*, 2013b, Blake *et al.*, 2015, Esan *et al.*, 2015). Dentists are at the fore- front of oral health promotion in many sectors of life including the school. The major strength of the dentist-led strategy is the depth of knowledge dentists have acquired through their training. The effectiveness/efficacy of dentist-led SBOHPP is such that in many countries including Nigeria, it was very effective

in improving oral health KAB as well as improved oral health status (Chapman *et al.*, 2006, Bankole *et al.*, 2011, Bhardwaj *et al.*, 2013b, Blake *et al.*, 2015, Esan *et al.*, 2015). Although, this method has been found to be highly beneficial in the promotion of oral health in both HICs and LICs it is fraught with sustainability issues in LICs like Nigeria, hence a need to explore other methods.

2.34.2 Teacher-led strategy

Teachers are central to the learning process through whom students acquire knowledge and skills. Teachers monitor and supervise students in their care. School oral health programme provide information to facilitate learning, that are directed by teachers. This strategy has been beneficial in reducing the prevalence and severity of oral diseases in India (Thomas *et al.*, 2000, Chandrashekar *et al.*, 2012b, Naidu and Nandlal, 2017) and Tanzania (Nyandindi *et al.*, 1996b). Whereas in China it was shown to have no impact in reducing the prevalence of dental caries (Tai *et al.*, 2009) but merely improved the oral health Knowledge, Attitude and Behaviour of the students (Tai *et al.*, 2009). Similar reports about failure of this method to improve oral health of students was documented in Tanzania (van Palenstein Helderman *et al.*, 1997).

2.34.3 Peer-led strategy

The huge cost implication of utilizing dentists in SBOHPP has informed the exploration of alternatives/alternative strategies, chief among which is the peer-led strategy. In addition, the limited number of dentists was also a contributory factor. The need is even more pronounced in LMICs as emphasized in a systematic review conducted by Haleem (Haleem and Khan, 2006). The study provided ample evidence justifying the need for substituting dentists with other personnel in oral health promotion programmes. This has thus opened another window into research on the effectiveness of other non-dentist interventions (Haleem and Khan, 2006). Simultaneously, there is growing body of evidence about the influence of peers in improving oral health (Vangipuram *et al.*, 2016, Khorakian *et al.*, 2019, Villanueva-Vilchis *et al.*, 2019, Sayar *et al.*, 2020). Peer-led healthy school strategy was able to effect a positive impact on the OHRQoL of students in Malaysia (Yusof and Jaafar, 2013a).

Before now, evaluation of the variables of importance in the effectiveness of peer-led strategy often utilized quantitative methods with little evidence from qualitative methods. Qualitative methods should help examine the perspectives and views of students on this method of intervention and may reveal areas of strengths and weaknesses that should be addressed for the success and sustainability of the programme.

Peer-led strategy may be as equally effective as other methods, more so that the influence of peers is an important determinant of health among adolescents. However, there is a dearth of knowledge about this in Nigeria.

2.34.4 Comparison of the effectiveness of SBOHPP strategies

Comparison of the relative effectiveness of the peer-led, dentist-led and teacher-led SBOHPP strategies has been an under researched area in dentistry with two studies (Haleem *et al.*, 2012c, Haleem *et al.*, 2015) found in the literature. Results from the studies showed that the three strategies were effective in improving the oral health knowledge, attitude and practices as well as the oral health status of the adolescents (Haleem *et al.*, 2012b, Haleem *et al.*, 2015). The studies concluded that peer-led strategy was comparable to the dentist-led strategy and was more effective than the teacher-led strategy (Haleem *et al.*, 2012b). The paucity of information about the comparative effectiveness of the three SBOHPP strategies globally elucidates the need for further study in this area to identify appropriate strategies for different contexts.

The few studies (Laiho *et al.*, 1993, Chandrashekar *et al.*, 2012a,Srivastava *et al.*, 2016, Vangipuram *et al.*, 2016, Villanueva-Vilchis *et al.*, 2019, Sayar *et al.*, 2020), which compared the effectiveness of pairs of the three SBOHPP strategies provided equivocal reports. In a study (Chandrashekar *et al.*, 2012a) that compared the dentist-led and teacher-led strategies at improving the oral hygiene of adolescents, it was observed that teacher-led strategy was more effective than the dentist-led strategy. The relative superiority of teacher-led strategy in that study was attributed to the frequency of intervention, which was higher among the teacher-led group than the dentist-led group (Chandrashekar *et al.*, 2012a). The study concluded that oral health programme conducted frequently by teachers was more effective at improving the oral hygiene of adolescents when compared with the less frequently conducted interventions by dentists

(Chandrashekar *et al.*, 2012a). On the other hand, dentist-led method was reported as a more effective strategy at improving the oral health of adolescents in North Bengaluru, India (Srivastava *et al.*, 2016). The effectiveness of dentist-led methods in promoting oral health among adolescents have been documented (Vanobbergen *et al.*, 2004, Pradhan *et al.*, 2020). Furthermore, teacher-led strategy improved the oral health knowledge of the students but it was ineffective at improving the oral health status (Srivastava *et al.*, 2016). Ineffectiveness of the teacher-led strategy in promoting oral health among adolescents had also been reported (van Palenstein Helderman *et al.*, 1997, Frencken *et al.*, 2001). Heavy school workload and tight school schedule were factors that could have contributed to the ineffectiveness of teacher-led strategy in SBOHPP.

The relevance of teachers in promoting oral health in schools cannot be over emphasized. The comparison of teacher-led and peer-led strategies in improving oral hygiene of adolescents in Iran showed superiority of the teacher-led method (Khorakian *et al.*, 2019). This is in contrast to findings in Pakistan (Haleem *et al.*, 2012b), where the teacher-led health education strategy was inferior to peer-led method, but the teacher-led method was more effective than self-learning method (Haleem *et al.*, 2012b). The superiority of teacher-led method over parent-guided oral health education and promotion programme in China, which resulted in improved oral health status of the students has been documented (Thomas *et al.*, 2000).

Assessment of the effectiveness of the dentist-led and peer-led strategies at improving oral health of adolescents in countries with formal school OHPn has shown equivocal trends. The peer-led strategy was comparable to the dentist-led strategy as reported by some authors (Haleem *et al.*, 2012b,Haleem *et al.*, 2015). Conversely, a study (Laiho *et al.*, 1993) reported the effectiveness of peer-led strategy as inferior to the dentist-led method. This finding was reported among Finnish adolescents (Laiho *et al.*, 1993) more than two decades ago. In that study, (Laiho *et al.*, 1993) peer-led strategy was the next most effective in improving oral health with teacher-led and self-learning strategies being the least effective. The peer-led strategy was however, reported as being superior to the dentist-led strategy by some authors (Vangipuram *et al.*, 2016, Villanueva-Vilchis *et al.*, 2019, Sayar *et al.*, 2020). The peer-led method was found to be better at improving the oral health status than the dentist-led strategy among adolescents in Bengaluru

(Vangipuram *et al.*, 2016), Iran (Sayar *et al.*, 2020) and Mexico (Villanueva-Vilchis *et al.*, 2019). Similarly, in a systematic review of the comparative effectiveness of peer and adult-led health education, the peer-led health education programme was found to be a better option at reducing the prevalence of oral and general diseases (Mellanby *et al.*, 2000). The effectiveness of peer-led strategy has been attributed to peer-influence and the continuous interaction among peers. These findings are further buttressed by those from studies to determine the role of peers in reducing diseases in fields other than dentistry (Campbell and MacPhail, 2002, Medley *et al.*, 2009). Peer-led education has been demonstrated to be effective in improving the knowledge of risk factors for cervical cancer among female adolescents (Sadoh *et al.*, 2018) and the practice of screening for the disease using pap smear in Nigeria (Mbachu *et al.*, 2017). It is however, worthy of note that the study conducted by Mellanby (2001) also identified non-effectiveness of peer-led method in promoting health. In view of the equivocal conclusions made by the various studies, it is important that the effectiveness of peer-led strategy in promoting oral health should, therefore, be evaluated in the Nigerian setting and other LICs.

2.35 Research gap

Effectiveness of SBOHPP at improving oral health has been repeatedly demonstrated in other countries (particularly in HICs), however no such programme exists in Nigeria. The school-based programme has been found beneficial in promoting oral health among students (children and adolescents) in countries where it has been instituted (Nyandindi *et al.*, 1996, Conrado *et al.*, 2004, Macnab *et al.*, 2008, Tai *et al.*, 2009, Yazdani *et al.*, 2009, Amalia *et al.*, 2012, Yekaninejad *et al.*, 2012, Ariga *et al.*, 2014). This is because the school is one of the avenues for influencing good oral health behaviour in life (Jurgensen and Petersen, 2013). The SBOHPP has been found to reduce the prevalence and severity of dental caries as well as improve oral hygiene status thereby reducing gingivitis and periodontal diseases (Nyandindi *et al.*, 1996, van Palenstein Helderman *et al.*, 1997, Biesbrock *et al.*, 2003, Chapman *et al.*, 2006, Tai *et al.*, 2009, Markeviciute and Narbutaite, 2015,Haque *et al.*, 2016a, Lai *et al.*, 2016a). Despite these numerous benefits, no such programme to the best of the researcher's knowledge is in existence anywhere in Nigeria.

The comparative evaluation of the various SBOHPP strategies has shown equivocal reports. Contextual factors have been considered as contributory to these results as they play cogent roles in the effectiveness of oral health promotion interventions (Tsai *et al.*, 2020). Furthermore, lack of conclusive reports on the effectiveness of SBOHPP strategies has contributed to the dearth of information on the most appropriate strategies for adolescents (Tsai *et al.*, 2020). In addition, late adolescence is a period that has not received attention in oral health promotion interventions when compared to young children who have been the target population set (Tsai *et al.*, 2020). This necessitates further investigation of the relative effectiveness of the strategies in the local context, in order to encourage non-dentist-led strategies among adolescents, especially in LICs. Investigation of the appropriateness of the various strategies in the Nigerian setting will be worthwhile since there is limited evidence and no comparative evaluation has ever been done despite the burden of unmet dental needs in adolescents, thus, making this study very important.

Sparse information exists on the assessment of school-based oral health education delivery strategies in low resource settings. Different educational delivery strategies have been employed in the implementation of school-based oral health promotion programmes in various parts of the world (Nyandindi *et al.*, 1996, van Palenstein Helderman *et al.*, 1997, Haleem *et al.*, 2012b, Yusof and Jaafar, 2013, D'Cruz and Aradhya, 2013b,Esan *et al.*, 2015, Reddy *et al.*, 2016). When evaluated, the different school-based oral health promotion strategies were varied by the person delivering the educational activities and these included dentist-led, teacher-led, peer-led and self-learning. These strategies have been assessed and found to be effective in the prevention of oral diseases and in improving the oral health of adolescents but the superiority of any of the methods remains unresolved (Nyandindi *et al.*, 1996, van Palenstein Helderman *et al.*, 1997,De Farias *et al.*, 2009, Shenoy and Sequeira, 2010, Haleem *et al.*, 2012b, D'Cruz and Aradhya, 2013, Esan *et al.*, 2015).

There is limited evidence on the relative effectiveness of the SBOHPP delivery strategies among adolescents in LICs. In Nigeria, the dentist-led method was evaluated among primary school children and found effective in adopting positive oral health preventive behaviour (Esan *et al.*, 2015). This study, however, did not assess the impact of the

strategy on oral health status of the school children. Furthermore, the dentist-led strategy is fraught with problem of sustainability in low resource settings due to the low dentist to population ratio. Comparative evaluation of other strategies of delivering oral health education by other persons therefore becomes imperative especially among adolescents as no study has chosen this age group for investigation in Nigeria.

Research into barriers/facilitators in the implementation of SBOHPP is sparse globally. Investigation of barriers to implementation of school general health programme showed that there were numerous barriers varying from lack of funds to inadequate health facilities (Ademokun *et al.*, 2014). This, however, has not been documented in relation to SBOHPP. So far, research on SBOHPP has almost exclusively utilized quantitative methods. This may have contributed to the gap in knowledge on the barriers to and facilitators of SBOHPP. Contextually, these may influence, to a large extent, the sustainabilityand outcome of the programme. Investigation into the barriers and facilitators specific to the implementation of SBOHPP, therefore becomes very important.

2.36Comparison of methodologies of assessing school-based oral health strategies

Most of the methods to evaluate the dentist-led strategy have been quantitative in nature. These methods varied from cross sectional studies (Amalia *et al.*, 2012) to Randomized Controlled Trials (RCT) (Yazdani *et al.*, 2009, Haleem *et al.*, 2012b). In addition, quasi experimental studies have also been employed in India and in the United Kingdom (Bhardwaj *et al.*, 2013, Blake *et al.*, 2015). The strength of quantitative methods in evaluating dentist-led method is its objectivity, with limited chances of introducing bias. The questionnaire-based method was used to evaluate changes in oral health knowledge, attitude and practices. Furthermore, indices have been used to assess oral health status and compared quantitative changes pre-and post-intervention to determine the change (Chapman *et al.*, 2006, Bhardwaj *et al.*, 2013, Blake *et al.*, 2015, Esan *et al.*, 2015). However, there is limited evidence on qualitative assessment of the students' perspective of the school health programmes at which the dentist were the facilitators.

To objectively compare oral health education strategies, an effective tool such as the RCT is preferred as noted in studies by Hebbal *et al.*, (2011), Srivastava *et al.*, (2016) and others (Haleem and Khan, 2006, Yekaninejad *et al.*, 2012, Haleem *et al.*, 2015).

Randomised controlled trials provide quantitative and objective comparison of the effectiveness of school-based oral health education methods (Hebbal *et al.*, 2011, Srivastava *et al.*, 2016). Hebbal *et al.*, (2011) conducted RCT among 12-year olds in Indian schools to compare oral health education aids geared at improving oral health of the students. The study was able to eliminate potential sources of bias that could have been introduced as a result of non-randomisation of the groups to the intervention and control groups. This was similar to the study by Srivastava *et al.*, (2016) among 12-year-old students in North Bengaluru to compare oral health education delivery strategies in a RCT. These two studies based the recruitment of study participants on the probability sampling technique. In addition, there was strict standardization of the instruments of data collection. However, in the study by Hebbal *et al.*, (2011) validation of the instrument prior to the final study was not addressed thus, invalidating the outcome of the study.

Non-randomised controlled trials also provide a strength of evidence, although this is lower than randomised controlled trial. Damle *et al.*, (2014) conducted a non-randomised controlled trial among rural and urban children aged 12 to 15-year-old in India. The study evaluated the effectiveness of school-based tooth brushing programme towards improving oral health of the students. Lack of randomization; a source of bias, may influence generalisation of findings in such studies. Similarly, estimation of sample size without effect of clustering also limits the generalization/accuracy of outcomes in cluster randomised interventions (Wang, 2014).Appropriate standardization of data collection instruments, training and calibration of examiners are fundamental requirements in the methodology of interventional studies (WHO, 2013). Lack of consideration for these basic principles in the methodology of interventional studies affects the validity and reliability of the outcome measure.

The dominance of the quantitative methods in assessing the effectiveness of SBOHPP has been a major weakness in the methodology of school-based interventional studies. Although the quantitative methods seem most appropriate as an objective way of assessment, qualitative assessment of opinions among participants is also crucial (Green and Thorogood, 2018). These opinions/perspectives, which can only be captured by qualitative measures may be important to identifying the pitfalls in the intervention process. This is currently non-existent in the literature of SBOHPP.

The perspective of adolescents about an instituted intervention or process is important in ascertaining the acceptability of such intervention. The qualitative approach of assessing the perspective of adolescents about oral health has been evaluated (Östberg *et al.*, 2002, Fitzgerald *et al.*, 2004). Ostberg *et al.*, (2002) assessed the perspective of Swedish adolescents along with the influencing factors, using an explorative design through Focus Group Discussions (FGD). Similarly, Fitzgerald *et al.*, (2004) conducted an explorative qualitative study among Otago adolescents to determine their views about oral health and health care using the same method. Both studies (Östberg *et al.*, 2002, Fitzgerald *et al.*, 2004) standardised their instruments and the process of FGD. The data analysis was also well documented. The perspective and views of adolescents were evaluated exploratively because the views of adolescents were unknown. In addition, assessing the perspective of adolescents about intervention studies may provide necessary evidence for the process and acceptability of the intervention, which may be important in achieving sustainability of the intervention.

From available evidence, RCTs provide the best level of evidence for objective evaluation of SBOHPP, but the subjective assessment of the views expressed by the target population is most important in determining their perspectives. It is also important for identifying the barriers or facilitators of the recommended behaviour change. Furthermore, the fidelity and sustainability of the programme evaluated both subjectively and quantitatively, makes a mixed method approach the best for evaluating SBOHPP. Furthermore, none of the available studies considered the views of participants nor their teachers about the intervention, which can form part of the contextual factors that influence long-term success and sustainability of the programme. In addition, the key methodological weakness noted in existing studies was the study designs as all were based on quantitative methods excluding the important role of qualitative assessment in intervention and evaluation. Qualitative methods are very helpful in evaluating the intervention process needed to identify the active component of the intervention that is responsible for the change in oral health. The method assesses the views of participants as well as those of the teachers about the intervention. Lack of mixed methods research has also hindered identification of the barriers and promoters (for example communication skills of the

person delivering the intervention) and probably the process and outcome of the intervention

In conclusion, the mixed method approach is the most appropriate method for comparing the effectiveness of school-based oral health education delivery strategies as it ensures both the objective and subjective assessment of the intervention.

2.37 Conclusion

This review has provided detailed insights into the fundamental knowledge of SBOHPP to identify gaps that need to be filled. There is dearth of information about the effectiveness of SBOHPP on the oral health of adolescents in Nigeria and some LICs. Available evidence in some international studies suggests equivocal outcomes when comparing peer-led, dentist-led and teacher-led strategies. An equivalent or superior level of effectiveness of peer-led or teacher-led as compared to dentist-led strategy would imply advantages in instituting SBOHPP in resource poor settings, albeit there are prominent gaps in the practicality (translational effect) as well as evaluation of the intervention process and impact. In addition, a comprehensive assessment of the role of concepts and conceptual framework as essential tools that guide the design of the research and raise methodological concerns was highlighted. It has also shown the importance of health behaviour theories in building the conceptual framework and the HBM and SCT are most widely used. Determinants of health were also identified in behaviour change. There is a weakness in the methodological components of the SBOHPP and the appropriateness of mixed methods was highlighted. Importantly, the review of the literature has assisted with the choice of methods that guided the implementation and evaluation of the intervention of this study.

CHAPTER THREE

MATERIALS AND METHODS

This chapter describes the materials and methods utilised to achieve the set objectives of the study.

3.1 Study design

This was a sequential mixed method study (explorative and explanative); where the qualitative approach was used at baseline and post intervention to achieve objectives one, two, six and seven. The qualitative approach for specific objective one and two was explorative while for objectives six and seven, it was explanative. The quantitative approach employed cross sectional study and cluster Randomized Controlled Trial (RCT) to achieve objectives three, four and five. The RCT was conducted to evaluate the effectiveness of the interventions in three study/intervention groups and in a control group (i.e. four trial arms). The intervention groups were peer-led, dentist-led and teacher-led.

3.2 Study period

The study was conducted over 20 months.

3.3 Study site

The study (qualitative and quantitative) was conducted in 36 randomly selected secondary schools from four Local Government Areas (LGA) that were randomly selected in Ibadan, Nigeria. One LGA was used for each of the study groups (three intervention groups and one-control group). This was done to avoid contamination that could occur if the unit of allocation was each school. Ibadan is the capital of Oyo State, Nigeria. It has metropolitan as well as rural areas. There are 11 LGA in the city, with five within the metropolitan area.The estimated population of Ibadan is 3,649,000.

3.4 Study population

This comprised of teachers and Senior Secondary School (SSS) I students for the qualitative and quantitative phases. The SSS I students were chosen because the students in this class would not have any major examination, which the study could jeopardize or disturb. In addition, students in SSS II were excluded because they would have been promoted to SSS III in the course of the study making them unsuitable for the study.

3.5 Sample size

3.5.1 (Qualitative phase)

Objectives 1, 2, 6 and 7

A sample size of 7 - 10 was recruited from the students selected for the study into each of the FGD,segregated by gender. A minimum of two FGDs was conducted for each gender in each trial arm. This was to avoid inhibition that may arise when adolescents of opposite gender are mixed in the same group. Thus, a minimum of eight FGDs for the students (two for each study group) was planned. The FGDs were continued until saturation was achieved. The FGDs for the teachers (one for each study group) was initiated and was continued until there was saturation of information on the research objectives. The participants in the FGDs for teachers were not segregated by gender because the views and opinions of adults about oral health was expected to be less influenced by gender.

3.5.2 (Quantitative phase)

Objectives 3, 4 and 5

Sample size determination: For students that were involved in the Randomized Controlled Trial; The study was designed to detect a difference in periodontal disease status of 50% with a power of 80% and at 5% significance level, using an approximately equal cluster size. The formula provides a consideration for individual randomization, N = 99(Rutterford *et al.*, 2015a, Rutterford *et al.*, 2015b, Ribeiro *et al.*, 2018). To adjust for the clustering effect, the above number was inflated by the variance inflation factor (VIF), VIF = 1+ $(\check{n} - 1)\rho$; where $\check{n}$ = average cluster size = 50 children/school, ρ = estimated intra cluster correlation coefficient = 0.05, VIF = 1+49*0.05 = 3.45. Thus n = 3.45 * 99 = 342 children. To allow for a dropout rate of 15%, a minimum of 402 school children per

trial arm was calculated. The minimum sample size calculated for the study was thus 1608 students. In view of the minimum sample per cluster estimated to be 50 and minimum sample per trial arm as 402. Division of 402 by 50 equals 8 remainder 2 students per trial arm. To ensure that the sample size was not short of the minimum sample size; an extra cluster was added to account for the remaining 2 participants; making a total of 9 clusters per trial arm and a total of 450 students, thus, total sample equals 1,800 for the four trial arms (Figure 3.1).

3.6 Sampling technique

3.6.1 (Qualitative phase) Objectives 1, 2, 6 and 7

A convenience sampling technique was utilized to select the teachers and students for the qualitative phase of the study. The selection of schools in each group was done using simple random sampling technique through the use of ballot papers by an independent research examiner. The sampling frame was made up of the schools selected for the study (as determined for the Cluster Randomised Controlled Trial) in each group. After the random selection of a school, the students in SSS I in the school formed the FGD study sample by convenience.

3.6.2 (Quantitative phase) Objectives 3, 4 and 5

A multistage cluster sampling technique was utilized for the selection of study participants for the study (Figure 3.1).

The first stage consisted of random selection of four Local Government Areas (LGAs) from the five LGAs in Ibadan metropolis. The LGAs that were randomly selected were: Ibadan North, Ibadan North East, Ibadan North West and Ibadan South East LGAs.

Stage 2: This involved random selection of nine schools from each selected LGA using a table of random numbers, resulting in a total of 36 schools.

Stage 3: This involved random selection of 50 students from the SSS I classes in each of the selected schools within each LGA using a table of random numbers. In schools where the total number of SSS I students were less than or equal to 50, all the students were

selected. This resulted in the selection of 450 students in each of the fourgroups (three intervention arms and a control group) and a total of 1800 students for the study.

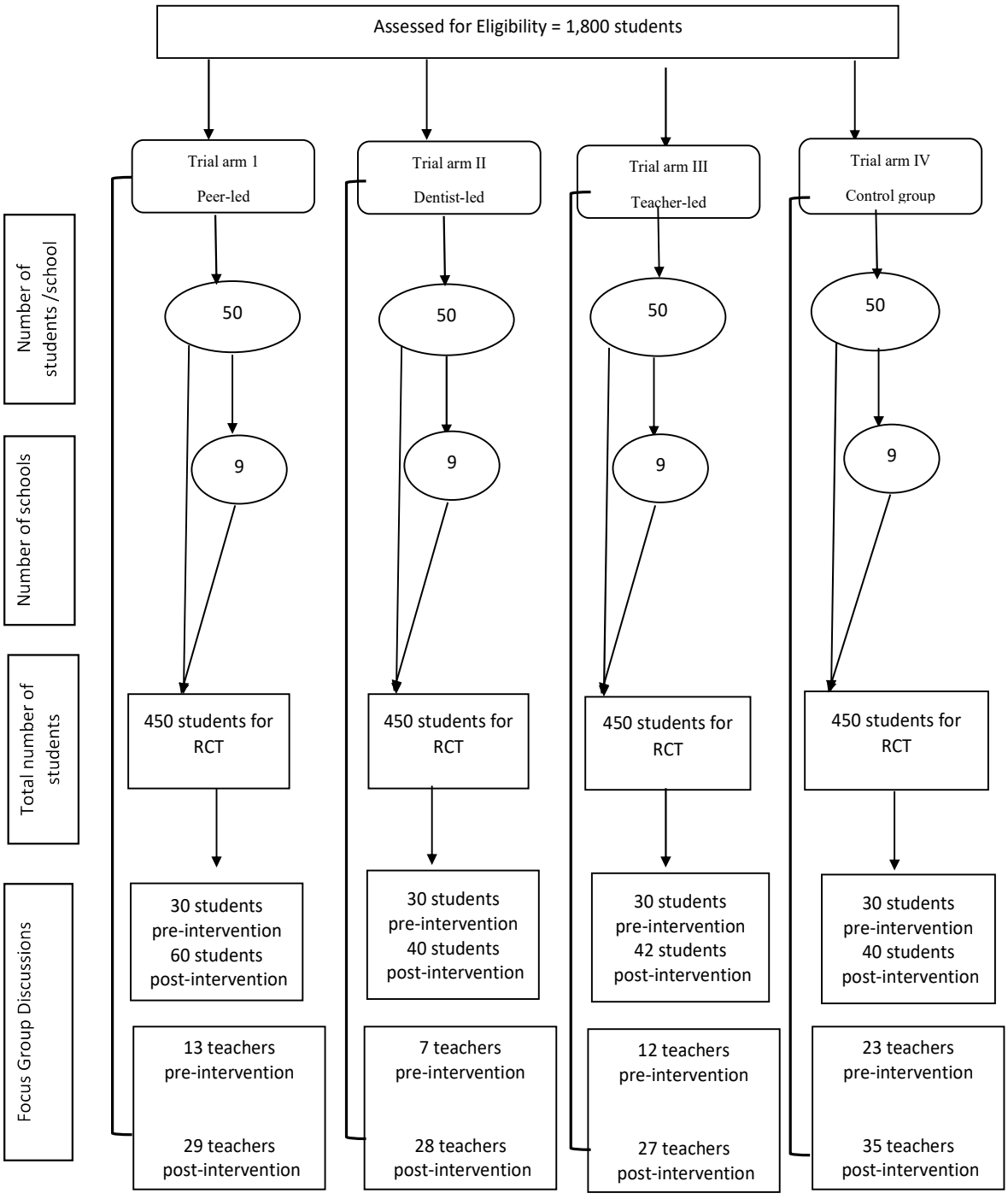

Figure 3.1: Flow chart for the research methodology

3.7 Selection criteria

3.7.1 Qualitative phase (Objectives 1, 2, 6 and 7)

Inclusion criteria

Objective 1

- Students who gave their consent/assent.
- Students who did not have special needs.
- Students who were able to communicate freely.

Objective 2

- Qualified teachers who had been in the service of the school for at least six months.
- Teachers who gave their consent.
- Teachers with permanent appointment.

Objective 6

- Students who gave their consent/assent.
- Students who had been attending the school since the study was commenced.

Objective 7

- Teachers who had taught in the school for a minimum of one year.
- Teachers who gave their consent.
- Teachers with permanent appointment.

Exclusioncriteria

Objective 1

- Students whose parents did not consent.
- Students who were not available at the time of the study.
- Students who were ill at the time of the study.

Objective 2

- Teachers who were ill at the time of the study.
- Teachers who were not available at the time of the study.

Objective 6

- Students who were not interested in the FGD.
- Students who were ill.
- Students who did not participate in the study.

Objective 7

- Teachers who had not been part of the school during the period of the study.
- Teachers who were ill at the time of the study were excluded.

3.7.2 Quantitative phase (Objectives 3, 4 and 5)

The following were the selection criteria for the quantitative phase of the study.

Inclusion criteria

- Only students who gave their consent/assent.
- Students who did not have special needs.
- Students who were able to communicate freely.
- Students who were available at the time of the study.

Exclusion criteria

- Students whose parents did not consent.
- Students who were ill at the time of the study.
- New students in the school having spent less than three months prior to commencement of the study.
- Students who would leave the school before the end the study.

3.8 Development of research instruments

Focus group guide (Qualitative phase objectives 1, 2, 6 and 7)

The focus group guide used to obtain information from the study participants was developed from previous studies (Pham *et al.*, 2015). The questions were developed in stages. The first stage involved review of literature to identify articles that focused on the

perspective of adolescents about oral health. Thereafter, the articles were screened and those related to the objectives of the study were selected. Questions were adapted from the interview guides, questionnaires used in the identified articles, the thematic analysis of information obtained from the review of qualitative studies and from the researcher's experience. The questions acted as prompts for the discussions. The focus group guide was reviewed by two expert qualitative researchers with the researcher for content validity and contents were modified after a consensus was reached. Thereafter, the focus group guide was pretested among two groups of 12 students each from two schools in the LGA in Ibadan Metropolis that was not selected for the study, to assess for comprehensiveness and content validity.It was found to be valid and comprehensive.

Quantitative phase

Questionnaire (Objectives 3, 4 and 5)

The questionnaire was developed from previously validated questionnaires (Yekaninejad *et al.*, 2012b,Lawal and Taiwo, 2018), one of which had been used in this environment (Lawal and Taiwo, 2018). The subsections of the questionnaire had been validated among adolescents in Ibadan (Lawal and Oke, 2020). The COHIP-SF 19, which constituted part of the questionnaire, was developed from the English version of the instrument (Broder *et al.*, 2012).

3.9 Data collection

3.9.1 (Qualitative phase) Objectives 1, 2, 6 and 7

Focus Group Discussions

After permission was given by the principal of each school, the students were assembled in a classroom and the purpose, content and implications of the study were carefully explained to them. Thereafter, each student was given a consent form in English and Yoruba languages (Appendix 1a and 1b) for the parents. Likewise, consents (Appendix 1c) were also obtained from the teachers before participating in the FGD pre- and post-intervention. The visit to each school followed a strict schedule provided by the school so as not to disrupt the academic activities. The co-curricular periods or the health periods were reserved for the study. After obtaining the consent forms from the students on the

scheduled date for the FGD, each student completed and signed assent or consent form (Appendix II).

The focus group guides (Appendix IIIa and IIIb)served as data collection tool to obtain the required information and a tape recorder was used to record the discussion. The researcher, who had received training in moderating FGDs, moderated the discussion and she was assisted by two non-dentists with no prior knowledge of the aim of the study. One of the assistants helped in taking notes of non-verbal expressions during the discussions. The second research assistant wrote the verbal responses, and these responses were compared with the tape-recorded discussions. Both assistants were trained in the facilitation of focus groups. They were also involved in taking notes from observations during the discussions and decided when saturation point was attained.

3.9.2 Quantitative phase (Objectives 3, 4 and 5)

Data collection procedure (cross-sectional and RCT)

Data were collected pre-intervention and post intervention by trained and calibrated research assistants.The research assistants were blinded as regards the intervention for each school.

Data were collected at baseline before instituting the intervention and at six months after intervention using structured self-administered questionnaires (Appendix IV) in addition to intra-oral examination. Data was collected with the use of pretested semi structured self- administered questionnaire, in addition to oral examination. After permission was given by the principal of each school, the students were assembled in a classroom and the purpose, content and implications of the study were carefully explained to them. Thereafter, each student was given a consent form (Appendix I) for the parents. The visit to each school followed a strict schedule provided by the school, which varied with each appointment. This became important so as not to disrupt the academic activities. The co-curricular periods or the health periods were reserved for the study.

Questionnaire

After consent from parents (Appendix I) and assent (Appendix II) were obtained from the students (or consent for older students), the students were assembled in a class and the

questionnaires were administered under guidance of the investigator and trained research assistants.

Measures

Data were collected using a pretested structured self-administered questionnaire on items that included socio-demographic data, oral health knowledge, attitude and practices as well as information on the oral health related quality of life of the students.

Sociodemographic data

Data obtained on sociodemographic characteristics of participants included age, gender, occupation of parents,' highest level of education attained by parents. Age was assessed as "age at last birthday in years", gender of the student was assessed as "male" or "female". The highest level of education attained by either of the parents was documented. In addition, the occupation of the parent was assessed, and this was regrouped into occupational class according to the Office Population Censuses Survey (OPCS) that had been modified for this environment (Lawal and Arowojolu, 2015). The occupation was, therefore, grouped into "skilled," "unskilled" and "dependents" categories.

Knowledge of oral health

Knowledge of oral health was evaluated with five categories of questions: knowledge of dentition size, knowledge of functions of teeth, knowledge of causes of dental caries, knowledge of causes of periodontal disease/gum disease and knowledge of fluoride.

Knowledge of dentition size: This was measured by two open-ended questions; "What is the total number of deciduous teeth in the mouth of a child?" and "What is the total number of permanent teeth in the mouth of an adult?" The response to each question was scored "1" for correct answers and "0" for wrong answers/missing response making a minimum score of "0" and maximum score of "2" for this sub category.

Knowledge of functions of the teeth: This was also measured using an open-ended question asking the students to mention any five functions of the teeth that they know. A correct response was scored "1" and "0" for wrong answer or missing response making a minimum score of "0" and maximum score of "5" for this sub category.

Knowledge of causes of dental caries: This was measured using an open-ended question asking the students to mention any three causes of dental caries.Each correct response was scored "1" and wrong answer or a missing response was scored "0" making a minimum score of "0" and maximum score of "3" for this sub category.

Knowledge of the causes of periodontal diseases/gum diseases: This was measured using an open-ended question; "List any three causes of gum diseases". A correct response was scored "1" and wrong answer or a missing response was scored "0" making a minimum score of "0" and maximum score of "3" for this sub category.

Knowledge of fluoride and its function: This was assessed by two questions; "Have you heard of fluoride before?" on a response of "Yes" or "No". A correct response was also scored "1" and wrong answer scored "0".

Knowledge of oral health score: The total Oral Health Knowledge score was calculated by summing up the scores of the four items assessing oral health knowledge. The maximum obtainable score was 14 while the least obtainable score was 0. Higher scores denoted better oral health knowledge.

Attitude towards oral health

Responses to attitude questions were rated on a 3-points' Likert scale and graded as "strongly agree/agree", "don't know or indifferent", "disagree/strongly disagree". There were 10 questions in this category. Attitude to oral hygiene measures assessed by; "If I floss my teeth, my teeth will break", "I am confident I can rinse my mouth after each meal", "I am confident that I can floss my teeth", "If I floss my teeth, it will prevent tooth problems", "If I have tooth decay/problems, my mouth will swell", "If I do not brush my teeth, I will have tooth problems". Attitude towards diet intake and dental visits were assessed by; "Taking sweet food will not cause harm to my teeth", "Sweet food is my choice all the time", "Visiting the dentist will not prevent tooth problems but only give me tooth problems" and "Taking no sweet will cause tooth holes".

The responses were scored as "1" for correct answers and "0" for wrong response. The maximum obtainable score was 10 while the least obtainable score was 0. Higher scores denoted better oral attitude towards oral health.

Oral health practices

The oral health practices of the students were assessed by evaluating the frequency of tooth cleaning with responses of; “none,” “once daily”, “twice daily”, and “more than twice daily”. Period of tooth cleaning was assessed with coded responses of; “not every day”, “once before breakfast”, “twice before breakfast and dinner”, “after each meal”, “after breakfast and dinner”, and “before breakfast and after dinner”. The correct responses for the question were “after each meal and after breakfast and dinner”. Also assessed was tooth cleaning aid; “What do you use to clean your teeth?” Responses include “chewing stick”, “toothbrush”, “cotton wool”, “nothing”, “others please specify ----------”. Also assessed was the kind of toothbrush they used. If they cleaned in between their teeth and what implement they used to do so, and average duration of toothbrush use/change were also evaluated. In addition, what the students used to remove debris or food stuck in between their teeth and smoking status as well as frequency of intake of sugar containing food daily were also assessed.

Correct response to a question was scored “1” while incorrect response was scored “0”. The maximum and minimum obtainable scores were “10” and “0” respectively. Higher scores were indicative of better oral health practices.

Oral Health Related Quality of Life (OHRQoL)

The OHRQoL of the adolescents was assessed using the Child Oral Health Impact Profile-Short Form 19 (COHIP-SF 19). The COHIP-SF 19 questions were; ‘During the past three months, how often have you experienced’: “pain in your teeth/toothache”, “discoloured teeth or spots on your teeth”, “crooked teeth or spaces between your teeth”, “bad breath”, “bleeding gums”, “difficulty eating foods you would like to eat”, “trouble sleeping”, “difficultly saying certain words” , “difficulty keeping your teeth clean”, “being unhappy or sad”, “worries or anxiety”, “avoiding smiling or laughing with others”, “feeling that you look different”, “being worried about what other people think about your teeth/mouth”, “being teased, bullied, or called names by other children because of your teeth”, absenteeism/missing school for any reason because of your teeth/mouth”, “not

wanting to speak/read out loud in class because of your teeth /mouth", "being confident", and "feeling that you were attractive (good looking)". The last two questions were the positive worded questions while the first 17 questions were negatively worded to describe the impact of oral condition on the quality of life of the adolescents.

Each COHIP-SF 19 question was rated on a 5-point scale in the range: 0 – 'never', 1 – 'almost never', 2 – 'sometimes', 3 – 'fairly often', to 4 – 'almost all the time'. Overall OHRQoL score was obtained by reversing the response scores for the 17 negatively worded questions of the COHIP-SF 19. The overall score ranged from 0 – 76. In this case, higher scores meant better quality of life.

Validity of COHIP-SF 19

The convergent validity of COHIP-SF 19 was assessed by evaluating its association with the self-report of oral condition and satisfaction with dental condition of the adolescents (Allen, 2003)

'Self-report' of oral condition was determined by a question: 'How do you consider the present condition of your mouth and teeth?' Response included: very good, good, neither good nor poor, poor and very poor. Satisfaction with dental condition was assessed by a single question "how satisfied are you with your mouth and teeth?". Responses included: very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied and very dissatisfied.

The self-report question, a standard global health question, was used to determine the convergent validity of the COHIP-SF 19 among the adolescents, more so this has not been done in this environment and in Nigeria. The internal consistency was assessed using the Cronbach alpha. The OHRQoL measure was validated and assessed for its reliability.

Pilot survey

A pilot survey was conducted on 10% of students who volunteered in three schools in another LGA that was not involved in the study in Ibadan, to ascertain comprehensibility and validity of the questionnaire as well as the feasibility of the study.

Test-retest reliability

The questionnaire was re-administered to 90 randomly selected study participants after one week of initial administration to assess the test-retest reliability.

3.10 Oral examination

Oral examination was conducted using cotton wool rolls, gloves, facemasks, sterile dental mirror and the WHO Community Periodontal Index (CPI) probe. The WHO CPI probe is lightweight with a ball end of 0.5mmand a black band of 2mm to give upper and lower limitsof 3.5mm and 5.5mm, respectively.

Standard procedures recommended by the WHO were adopted in assessing the oral health status of the students (WHO, 2013). The source of illumination for the examination was natural light throughout the study.

Students were examined seated upright on a chair near the window in a classroom in each school and natural lighting served as source of illumination. The privacy of each student was ensured, as only one student was allowed into the examination area at a time.

Oral health status

Information on oral health status was obtained using the Decayed Missing and Filled Teeth (DMFT) caries experience index, the Oral Hygiene Index-Simplified(Greene and Vermillion, 1964)and the Gingival Index (Löe and Silness, 1963).

A trained research assistant recorded findings from the oral examination in the assessment form (Appendix V) for each examiner who was a qualified dentist. The assistants were required for the recording in order to minimize cross infection as well as ease the process. Intra-examiner variability was calculated. All students with oral health conditions that required dental treatment were referred to the Primary Oral Health Care Centre Idikan for free treatment.

Caries experience: The 'DMFT' caries index, a composite measure was used to assess the past and present caries experience of the participants. The index comprised the D - decayed teeth, M -missing teeth due to dental caries and F - filled teeth secondary to caries.

Criteria for dental caries

Sound:A tooth was recorded as sound when there was no evidence of treated or untreated clinical caries.

Caries (D): Caries was recorded when a tooth has an obvious cavity, undermined enamel, or softened floor or wall. In addition, when a crown of a tooth showed destruction by caries with the root left in situ, caries was recorded.

Missing (M): This was recorded when a tooth was not present in the mouth due to caries.

Filled (F): This was recorded when a tooth has been restored due to caries and caries was not evident on the crown. A tooth crowned due to tooth decay was also charted as filled.

The total score for each studentequals D+M+F = Total DMFT score. The score ranged from 0 to 32 for each individual.

Criteria for assessing periodontal health status

The WHO CPI probe was used to assess the periodontal health of the participants. The Community Periodontal Index of Treatment Needs (CPITN) was used to assess the periodontal health and treatment needs of the study participants.

The Community Periodontal Index of Treatment Needs (CPITN)

This index assessed;

1. Gingival bleeding (GB).
2. Presence or absence of calculus.
3. Pathological periodontal pockets –shallow (3.5 – 5.5mm) and deep (> 5.5mm).

As the students were under 20 years of age, the modified CPITN was used, the teeth that were examined were as shown:

16		11		26
46		31		36

The periodontal pockets were examined in students aged 15 years and older.Where there was no index tooth in a sextant, the remaining teeth were examined. This modification

was made in order to avoid classifying the deepened crevices associated with eruption as periodontal pockets. In cases where no index tooth was present in a sextant, single fully erupted incisors or premolars were substituted.

Sensing of the gingiva: Each index tooth was probed (sensing) to assess pocket depth, presence or absence of subgingival calculus as well as gingival bleeding. The sensing force was established by placing the tip of the probe under the thumbnail and was pressed till blanching occurred. When sensing subgingival calculus, a light force less than or equal to 20g was used. During examination, the ballpoint of the probe was inserted in such a way to follow the anatomical configuration of the tooth root surface making sure that the student did not feel pain. The points examined on each tooth included the mesio-buccal, mid-buccal, disto-buccal, and the corresponding lingual sites.

CPITN scores:

0: a score of 0 indicated healthy periodontium

1: gingival bleeding

2: presence ofcalculus detected during probing

3: periodontal pockets between 3.5mm and 5.5mm

4: periodontal pocket 6mm or greater

The CPITN score was the highest score recordedin a sextant. An X was charted when there werefewer than two teeth in a sextant.

Simplified Oral Hygiene Index (OHI-S)

This index assesses the oral hygiene status of an individual. Use of this index entails division of the dentition into segments; Anterior: canine to canine and the Posterior segment: distal to 1st premolar. The index teeth (surfaces) used in this case were: 16 (buccal), 11 (labial), 26 (buccal), 31 (labial), 36 (lingual), and 46 (lingual) as shown below.

16	11	26

46	31	36

OHI-S has two components:

a) Simplified Debris Index (DI-S)

b) Simplified Calculus Index (CI-S)

The Simplified Debris Index (DI-S) assesses the accumulation of debris, which are pathologic and cause periodontal diseases. The assessment for DI-S was under three criteria and the gradings from examination ranged from 0 - 3 as follows; "0" – when there was no debris or stains present, "1" – when soft debris or stains covering not more than 1/3 of the tooth surface was noted, "2" – when soft debris covering > 1/3 but < 2/3 of exposed tooth surface was noted and "3" – presence of soft debris covering > 2/3 of the exposed tooth surface.

Evaluation and scoring of calculus CI-S was done as follows; "0" – was charted when there was no calculus present, "1" – charted when only supragingival calculus covering not more than 1/3 of the exposed tooth surface was observed, "2" – was charted when supragingival calculus covering > 1/3 but < 2/3 of the exposed tooth surface was found and "3" – supragingival calculus covered > 2/3 of the exposed tooth surface.

To calculate DI-S score and CI-S score;

DI-S score = Total debris score/No of tooth surfaces examined

CI-S score = Total calculus score/No of tooth surfaces examined.

The DI-S score and the CI-S score = 0 – 3, thus, the OHI-S for each participant (OHI-S = DI-S + CI-S) = 0 –6. The DI-S, CI-S and OHI-S were categorised as shown in Table 3.1.

Table 3.1: Categorisation of the calculus and debris indices

DI-S and CI-S		OHI-S	
Rating	**Scores**	**Rating**	**Scores**
Good	0.0 – 0.6	Good	0.0 – 1.2
Fair	0.7 – 1.8	Fair	1.3 – 3.0
Poor	1.9 – 3.0	Poor	3.1 – 6.0

The Gingival Index (GI)

The GI was developed by H. Loe and J. Silness in 1963 to assess severity and prevalence of gingivitis. The buccal, lingual, mesial, and distal surface areas of six teeth were examined and scored according to the criteria. The six teeth that were evaluated were as shown below:

16	12	24
44	32	36

Each surface area was scored 0 – 3 as follows;

0 = Absence of inflammation.

1 = Mild inflammation - slight change in colour and little change in texture.

2 = Moderate inflammation - moderate glazing, redness, oedema, and hypertrophy. Bleeding on pressure.

3 = Severe inflammation - marked redness and hypertrophy. Tendency to spontaneous bleeding.

Training and calibration of examiners

Examiners were dentists trained and calibrated according to the guidelines of WHO Basic Oral Health Survey (WHO, 2013). The training process lasted for four days. The first day was for the dentists to revise the indices and process of conducting oral examination under field conditions. This was followed by three days training using a mouth model. The training was concluded by examining 10 students each in a school. After a two-day break, calibration of the examiners was done. Each examiner independently examined 50 students and the findings were compared. Discrepancies were discussed and resolved. Only examiners who had a consistency of 85% - 90% (WHO, 2013) participated in the study.

Sterilization of instruments

Instruments used for oral examination were sterilized before and after each use on the students. The instruments were cleaned, pre-soaked, disinfected and sterilized in an autoclave by qualified Dental Surgery Technicians. Sterilized instruments were stored in air tight instrument drums and transported in a larger air tight drum to the field so as to maintain sterility. A total of 250 complete sets (dental mirrors and CPI probes) of instruments were purchased and used for the study in view of multiple appointments that had to be met on daily basis. Used instruments were not re-used on the field under no circumstances.

3.11 Randomization of study participants

The unit of randomization for this study was the LGA. Randomization was done using the simple method, which entailed concealment of allocation.

Concealment of allocation

The allocation of the groups was concealed using opaque envelopes in which the group numbers were inserted.

Intervention

This was in form of a 30-minute oral health education conducted by different persons; peer (Group I), dentist (Group II) or teacher (Group III) once every two months. After collection of pre-intervention information from the students, the LGAs were randomized into four groups by simple randomization technique through balloting into: peer-led group, dentist-led group, teacher-led group and a control group with no oral health intervention (Figure 3.5). In schools in which oral health promotion intervention was introduced, there was selection and training of the resource persons in conjunction with the teachers and the students.

Students participation in the pre-intervention data collection

The students were engaged in the pre-intervention data collection activities to make them familiar with the activities of dentists. Volunteers assisted with dispensing of incentives; tooth brush and tooth paste, manning of the posts for sterile instruments. They also assisted with filling of referral form and description of the Primary Oral Health Centre where the students were referred for dental treatment.

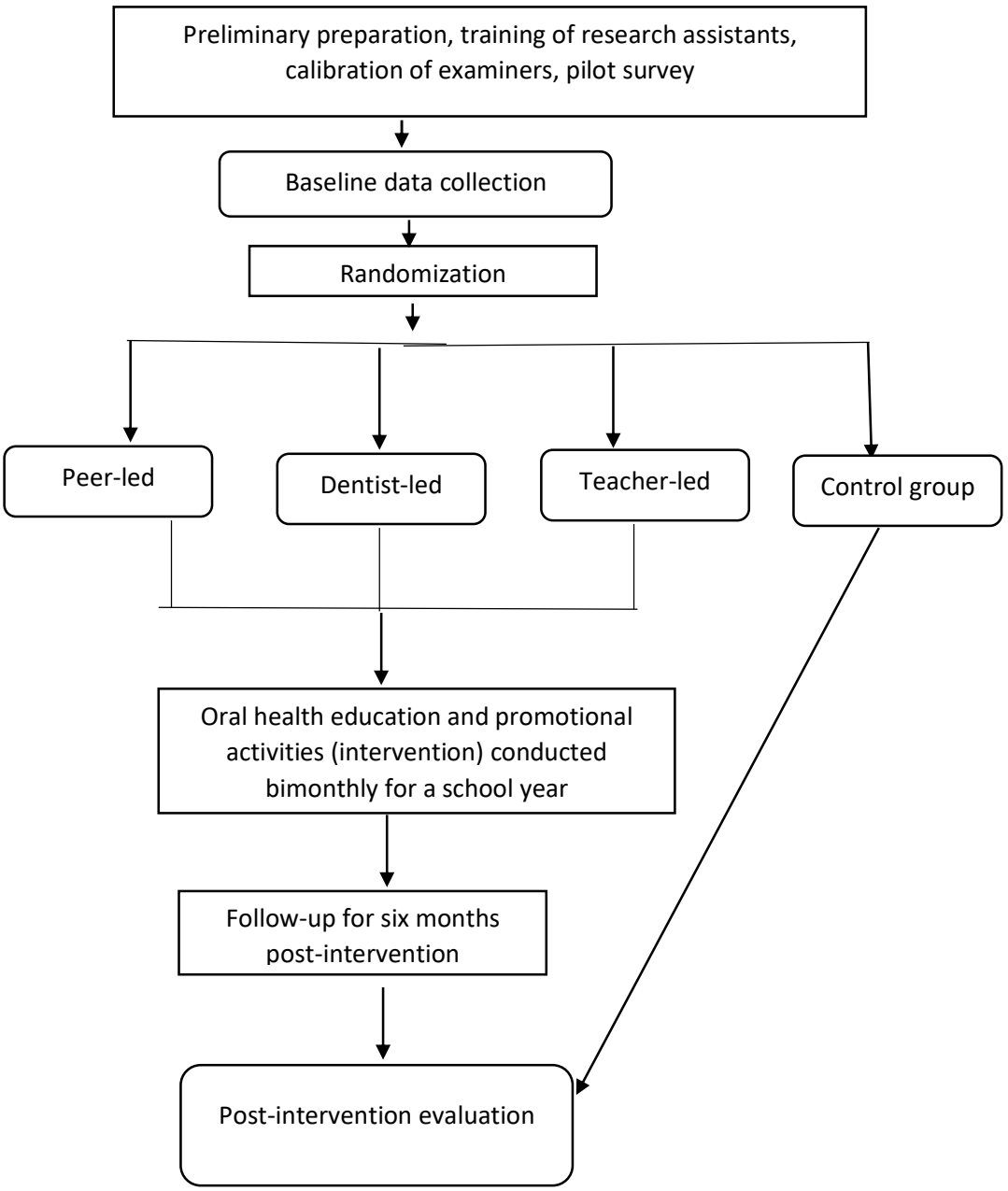

Figure 3.2Study flow chart

Training of persons delivering and conducting the oral health promotion activities

The training was for a week and each person was trained at the convenience of the trainee and the school authorities for the peer-led and teacher-led strategies. Four qualified dentists were selected and trained for the dentist-led groups. Students selected as peer mentors were selected with the assistance of their peers and teachers. The selection was based on interest, academic record, availability and personal relationship with other students. Likewise, the students and the teachers of SSSI classes were also involved in the decision making to select teachers for the teacher-led strategy. The training was based on a manual for oral health of senior school students (Centre for Dental Education and Research, 2018, Barzel R, 2019), which has been adapted for this environment. Training was done using lectures slides on power points. The power points were visualised by trainees on laptops and consisted of basic knowledge of oral health; number of teeth present in the mouth in both adults and children, causes of common oral diseases; gum diseases and dental caries, prevention of common oral diseases, oral hygiene habits, dental visits, diet and smoking. It also involved identifying poor oral hygiene status by obvious visual plaque and calculus detection and sighting of tooth decay as described on the coloured posters (Appendix VI). Good tooth brushing skills were also taught. The trainees (resource persons) were given a PDF version of the lecture slides to take home for further reading. After training of the different persons to deliver the oral health promotion activities, an assessment was conducted for each participant on the various aspects and a minimum score of 90% qualified the individual for inclusion as an educator/instructor. After this, a pilot survey was conducted among other students not included in the final study to assess the competencies of the trained educators. After each educator's activity in each school, the researcher evaluated the educator's oral health promotion activities. This was done by conducting FGDs among the students selected for the study and ensuring that the educators were blinded to this evaluation. Only educators that were assessed as friendly, confident and knowledgeable by the students continued with the intervention. Teaching aids that were used for the intervention included posters, dental floss, dental casts and mouth models. These materials were made available to the resource persons and students in the intervention groups.

Intervention sessions: A total of six sessions was conducted in the schools. The first session involved the introduction of the students to their educators by the researcher and explanation of the process. It also included educational activities by the resource persons on introduction to oral health and dental anatomy; number of teeth present in the mouth in both adults and children.

The second session involved the teaching of participants on the causes of common oral diseases; gum diseases and dental caries, prevention of common oral diseases, oral hygiene habits, dental visits, diet and smoking. The educational activities utilised health education aids such as posters, dental floss, dental casts and mouth models. The session was concluded by demonstration of tooth cleaning skills on the dental model with toothbrush for skill impartation. The students were asked to demonstrate the process on the models and encouraged by general praise/applaud by peers as a show of reinforcement of positive behaviour. Each session lasted 30 minutes. Different oral conditions were made identifiable on the posters. The posters (Appendix VI) also served as reminders/cues (Srivastava *et al.*, 2016). They were pasted on the walls of the classrooms throughout the study period. Worn-out posters were replaced regularly.

The educational activities were repeated and reinforced in the third, fourth, fifth and sixth sessions. Repetition and reinforcement of health education messages and activities have been identified as positive factors for successful behaviour change (Haleem *et al.*, 2012b, D'Cruz and Aradhya, 2013, Srivastava *et al.*, 2016). Students were given toothbrushes and toothpastes to clean their teeth.

The teachers and the schools created a supportive environment for the programme. They allowed the students to conduct the programme and ensured that the programme was carried out as planned. They also reinforced positive behaviour and attitude towards oral health among the students in the classrooms and on the assembly ground. The schools also put in place slots for oral health programme in the co-curricular activities, a form of healthy policy to ensure compliance with executing the activities so the students could gain from the programme.

Free dental care services were made available at the Primary Oral Health Care Clinic, Idikan for the students with dental conditions and diseases to consult with the dentist. Generally, the teachers encouraged all students to consult the dental clinic for free dental

treatment. In addition, this was also reinforced during the sessions anchored by the resource persons. Some of the students were permitted by the school to visit the dental centre during school hours with their parents.

The resource persons in each school were in charge of seeking permissions from the school to conduct educational activities and other health promoting activities in the schools such as instituting the need to change worn-out posters, making available the dental clinic address to the students or peers etc.

Intervention period: The intervention in the different trial arms continued for a period of three school terms. The principals and teachers of the various schools were contacted on mobile phones and the schools were visited to ensure that the intervention was instituted as planned. The researcher also visited the schools once monthly to monitor the various activities in the schools.

Follow-up: After intervention for the three school terms, the students had a six-month period when there was no form of intervention. Thereafter, post intervention assessment was conducted.

Control group: The researcher educated the students in the control group about reproductive health. This was interactive and questions on reproductive health as well as on oral health were entertained as the researcher was introduced to the students as a dentist. Following post-study assessment, the students in the control group received oral health promotion activities as done for the intervention groups.

Post intervention assessment: This was done using the same questionnaire as at baseline and by oral examination at six months after the last intervention to assess changes in oral hygiene and gingival health as this period was adequate to assess self-oral hygiene measures and its effect on the gingival health. In addition, this period afforded enough time for those found to have dental caries to have received treatment.

Expected outcomes

The primary outcome measures included oral hygiene status as defined by the presence/absence of dental plaque, calculus, bleeding gingiva on probing and oral health knowledge, attitude and practices. Also assessed was evidence of treated decayed teeth. The secondary outcome was impact of oral health on the quality of life of the participants.

3.12 Data management and analysis

Data was collated, cleaned and analysed using the Statistical Program for Social Sciences (SPSS) version 23 and STATA version 14. Data were manually cleaned for errors. Double data entry at random was conducted to validate data entry. Frequencies and percentages were used to summarize categorical variables.Means, standard deviations and confidence intervals were utilised to summarize numerical variables. The test of normality was done using Shapiro-Wilk test and a significant result indicated skewness of data(Shapiro and Wilk, 1965, Royston, 1982).

Descriptive analysis: For continuous variables, means and standard deviations were computed. The total knowledge of causes of oral diseases was computed as knowledge of causes of dental caries, knowledge of causes of gum diseases, knowledge of fluoride, dentition size and knowledge of function of the teeth. Scores for the questions assessing each variable were summed up to give a total score for each variable. The sum of decayed, missing and filled teeth (DMFT) for each participant was computed as individual DMFT score. Mean DMFT score for each group was calculated by totalling the D, M, F for each individual, then divided by the number of individuals examined in the group. This was computed separately for each study arm. Assessment of dental caries was done by compiling the sum of the D component (decayed teeth) of the DMFT index of students in each trial arm pre- and post- intervention to determine if there is any change in dental caries incidence.

Inferential analysis

Chi-square statistics was used to evaluate differences in the baseline categorical variables. One-way ANOVA was used to determine differences in continuous variable between the groups. Differences in oral examination findings that were categorical (number of coronal caries, periodontal health needs (CPITN scores) and oral hygiene status (OHI-S scores) of participants) was assessed using Chi-square statistics.

For data that were not normally distributed; non-parametric statistical test (Anderson, 1961, McCrum-Gardner, 2008) Kruskal Wallis and Wilcoxon signed-rank test were used to determine association between independent variables. Kruskal Wallis was used to determine the association between baseline parameters of continuous variables [oral health

knowledge, attitude and practices, Oral Health Related Quality of Life (COHIP-SF 19) scores and DMFT scores of participants in the four groups]. Kruskal Wallis is a non-parametric equivalent of One-way ANOVA (Lötsch and Ultsch, 2020).

The non- parametric equivalent of paired sample t test, Wilcoxon Signed Ranked test, was used to compare the oral indices, which included oral health knowledge scores, attitude towards oral health scores and oral health practices scores pre-and post-intervention in each group. The Wilcoxon Signed Ranked test compared the mean of the clusters so as not to ignore the clustering effects and skewness of the data. Effect size (r) for Wilcoxon Signed Rank statistics was calculated using $r = Z/\sqrt{N}$(Lötsch and Ultsch, 2020). In this equation, Z was the Wilcoxon Signed Rank value and N was the total number of participants involved in the analysis; an addition of the pre and post intervention sample for a study group. For Chi-square statistics, the effect size was calculated with $\phi = \sqrt{\frac{x^2}{N}}$ for 2x2 tables and $\phi = \sqrt{\frac{x^2}{N(K-1)}}$ for contingency tables larger than 2X2; wherex^2 was the Chi-square statistics value, N was the total sample size for the study group and K was the number of rows for the variable to be evaluated (Fritz *et al.*, 2012).

The effect size was used to determine the magnitude of change of intervention (Cohen, 1992,Kline, 2004, Fritz *et al.*, 2012, Sullivan and Feinn, 2012, Lakens, 2013). The r scores of 0.1 was considered as small effect, 0.3 considered moderate/medium effect and 0.5 and above considered large effect size (Cohen, 1992,Kline, 2004, Fritz *et al.*, 2012,Sullivan and Feinn, 2012, Lakens, 2013). Scores less than 0.1 was considered very small effect size.

At the bivariate level, Chi-square statistics was used for categorical data and Kruskal Wallis was used for skewed continuous data. The analyses were used to identify the explanatory variables that could independently predict the association between each dependent binary variable. Variables that were significant at p = 0.3 at the bivariate analysis were inputted into the model for the multivariate analysis.

Multi-variate analysis was carried out using Generalised Estimating Equation (GEE) to determine the effect size of the strategies. An exchangeable working correlation matrix was used to adjust for clustering effect of the samples as well as to take into consideration

the levels of the data collection in the models (Wang, 2014). A log link function was used to enable transformation of skewed data variables in the model such as the Tweedie with log link (Kurz, 2017) on continuous data (oral health knowledge, oral health attitude, oral health practice and Gingival Index). An ordinal logistic model was used to analyse OHI-S data while binary logistic model was used for the CPI, coronal caries and COHIP-SF 19 recoded variables. The models were all adjusted for the oral hygiene score, which was found significant at the baseline among the study groups. The ß estimates obtained from the models were exponentiated for meaningful risk/odds ratios (Ballinger, 2004). Lower risk ratios/odds ratios (<1) indicated lower risks of the presence of oral disease/condition, or oral health knowledge, attitude and practices compared to the control group. Higher risk ratios (>1) indicated higher risks or odds of having the presence of oral disease/condition or oral health knowledge, attitude and practices compared to the control group. Bonferroni correction was used to determine the relative effectiveness of the strategies. The statistical level of significance was $p< 5\%$.

Handling missing data

The occurrence of missing data was envisaged and thus addressed at each stage of the study – from the design stage of the study to data analysis. At the design stage, the sample size calculation took into consideration the attrition that could occur as a result of follow-up therefore, the sample size was inflated by 15% to account for this. In addition, at the stage of selection of study participants, students who would not be available at the time of the study or who would change school were excluded from the study. This was also emphasized during the conduct of the study; in the course of administration of the questionnaires, the researcher or a research assistant was always present to answer any question that may arise to guide the filling of the questionnaires. At the stage of submitting the filled questionnaires, the researcher or research assistant(s) went through the questionnaires to identify unanswered questions, which were pointed out to the students. The students were advised to mark the “don’t know” response or as applicable if not willing to answer the question or encouraged to answer the question if it was omitted unintentionally.

At the analysis stage; for those lost to follow up, the Intention to Treat analysis was considered appropriate (Gupta, 2011). The Intention to Treat analysis has an advantage of including all participants randomized at baseline irrespective of availability of post-intervention data thus preventing overestimation of the effectiveness of the intervention (Gupta, 2011). It has also been found very important in superiority design (Lesaffre, 2008). In inferiority research designs in which the effectiveness of interventions is evaluated, the use of per protocol analysis in addition to Intention to Treat analysis has been recommended (Gupta, 2011). However, it has the disadvantage of diluting the estimate obtained on the effectiveness of the intervention (Gupta, 2011). In view of these, both the per protocol analysis (using Wilcoxon Signed Rank Test or Chi-square statistics at bivariate analysis level) and the Intention to Treat analysis (using GEE) were combined (Gupta, 2011).

Inter and intra examiners variability: This was assessed using Cohen Kappa statistics. Inter examiners variability ranged from 0.81 – 0.93 and intra examiner variability ranged from 0.92 – 0.97.

Results were presented using tables and charts.

Dependent variable: Periodontal disease, presence of decayed teeth, oral health knowledge, attitude towards oral health, oral health practices and OHRQoL.

Exposure: Intervention; oral health education and oral health promotion activities.

Explanatory variables: Intervention groups; peer-led group, dentist-led group, teacher-led group and the control group.

Qualitative data analysis

Data analysis for the study was conducted in stages, which included; transcription, debriefing, coding, data display, thematic analysis and triangulation (Elo and Kyngäs, 2008). This enhances sensitivity to data, commitment and rigor transparency and importance of each response by the respondent to generate meaningful conclusions (Yardley, 2008).

The audiotaped recordings of the FGDs were transcribed verbatim and further analysis carried out using NVivo version 10. The researcher read the transcripts over again (about

two to three times) while listening to the audio tapes to correct all errors that might have occurred from the initial transcription. Thereafter, the transcripts were re-read carefully as many times as possible to familiarize the researcher with the information in the scripts. Next, themes were identified by exploring the transcripts systematically, then similar statements were grouped into subthemes as they emerged (Vaismoradi *et al.*, 2016). Some of the themes emerged from the questions of the FGD guides, while others emerged from the discussions. The transcripts were re-read to further identify new subthemes and new codes were assigned (inductive) until saturation was reached. The list of codes was then narrowed down to categories to produce a final codebook for the transcripts using comparative technique. Further validation of the coding was conducted by two independent specialists in qualitative studies from the Social Sciences and Anthropology by reading through four transcripts. New codes identified from the transcripts were added to the list of codes (investigator triangulation). Thereafter, trained dentists who were not involved in the data collection and had no prior knowledge of the study objectives applied the codes to the transcripts. Using iterative approach, the codes were compared, discussions were conducted among the researcher and the two dentists to reach a consensus of saturation of the coding system after applying them on all the transcripts (Yardley, 2008). Subsequently the researcher and the two dentists re-read the transcripts to identify overlaps or duplications of the codes and subthemes, then revised them to refine the codes and generated unique ones.

The transcripts were imported into the NVivo software (Leech and Onwuegbuzie, 2011) and organized according to the research questions. Nodes were created based on the manually identified inductive codes. Each transcript was read carefully, and corresponding statements of participants were highlighted and moved into the appropriate nodes for further organization of data and analysis.

Responses in quotes were used to illustrate the category of themes and subthemes. The quotes that best illustrated the subthemes were presented in the results.

Blinding

Double blinding technique was utilized for this study. The dentists and research assistants (data collectors) who administered the questionnaires and conducted oral examinations

were blinded to the group allocations, so that the study groups to which the schools or students belonged to were unknown to them. The data entry clerks were also blinded by concealing the study groups to which the schools belonged. This was made possible by assigning figures to the study groups. The teachers were also asked not to disclose the type of strategy used in their schools to the students. The students were also unaware of the time of post intervention evaluations.

3.13 Ethical consideration

Confidentiality

Names and other personal details were not used in the questionnaire. This ensured that responses of the students could not be linked to their personal details.

Beneficence

Students who were found to have oral diseases were referred to the Primary Oral Health Care Clinic, Idikan for free dental treatment and were followed up. Each participant was given toothbrush and toothpaste.

Non-maleficence to participants

Participants suffered no harm in the course of the study. No invasive procedure was carried out on the participants.

Voluntariness

Participants were free to opt out of the study as only those who gave their consent were recruited into the study. They had the right to withdraw from the interview and the study at any stage.

Ethical approval

Ethical approval was obtained from the Institutional Review Board of the College of Medicine, University of Ibadan and the University College Hospital (Appendix VII) and the Oyo State Ethics Review Board (Appendix VII).Permission for the study was obtained from the Commissioner for Education, Oyo State (Appendix VIII). Approval was also obtained from the principal of each of the selected secondary schools.

Trial registration

The study was registered with the assigned number PACTR201801002890993at the Pan African Clinical Trial Registry based in Tygerberg, South Africa.

Dissemination of Information

The outcome of the study was made known to the teachers and the students in each school.

CHAPTER FOUR

RESULTS

This chapter presents the baseline data of the study participants consisting of baseline perspective of the adolescents and the teachers about oral health and SBOHPP. It also presents data on the effect of the different interventions on the oral health knowledge, attitude, practices, oral health status and QoL of the students. The results of the comparison between the three school-based OHPn strategies based on the resource person and the control group were also presented. Thetest-retest reliabilityof the questionnaire was between 0.71and 0.85 for the different sections of the questionnaire.The flow chart of the quantitative phase of the study is as presented in Figure 4.1.

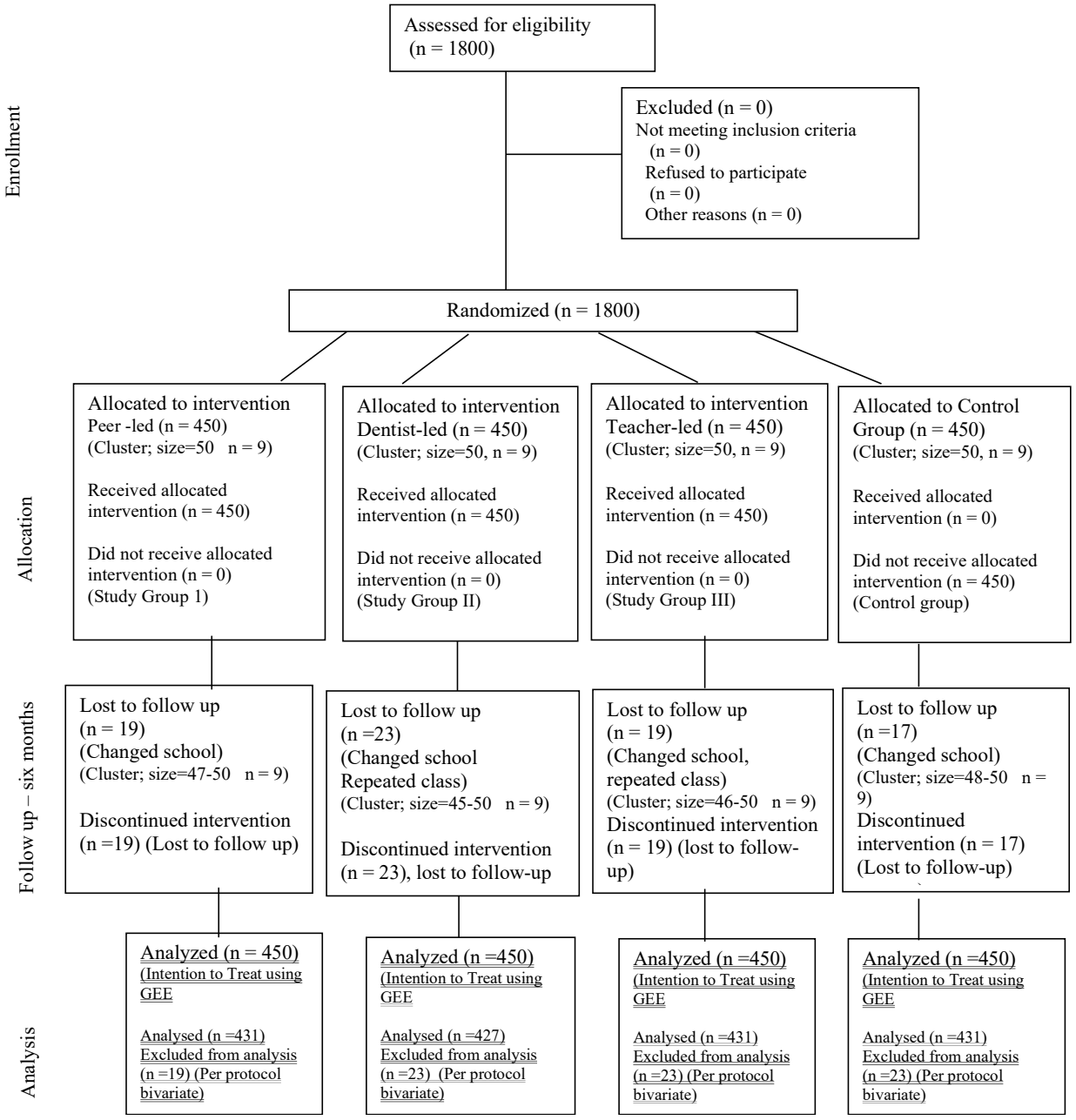

Figure 4.1: Flow chart of the randomized controlled trial

4.1 Sociodemographic characteristics of the participants

A total of 1800 students aged 14 – 18 years took part in the study. The students were in Senior Secondary School class one at the commencement of the study and Senior Secondary School class three at the end of the study. There were 886 (51.5%) males (Figure 4.2), and the mean age of the adolescents was 15.2 (±1.2) years.

4.2 Baseline perspective of adolescents about oral health (Objective I)

The baseline assessment of the perspective of the adolescents about oral health was obtained from 12 FGDs and as shown in Figure 4.3.

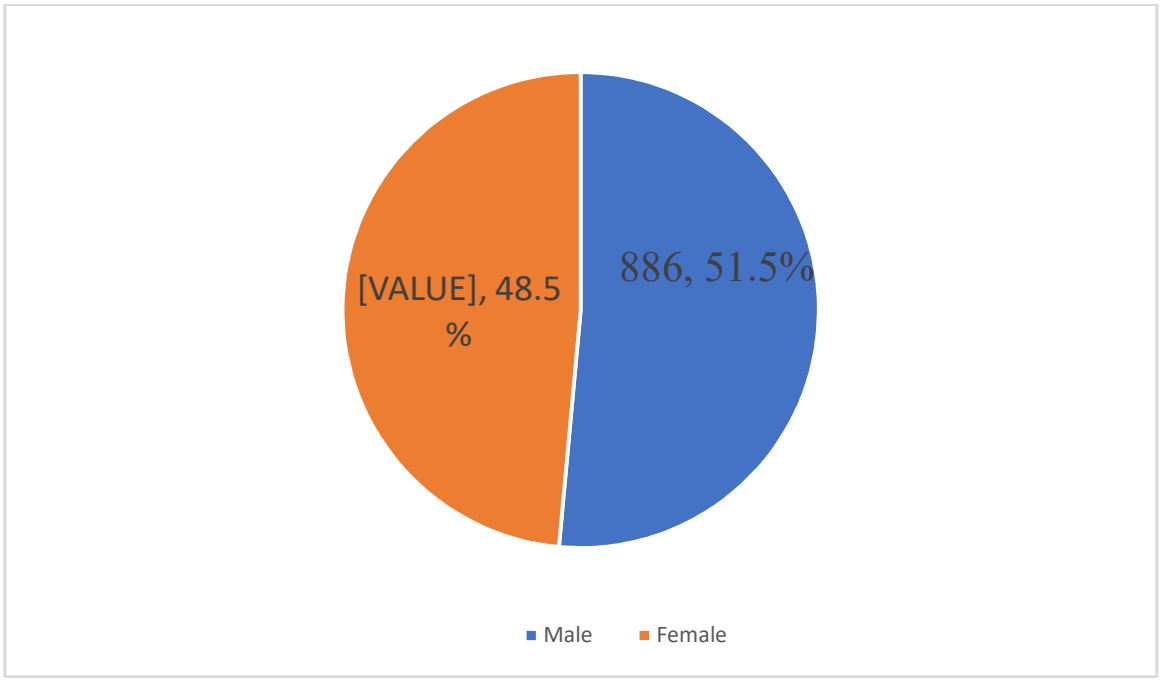

Figure 4.2: Gender distribution of the students in the study

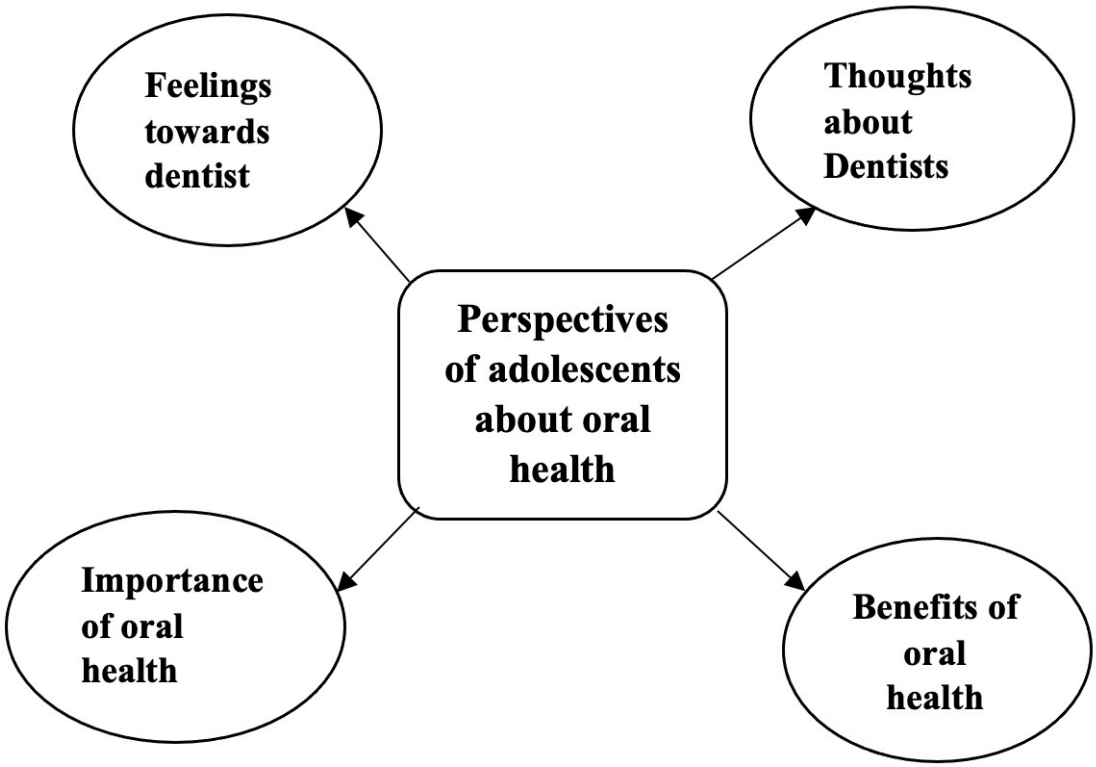

Figure 4.3: Perspective of adolescents on oral health

4.2.1 Sociodemographic characteristics of the adolescentsinvolved in the FGDs pre-intervention

Out of the 1800 students who participated in the baseline assessment, 120 students participated in 12 FGDs with representation from each LGA (Trial arm). They were all in SSS I and 60 (50.0%) were females. The mean age of the adolescents was 15.2 (±1.2) years.

4.2.2Emerging themes from the FGDs pre-intervention

Six emerging themes were identified: feelings towards dentist, thoughts about dentists, importance of oral health, benefits of oral health, self-perceived oral health needs and expectations about SBOHPP (Table 4.1).

Table 4.1: Themes and subthemes emerging from the FGDs on perspectives of adolescents on oral health

Themes	Subthemes
Feelings towards dentists	Excitement
	Apprehension
	Happiness
	Indifference
Thoughts about dentists	Treatment: Relievers of pain and dental ailment
	Synonymous with pain
	Chastisement
	Sources of oral health information
Importance of the teeth and mouth	Need for survival
	Social activities
Benefits of good oral health	Eating
	Confidence building
	Disease prevention
Self-perceived oral health needs	Knowledge of oral health
	Dental treatment needs
Expectations about School Oral Health Programme	Oral health education
	Skill imparting sessions
	Free school oral health care services

4.2.3 Theme 1: Feelings towards dentists' visits to school

There were mixed views about the presence of dentists in schools; while there were positive views, some were negative and others indifferent. Particpants expressed their views as positive; some were happy, exicited, delighted and anxious as they were eager to know more about the teeth and mouth on receiving the letter of invitation that a dentist will be visiting the school. Some of the statements mentioned included; *"...and when I saw the form that it is Dentist, I was happy that am going to know more about teeth."*

"*I feel eager to know about the uhum pleasant organ thing teeth. To know more about our teeth."*

"I felt delighted so that I will be able to learn more and gain more about our oral health."

"I feel happy because I will be able to know some things about my oral health so that will help me to improve, maybe I'm lacking in any way or the other."

"I feel excited and am eager to know what you will have for us."

"...very very happy because...., we will have more information concerning oral health. What we do not know before, we will be able to have more information about it, that's one."

Some were apprehensive as they expressed their fears and believed dentists were synonymous with tooth extraction and pain. *"..., I think they wanted to come and remove our teeth but when I now saw the book, I now saw that they came to teach us instead." (female)*

"Some said you wanted to come and remove our teeth, so I thought so too and because of that, I didn't want to come but when I now got here and I saw that it is not so ... I first looked closely at those inside before entering here." (male)

"I think they want to remove my teeth and they will say that I should... I should be taking care eh, I should be taking care of it every time."

"I think they want to come and remove our teeth."

Others were indifferent and undecided as mentioned by a student …*"I felt happy and sad I think that it's going to be helpful, boy, to know plenty dentistlike when I saw the pictures, I was like ah ah I need to know this thing so that this sickness would not likely happen to me."*

"I do not feel anything, I do not know."

4.2.4 Theme 2: Thoughts of dentists' visits to schools

The thoughts of the presence of dentists in school was described by the students in terms of knowledge acquisition, delivery of dental treatment, chastisement and sources of pain (Table 4.1).

Knowledge acquisition (sources of oral health knowledge)

One of the adolescents described his views about the visit of the dentists to the school on knowledge acquisition from the dentist, …*"we can hear oral health information ... because you are here in our school to educate and talk to us."*

"I think we have more experience about taking care of our teeth."

"I think is about the improvement of our health on teeth and our oral health."

Opinions on acquiring information on methods of tooth cleaning were also mentioned*"... To know more about our teeth, like to be taking care of it ehmmm ... brush being used ... and analysis on having uhmm some chemicals about wash teeth to wash it and we need the doctors to advise what we can use for our teeth that will make it ehmm keep it uhm clean."*

" ... to teach us on how to take care of our teeth."

Some also attributed the presence of the dentists to the possibility of obtaining information on prevention of oral health problems from the dentists. ...*"I felt you are going to talk*

about how our teeth are going to be neat and healthy. Like the treatment we can use to prevent them."

"... To know more about the teeth, because to know more about how to chew and to prevent tooth ache because of damage."

Dental treatment

The adolescents believed that dentists visit schools to treat them. They opined that their teeth would become cleaner.

... "I think my teeth will be cleaner." (male)

... "some are thinking that they are bringing machine to remove some teeth and fix another one." (male)

"... to clean our teeth for us."

"*… to treat our teeth."*

Some were of the opinion that dentists came to schools to screen them for oral problems.

"We think they're coming to do test for us because the other time that you people came, we were asked to do some tests and after that they give us results and some people are having problems."

"... without the doctor nowadays, we won't know maybe we have teeth problem, or we have mouth odour, but it is so so important for us to know when we should go to the hospital to check for our teeth and our mouth."

Chastisement

Some students believed that dentists would chastise their oral care practices and oral conditions.

... "I think you will scold us when you see dirt in our teeth." (male and female)

"I think you will be abusing us when you see dirt in our teeth."

4.2.5 Theme 3: Importance of oral health

There were mixed descriptions of how important the students viewed the importance of oral health. The importance of the mouth was discussed around the needs for survival, function and social interaction.

… "*without the mouth, I can't survive." (male*)

One other student mentioned that: "… *but let me just say that the patient can't survive because of what we can use our teeth to do." (female*)

Some students associated the significance of the mouth and teeth to functionality.

"The health of our teeth is so important because if there are no teeth, ah, we can`t eat o... we can`t eat, that is the truth."

"... the important of my teeth is that I like, I love food so without teeth, I can't eat."

... "Eh en, what I think, what I want to say is that if there are no teeth, we can't eat, because it is important for us to have teeth so that we can eat."

"Our teeth are very important so that we can use it to eat."

Those who had recognized the importance of oral health described it as a must for social interaction. As a student describes it as: *"... one will not be shy."*

"It is very important to me because health is wealth."

"It is very important because everywhere we go everywhere, we just have to express ourselves and communicate."

"... because ehnn we can't do without communicating."

"It is so important to me because I know fully well that I am a man, you know as a man I will have to toast girls." (male)

Some described the teeth and mouth as of no importance without reasons. *"It is not important at all." (males)*.

4.2.6 Theme 4: Benefits to good oral health

The benefit of good oral health was linked with confidence as opined by the adolescents. *"It is of benefit for me so that I can talk in the society very well as I like."*

"With clean teeth, you have confidence to talk anywhere, if you have mouth odour you will feel shy because you believe people will cover their mouth when you talk. So, it is good to have clean mouth."

Poor oral health was also described as a cause of unattractiveness.

"... if you take something to damage your teeth. Your teeth will give you signs. It will start to shrink, it will start to decay, in specific, it will start to decay in a way that when your teeth are being presented outside it won't look attractable at all."

Teeth lasting through life was also a reason for keeping the oral cavity healthy.

"... so that you would be old with the teeth."

Confidence in terms of social interaction and functional dentition were also mentioned as outcomes of good oral health.

"... bad result when talking if the teeth are not clean."

"... if you have clean teeth, you will be confident, and your mind will be at rest that you can eat anything."

"Good oral health is very important because if your mouth is smelling, your friends, your peer friends might be shy away from you. They will be saying 'ah, this person, her mouth is smelling'. So, they will not be able to cooperate with you again."

Absence of oral problems was also mentioned as a benefit of good oral health. *"... we will not have teeth problem." (girl)*

"It is of benefit to us because we will not have mouth odour."

"Yes, there is benefit. Because if we don't take care of our teeth, our mouth can be smelling

and we can have tooth decay. By that time, we can contact a disease. So, there is a benefit in taking care of our teeth."

"... my own benefit of taking care of my teeth is that I don't like mouth odour."

" ... because disease can enter our body through any means…."

"Yes, there is benefit so that bacteria ... so that we would not get sick or have body sickness." (male)

A negative opinion was also iterated by a student. *"... because everything everyday things change then, I don't think oral health is beneficial for our personal growth."*

4.2.7 Theme 5: Self-perceived oral health needs

The adolescents were positive about the needto have more information about oral self-care and dental care services.

"It is very important to know more about our teeth, how to keep it clean and how good to brush every day."

"I don't have enough information."

"... by supplying us with essential things to brush our teeth, to enlighten us to brush our teeth.You should give us free treatment on oral health."

"... by organizing a programme separately for students to educate them on how they can take care of their teeth."

4.2.8 Theme 6: Expectations of SBOHPP

The expectations of students about SBOHPP included provision of information on care of the teeth. "*I expect them to be coming to teach us about moral guides on how to take care our body, our teeth in other to prevent tooth decay…"*

"… tell me about the dangers, the benefits and of what my teeth can take and what it is not supposed to take. The dangers of what can constrain my teeth."

"The information that has been given by professors in oral health. That should be the teaching that you will teach we the public."

"The outcome will be very good because all the students will think about how to take care of their teeth in other to prevent tooth or mouth odour."

"We should know how to protect our teeth from germ, how to protect our teeth from odour."

Some were of the opinion that the programme should have skills imparting sessions on tooth cleaning.

"… learn how to wash our teeth regularly, how to take care of our teeth very well."

Also mentioned was the creation of positive attitude among the students.

"It will create a positive change in students so that they can know in details the processes involved in caring for their mouth and teeth."

"It makes students to know more about their teeth, how the well-being of their teeth is very

important to them."

Some were of the opinion that there should be dental care services for them.

"Students should know that they have come to teach us in our school and to help us care for our teeth."

One other expectation of SBOHPP mentioned by the students was the inclusion of the other

students in the school in the programme.

"I was expecting that you should call the junior ones in JSS I because they are too young, they don't know much about their teeth."

The students also reiterated that they expected the school oral health programme to equip them with the skills to be able to disseminate what they were taught to others.

" ... the outcome is that I personally, would have known more about the teeth, about the taking care of our teeth and I am going to teach all my brothers."

"I, myself would have known how to take care of teeth now and so I can teach my siblings."

"It is good and so advantaged because many students will learn the ways of maintaining the health of their teeth and mouth and other parts of the body."

"... so that we can take care of their teeth and those who are lazy in brushing their teeth, that is why the program is good."

" ... ought to know that you have come to teach us in school and to also wash our teeth in school."

" ... be able to know how we can all take care of our teeth and how to do all the necessary things concerning the teeth."

" ... should be able to know that the care of teeth is very good."

4.3 Perspectives of teachers about oral health and the schools (Objective II)

Four major themes were identified from the perspectives of the teachers about oral health (Figure 4.4).

Theme1 Perceived barriers to good oral health	**Theme 2** Views about School Oral Health Programme	**Theme 3** Organizational/ teachers and schools' readiness	**Theme 4** Expectations about the school programme
Sub themes • Inadequate knowledge • Financial constraint • Priority scale • Time factor • Laziness	**Sub themes** • Source of enlightenment to the schools	**Subthemes** • Seeking approval • Integration of SBOHPP into existing co-curricular activities	**Sub themes** • Imparting tooth cleaning skills • Involvement of teachers • Subsidized dental care services • Presence of a dentist in the schools

Figure 4.4: Perspective of teachers about oral health and the school

4.3.1 Sociodemographic characteristics of the teachers who participated in the FGDs pre-intervention

Fifty-five teachers were involved in five pre-intervention FGDs. The number of teachers who participated in the FGDs ranged from 7 – 15. There were 32 (58.2%) females. Their ages ranged from 38 – 55 years and the mean age was 45.76 (± 5.01) years. The years of experience ranged from 5 – 29 years, mean = 16.25 (± 5.11) years.

4.3.2 Theme 1: Barriers to optimal oral health

Barriers to optimal oral health mentioned by the teachers included lack of knowledge of oral health in general and financial constraints.

" … *lack of adequate information because most people take oral health for granted*."

" ... another barrier could be poverty; some people find it eh... difficult to get reasonable and affordable toothpaste."

"*If you want to buy effective toothpaste today now, I think the family size is about #350, #380 or #400 but we have cheaper alternatives that are not as effective ... so that could be a factor too, money, lack of information, ignorance, carelessness and all those things like that." (Male Dentist-led)*

Placing of oral health on a low priority scale was another barrier mentioned.

"... we don't put our minds on it because we feel that it is not always that we should brush and normally we should always realize that it is good to always brush."(Female Peer-led)

Time factor was also identified as a barrier.

"*We are supposed to brush in the morning and the night, last thing in the nights, first thing in the morning. That is time barrieras not being able to do the thing at the right time." (Peer-led)*

Laziness/carelessness was also another barrier mentioned by the teachers.

" … *the fact that we are lazy. Laziness also causes it because of not been able to do the thing at the right time is really a part of laziness." (Peer-led)*

4.3.3 Theme 2: Views of teachers about school oral health programme

The teachers all agreed on the importance of oral health in relation to general health. They considered it as compulsory in the schools. A teacher mentioned that: *"... Hmm, it will be welcome, and it is a good idea. It will enlighten the students, teachers and anyone around on how to improve caring for the teeth…". (Female, Dentist-led)*

Another teacher also said *"It will be a welcome idea because many of these students…* It is when you *are elderly, you realize that it is better to take care of your teeth right from the youthful ... so that you won't have those problem of 'Akokoro' and everything that is disturbing we the elderly presently, so if such organizations can come to school and maybe tutor them on how to take proper care of their teeth it will be a welcome idea. I believe that the taking care of our mouth and teeth is a pre-requisite, it is sine-qua-non to having a good healthcare". (Male, Dentist-led)*

4.3.4 Theme 3: Organizational readiness

The teachers talked about the need to solicit approval from the school management and emphatically stated that conduct of the programme is a simple task for them. A female teacher reiterated that "*It is so simple, just like you have come this morning, before you go, we can gather the students and inform them that so so so time, you will come and talk to them, tell our students how to care for their teeth". (Female, Teacher-led)*

Another pointer of readiness of the teachers was by indicating that all that was required was taking permission from the school management. One of the teachers stated "*... just come to the school authority and ask for the period that is convenient, take permission then all the staff will be informed. Then we are going to assemble at a particular place where you are going to teach us". (Male, Dentist-led)*

"Since the school has a curriculum activity that normally take place on Thursdays, I think some of the teachers even the unhu the uhn, the specialist can give us time and come to the school to talk to the students (Yes, Yes, Yes) once in a term, they will just pick a date. You

can even say once in a term, I mean that the talk must be on oral health." (Female, Control Group)

Integrating the programme into an existing one in the school was suggested as an entry point. This was stated by a male teacher*: "There is a period we call 'learn and did period' programme in the school we can solicit the support of the school to use the learn and did period so that... but those that will come will have to come at a make-up time so as not to disrupt the programme for the school".(Male, Dentist-led)*

4.3.5 Theme 4: Expectations of SBOHPP

The teachers welcomed the idea of the school oral health programme and their expectations included regular visit by the dentist, education of both teachers and students and incentives for students and teachers.

The teachers' expectations included improved skills in cleaning teeth.

"*My expectation is that the students will be improved in taking care of their teeth."*

"Maybe some of them have not been, you know washing the teeth very well or they didn't know the method of washing teeth, you know some of them just wash anyhow and there is a way of washing teeth."

"I believe they will be taught how to wash teeth, so from there, they will know much about taking care of the teeth."

Some teachers strongly believed that the school oral health programme should be for both students and teachers as well as the public. *" ... not only the students, the teachers and then we can even take it to the public and tell them as well."*

Some teachers were of the opinion that there should be subsidized dental care services in the school. *"We are expecting them to supplement the treatment of the teeth."*

"The treatment of the teeth ehm programme for the students and even for the staff because of the financial implication." (Male Dentist-led)

The teachers opined that the presence of the dentists in the schools will be instrumental to promoting oral health as they serve as reminders to the students.One of the teachers mentionedthat"*I think by bringing the dentist will do better, because the students will see that this is a new person coming to their environment and as well a professional to the core. So, I think the students will be more interested in seeing a new person entirely to them". (Female, Dentist-led)*

4.4 Baseline data on oral health knowledge (OHK), attitude (OHA) and practices (OHP), and oral health status of the adolescents (Objective III)

The pre-intervention OHK, OHA and OHPof oral health as well as oral health status through oral examination is presented.

4.4.1 Sociodemographic characteristics of the adolescents

All the 1800 students filled the questionnaire and went through oral examination at baseline. There were 450 students in each of the four groups at baseline.

There were 930 (51.7%) males and 870 (48.3%) females. Table 4.2 shows that the gender of the adolescents was similar across the study groups. The age of the adolescents ranged from 14 to 18 years; mean age = 15.2 (SD = 1.2) years. The mean ages of the participants across the study groups were similar (Table 4.2). The parents of the study participants belonging to the skilled occupational stratum was 167 (9.3%) and dependents were 64 (3.6%) with the majority1569 (87.2%) in the unskilled occupational class (Table 4.2). The distribution of the parents by occupational classes was similar (Table 4.2).

Table 4.2: Sociodemographic characteristics of the adolescents at baseline (n = 1800)

Variable	Peer-led No (%)	Dentist-led No (%)	Teacher-led No (%)	Control No (%)	χ^2	P value
Gender						
Male	216 (23.2)	250 (26.9)	224 (24.1)	240 (25.8)	6.291	0.098
Female	234 (26.9)	200 (23.0)	226 (26.0)	210 (24.1)		
Total	450 (25.0)	450 (25.0)	450 (25.0)	450 (25.0)		
Parent						
Occupation class						
Skilled	42 (25.1)	44 (26.3)	40 (24.0)	41 (24.6)	1.188	0.977
Unskilled	392 (25.0)	388 (24.7)	397 (25.3)	392 (25.0)		
Dependent	16 (25.0)	18 (28.1)	13 (20.3)	17 (26.6)		
Total	450 (25.0)	450 (25.0)	450 (25.0)	450 (25.0)		
Age (years)					**F**	**P value**
Mean(SD) age	15.16 (1.17)	15.23 (1.14)	15.17 (1.19)	15.10 (1.14)	1.002	0.391

χ^2– Chi-square statistic; F – ANOVA statistic

4.4.2 Baseline OHK, OHA and OHP of the study participants

The baseline parameters of the study participants in terms of OHK, OHA and OHP are presented on Tables 4.3 – 4.5.

4.4.3 Baseline OHK of the adolescents

The mean OHK score of all the study participants at baseline was 2.71 (±1.43), 95%CI = 2.64 – 2.77 and the median score was 3.0. The OHK scores (SD) ranged from 2.62 (±1.39) to 2.80 (±1.51). There was a skewed distribution of OHK scores in the study groups as shown with the statistical significance of the Shapiro-Wilk's normality test (Table 4.3). The OHK scores of the study participants were similar across the study groups at baseline, p = 0.196 (Table 4.3).

Table 4.3: Baseline Oral Health Knowledge (OHK) scores of the participants (n =1800)

Study group	Range of scores	Mean(SD) OHK score	95%CI	Median OHK score	Shapiro -Wilk test	Kruskal Wallis	P value
I (N = 450) (Peer-led)	0 - 7	2.62 (±1.39)	2.49 – 2.75	3.0	< 0.001	4.692	0.196
II (N = 450) (Dentist-led)	0 - 8	2.76 (±1.34)	2.64 – 2.89	3.0	< 0.001		
III (N = 450) (Teacher-led)	0 - 8	2.80 (±1.51)	2.66 – 2.94	3.0	< 0.001		
IV (N = 450) (Control)	0 - 7	2.64 (±1.49)	2.51 – 2.78	3.0	< 0.001		

OHK – Oral Health Knowledge

4.4.4 Baseline OHA of the adolescents

The mean attitude score(OHA) of the adolescents at baseline was 3.33 (±3.68); the median was 0.0 and the scores ranged from 0 - 10. The mean scores (SD) of the study groups ranged from 3.14 (±3.67) to 3.50 (±3.80) as shown in Table 4.4. There was a skewed distribution of OHA scores in the study groups as shown with the statistical significance of the Shapiro-Wilk's normality test (Table 4.4). The baseline OHA scores of the participants were similar across the study groups, $p = 0.539$.

4.4.5 Baseline OHP of the adolescents

The baseline scores on Oral Health Practices (OHP) among the 1800 adolescents ranged from 0 – 8; mean score of 4.20 (±1.35), the median score was 4.0. The group mean scores ranged from 4.12 (±1.36) to 4.23 (±1.39). There was a skewed distribution of OHP scores in the study groups as shown by the statistical significance of the Shapiro-Wilk's normality test (Table 4.5). The OHP scores were similar at baseline (Table 4.5).

Table 4.4: Baseline Attitude towards Oral Health (OHA) scores of the study participants (n = 1800)

Study group	Range of scores (0-10)	Mean(SD) OHA score	95%CI	Median OHA score	Shapiro-Wilk test	Kruskal Wallis	P value
I (Peer-led)	0 – 10	3.14 (±3.67)	2.80 – 3.48	0.0	< 0.001	2.163	0.539
II (Dentist-led)	0 – 10	3.32 (±3.53)	3.00 – 3.65	3.0	< 0.001		
III (Teacher-led)	0 – 10	3.36 (±3.73)	3.01 – 3.70	0.0	< 0.001		
IV (Control)	0 – 10	3.50 (±3.80)	3.15 – 3.85	3.0	< 0.001		

OHA – Attitude towards Oral Health

Table 4.5: Baseline OHP scores of study participants (n = 1800)

Study group	Range of scores (0-10)	Mean(SD) OHP	95%CI	Median OHP score	Shapiro-Wilk test	Kruskal Wallis	P value
I (Peer-led)	1 – 8	4.22 (±1.26)	4.09 – 4.35	4.0	< 0.001	2.297	0.513
II (Dentist-led)	1 – 8	4.23 (±1.26)	4.11 – 4.34	4.0	< 0.001		
III (Teacher-led)	0 – 8	4.23 (±1.39)	4.10 – 4.36	4.0	< 0.001		
IV (Control)	1 – 8	4.12 (±1.36)	4.00 – 4.24	4.0	< 0.001		

OHP – Oral Health Practices

4.4.6 Baseline utilization of dental care services by the participants

Only a few of the study participants 82 (4.6%) had consulted a dentist prior to the study. The last dental visit ranged from 1 year to 13 years before the study. The utilization of dental services were similar at baseline (χ^2= 6.695, P = 0.082) (Figure 4.5).

4.4.7 Baseline oral health status of the adolescents

The oral health status of the adolescents,pre-intervention is presented in sequence.

4.4.8 Baseline dentition status using DMFT

The mean (SD) DMFT score of the 1800 participants was 0.08 (±0.38), and it ranged from 0 to 4. A total of 1701 (94.5%) participants had DMFT score of 0. The DMFT score was ≥ 1 in 99 (5.5%). Of the 99 with a DMFT score ≥ 1, 99 (100.0%) participants had one or more “D” (Decayed) component, 5 (5.1%) had one “M” (Missing) component and none (0.0%) had “F” (Filled) component. The DMFT score of the adolescents ranged from 0 – 4. The total DMFT score was 144 with the “D” (Decayed) component accounting for 139 (96.5%), “M” (Missing) component; 5 (3.5%) and “F”(Filled) component;0 (0.0%). The baseline DMFT scores were similar across the groups (p = 0.518) and this is as shown on Table 4.6.

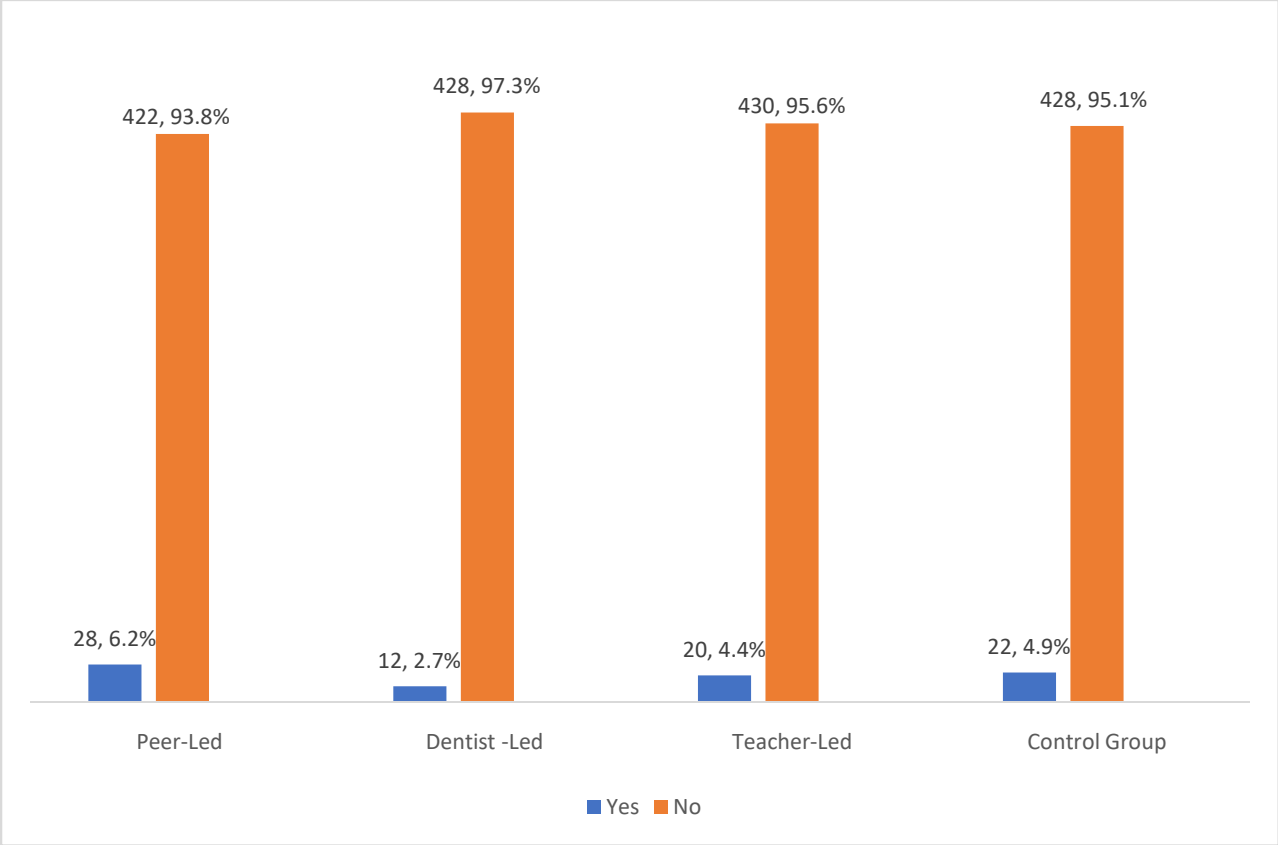

Figure 4.5: Utilization of dental services by participants across the study groups (n = 1800)

Table 4.6: Baseline dental caries experience of study participants (n = 1800)

Study group	Range of DMFT score	Mean (SD)DMFT	95%CI	Shapiro-Wilk test	Kruskal Wallis	P value
I (Peer-led)	0 - 3	0.09 (±0.38)	0.05 – 0.12	< 0.001	2.271	0.518
II (Dentist-led)	0 - 4	0.08 (±0.38)	0.05 – 0.12	< 0.001		
III (Teacher-led)	0 - 4	0.07 (±0.40)	0.03 – 0.10	< 0.001		
IV (Control)	0 - 4	0.08 (±0.38)	0.05 – 0.11	< 0.001		

DMFT – Decayed, Missing, Filled Teeth

4.4.9 Coronal caries

Coronal caries was present in the oral cavities of 99 (5.5%) adolescents. In 67 participants, only one tooth had caries, in 23, two teeth were carious, in five participants, three teeth were carious and in four adolescents, up to four teeth were carious (Table 4.7).

4.4.10 Baseline periodontal healthof the adolescents

The CPITN score ranged from 0 – 3. The CPITN scores of the students is as depicted in Table 4.8. The majority 1498 (83.2%) had a score of 2, while 109 (6.1%) had a score of one and 174 (9.6%) had a CPITN score of zero. Shallow pockets were recorded in 19 (1.1%).None of the students had a deep periodontal pocket. The baseline CPITN scores of participants in the four groups were similar (Table 4.8).

Table 4.7: Baseline distribution of coronal caries among study participants (n = 1800)

Study group	No of carious teeth					χ^2	P value
	0	1	2	3	4		
	No (%)	No (%)	No (%)	No (%)	No (%)		
I (Peer-led)	426 (94.7)	14 (3.1)	8 (1.8)	2 (0.4)	0 (0.0)	12.442	0.411
II (Dentist-led)	425 (94.4)	16 (3.6)	7 (1.6)	1 (0.2)	1 (0.2)		
III (Teacher-led)	431 (95.8)	13 (2.9)	2 (0.4)	2 (0.4)	2 (0.4)		
IV (Control)	419 (93.1)	24 (5.3)	6 (1.3)	0 (0.0)	1(0.2)		
Total	1701 (94.5)	67 (3.7)	23 (1.3)	5 (0.3)	4 (0.2)		

χ^2– Chi-square statistic

Table 4.8: Baseline CPITN scores of study participants

Study Group	CPITN scores			χ^2	P value
	0	1	≥2[#]		
	No (%)	No (%)	No (%)		
I (Peer-led)	41 (9.1)	27 (6.0)	382 (84.9)	2.417	0.878
II (Dentist-led)	42 (9.3)	22 (4.9)	386 (85.8)		
III (Teacher-led)	44 (9.8)	29 (6.4)	377 (83.8)		
IV (Control)	47 (10.4)	31 (6.9)	372(82.7)		
Total	174 (9.6)	109 (6.1)	1517 (84.3)		

[#]Scores 2 and 3 were combined for the purpose of analysis;χ^2– Chi-square statistic

4.4.11 Baseline OHI-S score of the adolescents

The total OHI-S score of the adolescents was such that 649 (36.1%) had good oral hygiene, 1085 (60.3%) fair and 66 (3.7%) had poor oral hygiene status. There was a significant difference between the OHI-S score of the adolescents across the study groups with those in the dentist-led group having least desirable oral hygiene status at baseline (Table 4.9).

4.4.12 Baseline gingival health of the adolescents

The gingival health of the adolescents as assessed by the number of sextants with bleeding to gingival sensing showed that the sextants with gingival bleeding ranged from 0 – 6, mean (SD) sextant with gingival bleeding = 1.21 (1.93), 95%CI = 1.11 – 1.30, median sextant with gingival bleeding = 0.0. A total of 1083 (60.2%) students had zero sextant with gingival bleeding, while 216 (12.0%) had gingival bleeding in one sextant and the others had gingival bleeding in 3 – 6 sextants (Figure 4.6). The results of the normality test for the number of sextants with gingival bleeding showed a non-normal distribution, Shapiro-Wilk test;0.662, $p < 0.001$.The gingival health status of the participants was similar across the groups (Table 4.10).

Table 4.9: Baseline OHI-S scores of study participants (n =1800)

Study Group	OHI-S Category			χ^2	P value
	Good	Fair	Poor		
	No (%)	No (%)	No (%)		
I (Peer-led)	157 (34.9)	274 (60.9)	19 (4.2)	26.8996	< 0.001*
II (Dentist-led)	132 (29.3)	290 (64.4)	28 (6.2)		
III (Teacher-led)	176 (39.1)	266 (59.1)	8 (1.8)		
IV (Control)	184 (40.9)	255 (56.7)	11 (2.4)		
Total	649 (36.1)	1085 (60.3)	66 (3.7)		

OHI-S – Simplified Oral Hygiene Index; χ^2– Chi-square statistic; * – statistically significant

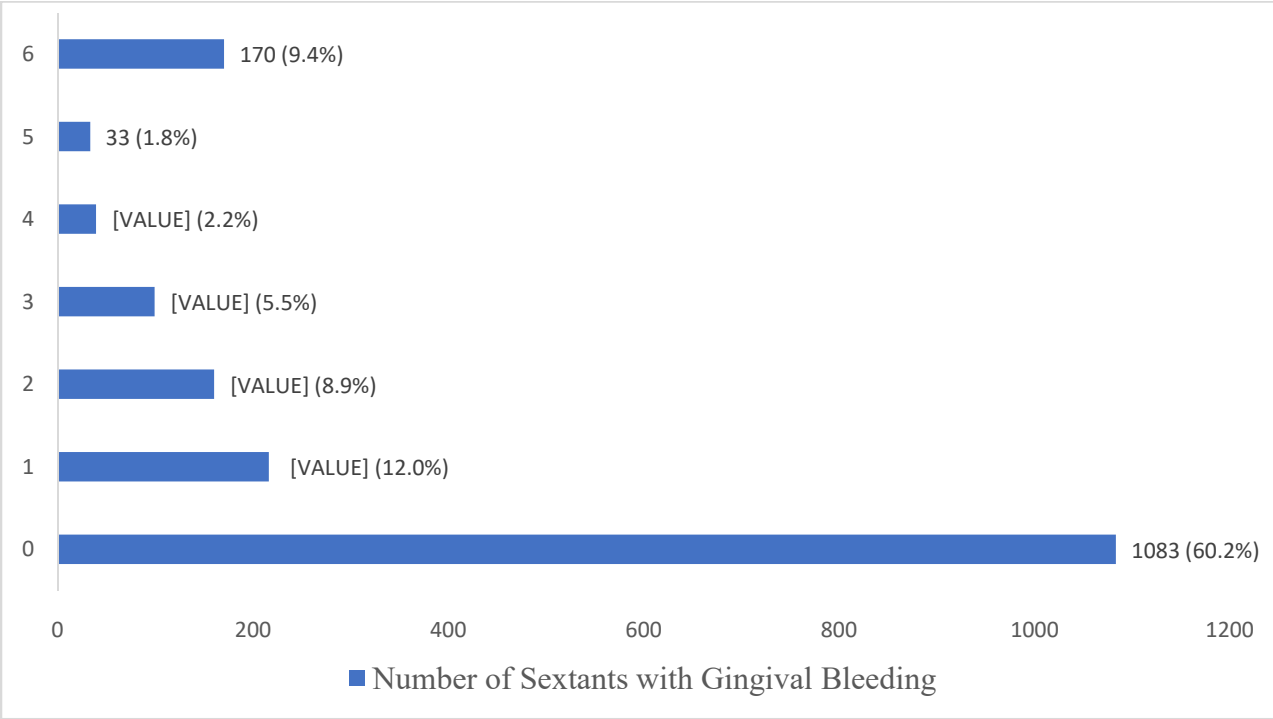

Figure 4.6: Sextants with gingival bleeding (n = 1800)

Table 4.10: Baseline gingival health of study participants (n = 1800)

Study group	Range of scores	Mean(SD) sextant with gingival bleeding	95%CI	Shapiro-Wilk test	Kruskal Wallis	P value
I (Peer-led)	0 – 6	1.29 (±2.08)	1.09 – 1.48	< 0.001	4.656	0.199
II (Dentist-led)	0 – 6	1.33 (±1.97)	1.15 – 1.51	< 0.001		
III (Teacher-led)	0 – 6	1.13 (±1.91)	0.95 – 1.31	< 0.001		
IV (Control)	0 – 6	1.11 (±1.73)	0.95 – 1.27	< 0.001		

4.5 Characteristics of adolescents that were lost to follow-up

There were 78 adolescents lost to follow up (Figure 4.7). Reasons for non-completion included change of school 67 (85.89%) and 11 (14.10%) students repeated the class they were at the beginning of the study and could not continue the study as their former classmates had moved to a new class. Out of the 1800 students that were randomized, 1722 completed the study. The overall attrition rate was less than 5%. The attrition rate for each study group ranged from 3.8 – 5.2% (Figure 4.7).

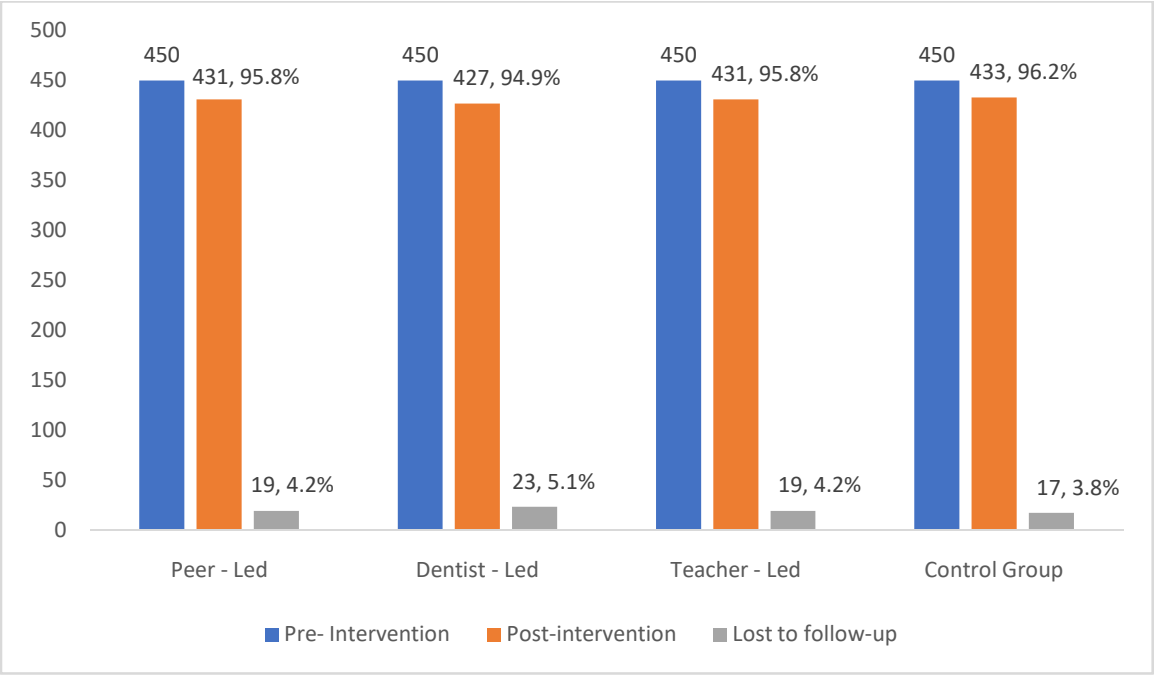

Figure 4.7: Distribution of adolescents in the groups at baseline and post-intervention

4.5.1 Sociodemographic data of participants that were lost to followup

The sociodemographic details of the students that were lost to follow up is as depicted in Table 4.11. There were no differences in the sociodemographic characteristics of the adolescentsthat were lost to follow up and those that completed the study (Table 4.11). The mean (SD) ages of participants in both categories were similar: 15.16 (1.16) and 15.23 (1.20), respectively (t =- 0.508. p = 0.61).

The gender distribution of all the study participants with complete baseline and post-intervention data was similar to those of participantsthat were lost to follow up (Table 4.11). Table 4.12 shows that this was also similar across the study groups.

Table 4.11: Sociodemographic characteristics of adolescents that were lost to follow up and those that completed the study.

Study group	Completed	Lost to follow up	Total	χ^2	P value
	No (%)	No (%)	No (%)		
Gender					
Male	886 (51.5)	44(56.4)	930 (51.5)	0.735	0.391
Female	836 (48.5)	34 (43.6)	870 (48.3)		
Total	1722(100.0)	78 (100.0)	1800 (100.0)		
Parent Occupational Class					
Skilled	158 (9.2)	9 (11.5)	167 (9.3)	0.696	0.708
Unskilled	1502 (87.2)	67 (85.9)	1569 (87.2)		
Dependants	62 (3.6)	2 (3.6)	64 (3.6)		
Total	1722 (100.0)	78 (100.0)			

χ^2– Chi-square statistic

Table 4.12: Comparison of the sociodemographic characteristics of adolescents that were lost to follow up and those that completed the study in the four groups

Study group	Peer-led: No (%)		Dentist-led: No (%)		Teacher-led: No (%)		Control: No (%)	
	Completed	Lost	Completed	Lost	Completed	Lost	Completed	Lost
Gender								
Male	207 (95.8)	9 (4.2)	234 (93.6)	16 (6.4)	214 (95.5)	10 (4.5)	231 (96.3)	9 (3.8)
Female	224 (95.7)	10 (4.3)	193 (96.5)	7 (3.5)	217 (96.0)	9 (4.0)	202 (96.2)	8 (3.8)
	χ^2 = 0.003		**χ^2 = 1.927**		**χ^2= 1.927**		**χ^2 = 0.001**	
	P = 0.955		**P = 0.165**		**P = 0.165**		**P = 0.974**	
Parent Occupational Class								
Skilled	41 (9.5)	1 (9.5)	41 (9.6)	3 (13.0)	39 (9.0)	1 (5.3)	37 (8.5)	4 (23.5)
Unskilled	374 (86.8)	18 (94.7)	369 (86.4)	19 (82.6)	379 (87.9)	18 (94.7)	380 (87.8)	12 (70.9)
Dependent	16(3.7)	0 (0.0)	17 (4.0)	1 (4.3)	13 (3.0)	0 (0.0)	16 (3.7)	1 (5.9)
	χ^2 = 1.190		**χ^2 = 0.308**		**χ^2 = 0.962**		**χ^2= 4.792**	
	P = 0.552		**P = 0.857**		**P = 0.618**		**P = 0.091**	
Age								
Mean (SD) age	15.14	15.53	15.25	14.91	15.17	15.21	15.09	15.35
	1.16	1.43	1.16	0.900	1.19	1.13	1.13	1.32
	t = - 1.396		**t = 1.377**		**t = - 0.139**		**t = - 0.941**	
	P = 0.163		**P = 0.169**		**P = 0.889**		**P = 0.347**	

Completed – Completed the study; Lost – Lost to follow up: χ^2– Chi-square statistic; t – Independent t test

4.6 Post-intervention characteristics of the adolescents

A total of 1722 adolescents filled the questionnaires and went through oral examination post-intervention i.e. overall response rate of 95.7%. The distribution of the study participants with complete data is as follows: 431 in Study Group One (SG I), 427 in Study Group Two (SG II), 431 in Study Group Three (SG III) and 433 in Study Group Four (SG IV).

4.6.1 Age distribution of the students who completed the study

The age of the 1,722 study participants with complete pre-and post-intervention data ranged from 14 to 18 years; mean (SD) age = 15.16 (1.16) years. The mean (SD) ages of the participants according to their study groups is as shown in Table 4.13. The age distribution of adolescents in the four study groups was similar.

Table 4.13: Ages of adolescents who completed the study (n = 1722)

Study group	n	Mean(SD) age years	F	P value
I (Peer-led)	431	15.14 (±1.6)	1.420	0.235
II (Dentist-led)	427	15.25 (±1.15)		
III (Teacher-led)	431	15.16 (±1.19)		
IV (Control)	433	15.09 (±1.13)		
Total	**1722**	**15.16 (±1.16)**		

n – Number; F – ANOVA statistic

4.6.2 Gender distribution of adolescentsthat completed the study

The gender distribution of study participants was such that 886 (51.5%**)** males participated in the study. The breakdown of gender for each study group is as shown below(Table 4.14). The gender distribution was similar across the four groups.

4.6.3 Occupational class of the parents of the adolescentswho completed the study

The majority 1502 (87.2%) of the parents of the adolescents belonged to the unskilled occupational class. The distribution of the occupational classes of the study participants is as depicted in Table 4.15. There were no significant differences between the occupational classes of parents of participants in the groups (Table 4.15).

Table 4.14: Gender distribution of participants by study group (n = 1722)

Study group	Male	Female	Total	χ^2	P value
	No (%)	No (%)	No (%)		
I (Peer-led)	207 (48.0)	224 (52.0)	431 (100.0)	5.123	0.163
II (Dentist-led)	234 (54.8)	193 (45.2)	427 (100.0)		
III (Teacher-led)	214 (49.7)	217 (50.3)	431 (100.0)		
IV (Control)	231 (53.3)	202 (46.7)	433 (100.0)		
Total	**886 (51.5)**	**836 (48.5)**	**1722 (100.0)**		

χ^2– Chi-square statistic

Table 4.15: Occupational classes of the parents of the adolescents who completed the study (n = 1722)

Study group	Unskilled No (%)	Dependent No (%)	Skilled No (%)	Total No (%)	χ^2	P value
I (Peer-led)	374 (86.8)	16 (3.7)	41 (9.5)	431 (100.0)	1.021	0.985
II (Dentist-led)	369 (86.4)	17 (4.0)	41 (9.6)	427 (100.0)		
III (Teacher-led)	379 (87.9)	13 (3.0)	39 (9.0)	431 (100.0)		
IV (Control)	380 (87.8)	16 (3.7)	37 (8.5)	433 (100.0)		
Total	**1502 (87.2)**	**62 (3.6)**	**158 (9.2)**	**1722 (100.0)**		

χ^2– Chi-square statistic

4.6.4 Oral Health Knowledge (OHK) scores of adolescents who completed the study

The OHK scores ranged from 0 – 8 pre-intervention. The mean OHK score pre-intervention was 2.72 (±1.44), 95%CI = 2.65 – 2.77 and median score was 3.0 for adolescents who completed the study. There was a skewed distribution of OHK scores as shown with the statistical significance of the Shapiro-Wilk's normality test (Table 4.5). There were no significant differences in the baseline OHK scores of the adolescents who completed the study in the four groups (Table 4.16).

Table 4.16: Baseline OHK scores of adolescents that completed the study (n = 1722)

Study group	Range of scores	Mean(SD) OHK	95%CI	Median OHK score	Shapiro -Wilk test	Kruskal Wallis	P value
I (Peer-led)	0 – 7	2.64 (±1.39)	2.51 – 2.77	3.0	< 0.001	10.436	0.125
II (Dentist-led)	0 – 8	2.78 (±1.34)	2.65 – 2.91	3.0	< 0.001		
III (Teacher-led)	0 – 8	2.82 (±1.51)	2.68 – 2.97	3.0	< 0.001		
IV (Control)	0 – 7	2.62 (±1.49)	2.50 – 2.78	3.0	< 0.001		

OHK – Oral Health Knowledge

4.6.5 Baseline OHA scores of adolescentswho completed the study

The mean (SD) OHA score at baseline for adolescents who completed the study was 3.35 (3.68), median was 0.0 and the scores ranged from 0 – 10. The mean (SD) scores for the groups ranged from 3.17 (3.68) to 3.48 (3.79) as shown in Table 4.17. There was a skewed distribution of OHA scores in the study groups as shown with the statistical significance of the Shapiro-Wilk's normality test. There were no significant differences in the baseline OHA scores of the adolescents who completed the study in the four groups (Table 4.17).

Table 4.17: Baseline OHA scores of the adolescents that completed the study (n = 1722)

Study group	Range of scores	Mean(SD) OHA score	95%CI	Median OHA score	Shapiro-Wilk test	Kruskal Wallis	P value
I (Peer-led)	0 – 10	3.17 (±3.68)	2.82 – 3.52	0.0	< 0.001	1.605	0.685
II (Dentist-led)	0 – 10	3.33 (±3.53)	3.00 – 3.67	3.0	< 0.001		
III (Teacher-led)	0 – 10	3.40 (±3.72)	3.05 – 3.76	0.0	< 0.001		
IV (Control)	0 – 10	3.48 (±3.79)	3.12 – 3.83	3.0	< 0.001		

OHA – Attitude towards Oral Health

4.6.6 Baseline OHP of adolescents who completed the study

The OHP scores at baseline for adolescents who completed the studywas between 0 and 8 with a mean (SD) score of 4.20 (±1.35). The median score was 4.0. The group mean (SD) scores ranged from 4.11 (±1.35) to 4.25 (±1.40). There was a skewed distribution of OHP scores in the Study groups as shown with the statistical significance of the Shapiro-Wilk's normality test (Table 4.18). The baseline OHP scores were similar among adolescents in the four groups(Table 4.18).

Table 4.18: Baseline OHP scores of adolescents who completed the study (n = 1722)

Study group	Range of scores	Mean(SD) OHP	95%CI	Median OHP score	Shapiro-Wilk test	Kruskal Wallis	P value
I (Peer-led)	1 – 8	4.20 (±1.40)	4.08 – 4.34	4.0	< 0.001	3.390	0.335
II (Dentist-led)	1 – 8	4.25 (±1.26)	4.13 – 4.37	4.0	< 0.001		
III (Teacher-led)	0 – 8	4.25 (±1.40)	4.12 – 4.38	4.0	< 0.001		
IV (Control)	1 – 8	4.11 (±1.35)	3.98 – 4.24	4.0	< 0.001		

OHP – Oral Health Practices

4.6.7 Baseline utilization of dental care services by adolescents who completed the study

The majority (1649, 95.8%) of the students had never been to the dentist. The last dental visit ranged from 1 year to 15 years before the study.

4.6.8 Baseline dentition status using DMFT of adolescents who completed the study

The mean (SD) DMFT was 0.08 (0.38) and it ranged from 0 to 4 at baseline for adolescents who completed the study. A total of 1627 (94.5%) students had a DMFT score of 0.The DMFT score was ≥ 1 in 95 (5.5%) students. Of the 95 with a DMFT score ≥ 1, 94 (98.9%) participants had one or more "D" component, 5 (5.3%) had one "M" component and none (0.0%) had "F" component. The total DMFT score was 138;out of which the "D" component accounted for the majority of the index 133 (96.4%), "M" = 5 (3.6%) and "F" = 0 (0). There were no significant differences in the mean DMFT scores at baseline for the study participants across the groups (p = 0.567) and is as shown on Table 4.19.

Table 4.19: Baseline dental caries experience of adolescents who completed the study (n = 1722)

Study group	DMFT score	Mean (SD)DMFT	95%CI	Shapiro-Wilk test	Kruskal Wallis	P value
I (Peer-led)	0 - 3	0.09 (±0.38)	0.05 – 0.12	< 0.001	2.026	0.567
II (Dentist-led)	0 - 4	0.09 (±0.39)	0.05 – 0.12	< 0.001		
III (Teacher-led)	0 - 4	0.07 (±0.38)	0.03 – 0.10	< 0.001		
IV (Control)	0 - 4	0.08 (±0.35)	0.05 – 0.11	< 0.001		

DMFT – Decayed, Missing, Filled Teeth

4.6.9 Baseline coronal caries status of adolescents who completed the study

Coronal caries was present, at baseline, in the oral cavities of 94 (5.5%) adolescents who completed the study. One tooth had caries in 63 participants, two teeth in 23, three teeth in four and four teeth in four adolescents (Table 4.20).

4.6.10 Baseline periodontal health status of adolescents who completed the study

The CPITN score at baseline for the adolescents who completed the study ranged from 0 – 3. Table 4.21 below shows the distribution of CPITN scores at baseline for the adolescents who completed the study. The majority 1432 (83.2%) had a score of 2, while 107 (6.2%) had a score of one and 166 (9.6%) had a CPITN score of zero. Shallow pockets were recorded in 17 (1.0%) students. There were no significant differences in the CPITN scores before intervention for the adolescents across the four groups (Table 4.21).

Table 4.20: Baseline distribution of coronal caries among adolescents who completed the study (n = 1722)

Study group	No of carious teeth					χ^2	P value
	0	1	2	3	4		
	No (%)	No (%)	No (%)	No (%)	No (%)		
I (Peer-led)	409 (94.9)	12 (2.8)	8 (1.4)	2 (0.5)	0 (0.0)	11.577	0.480
II (Dentist-led)	402 (94.1)	16 (3.7)	7 (1.6)	1 (0.2)	1 (0.2)		
III (Teacher-led)	413 (95.8)	13 (3.0)	2 (0.5)	1 (0.2)	2 (0.5)		
IV (Control)	404 (93.3)	22 (5.1)	6 (1.4)	0 (0.0)	1(0.2)		
Total	1628 (94.5)	63 (3.7)	23 (1.3)	4 (0.2)	4 (0.2)		

χ^2 – Chi-square statistic

Table 4.21: CPITN scores of adolescents who completed the study (n = 1722)

Study Group	CPITN scores			χ^2	P value
	0	1	≥2[#]		
	No (%)	No (%)	No (%)		
I (Peer-led)	41 (9.5)	27 (6.3)	363 (84.2)	2.128	0.908
II (Dentist-led)	40 (9.4)	21 (4.9)	366 (85.7)		
III (Teacher-led)	42 (9.7)	28 (6.5)	361 (83.8)		
IV (Control)	43 (9.9)	31 (7.2)	359(82.9)		
Total	166 (9.6)	107 (6.2)	1449 (84.1)		

[#]Scores 2 and 3 were combined for the purpose of analysis;χ^2– Chi-square statistic

4.6.11 Baseline OHI-S of adolescentswho completed the study

A total of 623 (36.2%) had good, 1035 (60.1%) fair and 64 (3.7%) poor oral hygiene status. There was a significant difference between the oral hygiene status of the participants across the study groups (Table 4.22).

4.6.12 Baseline gingival health of adolescents who completed the study

The number of sextants with gingival bleeding at baseline ranged from 0 – 6 with mean (SD) = 1.22 (1.93). A total of 692 (40.2%) adolescents that completed the study had at least a sextant with gingival bleeding at baseline. The gingival health of the adolescents was similar before intervention in thefour groups (Table 4.23).

Table 4.22: Baseline OHI-S scores of adolescents who completed the study (n = 1722)

Study Group	OHI-S scores			χ^2	P value
	Good	Fair	Poor		
	No (%)	No (%)	No (%)		
I (Peer-led)	150 (24.1)	263 (25.4)	20 (8.1)	27.179	< 0.001*
II (Dentist-led)	124 (19.9)	276 (26.7)	27 (42.2)		
III (Teacher-led)	170 (27.3)	254 (24.4)	8 (12.5)		
IV (Control)	179 (28.7)	243 (23.5)	11 (17.2)		
Total	623 (36.2)	1035 (60.1)	64 (3.7)		

* – statistically significant

Table 4.23: Baseline gingival health of adolescents that completed the study (n = 1722)

Study group	Range of scores	Mean(SD) Sextant with Gingival Bleeding	95%CI	Median sextant	Shapiro-Wilk test	Kruskal Wallis	P value
I (Peer-led)	0 – 6	1.32 (±2.11)	1.12 – 1.52	0.0	< 0.001	5.6661	0.129
II (Dentist-led)	0 – 6	1.35 (±1.96)	1.17 – 1.54	0.0	< 0.001		
III (Teacher-led)	0 – 6	1.13 (±1.91)	0.95 – 1.31	0.0	< 0.001		
IV (Control)	0 – 6	1.10 (±1.71)	0.94 – 1.27	0.0	< 0.001		

4.7 Effect of SBOHPP intervention on the oral health of the adolescents (Per Protocol Analysis) (Objective IV).

4.7.1 Effect of SBOHPP on the OHK of the participants

There was a significant difference in the OHK of the study participants pre-and post-intervention in the intervention groups.The post-intervention scores ranged from 0 – 14. In the peer-led group, the post intervention scores ranged from 0 – 11, median 4.0 compared to 0 – 7, median 3.0 pre-intervention. In the dentist-led group, the post-intervention scores ranged from 0 – 14, median score was 5.0 compared to 0 – 8, median 3.0 pre-intervention. For the teacher-led group, the post-intervention scores ranged from 0 – 11, median score 4.0 compared to 0 – 8, median score of 3.0 pre-intervention. In the control group, the scores ranged from 0 – 6, median 3.0 compared to a score of 0 – 7, median 3.0 pre-intervention.

The percentage change in mean OHK ranged from 6.9% to 87.1% (Table 4.24). The dentist-led group had the highest change in oral health knowledge (87.1%) (Table 4.24).

Table 4.24: Effect of SBOHPP on OHK of adolescents in the four groups

Group	OHK score		Change	95%CI	%Change in OHK	Z	P value
	Post Mean (SD)	Pre Mean (SD)	Mean(SD)				
I(Peer-led)	4.47 (±1.74)	2.64 (±1.39)	1.83 (±2.21)	1.63 – 2.04	69.32	-13.544	< 0.001*
II(Dentist-led)	5.20 (±2.20)	2.78 (±1.34)	2.42 (±2.59)	2.17 – 2.67	87.05	-14.463	< 0.001*
III (Teacher-led)	4.40 (±1.95)	2.82 (±1.51)	1.58 (±2.15)	1.37 – 1.77	56.03	-12.656	< 0.001*
IV (Control)	2.80 (±1.56)	2.62 (±1.49)	0.18 (±2.00)	-0.03 – 0.35	6.87	-1.791	0.073

OHK – Oral Health Knowledge; Z – Wilcoxon Signed Rank Test; * – statistically significant

4.7.2 Effect of SBOHPP on the OHA of the participants

There was a significant difference in the OHA of the study participants in the three intervention groups post-intervention. At baseline, the attitude scores ranged from 0 – 10 in all the groups. In the peer-led group, the post-intervention scores ranged from 2 – 10, median score was 7.0. In the dentist-led group, the post-intervention attitude scores ranged from 3 – 10, median score was 8.0. In the teacher-led group, post-intervention scores ranged from 2 – 10, median score was 8.0 and in the control group post-intervention scores ranged from 0 – 10, median 5.0. The percentage change in mean OHA score pre- and post-intervention ranged from 11.5% to 135.1% (Table 4.25). The dentist-led group had the highest change in OHA, 135.1% (Table 4.25).

Table 4.25: Effect of SBOHPP on OHA of participants in the study groups

Study group	OHA score		Change	95%CI	%Change	Z	P value
	Post	Pre	Mean (SD)		in OHA		
	Mean (SD)	Mean (SD)					
I(Peer-led)	7.21 (±1.38)	3.17 (± 3.68)	4.04 (± 3.91)	3.67 – 4.41	127.44	-14.857	< 0.001*
II(Dentist-led)	7.83 (±1.40)	3.33 (± 3.53)	4.50 (± 3.84)	4.13 – 4.86	135.14	-15.620	< 0.001*
III (Teacher-led)	7.87 (±1.09)	3.40 (± 3.72)	4.47 (± 3.88)	4.10 – 4.83	131.47	-15.584	< 0.001*
IV(Control)	3.87 (±3.87)	3.48 (± 3.79)	0.40 (± 5.40)	-0.11 – 0.91	11.49	-1.598	0.110

OHA – Attitude to Oral Health; Z – Wilcoxon Signed Rank Test; * – statistically significant

4.7.3 Effect of SBOHPP on the OHP of the participants

The OHP of the study participants improved in the four groups pre- and post-intervention. In the peer-led group, the post intervention scores ranged from 1 – 9, median 5.0 compared to 1 – 8, median 4.0 for pre-intervention. In the dentist-led group, the post-intervention practice scores ranged from 1 – 10, median score was 6.0 compared to pre-intervention score of 1 – 8, median score 4.0. In the teacher-led group, the post-intervention score ranged from 1 – 9, median score was 5.0 compared to 0 – 8, median 4.0 pre-intervention. For the control group, the pre- and post-intervention scores ranged from 1 – 8, while the median scores were 5.0 and 4.0, respectively. The percentage change in mean OHP pre- and post-intervention ranged from 7.3% to 36.2% (Table 4.26). The dentist-led group had the highest change in OHP while the control group had the lowest change (Table 4.26).

Table 4.26: Effect of SBOHPP on the OHP of adolescents

Study group	Mean (SD)OHP score	Mean (SD)change	95%CI	%Change in OHP	Z	P value
I (Peer-led)						
Post-intervention	5.36 (±1.61)	1.15 (±2.13)	0.95 – 1.35	27.32	- 10.052	< 0.001*
Pre-intervention	4.21 (±1.40)					
II (Dentist-led)						
Post-intervention	5.78 (±1.57)	1.54 (±1.99)	1.35 – 1.73	36.24	- 12.761	< 0.001*
Pre-intervention	4.25 (±1.26)					
III (Teacher-led)						
Post-intervention	5.20 (±1.49)	0.95 (±1.96)	0.77 – 1.14	22.35	- 9.154	< 0.001*
Pre-intervention	4.25 (±1.40)					
IV (Control)						
Post-intervention	4.41 (±1.42)	0.30 (±1.88)	0.12 – 0.48	7.30	- 3.391	0.001*
Pre-intervention	4.11 (±1.35)					

OHP – Oral Health Practices; Z – Wilcoxon Signed Rank Test; * – statistically significant

4.7.4 Effect of SBOHPP on the utilization of dental services

There was an increased utilization of dental care services by the students in the four trial arms (Table 4.27). There was increased utilization of dental care services by 12.6%, 16.6%,10.5%and 6.0% in the peer-led, dentist-led, teacher-led and control groups respectively.

4.7.5 Effect of SBOHPP on the number of decayed teeth among the students

There was a reduction in the number of decayed teeth across the groups (4.2%, 4.7%, 3.0% and 0.7% in the peer-led, dentist-led, teacher-led and control groups, respectively. The least (0.7%) as well as insignificant reduction was observed among participants in the control group (Table 4.28). There was an increase across board in the proportion of participants with missing teeth due to caries post-intervention.

Table 4.27: Effect of SBOHPP on the utilization of dental services among the students

Study group	Utilization of dental services		χ^2	P value
	Yes (%)	No (%)		
I (Peer-led)				
Pre-intervention	26 (6.0)	405 (94.0)	31.367	< 0.001*
Post-intervention	80 (18.6)	351(81.4)		
Total	106 (12.3)	756 (87.7)		
II (Dentist-led)				
Pre-intervention	12 (2.8)	415 (97.2)	59.705	< 0.001*
Post-intervention	83 (19.4)	344 (80.6)		
Total	95 (11.1)	759 (88.9)		
III (Teacher-led)				
Pre-intervention	20 (4.6)	411 (95.4)	26.430	0.001*
Post-intervention	65 (15.1)	366 (84.9)		
Total	85 (9.9)	777 (90.1)		
IV (Control)				
Pre-intervention	20 (4.6)	413 (6.7)	11.087	0.001*
Post-intervention	46 (10.6)	387 (89.4)		
Total	66 (7.6)	800 (92.4)		

* – statistically significant

Table 4.28: Effect of SBOHPP on dental caries

Study group	Carious teeth		χ^2	P value
	0	≥1		
	No (%)	No (%)		
I (Peer-led)				
Pre-intervention	409 (94.9)	22 (5.1)	12.849	< 0.001*
Post-intervention	427 (99.1)	4 (0.9)		
II (Dentist-led)				
Pre-intervention	402 (94.1)	25 (5.9)	13.819	< 0.001*
Post-intervention	422 (98.8)	5 (1.2)		
III (Teacher-led)				
Pre-intervention	413 (95.8)	18 (4.2)	7.549	0.006*
Post-intervention	426 (98.8)	5 (1.2)		
IV (Control)				
Pre-intervention	404 (93.3)	29 (6.7)	0.175	0.676
Post-intervention	407 (94.0)	26 (6.0)		

χ^2– Chi-square statistic; * – statistically significant

4.7.6 Effect of SBOHPP on CPITNof the adolescents

There was a significant improvement in the periodontal health of the study participants, apart from those in the control group. There was an increase in the proportion of participants with healthy periodontium and periodontal treatment needs across the intervention groups (4.9%, 9.6%, 7.9% in the peer-led, dentist-led and teacher-led groups, respectively. In the control group there was a 0.2% reduction in the proportion of students with healthy periodontium. In addition, the percentage changes in the proportion of students with healthy periodontium were 44.7%, 87.2%, 82.9% and 3.7% for the peer-led, dentist-led, teacher-led and control groups, respectively (Table 4.29).

Table 4.29: Effect of SBOHPP on the periodontal treatment needs of the students by study group

Study group	CPITN Score		χ^2	P value
	0	≥1		
	No (%)	No (%)		
I (Peer-led)				
Pre-intervention	47 (10.9)	384 (89.1)	4.425	0.035*
Post-intervention	68 (15.8)	363 (84.2)		
II (Dentist-led)				
Pre-intervention	47 (11.0)	380 (89.0)	14.790	< 0.001*
Post-intervention	88 (20.6)	339 (79.4)		
III (Teacher-led)				
Pre-intervention	41 (9.5)	390 (90.5)	11.515	0.001*
Post-intervention	75 (17.4)	356 (82.6)		
IV (Control)				
Pre-intervention	27 (6.2)	406 (93.8)	0.020	0.887
Post-intervention	26 (6.0)	407 (94.0)		

χ^2 – Chi-square statistic; * – statistically significant

4.7.7 Effect of SBOHPP on the OHI-S of the students

There was a significant improvement in the OHI-S of the adolescents in the intervention groups(Table 4.30). The proportion of participants with good oral hygiene status increased across the three intervention groups (peer-led = 12.1%, dentist-led = 24.4 % and teacher-led = 16.7%). Among the controls, the increase in the proportion of students with good oral hygiene post-intervention (1.3%) was not statistically significant. The percentage change in good oral hygiene was 34.7% (peer-led), 83.9% (dentist-led), 42.4% (teacher-led) and 2.8% (control group). For the category of fair oral hygiene status, there was a reduction in the proportion of adolescents post-intervention as compared to pre-intervention findings (12.0%, 22.0%, 18.3% and 2.8%) in the peer-led, dentist-led, teacher-led and control groups, respectively, although this reduction was not statistically significant in the control group. A reduction in the number of adolescents with poor oral hygiene was only observed in the dentist-led group with a 2.3% reduction ($p < 0.001$).

Table 4.30: Effect of SBOHPP on the OHI-S of the adolescents

Study group	OHI-S			χ^2	P value
	Good	Fair	Poor		
	No (%)	No (%)	No (%)		
I (Peer-led)					
Pre-intervention	150 (34.8)	263 (61.0)	18 (4.2)	13.386	0.001*
Post-intervention	202 (46.9)	211 (49.0)	18 (4.2)		
II (Dentist-led)					
Pre-intervention	124 (29.0)	276 (64.6)	27 (6.3)	52.293	< 0.001*
Post-intervention	228 (53.4)	182 (42.6)	17 (4.0)		
III (Teacher-led)					
Pre-intervention	170 (39.4)	253 (58.7)	8 (1.9)	29.329	< 0.001*
Post-intervention	242 (56.1)	174 (40.4)	15 (3.5)		
IV (Control)					
Pre-intervention	179 (41.3)	243 (56.1)	11 (2.5)	2.062	0.357
Post-intervention	184 (42.5)	231 (53.3)	18 (4.2)		

OHI-S – Simplified Oral Hygiene Index; χ^2– Chi-square statistic; * – statistically significant

4.7.8 Effect of SBOHPP on the gingival health of the participants

There was a significant improvement in the gingival health of the study participants in the intervention groups (Figure 4.8). There was a reduction in the mean sextants with gingival bleeding post-intervention across the three intervention groups with percentage changes of 62.1%, 68.2% 46.9% and 10.0% in the peer-led, dentist-led, teacher-led and control groups respectively (Table 4.31).

4.7.9 Relative effectiveness of the SBOHPP on the oral health of the study participants

The relative effectiveness of the intervention on the oral health of the students was assessed with the effect size in the Per Protocol analysis as presented belowin Table 4.32.

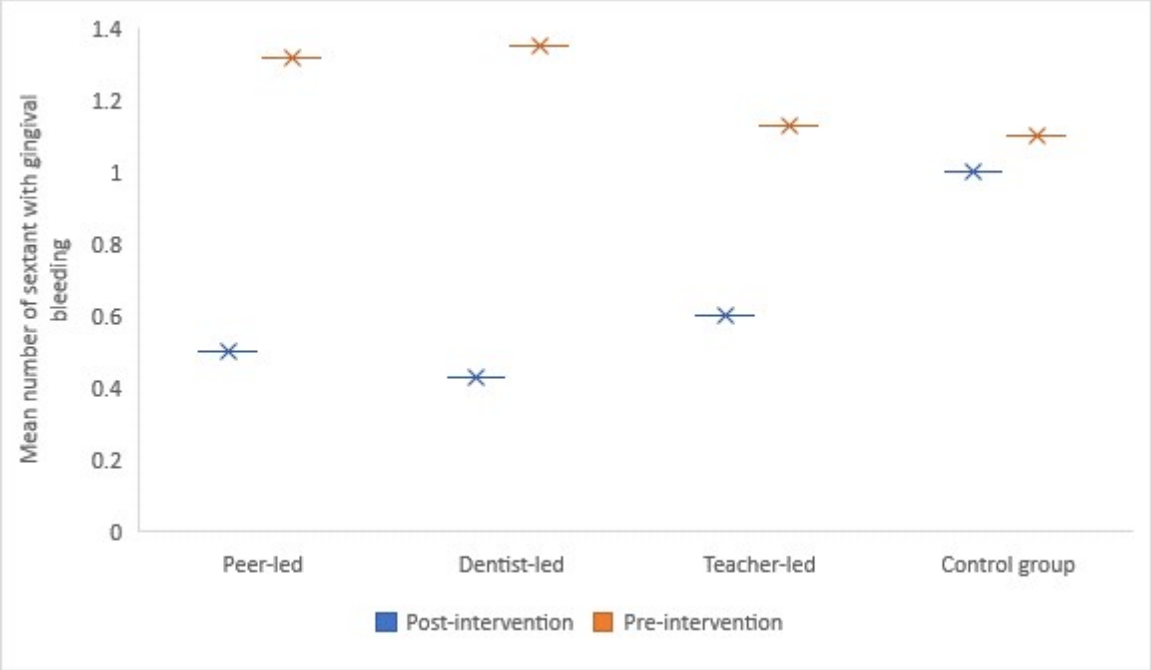

Figure 4.8: Effect of SBOHPP on the gingival health of the students

Table 4.31: Effect of SBOHPP on the gingival health of the students by study group

Study group	Mean(SD) sextants with gingival bleeding	Mean (SD)change	%Change in sextant with GB	Mean Ranks	Z	P value
I (Peer)						
Pre-intervention	1.32 (±2.08)	0.82 (±2.13)	62.12	85.45	-6.314	< 0.001*
Post-intervention	0.50 (±1.19)			115.15		
II (Dentist)						
Pre-intervention	1.35 (±1.97)	0.92 (±1.99)	68.15	134.94	- 8.319	< 0.001*
Post-intervention	0.43 (±0.85)			79.39		
III (Teacher)						
Pre-intervention	1.13 (±1.91)	0.53 (±1.96)	46.90	106.50	- 4.327	< 0.001*
Post-intervention	0.60 (±1.35)			103.50		
IV (Control)						
Pre-intervention	1.10 (±1.74)	0.11 (±1.88)	10.0	112.40	- 1.432	0.152
Post-intervention	1.00 (±1.93)			137.80		

Z – Wilcoxon Signed Rank Test; * – statistically significant

Table 4.32: Effect sizes of SBOHPP on the oral health parameters of the study participants per protocol (n = 1722)

Variable/Study group	I (Peer-led)	II (Dentist-led)	III (Teacher-led)	IV (Control)
KAP				
OHK	0.46[@]	0.49[@]	0.43[@]	0.09***
OHA	0.51#	0.54#	0.53#	0.05***
OHP	0.34[@]	0.44[@]	0.31[@]	0.12**
Oral health Status				
Coronal caries	0.44[@]	0.47[@]	0.26**	0.01***
Periodontal needs	0.15**	0.50#	0.39[@]	0.00***
Gingival health	0.22**	0.28**	0.15**	0.05***
Oral hygiene	0.23**	0.89#	0.50#	0.07***

- Large effect size; [@] - Moderate size; ** - Small size ***-Very small size

4.7.10 Effect sizes of SBOHPP on the oral health parameters of the study participants

Multivariate analysis showed that SBOHPP had positive effects on the OHK, OHA and OHP of the adolescents (Table 4.33 and Table 4.34). The dentist-led strategy had the highest odds of improving oral health. The Bonferroni adjustment of the estimates is as shown on Table 4.35.

Table 4.33: Multivariate analysis of the effects of SBOHPP on the Oral KAP of the study participants

Variable/Study group	ß	SE	OR	95%CI	P value
HK					
Peer-led	0.468	0.0326	1.60	1.50 – 1.70	< 0.001
Dentist-led	0.619	0.0338	1.86	1.74 – 1.99	< 0.001
Teacher-led	0.453	0.0342	1.57	1.47 – 1.68	< 0.001
Control	0	0	1		
OHA					
Peer-led	0.622	0.0488	1.86	1.69 – 2.05	< 0.001
Dentist-led	0.704	0.0481	2.02	1.83 – 2.22	< 0.001
Teacher-led	0.710	0.0484	2.03	1.85 – 2.23	< 0.001
Control	0	0	1		
OHP					
Peer-led	0.196	0.021	1.22	1.17 -1.27	< 0.001
Dentist-led	0.272	0.203	1.31	1.26 – 1.37	< 0.001
Teacher-led	0.166	0.207	1.18	1.13 – 1.23	< 0.001
Control	0		1		

SE – Standard Error; OR – Odds Ratio

Table 4.34: Multivariate analysis of the effects of SBOHPP on the oral health status of the study participants

Variable/Study group	ß	SE	RR	95%CI	P value
Periodontal treatment needs					
Peer-led	-1.040	0.200	0.35	0.24 – 0.52	< 0.001*
Dentist-led	- 1.298	0.1966	0.27	0.19 – 0.40	< 0.001*
Teacher-led	- 1.120	0.1987	0.33	0.22 – 0.48	< 0.001*
Control	0	0	1		
Oral hygiene					
Peer-led	- 0.436	0.1777	0.65	0.78 – 1.07	0.014*
Dentist-led	- 0.962	0.1815	0.38	0.27 – 0.55	< 0.001*
Teacher-led	- 0.586	0.1178	0.56	0.39 – 0.79	0.001*
Control	0	0	1		
Gingival health					
Peer-led	-0.683	0.1472	0.50	0.38 – 0.67	< 0.001*
Dentist-led	-0.844	0.1339	0.43	0.33 – 0.56	< 0.001*
Teacher-led	-0.512	0.1433	0.60	0.45 – 0.79	< 0.001*
Control	0	0	1		
Coronal caries					
Peer-led	-0.814	0.2095	0.44	0.29 – 0.67	< 0.001*
Dentist-led	-0.699	0.1976	0.50	0.34 – 0.73	< 0.001*
Teacher-led	-0.699	0.1977	0.51	0.35 – 0.76	< 0.001*
Control	0	0	1		

SE – Standard Error; RR – Risk Ratio; *Statistically significant.

Table 4.35: Bonferroni adjustment of the estimates

Variable/Study group	I (Peer-led)	II (Dentist-led)	III (Teacher-led)	IV (Control)
OHK				
Peer-led	-	< 0.001*	1.000	< 0.001*
Dentist-led	< 0.001*	-	0.011	< 0.001*
Teacher-led	1.000	0.011	-	< 0.001*
OHA				
Peer-led	-	0.38	0.27	< 0.001*
Dentist-led	0.38	-	1.00	< 0.001*
Teacher-led	0.27	1.00	-	< 0.001*
OHP				
Peer-led	-	0.060	1.000	< 0.001*
Dentist-led	0.060	-	0.002	< 0.001*
Teacher-led	1.000	0.002	-	< 0.001*

* Statistically significant.

4.8 Effect of SBOHPP on the OHRQoL of the students (Objective IV)

4.8.1 The OHRQoL of study participants with COHIP-SF 19

The OHRQoL measure was validated and assessed for its reliability.

4.8.2 Self-report of oral health status by the students

Most of the adolescents rated their oral health status as very good 703 (40.8%) or good 562 (32.6%), while only 131 (7.6%) rated it as poor or very poor (Figure 4.9).

4.8.3 Satisfaction with dental condition of the students

Many of the adolescents were very satisfied with their oral health condition 489 (28.4%) or satisfied 628 (36.5%), while 319 (18.5%) were dissatisfied or very dissatisfied with their dental condition (Figure 4.10).

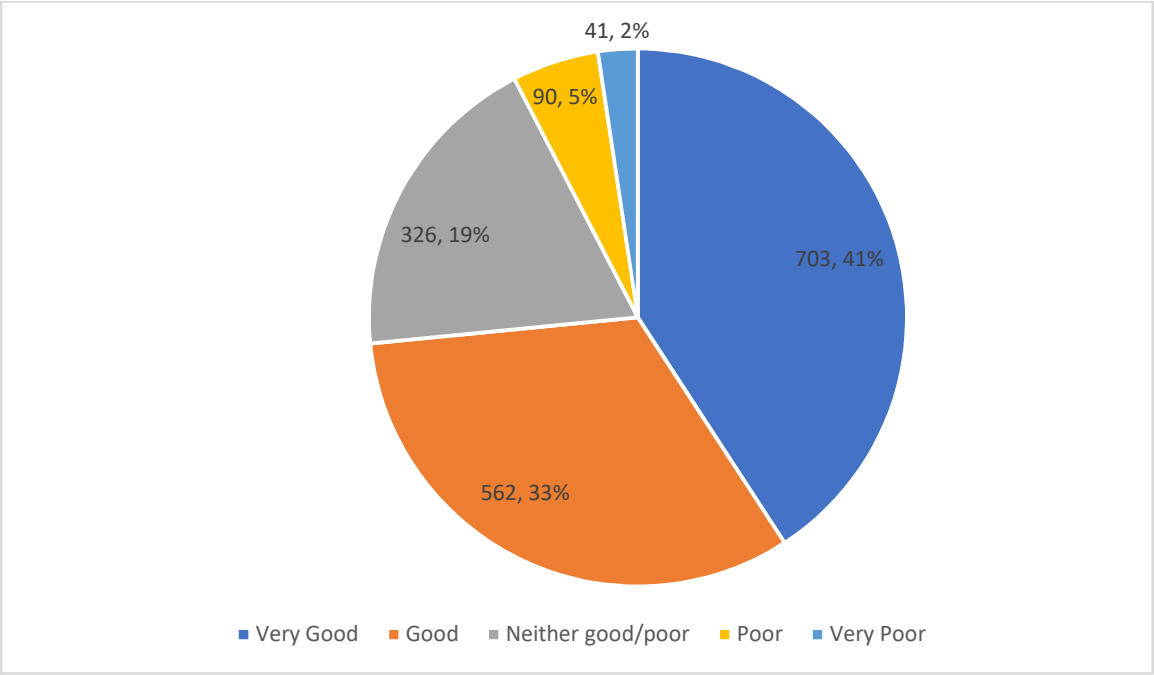

Figure 4.9: Baseline self-rating of oral health of the students (n = 1722)

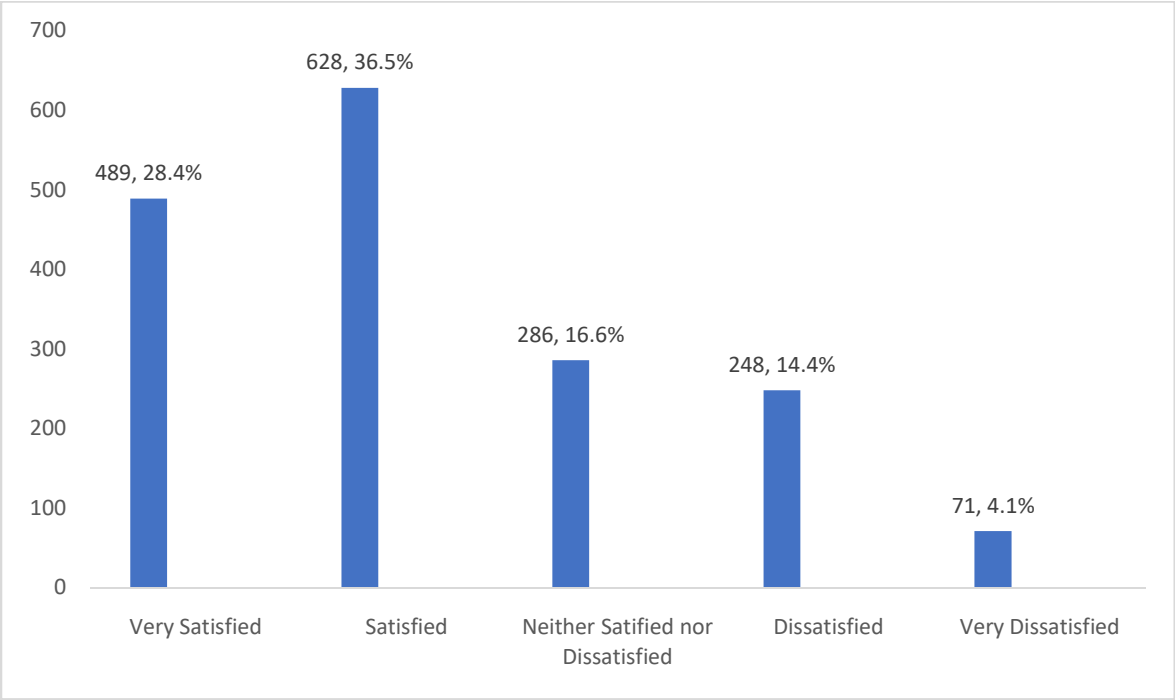

Figure 4.10: Satisfaction with dental condition of the students (n = 1722)

4.8.4 Convergent validity of the COHIP-SF 19 among the students

A higher proportion of students who rated their oral health as poor or very poor had more impact on their OHRHoL compared with those who were satisfied or very satisfied with their oral health condition (Table 4.36). Students who were dissatisfied or very dissatisfied with their oral condition reported higher impacts on their OHRQoL compared to those who were satisfied and very satisfied with their oral condition (Table 4.36).

4.8.5 Reliability of COHIP-SF 19

The Cronbach alpha score was 0.873 and Cronbach alpha score when any of the items was deleted ranged from 0.835 to 0.870 (Table 4.37).

Table 4.36: Convergent Validity of the COHIP-SF 19

Variables	COHIP-SF 19		χ^2	P value
	No Impact	Impact		
	No (%)	No (%)		
Self-rating of oral health				
Very poor	1 (2.4)	40 (97.6)	27.410	< 0.001*
Poor	4 (4.4)	86 (95.6)		
Neither poor nor good	8 (2.5)	318 (97.5)		
Good	27 (4.8)	535 (95.2)		
Very good	70 (10.0)	633 (90.0)		
Total	110 (6.4%)	1612 (93.6%)		
Satisfaction with dental condition				
Very dissatisfied	0 (0.0)	71 (100.0)	37.007	< 0.001*
Dissatisfied	9 (3.6)	239 (96.4)		
Neither satisfied nor dissatisfied	12 (4.2)	274 (95.8)		
Satisfied	31 (4.9)	597 (95.1)		
Very satisfied	58 (11.9)	431 (88.1)		
Total	110 (6.4%)	1612 (93.6%)		

χ^2– Chi-square statistic; * – statistically significant

Table 4.37: Internal consistency of COHIP-SF 19 among the students

COHIP-SF 19 Item	Cronbach alpha if item is deleted
Pain in your teeth/toothache	0.843
Discoloured teeth or spots on your teeth	0.842
Crooked teeth or spaces between your teeth	0.841
Bad breath	0.839
Bleeding gums	0.841
Difficulty eating foods you would like to eat	0.839
Trouble sleeping”	0.839
Difficultly saying certain words	0.838
“Difficulty keeping your teeth clean	0.837
Being unhappy or sad	0.835
Worries or anxiety	0.835
Avoiding smiling or laughing with others	0.836
Feeling that you look different	0.835
Being worried about what other people think about your teeth/mouth	0.835
Being teased, bullied, by other children because of your teeth	0.839
Missing school for any reason because of your teeth/mouth	0.841
Not wanted to speak/read out loud in class because of your teeth /mouth	0.838
Being confident	0.870
Feeling that you were attractive (good looking).	0.868
Standardized Cronbach alpha	**0.873**

4.8.6 Baseline OHRQoL of the students

The OHRQoL scores of the adolescents ranged from 9 – 76 and the median score varied from 64 to 65. There was a skewed distribution of the COHIP-SF 19 scores among the study participants (Table 4.38). The OHRQoL of the participants was similar before intervention across the study groups.

4.8.7 Baseline OHRQoL of the students by quartiles

Table 4.39 shows the impact of oral health on the OHRQoL of the students by quartiles. The first quartile was 55, second 64, third quartile 68 and the last was 76. A higher proportion (50.7%) fell into the lower (first and second) quartiles. Table 4.39 shows the distribution of oral impact among the adolescents into four categories of first, second, third and fourth based on quartiles.

Table 4.38: Baseline OHRQoL of theadolescents

Study group	COHIP-SF 19 score	Mean(SD) COHIP score	95%CI	Median	Shapiro-Wilk test	Kruskal Wallis	P value
I(Peer-led)	9 - 76	60.19 (±12.43)	59.02 – 61.37	64.0	< 0.001	2.149	0.542
II(Dentist-led)	12 - 76	60.37 (±13.09)	59.12 – 61.61	65.0	< 0.001		
III(Teacher-led)	12 - 76	61.67 (±11.60)	60.51 – 62.71	64.0	< 0.001		
IV(Control)	20 - 76	61.70 (±10.71)	60.69 – 62.71	64.0	< 0.001		

Table 4.39: Category of impact reported by the students based on quartiles (n = 1722)

Study group	Category of Impact				χ^2	P value
	1	2	3	4		
	No (%)	No (%)	No (%)	No (%)		
I(Peer-led)	114 (26.3)	112 (25.5)	112 (26.7)	93 (21.6)	15.233	0.085
II(Dentist-led)	123 (28.3)	88 (20.0)	110 (26.3)	106 (24.7)		
III (Teacher-led)	101 (23.3)	116 (26.4)	97 (23.2)	117 (27.2)		
IV(Control)	96 (22.1)	123 (28.0)	100 (23.9)	114 (26.5)		
Total	432 (25.2)	439 (25.5)	419 (24.3)	430 (25.0)		

χ^2 – Chi-square statistic

4.8.8 Frequency of impact on daily performances

Table 4.40 shows the occurrence of impact on daily performances of the students. The most frequently impacted item reported by the students was toothache (47.8%) while the least commonly reported item was missing school due to dental illness (16.8%). A total of 1612 (93.5%) had at least an impact on their OHRQoL.

4.8.9 Effect of intervention on the OHRQoL of the participants

There was little improvement in the OHRQoL of the participants with the highest and significant percentage mean change (3.3%) reported in the dentist-led group. The change was, however, very small as reported in Table 4.41.

Multivariate analysis of the effects of the SBOHPP strategies on the QoL of the adolescents showed that students in the intervention groups were more likely to have better OHRQoL than those in the control group (Table 4.42).

Table 4.40: Baseline frequency of impact of oral health on the QoL of thestudents

COHIP-SF 19 item	No impact No (%)	Impact No (%)
Pain in your teeth/toothache	899 (52.2)	823 (47.8)
Discoloured teeth or spots on your teeth	1009 (58.6)	713 (41.4)
Crooked teeth or spaces between your teeth	1199 (69.9)	523 (30.4)
Bad breath	1194 (69.3)	528 (30.7)
Bleeding gums	1115 (64.8)	607 (35.2)
Difficulty eating foods you would like to eat	1157 (67.2)	565 (32.8)
Trouble sleeping	1294 (75.1)	428 (24.9)
Difficultly saying certain words	1257 (73.0)	465 (27.0)
Difficulty keeping your teeth clean	1222 (71.0)	500 (29.0)
Being unhappy or sad	1111(64.5)	611 (35.5)
Worries or anxiety	1098 (63.8)	624 (37.2)
Avoiding smiling or laughing with others	1176 (68.3)	546 (31.7)
Feeling that you look different	1160 (67.4)	562 (32.6)
Being worried about what other people think about the teeth/mouth	1180 (68.5)	542 (31.5)
Being teased, bullied because of the teeth	1334 (77.5)	388 (22.5)
Missed school because of the teeth/mouth	1432 (83.2)	290 (16.8)
Not wanted to speak in class because of the teeth/mouth	1385 (80.4)	337 (19.6)
Being confident	1109 (64.4)	613 (35.6)
Feeling of not being attractive	1169 (68.9)	553 (32.1)

Table 4.41: Effect of intervention on the OHRQoL of the participants

Study group	Mean (SD) COHIP-SF 19 score	Mean (SD) change	%Change in OHRQoL	Mean Ranks	Z	P value
I (Peer-led)						
Post	61.19 (13.56)	1.00 (2.13)	1.67	211.51	-1.374	0.170
Pre	60.19 (12.49)			207.13		
II (Dentist-led)						
Post	62.38 (13.09)	2.01 (1.99)	3.33	206.74	- 2.499	0.012*
Pre	60.37 (13.43)			193.81		
III (Teacher-led)						
Post	62.33 (13.00)	0.53 (1.96)	0.86	213.71	- 1.960	0.050
Pre	61.61 (11.60)			200.23		
IV (Control)						
Post	62.77 (11.49)	0.11 (1.88)	0.18	209.14	- 1.700	0.089
Pre	61.70 (10.72)			202.31		

* – statistically significant

Table 4.42: Multivariate analysis of the effects of SBOHPP on the OHRQoL of the study participants

Variable/Study group	ß	SE	OR	95%CI	P value
COHIP-SF 19					
Peer-led	0.585	0.2343	1.80	1.13 – 2.84	0.013*
Dentist-led	0.592	0.2346	1.81	1.14 – 2.86	0.012*
Teacher-led	0.453	0.2391	1.57	0.98 – 2.51	0.058
Control	0	0	1		

SE – Standard Error; OR – Odds Ratio; * – statistically significant

4.9 Exploring the acceptability of the three-different school-based OHPn strategies by the students (Objective VI)

A total of 182 students participated in 15 FGDs post-intervention.

4.9.1 Perspectives of the students about the SBOHPP and its acceptability

The students had positive feelings about the instituted oral health programme in their schools and believed that they had benefited from it. They expressed dismay at the fact that only their classes had benefited and all other classes in the schools were left out. Summary of the themes and subthemes that emerged from the discussions with the students is as stated in Table 4.43.

Table 4.43: **Emerging themes and subthemes on the acceptability of SBOHPP by the adolescents**

Themes	Subthemes
Feelings towards dentists visit to the school	Excitement
	Gratitude/Appreciation
	Happiness
	Disappointment
Benefits of SBOHPP	Improved knowledge on oral health
	Imparting tooth cleaning skills
	Confidence building
	Disease prevention
	Good oral health
	Dental treatment
Factors associated with preference of strategies	Profession related
	Chastisement
	Skill imparting
	Oral health care services
	Time factor

4.9.2 Theme 1: Feelings towards the dentists' visits to the school

All the participants were happy and excited about the presence of the dentist. The major subthemes were; excitement, appreciation, happiness and disappointment.

Excitement

Many of the students were excited about the SBOHPP and they expressed their feelings as one of them stated that;

"... because it is rare to find that dentists visit schools to care for teeth of students. ... because it is their first time of coming and we will gain more experience about our teeth." (Female, Teacher-led group)

Appreciation and Happiness

Students who appreciated the presence of dentists in school expressed this by asking for the dentists to make the programme permanent. Statements made by students included;

"I want them to be coming often and often to ensure our teeth are in good condition for a healthy environment." (Female, Control group)

"It should become a permanent programme, they should look for sponsors…" (Female, Dentist-led group) "... or we may contribute money among ourselves so that they can be coming every time…" (Female, Dentist-led group)

"Not everyone is privileged to go for check-ups so if they come often and often, we will know the state that our teeth are." (Female, Control group)

"... very good and students appreciate it." (Male, Peer-led group)

Expression of disappointment that some students did not benefit from the SBOHPP

"Not all of us benefitted; Only the SS3 students did." (Male, Peer-led group)

4.9.3 Theme 2: Benefits of the programme

The benefits of the SBOHPP according to the students included; acquisition of knowledge about oral health, imparting of tooth cleaning skills and oral care, prevention of oral diseases and confidence about their dentition.

Acquisition of knowledge

"I benefitted that we should be washing our teeth regularly." (Male, Peer-led group)

"The benefit is ehm after the oral programs I learnt that we don't have to use hard brush, not to spoil the teeth." (Male, Peer-led group)

"It helped to know the type of toothpaste to use, the one with fluoride and the type of brush to use." (Male, Peer-led group)

"I learnt that we should not be taking sugary things." (Male, Peer-led group)

Imparting of tooth cleaning skills and oral care

The students mentioned being able to engage in daily tooth brushing and acquiring skills on proper tooth cleaning techniques as stated below in quote;

"... brush my teeth every day." (Male, Peer-led group)

"It helped to know ... how to brush our teeth both horizontally and vertically" (Male, Peer-led group)

Prevention and treatment of oral diseases

Prevention of oral diseases was one of the benefits of SBOHPP mentioned by the students. Some of the statements made are quoted below;

"*… there will not be tooth decay or tooth disease again."(Male, Peer-led group)*

"……. Because you will know the position or the status of your teeth so that you will know the way to prevent decay or tooth hole". (Female, Control group)

"Ok, to do proper medical check-up of the teeth for the students and give them enough brushing equipment like toothbrush and toothpaste and other necessary things for tooth decay and other tooth problems" (Female, Control group)

Confidence building

Some of the students stated that the programme has made them proud, one stated that *"……..able to properly brush their teeth and proud to talk to anybody". (Male, Peer-led Group)*

Good oral health status

Other benefits of SBOHPP that were mentioned by the students included; optimal oral health in terms of aesthetics and good alignment of the teeth as well as good oral condition.

"To make our teeth look good." (Female, Control group)

"So as to ensure our teeth are in good position and healthy position." (Female, Control group)

"To ensure and be relaxed that our teeth are in good conditions." (Female, Control group)

"……. Made our teeth stronger." (Male, Peer-led group)

Dental screening and treatment

Free dental screening and dental treatment was also one of the benefits of the SBOHPP mentioned by the student. One of the students in the control group stated that;

"……. Make sure that they check our teeth and all the teeth are in good position." (Female, Control group)

4.9.4 Theme 3: Preferences of the SBOHPP strategies by the students

There were mixed perspectives about the preferred SBOHPP strategy, although almost all preferred the dentist-led method over the peer-led and teacher-led methods.

Preference of the dentist-led method was based on skills and profession-related experiences of the dentists as stated by the students.

"Dentists should come by themselves to train the students, because they know better about the teeth and some teeth problems." (Female, Control group)

"Dentist is preferable because the dentists are more experienced than the teachers and students." (Female student, Control group)

"The dentists are more experienced than the teachers and students." (Female, Control group)

"*……because it is their profession." (Female, Control group)*

"*……because it is their field of specialization and they have more knowledge about the field." (Female, Control group)*

"Dentist, because they have the idea of treating all the teeth." (Female, Control group)

"I prefer the dentists themselves; we will understand more, I will not have solid knowledge about it if my peers are trained …" (Male, Peer-led group)

"… because all the school will listen." (Male, Peer-led group)

"I prefer the dentists because they will teach us better. There are some key points that our teachers will not tell us if they are trained and we will be making jest of our mates if they are trained." (Male, Peer-led group)

The reason why we did not prefer our teachers, parents or peer groups is because the dentists, they are more experienced than those we are talking about. Because they will know the… how to cure it and how to even prevent it." (Female, Dentist-led group)

Time factor

Busy nature of the school curriculum and consequence of teachers being busy was also stated by one of the students.

"I prefer the dentist to teach us directly because the teachers will be very busy and the students cannot teach us very well as we will be making jest of one another." (Male, Peer-led group)

Some students preferred the peer-led method: the reasons included peer self-management

"I prefer that the dentist should train us so that we can train others …we would be able to address them better." (Male, Peer-led group)

"… dentists may not be able to teach a large group." (Male, Peer-led group)

Some students did not prefer the peer-led method because of perspective of inadequacy of knowledge

"Ahh, we don't have the knowledge that you have because you went to the university to read the course." (Female, Control group)

"*… because my peers cannot do up to what the dentist will do." (Female, Control group)*

Lack of peer-control was also a reason for non-preference of peer-led strategyas stated by the students

"… and they trained our peers, they will be making jest of themselves and the objective will not be achieved." (Male, Peer-led group)

"… and if my peers are trained, we will be making jest of them, we will not listen." (Male, Peer-led group)

"… because if a student tells his or her colleague, the colleague will just be making jest of her and thinking that she is saying rubbish." (Female, Dentist-led group)

Chastisement by peers was another reason

"… I don't even prefer my classmates because they will be abusing someone if… if the person did not know what they asked."

Teacher-led method was not preferred by the students because of the perspective that teachers have inadequate knowledge and skills relating to oral health and oral health care

"*… because they don't have enough knowledge for the training." "They are teaching us physics and other subjects but they don't have the skills." "The skills they have are to impart knowledge on us.*" *(Female, Control group)*

Another student mentioned that *"But how to clean our teeth, emm, they may not know the steps". (Female, Control group)*

"... because the teachers will not do it better like the dentist." (Female, Control group)

"... because they will not have the knowledge to teach it very well." (Male, Peer-led group)

Another reason mentioned included lack of time;

"*… our teachers may not have time." (Male, Peer-led group)*

Chastisement was also a reason

Discipline in form of spanking by the teachers was a reason for non-preference of the teachers as the anchor person by the students.

"I don't prefer my teacher because if they ask us one question and we don't know it, they will beat us." (Female, Dentist-led)

"... and they will be… they will also abuse me."

One of the students stated that the parent was the most preferred resource person

"I prefer my parents because some dentists, if you tell them…. Maybe if they see you outside, they might be thinking that this is the person that we taught, that her teeth are not good. But if it's your own parents, they cannot ignore you or do something to you like that." (Female, Dentist-led)

4.10 Evaluation of the acceptability of the three-different school-based oral health promotion strategies by the teachers (Objective VII)

A total of 119 teachers participated in nine post-intervention FGDs. The number of teachers who participated in each of the FGDs ranged from 7 – 15.

4.10.1 Perspectives of the teachers on the acceptability of the SBOHPP for adolescents

The teachers accepted the programme and were all appreciative and would prefer if the programme continues, as they all noticed improvement in the adolescents' oral health. The major themes were as listed below: benefits, curriculum change and preferences.

4.10.2 Theme 1*:* The benefit of SBOHPP

All the teachers emphasised that the SBOHPP has benefits that was termed positive.

"... they have impact on the children yes, even positive impact I have seen some of them when they are coming yearly to talk they will be doing ... and if people can keep on coming constantly like this bringing free toothbrush, no matter how small tooth paste and brush. I'm telling you yes, ..."(Female, Dentist-led)

4.10.3 Theme 2: Formalizing the programme in schools

The teachers appreciated the programme and would prefer a permanent programme that would be a continuum and is incorporated into the school curriculum. One of the teachers stated that

"... you go to the ministry first...You go to the ministry, you inform them; you write a proposal so you give the ministry, if it is approved you bring it to the school, so, the school will know how to slot it in their curriculum activities – the teeth." (Male, Control group)

"I will suggest that if the government will allow it that we should be slotting it within the curriculum activities maybe you know we normally have different clubs maybe when we have medical club ehn uhn under this we can have different aspects not only on ehn teeth issue or oral issue alone even other medical aspects when we have it under the curriculum activities." (Female Dentist-led)

Follow-up by the dentists was emphasized by the teachers

"... but if the students can see you once in a term. Once a term is enough, once a term I am sure some of your students you tested the other time, the moment they saw you this morning they said 'the dentists is around'. Even when they see you outside ... But once a term should be enough then if you cannot come once a term then we are now going back to the problem, if there is no follow up… There must be follow-up, if you know you really want to succeed." (Female Control group)

"... you will be calling the teachers, may be twice or once in a term to re-educate them on what to do thereby, the teachers will be feeding the students back. They will be educating them on your behalf." (Female, Control group)

Forming a dental health club was recommended by some teachers

"... if approval is given, you can have a kind of club in the school and that club will be a kind of sensitization in an arena for the students and that will help getting close to the other students when you have the club that is promoting the dental health." (Female Control group).

4.10.4 Theme 3: Preference of the SBOHPP by the teachers

There were mixed opinions on the most preferred strategy. While some preferred dentists, some preferred teachers, some did not have a specific preference while others preferred a combination of methods.

Some teachers preferred the dentist anchoring the programme

"I think by bringing the dentist will be better, because the students will see that this is a professional to the core. So, I think the students will be more interested in seeing a person that is entirely new to them." (Male, Teacher-led)

Some would want dentists to initiate the process and teachers to maintain it

"I think I will suggest we have the dentist around. When we have the dentist around, the teacher can do some follow-up like I told you I'm a maths teacher. That will not stop me from asking them, it can be the first thing. Hello students good morning, if your good morning is sluggish ah is it because you didn't brush your teeth properly? Is that why you cannot open your mouth? You know they will want to show me that they are brushing their teeth properly. If they have not been trained. How will I now bring that in? So, we suggest we have a dentist on a regular basis but if on your own side you want some teachers to be trained, there is no problem. We are gaining more." (Female, Control group)

Some teachers had no specific preference

Some teachers had no specific preference and would prefer a combination of methods. One of the teachers said *"I wouldn't want to recommend a particular style. A mixture of all the styles. All the styles are good and they are complementary. We need to adopt all. They will work. That is our objective". (Male, Control group)*

Other teachers prefer teachers to anchor the programme

Teachers who preferred themselves as the anchor person based this on their expertise and profession.

"... you can teach the teacher and let the teachers go to teach the students because we are so familiar with them. We know how to talk to them." *(Female, Teacher-led)*

A teacher believed that teachers are in the best position to anchor SBOHPP based on their expertise.

"... the one that will be more effective is for you to train some teachers because we are more familiar with them and we know how to teach them properly. We know how to explain to them. We know how to come down to their level. So, when you train some teachers then we come back and give them the training but that does not disturb you from coming once in a while to see how far the trained teachers have gone." (Female, Dentist-led)

Organising regular seminars by dentists was also suggested as an option to engage teachers as the anchor persons for SBOHPP.

"You can be organizing seminars for teachers. You will teach them how to educate the students and it is these teachers that will be educating the students on how to take care of their teeth." (Female, Control group)

Training of both the teachers and students in the schools to step down acquired skills to the immediate environment was also suggested by some teachers.

"We are talking about the parents of these children also if as you train teachers, you can as well select few students to be trained so, he may take this home ... they would take it home and also teach their parents." (Male, Teacher-led)

CHAPTER FIVE

DISCUSSION

This chapter describes the results of the study and the implications on school oral health promotion among adolescents. The SBOHPP had been described by the WHO as an appropriate and invaluable programme to promote oral and general health among adolescents, minimizing or completely eliminating the inequalities that could arise due to socioeconomic and other determinants of health. Although SBOHPP does not exist formally in most parts of Nigeria, it is an integral part of the National Oral Health Policy of the country. In order to translate the policy into practices appropriate to our local context, strategies on the manpower to anchor the various activities need to be identified. This is especially important in view of the relatively few dentists in the country compounded by the increasing brain drain of dentists and other health professionals that has become worrisome in the country. This study, therefore investigated the effectiveness of interventions, varied by anchor resource persons, in promoting oral health among adolescents in schools in Ibadan using mixed methods.

The study revealed that students were of mixed feelings towards dentists' visiting schools, ranging from excitement to apprehension.Nevertheless, at baseline, the students expressed the desire to participate in the SBOHPP for the purpose of gaining relevant knowledge and skills of oral care. In the same way, the teachers excitedly welcomed the idea of the SBOHPP, emphasising that the presence of dentists in the schools would greatly enhance the success of the interventions, which if appropriately spaced out should not interfere with the school calendar. The interventions significantlyimproved the oral heath knowledge, attitude and practices of the study participants. In addition, there was a positive effect on the utilization of dental services, periodontal treatment needs, gingival health and oral hygiene status of the students. The intervention also improved the OHRQoL of the students. The highest effect, on virtually all the parameters

assessed, was observed in the dentist-led group. The perspectives of the students changed positively after intervention with the majority becoming confident of gaining from the programme. They also observed changes in their oral health status and in the level of their awareness of oral health. They consequently wished that other students would be exposed to the same programme. Furthermore, the teachers desired that the programme be included in the school curriculum.

5.1 Baseline sociodemographic characteristics of the study participants

The sociodemographic characteristics of the study participants at baseline were not significantly different between the study groups; depicting the strength of randomization in ensuring unbiased distribution of the study participants (Armitage, 1982). The gender distribution of the study participants was almost equal among females and males. This can also be attributed to the randomization process. In addition, similar documentations on the gender distribution in a similar setting have been made(Lawal and Taiwo, 2018, Lawal and Oke, 2020). Most of the study participants had parents who belonged to the unskilled occupational class with very few in the skilled and dependent classes. This finding is consistent with previous studies conducted in the country (Lawal and Taiwo, 2018, Lawal and Oke, 2020). It has been reported that most of the students attending Government-owned public schools in Nigeria belonged to the lower social classes (Okeke-James *et al.*, 2020). Overall, the baseline sociodemographic characteristics of the students reflects the description of adolescents from public secondary schools in the city.

Very few students were lost to follow up. The non-existence of any previous oral health programme for adolescents in the state may have aroused their curiosity, thus being an important factor in sustaining participation. The baseline data of the students who were lost to follow up were similar to the baseline data of those who completed the study. Adequate and complete randomization process of study participants has been found useful in minimizing significant differences across study groups (Lachin *et al.*, 1988).

5.2 Perspective of adolescents about oral health

The perspective of the students about dentists' visits to the schools was mixed. While some were happy and excited that they would gain knowledge, others were apprehensive or indifferent. The happiness of students about the visit to schools has been described as a positive attitude towards oral health as reported by other authors (Östberg *et al.*, 2002, Pham *et al.*, 2015). On the other hand, some students were apprehensive about the

sighting of dentists, a phenomenon closely linked to the fear of dentists, a major hinderance to seeking dental care (Dodd *et al.*, 2014, Pham *et al.*, 2015). In addition, the fear of dentists has been mentioned by adolescents in various forms, which include fear of dental treatment and fear of "stories of dentists as inflictors of pain" (Dodd *et al.*, 2014). Apprehension towards dental visits, opined by students in this study, was corroborated by their thoughts, which described a dentist as "*someone who causes pain*" or "*chastise people with poor oral health*". Previous studies (Dodd *et al.*, 2014) have reported similar views of adolescents about a dentist as "someone who judges their oral hygiene habits" (Dodd *et al.*, 2014). Further explanation on this by the adolescents was that those identified by the dentists as having poor oral health would be chastised or punished. These are possible explanations and contributory factors to the level of apprehension by the students. Fear of being chastised by the dentist due to judging of their oral health has equally been mentioned as a deterrent to dental care (Dodd *et al.*, 2014). Apprehension as a result of the fear of dentists has been documented as a factor that negatively influences dental care (Dodd *et al.*, 2014, Pham *et al.*, 2015). The apprehension demonstrated by the adolescents may also be linked to their perceived low Self-Efficacy of oral care, leading to perceived poor oral health and a need for treatment, which arising from "dentist stories" should ultimately lead to extraction and severe pain (Dodd *et al.*, 2014, Pham *et al.*, 2015). Their notion of dentists being synonymous with causing pain was also a recurring myth among the students in this study. This same finding has been documented in othercountries(Dodd *et al.*, 2014, Pham *et al.*, 2015). The fixation about dentists causing pain may not have been self-experienced as reported from some studies, which documented the origin of such erroneous claim as fables(Dodd *et al.*, 2014). The role of peers and the environment on adolescents' perspectives cannot be overemphasized. Fear, pain and apprehension are considered threats and untoward negative attitudes that are barriers to seeking dental care. Threat is a driving force that makes an individual to avoid its source (Witte and Allen, 2000). It can also be cues to negate the impact of any SBOHPP if not mitigated at the pre-intervention stage. This informed the mediatory steps introduced into the methodology stage by involving the students in data collection. Active involvement of students in health promotional activities has been recommended for its success (Biesbrock *et al.*, 2003a). Secondly, connecting or bonding with the students was another strategy at mitigating the fear of the dentist, as mirrored from a previous study(Dodd *et al.*, 2014). Some students were indifferent, they were both sad and happy displaying the negative and positive emotions

at the same time. All these were considered in designing the study so as to reinforce positive cues and mitigate threats for a successful intervention.

Most encouraging however, is the zeal of the students to gain knowledge about self-oral care. The acceptance of dentists as a choice source of dental knowledge by adolescents was previously reported by Pharm *et al.*,(2015). The zeal to gain knowledge about oral health can be considered as positive cue that should motivate participation of the students in the oral health programme instituted in schools. It could be an important peer factor capable of influencing participation in SBOHPP. Importantly, it may be a positive response to self-perceived low efficacy of oral care by the students.

Dental care service was perceived as a necessity by the adolescents. This was corroborated by the enthusiasm of some of the students who assumed that the visit of dentists to the schools was for dental treatment. While this was positive for some students in that they would be relieved of the dental pain they had been experiencing, some felt it would be a source of pain or they could be chastised by the dentists. The importance of school dental treatment as a promoter of dental care has been recognised by some adolescents (Dodd *et al.*, 2014).

The students considered oral health as important for survival. This could be related to eating being the major function ascribed to the oral cavity by the students. The role of diet in daily living is well established. Another function of importance ascribed to the oral cavity wassocial activity. This is consistent with what others had reported among adolescents (Dodd *et al.*, 2014, Pham *et al.*, 2015). Middle and late adolescence periods have been characterized by increased social interactions as the transition into adulthood is nearer (Sanders, 2013). In addition, the appearance of the teeth has been considered as a prerequisite for social life among adolescents (Stokes *et al.*, 2006). Confidence building, which is an attribute of social living among adolescents, was also an important benefit of good oral health as perceived by the students. The appearance of the teeth, amongst other reasons, was also mentioned as anessential part of oral health by adolescents (Dodd *et al.*, 2014). The students expressed the desire for improved oral health education, being their major expectation from the SBOHPP. This position of positive attitude towards oral health could only have stemmed from the confidence reposed in dentists.

In the same way, the students had confidence in the capability of the dentists in imparting tooth cleaning skills on them. Confidence in the person conducting the oral

health programme and credibility of the information as well as the activities of the programmes are important elements of oral health education that students subscribe to during oral health programmes (Östberg *et al.*, 2002). This has been associated with higher likelihood of success (Dodd *et al.*, 2014). The aforementioned also corroborate the need for disease prevention as indicated by the students. Skill imparting sessions and didactic oral health education were integral aspects of the intervention of this study.

Another self-perceived need of importance to the students was dental treatment.This doubly appeared as an expectation of SBOHPP. High unmet dental needs among adolescents in the city has been reported (Popoola *et al.*, 2015, Lawal and Oke, 2020) and may partly account for this. In addition, the financial implication of dental treatment and accessibility, among other factors, may also be responsible for the high desirability of dental care services in the schools. Dental care services were thus considered as an integral part of the intervention for this study. Students that were diagnosed with dental conditions were asked to visit a Primary Oral Health Care Centre within Ibadan metropolis for free treatment.

5.3 Perspectives of teachers about oral health

The responses by the teachers revealed their enthusiasm about SBOHPP. The data from this study also showed that the teachers considered the programme beneficial and a means of enlightening to the students. The positive attitude of teachers to school oral health programmes have been earlier documented (Stokes *et al.*, 2009). The teachers expressed readiness for the SBOHPP and suggested pathways to make the programme successful. Areas of major concern among the teachers included obtaining permissions and approvals from the appropriate authorities coupled with integrating the programme into existing co-curricular activities. The positive attitude of the teachers to the oral health programme is, therefore a positive cue to action that is encouraging to the institution of the programme. Other activities the teachers recommended for inclusionin the SBOHPP were self-oral care skills acquisition and teachers' involvement in the programme. The central role of teachers in school-based programmes has been emphasized (Lawal and Gbadebo, 2016, Priya *et al.*, 2019, Edomwonyi *et al.*, 2020, Tsai *et al.*, 2020). Another dominant sub-theme from the FGDs with the teachers was the presence of dentists in schools. The teachers seemed to hinge SBOHPP on dentists and blamed its non-existence on short supply of dentists (Lawal and Gbadebo, 2016). Another issue of prominence during the discussions was subsidy for dental care services.

Participants noted the limited access and huge cost of dental treatment. Other barriers to the oral health of the students that came to the fore in the discussions with the teachers included inadequate knowledge of oral health, financial constraints, misplaced priority of oral health, time factor and laziness of students in carrying out self-oral care. Limited knowledge of oral health is a public health challenge in most LMICs, including Nigeria (Sofola *et al.*, 2002, Sofola, 2010,Lawal and Taiwo, 2018,Lawal and Fagbule, 2020, Lawal and Oke, 2020). Financial constraints as a barrier to oral health can be alluded to the prominent roles the determinants of health play in achieving optimal oral health. (Michie *et al.*, 2011, Naghibi Sistani *et al.*, 2013, Michie *et al.*, 2014). Financial capability was an important determinant of health (Jurgensen and Petersen, 2009) while planning and implementing the interventions in this study as many of the study participants belonged to the lower occupational class. Consequently, the students were provided with toothbrushes and toothpastes to ensure they had tooth cleaning agents during the period of the study and minimizing inequalities that financial constraint could cause. In addition, the acceptability of chewing stick, which is a major tooth cleaning aid in this environment (Okoye and Ekwueme, 2011) was emphasized for sustainability purposes.

Another point of concern for the teachers was the prioritization of dental health. This appears to be the case in some developed countries where oral health promotion programmes are not mainstreamed into existing healthy schools' scheme(Stokes *et al.*, 2009). A proposal has been made by the WHO to integrate oral health into existing healthy schools (Jurgensen and Petersen, 2013). Dedicated time was another barrier highlighted by the teachers. Time is often considered essential if adequate and thorough self-care is to be conducted. In particular, the frequency and the duration of tooth cleaning as well as the time needed to access dental care services outside the school could pose a major constraint. Time factor was incorporated into the design of the intervention for this study.

Laziness in carrying out the recommended oral care measures was also a recurring barrier to oral care of the students. Low self-efficacy may be a contributing factor as well as lack of knowledge and skills (Östberg *et al.*, 2002, Dodd *et al.*, 2014, Pham *et al.*, 2015). The foundation for the interventions in this study was laid upon the strong themes that emerged from the FGDs with the teachers as well as the students.

5.4 Baseline oral health parameters of the students

The baseline oral health knowledge of participants in this study was very poor across the study groups and it was an indication of a generally poor oral health awareness of the students. Similar findings of poor oral health awareness among adolescents had been reported in this environment (Lawal and Fagbule, 2020, Lawal and Oke, 2020). Contrasting findings were, however, reported among adolescents in Sarawak, China (Lian *et al.*, 2010) where the mean score of oral knowledge was above the average. In addition, the level of awareness noted in the present study was poorer than that reported among adolescents in Shaanxi, Western China (Gao *et al.*, 2014). Relatively comparable oral health knowledge was reported among adolescents in Karachi, Pakistan (Haleem *et al.*, 2015) and in Ibadan, Nigeria (Lawal and Oke, 2020). The differences in the findings of the studies could be attributed to the variable level of oral health awareness in the different countries. The poor oral knowledge among adolescents noted in this study further corroborates the necessity for oral health promotion programmes for adolescents in the schools.

Baseline attitude score was also found to be low. Findings from this study differ from those reported in China and Pakistan (Lian *et al.*, 2010, Gao *et al.*, 2014, Haleem *et al.*, 2015) as adolescents studied in those countries had positive attitudes towards oral health. The sociocultural influences on health and oral health may account for these differences.

The oral health practices of the adolescents were also found to be suboptimal. Similar findings to this have been reported (Lian *et al.*, 2010, Gao *et al.*, 2014, Haleem *et al.*, 2015,Lawal and Taiwo, 2018, Lawal and Oke, 2020). Poor oral health practices observed among the adolescents may have been responsible for the unmet dental needs among them as reported previously in the country (Okeigbemen, 2004, Popoola *et al.*, 2015, Lawal and Oke, 2020, Ofili *et al.*, 2020).

Results of the baseline oral health status assessment of the students showed that the majority of the students had periodontal treatment needs and many of them had calculus accumulation. Similar findings to this have been reported by others in Nigeria (Popoola *et al.*, 2015, Lawal and Oke, 2020).

Oral hygiene status as evaluated by the OHI-S revealed that 36.1% of the students had good oral hygiene and many (60.3%) had fair oral hygiene status. This contrasts findings from Davangere (Vishwanathaiah, 2016) where over 70% of the adolescents had poor

oral hygiene at baseline of the study. Furthermore, in Albania, about 53.1% of the studied adolescents had good oral hygiene (Laganà *et al.*, 2015). The differences in the studies could be varying global distribution of disease burden as well as sociocultural factors.

Almost 40% of the study participants had gingival bleeding to probing. The proportion of students with gingival bleeding was similar (42%) to that reported in Kerala, India (Baiju *et al.*, 2019). It was, however, higher than that reported among adolescents (14.6%) in Moldova (Bilder *et al.*, 2021) and Kozhikode district, India with a proportion of 20.3% (Das *et al.*, 2017) and 23% in Turkey (Keles *et al.*, 2018). Conversely, a higher proportion of adolescents with gingival bleeding of 61.0% was reported from China (Chen *et al.*, 2018). The differences in the findings of the various studies could be attributed to the ages of the studied population in which the study participants with lower proportion of gingival bleeding as observed in Moldova belonged to the younger age group. Periodontal diseases have been shown to increase with age (Bendoraitienė *et al.*, 2017, Chen *et al.*, 2018). In addition, the differences may be attributed to varying burdens of the diseases across the globe; indicative of the need for prevention of periodontal diseases among adolescents.

The caries experience of the study participants was very low with a prevalence of 5.5% and mean DMFT of 0.08 (SD = 0.38). Much higher prevalence rates have been reported in Chile – 64.6% (Giacaman *et al.*, 2018) and in Turkey – 69.5% (Keles *et al.*, 2018). The mean DMFT scores in the aforementioned studies were 4.8 (SD =3.6) in Chile and 2.4 (SD = 2.5) in Turkey. All but five participants (5.1%) with decayed teeth in this study had missing teeth due to caries and none had a filled tooth, highlighting the high unmet dental needs despite the low prevalence of dental caries. This contrasts findings from more developed countries with results of dental care for dental caries in terms of filled teeth (Giacaman *et al.*, 2018, Keles *et al.*, 2018). The differences may be explained by the generally low prevalence and severity of dental caries in Nigeria, which has been recorded in the range of 0.4 – 1.3. (Akpata, 2004, Adekoya–Sofowora *et al.*, 2006, Umesi-Koleoso *et al.*, 2007, Adeniyi *et al.*, 2012a, Sofola *et al.*, 2014). In addition, most of the parents of the students belonged to the low social class, thus the students were less likely to have exposure to refined carbohydrates. Furthermore, the availability of fluoride containing toothpaste in the state, and in the country in general, may also be a confounding factor.

5.5 Effectiveness of the intervention on the oral health status

The study showed that there were positive effects of the intervention on the oral health parameters. There were positive changes in the knowledge of the adolescents in the intervention groupswhen compared to the controls. Studies (Goel *et al.*, 2005, Chapman *et al.*, 2006, Ajithkrishnan *et al.*, 2010, Shenoy and Sequeira, 2010, Chachra *et al.*, 2011, Hebbal *et al.*, 2011, Chandrashekar *et al.*, 2012, D'Cruz and Aradhya, 2013, Chandrashekar *et al.*, 2014, Damle *et al.*, 2014, Blake *et al.*, 2015, Haque *et al.*, 2016, Vangipuram *et al.*, 2016, Naidu and Nandlal, 2017) have showed improved oral health knowledge following professional instructions on oral health of in-school adolescents. Oral health education and promotion have been shown to improve the knowledge of adolescents about oral health (Tsai *et al.*, 2020). The effectiveness of the intervention could be associated with the duration of the programme, which was for a school year. The correlation of success rate to the period of intervention has been previously documented (Tsai *et al.*, 2020). In addition, the repetition and reinforcement of the intervention displayed in the study could have contributed to the improvements in the oral health knowledge observed. Repetition and reinforcements have been identified as important factors for improved OHK(Haleem *et al.*, 2015).

This study showed that the percentage changes in oral health knowledge in the peer-led, dentist-led, teacher-led and control groups were 69.3%, 87.1%, 56.0% and 6.9%, respectively. The percentage improvement reported in this study was higher than that reported among adolescents in Pakistan where percentage improvement noted ranged from 23% to 27% among similar groups (Haleem *et al.*, 2012b). The differences between the studies can be explained by the post-intervention follow up period, which was one year in the study by Haleem *et al.*, (2012b) compared to six months in the present study. In addition, it could be attributed to the age groups of the adolescents recruited, which were 14 to 18 years (middle to late adolescence) in the present study compared with 10 to 11 years (early adolescence) in the previous study conducted in Pakistan (Haleem *et al.*, 2012b). The dentist-led SBOHPP strategy had the highest effect on oral health knowledge, which contrasts findings from a previous study (Haleem *et al.*, 2012b) where there was no significant difference between the three intervention groups. In that study, the peer-led group had a slightly better improvement in oral health knowledge. A slightly higher effectiveness of peer-led strategy over dentist-led strategy was also observed in India (Vangipuram *et al.*, 2016). The effectiveness of peer-led method in improving

health knowledge over adult-led strategies has also been reported by Mellanby*et al.*,(2000). The positive influence of teacher-led methods on oral health knowledge of adolescents has equally been reported (Chandrashekar *et al.*, 2012). Likewise, the effectiveness of dentist anchored oral health programme has been reported by some authors(Vanobbergen *et al.*, 2004, Haleem *et al.*, 2012b).The effect sizes of the SBOHPP strategies was moderate for the intervention groups and low for the control group. The first hypothesis, which was the null hypothesis,was thus rejected and the alternate hypothesis accepted due to the differences observed in the oral health knowledge among the study groups post-intervention.

Attitude towards oral health of the students was also found to be positively impacted upon by the intervention. None of the SBOHPP strategies in the present study was found superior to the others in terms of attitude change as indicated by the Bonferroni correction. The peer-led and teacher-led methods were found equally as effective as the dentist-led methodin improving the attitude of the students to oral health. Oral health programmes conducted by peers, dentist and teachers were found to improvethe attitude towards oral health among adolescents (Vanobbergen *et al.*, 2004, Haque *et al.*, 2016, Vangipuram *et al.*, 2016, Priya *et al.*, 2019, Tsai *et al.*, 2020). The percentage mean changes in the three intervention groups ranged from 127.4%, 135.1% and 131.5% in the peer-led, dentist-led and teacher-led groups, respectively. Comparatively, the improvement in the control group was 11.5%. The mean percentage changes observed in the intervention groups in this study were higher than those reported in Bengaluru (Vangipuram *et al.*, 2016). The differences in the two studies may be as a result of the additional promotional activities included in the present study that were not incorporated into the study in Bengaluru. The effect size of the improvement observed in the intervention groups was found to be large, and significantly different from the control group indicative of the positive influence of intervention. The quest for knowledge and the confidence reposed in the dentists visiting their schools as well as involvement of the students during baseline data collection may be contributory to the findings. Based on these findings, the null hypothesis was rejected as there were differences in the attitude towards oral health among the study groups following the intervention.

The oral health practices of the respondents in the intervention groups also improved over the course of intervention compared to the control group. The dentist-led group had thehighest improvement when compared with other groups. This may be attributed to the

fact that dentists are well trained in the required skills, which would, necessarily, be superior to those of non-dentists. The effect size of the strategies was found to be moderate and encouraging. The dentist-led method had previously been reported to have abetter influence on oral health practices than the other strategies (Haleem *et al.*, 2012b,Haleem *et al.*, 2015). In the present study, the mean percentage changes in oral health practices were 27.3%, 36.2%, 22.3% and 7.3% in the peer-led, dentist-led, teacher-led and control groups, respectively. The findings are similar to the results on oral health behaviour (30% – 37%) documented among adolescents in similar intervention groups, at post-intervention in Pakistan (Haleem *et al.*, 2012b). Positive change in oral health practices of adolescents following school-based interventions have been reported by some others (Vanobbergen *et al.*, 2004,Yang *et al.*, 2009, Yazdani *et al.*, 2009, Sushanth *et al.*, 2011,Haleem *et al.*, 2012b, Yekaninejad *et al.*, 2012b, Vangipuram *et al.*, 2016, Wickremasinghe and Ekanayake, 2017, Tashiro *et al.*, 2019,Villanueva-Vilchis *et al.*, 2019, Tsai *et al.*, 2020). The dentist-led strategy had the highest improvement, similar to findings by (Srivastava *et al.*, 2016), who reported that the dentist-led oral health education method was more effective than the teacher-led method. Contrasting finding was, however, noted by Haleem*et al.*, (2012b) who reported that the peer-led method was the most effective when it was compared with the teacher-led and dentist-led strategies. The differences between the findings of the studies may be attributed to the fact that many students believed the dentists had superior skills when it comes to the teeth and oral cavity in general because of their profession. This was opined by many students in the post-intervention study FGD as a deterrent to preference for other strategies. The peer-led group was, however, the best at improving oral health practices in Pakistan, possibly due to the one on one interaction and influence that exists among the peers. On the other hand, in this study, the students reported dominance and chastisement of peers as a threat to acceptance of peer-led SBOHPP, which was iterated in the FGD. Although there was improvement in the peer-led group, the threat envisaged or experienced by some peers may have deterred some of the adolescents from participating fully in the programme in the group. Albeit the selection of the peers involved both the students and the teachers, it is not uncommon that peer bullying may occur from others who believed they are superior in knowledge and skills. In view of the findings, the null hypothesis was rejected and the alternate hypothesis accepted as there were differences in practices of the students in the study groups.

The oral health status of the adolescents was positively affected by the SBOHPP. The periodontal treatment needs were reduced in the intervention groups when compared to the control group. Improved periodontal treatment needs following an educational intervention was also reported among adolescents in the intervention group in Taiwan (Lai *et al.*, 2016). The reasons for these findings could be as a result of increased motivation of the students through the health education programmes; thus, improved oral hygiene practices by the students as recorded in the results. In addition, it can be ascribed to the availability of free dental care services and its utilization by them. The positive influence of school oral health education programme on utilization of dental care services by adolescents has been documented(Lai *et al.*, 2016). The dentist-led strategy had a large effect size while the teacher-led strategy had a moderate effect size and the peer-led strategy had a small effect size. The control group had a small effect size. This shows the relative superior effectiveness of the dentist-led strategy at improving the periodontal treatment need over the other strategies. In addition, the intervention groups were better than the control groups, thus the null hypothesis was rejected and the alternate hypothesis accepted.

The oral hygiene status of the participants in the intervention groups improved over the course of the study. The positive effect of school-based oral health interventions on oral hygiene of adolescents is consistent with findings in dental literature (Laiho *et al.*, 1993, Haleem *et al.*, 2012b, Lai *et al.*, 2016, Priya *et al.*, 2019). At variance is a review that reported a temporary effect of oral health education on oral hygiene, lasting till just after the intervention (Kay and Locker, 1997). Also, at variance are studies reporting no effect on oral hygiene status on long-term (van Palenstein Helderman *et al.*, 1997, Frencken *et al.*, 2001) or short-term bases (Angelopoulou *et al.*, 2015). Conversely, studies have reported improvement of oral hygiene after a period of three and half as well as 10 years after school-based intervention (Lai *et al.*, 2016b). The differences in the studies can be alluded to the duration of the interventions as well as repetition and reinforcement of the promotional activities, which was utilized in this study as previously described (Haleem *et al.*, 2012b, D'Cruz and Aradhya, 2013, Srivastava *et al.*, 2016). The effect size of the intervention after a six-month follow-up period was large for the dentist-led and teacher-led groups but small for the peer-led group. This was however, not the case in Pakistan, where minimal effect of the oral health education intervention was observed on calculus accumulation among adolescents (Haleem *et al.*, 2012b). The differences in the studies

can be ascribed to the inclusion of dental care services as part of the intervention in this study and its non-inclusion in the former study. Accessibility to free dental care services by the students was mandated in this study based on the framework of the health promoting schools (WHO, 1997a, Kwan *et al.*, 2005) in addition to its desirability by students during the pre-intervention FGDs. The dentist-led strategy achieved the highest improvement in oral hygiene status compared to the other two strategies, similar to a previous study in Pakistan (Haleem *et al.*, 2012b). Contrasting findings to this were reported in Bengaluru, where comparative effectiveness of the strategies among adolescents revealed that the peer-led group had better plaque control compared to the dentist-led group (Vangipuram *et al.*, 2016). Whereas in Greece, the relative effectiveness of experiential intervention conducted by teachers was positive compared to the traditional dentist-led method, which recorded no effect post intervention (Angelopoulou *et al.*, 2015). In India, the teacher-led and dentist-led strategies were comparable in terms of debris index score (John *et al.*, 2013), although the study was conducted among pre-schoolers. Context, may be an important factor responsible for the different findings in the studies, although the dentist-led strategy was the most effective in this study other strategies also resulted in improvements in the oral hygiene status. Teachers, if they have adequate knowledge of the matter, are professional to pass the message to pupils, which may be better than the dentist. The dentists, in the present study, are trained community dentists, who are better able to pass the knowledge, attitude and practices of oral health to the adolescents.

Gingival health of the students improved over the study period. This is similar to findings from other studies post-interventions (Biesbrock *et al.*, 2003, Vanobbergen *et al.*, 2004, Tai *et al.*, 2009a). The percentage mean changes in sextants free of gingival bleeding observed in the three intervention groups ranged from 46.9% to 68.2%. A 10% improvement was also noted in the control group, although this was not statistically significant. The percentage mean changes in the intervention groups in the studywere higher than that reported in Pakistan (Haleem *et al.*, 2012b), where a reduction of 5-12% was reported in the three intervention groups. Utilization of free dental services by the students and provision of toothbrushes and toothpastes for the students may have contributed to the higher improvements reported in this study. The dentist-led strategy showed the highest improvement, the peer-led strategy was comparable and the teacher-led strategy had the least improvement of the three intervention groups. This finding

contrasts findings by other authors where the teacher-led group was found most effective at improving gingival health among 15-year olds in Nalgonda, India (Chandrashekar *et al.*, 2014). The use of teachers as resource persons for oral health promotion has been based on their communication and teaching skills, and ready availability in schools making regular assessments and encouragement of the students easier than in other methods(Chandrashekar *et al.*, 2012). On the other hand, lack of time and heavy workload are peculiar reasons for lower effectiveness of teachers as opined by Nyandindi *et al.*,(1996) and by students and teachers in this study from the FGD. The effectiveness of peer-led strategy has been attributed to peer pressure, time factor and peer interaction especially in a friendly environment (Snyder *et al.*, 2016). The null hypothesis is therefore rejected based on the findings that there were differences in the gingival health of the study participants across the study groups and the alternate hypothesis is hereby accepted.

The study showed that the intervention had positive effects on the caries experience of the students.Similar result observing reduced caries experience was documented in Taiwan (Lai *et al.*, 2016b), in Portugal (Bica *et al.*, 2015) and India (Gauba *et al.*, 2013). The result however, differs from some other studies (van Palenstein Helderman *et al.*, 1997, Ajithkrishnan *et al.*, 2010, Bhardwaj *et al.*, 2013, Chandrashekar *et al.*, 2014), where no effect on the number of carious teeth among participants in the intervention groups was reported. Contrary and inconclusive result was documented in Zimbabwe following a 3.5year health education programme among adolescents (Frencken *et al.*, 2001). The differences in the studies have been ascribed to the duration of study and follow up (Tsai *et al.*, 2020). Studies with shorter duration did not provide adequate time to allow for the observation or initiation of carious lesions (Tsai *et al.*, 2020). Also, health promotional activities have been documented as contributory factors to success since oral health education (alone) programmes were found less effective in reducing caries experience among participants (Gauba *et al.*, 2013, Tsai *et al.*, 2020). More so, some of the studies that reported no change in number of decayed teeth did not include other health promotional activities to oral health education. In addition, a study alluded the reduction in the number of decayed teeth among participants to utilization of dental services coupled with health promotional activities; and an increased number of filled teeth was documented (Al-Jundi *et al.*, 2006). In the present study, the reduction in the number of decayed teeth can be explained in part by the free dental services made

available to the students in addition to other health promotional activities, which included health education, supportive school personnel and cues to actions. This was further supported by increased number of missing teeth due to caries observed among the study participants. A slight insignificant reduction in number of decayed teeth was noted among students in the control group in this study, although they were also referred for free dental care. Low certainty evidence was reported on the effectiveness of dental screening and referral for dental care on oral health (Arora *et al.*, 2019). The dentist-led strategy was the most effective in this study; other strategies also resulted in improvements of the oral health status of the adolescents. The null hypothesis was therefore, rejected based on the findings that there were differences in the oral health status of the study participants across the study groups thus, the alternate hypothesis was accepted.

5.6 Relative effectiveness of school-based oral health promotion strategies on the OHRQoL of students.

The COHIP-SF 19 scores were associated with the self-rating of oral condition and satisfaction with dental condition of adolescents. Higher scores (better quality of life) were associated with good rating of oral health and satisfaction with dental condition. Thus, the COHIP-SF 19 has a good convergent validity similar to findings in other settings where the instrument had been validated (Broder *et al.*, 2012, Arheiam *et al.*, 2017, Nuraini *et al.*, 2021). The Cronbach alpha value of COHIP-SF 19 was 0.873, a value above the minimum recommended value 0.7 (Streiner *et al.*, 2015), ascertaining its internal consistency and reliability of the measure. In addition, the Cronbach alpha value was reduced each time an item (question) was deleted depicting that all the questions are important for the measure. The measure does not exhibit ceiling or floor effects as the lowest score obtained was 9 and only 6.3% had the highest score of 76. Ceiling and floor effects have been described as record of greater than 15% of participants with the maximum score of the measure (ceiling effect), which was 76 or minimum score (floor effect), which in this case was 0 (Terwee *et al.*, 2007). The COHIP-SF 19, is thus a valid OHRQoL tool with acceptable psychometric properties in this environment. The validity and reliability of COHIP-SF 19 has been documented in other parts of the world (Broder *et al.*, 2012, Arheiam *et al.*, 2017, Nuraini *et al.*, 2021).

At baseline the impact of oral conditions on the QoL was high with over 90% reporting at least an impact on OHRQoL. This is higher than the impact of OHRQoL previously

reported among adolescents in this environment: 21.1% among those aged 9 – 12 years (Lawal and Oke, 2021), 21.4% among ages 6 – 15 years (Lawal and Bankole, 2019), 41.4% in those aged 10 – 13 years (Lawal and Dauda, 2017) and 51.5% among ages 13 – 15 years (Lawal and Ifesanya, 2017). Lower values of 57.4% – 67.9% were also reported among 16 – 19-year-old Albanian adolescents (Thelen *et al.*, 2011) and 57.8% – 60.8% in 10 – 11-year-old Malaysian adolescents (Yusof and Jaafar, 2012). The varying distribution of oral diseases as well as the age of the study population may be responsible for the differences observed. Older adolescents have been shown to be more conscious of their health compared to younger age groups (Sanders, 2013), leading to a higher likelihood of reporting negative effects of health conditions on them. This finding may also be explained in part by toothache being the most frequently reported item of the COHIP-SF 19 measure resulting in the desirability of the adolescents for accessible oral health care services and its utilization during the intervention. Toothache has been widely reported as the commonest reason for utilisation of dental care services in this environment.

There were improvements in the OHRQoL of the study participants post intervention. Although there were improvements in all the groups, it was not statistically significant at bivariate level in the peer-led, teacher-led and control groups. It however, became significant when adjusted for the clustering effect and the oral hygiene status in the multivariate analysis in the peer-led group. Positive effect of school-based interventions on the OHRQoL of adolescents in Brazil (Carvalho *et al.*, 2013) and Malaysia have been reported (Yusof and Jaafar, 2013b). The contribution of oral health education supplemented with availability of dental treatment was emphasized in the present study, more so, participants in the "oral health education only" group experienced no improvement in their OHRQoL (Carvalho *et al.*, 2013, Lattanzi *et al.*, 2020). This could, partly, explain the findings in the present study as the peer-led and dentist-led groups had more students utilizing dental services compared to the teacher-led group. It, therefore, becomes important to incorporate oral health care services into oral health promotional programmes in the schools to increase the probability of improving the OHRQoL of the participants. In addition, consideration of mobile dental services for the schools could be worthwhile. The null hypothesis was, therefore, rejected and alternate hypothesis accepted as there were differences among the groups as it relates to the effect of the SBOHPP on the quality of life of the adolescents.

5.7 Acceptability of the three different SBOHPP strategies to the students

The FGDs post-intervention showed that the students had positive feelings towards SBOHPP and accepted the different strategies instituted in their schools. The dentist-led was preferred based on their experiences and professional skills. Some of the students expressed disappointment at the programme being restricted to their class with students in other classes (junior classes) not benefitting from it. This is a description of stewardship among the students and a positive attitude that could be utilized in SBOHPP, whereby senior students can be trained to anchor oral health programmes in their classes as well as among junior students in the school. The students opined that they benefitted from the programme, which was also corroborated by the improvements recorded in the oral health knowledge, attitude and practices as well as in the oral health status and OHRQoL.

The disciplinarian nature of teachers and possible chastisement if the students are not compliant with instructions were mentioned as reasons for non-preference of the teacher led strategy by some students. Lack of time was also mentioned by the students. The heavy workload of teachers and tight school schedule, resulting in lack of time, have been mentioned as barriers to effectiveness of oral health education by teachers (Nyandindi *et al.*, 1996).

Peer bullying was a factor that mitigated against preference for the peer-led strategy, in spite of its effectiveness. The dentist-led method was also not spared as some students cited the lack of time and being rebuked by dentists, when they manifest poor oral health status, as reasons for not being keen about it. All the perspectives highlighted by the students are factors that should be considered when any of the strategies are planned for SBOHPP. More so, none of the strategies was outrightly rejected by the adolescents and evidence from the quantitative phase of the study showed that all the strategies were effective in improving the oral health of the adolescents.

5.8 Acceptability of the three-different SBOHPP strategies by the teachers

The teachers' perspective of the SBOHPP was positive and in agreement with the views of the students. This finding is consistent with a qualitative study conducted post intervention in Australia, in which the teachers opined a need for school oral programme as well as commended its positive impact (Dimitropoulos *et al.*, 2019). The teachers would prefer a continuum of the programme, similar to findings from a previous study

where the teachers advocated making a school toothbrushing programme routine (Dimitropoulos *et al.*, 2019). Inclusion of oral health care services was also mentioned by the teachers as a basic need for both teachers and students. This is consistent with a previous study where teachers advocated for the inclusion of preventive oral health into the school curriculum of adolescents (Vishwanathaiah, 2016). Integration of dental care services into existing primary health care services to simulate that instituted in this study may go a long way to address the non-accessibility to oral health care in schools (Carvalho *et al.*, 2013). The teachers accepted the three strategies and suggested the combination of methods for a more successful outcome. The findings show a need for a proactive national oral health policy. The role of policy becomes important in the inclusion of oral health into existing curriculum. In addition, the institution of health promoting school may address many of the issues pertaining to oral health care. In addition, establishing network with other sectors such as toothbrush and toothpaste producing industries among others may also assist in the quest for better oral health and overall health of adolescents and, by extension, the populace.

5.9 Limitation of the study

The study,although with strengths, also presented with limitations as stated below:

1. Students recruited for this study were from public schools in the city. This may affect generalizability of the findings to all students in the city as private schools were excluded. However, students from private schools are more likely to be from higher social classes who have been shown to exhibit greater improvements in oral health following health promotional interventions. In addition, the burden of unmet dental needs has been shown to be higher among adolescents from low social classes who have little access to health information among others and are mostly seen in public schools.
2. Different resource persons were trained to anchor the oral health promotional programmes in the schools. Although the training was standardized and selection of the resource persons was based on specific criteria, it is not impossible that factors such as efficiency and communication skills could have influenced the delivery of the health education and other oral health promotional activities. However, the study was designed to be as pragmatic as possible to simulate real life situations in the schools.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

This study investigated the effectiveness of the peer-led, dentist-led and teacher-led oral health promotion strategies at improving oral health and oral health related quality of life of adolescents in public secondary schools in Ibadan, Nigeria.

6.1 Conclusions

The following conclusions were drawn from the findings of the study.

- At baseline there were mixed perspectives about the importance of oral health and dentists' presence in school.
- Almost all the students were interested in school oral health programme.
- The students desire dental care service.
- The teachers in the school were enthusiastic about the school oral health programme.
- At baseline poor oral health knowledge, attitude and practices existed among the students.
- There was also high periodontal treatment need observed among the adolescents, which was indicative of need for oral health promotion.
- There was low prevalence of dental caries but high burden of untreated dental caries among participants.
- The impact of oral health on the quality of life of participants was also high affecting all the domains of quality of life.
- Post intervention, there was a positive change in the oral health knowledge, attitude and practices of students in the three intervention groups compared to the control group.
- Students in the dentist-led group had the highest change in oral health knowledge and practices, while the three groups were comparable in terms of attitude towards oral health.

- There was improvement in the oral health status of the students in the three intervention groups, with the highest improvement in the dentist-led group.
- There was improvement in the OHRQoL of the students in the three intervention groups and the greatest improvement was in the dentist-led group.
- Post intervention, the perspectives of the students changed positively and many reported gaining from the programme.
- Students expressed disappointment that those from other classes did not benefit from the programme and would appreciate extension of the programme to them.
- The teachers believed the students have gained from the programme and would appreciate a continuum.
- The preference of students for the different strategies varied. While some would prefer the dentist-led strategy, others preferred teachers or the peer-led strategy.
- Disciplinarian nature of teachers and chastisement were major reasons for non-preference of teachers.
- Dominance of peers and chastisement were reasons for non-preference of peers mentioned in the study.

6.2 Contribution to knowledge

- The research provided evidence of the effectiveness of SBOHPP in improving the oral health status of in-school adolescents.
- The research demonstrated the improvement in OHRQoL of in-school adolescents by the institution of a SBOHPP.
- The work showed that the dentist-led strategy for SBOHPP was the most effective method of reducing the unmet burden of oral diseases among in-school adolescents.
- The research revealed the comparability of peer-led and teacher-led strategies to the dentist-led approach, and confirmed the utilityof using those strategies to replace or complement the dentist-led approach especially in settings with inadequacy of dentists.

6.3 Recommendations

The following recommendations are made based on the findings of this study.

1. Peer-led and teacher-led interventions could effectively support or replace dentist-led method in SBOHPP.
2. Integration of oral health programme into the existing curriculum of schools.
3. Implementation of the oral health policy could take into consideration the tested non-dentist led strategies to safely replace or complement the dentist-led oral health promotion strategy in school oral health promotion for wider coverage.
4. Integration of oral health education into the training of teachers is advocated.
5. Teachers should undergo regular training in oral health care with reinforcement by dentists.
6. Periodic training of peers by dentists should be encouraged to complement school-based oral health promotion programmes.
7. Development of networks between the school personnel, dental health professionals and the government for sustainability of school-based oral health programme.
8. Dental health professionals should collaborate with toothbrushes and toothpaste manufacturing companies to provide toothbrushes and toothpastes for free or at a concessional price to students in schools periodically to address this social determinant of health.
9. Dental care services can be integrated into existing primary health care centres located close to schools in view of the high cost of setting up school dental clinics in LICs.
10. Mobile dental clinics subsidized by the government could be provided in schools to address the unmet dental needs that already exist.

6.4 Practical implications

The results of this study can be utilised by public health dentists and health educators in schools and other settings to improve the oral health of adolescents and children.

The findings of this study will help policy making and advocacy for improved health among adolescents.

6.5 Future implications

Based on the findings of the study, future implications are listed below.

- Additional research is required for long term effects of the strategies to further validate the sustainability of using non-dentists for oral health promotion in schools.
- Conducting similar studies in different parts of the states including private schools to confirm the generalizability of the findings.
- Evaluating the cost effectiveness of the various strategies will provide additional evidence for the appropriateness and economic viability of the strategies for the local context.
- Research with interventions that would involve the family of students may be explored to investigate the role of the family in the oral health of older adolescents.

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APPENDICES

APPENDIX IA - INFORMED CONSENT FORM (PARENTS/GUARDIANS)

INFORMED CONSENT (PARENT/GUARDIAN)

I am Dr.F.B. Lawal, a PhD studentat the University of Ibadan.

I am using this opportunity to invite your child/ward to participate in a study designed to know if oral health promotion activities conducted in schools for one school year will make our children knowledgeable about their oral health as well as if this can prevent tooth decay and diseases of the structures that hold the teeth in place in the mouth. This will involve asking each child, questions about their oral health and examining his/ her mouth by looking into your child/wards mouth to detect tooth decay and any of the diseases of the structures that support the teeth in the mouth at the beginning and at the six months after the oral health activities of the study. Examination of the mouth is not painful and if any dental/oral diseases are found in your child/wards, he/she will be appropriately referred to the dental clinic for free treatment.

I want to assure you that any information I get from asking questions or from examining your child's mouth will be kept in confidence and your child's name shall not be indicated at all. This study is for a period of three terms and it will not disturb your child/ ward's education in any way.
You are free to decline your child/ward's participation and if you agreed that your child/ward should participate, you can withdraw your child/ward from the study if you so desire. However, I greatly appreciate your allowing your child/ward participate.

Consent

……. **……..**

Signature/Thumbprint of Parent/Guardian **Interview Date**

APPENDIX IB-TRANSLATED QUESTIONNAIRE INTO YORUBA LANGUAGE

KIKOPA NINU ISE IWADI (OBI/ALAGBATO)

School Oral Health Promotion

Department of Periodontology & Community Dentistry
University of Ibadan and University College Hospital, Ibadan, Nigeria

Dr F.B. Lawal
Phone: 0813 173 3311
Email: fblawal@com.ui.edu.ng
Website: http://www.com.ui.edu.ng

Eyin Obi wa,

Kikopa ninu ise iwadi

Oruko mi ni Dokita F.B. Lawal. Mo je dokita ti o n se itoju enu ati eyin ni ile itoju eyin Oritamefa Ibadan. Mo nfi asiko yi ro yin lati je ki omo yin kopa ninu iwadi ti a nse lati mo boya idani leko nipa itoju eyin ati enu ti a ba se ni ile-iwe le je ki awon omo wa ni imo nipa ilera eyin ati enu ati pe boya o le dena aarun eyin rira (iho ninu eyin) ati arun erigi/awon ohun ti o gbe eyin duro ninu enu wa.
A o beere oro lowo omo kookan nipa eyin ati enu lehin yii ni a o ye enu won wo lati mo boya won ni eyin ti o ti jera ati arun erigi tabi awon ohun ti o gbe eyin duro ninu enu ni ibeere ati opin iwadi yii. Ayewo yi ko ni mu irora tabi wahala kankan dani rara fun olukopa.Olukopa ti a ba ri ti o ni arun eyin tabi erigi yi ni a o tosona bi o se le ri itoju ni ile iwosan wa.
A ti se eto lati ri pe oruko awon olukopa ko ni farahan fun idanimo. Anfaani wa fun olukuluku obi tabi alagbato lati gba ki omo re kopa tabi lodi lati jeki omo re kopa ninu ise iwadi yi. Iwadi yii wa fun asiko taamu meta ko si ni di eko omo wa lowo ni ona kona.
Ore ofe si tun wa lati kuro ni igbakugba ti olukopa ba fi iru ero yii han laisi ikunsinu tabi ifiyajeni kankan bi o ti wu ki o ri. E se lopolopo.

Fifi owo si iwe
Niwon igbati won ti se alaye lekunrere nipa ise iwadi yi, mo gba lati je ki omo mi ti oruko re n je

---------- kopa ninu eto idanileko yii.

---------- ----------

Fifi owo si iwe Obi **Ojo/Osu/Odun**

APPENDIX IC - INFORMED CONSENT FORM (TEACHERS)

INFORMED CONSENT (TEACHERS)

I am Dr.F.B. Lawal, a PhD studentat the University of Ibadan.

I am using this opportunity to invite you to participate in a study designed to know if oral health promotion activities conducted in schools for one school year will make our children knowledgeable about their oral health as well as if this can prevent tooth decay and diseases of the structures that hold the teeth in place in the mouth. This will involve asking you questions about oral health.

I want to assure you that any information I get from asking questions from you will be kept in confidence and your name shall not be indicated at all. This study is for a period of three terms and it will not disturb your school activities in any way.
You are free to decline participation and if you agree that you would participate, you can withdraw from the study if you so desire. However, I greatly appreciate your taking part in the study.

Consent

……. **……..**

Signature of Teacher **Interview Date**

APPENDIX II - LETTER OF ASSENT AND CONSENT FOR STUDENTS

ASSENT (STUDENT)

I am Dr.F.B. Lawal, a PhD studentof the University of Ibadan.

I am using this opportunity to invite you to participate in a study designed to know if oral health promotion activities conducted in schools for one school year will make our students knowledgeable about their oral health as well as if this can prevent tooth decay and diseases of the structures that hold the teeth in place in the mouth. This will involve asking each student, questions about their oral health and examining his/her mouth by looking into your mouth to detect tooth decay and any of the diseases of the structures that support the teeth in the mouth at the beginning and at six months after the last oral health promotional activities. Examination of the mouth is not painful and if any dental/oral diseases are found in your mouth, you will be appropriately referred to the dental clinic for free treatment.

I want to assure you that any information I get from asking you questions or from examining your mouth will be kept in confidence and your name shall not be indicated at all. This study is for a period of three terms and it will not disturb your education in any way.

You are free to decline your participation and if you agree that youwould participate, you can withdraw from the study if you so desire. However, I greatly appreciate your taking part in the study.

Consent

……. **……..**

Signature of student and Name **Interview Date**

…….
Witness

CONSENT (STUDENT)

I am Dr.F.B. Lawal, a PhD studentof the University of Ibadan.

I am using this opportunity to invite you to participate in a study designed to know if oral health promotion activities conducted in schools for one school year will make our students knowledgeable about their oral health as well as if this can prevent tooth decay and diseases of the structures that hold the teeth in place in the mouth. This will involve asking each student, questions about their oral health and examining his/her mouth by looking into your mouth to detect tooth decay and any of the diseases of the structures that support the teeth in the mouth at the beginning and at six months after the last oral health promotional activities. Examination of the mouth is not painful and if any dental/oral diseases are found in your mouth, you will be appropriately referred to the dental clinic for free treatment.

I want to assure you that any information I get from asking you questions or from examining your mouth will be kept in confidence and your name shall not be indicated at all. This study is for a period of three terms and it will not disturb your education in any way.

You are free to decline your participation and if you agree that youwould participate, you can withdraw from the study if you so desire. However, I greatly appreciate your taking part in the study.

Consent

……. **……..**

Signature of student and Name **Interview Date**

APPENDIX III

Focus group interview guide -Students (pre-intervention)

Good afternoon everybody. Thank you for meeting with me today. My name is Folake Lawal and I am a PhD student from the University of Ibadan. Today I will like to explore your views about the importance of oral health and oral health promotion activities in schools. The interview will take about 30 to 60 minutes. I have some specific questions to ask but please feel free to tell me more or provide additional information. Your participation will assist us in evaluating and making improvements to school oral health program. Your answers to my questions will be kept confidential and will not be shared with anyone outside the research team. We will not use your name in any reports or publications. Do you have any questions? I will like to record the interview in order to ensure we capture all the details. Is it alright if I record? Can we proceed PLEASE? Thank you so much.

QUESTIONS

1. How do you feel when you saw the letter of invitation that I will be talking to you about oral health?
2. When you received the letter of invitation that I will be talking to you about oral health, what do you think?
3. How important to you is the health of your teeth and mouth?
4. Does taking the health of the teeth and mouth seriously of any benefit?
5. Has anyone taught you about how to clean your teeth and mouth?
6. What are the barriers to good health of the mouth and the teeth?
7. What do you think about organizing a school programme on the health of the teeth and mouth?
8. What are your expectations about any school programme for the health of the teeth and the mouth?

Focus group interview guide for Teachers (pre-intervention)

Good afternoon mas/sirs. Thank you for meeting with me today. My name is Dr Folake Lawal, a PhD student and a lecturer from the University of Ibadan. Today I will like to explore your views about the importance of oral health and oral health promotion activities in schools. The interview will take about 30 to 45 minutes. I have some specific questions to ask but please feel free to tell me more or provide additional information. Your participation will assist us in evaluating and making improvements to school oral health program. Your answers to my questions will be kept confidential and will not be shared with anyone outside the research team. We will not use your name in any reports or publications. Do you have any questions? I will like to record the interview in order to ensure we capture all the details. Is it alright if I record? Can we proceed PLEASE? Thank you so much.

QUESTIONS

1. How do you feel when you knew that I will be talking to you about oral health?
2. When you knew that I will be talking to you about oral health, what do you think?
3. How important to you is the health of your teeth and mouth?
4. Does taking the health of the teeth and mouth seriously of any benefit?
5. What are the barriers to good health of the mouth and the teeth?
6. What do you think about organizing a permanent school programme on the health of the teeth and mouth?
7. What are your expectations about any school programme for the health of the teeth and the mouth?
8. What should be the outcome of any school programme on the health of the teeth and the mouth?
9. What things will make a school oral health programme work/function and come to stay.

Thank you so much.

Focus group interview guide for students(post-intervention)

Good afternoon everybody.

Thank you for meeting with me today. I amDr FB Lawal. I am a PhD student and a lecturer from the University of Ibadan. Today I will like to explore your views about the importance of oral health and oral health promotion activities in schools. The interview will take about 30 to 60 minutes. I have some specific questions to ask but please feel free to tell me more or provide additional information. Your participation will assist us in evaluating and making improvements to school oral health program. Your answers to my questions will be kept confidential and will not be shared with anyone outside the research team. We will not use your name in any reports or publications. Do you have any questions? I will like to record the interview in order to ensure we capture all the details. Is it alright if I record? Can we proceed PLEASE? Thank you so much.

QUESTIONS

1. How do you feel when you saw the letter of invitation that I will be talking to you about oral health after the first interview?
2. When you received the letter of invitation that I will be talking to you about oral health, a second time, what do you think?
3. Do you think you have enough information about the health of your teeth and mouth?
4. Has anyone taught you about how to clean your teeth and mouth?
5. What are the barriers to good health of the mouth and the teeth?
6. What do you think about the school programme on the health of the teeth and mouth?
7. Did the school programme for the health of the teeth and the mouth meet your expectations?
8. Do you think the programme is helpful in any way?
9. Which of these programmes do you prefer and why, students anchoring the programme, dentists doing so or the teachers anchoring the programme?
10. Why do you not prefer the other programmes mentioned above.

Thank you so much.

Focus group interview guide for teachers (post-intervention)

Good afternoon mas/sirs. Thank you for meeting with me today. My name is Folake Lawal, a PhD student and a lecturer from the University of Ibadan. Today I will like to explore your views about the importance of oral health and oral health promotion activities in schools. The interview will take about 30 to 45 minutes. I have some specific questions to ask but please feel free to tell me more or provide additional information. Your participation will assist us in evaluating and making improvements to school oral health program. Your answers to my questions will be kept confidential and will not be shared with anyone outside the research team. We will not use your name in any reports or publications. Do you have any questions? I will like to record the interview in order to ensure we capture all the details. Is it alright if I record? Can we proceed PLEASE? Thank you so much.

QUESTIONS

1. What do you think of school programme for the health of the teeth and the mouth?
2. Do you think the students have benefitted from the programme in your school?
3. What are these benefits?
4. What are the barriers to a school oral health programme that you have noticed in your school?
5. What things will make a school oral health programme work/function and come to stay.
6. Which of these styles/ methods of teaching will you prefer most? Teachers trained by dentists teaching the students, peers trained by dentists teaching other students or Dentists coming to teach the students themselves
7. What are the reasons for your preference?
8. Why will you not prefer the other methods? Please take each method; one by one

APPENDIX IV

Questionnaire

Dear students,

This questionnaire is designed to assess your knowledge, attitude and practices as it relates to oral health. Your honest answers will be treated with upmost confidentiality. Thank you.

---------- signature

1. Serial number ----------
2. School name ----------
3. Date of data collection ----------
4. Trial arm 1) I 2) II 3) III 4) IV
5. Age as at last birthday ----------
6. Gender 1) Male 2) Female
7. Father's Occupation----------
8. Father's level of education----------
9. Mother's occupation----------
10. Mother's level of education----------
11. Have you been educated about your oral health in school 1) Yes 2) No
12. If Yes, who did?----------
13. If yes to Q21, who educated you?----------

Oral health Knowledge

14. What is the total number of teeth in a grown child?----------
15. How many teeth should an adult have ?----------
16. Write any three functions or uses of the teeth 1.----------

    2.---------- 3.----------
17. Mention three causes of tooth decay ---------- ---------- ---

---------- ---------- ---------- ----------

18. Mention three causes of gum diseases ---------- ----------

---------- ---------- ----------

19. What are the functions of fluoride?---------- ----------

20. Are the teeth important? 1) Yes 2) No

Oral Health Practices. Please tick as appropriate. You can tick more than one option

21. How many times do you clean your teeth? 1) None 2) once before breakfast 3) twice before breakfast and dinner 4) after each meal 5) after breakfast and dinner 6) before breakfast and after dinner 7) others ----------

22. What do you use to clean your teeth?1) chewing stick 2) toothbrush 3) cotton wool 4) nothing 5) others ----------

23. What kind of toothbrush do you use? 1) Soft 2) medium3) hard 4) very hard 5) don't know

24. How many minutes to you spend cleaning your teeth?1) <1minute 2) 1minute3)2minutes 4) 3 minutes 4) don't know

25. Do you clean between your teeth? 1) Yes 2) No

26. If something gets stuck in between your teeth what will you use to remove it ? 1) toothpicks 2) broom sticks 3) blade 4) dental floss 5) others----------

27. When do you change your toothbrush? 1) less than 3months 2) 3months 3) more than 3months 4) when bristles are fraying 5) one year or more than one year

28. Have you been to the dentist before? 1) Yes 2) No

29. If yes, when was that? ----------Year----------, year----------, year----

30. Do you use tooth paste? 1) Yes 2) No. If yes, what is the name of the toothpaste ----------

31. Do you smoke? 1) Yes 1) No

32. How often do you take sugar containing food daily 1) at least twice everyday2) once 3) I do not take it every day?

Section C

33. How would you rate the present condition of your mouth and teeth?

a) Very bad b) bad c) I don't know d) Good e) Very good

34. How satisfied are you with the appearance of your teeth?

a) Very dissatisfied b) Dissatisfied c) don't know d) Satisfied e) Very satisfied

35. How satisfied are you with the condition of your teeth and mouth?

a) Very dissatisfied b) Dissatisfied c) don't know d) Satisfied e) Very satisfied

Please tick as appropriate;

Question	Strongly disagree	Disagree	Don't know	Agree	Strongly agree
36. If I do not brush my teeth, It is likely that I will develop tooth decay or gum disease or mouth odour					
37. If I take tobacco, I may develop oral cancer					
38. If I get tooth decay or gum disease, I will suffer severe pain".					
39. If I have mouth odour, my friends will not play with me.					
40. If I get tooth decay or gum disease, I will suffer severe pain".					
41. If I get tooth decay or gum disease, my					

teeth may become loose and eventually fall off.					
42. If I get tooth decay or gum disease, I will suffer severe pain".					
43. Brushing my teeth at least two times a day will prevent tooth decay and gum disease"					
44. Brushing my teeth at least two times a day will prevent mouth odour"					
45. Flossing my teeth once a day will prevent tooth decay and gum disease.					
46. If I visit the dentist at least two times a year will prevent tooth/mouth problems.					
47. If I do not take sweet food and drinks will help me to prevent tooth decay.					
48. My gums will bleed when I brush.					
49. My teeth will break when I floss.					
50. My teeth will have holes if I don't take sweet things					
51. I will have toothache if I visit the dentist					
52. I am confident I can brush my teeth at least two times a day"					
53. I am confident I can floss my teeth once a day					
54. I am confident I can rinse my mouth after each meal					

Oral-health-related-quality-of-life

In the last three months: How often have you

	almost all of the time	"fairly often	"sometimes" = 2	almost never	never"
Had pain in your teeth/toothache					
Had discoloured teeth or spots on your teeth					
Had crooked teeth or spaces between your teeth					
Had bad breath					
Had bleeding gums					
Had difficulty eating foods you would like to eat					
Had trouble sleeping					
Had difficultly saying certain words					
Had difficulty keeping your teeth clean					
Been unhappy or sad					
Felt worried or anxious					
Avoided smiling or laughing with other children					
Felt that you look different					

Been worried about what other people think about your teeth/mouth					
Been teased, bullied, or called names by other children because of your teeth					
Missed school for any reason because of your teeth/mouth					
Not wanted to speak/read out loud in class because of your teeth /mouth					
Been confident					
Felt that you were attractive (good looking)					

APPENDIX V

Oral Health Assessment Form

SN---------- Age ---------- Class ----------

Simplified Oral hygiene index (OHI-S)

Debris index =

Calculus index =

6	1 6
6 1	6

6	1 6
6 1	6

OHI-S SCORE =

Gingival index

6 2	4
4	2 6

=

Periodontal Status (CPI)

6	1 6
6 1	6

Caries Experience

D-Decayed due to caries = Carious teeth----------

M-Missing due to caries = Missing tooth----------

F- Filled due to caries = Filled tooth----------

DMFT SCORE =

School Oral Health Promotion Programme (SOHEPP)

Your teeth and mouth

The teeth and mouth

The mouth comprises of

- Soft tissues e.g. gums, tongue, oral tissues
- Hard tissues e.g. bone and teeth etc.

The teeth

- The milk teeth or deciduous teeth are found in children and are 20 in total
- The second set of teeth that replaces the milk teeth is the permanent teeth and are 32 in total.
- The different types of teeth in the mouth are; Incisors, canines, premolars and molars.
- The white part of the tooth that we see in our mouth is the crown.
- The part of the tooth within the gums is the root of the tooth.

If the teeth or mouth is not healthy;

- The tooth and gums may become painful
- The gums and mouth may become swollen
- There can be mouth odour
- There may be fever

Functions of the teeth and the mouth

The teeth is very important because of many functions which include;

- Eating; cutting, chewing and biting food
- Assist in digestion of food
- Speaking - speech
- Laughing /smiling
- Maintaining self-confidence
- Looking good
- Singing
- Good/ high self esteem
- Enhances social communication and social activities, etc.

The Teeth can last in the mouth

The teeth is very important and can last in the mouth if we;

- Clean our teeth regularly at least twice a day
- Eat balanced diet
- Visit the dentist regularly
- Avoid rough play in school
- Maintain safety on the road e.g. using seat belt
- Do not smoke

What happens if we do not take good care of our teeth

1. Dirty teeth and mouth

2. Gum diseases

3.Tooth decay or dental caries

4. Malocclusion or scattered teeth

5. Fractured or broken teeth

6. Mouth odour etc.

The teeth and mouth are very important and serve many functions therefore we must take good care of them

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School Oral Health Promotion Programme (SOHEPP)
Common oral diseases

Periodontal diseases/ Gum diseases

Diseases affecting the gum and other structures supporting the teeth

Signs and symptoms

- Red gums
- Swollen gums
- Bleeding gums on brushing the teeth
- Mouth odour
- Painful gums
- Shaking tooth
- Removal of the tooth

Causes of gum diseases

Poor oral hygiene (dirty mouth) – not cleaning the teeth regularly
Poor diet, Bacteria, Smoking, Scattered teeth

Dirty mouth

Not cleaning the teeth leads to dirty mouth

→ Bacteria plaque = Bacteria + dirty mouth

→ Inflammation of gums; there will be (red, swollen, painful and bleeding gums)

→ Shaking tooth/teeth and eventually loss of the tooth

Prevention is cheaper and better than cure

Tooth decay (Dental caries)

Signs and symptoms

- Hole on the tooth
- Pain from the tooth
- Swelling of the mouth
- Fever in advanced cases

Causes of tooth decay

- Eating sugar containing food; biscuits, cake
- Not cleaning the teeth regularly
- Bacteria in the mouth
- Dental plaque

Sugar containing food and snacks

Eating sugar containing food + Not cleaning the tooth

→ Bacteria eating food remnants

→ Acid production

→ Cavity/Hole on the tooth

Prevent these diseases by avoiding the causes

Malocclusion/ scattered teeth

Causes of malocclusion

Sucking the thumb/fingers
Lip sucking
Tongue sucking
Breathing with the mouth
Biting on nails, pins etc
Family trait
Retained milk teeth

Mouth odour can be caused by:
Not cleaning the teeth regularly
Some food
Gum diseases
Tooth decay
Body diseases
Smoking

Supported by CARTA

APPENDIX VII - ETHICAL APPROVAL

INSTITUTE FOR ADVANCED MEDICAL RESEARCH AND TRAINING (IAMRAT)
College of Medicine, University of Ibadan, Ibadan, Nigeria.

Director: **Prof. Catherine O. Falade,** *MBBS (Ib), M.Sc., FMCP, FWACP*
Tel: 0803 326 4593, 0802 360 9151
e-mail: cfalade@comui.edu.ng lillyfunke@yahoo.com

UI/UCH EC Registration Number: **NHREC/05/01/2008a**

NOTICE OF FULL APPROVAL AFTER FULL COMMITTEE REVIEW

Re: Comparison of school-Based Oral Health Promotion Strategies among Adolescents in Ibadan, Nigeria.

UI/UCH Ethics Committee assigned number: UI/EC/18/0129

Name of Principal Investigator:	**Dr. Folake B. Lawal**
Address of Principal Investigator:	Department of Periodontology & Community Dentistry College of Medicine University of Ibadan, Ibadan
Date of receipt of valid application:	16/03/2018

Date of meeting when final determination on ethical approval was made: **26/04/2018**

This is to inform you that the research described in the submitted protocol, the consent forms, and other participant information materials have been reviewed and *given full approval by the UI/UCH Ethics Committee.*

This approval dates from **26/04/2018 to 25/04/2019.** If there is delay in starting the research, please inform the UI/UCH Ethics Committee so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the* UI/UCH EC *assigned number and duration of* UI/UCH EC *approval of the study.* It is expected that you submit your annual report as well as an annual request for the project renewal to the UI/UCH EC at least four weeks before the expiration of this approval in order to avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the UI/UCH EC. *No changes are permitted in the research without prior approval by the* UI/UCH EC *except in circumstances outlined in the Code. The* UI/UCH EC *reserves the right to conduct compliance visit to your research site without previous notification.*

UI/UCH EC
26 APR 2018
APPROVED
COLLEGE OF MEDICINE, U.I.

Dr. R. O. Akinyemi
For: Director, IAMRAT
Chairman, UI/UCH Ethics Committee
E-mail: uiuchec@gmail.com

TELEGRAMS..... TELEPHONE.....

MINISTRY OF HEALTH

DEPARTMENT OF PLANNING, RESEARCH & STATISTICS DIVISION

PRIVATE MAIL BAG NO. 5027, OYO STATE OF NIGERIA

Your Ref. No. .....
All communications should be addressed to
the Honorable Commissioner quoting
Our Ref. No. AD 13/479/ 743

6th April, 2018

The Principal Investigator,
Department of Periodotology and Community Dentistry,
University College Hospital,
Ibadan.

Attention: Lawal Folake

ETHICS APPROVAL FOR THE IMPLEMENTATION
OF YOUR RESEARCH PROPOSAL IN OYO STATE

This is to acknowledge that your Research Proposal titled: "Comparison of School Based on Oral Health Promotion Strategies among Adolescents in Ibadan" has been reviewed by the Oyo State Ethics Review Committee.

2. The committee has noted your compliance. In the light of this, I am pleased to convey to you the full approval by the committee for the implementation of the Research Proposal in Oyo State, Nigeria.

3. Please note that the National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations, in line with this, the Committee will monitor closely and follow up the implementation of the research study. However, the Ministry of Health would like to have a copy of the results and conclusions of findings as this will help in policy making in the health sector.

4. Wishing you all the best.

Dr. Abbas Gbolahan
Director, Planning, Research & Statistics
Secretary, Oyo State, Research Ethics Review Committee

APPENDIX VIII - PERMISSION FROM MINISTRY OF EDUCATION, OYO STATE

PRIVATE MAIL BAG NO 5014

MINISTRY OF EDUCATION

SCIENCE AND TECHNOLOGY

SCHOOLS DEPARTMENT

IBADAN, OYO STATE OF NIGERIA

*Your Ref. No*_____
All correspondence should be addressed to the Hon. Commissioner
Quoting. FLHE/10/4/T3/208
Our Ref. No _____

Date Feb. 18, 20

Dr. Folake B.Lawal

Department of Periodontology and Community Dentistry,

College of Medicine,

University of Ibadan.

Re: Application for Permission to conduct Oral Health Education Programme in Secondary Schools in Ibadan.

I am directed to refer to the above subject and to convey the approval of the Honourable Commissioner to you to carry out your project of conducting the Oral Health Education Programme in ten (10)Secondary Schools in Ibadan North L.G, Ibadan North East L.G, Ibadan North West L.G. and Ibadan South East L.G Areas. The Schools in each Local Government are stated below:

IBADAN NORTH LGA

(i) Anglican Grammar School, Total Garden.
(ii) Ikolaba Grammar School, Agodi Gate.
(iii) Ikolaba High School, G.R.A.
(iv) Community Secondary School, Ikolaba.
(v) Community Grammar School, Mokola.
(vi) IMG Grammar School, Yemetu Igosun.
(vii) IMG Grammar School, Yemetu Aladorin.
(viii) Methodist Grammar School, Bodija.
(ix) Methodist Secondary School, New Bodija.
(x) Islamic High School, Bashorun.

IBADAN NORTH EAST LGA

(i) Olubadan High School, Aperin.
(ii) Community Grammar School, Orita Aperin.
(iii) St. John's Secondary School, Ode Aje.
(iv) Ode- Aje/ Ajibola High School, Ode aje.
(v) Christ the King Secondary School, Oluyoro.
(vi) Queens of Aposties Secondary Community Grammar School, Oluyoro.
(vii) Holy Trinity Grammar School, Agugu.
(viii) Islamic Mission Grammar School, Agugu.

(x) Loyola College, Old Ife Road, Aromolaran.

IBADAN NORTH WEST LGA

(i) Army Day High School, Jericho.
(ii) Jericho High School, Jericho.
(iii) Community High School, Adamasingba.
(iv) Sacred Heart Secondary School, Ode Olo.
(v) Army Barracks Grammar School, Letmuck Barracks, Eleyele.
(vi) Ansar- Ud- deen High School, Sango Eleyele Road, Eleyele.
(vii) Eleyele High School, Polo Ground, Eleyele.
(viii) Oba Abass Alesinloye Grammar School, Alesinloye Market.
(ix) Community Secondary School, Olopomewa.
(x) Anwal- ul- Islam Grammar School, Eleyele.

IBADAN SOUTH EAST LGA

(i) Olubi Memorial Grammar School, Molete.
(ii) St. Anne's School, Molete.
(iii) Ibadan Grammar School, Molete.
(iv) Community Grammar School, Eyinni Area, Eyinni.
(v) IMG Grammar School, Eyinni.
(vi) Nuru Islamiyya Grammar School, Eyinni.
(vii) Community Grammar School, Kudeti.
(viii) St. David Grammar School, Kudeti.
(ix) CAC High School, Adesola.
(x) CAC Grammar School, Adesola.

2. I wish to reiterate, as written in your letter that, the project is **at no cost to neither students nor the schools.** However, you are requested to forward the outcome of the project to the **Family Life and HIV/AID Education Unit of the Schools' Department of the Ministry** for further necessary actions.

3. Thank you.

Bolaji C.O.{Mrs}
For: Honourable Commissioner