[UCI]I804:11046-000000521390

Factors Associated with the Use of Dental Service and Oral Health-Related Quality of Life in Ghanaian Adults

Eunji Kim

The Graduate School
Yonsei University
Department of Medical Law and Ethics

Factors Associated with the Use of Dental Service and Oral Health-Related Quality of Life in Ghanaian Adults

A Dissertation
Submitted to the Department of Medical Law and Ethics
and the Graduate School of Yonsei University
in partial fulfillment of the
requirements for the degree of
Doctor of Medical Law and Ethics

Eunji Kim

June 2019

This certifies that the dissertation of Eunji Kim is approved.

_____

Thesis Supervisor: So Yoon Kim

_____

Myongsei Sohn: Thesis Committee Member #1

_____

Ho Keun Kwon: Thesis Committee Member #2

_____

Heejin Kimm: Thesis Committee Member #3

_____

Hoi In Jung: Thesis Committee Member #4

The Graduate School
Yonsei University
June 2019

감사의 말씀

지난 2015년, 국제사회의 구강건강불평등 해소에 대한 막연한 목표를 가지며 시작한 학위과정이 긴 여정을 거쳐 논문이라는 결실을 맺으며 마무리하게 되었습니다. 그 동안 저의 곁에서 힘이 되어 주신 많은 분들께 감사 인사를 드리고자 합니다.

먼저, 가나라는 제2의 고향을 가질 수 있도록 해주시고 국제보건 분야에서도 구강보건과 관련하여 학습할 수 있도록 다양한 경험의 기회와 논문을 지도해주신 김소윤 교수님 감사 드립니다. 부족했던 논문 분석 방향에 대하여 짚어 주신 손명세 교수님, 논문 지도뿐 아니라 향후 진로에 대해서도 생각해 볼 수 있도록 해 주신 권호근 교수님, 길을 잃고 헤매던 저에게 핵심적인 내용을 짚어 주시고 마지막까지 꼼꼼히 지도해주신 김희진 교수님, 바쁘신 가운데 논문을 지도해주신 정회인 교수님 감사 드립니다.

그 동안 찾아 뵙거나 연락 드리지 못하였지만 치과위생사로서 성장할 저희에게 다양한 분야를 소개해주시고, 역량을 갖출 수 있도록 해 주신 원주의과대학 치위생학과 교수님들께 감사 인사를 전하고 싶습니다. 간호학 및 국제보건 역사의 산증인 이신 김의숙 교수님, 교수님과 가나를 왕래하며 대한민국 지역보건의 발전, 모자보건, 교육과정 개발에 관한 교수님의 경험과 노하우를 전해 들으며 많은 공부가 되었고, 교수님의 간호학, 국제보건학에 대한 열정과 애정이 많은 귀감이 되었습니다. 보건대학원 국제보건전공 이명근 교수님, 2년이라는 기간 동안 전공 조교로서 강의 준비를 지원하며 국제보건 분야의 다양한 영역과 인사들을 접할 수 있어 매우 유익하였습니다. 국제보건 전문가 과정을 개설하여 개괄적인 이론과 전문적인 평가 부분을 교육해주신 서원석 교수님, 교수님의 지도가 큰 밑 거름이 되었습니다. 의료법윤리학연구원을 소개해주시고, 국제보건팀을 위해 노력해주신 이유리 교수님 감사 드립니다.

이외에도 연세대학교 의료법윤리학연구원 및 연세의료원 통일보건의료센터의 연구원과 보건대학원 전공조교로 활동하며 인연이 되었던 많은 분들이 있습니다.

가장 먼저, 국제보건팀의 맏언니이자 저와 동기들의 동경의 대상으로, 든든한 후원자로 늘 모범이 되셨던 신보경 선생님, 학부 때부터 지금까지 약 10 년이라는 가장 긴 세 월 동안 함께하며 공부와 이외에도 여기 시간을 함께한 언니이자 나의 친구 김시우 선생님, 국제보건의 시작을 함께하며, 나약 해 질 때마다 응원의 문구, 기도로 함께해주며 부족한 저를 늘 최고라 해주시는 이재은 선생님, 지금 돌이켜 보면 그대들 없이는 지금의 나는 존재할 수 없었습니다. 정말 감사합니다.

보건대학원 조교실에서 늦은 밤까지 같이 근무하며, 저의 칭얼거림과 볼멘소리를 들어준 멋있는 언니들 양지현, 이예지 선생님, 지금은 그 자리를 지키며 열심히 가나 사업에 매진하고 있는 정하준 선생님, 감사하고 덕분에 행복했습니다. 많은 두려움을 안고 떠난 가나 첫 출장을 한달 간 함께했던 김지민 선생님, 지하 골방에서 같이 밤을 지새우며 웃을 수 있게 해 주셨던 김영기, 장성규 선생님, 지금은 이 자리를 지키시며 갈 때마다 환영해주시는 손인배 팀장님, 최지원 선생님 감사합니다. 410 호의 불이 꺼질 틈 없이 늘 열심이셨던 이동현, 이원, 최성경, 표희진, 정유진, 김수민, 장승경, 오혜미, 백승주 선생님 감사하고 늘 응원합니다. 통계 분석에 헤매고 있는 저에게 기꺼이 본인의 책을 장기간 대여해주며 힘이 되어 주신 간호대 김고운 선생님, 감사합니다. 무엇보다도 가나 현지에서 같이 고생해준 Philp, Parbey, Hubert, Francis 교수님, 조사에 참여하였던 유하스 학생들, 저의 고민을 같이 나눠 주었던 동료 교수진에게 곧 가나에 돌아가는 대로 별도의 감사인사를 전하겠습니다.

마지막으로 저를 존재하게 해주시고, 지금의 저로 성장할 수 있도록 해 주신 부모님, 딸의 꿈을 늘 지지해주시고 지원 해 주셔서 감사합니다. 이여사님, 그 동안 못다한 효도 앞으로 열심히 하겠습니다. 누나의 잔심부름을 도 맡아 하느라 고생한 나의 동생 정훈이에게 고맙다는 말을 전하며, 곧 시작하는 박사과정 앞으로 힘내라 하고 싶습니다. 다시 한번 모든 분들께 감사 드립니다. 학위과정을 시작했던 그 목표를 되새기며, 끝이 아닌 새로운 시작으로 더욱이 겸손한 자세로 계속하여 정진하겠습니다.

2019 년 6 월 김은지 올림

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Factors Associated with the Use of Dental Services and Oral Health-Related Quality of Life in Ghanaian Adults

Kim, Eunji
Dept. of Medical Law & Ethics
The Graduate School
Yonsei University

Oral health is related to general health and quality of life by enabling chewing, speaking, swallowing, and conveying emotions through facial expressions. Oral diseases resulting from poor oral status can lead to pain and reduce quality of life in the functional, psychological, and social dimensions. Moreover, dental services can economically burden individuals. In lower-middle-income countries or low-income countries, the lack of access to medical services due to lack of health facilities and human resources are likely to have a more significant impact on quality of life. In Ghana, which is located in West Africa, it has been confirmed that lack of health care facilities and of human resources and high unmet needs are associated with impaired oral health. Therefore, in order to improve the overall oral health and quality of life of the residents of Ghana, it is necessary to identify relevant factors and to establish policies based on evidence. Notably, it is necessary to examine the association between quality of life and the use of dental services and to take into account those who lack access to the use of dental services.

The purpose of this study was to investigate the factors related to dental health utilization and oral health-related quality of life in the Volta region of Ghana. Moreover, it aimed to examine differences in oral health-related quality of life according to the use of dental services.

The survey was conducted among the adult population dwelling in the Volta region in Ghana and was aged 18 years or older. Based on Andersen's Behavior Model, factors associated with oral health-related quality of life and dental service utilization was classified into predisposing, enabling, and need factors and health behavior. Chi-square tests, Mann–Whitney U tests, and hierarchical logistic regression analysis were performed using STATA 14.0.

Need factors were the ones most significantly associated with oral health-related quality of life. There were various factors associated with quality of life: age, hypertension, place of residence, oral pain, wearing dentures, self-evaluated tooth and gum status, and sugar consumption. Of these, oral pain and dental service utilization were the ones most strongly associated with quality of life.

The results of this study suggested that it is necessary to intervene through primary health care to improve the oral health-related quality of life of the residents in the Volta region in Ghana, considering the lack of health facilities and health professionals that are available to provide dental services. Moreover, special attention should be paid to the following groups when developing policy: the older population, those diagnosed with hypertension or diabetes, those with oral pain, those wearing dentures, and those with poor tooth and gum status. In order to ensure appropriate treatment for such individuals, it is necessary to establish infrastructure for emergency treatment on the primary level and a referral system if needed, as well as daily life oral health education to prevent oral diseases.

Keywords: Oral health, Oral Health-related quality of life, Oral Health Impact Profile, Dental Service Utilization, Andersen's Behavior Model, Logistic regression, Ghana, Low-middle income country, Global Health

I. INTRODUCTION

1.1 Background

The development and modernization of science have increased quality of life and have led to the pursuit of well-being over only seeking to ensure a life free of illness. In modern society, health is considered to be a fundamental human right, and attention has been paid to promoting health as opposed to only survival. Furthermore, the United Nations (UN) set Sustainable Development goals after the Millennium Development goals, which aimed at fighting diseases, especially in developing countries, not only concerning health but also various other factors presenting a strategy to improve global quality of life.

These changes were also instigated by the paradigm shift in disease prevalence. The prevalence of chronic diseases such as cardiovascular diseases, diabetes, and obesity has been increasing worldwide. For example, according to the Global Burden of Disease Study 2016, the burden of chronic diseases, including oral diseases, has been found to increase in both developed and developing countries.

Oral health can affect quality of life and general health, by enabling multiple functions such as biting, chewing, or swallowing for food intake, and talking for interpersonal communication. The most common disease that affects oral health is dental caries, followed by periodontitis. These diseases constitute a considerable global burden according to previous studies. For instances, globally, the untreated population with oral conditions increased from 2.5 million in 1990 to 3.5 million in 2015, and oral diseases including dental caries and periodontitis affect up to half of the world's population.

Furthermore, in developing countries, there are difficulties in accessing dental services due to the shortage of facilities or oral health care workers as well as the absence of inadequacy of health care systems, which is considered to burden the population further.

Oral diseases share risk factors with chronic diseases such as smoking, inappropriate eating habits, and drinking alcohol. In particular, periodontal disease is significantly correlated to diabetes to the extent that it is called the sixth complication of diabetes. In conclusion, oral health should be treated as part of overall health by applying integrated health promotion strategies (World Health Organization, 2016a).

Accordingly, in 2016, the World Health Organization (WHO) Regional Office for Africa announced the "Regional oral health strategy 2016-2025: Addressing oral disease as part of noncommunicable disease" (World Health Organization, 2016b). The goal of the strategy was to contribute to decreasing the burden of non-communicable diseases and reliable risk factors within the context of universal health coverage. Explicitly, each country agreed on strengthening national advocacy, reducing common risk factors, improving health system capacity for integrated prevention and control of oral diseases, and improving integrated surveillance of oral diseases. Despite the agreement, the implementation of these strategies in each country has proven to be difficult.

For example, Ghana is a lower-middle income Western African country as classified by the World Bank. The population of Ghana comprises 2,883 million people as of 2017. The GDP of Ghana (47.3 billion) is higher than that of Senegal (16.3 billion).

However, the survey or integrated research on oral health at the national level in Ghana is insufficient. For instance, there is no information on oral health in the demographic and health survey of Ghana. Furthermore, the prevention and management policy for oral diseases is also not well organized, and there are difficulties pertaining to shortage of dental health professionals as well as considerable unmet dental needs (Kailembo, Preet, & Williams, 2018).

Besides, the blood sugar levels of people 18 years or older have been gradually increasing according to the WHO statistics reported in 2018. Moreover, according to previous studies, hypertension has become a problem in Ghana. For these reasons, there is need to develop specific strategies for oral health, controlling the risk factors that are common with other diseases.

Conversely, studies on oral health in Ghana were mostly regarding school-age children and the elderly population. Studies with young adults living in the Kanata area or with certain diseases such as diabetes and hypertension have also been conducted. Such studies were also conducted with patients who visited some hospitals. Thus, the subjects were limited to get the comprehensive status. In order to elucidate the general oral health level and to develop concrete policies, it is recommended to study the level of oral health and related factors in Ghana's adult population. Notably, it is necessary to analyze the use of dental services and predictors of dental service use and its outcome, oral health-related quality of life.

1.2 The Objective of the Study

The purpose of this study was to investigate factors influencing dental service use and oral health-related quality of life among the adult population living in four districts of the Volta region in Ghana using the Behavior Model of Health Service Use (R. M. Andersen, Davidson, & Baumeister, 2007). Primarily, this study aimed to examine factors associated with oral health-related quality of life according to dental service use. Hence, it was hoped to provide suggestions to improve oral health-related quality of life, especially among underserved populations with inadequate dental service use in Ghana. Accordingly, this study sought:

1. To understand predisposing, enabling, need, and oral health behavior factors; dental service use, and oral health-related quality of life among the adult residents of Ghana

2. To explore the differences in dental service use and oral health-related quality of life according to predisposing, enabling, need, and oral health behavior factors

3. To analyze factors that are associated with dental service use and oral health-related quality of life

4. To analyze factors that are associated with oral health-related quality of life according to dental service use

1.3 Research Questions

In this study, there were three research questions based on each objective:

1. What are the individual factors (predisposing, enabling, and need factors), oral health behavior, and oral health-related quality of life of the adult population living in the Volta region in Ghana?

2. What are the differences in dental service use and oral health-related quality of life of adults living in the Volta region of Ghana in terms of individual characteristics and oral health behavior?

3. How do individual factors, including oral health behavior, influence dental service use and oral health-related quality of life?

4. What is the impact of dental service use on oral health-related quality of life?

1.4 Definition of Key Variables

1.4.1 Adult Population

In this study, the adult population comprised individuals 18 years old or older based on the Ghanaian context.

1.4.2 A Behavior Model of Health Service Use

A behavior model of health service use was initially suggested by Andersen in the 1960s. It was developed over the decades by Andersen and other scholars. It was extended to show the patterns of individual health service utilization from the individual to contextual level. In this study, the latest version was adopted as described in the article: *"National health surveys and the behavior model of health services use."*

Predisposing Factors

The definition of "to predispose" is *"to influence someone to behave or think in a particular way or to have a particular condition"* in the Cambridge dictionary. It includes demographic, genetic, and social components and an individual's health beliefs based on the Andersen's model. Accordingly, the following factors were assigned as the predisposing factors in this study: age, sex, education level, ethnicity, religion, and diagnosis of hypertension or diabetes.

Enabling Factors

An enabling factor contributes to the individual seeking the use of health services or having a certain level of quality of life in the model. It includes financing and organization. For the purposes of this study, regular income and employment as well as indirect factors such as place of residence and the experience of oral health education were included.

Need Factors

Medical or dental needs are evaluated or perceived. In this study, perceived needs were mainly evaluated and self-reported conditions that may indirectly denote evaluated needs indirectly were partially evaluated. For instance, the number of remaining natural teeth, wearing dentures, self-reported status of teeth or gums, and experience of oral pain.

1.4.3 Oral Health-Related Quality of Life

Quality of life is defined in many ways. In this study, oral health-related quality of life was measured using the oral health impact profile (OHIP). Therefore, it signifies a condition where there is no functional limitation, psychological discomfort, or social disability.

II. MATERIALS AND METHODS

2.1 A Behavioral Model of Health Service Use

Oral health status and oral health-related quality of life are often used interchangeably with respect to health outcomes. Oral health-related quality of life has not been conceptualized using a simple theoretical framework (Gift & Atchison, 1995). Thus, researchers have utilized various frameworks based on their research objectives related to oral health or oral health-related quality of life. The literature on oral health or oral health-related quality of life was reviewed to develop the conceptual framework of this study. There were various conceptual frameworks available showing the determinants of oral health as well as the following resources: Oral Health-related Quality of Life: A model of Oral Health-related Quality of Life for Dental Hygiene (Williams, Gadbury-Amyot, Krust-Bray, Manne, & Collins, 1998), A risk-factor approach model (P. E. Petersen, 2003, 2005), A Behavior Model of Health Service Use (Baker, 2009), and others.

The Behavioral Model of Health Service Use was adopted as the conceptual framework in this study for the following reasons. First, Andersen's model allowed us to understand the interaction both between individual or contextual characteristics and dental service use or oral health outcomes and among individual characteristics or contextual characteristics (R. Andersen, 2008). Second, it has been used in many studies, mainly pertaining to health service use and quality of life. Thus, its validity has already been established. Third, the individual characteristics were grouped into predisposing, enabling, and need factors. Therefore, it was relatively straightforward to uncover the challenges that should be addressed to improve the quality of life of the respondents. For instance, each group of factors was divided into predisposing, enabling, and need factors. This enabled identifying which factors were significantly associated with quality of life and compare the impact of each group of factors for prioritizing further action.

2.1.1 Overview

Ronald Andersen, a scholar in the United States of America, became interested in the access to care aspect while participating in the National Survey of health care use and expenditure around the 1960s. As a result, the initiative behavior model of health care use was designed. For a few decades, Andersen's model was revised based on the changing demands of the times. If the initial model focused on the individual factors, the later model gradually appeared to incorporate social environment factors, based on the results of empirical studies by Andersen and other scholars (R. Andersen, 2008).

The initial model was that individual characteristics, divided into three components: predisposing, enabling, and need factors, affect the use of medical services. It enabled examining the potential, realized, equitable, and inequitable access to healthcare among individuals. In the 1970s, it was agreed that the overall healthcare system, including national policies and health facilities, played an important role in the use of health care, and the results are expressed as satisfaction with patient services. Accordingly, the Phase 2 model, in which the outcome of medical use is expressed as patient satisfaction, was suggested (R. Andersen & Newman, 1973). In the 1980s, Phase 3 showed that individual needs were perceived and evaluated by health professionals. Besides, health behavior was considered as one of the interactive factors in the use of healthcare and the health outcomes. It facilitated measurement of an effective and efficient aspect of healthcare policy. In Phase 4, the unidirectional pattern of medical use appeared to show dynamic backwardness, and the contextual concept was embodied as were the individual characteristics (R. Andersen, 2008; R. M. Andersen et al., 2007). The most recent model proposed by Andersen is shown in the following figure1.

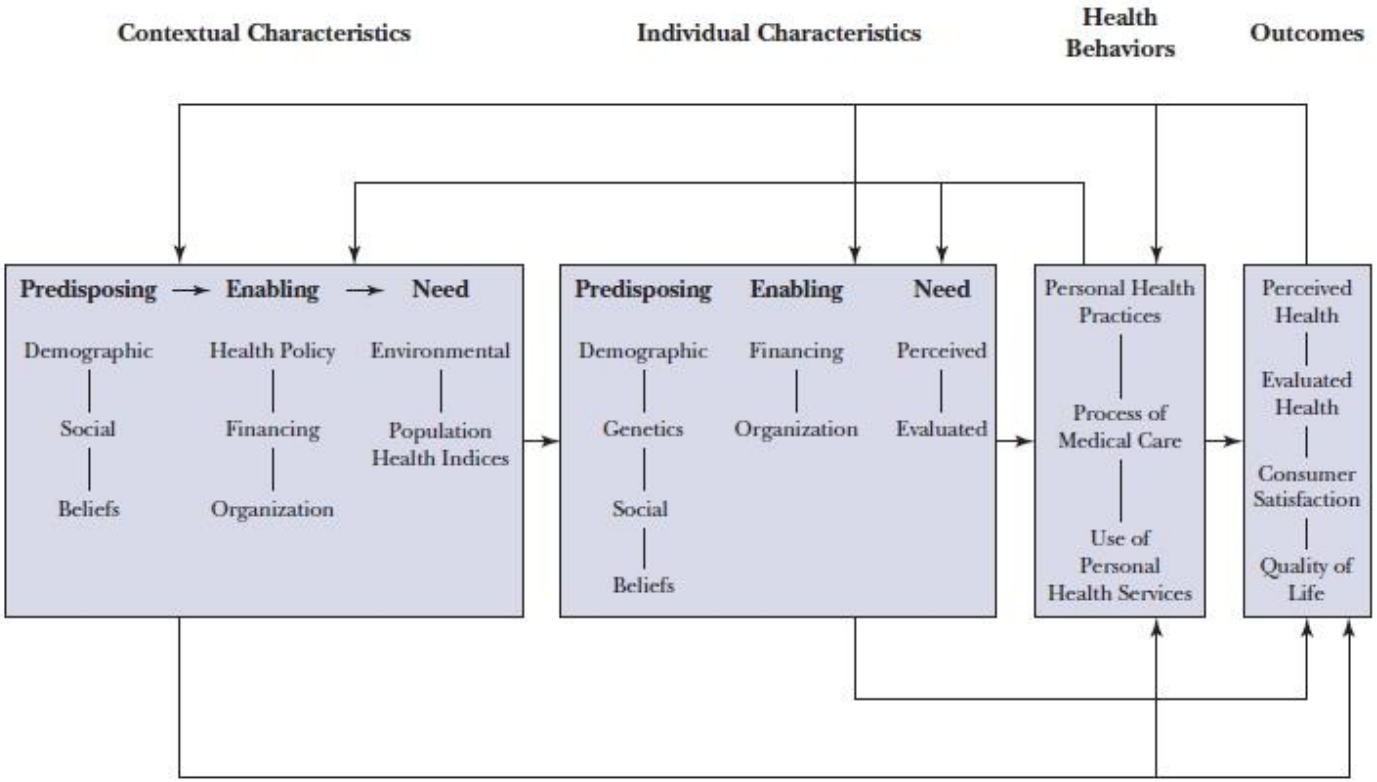


Figure 1. A Behavior Model of Health Service Use including contextual and individual characteristics

(Retrieved from: (R. Andersen, 2008; R. M. Andersen et al., 2007))

The theoretical definition of each variable is as follows. First, predisposing factors include demographic and sociological characteristics such as age, sex, and ethnicity. Enabling factors include economic means, such as income and health insurance, residential areas, and medical resources related to the accessibility of health facilities. Individual needs are perceived and evaluated. Perceived need is described as behavior limited by a disease or condition as the person perceives it. Evaluated need is the state of health as objectively diagnosed by experts including any diseases that may be present.

Contextual characteristics refer to environmental aspects surrounding health services use and health, such as health policy and health financing. That is, it is associated with personal health service use and health status, both indirectly and directly. They are classified as predisposing, enabling, and need factors, as is performed for the individual level (R. Andersen & Newman, 2005; R. M. Andersen et al., 2007).

2.1.2 Variables in the Previous Studies

The behavior model of health care use, which has evolved over many years, has contributed to conceptualizing health care use and to establishing evidence-based health policy in many countries. This model is still used in various studies to date.

Many studies have been conducted using this model to explain and predict health care use in various fields. Of these, there were studies on specific services such as maternal and child health, immunization, HIV treatment, and oral health (Nasir, Å strøm, David, & Ali, 2009). For instance, Baker (2009) conducted a study to test whether the model could be used in oral health research using structural equation modeling. As a result, it was confirmed that the pathway from predisposing factors to health status outcome suggested by Andersen, was also valid for oral health research. Besides, Andersen adapted the conceptual framework for analysis of the use of dental services among Americans (R. Andersen & Davidson, 1997).

Additionally, other studies confirmed health status and health-related quality of life as outcomes of health care utilization (Gaber, Galarneau, Feine, & Emami, 2018; Gaewkhiew, Bernabé, Gallagher, Klass, & Delgado-Angulo, 2017; Holde, Baker, & Jönsson, 2018). In contrast, the pattern of health care utilization has been extensively studied in all ages, from children to adults, and in many countries (Astrom, Ekback, Nasir, Ordell, & Unell, 2013; Finlayson, Gansky, Shain, & Weintraub, 2010; Marshman, Baker, & Robinson, 2014; Marshman et al., 2012; McGlynn, Wilk, Luginaah, Ryan, & Thind, 2014; Varenne et al., 2006), including in Ghana, which is the site of this study (McGlynn et al., 2014). Therefore, this is a suitable theoretical model for this study, which aims to investigate the effects of oral health-related quality of life as well as dental service use in Ghanaian adults.

The previous studies referred to the theoretical definition presented in Andersen's model and set the variables by deriving an operational definition consistent with the purposes of each study. Likewise, the variables comprising the predisposing, enabling, and need factors are slightly different in each study.

Aday and Eichhorn (1972) wrote a report summarizing empirical studies in the early days after Andersen's model developed. The variables of this study were selected based on those results **(Appendix A)**.

Specifically, the dependent variable is oral health-related quality of life using the OHIP, which is the most commonly used instrument. Moreover, the variables from the previous studies with high frequency of use and significance were included, mainly from three studies **(Appendix B)**. Additionally, in order to account for cultural aspects, some of the predisposing variables used in studies on the Ghanaian population were included (Ayernor, 2012; Finlayson et al., 2010; McGlynn et al., 2014; Minicuci et al., 2014; Roberto, Martins, Paula, Ferreira, & Haikal, 2017; Yawson, Malm, Adu, Wontumi, & Biritwum, 2012).

Among the enabling factors, following variables were examined: income, occupation (Roberto et al., 2017), place of residence (Choi, Kim, Noh, & Park, 2015; Willet, Dorstyn, Due, & Li, 2018b), oral health education (Baker, 2009). In case of need factors, tooth number, denture (Muirhead, Quinonez, Figueiredo, & Locker, 2009), tooth status, gum status, oral pain were included.

Also, some variables for measuring oral health behaviors have been used in other research, which is not even applying Andersen's model: sugar consumption (Stapleton, Finlayson, Ohmit, & Hunte, 2016), drinking alcohol, smoking tobacco, toothbrushing (Roberto et al., 2017), fluoride toothpaste. The independent variables used in this study are presented in the figure 4.

2.2 Study Design

The present study was quantitative; a descriptive cross-sectional design was adopted.

2.2.1 Study Site

The Volta region was one of the 10 administrative regions in Ghana until Ghana reorganized the administrative regions into 16 in December 2018. Currently, the Volta region is divided into two regions: the Oti and Volta regions. However, there was not sufficient information on the newly divided regions at the time of the study, as the new government organization is yet to be officially implemented. Further, this survey was conducted before the decision for the new division was made. Thus, in this study, the Volta region was considered as it appeared in the previous region division. The Volta region, in this study, included four districts: Nkwanta South, Hohoe, Ho West, Ketu South **(Figure 2)**.

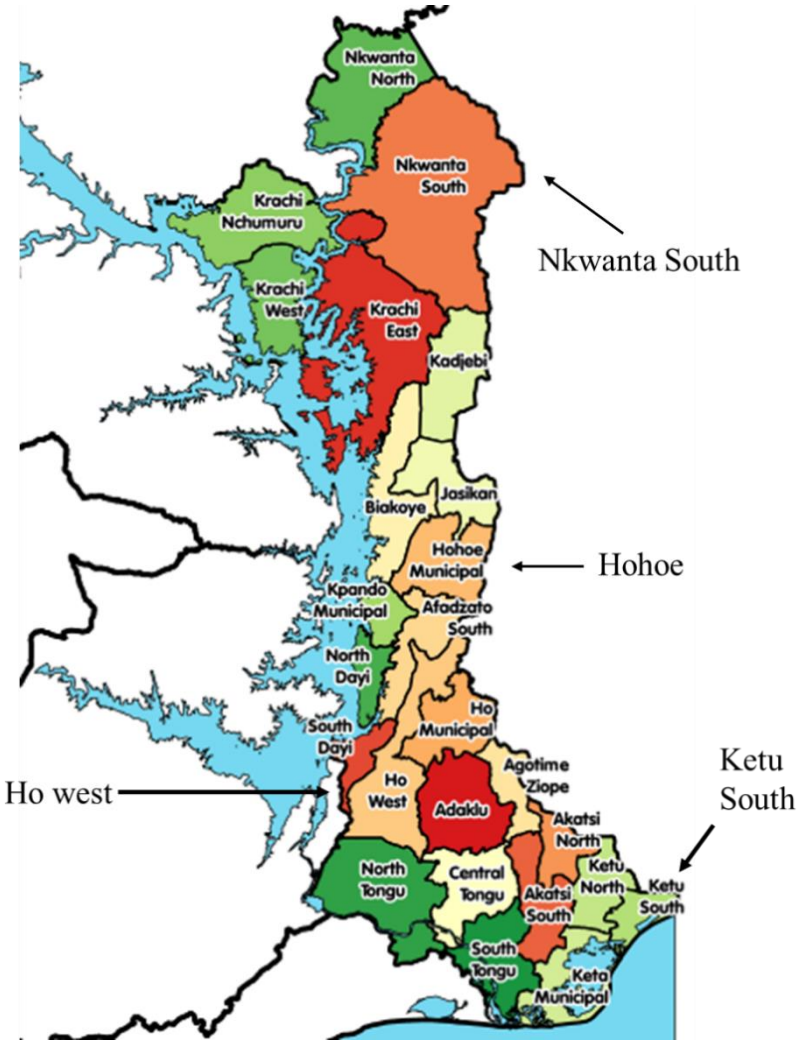


Figure 2. Map of the Volta region (as of November 2018)

2.2.2 Study Population

The study population comprised of men and women older than 18 years living in the Nkwanta South district, Hohoe municipality, Ho west district, and Ketu South District and who participated in the Community Health Need Assessment conducted by collaboration between Yonsei University in Korea and the University of Health and Allied Sciences in Ghana.[i]

A total of 2,493 households were assessed through the Community Health Need Assessment; of 1,093 men and of 1,400 women. Among them, 83 people who did not meet the age criteria and 768 people who did not answer multiple questions were excluded. Moreover, 255 respondents who answered *"Don't know"* for each of the questions regarding oral health-related quality of life were excluded. Therefore, the total sample size was 1,387 **(Figure 3)**.

[i] Yonsei University in South Korea and the University of Health and Allied Sciences of Ghana have been collaborating to improve the curriculum and vocational training program, especially in the School of Medical, School of Nursing and Midwifery and School of Public Health since 2017. The Community Need Assessment was conducted for the community-need based curriculum development. Hereby, oral health was part of the data collection.

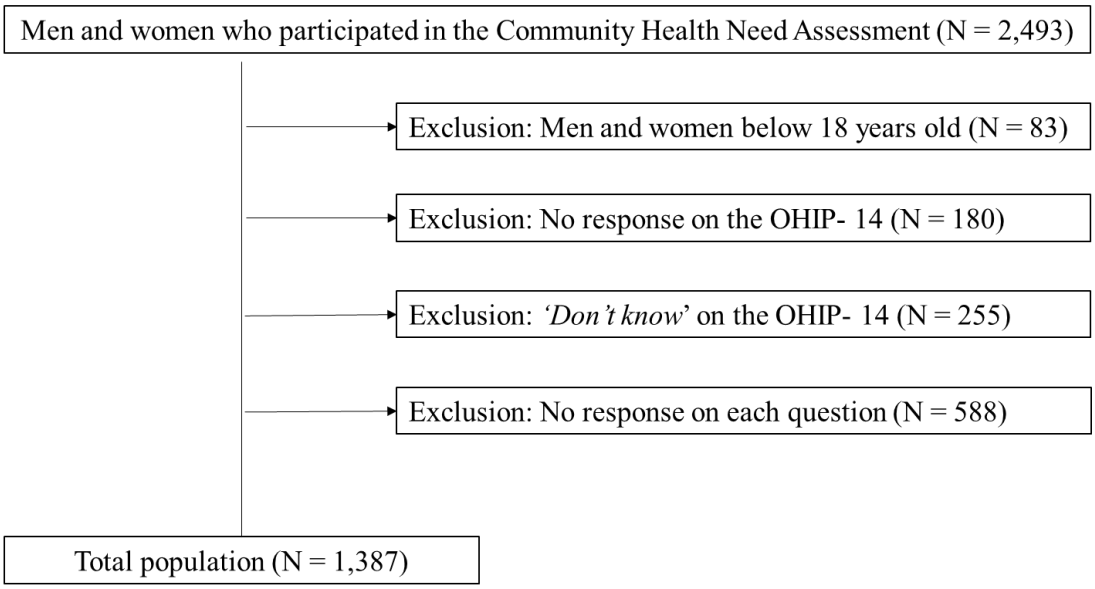


Figure 3. The study population flow chart

2.2.3 Sampling Procedures

Sample Size Calculations

In order to select a representative sample, the sample size was decided using Yamane's formula (1967), which allows for easy calculation of the sample size (Singh & Masuku, 2014). A 95% confidence level and p = 0.05 were assumed. Regarding the non-response rate, 10% was considered so that the final number of expected households was as presented in the following table **(Table 1)**.

Yamane's Formula:

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

Where:

n = Sample size

N = Study population

E = margin of error, 0.05 with a significance level of 95%

Table 1. The total number of households in each district

District/Municipality	Total Household (N)	Target Household (N)
Nkwanta South	22,733	432
Hohoe	43,329	437
Ho west	23,875	433
Ketu South	39,119	436

Resources from: (Ghana Statistical Service, 2010)

Sampling Process

A multi-stage cluster sampling method was adopted. For the first stage, the cluster was decided with identifiable geographical boundaries in the Volta region in Ghana. All districts in the Volta region were grouped into three different ecological zones: Savanna, Middle, and Coastal Zones for the first stage of sampling. More districts are located in the Middle Zone compared to the other zones. Accordingly, in each ecological zone, one to two districts were selected using a simple random sampling procedure: Nkwanta South in the Savana, Ketu South in the Coastal, and Ho west and Hohoe in the Middle Zone.

In each cluster or district, 30 communities were selected, and 15 households were visited in each community at random. In total, 450 communities were surveyed in each district using random selection.

In terms of deciding the 15 households, the random walk technique was adopted. For example, each data collector moved clockwise from the center of each community and decided the first household. In sequence, other participants were selected by following a specific path of travel from the first household.

2.2.4 Research Flow

This study was conducted in four different phases: literature review, preparation, data collection, and data analysis. Literature on “Oral Health,” “Oral Health-related Quality of Life,” “Dental Service Use, Dental Service Utilization, or Use of Dental Service,” and “A Behavior Model for Health Service Use or Andersen’s Model” was reviewed. All literature was found in RISS, PubMed, and Google Scholar. The materials of literature review included articles, theses, and reports published by the WHO, Ghanaian governmental organizations such as the Ministry of Health and Ghana Health Service, and other relevant organizations.

In the second phase, preparation for the data collection was performed. The questionnaire was developed based on the tool suggested by the WHO (World Health Organization, 2013). A mobile application was developed, and the developed questionnaire was installed on the application in order to conduct the Computer-Assisted Personal Interview (CAPI). The data collectors were recruited among students studying Public Health Nursing and Public Health in the University of Health and Allied Sciences of Ghana and were trained before the data collection. Meanwhile, the persons responsible for providing approval for this study were thoroughly informed.

Data were collected at the four different districts in the Volta Region in Ghana. Then, the collected data were retrieved from the database as an excel and STAT dataset. All the data were analyzed with chi-square tests, Mann–Whitney U tests, and hierarchical logistic regression using STATA 14.0 (STATA Corp, College Station, TX, USA). Finally, factors related to oral health-related quality of life and dental service use among the adult population in the Volta region in Ghana were identified. The detailed process is described below.

2.2.5 Conceptual Model

As shown in the following figure 4, the research framework of this study was mainly based on the Behavior Model of Health Service Use by reviewing previous studies (R. Andersen, 1995; R. M. Andersen et al., 2007; Baker, 2009; Willet, Dorstyn, Due, & Li, 2018a). The research model included individual characteristics such as predisposing, enabling, and need factors, oral health behavior, dental service use, and oral health-related quality of life. Sub-items were stated as follows.

Predisposing factors comprised age, sex, education level, ethnicity, religion, and diagnosed status of hypertension or diabetes. These are referred to as factors inherent to each individual.

Enabling factors referred to factors facilitating or impeding dental service use (R. M. Andersen et al., 2007). In other studies, enabling factors included indicators such as health insurance, distance to health facilities, and the number of health facilities in the living area. The place of residence indirectly shows all these aspects simultaneously (Willet et al., 2018a). Thus, regular income and employment, place of residence, and oral health education were included in this study.

Need factors, generally recognized as requiring dental service, included the number of remaining teeth, wearing dentures, self-evaluated status of teeth and gums, and experience of oral pain.

Regarding health behavior factors, sugar consumption, drinking alcohol, smoking, toothbrushing, using a fluoride toothpaste, and dental service use were included. Oral health-related quality of life was the outcome indicator in this study.

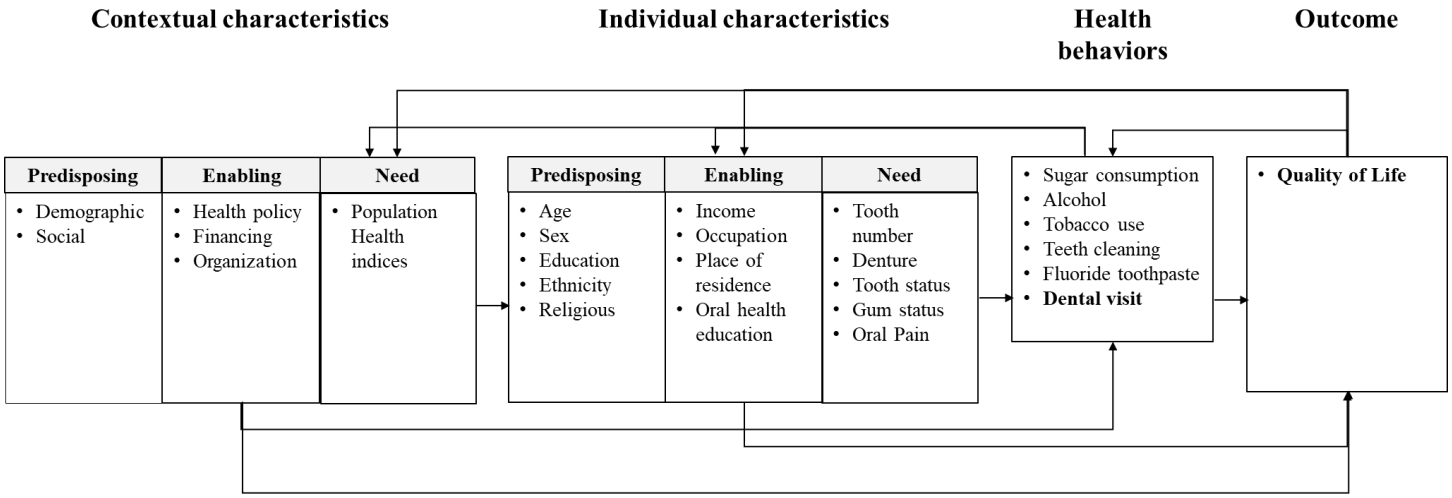


Figure 4. Conceptual framework of this study

2.3 Data Collection

2.3.1 Data Collection Instruments

The questionnaire developed by the WHO (P. E. Petersen, Baez, Ramon J & World Health Organization., 2013) was mainly used in this study. Some part of the questionnaire was revised to meet the research objectives and the cultural characteristics of Ghana **(Table 3)**.

Independent Variable: Oral Health-Related Quality of Life

The OHIP-14 was created by Slade as a measure of oral health-related quality of life and has seven composite domains with 14 questions: Functional Limitation, Physical Pain, Psychological Discomfort, Physical Disability, Psychological Disability, Social Disability, and Handicap (David Locker & Miller, 1994; G. D. Slade, 1997). Meanwhile, the questionnaire items in this study included 12 questions under three domains: Functional Limitation, Psychological Discomfort, and Social Disability derived from the original version of the OHIP-14 (J. K. Park, 2015; P. E. Petersen, Baez, Ramon J & World Health Organization., 2013).

It was investigated with the question which asked respondents whether they had any difficulties or discomfort because of the state of their teeth or mouth during the past 12 months, describing the specific types of difficulties or discomfort in terms of functional limitation, psychological discomfort, and social disability.

All respondents answered how frequently they experienced problems on their teeth or mouth on the Likert scale: *"Very often," "Fairly often," "Sometimes," "No,"* and *"Don't know."* For the scoring, response categories were scored from 0 to 3*: "Very often (0)", "Fairly often (1)," "Sometimes (2)," and "No (3)."* Responses of *"Don't know"* were considered as missing values for the statistical analysis (G. D. Slade, 1997; Souza, Oliveira, & Lima, 2017).

The scores of the OHIP for each subject can be summarized in different ways (P. F. Allen, McMillan, & Locker, 2001; Batista, Lawrence, & de Sousa, 2014; Bof de Andrade & Drumond Andrade, 2019; Huang & Park, 2015; Isiekwe, Onigbogi, Olatosi, & Sofola, 2014; John et al., 2004; Keles, Abacigil, & Filiz, 2018; Mason, Pearce, Walls, Parker, & Steele, 2006; G. Slade et al., 1996; G. D. Slade, 1997; Souza et al., 2017; Walter et al., 2011). The simplest one is to count the total number of responses of *"Very often"* or *"Fairly often."* However, the result may have a skewed distribution, which may influence the statistical analysis, violating assumptions required for the parametric statistical procedure (G. D. Slade, 1997).

Another way is to calculate a weight standardized score. Slade and Spencer suggested the method of question-specific weights (G. D. Slade & Spencer, 1994). It is a way to multiply each code of the answers by stated weights and sum the total score within the subscales (P. F. Allen et al., 2001; G. Slade et al., 1996; G. D. Slade, 1997). Meanwhile, Previous studies have found that there were no significant differences between weighting and non-weighting the scores to assess oral health-related quality of life (P Allen & Locker, 1997; Jang et al., 2006).

In this study, for each subject, the overall score of the OHIP was summarized as the sum of each response code. Those scores ranged from zero to 36 points, but it was required to convert them into a binary variable for the logistic regression.

Finally, two grouping variables were prepared based on the total score of the OHIP: "Low" and "High," dividing each score as lower than 36 points, which was termed "Low" and 36 points, which was termed "High" (Montero, Costa, Bica, & Barrios, 2018). Hence, "Low" signified low quality of life, and "High" signified high quality of life in this study.

Cronbach alpha coefficients were calculated to measure the internal consistency of all scales. The Cronbach alpha values were 0.941 for the total score, 0.849 for Functional Limitation, 0.864 for Psychological Discomfort, and 0.897 for Social Disability **(Table 2)**. The alphas were similar to those reported by previous studies (Drachev, Brenn, & Trovik, 2018; Keles et al., 2018; Kim & Min, 2009; E.-G. Lee, Park, Park, & Park, 2011; J.-K. Park, 2015).

Table 2. Internal consistency of scales

No.	Subscale	Questions	Cronbach's α
1	Functional limitation	Difficulty in biting foods	0.849
2		Difficulty chewing foods	
3		Difficulty with speech/trouble pronouncing words	
4		Dry mouth	
5	Psychological discomfort	Felt embarrassed due to appearance of teeth	0.864
6		Felt tense because of problems with teeth or mouth	
7		Have avoided smiling because of teeth	
8		Had sleep that is often interrupted	
9	Social disability	Have taken days off work	0.897
10		Difficulty doing usual activities	
11		Felt less tolerant of spouse or people who are close to you	
12		Have reduced participation in social activities	
		Total	0.941

Dependent Variable

(1) Predisposing factors

The seven indicators included: age, sex, education level, ethnicity, religion, and diagnosis of hypertension or diabetes (Ayernor, 2012; Finlayson et al., 2010; McGlynn et al., 2014; Minicuci et al., 2014; Roberto et al., 2017; Yawson et al., 2012).

Age

Each respondent stated their age in an open-ended question. This study mainly focused on the adult population of Ghana. Generally, an adult is a person aged older than 19 years. In Ghana, people over 18 years old are included in the adult population. Hence, all answers were coded as: young adult, aged 18 to 29 years; middle-age, aged 30 to 49 years; old adult, aged 50 to 64 years; and elderly, aged over 65 years (Jang et al., 2006; David Locker & Miller, 1994).

Education Level

In Ghana, educational institutions are classified into primary schools, junior high schools, senior high schools, and tertiary schools such as colleges and universities (Ghana Statistical Service, 2013) Thus, Education level was reported as follows: “None,” “Primary,” “Junior High,” “Senior High,” and “Tertiary.” For the logistic regression, a dichotomous scale was used: “Below junior high school” and “Beyond junior high school.”

Ethnicity

There are many tribes in Ghana (Ganle, 2016). Most individuals belong to the "Ewe (73.8%)" in the Volta region (Ghana Statistical Service, 2013). Accordingly, ethnicity was categorized as follows: "Ewe," "Akan," "Guan," and "Other," and combined as a dichotomous scale: "Non-Ewe" and "Ewe" for the logistic regression.

Religion

More than half (71.2%) of the population are Christians in Ghana. This includes all denominations of Christianity: Catholic, Protestant, Pentecostal, Charismatic, and other. Additionally, 17.6% of Ghanaians are Muslims, 5.3% are Non-religious, 5.2% are Traditionalists, and 0.8% report belonging to another religion (Ghana Statistical Service, 2013). The distribution is similar in the Volta region. For this reason, religion was investigated as: "Christian," "Muslim," and "Traditionalist." Meanwhile, it was coded as "Non-Christian" and "Christian" for the logistic regression.

Non-Communicable Diseases: Hypertension and Diabetes

Oral health has a strong relationship with other non-communicable diseases such as diabetes and cardiovascular diseases (Croser, 2018) and the prevalence of these diseases in Ghana has increased (Kodaman et al., 2016). Of these, hypertension and diabetes were surveyed in this study with two combination questions. Hypertension was coded as "No" or "Yes" depending on the answers to the following two questions: *"Have you ever had your blood pressure measured by a health worker?"* and *"Have you ever been told by a health worker that you have raised blood pressure or hypertension?"*. Diabetes was also examined with the following two questions and coded as "No" or "Yes": *"Have you ever had your blood sugar measured by a health worker?"* and *"Have you ever been told by a health worker that you have raised blood sugar or Diabetes?"*.

(2) Enabling factors

There were four indicators under enabling factors: the presence of regular income, employment status, place of residence, and experience of oral health education.

Income and Employment

The presence of regular income and employment status are crucial factors for healthcare service use. Respondents were asked about their monthly income and employment, which were coded as: “No” or “Yes” for the statistical analysis (Roberto et al., 2017).

Place of Residence

Each district has a different infrastructure for healthcare: a different number of health professionals and health facilities (Ghana Statistical Service, 2013). Place of residence was classified as “Nkwanta South,” “Hohoe,” “Ho west,” and “Ketu South” (Choi et al., 2015; Willet et al., 2018b).

Oral Health Education

The experience of oral health education was examined with the following questions using a dichotomous scale: *“Have you ever been taught in any of your education, the importance of cleaning your teeth?”* and *“Have you ever been taught in any of your education, the method of cleaning your teeth?”*. If the response was “Yes” for any of the two questions, the response was considered “Yes” for the new variable, experience of oral health education (Baker, 2009).

(3) Need factors

Need factors were divided in two sub-items: evaluated needs and perceived needs. Evaluated needs signify any symptom or status diagnosed by experts, such as health professionals (R. Andersen, 1995, 2008; R. Andersen & Newman, 1973). Perceived needs are an individual's perception of their status, i.e., self-reported oral health status. It is another approach to measuring the illness or impairment domain (Gift & Atchison, 1995) and can be used instead of objective measurements. In this study. five indicators were examined: the self-reported number of remaining teeth, wearing dentures, self-evaluated status of teeth and gums, and experience of oral pain.

The Self-Reported Number of Remaining Teeth

Tooth loss and the number of functional teeth units are associated with oral health-related quality of life (Brennan, Spencer, & Roberts-Thomson, 2008). A minimum of more than 20 teeth is required for proper function (Brennan et al., 2008; Ha et al., 2009; Käyser, Witter, & Spanauf, 1987; Shin & Kim, 2015). The self-reported number of remaining teeth was investigated with the question: *"How many natural teeth do you have?"*. Responses comprised the following: "No natural teeth," "1-19 teeth," and "20 or more teeth," and divided into two groups again as: "Less than 20" and "More than 20" for further analysis.

Wearing Dentures

Wearing dentures was investigated with the question: *"Do you have any denture?*", and the answers were coded on a dichotomous scale: "No" or "Yes" (Muirhead et al., 2009).

The Self-Evaluated Status of Teeth and Gums

Tooth and gum status was self-reported as following: “Excellent,” “Very good,” “Good,” “Average,” “Poor,” “Very poor,” and “Don’t know.” It was categorized into two groups by means of data analysis. Answers of Excellent, Very Good, and Average were coded as “Good.” “Very poor” was considered as “Poor” and “Don’t know” was considered a missing value.

Oral Pain

The experience of oral pain was considered present if respondents had any pain or discomfort on their teeth or mouth during the past 12 months. The response was coded on a dichotomous scale: “No” or “Yes.”

(4) Health behavior

Oral health behavior was inspected in a variety of aspects: sugar consumption, drinking alcohol, smoking tobacco, toothbrushing, and using a fluoride toothpaste.

Sugar Consumption

In case of sugar consumption, respondents answered how frequently they consumed 10 different types of sugary beverages and snacks, even in small quantities as “Several times a day (5),” “Every day (4),” “Several times a week (3),” “Once a week (2),” “Several times a month (1),” and “Seldom/never (0).” The total score was summed based on the answers to each question and converted into 100 points for data analysis. If the total score was high, it denoted that respondents consumed sugary beverages or snacks relatively often compared to those with a lower score, and the consistency of the question was confirmed with the Cronbach alpha ($\alpha = 0.821$) (Stapleton et al., 2016).

Drinking Alcohol, Smoking Tobacco, and Using a Fluoride Toothpaste

All three questions were answered on a dichotomous scale: “Yes” or “No.”

Toothbrushing

The question on the frequency of toothbrushing was surveyed as: “Never,” “Once a month,” “2-3 times a month,” “Once a week,” “2-6 times a week,” “Once a day,” and “Twice or more times a day.” For the statistical analysis, it was re-grouped as: “Less than twice” and “Twice or more times” per day (Roberto et al., 2017).

(5) Use of Oral Health Services

Participants reported when their last dental visit was as: “Less than 6 months,” “6-12 months,” “More than 1 year but less than 2 years,” “2 years or more but less than 5 years,” “5 years or more,” and “Never have received dental care.” The data were coded as “No” or “Yes,” signifying “no visit” and “visit” (Herkrath, Vettore, & Werneck, 2018). Moreover, in order to examine the unmet needs, one more variable was produced examining whether the respondents had visited a dental service within 1 year or not.

Table 3. Dependent and independent variables

Categories		Variables (N)	Code
Dependent Variable		・Quality of life (12)	・Low/High
Independent Variable	Predisposing	・Age (1)	・18~29, 30~49, 50~64, 65~
		・Sex (1)	・Male, Female
		・Education (1)	・None, Primary, Junior high, Senior high, Tertiary
		・Ethnicity (1)	・Ewe, Akan, Guan, Ga, Others
		・Religion (1)	・Christianity, Muslim, Traditionalist
		・Hypertension (2)	・Yes, No
		・Diabetes (2)	・Yes, No
	Enabling	・Income (1)	・Yes, No
		・Occupation (1)	・Yes, No
		・Place of residence (1)	・Nkwanta South, Hohoe, Ho west, Ketu South
		・Oral Health Education (1)	・Yes, No
	Need	・Tooth number (1)	・No teeth, 1-19 teeth, 20 teeth or more
		・Denture (1)	・Yes, No
		・Tooth status (1)	・Good, Poor
		・Gum status (1)	・Good, Poor
		・Oral Pain (1)	・Yes, No
	Oral Health Behavior	・Sugar consumption (10)	・(Scored)
		・Alcohol (1)	・Yes, No
		・Tobacco (1)	・Yes, No
		・Toothbrushing (1) (per day)	・Less than twice, Twice or more times
		・Fluoride toothpaste (1)	・Yes, No
	Use of dental service	・Dental visit (1)	・Yes, No

2.3.2 Data Collection Tool

The data were collected using CAPI. CAPI is one of the techniques for data collection using portable devices such as smartphones and tablet PCs. In large-population based surveys, CAPI has been generally used because of its advantages, cost-effectiveness, ease of use, and immediate availability of data (Brahme et al., 2018; Morgan et al., 2018; Skarupova, 2014).

Study data were collected and managed using REDCap electronic data capture tools hosted at the collaborative team between Yonsei University in South Korea and the University of Health and Allied Sciences in Ghana. REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed to support data capture for research studies, providing an intuitive interface for validated data capture, audit trails for tracking data manipulation and export procedures, automated export procedures for seamless data downloads to common statistical packages, and procedures for data integration and interoperability with external sources (P. Harris et al., 2009; P. A. Harris et al., 2019).

2.3.3 Data Collection Procedure

Community Sensitization

In Ghana, all visitors should inform the chief, community committee, or other official in advance if visitors hope to perform official activities. If this cannot be arranged before the visit, they need to meet and inform a person/people staying in the village as soon as they arrive there.

Accordingly, this study was required to send official letters to the director of each District/Municipal Health Directorate prior to the data collection. The collaborative team in the University of Health and Allied Sciences proceeded with these processes by sending official letters to such officials and asking them to announce the visit to the communities. The letters aimed to help the people concerned such as the director and staff of the Health Directorate and the village residents to understand the purpose of the survey, date of data collection, contents of the study, and further plan for data release.

Data Collector Training

Investigators of this study were students studying in the School of Nursing and Midwifery and School of Public Health at University of Health and Allied Sciences. Their majors were mostly in Public Health Nursing or Public Health and they were in levels 200 to 400. They were, therefore, skilled investigators with some knowledge and skill in community assessment. All researchers joined the survey voluntarily. The total number of data collectors was approximately 170. All students were trained in order to join the survey on the research purposes, questionnaire items, and how to use the application. During the training, each student was required to install the application, REDCap, on their smartphone and were supervised by the ICT team on the use of the application.

Pilot Test

After training the investigators, a preliminary survey was conducted in the Hohoe municipality and Ho District. During this period, data collector proficiency, errors on the questionnaire, and the REDCap application were reviewed. The confirmed problems were discussed and revised with the ICT team right after the preliminary test.

Data Collection

The data collection began in October 2018. Investigators from the School of Public Health surveyed in the Nkwanta South district, Hohoe municipality, and Ho west district. For the Ketu South district, investigators from the School of Nursing and Midwifery conducted the survey. The specific period for the survey is presented in the following table. In total, 2,493 responses were collected **(Table 4)**.

Table 4. Period of the data collection and the number of collected data

District/Municipality	Period	# of collected data
Nkwanta South	11/03/2018	447
Hohoe	10/13/2018 ~ 10/14/2018	539
Ho west	10/27/2018 ~ 10/28/2018 02/01/2019	670
Ketu South	10/01/2018 ~ 10/12/2018	837
Total		2,493

2.4 Data Management

The collected data were mainly supervised by the ICT team who developed the application for this study. All investigators were able to save the data on the online REDcap database during data collection. Meanwhile, data were retrieved from each smartphone immediately after the investigation to collect un-uploaded data and to protect the dataset. After the data collection, investigators were required to delete the application, supervised by the ICT team. All the collected data were converted to an Excel file and a dataset for STATA.

2.5 Statistical Analysis

Data analysis was carried out using STATA 14.0. The statistical analysis method used in this study was the following: the chi-square test and Mann–Whitney U test were used to examine the characteristics of each factor by sex and to explore the differences in oral health-related quality of life, dental service use, and oral pain according to other factors. Hierarchical logistic regression analysis was used to analyze factors that are associated with oral health-related quality of life, dental service use, and oral pain.

2.6 Ethical Approval of Research

The University of Health and Allied Sciences Ethics Review Committee approved the study (ID: UHAS-REC A.6[7] 17/18). Additionally, permission to conduct this study was provided by each District/Municipal Health Directorate and community leader, such as chiefs and assembly members in each community prior to data collection. Informed consent was also verbally obtained from each participant.

III. ORAL HEALTH-RELATED QUALITY OF LIFE

3.1 Oral Health in the Adult Population

Oral Health

The word "oral" refers to the mouth. It includes the teeth and gums as well as all tissues and bone located in the craniofacial complex, such as the tongue, lips, salivary glands, muscles, and jaw (Evans & Kleinman, 2000). It has various functions such as chewing, swallowing, speaking, and expressing emotions.

Traditionally, oral health was explained as the absence of oral disease as was also general health. Definitions of oral health, however, have been developed and specified in line with changes in the definition of health (Kent & Croucher, 1998). Originally, the meaning of oral health suggested by the WHO was generally utilized to characterize oral health[ii] (P. E. Petersen, 2003).

However, new descriptions have been more holistic and linking oral health to general health. Recently, oral health was summarized again in 2016 as: "*Oral health is multi-faceted and includes the ability to speak, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort, and diseases of the craniofacial complex. Further attributes include that it is a fundamental component of health and physical and mental wellbeing. It exists along a continuum influenced by the values and attitudes of individuals and communities: reflects the physiologic, social, and psychological attributes that are essential to quality of life: is influenced by the individual's changing experiences, perceptions, expectations and ability to adapt to circumstances* (Glick et al., 2016; J. Lee, Watt, Williams, & Giannobile, 2017).

[ii] The WHO defined oral health as "*A state of being free from chronic mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal diseases, tooth decay, tooth loss, and other diseases and disorders that limit an individual's capacity in biting, chewing, smiling, speaking, and psychosocial well-being.*"

Oral Health in the Adult Population

The adult population generally includes persons older than 19 years based on the WHO definition. It is distinguished from “youth” termed as a person aged between 15 and 35 years according to the African Union (African union commission, 2006).

The health of adults is generally influenced by risks that each individual has accumulated since their childhood. For example, non-communicable disease such as cardiovascular disease, diabetes, cancer, and oral diseases are influenced by earlier exposures or experiences based on the life course approach (Kuh D et al. 2004: Lynch J et al 2005: Lu HX et al. 2011. Therefore, it is emphasized that efforts are needed to prevent these diseases starting in early childhood or adolescence. It is also essential to reduce risks in early adulthood (Annamari Nihtila et al 2016).

Moreover, in most of countries, drinking alcohol and smoking tobacco are allowed starting at a certain age in adulthood. This may also influence the health status of the adult population (Baris K. Yoruk et al. 2011).

In addition to these external factors, age-related physical and anatomical changes also accelerate health deterioration. Oral health is strongly dependent on age (Sischo & Broder, 2011). The primary teeth erupt throughout the growth process, unlike other organs in our body. After that, permanent teeth begin to appear at age 6 years and are completed at 12 to 13 years ("Tooth eruption: The primary teeth" 2005). Then, gingival recession occurs as aging progresses. If the oral health condition has not been managed well, tooth loss also appears in the elderly period. Likewise, the oral status can change throughout life by external factors and anatomical characteristics. Timely management is required to manage appropriately by time (Mikkelsen et al., 2019).

3.2 Dental Service Utilization

Oral diseases are preventable. In order to prevent them effectively, it is required to focus on avoiding their causes as is also the case for other non-communicable diseases (Mikkelsen et al., 2019). Moreover, oral diseases are irreversible. For instance, dental caries is caused by decomposition of tooth enamel by acid generated by bacteria present in the mouth. If left untreated for a long time, not only the tooth enamel but also the teeth and the gums are destroyed, and the oral tissues can be harmed. That is, when this process continues, demineralization of tooth enamel and natural mineralization processes are repeated. Thereafter, it reaches an irreversible state ("Maintaining and improving the oral health of young children" 2014) and dental caries may cause pulpitis and periodontitis. Additionally, most oral pain is odontogenous. In this regard, individual efforts for preventive management are needed, and health professionals should also provide adequate preventive care or treatment according to an individual's symptoms.

Dental services are all services that aim to improve oral health: preventive services, symptom treatment, and restorative services (Aday & Eichhorn, 1972). Preventive services include examinations and cleaning to screen for the early stage of oral diseases. Basic restorative services such as symptom treatment aim to provide symptom relief by fillings and extractions. Major restorative services include crowning and root canals among others (Meyerhoefer, Zuvekas, & Manski, 2014). Through regular oral examinations and proper health behavior, it is necessary to prevent and screen early for dental caries, as well as for other for oral diseases, to avoid harm to orofacial organs.

In developed countries, the pattern of dental service utilization has changed to seeking preventive services, whereas it has remained focused on symptom-based treatment in the developing countries. These patterns of service use may influence the oral health status in each country.

Many factors are associated with dental service utilization: the socio-demographic characteristics of individuals, health policies, accessibility of health facilities, health professionals, individual health status, health behavior, and others. As a result of dental service utilization, oral health, as well as quality of life can improve. Accordingly, using dental services in accordance with dental needs is essential (R. Andersen & Davidson, 1997; R. Andersen & Newman, 1973). An unmet need is defined when an individual does not receive adequate services even if he or she has an oral disease. The reasons for unmet medical needs vary and include economic burden, lack of available health facilities, lack of information, waiting time for the service, and others. Among these, economic factors are known to be the most important variables impeding access to health care services.

Dental care is relatively expensive compared to general health care services (R. Andersen & Newman, 1973). Thus, economic factors at all levels are an impediment to the use of dental care. Therefore, the socio-economically vulnerable classes will be more economically burdened with the use of dental care.

In order to achieve universal health coverage on the basis of human rights, especially for the underserved populations, the WHO has emphasized the need to reduce barriers to easy access to health care services excluding no individual. To this end, each country needs to analyze the factors that affect individual health care use and to establish policies to provide effective and efficient health services. The analysis of health service utilization includes analysis of the volume, type, and reasons for health care utilization (Aday & Eichhorn, 1972).

However, in developing countries, which have shortages of health resources, such as health facilities and health professionals, it is required to look at both accessibility and availability for all types of health service utilization. That is, the existing challenges do not only pertain to economic reasons, but also to lack of healthcare infrastructure.

For instance, in Burkina Faso, the ratio of dentists to the general population is one per 220,000 nationally, and no type of curative dental service is covered by the national health insurance system. In previous studies, the unmet dental needs in Ghana were confirmed at 68% and dental aid is not covered by the Ghana National Insurance Scheme. Moreover, the ratio of dentists to the general population is one per 104,000 nationally with great discrepancies among regions. Further, the oral health coverage in Ghana in 2002 to 2004 was 32.2%; a low degree of coverage and high degree of relative inequality were seen. For these reasons, there is need to improve the oral health care delivery system by proper action plans (Aday & Eichhorn, 1972).

3.3 Oral Health-Related Quality of Life

3.3.1 Health and Quality of Life

Quality of life was first suggested in 1920 by Pigou, the British economist (Benzer, 2011; Gift & Atchison, 1995; Ruževičius, 2014; Wood-Dauphinee, 1999). He stated that *"For every form of welfare depends ultimately on something much more fundamental than economic arrangements, namely, the general forces governing biological selection,"* highlighting issues of reaction to economic causes on the quality of life of the population (Pigou, 2017). However, this position did not make a great impression and disappeared.

This term started being applied to many fields including the health areas after World War II (Haag, Peres, Balasubramanian, & Brennan, 2017). By the mid-1900s, all concerns focused on material welfare or wealth, as well as the amount of the population. Yet, considerations regarding life and values were changed to encompass quality of life, as side effects of economic growth, such as overpopulation and environmental issues, highlighted the need for this inclusion (Benzer, 2011; Ruževičius, 2014).

Since then, research on the evaluation of quality of life has become active, and it exploded in earnest since the founding of the journal "*Social Indicators Research"* in 1974. The earliest indicators were mainly objectively measurable, and gradually subjective indicators were proposed for the evaluation of subjective well-being (Benzer, 2011). To date, various studies and discussion on quality of life have been conducted.

Medical scientists began to have questions regarding the non-biological factors that affected an individual's health status between the 1930s and 1960s (Benzer, 2011). For instance, measurements of physical and functional capacity and psychological stability were used for the recruitment of soldiers (Gift & Atchison, 1995).

After World War II, a number of medical techniques were developed and enabled curing diseases and prolonging individual life. However, the advancement of medical technology caused other problems: sustained pain, impairment, and handicap, as opposed to just issues concerning life or death. Besides, the WHO defined health as *"a state of complete physical, mental and social well-being and not merely the absence of disease infirmity."* (World Health Organization, 1946). These changes motivated an idea of health not based on the biological model but on the biopsysocial model, and the regonition of the need for new health indicators.

However, quality of life was not included until Elkington mentioned it for the first time in 1966 (Wood-Dauphinee, 1999). He enquired on the responsibility of medicine regarding the patients' quality of life asking the following questions: *"How does a physician protect the proper quality of life of an individual patient? How can the quality of life be improved in other patients in the future without jeopardizing that of the particular patient through whom this new knowledge is gained? Into which programs of preventive and therapeutic medicine should the resources of society be put to achieve most in health and quality of life for all members of that society?"* (Pennacchini, Bertolaso, Elvira, & De Marinis, 2011). That is, each patient should be regarded as a human being influenced by various factors, such as psychosocial factors, not just as a body seeking material prosperity, and should be treated following this idea.

In the 1970s, as part of patient-centered care, quality of life was used to make decisions on health issues. Specifically, measurements of quality of life in health were adopted for the first time.

This was of great importance because it showed that the subjective perspective of patients was included in the concept of quality of life in a relatively early stage compared to in other fields, and it began to shift from simply viewing biological performance through clinical indicators to measuring health-related quality of life based on the patient's perspective (Benzer, 2011; Pennacchini et al., 2011; Post, 2014).

In the 1980s, the measurements of quality of life were useful for both patients and health professionals to select effective and efficient treatments, and there was great interest in this issue. Likewise, more systematic measurements were needed, and a variety of studies were conducted on quality of life. During this period, the term “Health-related Quality of Life” was included in the title of an article, which was published by Torrance (Post, 2014; Torrance, 1987). The term was derived from the perspective of the International classification of Impairments, Disabilities and Handicaps (ICIDH).

The development of new measurement continued till the 1990s. The tools could be divided into generic measures and diseases-specific measures. The first was useful to collect a trove of information from the general population, and the other was suitable for assessment with specific aims (Pennacchini et al., 2011).

Measuring quality of life was not a means to achieve quantitative goals, but rather a way to examine individual needs more closely. It also has the advantage of being able to measure outcomes for treatment and to deliver medical services using a holistic approach (World Health Organization, 1996). Many types of measurements have been developed to date: The Quality of Well Being Scale, Sickness Impact Profile, McMaster Health Index Questionnaire, The Nottingham Health Profile, Duke Health Profile, The Quality of Life-Index, The Health Utilities Index, EuroQol, The 36-Item Short Form Heath Survey, the World Health Organization Quality of Life Assessment, and others (Wood-Dauphinee, 1999).

Meanwhile, there was constant criticism of the studies on quality of life, especially emphasizing the lack of scientific knowledge. The fact was that there was no agreement on the definition or a conceptual framework to explain quality of life. Some researchers defined quality of life and suggested a theorical model of quality of life according to their research objectives. However, no single definition or framework covered all aspects of quality of life.

In 1995, the WHO reported the definition of quality of life, based on the new concept of health: "*An individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectation, standards and concerns,"* and suggested six domains of quality of life: physical, psychological, level of independence, social relationships, environment, and personal beliefs.

Regarding conceptual models, the Wilson and Cleary model is mostly applied in the research on quality of life. It was developed integrating the biomedical and social models into the biopsychosocial approach and using six domains: Body functions, Body structures, Activities, Participation, Environmental factors, and Personal factors (Wilson & Cleary, 1995). However, it was later revised by Ferrans (Ferrans, Zerwic, Wilbur, & Larson, 2005).

There is a limitation in defining and conceptualizing quality of life in a single simple manner because it has a subjective and multi-dimensional nature and should encompass both positive and negative dimensions (World Health Organization, 1995, 1996). Nonetheless, quality of life is still used as an important indicator in studies and the healthcare field.

3.3.2 Oral Health and Quality of Life

In dentistry, there was a need to define well-being and a wide range of oral health states according to oral conditions later than in medicine. In addition, interest in quality of life also appeared later, initially only in oncology due to the different natures of the physical and oral disorders. Decisively, the severity of oral diseases is limited to severe pain and loss of work (D. Locker, 1988). However, as an important indicator of oral health or quality of life, it is evaluated for various age groups, both male and female.

Oral health-related quality of life has neither one simple definition nor is explained by one simple theory. To date, oral health-related quality of life has not been specifically defined. For instance, Gift and Atchison defined: *"Self-report specifically pertaining to oral health capturing both the functional, social and psychological impacts of oral disease."* Locker described as*: "Symptoms and functional and psychological impacts that emanate from oral disease and disorders."*

In 1998, Locker developed a model for oral health-related quality of life for the first time, inspired by the ICIDH **(Figure 5)**. It has been validated by Baker and is the most commonly used among the oral health-related quality of life tools (David Locker, 1997).

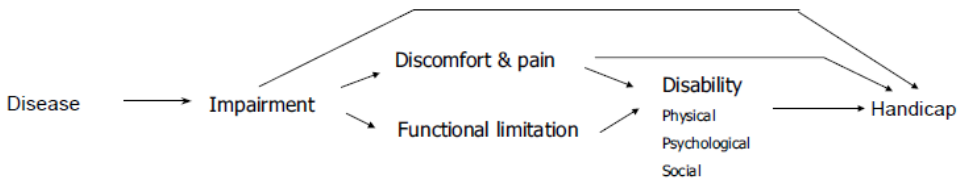


Figure 5. The conceptual model of oral health (Patrick Allen, 2003)

3.3.3 Measurement: Oral Health Impact Profile

It is essential to promote the individual oral health status to improve overall quality of life. Accordingly, there is great interest in the measurement for analysis of the determinants of quality of life. Oral health-related quality of life can be measured with both generic instruments and disease-specific instruments (Haag et al., 2017). Of these, disease-specific instruments have several advantages over generic measures; they are more sensitive to oral health conditions and have fewer “floor effects” in order to specifically investigate oral health (Sischo & Broder, 2011). For these reasons, disease-specific instruments are described according to the objectives of this study.

The measurement of quality of life has used subjective oral health indicators. Most subjective oral health indicators were created to assess the perception of individual oral health status, but are commonly used for evaluating oral health-related quality of life (Haag et al., 2017). Oral health was measured with the Decayed Missing and Filled Teeth index (DMFT) for a long time. However, there were some issues with using only this indicator for the diagnosis of oral health status. The fact is that this index measures the presence of diseases based on health professional judgement. Oral diseases are cumulative; therefore, professional assessment with this instrument does not necessarily represent the current dental health status. Additionally, it raises doubts on reliability in the context of individual perception. Besides, the judgement by health professionals may differ to the perception of patients regarding oral health. Conversely, it does not reflect the various determinants of oral health such as social function, disability, and handicap. Thus, it was required to develop indicators to meet these limitations (Gift & Atchison, 1995; Kent & Croucher, 1998).

There are a variety of tools to measure quality of life associated with oral health as follows. The OHIP, the subjective oral health status indicators (SOHSI), the oral health-related quality of life (OHQoL) and Oral Impacts on Daily Performance: OIDP (MA Brondani et al. 2006). (D. Locker, 1988). In this study, the OHIP was selected to measure oral health-related quality of life.

Oral Health Impact Profile

G. D. Slade (1997) developed one of the measurements for subjective oral health indicators, which is conventionally called the OHIP, based on Locker's theoretical framework. It was purposed to provide information regarding dysfunction, discomfort, and disability affecting the oral health status. Likewise, it shows the impact of the social, psychological, and physical dimensions on oral health status in the social, psychological, and physical dimensions. Mostly, it is useful for measuring the comprehensive oral health status, not only focusing on specific diseases or symptoms. In contrast, it is limited by the fact that it only includes negative effects on oral health. The initiative questionnaires comprised a total of 535 statements. It was finally revised as a questionnaire with 49 items. The respondents are required to answer the questions on a five-point Likert scale. By using this measurement, it is possible to indirectly identify the clinical oral status. It has been validated in many countries.

Later, the OHIP-14 was developed as a representative disease-specific quality of life measurement tool. It is a brief summary of the OHIP-49 developed by Slade. In the past years, 14 items and a 5-point Likert scale have been used to measure oral health-related quality of life. The OHIP has been translated and widely used in many countries since it was constructed by Slade in 1994. Consistency, the validity of the tool is recognized in most countries. Since the development of OHIP, its reliability and validity have been proven.

In previous studies, it was found that oral health was influenced by the following factors: age, sex, education level, socio-economic level, wearing dentures, the number of remaining natural teeth, tooth loss, smoking, the frequency of toothbrushing, dental service utilization, and others (African Development Bank Group; Brennan et al., 2008; Ghana Statistical Service (GSS), Ghana Health Service (GHS), & ICF International, 2015; P. Harris et al., 2009; Holde et al., 2018; John et al., 2004; Marshman et al., 2014; Shin & Kim, 2015; G. Slade et al., 1996). Meanwhile, no previous study has assessed quality of life using the OHIP in Ghana.

IV. ORAL HEALTH-RELATED QUALITY OF LIFE IN GHANA

4.1 Overview of Ghana

The Republic of Ghana is located at the center of West Africa. Its land area is 239,460 km^2 (African Development Bank Group), which is the sixth largest among the West African countries, even 2.4 times bigger than South Korea. Ghana is bordered by Togo in the east, Côte d'Ivoire in the west, and Burkina Faso in the north facing the Atlantic Ocean to the south. It is divided into three ecological zones: sandy coastal plains, a heavy canopy of semi deciduous rainforest, and a savannah. It was originally divided into 10 regions and 216 districts (Ghana Statistical Service (GSS) et al., 2015). Currently, there are 16 regions; new regions were added by referendum in December 2018 (Information Services Department (ISD)).

Ghana is historically and economically one of the leading countries of West Africa. The Asanti Kingdom, which dominated West Africa for a long time, was established where is presently Ghana by Osei Tutu in the 1670s. To date, the Asanti Kingdom continues its influence and culture. For some time, Ghana was colonized by the British, and it gained its independence from Britain first among West African countries after the end of World War II. Since the establishment of the Republic on July 1, 1960, a presidential representative democratic republic has been operating. It has been developing as a peaceful democracy compared to other countries in West Africa (Ministry of Foreign Affairs, 2019). In addition, after Nigeria, the economy of Ghana is the second largest in West Africa (OECD, 2016). Indeed, in 2011, it was classified as a lower middle income country according to the World Bank country classification (World Bank, 2011). As of 2018, the GDP was $65.556 billion and GNI per capita was $2,130. Its economy has developed rapidly; its GDP growth was 6.3% (World Bank, 2019).

Overview of the Volta Region

The Volta region is located at the Eastern part of Ghana. It included 25 districts and it occupied 8.7% of the total land of Ghana and divided into three ecological zones: Semi-savannah woodland, Semi-deciduous forest, and Savannah grassland from the Northern to the Coastal part of the Volta region (Ghana Health Service (GHS)). The Volta region has characteristics representative of Ghana, as some demographic and development indicators showed similarity to the average of the national level: population, poverty rate, urbanization, and others (Wang, Otoo, & Dsane-Selby, 2017). Recently, it was divided into two regions: the Volta and Oti Regions **(Figure 6)**.

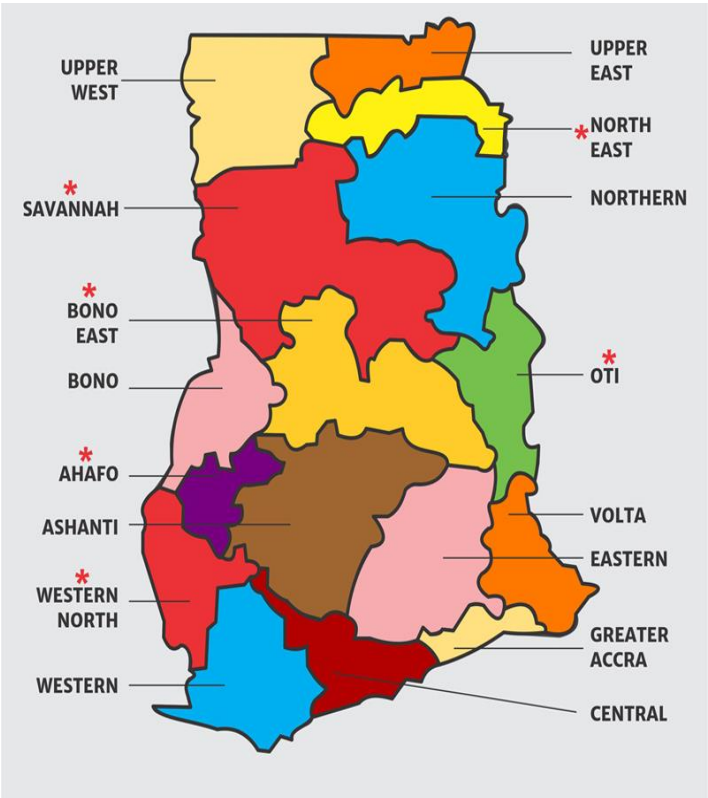


Figure 6. Map of Ghana (as of 2019) (Information Services Department (ISD))

4.1.1 Demographic Characteristics

Population

The population of Ghana has increased from 6.7 million in 1960 to 27.7 million in 2015 (Ghana Statistical Service, 2013, 2018). and it is estimated to be at 29.8 million in 2018 with 2.2% of annual population growth according to the country profile reported by the World Bank. In the Volta region, which was the region with the third lowest population among the 10 regions in 2015, the population had increased from 0.8 million in 1960 to 2.3 million by 2015. Meanwhile, it decreased in terms of the percentage of the distribution of the total population from 11.4% in 1960 to 8.6% in 2015. The sex ratio in Ghana changed from 1960 to 2015: 102.2 men per 100 women to 96.1 men per 100 women. Likewise, there were recently more women than men in the Volta region: women, 1.2 million; men, 1.2 million as of 2015. This is the case for most regions in Ghana. For the Volta region, the sex ratio was 95.2 in 1960 and 96.3 in 2015 (Ghana Statistical Service, 2013, 2018). Looking at the population distribution by age group in Ghana, as of 2015, 37.43% was under 14 years old and 4.22% was 65 years or older. The Volta region had a similar distribution (37.7%, 6.01%) <**Appendix C, D**>.

Ethnicity

The ethnicity of Ghanaians is classified according to the ethnic group they belong. The major ethnic groups are eight. Of these, most Ghanaians belong to a tribe called “Akan” (47.3%). The others are Mole-Dagbani (16.6%), Ewe (13.9%), Ga-Dangme (7.4%), Gurma (5.7%), Guan (3.7%), Grusi (2.5%), Mande (1.1%) and other (1.4%). For the Volta region, most people belonged to the “Ewe” group (73.8%) followed by Gurma (11.3%), Guan (8.1%), Akan (2.8%), Ga-Dangme (1.5%), and others (2.5%), as of 2010 (Ghana Statistical Service, 2013).

Education Level

Education is essential not only for human resource development but also for economic growth. Ghana has pushed ahead with free compulsory basic education (Ghana Statistical Service, 2013). In Ghana, the education level is classified as primary school for 6 years, junior high school for 3 years, senior high school for 3 years, and tertiary school for 3 years or longer. Of these, free education is provided up to junior high school (Ministry of Foreign Affairs, 2019). As of 2010, the literacy rate was 71%, which is quite higher than that in other West African countries **<Appendix E>**, and 71.3% of the population aged 6 years or older were educated up to the level of junior high school. For the Volta region, it was 78.1% (Ghana Statistical Service, 2013). The primary completion rate was 94% (World Bank, 2019).

Religion

Only 5.3% of Ghanaians reported that they are nonreligious as of 2010. Of the total population, 71.2% are Christians and 17.6% are Muslims. There are also some Traditionalists (5.2%). There are several Christian denominations such as Catholic, Protestant, Pentecostal, and others. In the Volta region, most of the population was Christian (72.8%), followed by Muslim (5.7%), and Traditionalist (1.4%) (Ghana Statistical Service, 2013).

4.2 Health Status

4.2.1 General Health

The health status of the Ghanaian population has improved. For instance, life expectancy at birth has increased from 57 years in 1990 and 2000 to 63 years in 2018. The mortality rate of children under 5 years has decreased from 127 per 1,000 live births in 1990 to 49 per 1,000 live births in 2018 (World Bank, 2019).

Nonetheless, communicable diseases are still threatening the health of Ghanaians. For instance, in 2016, malaria (31.1%) was the most common outpatient disease followed by upper respiratory tract infections (17.2%), rheumatism (7.2%), diarrhea-related diseases (7%) and skin diseases (5.1%). This pattern was similar to the previous 3 years from 2014 to 2016, and the number of cases increased. Of these, the major cause of death was malaria (7.28%) (Ghana Health Service, 2017b; Ghana Health Services, 2016).

Meanwhile, the proportion of chronic diseases is also increasing. The major non-communicable diseases are in order: cardiovascular diseases, cancer, diabetes, chronic respiratory disease, and sickle cell diseases. Those have common risk factors: smoking, drinking alcohol, unhealthy diet, and lack of physical activity. The morbidity of non-communicable diseases is expected to increase due to aging, rapid urbanization, and unhealth lifestyles (Ghana Health Service, 2017a).

Indeed, according to the report of the Ghana Demographic Health Survey 2014, of all respondents aged 15 to 49 years, 12.9% of women and 12.5% of men had hypertension, as classified based on the WHO criteria. Moreover, it appeared that hypertension was more frequent among the older and poorer. Meanwhile, 14% of respondents living in the Volta region had hypertension. It was relatively high among the other regions, following the Ashanti region (18.1%) and Central region (16.3%) (Ghana Statistical Service (GSS) et al., 2015) <**Appendix F, G**>.

4.2.2 Oral Health

Information on oral health was difficult to collect because most was outdated and noncomprehensive. Therefore, the morbidity of dental caries and dental swelling among patients who visited any facilities in 2017 and 2018 was confirmed from the District Health Information Management System (DHIMSII). In 2017 and 2018, individuals aged 18 to 34 years showed high percentage of morbidity of dental caries and dental swelling. The morbidity of diseases showed different distribution in each district. The cases of dental caries were more than were the cases of dental swelling **<Appendix H, I>**.

4.3 Health Policy and System

Ghana prioritized reducing the maternal mortality rate and reducing the mortality rate of children under 5 years to achieve the millennium development goals by 2015. Afterward, it established policies of each department on the basis of the sustainable development goals. Meanwhile, in the prevalence rate of chronic diseases, Ghana emphasized the education, screening, early detection, treatment, and health promotion for non-communicable diseases on the Public Health Act 851, which was enacted in 2012. However, specific policy on oral health could not be found on the website of the Ministry of Health or Ghana Health Services.

Delivery for the services of non-communicable diseases is not easy because of lack of infrastructure and lack of capacity among health professionals. The allocation of the national budget to the health sector declined from 2012 (13.5%) to 2015 (9.5%). In 2017, it was 13% but it was still lower than what was internationally required based on the Abuja Declaration. Moreover, the allocation distribution for communicable diseases weighs more than that for non-communicable diseases (Kushitor & Boatemaa, 2018). It can be assumed that the national budget for oral health may be minimal or none.

In 2003, the National Health Insurance Scheme was introduced by Act 650. As of 2011, 72.7% of the health insurance fund consisted of tax followed by 17.4% for the social security fund, 4.5% premium, and others. It exempts the premium for vulnerable groups: children under 18 years old, pregnant women, and the poor. Poverty is calculated at approximately 40% and extreme poverty at higher than 25%. This signifies that many people may have difficulty paying premiums and using health care services. Especially, in the case of dental services, dental aid is not covered by the health insurance.

In Ghana, there are dental surgeons, dentists, dental clinic assistants, dental technicians, dental technologists, and dental therapists. The nationwide dentist to population ratio is 1 per 104,900. For the Volta region, it is 1 per 1,049,928. A total of 18 dental-related professionals are working in the Volta region. Of them, one dental surgeon and three dental technicians are working in the Hohoe municipality.

V. FACTORS OF ORAL HEALTH-RELATED QUALITY OF LIFE IN GHANA

5.1 Characteristics of Subjects

A total of 2,493 residents of the Volta region in Ghana participated in this study, and finally 1,387 responses were analyzed excluding some responses based on the criteria previously mentioned. There were 671 male (44.48%) and 770 female participants (55.52%). The mean age was 40.95 years, 41.77 years for men and 40.30 for women. The following figure shows the distribution of respondents in this study and next, the characteristics of respondents are described in line with the study model **(Figure 7)**.

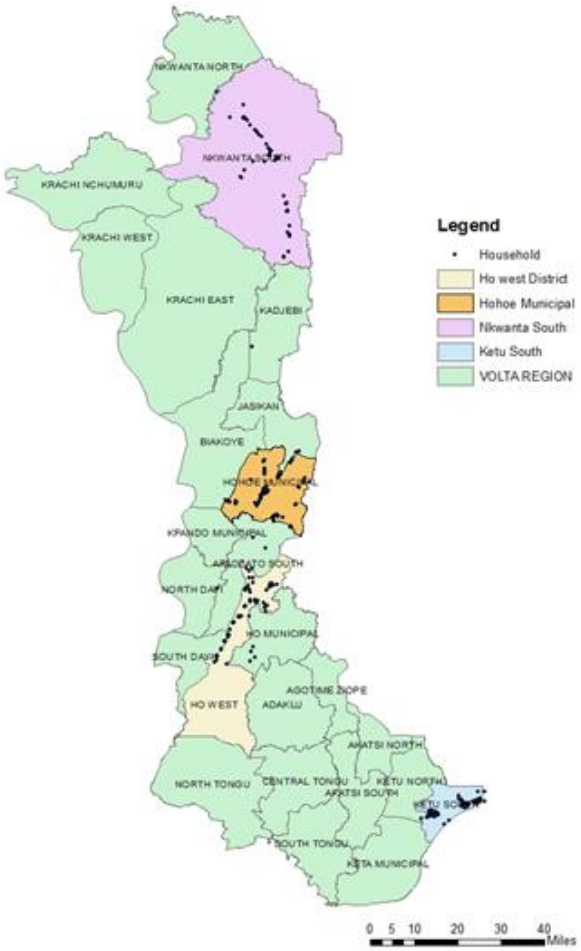


Figure 7. Map of distribution of respondents[iii]

[iii] This figure was designed in 2018 by Philip Kofie, a researcher working in the international collaborative project between Yonsei University in Korea and the University of Health and Allied Sciences in Ghana (UHAS), which title is 'Public health educational capacity development of UHAS, as worked for the community health need assessment of Volta region of Ghana funded by National Research Foundation in Korea.

5.1.1 Participant Characteristics

Participant characteristics were examined as shown in the following table. Of these, some items were significant by sex: age, education level, ethnicity, religion, diagnosis of hypertension and diabetes, status of income and employment, place of residence, experience of oral health education, number of remaining teeth, drinking alcohol, smoking (tobacco), and sugar consumption.

The age of the participants was examined in groups: 18 to 29, 30 to 49, 50 to 64, and over 65 years. Most participants belonged to the 30 to 49 (46.29%) year group, followed by the 18 to 29 (25.96%), 50 to 64 (19.75%), and over 65 (8.00%) year groups for both male and female respondents. The education level of respondents showed the following distribution: Junior High (40.59%), Senior High (23.94%), Primary (14.71%), None (10.74%), and Tertiary (10.02%). There was a higher percentage of men with an education level higher than senior high school. Most respondents belonged to the Ewe (81.69%) and were Christians (89.26%). Few individuals were diagnosed with non-communicable diseases such as hypertension (23.29%) and diabetes (2.88%).

Meanwhile, the hypertension rate was significantly higher among female than among male respondents. Most respondents had a regular income (67.63%) and were employed (76.09%). Most respondents were dwelling in Ketu South (34.82%) followed by Ho west (28.62%), Hohoe (21.77%), and Nkwanta South (14.78%). Only 36.05% of participants had experience of oral health education. Of all respondents, 96.47% had 20 or more teeth followed by 1-19 (2.45%), No teeth (1.08%), and 5.91% were wearing dentures. Most respondents self-reported the status of their teeth (96.54%) or gums (97.19%) as good. Of all respondents, 25.67% had oral pain in the prior 12 months; 28.91% were drinking alcohol and 3.03% were smoking tobacco. Male respondents had a higher tendency to drink alcohol (46.68%) and smoke tobacco (6.32%) compared to female respondents.

Of all respondents, 60.78% reported that they brushed their teeth more than twice per day and 97.76% that they were using a fluoride toothpaste; 86.23% of respondents had never visited a dental service. Regarding oral health related quality of life, 79.16% of respondents reported that they had high quality of life.

Table 5. Participant characteristics by sex

Variables		Male (n=671)	Female (n=770)	Total (n=1,387)	p-value
		N(%)	N(%)	N(%)	
Age	18 ~ 29	168(27.23)	192(24.94)	360(25.96)	.042*
	30 ~ 49	261(42.30)	381(49.48)	642(46.29)	
	50 ~ 64	130(21.07)	144(18.70)	274(19.75)	
	65 ~	58(9.40)	53(6.88)	111(8.00)	
Education	None	43(6.97)	106(13.77)	149(10.74)	<.001
	Primary	65(10.53)	139.(18.05)	204(14.71)	
	Junior High	226(36.63)	337(43.77)	563(40.59)	
	Senior High	193(31.28)	139(18.05)	332(23.94)	
	Tertiary	90(14.59)	49(6.36)	139(10.02)	
Ethnicity	Ewe	484(76.44)	649(84.29)	1,133(81.69)	.003**
	Akan	7(1.13)	16(2.08)	23(1.66)	
	Guan	45(7.29)	45(5.84)	90(6.49)	
	Others	81(13.13)	60(7.79)	141(10.17)	
Religion	Christianity	537(87.03)	701(91.04)	1,238(89.26)	.036*
	Muslim	21(3.40)	23(2.99)	44(3.17)	
	Traditionalist	59(9.56)	46(5.97)	105(7.57)	
Hypertension	No	500(81.04)	564(73.25)	1,064(76.71)	<.001
	Yes	117(18.96)	206(26.75)	323(23.29)	
Diabetes	No	605(98.06)	742(96.36)	1,347(97,12)	.061
	Yes	12(1.94)	28(3.64)	40(2.88)	
Income	No	177(28.69)	272(35.32)	449(32.37)	.009**
	Yes	440(71.31)	498(64.68)	938(67.63)	
Occupation	No	60(9.72)	119(15.45)	179(12.91)	.002**
	Yes	557(90.28)	651(84.55)	1,208(76.09)	
Place of residence	Nkwanta South	113(18.31)	92(11.95)	205(14.78)	.004**
	Hohoe	136(22.04)	166(21.56)	302(21.77)	
	Ho West	174(28.20)	223(28.96)	397(28.62)	
	Ketu South	194(31.44)	289(37.53)	483(34.82)	
OH education	No	364(59.00)	523(67.92)	887(63.95)	<.001
	Yes	253(41.00)	247(32.08)	500(36.05)	

* p<0.05 ** p<0.01

Table 5. Participant characteristics by sex (Continued)

Variables		Male (n=671)	Female (n=770)	Total (n=1,387)	p-value
		N(%)	N(%)	N(%)	
Teeth number	No teeth	12(1.94)	3(0.39)	15(1.08)	.012*
	1 ~ 19	18(2.92)	16(2.08)	34(2.45)	
	20 or more	587(95.14)	751(97.53)	1,338(96.47)	
Denture	No	581(94.17)	724(94.03)	1,305(94.09)	.913
	Yes	36(5.83)	46(5.97)	82(5.91)	
Teeth status	Poor	24(3.89)	24(3.12)	48(3.46)	.434
	Good	593(96.11)	746(96.88)	1,339(96.54)	
Gum status	Poor	18(2.92)	21(2.73)	39(2.81)	.831
	Good	599(97.08)	749(97.27)	1,348(97.19)	
Oral pain	No	456(73.91)	575(74.68)	1,031(74.33)	.744
	Yes	161(26.09)	195(25.32)	356(25.67)	
Alcohol	No	329(53,32)	657(85.32)	986(71.09)	<.001
	Yes	288(46.68)	113(14.68)	401(28.91)	
Tobacco	No	578(93.68)	767(99.61)	1,345(96.97)	<.001
	Yes	39(6.32)	3(0.39)	42(3.03)	
Teeth cleaning	n < 2	259(41.98)	285(37.01)	544(39.22)	.060
	2 ≤ n	358(58.02)	485(62.99)	843(60.78)	
Fluoride toothpaste	No	14(2.27)	17(2.21)	31(2.24)	.939
	Yes	603(97.73)	753(97.79)	1,356(97.76)	
Dental service use	No visit	530(85.90)	666(86.49)	1,196(86.23)	.750
	Visit	87(14.10)	104(13.51)	191(13.77)	
Quality of Life	Low	133(21.56)	156(20.26)	289(20.84)	.555
	High	484(78.44)	614(79.74)	1,098(79.16)	
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	**p-value**
Sugar consumption		15.48 ± 0.55	18.67 ± 0.54	17.25 ± 0.39	<.001

* p<0.05 ** p<0.01

5.2 Differences in Dental Service Use and Oral Health-related Quality of Life

Chi-squared tests were used to determine whether individual characteristics were related to dental service use and oral health-related quality life. In addition, the Mann–Whitney U test was used to analyze sugar consumption by dental service use and quality of life.

5.2.1 Oral Pain

The respondents were asked whether they had experienced pain or discomfort in their oral cavity in the past year. There were significant differences according to: age, religion, diagnosis of hypertension or diabetes, place of residence, number of remaining natural teeth, wearing dentures, drinking alcohol, and dental visits within the past year.

Of all respondents, 25.67% reported having oral pain during last year and comprised the “pain group.” Most respondents in the pain group were aged 30 to 49 years (44.10%) and their education was at the Junior High level (37.08%). Meanwhile, the percentage of elderly in the pain group (15.17%) was relatively higher than that in the no pain group (5.53%). Moreover, among the elderly, 54% had oral pain. This was the highest percentage of having oral pain among the age groups. Significantly, the morbidity of hypertension and diabetes was high in the pain group (31.18%, 5.90%). Most respondents in the pain group had 20 or more teeth (96.47%), but 5.62% had few tooth losses and 14.89% wore dentures. Respondents in the pain group had a higher tendency to drink alcohol (33.43%) compared to the respondents in the no pain group (27.35%). Tooth brushing and use of a fluoride toothpaste were similar between the pain group and no pain group.

Table 6. Oral pain by subject characteristics

Variables		No Pain (n=1,031)	Pain (n=356)	Total (n=1,387)	p-value
		N(%)	N(%)	N(%)	
Age	18 ~ 29	292(28.32)	68(19.10)	360(25.96)	<.001
	30 ~ 49	485(47.04)	157(44.10)	642(46.29)	
	50 ~ 64	197(19.11)	77(21.63)	274(19.75)	
	65 ~	57(5.53)	54(15.17)	111(8.00)	
Education	None	109(10.57)	40(11.24)	149(10.74)	.335
	Primary	141(13.68)	63(17.70)	204(14.71)	
	Junior High	431(41.80)	132(37.08)	563(40.59)	
	Senior High	248(24.05)	84(23.60)	332(23.94)	
	Tertiary	102(9.89)	37(10.39)	139(10.02)	
Ethnicity	Ewe	848(82.25)	285(80.06)	1,133(81.69)	.454
	Akan	13(1.26)	10(2.81)	23(1.66)	
	Guan	62(6.01)	28(7.87)	90(6.49)	
	Others	108(10.48)	33(9.27)	141(10.17)	
Religion	Christianity	934(90.59)	304(85.39)	1,238(89.26)	.021*
	Muslim	30(2.91)	14(3.93)	44(3.17)	
	Traditionalist	67(6.50)	38(10.67)	105(7.57)	
Hypertension	No	819(79.44)	245(68.82)	1,064(76.71)	<.001
	Yes	212(20.56)	111(31.18)	323(23.29)	
Diabetes	No	1,012(98.16)	335(94.10)	1,347(97.12)	<.001
	Yes	19(1.84)	21(5.90)	40(2.88)	
Income	No	336(32.59)	113(31.74)	449(32.37)	.768
	Yes	695(67.41)	243(68.26)	938(67.63)	
Occupation	No	131(12.71)	48(13.48)	179(12.91)	.706
	Yes	900(87.29)	308(86.52)	1,208(87.09)	
Place of residence	Nkwanta South	155(15.03)	50(14.04)	205(14.78)	.005**
	Hohoe	222(21.53)	80(22.47)	302(21.77)	
	Ho West	318(30.84)	79(22.19)	397(28.62)	
	Ketu South	336(32.59)	147(41.29)	483(34.82)	
OH education	No	657(63.72)	230(64.61)	887(63.95)	.765
	Yes	374(36.28)	126(35.39)	500(36.05)	

* $p<0.05$ ** $p<0.01$

Table 7. Oral pain by oral health and health behavior

Variables		No Pain (n=1,031)	Pain (n=356)	Total (n=1,387)	p-value
		N(%)	N(%)	N(%)	
Teeth number	No teeth	14(1.36)	1(0.28)	15(1.08)	<.001
	1 ~ 19	14(1.36)	20(5.62)1	34(2.45)	
	20 or more	1,003(97.28)	335(94.10)	1,338(96.47)	
Denture	No	1,002(97.19)	303(85.11)	1,305(94.09)	<.001
	Yes	29(2.81)	53(14.89)	82(5.91)	
Teeth status	Poor	14(1.36)	34(9.55)	48(3.46)	<.001
	Good	1,017(98.64)	322(90.45)	1,339(96.54)	
Gum status	Poor	12(1.16)	27(7.58)	39(2.81)	<.001
	Good	1,019(98.84)	329(92.42)	1,348(97.19)	
Alcohol	No	749(72.65)	237(66.57)	986(71.09)	.029*
	Yes	282(27.35)	119(33.43)	401(28.91)	
Tobacco	No	1,004(97.38)	341(95.79)	1,345(96.97)	.130
	Yes	27(2.62)	15(4.21)	42(3.03)	
Teeth cleaning	n < 2	400(38.80)	144(40.45)	544(39.22)	.582
	2 ≤ n	631(61.20)	212(59.55)	843(60.78)	
Fluoride toothpaste	No	22(2.13)	9(2.53)	31(2.24)	.664
	Yes	1,009(97.87)	347(97.47)	1,356(97.76)	
Dental visit (in 1 year)	No	1,022(99.13)	322(90.45)	1,344(96.90)	<.001
	Yes	9(0.87)	34(9.55)	43(3.10)	
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	**p-value**
Sugar consumption		17.41 ± 0.46	16.80 ± .71	17.25 ± 0.39	.955

* p<0.05 ** p<0.01

5.2.2 Dental Service Use

The following table shows the characteristics of the respondents depending on whether they had visited a dental service in the past or not. That is, all respondents were divided into two groups, the “no-visit” group and “visit” group in this study (Table 8).

Age was categorized and analyzed by group. Of all included respondents, the 30 to 49-year group was the most frequent in the no-visit group (48.41%). The 30 to 49 and 50 to 64-year groups were equally represented (32.98%). In contrast, the category with the fewest respondents in the no-visit group was that of participants older than 65 years (5.85%) and that of participants 18 to 29 years old in the visit group (12.57%).

Regarding the level of education, most respondents in both groups had completed junior high school (No-visit 42.06%, Visit 31.41%). Among the respondents in the no-visit group, the least populated category was that of participants having completed tertiary school (7.86%), while that in the visit group was of participants having completed no schooling (6.81%).

The ethnic groups of the respondents varied, with the Ewe ethnic group making up the largest proportion of both groups (No-visit 81.02%, Visit 85.86%). Most respondents in both groups were Christians (No-visit 88.96%, Visit 91.10%) followed by Traditionalists (No-visit 7.94%, Visit 5.24%), and Muslims (No-visit 3.09%, Visit 3.66%).

Hypertension was diagnosed in 21.24% and 36.13% in the no-visit and visit groups, respectively, while diabetes was diagnosed in 2.01% and 8.38% in the no-visit and visit groups, respectively. The diagnosis of hypertension and diabetes and the visit to dental services were statistically significantly associated. Regular income was reported by 67.14% of the participants in the no-visit group and 70.68% of those in the visit group.

Most respondents in both groups were employed (No-visit 87.54%, Visit 84.29%) and lived in the Ketu south district (No-visit 34.20%, Visit 38.74%). Most respondents in both groups had no oral health education, and their percentage was higher in the no-visit group (65.3%) than in the visit group (55.5%).

Oral health and health behavior were also examined. There were 97.32% in the no-visit and 91.10% in the visit group who had 20 or more teeth, and the least populated category in both groups was that of respondents who had no teeth (No-visit group 1.09%, Visit group 1.05%).

There was a significant relationship between dental service visits and the number of remaining teeth. Wearing dentures was also significantly associated with the use of dental service, with 3.34% of respondents in the no-visit group and 21.99% in the visit group wearing dentures. Most respondents reported having good tooth (No-visit group 97.49%, Visit group 90.58%) and gum health (No-visit group 978.24%, Visit group 90.58%).

In case of the experience of oral pain in the previous 1 year, 79.01% of No-visit group had no pain, but 54.97% of Visit group had pain. Likewise, there was statistically significant differences between both groups. The visit group had a higher smoking (No-visit group 2.84% Visit group 4.19%) and drinking (No-visit group 28.34% Visit group 32.46%) rate than did the no-visit group, as well as a ratio of toothbrushing more than twice per day (No-visit group 59.95% Visit group 65.97%). Many participants in both groups reported using a fluoride toothpaste (No-visit group 97.66% Visit group 98.43%). Sugar consumption was more frequent in the visit group (No-visit group 16.62 ± 1.01 Visit group 17.25 ± 0.39).

Table 8. Dental service use by subject characteristics

Variables		No visit (n=1,196)	Visit (n=191)	Total (n=1,387)	p-value
		N(%)	N(%)	N(%)	
Age	18 ~ 29	336(28.09)	24(12.57)	360(25.96)	<.001
	30 ~ 49	579(48.41)	63(32.98)	642(46.29)	
	50 ~ 64	211(17.64)	63(32.98)	274(19.75)	
	65 ~	70(5.85)	41(21.47)	111(8.00)	
Education	None	136(11.37)	13(6.81)	149(10.74)	<.001
	Primary	180(15.05)	24(12.57)	204(14.71)	
	Junior High	503(42.06)	60(31.41)	563(40.59)	
	Senior High	283(23.66)	49(25.65)	332(23.94)	
	Tertiary	94(7.86)	45(23.56)	139(10.02)	
Ethnicity	Ewe	969(81.02)	164(85.86)	1,133(81.69)	.445
	Akan	21(1.76)	2(1.05)	23(1.66)	
	Guan	80(6.69)	10(5.24)	90(6.49)	
	Ga	126(10.54)	15(7.85)	141(10.17)	
	Others	121(10.12)	13(6.81)	134(9.66)	
Religion	Christianity	1,064(88.96)	174(91.10)	1,238(89.26)	.397
	Muslim	37(3.09)	7(3.66)	44(3.17)	
	Traditionalist	95(7.94)	10(5.24)	105(7.57)	
Hypertension	No	942(78.76)	122(63.87)	1,064(76.71)	<.001
	Yes	254(21.24)	69(36.13)	323(23.29)	
Diabetes	No	1,172(97.99)	175(91.62)	1,347(97.12)	<.001
	Yes	24(2.01)	16(8.38)	40(2.88)	
Income	No	393(32.86)	56(29.32)	449(32.37)	.332
	Yes	803(67.14)	135(70.68)	938(67.63)	
Occupation	No	149(12.46)	30(15.71)	179(12.91)	.214
	Yes	1,047(87.54)	161(84.29)	1,208(87.09)	
Place of residence	Nkwanta South	195(16.30)	10(5.24)	205(14.78)	<.001
	Hohoe	246(20.57)	56(29.32)	302(21.77)	
	Ho West	346(28.93)	51(26.70)	397(28.62)	
	Ketu South	409(34.20)	74(38.74)	483(34.82)	
OH education	No	781(65.30)	106(55.50)	887(63.95)	.009*
	Yes	415(34.70)	85(44.50)	500(36.05)	

* p<0.05 ** p<0.01

Table 9. Dental service use by oral health and health behavior

Variables		No visit (n=1,196)	Visit (n=191)	Total (n=1,387)	p-value
		N(%)	N(%)	N(%)	
Teeth number	No teeth	13(1.09)	2(1.05)	12(1.08)	<.001
	1 ~ 19	19(1.59)	15(7.85)1	34(2.45)	
	20 or more	1,164(97.32)	174(91.10)	1,338(96.47)	
Denture	No	1,156(96.66)	149(78.01)	1,305(94.09)	<.001
	Yes	40(3.34)	42(21.99)	82(5.91)	
Teeth status	Poor	30(2.51)	18(9.42)	48(3.46)	<.001
	Good	1,166(97.49)	173(90.58)	1,339(96.54)	
Gum status	Poor	21(1.76)	18(9.42)	39(2.81)	<.001
	Good	1,175(98.24)	173(90.58)	1,348(97.19)	
Oral pain	No	945(79.01)	86(45.03)	1,031(74.33)	<.001
	Yes	251(20.99)	105(54.97)	356(25.67)	
Alcohol	No	857(71.66)	129(67.54)	986(71.09)	.244
	Yes	339(28.34)	62(32.46)	401(28.91)	
Tobacco	No	1,162(97.16)	183(95.81)	1,345(96.97)	.359
	Yes	34(2.84)	8(4.19)	42(3.03)	
Teeth cleaning	n < 2	479(40.05)	65(34.03)	544(39.22)	.114
	2 ≤ n	717(59.95)	126(65.97)	843(60.78)	
Fluoride toothpaste	No	28(2.34)	3(1.57)	31(2.24)	.504
	Yes	1,168(97.66)	188(98.43)	1,356(97.76)	
		Mean ± SD	**Mean ± SD**	**Mean ± SD**	**p-value**
Sugar consumption		17.35 ± 0.42	16.62 ± 1.01	17.25 ± 0.39	.829

* p<0.05 ** p<0.01

5.2.3 Oral Health-Related Quality of Life

Oral health-related quality of life was defined as a condition with or without any functional limitation, psychological discomfort, and social disability in daily life, based on information collected using the OHIP. The respondents were grouped as having low quality of life and high quality of life according to their answers, i.e., the low group and high group, respectively. The characteristics of respondents are presented in the following table, as well as their oral health status and health behavior **(Table 10, 11)**.

Most respondents were 30 to 49 years old (Low 44.98%, High 46.63%) and the fewest were over 65 years old (Low 14.88%, High 6.19%). A similar distribution was found in the low and high groups for the education level: most had completed junior high school (Low 41.18%, High 40.44%) and the fewest had completed tertiary school (Low 8.65%, High 10.38%). Ethnicity varied, with the Ewe group making up the highest proportion of the low and high groups (Low 83.04%, High 81.33%). There were many Christians in both groups (Low 85.47%, High 90.26%) and the rate of Traditionalists was higher in the low group than in the high group (Low 10.73%, High 6.74%).

The rate of hypertension and diabetes diagnoses was significantly associated with quality of life: Hypertension (Low 32.53%, High 20.86%) and Diabetes (Low 5.19%, High 2.28%). Most respondents in both groups had a regular income and were employed, with a higher percentage in the low group than in the high group: Income (Low 70.24%, High 66.94%) and Occupation (Low 87.89%, High 86.89%). In the low group, most (41.87%) of respondents were dwelling in the Ketu South district, whereas most (30.24%) of respondents in the high group were living in the Ho West district. Regarding the experience of oral health education, it was slightly higher in the high group (Low 35.64% High 36.16%).

Oral health status such as the number of remaining teeth, wearing dentures, self-evaluated status of teeth and gums, and oral pain was strongly associated with quality of life ($p < .001$). Most respondents had 20 or more teeth in both groups (Low 92.73% High 97.45%). The rate of wearing dentures was higher in the low group than in the high group (Low, 15.57%; High, 3.37%).

The self-evaluated status of teeth and gums was generally good in all groups and those rates were higher in the high group than in the low group: good tooth status (Low 86.85% High 99.09%) and good gum status (Low 89.27% High 99.27%).

As for experience of oral pain during the previous 12 months, different aspects appeared in the two groups; 70.24% of respondents in the Low group had oral pain in contrast to 13.93% of respondents in the high group. Additionally, the rate of drinking and smoking was higher in the low group than in the high group: drinking (Low 35.64 % High 27.14%) and smoking (Low 3.81% High 2.82%). In contrast, more respondents brushed their tooth more than twice per day (Low 55.36% High 62.20%) and used a fluoride toothpaste (Low 96.19% High 98.18%) in the high group than in the low group. Sugar consumption was more frequent in the low group (Low 18.39 ± 0.94 High 16.95 ± 0.43).

There was a strongly significant association only for the dental service use ($p < .001$). Among the respondents in the low group, 68.51% had not visited a dental service, and 90.89% of respondents in high group neither; 76% of respondents in the high group had unmet dental needs.

Table 10. Oral health-related quality of life by subject characteristics

Variables		Low (n=289)	High (n=1,098)	Total (n=1,387)	p-value
		N(%)	N(%)	N(%)	
Age	18 ~ 29	45(15.57)	315(28.69)	360(25.96)	<.001
	30 ~ 49	130(44.98)	512(46.63)	642(46.29)	
	50 ~ 64	71(24.57)	203(18.49)	274(19.75)	
	65 ~	43(14.88)	68(6.19)	111(8.00)	
Education	None	38(13.15)	111(10.11)	149(10.74)	.486
	Primary	44(15.22)	160(14.57)	204(14.71)	
	Junior High	119(41.18)	444(40.44)	563(40.59)	
	Senior High	63(21.80)	269(24.50)	332(23.94)	
	Tertiary	25(8.65)	114(10.38)	139(10.02)	
Ethnicity	Ewe	240(83.04)	893(81.33)	1,133(81.69)	.156
	Akan	8(2.77)	15(1.37)	23(1.66)	
	Guan	20(6.92)	70(6.38)	90(6.49)	
	Others	21(7.27)	120(10.93)	141(10.17)	
Religion	Christianity	247(85.47)	991(90.26)	1,238(89.26)	.054
	Muslim	11(3.81)	33(3.01)	44(3.17)	
	Traditionalist	31(10.73)	74(6.74)	105(7.57)	
Hypertension	No	195(67.47)	869(79.14)	1,064(76,71)	<.001
	Yes	94(32.53)	229(20.86)	323(23.29)	
Diabetes	No	274(94.81)	1,073(97.72)	1,347(97.12)	.008**
	Yes	15(5.19)	25(2.28)	40(2.88)	
Income	No	86(29.76)	363(33.06)	449(32.37)	.286
	Yes	203(70.24)	735(66.94)	938(67.63)	
Occupation	No	35(12.11)	144(13.11)	179(12.91)	.651
	Yes	254(87.89)	954(86.89)	1,208(87.09)	
Place of residence	Nkwanta South	27(9.34)	178(16.21)	205(12.78)	<.001
	Hohoe	76(26.30)	226(20.58)	302(21.77)	
	Ho West	65(22.49)	332(30.24)	397(28.62)	
	Ketu South	121(41.87)	362(32.97)	483(34,82)	
OH education	No	186(64.36)	701(63.84)	887(63.95)	.871
	Yes	103(35.64)	397(36.16)	500(36.05)	

* p<0.05 ** p<0.01

Table 11. Oral health-related quality of life by oral health and health behavior

Variables		Low (n=289)	High (n=1,098)	Total (n=1,387)	p-value
		N(%)	N(%)	N(%)	
Teeth number	No teeth	1(0.35)	14(1.28)	15(1.08)	<.001
	1 ~ 19	20(6.92)	14(1.28)	34(2.45)	
	20 or more	268(92.73)	1.070(97.45)	1,338(96.47)	
Denture	No	244(84.43)	1,061(96.63)	1,305(94.09)	<.001
	Yes	45(15.57)	37(3.37)	82(5.91)	
Teeth status	Poor	38(13.15)	10(0.91)	48(3.46)	<.001
	Good	251(86.85)	1,088(99.09)	1,339(96.54)	
Gum status	Poor	31(10.73)	8(0.73)	39(2.81)	<.001
	Good	258(89.27)	1,090(99.27)	1,348(97.19)	
Oral pain	No	86(29.76)	945(86.07)	1,031(74.33)	<.001
	Yes	203(70.24)	153(13.93)	356(25.67)	
Alcohol	No	186(64.36)	800(72.86)	986(71.09)	.005**
	Yes	103(35.64)	298(27.14)	401(28.91)	
Tobacco	No	278(96.19)	1,067(97.18)	1,345(96.97)	.439
	Yes	11(3.81)	31(2.82)	42(3.03)	
Teeth cleaning	n < 2	129(44.64)	415(37.80)	544(39.22)	.034*
	2 ≤ n	160(55.36)	683(62.20)	843(60.78)	
Fluoride toothpaste	No	11(3.81)	20(1.82)	31(2.24)	.042*
	Yes	278(96.19)	1,078(98.18)	1,356(97.76)	
Dental service use	No visit	198(68.51)	998(90.89)	1,196(86.23)	<.001
	Visit	91(31.49)	100(9.11)	191(13.77)	
Unmet needs	Unmet	138(68.66)	116(76.32)	254(71.95)	.113
	Met	63(31.34)	36(23.68)	99(28.05)	
		Mean ± SD	Mean ± SD	Mean ± SD	p-value
Sugar consumption		18.39 ± 0.94	16.95 ± 0.43	17.25 ± 0.39	.967

* p<0.05 ** p<0.01

5.3 Factors Associated with Dental Service Use

Hierarchical logistic regression was adopted to confirm how predisposing, enabling, need, and health behavior factors influence dental service use. In Model 1, only predisposing factors were included: Age, Sex, Education, Ethnicity, Hypertension, and Diabetes. Predisposing and enabling factors (e.g., Income, Occupation, Place of residence, Oral health education) were included in Model 2. In Model 3, need factors were added to Model 2, including: Number of remaining teeth, Dentures, Self-evaluated tooth and gum status. Health behavior factors were included in Model 4 adjusting for other factors in Model 3.

Each model was significant. The coefficient of determinants (Pseudo R^2) on each Model increased: R^2=.102 in Model 1, R^2=.119 in Model 2, R^2=.220 in Model 3, and R^2=.229 in Model 4. The degree of increase in the coefficient of determinants ($\triangle R^2$) was calculated: .016 from Model 1 to Model 2, .102 from Model 2 to Model 3, and .084 from Model 3 to Model 4. Accordingly, predisposing factors appeared to relate to the pattern of dental service use more than other factors and need factors followed. Moreover, the significance of each sub-indicator, under predisposing, enabling, need, and health behavior factors was identified as follows.

Among the predisposing factors, age and education level were significantly associated with dental service use. For example, the group aged 30 to 49 years visited dental services 1.69 times more frequently than did the group aged 18 to 29 years, which was the reference group (OR = 1.69, 95% CI 1.02 to 2.78, $p < .041$). The group aged 50 to 64 years visited dental services 4.31 times more frequently than did the reference group (OR = 4.31, 95% CI 2.53 to 7.532, $p < .001$). The group aged over 65 years visited dental services 7.58 times more frequently than did the reference group (OR = 7.58, 95% CI 4.14 to 13.87, $p < .001$).

In terms of education level, the group that had higher than junior high school education appeared to be using dental services more than did the group that had a junior high school education or lower (OR = 2.33, 95% CI 1.66 to 3.29, $p < .001$).

In Model 2, enabling factors were confirmed adjusting for the predisposing factors. Respondents who had regular income or were employed, had visited dental care services more than the others (OR = 1.31, 95% CI 0.88 to 1.95, $p = .178$) (OR = 0.77, 95% CI 044 to 1.32, $p = .336$), but the result was not significant. Respondents who lived in the Hohoe municipality (OR = 3.01, 95% CI 1.37 to 6.59, $p = .006$) and Ketu South district (OR = 2.95, 95% CI 1.29 to 6.75, $p = .010$) used the services significantly more than did respondents who lived in the Nkwanta South district.

Some need factors had a significant effect on dental service use adjusting for predisposing and enabling factors in Model 3. Pain ($z = 6.20$, $p < .001$) was the most significant, followed by wearing dentures ($z = 5.86$, $p < .001$) and gum status ($z = -2.20$, $p = .028$). Dental service use appeared to be more frequent according to having oral pain (OR = 3.17, 95% CI 2.20 to 4.56, $p < .001$), wearing dentures (OR = 5.41, 95% CI 3.08 to 9.52, $p < .001$), and poor gum status (OR = 0.28, 95% CI 0.09 to 0.87, $p = .028$).

Health behavior factors were added to Model 4, adjusting for other factors. Toothbrushing appeared to be a significant factor for dental service use ($p = .019$), while the others had no association with dental service utilization. Respondents brushing their teeth more than twice per day visited 1.59 times more frequently than did the others (OR = 1.59, 95% CI 1.08 to 2.34).

Table 12. Factors associated with dental service use

	Dental Service Utilization, Odds ratio (95% CI)			
	Model 1	Model 2	Model 3	Model 4
Age				
18~29	1.00	1.00	1.00	1.00
30~49	**1.69(1.02-2.78)**	1.68(0.99-2.85)	1.42(0.82-2.47)	1.45(0.83-2.54)
50~64	**4.31(2.54-7.32)**	4.29(2.46-7.48)	3.88(2.16-6.98)	4.14(2.27-7.56)
65~	**7.58(4.14-13.87)**	7.72(4.17-14.30)	5.13(2.66-9.90)	5.74(2.92-11.31)
Gender				
Male	1.00	1.00	1.00	1.00
Female	1.19(0.85-1.68)	1.15(0.81-1.64)	1.22(0.84-1.78)	1.27(0.84-1.92)
Education				
JHS, below	1.00	1.00	1.00	1.00
Beyond JHS	2.33(1.66-3.29)	2.01(1.41-2.88)	2.33(1.58-3.43)	2.22(1.50-3.30)
Ethnicity				
Non-Ewe	1.00	1.00	1.00	1.00
Ewe	1.06(0.67-1.69)	0.74(0.42-1.31)	0.72(0.39-1.34)	0.71(0.38-1.34)
Religion				
Non-Christian	1.00	1.00	1.00	1.00
Christian	1.04(0.59-1.83)	0.99(0.55-1,78)	1.17(0.62-2.19)	1.17(0.62-2.21)
Hypertension				
No	1.00	1.00	1.00	1.00
Yes	1.23(0.85-1.78)	1.21(0.83-1.76)	1.10(0.73-1.64)	1.11(0.74-1.67)
Diabetes				
No	1.00	1.00	1.00	1.00
Yes	2.01(0.98-4.13)	2.00(0.97-4.13)	1.31(0.57-3.00)	1.33(0.57-3.09)
Income				
No		1.00	1.00	1.00
Yes		1.31(0.88-1.95)	1.25(0.82-1.91)	1.21(0.79-1.86)
Occupation				
No		1.00	1.00	1.00
Yes		0.77(0.44-1.32)	0.82(0.46-1.46)	0.81(0.45-1.44)
Place of residence				
Nkwanta South		1.00	1.00	1.00
Hohoe		**3.01(1.37-6.59)**	3.29(1.42-7.64)	3.58(1.52-8.47)
Ho west		2.28(0.98-5.28)	2.33(0.94-5.80)	2.42(0.96-6.15)
Ketu South		**2.95(1.29-6.75)**	3.70(1.50-9.08)	3.58(1.43-8.97)
Oral health education				
No		1.00	1.00	1.00
Yes		1.41(0.99-2.00)	1.39(0.95-2.02)	1.36(0.94-1.99)
# of teeth				
Less than 20			1.00	1.00
20 and more			0.54(0.24-1.21)	0.51(0.23-1.13)
Denture				
No			1.00	1.00
Yes			**5.41(3.08-9.52)**	5.43(3.07-9.60)

Table 12. Factors associated with dental service use (Continued)

	Dental Service Utilization, Odds ratio (95% CI)			
	Model 1	Model 2	Model 3	Model 4
Teeth status				
Poor			1.00	1.00
Good			1.27(0.42-3.84)	1.10(0.35-3.46)
Gum status				
Poor			1.00	1.00
Good			**0.28(0.09-0.87)**	0.29(0.09-0.90)
Oral pain				
No			1.00	1.00
Yes			**3.17(2.20-4.56)**	3.17(2.20-4.58)
Sugar intake				1.00(0.99-1.02)
Alcohol				
No				1.00
Yes				1.17(0.77-1.78)
Tobacco				
No				1.00
Yes				1.56(0.62-3.92)
Teeth cleaning				
n<2				1.00
n>=2				**1.59(1.08-2.34)**
Fluoride toothpaste				
No				1.00
Yes				2.82(0.69-11.63)
Likelihood ratio	113.75	132.01	245.06	254.42
Log likelihood	-499.007	-489.879	-433.352	-428.673
Wald chi2	106.51***	16.85***	105.10***	8.87

* p<0.05 ** p<0.01 *** p<0.001, Significant variables were highlighted in the table.
Model 1: Adjusted for Predisposing factors
Model 2: Adjusted for Model 1 + Enabling factors
Model 3: Adjusted for Model 2 + Need factors
Model 4: Adjusted for Model 3 + Oral Health behavior

5.4 Factors Associated with Unmet Dental Needs

Unmet dental need was defined as having oral pain during the last 12 months, but not visiting any health facilities. The total number of respondents with unmet dental needs was 353. This analysis intended to elucidate the factors that influence unmet dental needs using hierarchical logistic regression.

In each model, predisposing, enabling, need, and health behavior factors excluding “Oral pain” and “Dental visit” factors were included as in the other analysis.

The model was significant and the coefficient of determinants (Pseudo R^2) was as follows: .056, .066, 0.087, and 0.114, respectively. It showed that predisposing factors were the most important followed by health behavior factors.

Of the predisposing factors, the diagnosis of diabetes significantly showed that respondents with diabetes were three times more likely than the others to have unmet needs (OR = 3.00, 95% CI 1.13 to 7.99, p = .028), whereas, there was no significant association with the enabling factors. For the need factors, wearing dentures (OR = 2.48, 95% CI 1.26 to 4.91, p = .009) and toothbrushing (OR = 2.62, 95% CI 1.46 to 4.71, p = .001) were significant in Model 4.

Table 13. Factors associated with unmet dental needs

	Unmet needs, Odds ratio (95% CI)			
	Model 1	Model 2	Model 3	Model 4
Age				
18~29	1.00	1.00	1.00	1.00
30~49	1.12(0.55-2.29)	1.00(0.46-2.15)	0.97(0.45-2.11)	1.03(0.47-2.27)
50~64	1.83(0.83-4.04)	1.67(0.73-3.84)	1.57(0.67-3.67)	1.94(0.80-4.66)
65~	2.12(0.89-5.02)	2.04(0.85-4.90)	1.90(0.78-4.67)	2.44(0.96-6.23)
Gender				
Male	1.00	1.00	1.00	1.00
Female	1.05(0.63-1.77)	1.10(0.65-1.85)	1.08(0.63-1.86)	0.93(0.51-1.70)
Education				
JHS	1.00	1.00	1.00	1.00
More than JHS	1.33(0.79-2.23)	1.21(0.71-2.08)	1.31(0.75-2.30)	1.11(0.62-1.99)
Ethnicity				
Non-Ewe	1.00	1.00	1.00	1.00
Ewe	2.02(0.99-4.14)	1.81(0.70-4.65)	1.68(0.66-4.31)	1.85(0.71-4.86)
Religion				
Non-Christian	1.00	1.00	1.00	1.00
Christian	1.24(0.58-2.62)	1.02(0.47-2.24)	1.11(0.50-2.47)	1.16(0.51-2.62)
Hypertension				
No	1.00	1.00	1.00	1.00
Yes	1.02(0.59-1.79)	1.04(0.59-1.82)	1.14(0.64-2.03)	1.12(0.62-2.03)
Diabetes				
No	1.00	1.00	1.00	1.00
Yes	**3.00(1.13-7.99)**	**3.04(1.13-8.21)**	2.54(0.91-7.06)	2.40(0.82-7.00)
Income				
No		1.00	1.00	1.00
Yes		0.83(0.47-1.47)	0.81(0.45-1.46)	0.67(0.36-1.24)
Occupation				
No		1.00	1.00	1.00
Yes		1.22(0.53-2.79)	1.28(0.56-2.94)	1.27(0.55-2.95)
Place of residence				
Nkwanta South		1.00	1.00	1.00
Hohoe		1.80(0.58-5.58)	1.89(0.61-5.92)	2.07(0.65-6.57)
Ho west		1.98(0.58-6.85)	1.96(0.57-6.77)	1.99(0.57-6.97)
Ketu South		1.20(0.35-4.08)	1.54(0.45-5.30)	1.32(0.38-4.65)
Oral health education				
No		1.00	1.00	1.00
Yes		1.14(0.67-1.95)	1.09(0.63-1.89)	1.01(0.58-1.77)

Table 13. Factors associated with unmet dental needs (Continued)

	Unmet dental needs Odds ratio (95% CI)			
	Model 1	Model 2	Model 3	Model 4
# of teeth				
Less than 20			1.00	1.00
20 and more			0.92(0.31-2.78)	0.83(0.27-2.57)
Denture				
No			1.00	1.00
Yes			2.48(1.26-4.91)	**2.51(1.23-5.12)**
Teeth status				
Poor			1.00	1.00
Good			**0.46(0.12-1.70)**	0.56(0.15-2.19)
Gum status				
Poor			1.00	1.00
Good			1.93(0.44-8.53)	1.60(0.34-7.51)
Sugar intake				1.00(0.98-1.02)
Alcohol				
No				1.00
Yes				1.05(0.58-1.92)
Tobacco				
No				1.00
Yes				0.70(0.17-2.91)
Teeth cleaning				
n<2				1.00
n>=2				2.62(1.46-4.71)
Likelihood ratio	23.26	27.79	36.64	47.92
Log likelihood	-197.78582	-195.59672	-191.29291	-185.50557
Wald chi2	21.08*	4.32	8.72	10.75*

5.5 Factors Associated with Oral Health-Related Quality of Life

The effect of individual characteristics and health behavior on oral health-related quality of life was examined among a total of 1,387 respondents. The hierarchical logistic regression analysis was fit on the conceptual framework. In total, three models were derived: Predisposing and Enabling factors together in Model 1, Needs in Model 2, and Health behavior factors including the factor of dental service use in Model 3. In addition, it was specifically examined which sub-indicators were associated with oral health-related quality of life. The fit of all models was confirmed to be significant before the statistical analysis.

In Model 1, sub-indicators under the predisposing factors: age, sex, education level, ethnicity, hypertension, and diabetes; enabling factors: income and employment status, and regional factors, place of residence and oral health education, were adjusted. The self-evaluated status of teeth and gum, wearing dentures, and experience of having oral pain were included in Model 2, and sugar consumption, drinking alcohol, smoking tobacco, using a fluoride toothpaste, and use of dental services were included in Model 3.

The coefficient of determinants (Pseudo R^2) was at each stage: = .051, = .300, and = .315, respectively. Correspondingly, need factors ($\triangle R^2$= .250) were strongly associated with oral health-related quality of life followed by predisposing and enabling factors ($\triangle R^2$=.051), and health behavior factors ($\triangle R^2$=.015).

All age groups and some living area groups appeared to be significantly associated with oral health-related quality of life among the predisposing and enabling factors. As the age increased, oral health-related quality of life appeared to decrease. For instance, respondents aged 30 to 49 years were 0.65 times the quality of life of people aged 18 to 29 years, the reference age group (OR = 0.65 95% CI 0.44 to 0.97, p = .033).

The group aged 50 to 64 years had 0.52 times (OR = 0.52 95% CI 0.33 to 0.81, p = .004), and the group aged over 65 years had 0.29 times (OR = 0.29, 95% CI 0.17 to 0.49, p < .001) the quality of life of the reference age group.

Residents of the Hohoe municipality (OR = 0.41, 95% CI 0.23 to 0.72, p = .002) and Ketu South (OR = 0.39, 95% CI 0.22 to 0.71, p = .002) had low oral health-related to quality of life compared to the residents of Nkwanta South.

Among the need factors, most were significantly related to quality of life, excluding the number of remaining teeth (p = 0.586). Oral pain was most strongly associated with oral health-related quality of life (z = -14.87 p < .001). It appeared that people who had oral pain during the last 12 months had 0.08 times lower quality of life than did the others (OR = 0.08, 95% CI 0.06 to 0.12, p < .001). Moreover, respondents wearing any type of denture had quality of life 0.40 times higher quality of life than the others (OR = 0.41, 95% CI 0.23 to 0.73, p = .003). However, when the status of teeth (OR = 4.37, 95% CI 1.54 to 12.40, p = .006) and gums (OR = 4.11, 95% CI 1.24 to 13.60, p = .020) was subjectively considered as good, the quality of life was also evaluated as good.

Sugar consumption had a negative effect on quality of life (z = -2.70, p = .007). The higher the intake of sugary foods, the lower the quality of life (OR = 0.98, 95% CI 0.97 to 1.00, p = .007). Additionally, dental service use was a quite powerful factor negatively influencing quality of life (z = -3.06, OR = 0.50, 95% CI 0.32 to 0.78, p = .002).

Table 14. Factors associated with oral health-related quality of life

	Oral Health-related Quality of Life, Odds ratio (95% CI)		
	Model 1	Model 2	Model 3
Age			
18~29	1.00	1.00	1.00
30~49	**0.65(0.44-0.97)**	0.74(0.47-1.17)	0.71(0.45-1.14)
50~64	**0.52(0.33-0.81)**	0.61(0.36-1.03)	0.64(0.37-1.12)
65~	**0.29(0.17-0.49)**	0.63(0.33-1.19)	0.67(0.34-1.31)
Gender			
Male	1.00	1.00	1.00
Female	1.19(0.89-1.58)	1.20(0.85-1.69)	1.15(0.79-1.68)
Education			
JHS	1.00	1.00	1.00
More than JHS	1.29(0.94-1.76)	1.29(0.89-1.87)	1.34(0.91-1.96)
Ethnicity			
Non-Ewe	1.00	1.00	1.00
Ewe	1.29(0.81-2.05)	1.21(0.67-2.17)	1.25(0.70-2.24)
Religion			
Non-Christian	1.00	1.00	1.00
Christian	1.45(0.95-2.20)	1.20(0.72-2.00)	1.18(0.71-1.98)
Hypertension			
No	1.00	1.00	1.00
Yes	0.73(0.54-1.01)	0.77(0.52-1.13)	0.75(0.51-1.11)
Diabetes			
No	1.00	1.00	1.00
Yes	0.66(0.33-1.33)	1.32(0.56-3.11)	1.25(0.52-3.02)
Income			
No	1.00	1.00	1.00
Yes	0.82(0.60-1.13)	0.86(0.59-1.26)	0.85(0.58-1.25)
Occupation			
No	1.00	1.00	1.00
Yes	1.07(0.67-1.72)	0.96(0.54-1.68)	0.93(0.52-1.66)
Place of residence			
Nkwanta South	1.00	1.00	1.00
Hohoe	0.41(0.23-0.72)	**0.33(0.17-0.66)**	0.39(0.20-0.78)
Ho west	0.63(0.34-1.15)	0.51(0.24-1.08)	0.60(0.28-1.28)
Ketu South	0.39(0.22-0.71)	**0.30(0.15-0.63)**	0.36(0.17-0.75)
Oral health education			
No	1.00	1.00	1.00
Yes	0.93(0.70-1.25)	0.96(0.68-1.37)	0.95(0.67-1.36)

Table 14. Factors associated with oral health-related quality of life (Continued)

	Oral Health-related Quality of Life, Odds ratio (95% CI)		
	Model 1	Model 2	Model 3
# of teeth			
Less than 20		1.00	1.00
20 and more		1.26(0.55-2.92)	1.22(0.53-2.82)
Denture			
No		1.00	1.00
Yes		0.41(0.23-0.73)	**0.50(0.28-0.92)**
Teeth status			
Poor		1.00	1.00
Good		4.37(1.54-12.40)	**4.13(1.44-11.90)**
Gum status			
Poor		1.00	1.00
Good		4.11(1.24-13.60)	**3.31(0.97-11.26)**
Oral pain			
No		1.00	1.00
Yes		0.08(0.06-0.12)	**0.09(0.06-0.12)**
Sugar intake		-	**0.98(0.97-1.00)**
Alcohol			
No			1.00
Yes			0.78(0.53-1.15)
Tobacco			
No			1.00
Yes			1.25(0.53-2.97)
Teeth cleaning			
n<2			1.00
n>=2			1.35(0.96-1.89)
Fluoride toothpaste			
No			1.00
Yes			1.73(0.63-4.72)
Dental service use			
No visit			1.00
Visit			**0.50(0.32-0.78)**
Likelihood ratio	71.62	426.49	447.71
Log likelihood	-674.02708	-496.59422	-485.9818
Wald chi2	67.14***	264.55***	20.73*

* p<0.05 ** p<0.01 *** p<0.001, Significant variables were highlighted in the table.
Model 1: Adjusted for Predisposing factors + Enabling factors
Model 2: Adjusted for Model 1 + Need factors
Model 3: Adjusted for Model 2 + Oral health behavior + Dental service use

5.6 Association Between Quality of Life and Dental Service Use

All responses from the total of 1,387 respondents were analyzed to confirm the association between quality of life and dental service utilization. Specifically, it was confirmed that dental service use was significantly related to quality of life, although the variables were adjusted in order. At each stage, the fit of the model was significant.

In Model 1, predisposing and enabling factors were included. The quality of life those who had never used any dental service (reference group), was 0.25 times higher than that of those who had visited at least once (OR = 0.25, 95% CI 0.18 to 0.35, $p < .001$). In Model 2, the need factors were additionally included. It was shown that the odds ratio was significantly 0.52 times more in the group that respondents have not visited any dental services before than the reference group (OR = 0.52, 95% CI 0.34 to 0.80, $p = .003$). Moreover, there was significant effect on the quality of life between those who had never used dental services and those who had, and the odds ratio was 0.5 (OR = 0.50, 95% CI 0.32 to 0.78, $p = .002$).

Meanwhile, there were significant variables in each model: age, education level, and place or residence in Model 1; education level, wearing dentures, tooth and gum status, and oral pain in Model 2; and place of residence, wearing dentures, tooth status, and sugar consumption in Model 3.

Table 15. Association between quality of life and dental service utilization

	Oral Health-related Quality of Life, Odds ratio (95% CI)		
	Model 1	Model 2	Model 3
Dental service use			
No visit	1.00	1.00	1.00
Visit	**0.25(0.18-0.35)**	**0.52(0.34-0.80)**	**0.50(0.32-0.78)**
Age			
18~29	1.00	1.00	1.00
30~49	0.70(0.47-1.04)	0.75(0.48-1.19)	0.71(0.45-1.14)
50~64	0.67(0.42-1.07)	0.68(0.39-1.16)	0.64(0.37-1.12)
65~	**0.43(0.25-0.75)**	0.72(0.37-1.39)	0.67(0.34-1.31)
Gender			
Male	1.00	1.00	1.00
Female	1.22(0.91-1.64)	1.21(0.86-1.71)	1.15(0.79-1.68)
Education			
JHS	1.00	1.00	1.00
More than JHS	**1.52(1.09-2.11)**	1.38(0.95-2.00)	1.34(0.91-1.96)
Ethnicity			
Non-Ewe	1.00	1.00	1.00
Ewe	1.22(0.76-1.98)	1.21(0.67-2.16)	1.25(0.70-2.24)
Religion			
Non-Christian	1.00	1.00	1.00
Christian	1.48(0.96-2.27)	1.22(0.73-2.04)	1.18(0.71-1.98)
Hypertension			
No	1.00	1.00	1.00
Yes	0.75(0.54-1.04)	0.78(0.53-1.14)	0.75(0.51-1.11)
Diabetes			
No	1.00	1.00	1.00
Yes	0.79(0.38-1.62)	1.39(0.58-3.33)	1.25(0.52-3.02)
Income			
No	1.00	1.00	1.00
Yes	0.86(0.62-1.19)	0.88(0.60-1.29)	0.85(0.58-1.25)
Occupation			
No	1.00	1.00	1.00
Yes	1.02(0.62-1.66)	0.94(0.53-1.66)	0.93(0.52-1.66)
Place of residence			
Nkwanta South	1.00	1.00	1.00
Hohoe	**0.47(0.26-0.83)**	**0.36(0.18-0.72)**	**0.39(0.20-0.78)**
Ho west	0.69(0.37-1.28)	0.53(0.25-1.13)	0.60(0.28-1.28)
Ketu South	**0.44(0.24-0.81)**	**0.33(0.16-0.68)**	**0.36(0.17-0.75)**
Oral health education			
No	1.00	1.00	1.00
Yes	1.00(0.74-1.36)	0.98(0.68-1.39)	0.95(0.67-1.36)

Table 15. Association between quality of life and dental service utilization (Continued)

	Oral Health-related Quality of Life, Odds ratio (95% CI)		
	Model 2	Model 3	Model 5
# of teeth			
Less than 20		1.00	1.00
20 and more		1.20(0.52-2.78)	1.22(0.53-2.82)
Denture			
No		1.00	1.00
Yes		**0.49(0.27-0.90)**	**0.50(0.28-0.92)**
Teeth status			
Poor		1.00	1.00
Good		**4.53(1.58-13.01)**	**4.13(1.44-11.90)**
Gum status			
Poor		1.00	1.00
Good		**3.67(1.11-12.14)**	3.31(0.97-11.26)
Oral pain			
No		1.00	1.00
Yes		**0.09(0.06-0.12)**	**0.09(0.06-0.12)**
Sugar intake		-	**0.98(0.97-1.00)**
Alcohol			
No			1.00
Yes			0.78(0.53-1.15)
Tobacco			
No			1.00
Yes			1.25(0.53-2.97)
Teeth cleaning			
n<2			1.00
n>=2			1.35(0.96-1.89)
Fluoride toothpaste			
No			1.00
Yes			1.73(0.63-4.72)
Likelihood ratio	130.11	435.08	447.71
Log likelihood	-644.78235	-492.29868	-485.9818
Wald chi2	120.33***	237.65***	12.62*

* p<0.05 ** p<0.01 *** p<0.001, Significant variables were highlighted in the table.
Model 1: Adjusted for Predisposing factors + Enabling factors
Model 2: Adjusted for Model 1 + Need factors
Model 3: Adjusted for Model 2 + Oral health behavior + Dental service use

5.7 Association Between Quality of Life and Oral Pain

The relationship between experience of oral pain and oral health-related quality of life was confirmed in 1,387 respondents with hierarchical logistic regression on the basis of the conceptual framework of this study. Each model appeared to be suitable for analysis.

In Model I, predisposing and enabling factors were included. In Model II, need factors, and in Model III, health behavior factors were included. Significantly, quality of life in accordance with oral pain, increased very slightly in each model (Model I: OR = 0.07, 95% CI 0.05 to 0.10, $p < .001$, Model II: OR = 0.08, 95% CI 0.06 to 0.12, $p < .001$, Model III: OR = 0.09, 95% CI 0.06 to 0.12, $p < .001$). There were statistically significant variables among the adjusted variables in each model as highlighted in the following table **(Table 16)**.

Table 16. Association between quality of life and oral pain

	Oral Health-related Quality of Life, Odds ratio (95% CI)		
	Model 1	Model 2	Model 3
Oral pain			
No	1.00	1.00	1.00
Yes	**0.07(0.05-0.10)**	**0.08(0.06-0.12)**	**0.09(0.06-0.12)**
Age			
18~29	1.00	1.00	1.00
30~49	0.69(0.44-1.08)	0.74(0.47-1.17)	0.71(0.45-1.14)
50~64	**0.55(0.33-0.92)**	0.61(0.36-1.03)	0.64(0.37-1.12)
65~	**0.47(0.25-0.87)**	0.63(0.33-1.19)	0.67(0.34-1.31)
Gender			
Male	1.00	1.00	1.00
Female	1.21(0.87-1.68)	1.21(0.85-1.69)	1.15(0.79-1.68)
Education			
JHS	1.00	1.00	1.00
More than JHS	1.43(1.00-2.06)	1.29(0.89-1.87)	1.34(0.91-1.96)
Ethnicity			
Non-Ewe	1.00	1.00	1.00
Ewe	1.17(0.67-2.04)	1.21(0.67-2.17)	1.25(0.70-2.24)
Religion			
Non-Christian	1.00	1.00	1.00
Christian	1.23(0.74-2.02)	1.20(0.72-2.00)	1.18(0.71-1.98)
Hypertension			
No	1.00	1.00	1.00
Yes	0.80(0.55-1.16)	0.77(0.52-1.13)	0.75(0.51-1.11)
Diabetes			
No	1.00	1.00	1.00
Yes	1.09(0.48-2.46)	1.32(0.56-3.11)	1.25(0.52-3.02)
Income			
No	1.00	1.00	1.00
Yes	0.83(0.57-1.21)	0.86(0.59-1.26)	0.85(0.58-1.25)
Occupation			
No	1.00	1.00	1.00
Yes	0.98(0.56-1.71)	0.96(0.54-1.68)	0.93(0.52-1.66)
Place of residence			
Nkwanta South	1.00	1.00	1.00
Hohoe	**0.34(0.17-0.65)**	**0.33(0.17-0.66)**	**0.39(0.20-0.78)**
Ho west	0.49(0.24-1.00)	0.51(0.24-1.08)	0.60(0.28-1.28)
Ketu South	**0.37(0.19-0.75)**	**0.30(0.15-0.63)**	**0.36(0.17-0.75)**
Oral health education			
No	1.00	1.00	1.00
Yes	0.96(0.68-1.36)	0.96(0.68-1.37)	0.95(0.67-1.36)

Table 16. Association between quality of life and oral pain (Continued)

	Oral Health-related Quality of Life, Odds ratio (95% CI)		
	Model 2	Model 3	Model 5
# of teeth			
Less than 20		1.00	1.00
20 and more		1.26(0.55-2.92)	1.22(0.53-2.82)
Denture			
No		1.00	1.00
Yes		**0.41(0.23-0.73)**	**0.50(0.28-0.92)**
Teeth status			
Poor		1.00	1.00
Good		**4.37(1.54-12.40)**	**4.13(1.44-11.90)**
Gum status			
Poor		1.00	1.00
Good		**4.11(1.24-13.60)**	3.31(0.97-11.26)
Sugar intake		-	**0.98(0.97-1.00)**
Alcohol			
No			1.00
Yes			0.78(0.53-1.15)
Tobacco			
No			1.00
Yes			1.25(0.53-2.97)
Teeth cleaning			
n<2			1.00
n>=2			1.35(0.96-1.89)
Fluoride toothpaste			
No			1.00
Yes			1.73(0.63-4.72)
Dental service use			
No visit			1.00
Visit			**0.50(0.32-0.78)**
Likelihood ratio	377.52	426.47	447.71
Log likelihood	-521.07704	-496.59422	-485.9818
Wald chi2	13.62*	37.97***	20.73**

* p<0.05 ** p<0.01 *** p<0.001, Significant variables were highlighted in the table.
Model 1: Adjusted for Predisposing factors + Enabling factors
Model 2: Adjusted for Model 1 + Need factors
Model 3: Adjusted for Model 2 + Oral health behavior + Dental service use

5.8 Association Between Quality of Life and Unmet Dental Needs

Of the respondents who answered to have had oral pain, 353 respondents responded whether they received dental services or not; 254 respondents did not and 99 did. The effect of unmet dental needs on quality of life was analyzed based on the responses of these 353 respondents.

While the fit of the model was confirmed, some insignificant variables were excluded only for this analysis. In Model I, age, religion, and place of residence were included. In Model II, need factors were added to Model I. In Model III, oral health behavior was additionally included.

The odds ratio of quality of life by unmet dental needs changed in each Model (Model I: OR = 0.73, 95% CI 0.45 to 1.19, p = .204; Model II: OR = 0.79, 95% CI 0.47 to 1.32, p = .368; Model III: OR = 0.78, 95% CI 0.46 to 1.33, p = .358). In contrast, the number of remaining natural teeth and the self-reported status of teeth were significant.

Table 17. Association between quality of life and unmet dental needs

	Oral Health-related Quality of Life, Odds ratio (95% CI)		
	Model 1	Model 2	Model 3
Unmet needs			
Unmet	1.00	1.00	1.00
Met	0.73(0.45-1.19)	0.79(0.47-1.32)	0.78(0.46-1.33)
# of teeth			
Less than 20		1.00	1.00
20 and more		**4.96(1.07-23.05)**	**5.07(1.08-23.67)**
Denture			
No		1.00	1.00
Yes		0.74(0.37-1.46)	0.73(0.37-1.47)
Teeth status			
Poor		1.00	1.00
Good		5.04(0.93-27.34)	**5.92(1.01-34.74)**
Gum status			
Poor		1.00	1.00
Good		2.01(0.35-11.59)	1.59(0.27-9.53)
Sugar intake		-	0.99(0.97-1.00)
Alcohol			
No			1.00
Yes			0.65(0.40-1.07)
Tobacco			
No			1.00
Yes			1.22(0.41-3.66)
Teeth cleaning			
n<2			1.00
n>=2			1.03(0.64-1.66)
Fluoride toothpaste			
No			1.00
Yes			0.91(0.16-5.23)
Likelihood ratio	10.27	39.30	44.59
Log likelihood	-236.1359	-221.61746	-218.97594
Wald chi2	9.75*	17.94**	5.10

* p<0.05 ** p<0.01 *** p<0.001, Significant variables were highlighted in the table.
Model 1: Adjusted for age, religion, place of residence
Model 2: Adjusted for Model 1 + Need factors
Model 3: Adjusted for Model 2 + Oral health behavior

VI. DISCUSSION

6.1 Discussion of the Findings

The nature of oral health is preventive and irreversible. Oral health in the adult population is shaped by previous cumulative experience. Therefore, it is emphasized that the adult population should take action for oral disease prevention and should receive appropriate treatment to avoid causing irrevocable harm to oral health. Moreover, oral health is linked to quality of life in terms of function in daily life: chewing, speaking, communicating, and other factors. That is, everyone should act to prevent oral diseases to improve both oral health and quality of life by practicing health behaviors and using dental services.

The purpose of this study was to examine oral health-related quality of life among Ghanaian adults, along with their dental service utilization, which directly impacts quality of life. Moreover, it attempted to determine the factors associated with quality of life aiming to improve it. Therefore, people living in four districts of the Volta region in Ghana were surveyed to determine factors associated with oral health-related quality of life and dental service utilization. Furthermore, it was hoped to find differences in oral health-related quality of life according to dental service utilization.

There were 2,493 people who participated in the survey. Among them, the responses of 1,387 respondents were analyzed, excluding those who did not meet the criteria. Of them, 44.48% were male and 55.52% were female. In 2015, the sex ratio in Ghana was 96.1 per 100 women, and specifically in the Volta region, it was 96.3 per 100 women (Ghana Statistical Service, 2013, 2018). In this survey, the female population was over-represented based on the actual female to male ratio in the Volta region. This result is believed to be related to the timing of the investigation. For instance, the survey took place during weekday mornings in the Ketu South district and throughout the weekend in other areas.

Generally, the heads of household, who are the persons responsible for the family in economic and social respects, are the men in the Volta region; 61.6% of them were male, and the others (38.4%) were female in 2010. Thus, most are at work during the daytime on weekdays, which influenced the distribution of the surveyed population in the Ketu South district. Furthermore, Ghanaians often visit distant areas for funeral services on the weekends. For these reasons, the female population was more likely to be surveyed because of the absence of the male population during the data collection period.

Ghana has a high fertility rate and the population distribution decreases as the population age increases, as shown in the population pyramid. The result of the survey showed generally similar distribution to that of the population pyramid. There was a significant difference in the age distribution in this survey, and a relatively large number was surveyed in the ages between 30 and 49 (46.29%).

The proportion of people over 65 years old was 8%, which was slightly higher than the actual population ratio in the Volta region. In addition, the population proportions of each district in the Volta region were in the order of the Hohoe municipality, Ketu south district, Nkwanta south district, and Ho west district. However, in this study, there was a slight difference in the order: first was the Ketu South district, followed by the Ho west district, Hohoe municipality, and Nkwanta south district, despite the fact that sampling was performed considering the ratio of the regional population. The distributions of ethnicity and religion were similar to their actual distribution in the Volta region, having a high proportion of respondents belong to the Ewe ethnic group and being Christians. Accordingly, the results were analyzed considering these respondent characteristics in this study.

Oral Health-Related Quality of Life

Oral health-related quality of life is variously defined. The definition of quality of life varies depending on how the terms are defined and where they are used. However defined, it is clear that it is based on the question: *"what is normal or worthwhile and are heavily imbued with values?"* (David Locker, 1997).

Therefore, in order to accurately grasp the results of oral health-related quality of life, it is necessary to understand what values the respondents seek. In this study, oral health-related quality of life was defined as their oral condition with or without any limitation or discomfort in daily life, in line with the information collected using the OHIP. Oral health-related quality of life as the dependent variable was classified as "Low" or "High," by scoring the impact in terms of functional, psychological, and social oral health in daily life that the respondents reported. Hierarchical logistic regression analysis was carried out based on Andersen's behavior model to determine the factors associated with quality of life.

Ghanaians had a relatively high oral health-related quality of life (79.16%) compared to other countries. When it comes to see which factors impacted Ghanaian oral health-related quality of life, need factors were the most significant among the individual characteristics: predisposing factors, enabling factors, need factors, and health behavior factors including dental service use. Oral health-related quality of life was impacted by age, oral pain, wearing dentures, status of teeth or gums, sugar consumption, and dental service utilization.

Some of the results were similar to those reported by previous studies. As aging progresses, the oral condition changes (R. Andersen & Davidson, 1997), and this includes tooth loss (Varenne et al., 2006) in a manner that the older the age, the lower the quality of life.

Oral pain was the most powerful factor affecting oral health-related quality of life in this study. Oral pain is defined as any pain that appears in the orofacial part of our body. It can be divided based on the cause of the symptoms, such as toothache, gum pain, and periapical periodontitis (Renton, 2011). Oral pain causes not only physical distress but also psychological and social disability, which influence quality of life (Ayo-Yusuf & Naidoo, 2016). In case of the self-evaluated status of teeth or gums, it is linked to quality of life based on subject perception.

Sugar consumption causes the development of dental caries. The higher the sugar intake, the higher the incidence of dental caries. That is, frequent sugar intake results in poor oral status and it can affect quality of life (World Health Organization, 2017).

Wearing dentures was associated with low quality of life. Dentures are used aesthetically and functionally in order to maintain and promote the oral health of patients with partial or complete tooth loss. Apparently, dentures contribute to have high quality of life supplementing natural tooth loss (Ha et al., 2009). However, if the dentures do not exactly fit into the patient's mouth, they can become fractured or cause complications: abutment fracture and periodontal diseases. It is crucial to ensure that the dentures fit into the mouth and that they can be managed by the patients themselves. Accordingly, wearing dentures that do not fit or are poorly managed may influence the individual's quality of life (Yang, Cho, Jeong, Jeon, & Yun, 2009)

Conversely, no enabling factor, including status of regular income and employment and place of residence, was significant. It was not possible to confirm differences according to economic status more specifically, as it was only investigated whether the respondents had regular income or were employed. This may have influenced the results. The place of residence may be used to replace indicators pertaining to the capacity of the infrastructure that respondents can access. In this study, however, there appeared to be no significant difference among the four regions. Only the respondents in the Hohoe municipality and Ketu South district had significantly lower quality of life than did the respondents in the Nkwanta South district.

Surprisingly, there was a dentist in the Hohoe district and not in the other areas. It would be necessary to select a geographical area under the district or municipality level or to select other indicators.

Regarding non-communicable diseases, integrated management is internationally emphasized because of the common risk factors. In this study, hypertension and diabetes, among the non-communicable diseases, were selected to examine the relationship with oral health. Thus, respondents answered whether they were diagnosed in the past by health professionals without measurement of blood pressure or glucose level.

According to Kushitor and Boatemaa (2018), some facilities such as the Community Health Planning and Services (CHPS) were not prepared to provide any health care services with regard to non-communicable diseases, as it was not legally mandatory in the CHPS level. There was less availability to measure diabetes (16.7%) in the Volta region compared to hypertension (94.1%). Considering this, it was likely that subjects who were unaware that they had hypertension or diabetes could have been missed in this study. Meanwhile, periodontitis is related to diabetes to an extent that it is considered its sixth complication. However, Ghanaian patients with diabetes were unaware of this association (Broder et al., 2014). Thus, measures should be taken to ensure testing for hypertension and diabetes at least for the adult population.

When the respondents were toothbrushing frequently or using a fluoride toothpaste, their quality of life appeared to be higher, but this result was not significant. This study only enrolled adults. The impact of care of lack thereof on the oral health status and quality of life is cumulative; therefore, if respondents were taking preventive measures now may not have made a significant difference.

Dental Service Utilization

Among the respondents who reported having high quality of life, 90.89% had never visited dental services and 9.11% had visited dental services once or more during their lifetime. In addition, of the respondents who reported having low quality of life, 68.51% had no history of dental service utilization and 31.49% had visited once or more. The result of the regression analysis showed that quality of life in the group who did not was dental services had 0.5 times higher than in the other. In addition, it confirmed the relationship between dental use and quality of life adjusting for all other factors and it was significant in all models. This result differed from those of previous studies. Generally, in developed countries, the higher the use of dental services, the higher the quality of life.

Quality of life may increase or decrease in the process of coping and adapting with the disease. Thus, even if respondents reported having oral discomfort or pain, they reported having high quality of life without dental service utilization because they had adapted and coped with the pain.

In this study, respondents were asked how frequently they visited dental services. The outcome of the service can different depending on the type of service received or the purpose for the visit. Therefore, it was not possible to determine whether all services were not associated with quality of life or whether some specific treatment was not.

Nevertheless, Dental service utilization mediated between oral pain and quality of life. The quality of life of respondents improved when they had visited dental services. Accordingly, dental service use was not a causative factor of low quality of life. However, it is suggested to conduct additional qualitative research on the association between low quality of life and dental service utilization.

As one of the strongly significant factors in this study, the barriers to dental service utilization were investigated to ultimately improve oral health-related quality of life. Among respondents, 86.23% had never visited a dental service.

Furthermore, 86.67% of respondents without natural teeth, 62.5% of those who reported their tooth condition as poor, and 70.51% of those who experienced pain or discomfort within the past 12 months had never visited any facilities to receive dental services.

The patterns mentioned above, specifically receiving no dental treatment in spite of need, are considered to refer to unmet needs. Unmet needs are detrimental to achieving universal health care (Shin & Kim, 2015). In order to ensure universal health coverage, it is necessary to determine what factors contribute to dental service use, especially dental treatment for unmet needs. Accordingly, the factors affecting the use of dental services were identified based on Andersen's Model, by classifying predisposing, enabling, and need factors and health behavior. The use of dental service was significantly influenced by predisposing and need factors. Specifically, age and education level were significant among the predisposing factors. The older the age and the higher the education level, the higher the probability of having received dental care services.

As the level of education increased, the use of dental care increased. This was similar to the findings of previous studies. However, the association between age and the dental service utilization showed different results from those of some of the previous studies.

Generally, the use of medical care shows a U-shaped usage frequency which shows that the younger the child and the older the adult, the more frequent the medical use. However, age has a significant effect on dental care use showing an inverted U-shaped frequency, which is opposite to that of general medical use (Aday & Eichhorn, 1972). As aging progresses, the oral condition changes (R. Andersen & Davidson, 1997), and this includes tooth loss (Varenne et al., 2006). Previously, Varenne et al. (2006) and Wall, Vujicic, and Nasseh (2012) reported that there was an association between older age and the lower dental service utilization.

In contrast, in this study, an opposite pattern of service utilization emerged. Both this study and a few previous ones (Herkrath et al., 2018; Olusile, Adeniyi, & Orebanjo, 2014) confirmed that the use of dental services increases together with age. This is due to the fact that the number of natural teeth remaining among the respondents older than 65 years was different from those of the previous studies. For example, 88.29% of the respondents aged over 65 years in this study had more than 20 remaining natural teeth and 1.8% of them were the edentulous. That is, the number of remaining teeth in the elderly population did not appear to hinder dental service use.

Moreover, Olusile et al. (2014) noted that as age increases, dental problems frequently occur, and in many African countries, oral pain or symptoms have a major impact on dental service use. Therefore, the increase in oral problems with age will eventually lead to an increase in dental service use. For those aged 65 years or older, additional analysis was conducted to identify relevant factors facilitating dental care use. It was confirmed that the most significant factor was pain ($z = 3.19$, $p = .001$). Additionally, pain was the strongest among the enabling factors related to the use of dental services.

That is, oral pain is a decisive factor for the use of dental care (Gift & Atchison, 1995), and it is also affected by age among others. Meanwhile, oral pain, mainly toothache, is the result of dental caries (Boeira et al., 2012; Okunseri, Hodges, & Born, 2005). Therefore, it is necessary to encourage people to visit any type of dental clinic for preventive treatment, not only for pain control.

Factors such as income and occupation are known to have a significant impact on enabling dental service use (R. Andersen & Newman, 2005). However, they were not found to be significant in this study. This may be due to the fact that variables were only selected to confirm the existence of regular income and employment status. It was limited to confirm the significant effect of the economic characteristics on the utilization of dental care in accordance with the income and occupational differences.

In addition, factors affecting unmet needs were identified. There was a significant effect for respondents who were Traditionalists (OR = 2.02, 95% CI 1.29 to 3.17, p = .002), whose self-reported tooth status was good (OR = 0.36 95% CI 0.20 to 0.67, p = .001), and who were wearing dentures (OR = 1.71, 95% CI 1.02 to 2.86, p = .043). According to previous studies (Banchani & Tenkorang, 2014; Gyimah, Takyi, & Addai, 2006), Traditionalists use medical services according to religious beliefs. No religious beliefs related to dental services were found. This should be studied in depth in future studies.

6.2 Discussion of the Research Method

This study was useful to determine factors associated with oral health-related quality of life among Ghanaian adults, particularly in the Volta region. Meanwhile, this study has the following strengths and limitations.

The subject of this study were adults older than 18 years. Generally, health policy prioritizes underserved populations, i.e., children, pregnant women, elderly people, and those with specific diseases, on the basis of cost effectiveness and cost efficiency. Adults comprise the workforce of the country and contribute to the country's economy. Therefore, work loss due to pain and discomfort caused by any oral disease can be extended to signify decrease in labor force and economic losses (Ayo-Yusuf & Naidoo, 2016). In this respect, attention needs to be paid to the adult population. In addition, Ghana is now increasingly concerned about the elderly population. Thus, including older adults in this study was advantageous.

The research site was the Volta Region out of the 10 regions in Ghana as of 2018. It is an area on the average of some indicators: poverty level, population, and others. Additionally, it is divided into three ecological zones, as is the entirety of Ghana. The population of the region may therefore be representative of the Ghanaian population. However, there is also the limitation that the study only included part of the population selected by random sampling.

This study has the advantage that it used Andersen's behavior model. The model has evolved over many years and has been used in many countries for validated evaluation of dental service utilization or health outcomes. It shows the individual characteristics specifically as: predisposing, enabling, and need factors, health behavior, and dental service utilization. Moreover, it facilitates appropriate policy by both linking to factor analysis and evaluating effectiveness and efficiency. Therefore, this study using Andersen's behavior model can be systematically analyzed.

Regarding oral health-related quality of life, oral health status and quality of life were easily evaluated using a conventional measurement, the OHIP. To the best of my knowledge, this study was the first to examine oral health-related quality of life in Ghana using the OHIP. However, many of the respondents reported that their quality of life was high; hence, the results of the study may have been affected by a celling effect. In order to clarify, additional qualitative research should be conducted to determine the criteria of quality of life in Ghana.

It is essential to ensure the quality of data by elaborative sampling and using validated questionnaires, as well as the recruitment of competent investigators. The investigators in this study were students at the University of Health and Allied Sciences in Ghana. They mainly majored in Public Health Nursing and Public Health, so that they understood the principles of community health and had skills for the need assessment. Further, it was advantageous in that it was easy to manage data efficiently and quality through the CAPI system. Thus, the quality of the collected data was guaranteed.

VII. CONCLUSION

The definition of quality of life may vary depending on the perspectives of each country, region, culture, and individual. It is not possible to apply absolutely objective criteria for individual quality of life because it is defined by complex, diverse, and subjective perception. Therefore, care should be taken when assessing individuals, groups, and countries with different cultures or values. However, as mentioned, ultimately, in the context of health-related quality of life, everyone is expected to have a physically, mentally, and socially normal and valuable life. Thus, quality of health can be judged differently, but at least the conditions of having or not any disease and difficulties in daily life can be applied on a universal basis. Moreover, health is one of the basic rights, so that *"Everyone has the right to a standard of living adequate for the health and well-being of himself and of family*."

In conclusion, the entire world population has a right to quality life. Policy must secure this right, and the efforts of experts are also needed. Particularly, there is need for specific support for those who are underserved in terms of quality of life due to their socio-economic status. Accordingly, this study was conducted to investigate oral health-related quality of life among the adults living in the Volta region of Ghana. It was possible to determine related factors and consider how quality of life can be improved.

It is hoped that the findings of this study will be used as the basis for policy making and planning of international collaborative projects to improve oral health-related quality of life in the Volta region of Ghana.

Aday, L., & Eichhorn, R. (1972). The Utilization of Health Services Indices and Correlates Lafayette. *Indiana: Purdue University*.

African Development Bank Group. Retrieved from https://www.afdb.org/en/countries/west-africa/ghana/

Allen, P. (2003). *Assessment of oral health related quality of life* (Vol. 1).

Allen, P., & Locker, D. (1997). Do item weights matter? An assessment using the oral health impact profile. *Community dental health, 14*(3), 133-138.

Allen, P. F., McMillan, A. S., & Locker, D. (2001). An assessment of sensitivity to change of the Oral Health Impact Profile in a clinical trial. *Community Dentistry and Oral Epidemiology, 29*(3), 175-182.

Andersen, R. (1995). Revisiting the behavioral model and access to medical care: does it matter? *Journal of health and social behavior*, 1-10.

Andersen, R. (2008). National health surveys and the behavioral model of health services use. *MEDICAL CARE, 46*(7), 647-653.

Andersen, R., & Davidson, P. (1997). Ethnicity, aging, and oral health outcomes: a conceptual framework. *Advances in dental research, 11*(2), 203-209.

Andersen, R., & Newman, J. F. (1973). Societal and individual determinants of medical care utilization in the United States. *The Milbank Memorial Fund Quarterly. Health and Society*, 95-124.

Andersen, R., & Newman, J. F. (2005). Societal and individual determinants of medical care utilization in the United States. *The Milbank Quarterly, 83*(4), Online- only-Online- only.

Andersen, R. M., Davidson, P. L., & Baumeister, S. E. (2007). Improving access to care in America. *Changing the US health care system: key issues in health services policy and management. 3a. edición. San Francisco: Jossey-Bass*, 3-31.

Astrom, A. N., Ekback, G., Nasir, E., Ordell, S., & Unell, L. (2013). Use of dental services throughout middle and early old ages: a prospective cohort study. *Community Dentistry and Oral Epidemiology, 41*(1), 30-39.

Ayernor, P. (2012). Diseases of ageing in Ghana. *Ghana medical journal, 46*(2), 18-22.

Ayo-Yusuf, I. J., & Naidoo, S. (2016). Social gradient in the cost of oral pain and related dental service utilisation among South African adults. *BMC oral health, 16*(1), 117. doi:10.1186/s12903-016-0313-x

Baker, S. (2009). Applying Andersen's behavioural model to oral health: what are the contextual factors shaping perceived oral health outcomes? *Community Dentistry and Oral Epidemiology, 37*(6), 485-494.

Banchani, E., & Tenkorang, E. Y. (2014). Occupational types and antenatal care attendance among women in Ghana. *Health care for women international, 35*(7-9), 1040-1064.

Batista, M. J., Lawrence, H. P., & de Sousa, M. d. L. R. (2014). Impact of tooth loss related to number and position on oral health quality of life among adults. *Health and quality of life outcomes, 12*(1), 165.

Benzer, M. (2011). Quality of life and risk conceptions in UK healthcare regulation: towards a critical analysis.

Boeira, G. F., Correa, M. B., Peres, K. G., Peres, M. A., Santos, I. S., Matijasevich, A., . . . Demarco, F. F. (2012). Caries is the main cause for dental pain in childhood: findings from a birth cohort. *Caries Res, 46*(5), 488-495. doi:10.1159/000339491

Bof de Andrade, F., & Drumond Andrade, F. C. (2019). Socioeconomic Inequalities in Oral Health-Related Quality of Life among Brazilians: A Cross-Sectional Study. *Dentistry Journal, 7*(2), 39.

Brahme, R., Godbole, S., Gangakhedkar, R., Sachdeva, K. S., Verma, V., & Risbud, A. (2018). Use of computer-assisted personal interviewing and information management system in a survey among hiv high-risk groups in India: Strengths, weaknesses, opportunities, and threats analysis. *Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine, 43*(2), 107.

Brennan, D. S., Spencer, A. J., & Roberts-Thomson, K. F. (2008). Tooth loss, chewing ability and quality of life. *Quality of Life Research, 17*(2), 227-235.

Broder, H., Tormeti, D., Kurtz, A., Baah-Odoom, D., Hill, R., Hirsch, S., . . . Sischo, L. (2014). Type II diabetes and oral health: perceptions among adults with diabetes and oral/health care providers in Ghana. *Community Dent Health, 31*(3), 158-162.

Choi, E., Kim, M.-N., Noh, S., & Park, J. (2015). Factors Affecting Dental Service Utilization of Adult: An Application of the Andersen Model. *Journal of dental hygiene science, 15*(1), 67-76.

Croser, D. (2018). Oral health waits another seven UN years. *British dental journal, 225*(10), 927-929.

Drachev, S., Brenn, T., & Trovik, T. (2018). Oral Health-Related Quality of Life in Young Adults: A Survey of Russian Undergraduate Students. *International journal of environmental research and public health, 15*(4), 719.

Evans, C. A., & Kleinman, D. V. (2000). The Surgeon General's report on America's oral health: opportunities for the dental profession. *The Journal of the American Dental Association, 131*(12), 1721-1728.

Ferrans, C. E., Zerwic, J. J., Wilbur, J. E., & Larson, J. L. (2005). Conceptual model of health- related quality of life. *Journal of nursing scholarship, 37*(4), 336-342.

Finlayson, T. L., Gansky, S. A., Shain, S. G., & Weintraub, J. A. (2010). Dental utilization among Hispanic adults in agricultural worker families in California's Central Valley. *Journal of public health dentistry, 70*(4), 292-299.

Gaber, A., Galarneau, C., Feine, J. S., & Emami, E. (2018). Rural- urban disparity in oral health- related quality of life. *Community Dentistry and Oral Epidemiology, 46*(2), 132-142.

Gaewkhiew, P., Bernabé, E., Gallagher, J. E., Klass, C., & Delgado-Angulo, E. K. (2017). Oral impacts on quality of life and problem-oriented attendance among South East London adults. *Health and quality of life outcomes, 15*(1), 82.

Ganle, J. K. (2016). Ethnic disparities in utilisation of maternal health care services in Ghana: evidence from the 2007 Ghana Maternal Health Survey. *Ethn Health, 21*(1), 85-101. doi:10.1080/13557858.2015.1015499

Ghana Health Service. (2017a). *2016 Annual Report*. Accra, Ghana

Ghana Health Service. (2017b). *The Health Sector In Ghana: Facts, Figures 2017*. Accra, Ghana

Ghana Health Service (GHS). Regional Health Directorate: Volta Region. Retrieved from http://www.ghanahealthservice.org/rhdcategory.php?ghsrid=2&cid=43

Ghana Health Services. (2016). *The Health Sector In Ghana: Facts, Figures 2016*. Accra, Ghana

Ghana Statistical Service. (2010). Population and Housing Census 2010 (PHC 2010). Retrieved from http://www.statsghana.gov.gh/nada/index.php/catalog/51"

Ghana Statistical Service. (2013). *2010 Population & Hosing Census National Analytical Report*. Accra, Ghana Retrieved from http://www.statsghana.gov.gh/gsspublications.php?category=OTc2NDgyNTUzLjkzMDU=/webstats/p9r0796n5o

Ghana Statistical Service. (2018). *Statistical Year Book 2012-2015*. Accra, Ghana Retrieved from http://www.statsghana.gov.gh/gsspublications.php?category=OTc2NDgyNTUzLjkzMDU=/webstats/p9r0796n5o

Ghana Statistical Service (GSS), Ghana Health Service (GHS), & ICF International. (2015). *Demographic and Health Survey 2014*. Accra, Ghana Retrieved from https://dhsprogram.com/pubs/pdf/fr307/fr307.pdf

Gift, H. C., & Atchison, K. A. (1995). Oral health, health, and health-related quality of life. *MEDICAL CARE*.

Glick, M., Williams, D. M., Kleinman, D. V., Vujicic, M., Watt, R. G., & Weyant, R. J. (2016). A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. *British dental journal, 221*(12), 792.

Gyimah, S. O., Takyi, B. K., & Addai, I. (2006). Challenges to the reproductive-health needs of African women: on religion and maternal health utilization in Ghana. *Soc Sci Med, 62*(12), 2930-2944. doi:10.1016/j.socscimed.2005.11.034

Ha, J., Han, G., Kim, N., Jin, B., Kim, H., Paik, D., & Bae, K. (2009). The improvement of oral health related quality of life by the national senile prosthetic restoration program. *J Korean Acad Dent Health, 33*(2), 227-234.

Haag, D., Peres, K., Balasubramanian, M., & Brennan, D. (2017). Oral conditions and health-related quality of life: a systematic review. *Journal of dental research, 96*(8), 864-874.

Harris, P., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. (2009). Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of biomedical informatics, 42*(2), 377-381.

Harris, P. A., Taylor, R., Minor, B. L., Elliott, V., Fernandez, M., O'Neal, L., . . . Kirby, J. (2019). The REDCap Consortium: Building an International Community of Software Platform Partners. *Journal of biomedical informatics*, 103208.

Herkrath, F. J., Vettore, M. V., & Werneck, G. L. (2018). Contextual and individual factors associated with dental services utilisation by Brazilian adults: A multilevel analysis. *PloS one, 13*(2), e0192771.

Hewlett, S. A., Calys-Tagoe, B. N., Yawson, A. E., Dako-Gyeke, P., Nakua, E., Folson, G., . . . Biritwum, R. B. (2015). Prevalence and geographic distribution of edentulism among older Ghanaians. *J Public Health Dent, 75*(1), 74-83. doi:10.1111/jphd.12075

Holde, G. E., Baker, S. R., & Jönsson, B. (2018). Periodontitis and quality of life: What is the role of socioeconomic status, sense of coherence, dental service use and oral health practices? An exploratory theory- guided analysis on a Norwegian population. *Journal of clinical periodontology, 45*(7), 768-779.

Huang, D. L., & Park, M. (2015). Socioeconomic and racial/ethnic oral health disparities among US older adults: oral health quality of life and dentition. *Journal of public health dentistry, 75*(2), 85-92.

Information Services Department (ISD). EC TO CONDUCT REFERENDUM FOR NEW REGIONS IN DECEMBER. Retrieved from http://www.ghana.gov.gh/index.php/media-center/regional-news/5233-ec-to-conduct-referendum-for-new-regions-in-december

Information Services Department (ISD). Regions. Retrieved from http://www.ghana.gov.gh/index.php/about-ghana/regions

Isiekwe, G., Onigbogi, O., Olatosi, O., & Sofola, O. (2014). Oral health quality of life in a Nigerian university undergraduate population. *Journal of the West African College of Surgeons, 4*(1), 54.

Jang, M. S., Kim, G.-U., Shim, Y.-S., Rhyu, I.-C., Han, S.-B., Chung, C.-P., & Young, K. (2006). Association between the self-reported periodontal health status and oral health-related quality of life among elderly Koreans. *The journal of Korean academy of periodontology, 36*(3).

John, M. T., Koepsell, T. D., Hujoel, P., Miglioretti, D. L., LeResche, L., & Micheelis, W. (2004). Demographic factors, denture status and oral health- related quality of life. *Community Dentistry and Oral Epidemiology, 32*(2), 125-132.

Kailembo, A., Preet, R., & Williams, J. S. (2018). Socioeconomic inequality in self-reported unmet need for oral health services in adults aged 50 years and over in China, Ghana, and India. *International journal for equity in health, 17*(1), 99.

Käyser, A., Witter, D., & Spanauf, A. (1987). Overtreatment with removable partial dentures in shortened dental arches. *Australian dental journal, 32*(3), 178-182.

Keles, S., Abacigil, F., & Filiz, A. (2018). Oral health status and oral health related quality of life in adolescent workers. *Clujul Medical, 91*(4), 462.

Kent, G., & Croucher, R. (1998). Achieving Oral Health: The social context of dental care. Wright. In: Oxford.

Kim, G.-U., & Min, K.-J. (2009). The Impact of Oral Health Impact profile (OHIP) Level on Degree of PatientsKnowledge about Dental Hygiene. *Journal of the Korea Academia-Industrial cooperation Society, 10*(4), 717-721.

Kodaman, N., Aldrich, M. C., Sobota, R., Asselbergs, F. W., Poku, K. A., Brown, N. J., . . . Williams, S. M. (2016). Cardiovascular disease risk factors in Ghana during the rural-to-urban transition: a cross-sectional study. *PloS one, 11*(10), e0162753.

Kushitor, M. K., & Boatemaa, S. (2018). The double burden of disease and the challenge of health access: Evidence from Access, Bottlenecks, Cost and Equity facility survey in Ghana. *PloS one, 13*(3), e0194677. doi:10.1371/journal.pone.0194677

Lee, E.-G., Park, J.-H., Park, J.-R., & Park, J.-Y. (2011). A study on OHIP-14 and EQ-5D of residents in some rural areas. *Journal of Korean society of Dental Hygiene, 11*(2), 197-211.

Lee, J., Watt, R., Williams, D., & Giannobile, W. (2017). A new definition for oral health: implications for clinical practice, policy, and research. In: SAGE Publications Sage CA: Los Angeles, CA.

Locker, D. (1988). Measuring oral health: a conceptual framework. *Community Dent Health, 5*(1), 3-18.

Locker, D. (1997). Concepts of oral health, disease and the quality of life. *Measuring oral health and quality of life, 11*, 24.

Locker, D., & Miller, Y. (1994). Subjectively reported oral health status in an adult population. *Community Dentistry and Oral Epidemiology, 22*(6), 425-430.

Maintaining and improving the oral health of young children. (2014). *Pediatrics, 134*(6), 1224-1229. doi:10.1542/peds.2014-2984

Marshman, Z., Baker, S. R., & Robinson, P. G. (2014). Does dental indifference influence the oral health- related quality of life of prisoners? *Community Dentistry and Oral Epidemiology, 42*(5), 470-480.

Marshman, Z., Porritt, J., Dyer, T., Wyborn, C., Godson, J., & Baker, S. (2012). What influences the use of dental services by adults in the UK? *Community Dentistry and Oral Epidemiology, 40*(4), 306-314.

Mason, J., Pearce, M., Walls, A., Parker, L., & Steele, J. (2006). How do factors at different stages of the lifecourse contribute to oral-health-related quality of life in middle age for men and women? *Journal of dental research, 85*(3), 257-261.

McGlynn, N., Wilk, P., Luginaah, I., Ryan, B. L., & Thind, A. (2014). Increased use of recommended maternal health care as a determinant of immunization and appropriate care for fever and diarrhoea in Ghana: an analysis pooling three demographic and health surveys. *Health policy and planning, 30*(7), 895-905.

Meyerhoefer, C. D., Zuvekas, S. H., & Manski, R. (2014). The demand for preventive and restorative dental services. *Health Econ, 23*(1), 14-32. doi:10.1002/hec.2899

Mikkelsen, B., Williams, J., Rakovac, I., Wickramasinghe, K., Hennis, A., Shin, H.-R., . . . Breda, J. (2019). Life course approach to prevention and control of non-communicable diseases. *BMJ, 364*, l257. doi:10.1136/bmj.l257

Minicuci, N., Biritwum, R. B., Mensah, G., Yawson, A. E., Naidoo, N., Chatterji, S., & Kowal, P. (2014). Sociodemographic and socioeconomic patterns of chronic non-communicable disease among the older adult population in Ghana. *Global health action, 7*(1), 21292.

Ministry of Foreign Affairs. (2019). *2019 Republic of Ghana*. Retrieved from http://www.mofa.go.kr/www/brd/m_4099/view.do?seq=367563&srchFr=&srchTo=&srchWord=&srchTp=&multi_itm_seq=0&itm_seq_1=0&itm_seq_2=0&company_cd=&company_nm=

Montero, J., Costa, J., Bica, I., & Barrios, R. (2018). Caries and quality of life in portuguese adolescents: Impact of diet and behavioural risk factors. *Journal of clinical and experimental dentistry, 10*(3), e218.

Morgan, J. P., Isyagi, M., Ntaganira, J., Gatarayiha, A., Pagni, S. E., Roomian, T. C., . . . Mumena, C. H. (2018). Building oral health research infrastructure: the first national oral health survey of Rwanda. *Global health action, 11*(1), 1477249.

Muirhead, V., Quinonez, C., Figueiredo, R., & Locker, D. (2009). Predictors of dental care utilization among working poor Canadians. *Community Dentistry and Oral Epidemiology, 37*(3), 199-208.

Nasir, E. F., Åstrøm, A. N., David, J., & Ali, R. W. (2009). Utilization of dental health care services in context of the HIV epidemic-a cross-sectional study of dental patients in the Sudan. *BMC oral health, 9*(1), 30.

OECD. (2016). *OECD Development Co-operation Peer Reviews: Denmark 2016*. doi:https://doi.org/10.1787/9789264259362-en

Okunseri, C., Hodges, J. S., & Born, D. (2005). Self-reported toothache experience in an adult population in Benin City, Edo State, Nigeria. *Oral Health Prev Dent, 3*(2), 119-125.

Olusile, A. O., Adeniyi, A. A., & Orebanjo, O. (2014). Self-rated oral health status, oral health service utilization, and oral hygiene practices among adult Nigerians. *BMC oral health, 14*, 140. doi:10.1186/1472-6831-14-140

Park, J.-K. (2015). *The effects of oral health status on Oral Health-related Quality of Life in emerging countries.* The grduate school, Seoul national university,

Park, J. K. (2015). *The effects of oral health status on Oral Health-related Quality of Life in emerging countries.* The Graduate School of Seould National University

Pennacchini, M., Bertolaso, M., Elvira, M., & De Marinis, M. (2011). A brief history of the Quality of Life: its use in medicine and in philosophy. *Clin Ter, 162*(3), e99-e103.

Petersen, P. E. (2003). The World Oral Health Report 2003: continuous improvement of oral health in the 21st century–the approach of the WHO Global Oral Health Programme. *Community Dentistry and Oral Epidemiology, 31*, 3-24.

Petersen, P. E. (2005). Sociobehavioural risk factors in dental caries–international perspectives. *Community Dentistry and Oral Epidemiology, 33*(4), 274-279.

Petersen, P. E., Baez, Ramon J & World Health Organization. (2013). *Oral health surveys: basic methods*: World Health Organization.

Pigou, A. (2017). *The economics of welfare*: Routledge.

Post, M. (2014). Definitions of quality of life: what has happened and how to move on. *Topics in spinal cord injury rehabilitation, 20*(3), 167-180.

Renton, T. (2011). Dental (Odontogenic) Pain. *Reviews in pain, 5*(1), 2-7. doi:10.1177/204946371100500102

Roberto, L. L., Martins, A. M. E. d. B., Paula, A. M. B. d., Ferreira, E. F., & Haikal, D. S. A. (2017). Dissatisfaction with the dental services and associated factors among adults. *Ciencia & saude coletiva, 22*(5), 1601-1613.

Ruževičius, J. (2014). *Quality of Life and of Working Life: Conceptions and Research.* Paper presented at the Liverpool (2014): 17th Toulon-Verona Conference" Excellence in Services".

Shin, H.-S., & Kim, H.-D. (2015). Association between the number of existing permanent teeth and health-related quality of life (EuroQol-5 Dimension) among adults: findings from the fifth Korea National Health and Nutrition Examination Surveys, 2012. *Journal of Korean Academy of Oral Health, 39*(4), 303-310.

Singh, A. S., & Masuku, M. B. (2014). Sampling techniques & determination of sample size in applied statistics research: An overview. *International Journal of Economics, Commerce and Management, 2*(11), 1-22.

Sischo, L., & Broder, H. (2011). Oral health-related quality of life: what, why, how, and future implications. *Journal of dental research, 90*(11), 1264-1270.

Skarupova, K. (2014). TECHNICAL REPORT: Computer-assisted and online data collection in general population surveys. *Eropean Monitoring Center for Drugs and Drugs Addiction*.

Slade, G., Spencer, A., Locker, D., Hunt, R., Strauss, R., & Beck, J. (1996). Variations in the social impact of oral conditions among older adults in South Australia, Ontario, and North Carolina. *Journal of dental research, 75*(7), 1439-1450.

Slade, G. D. (1997). *Measuring oral health and quality of life*: Department of Dental Ecology, School of Dentistry, University of North Carolina.

Slade, G. D., & Spencer, A. J. (1994). Development and evaluation of the oral health impact profile. *Community dental health, 11*(1), 3-11.

Souza, J. G. S., Oliveira, B. E. C., & Lima, A. M. E. D. B. (2017). Contextual and individual determinants of oral health-related quality of life in older Brazilians. *Quality of Life Research, 26*(5), 1295-1302.

Stapleton, S., Finlayson, T. L., Ohmit, A., & Hunte, H. E. (2016). Correlates of past year dental health visits: findings from the I ndiana black men's health study. *Journal of public health dentistry, 76*(2), 157-165.

Tooth eruption: The primary teeth. (2005). *The Journal of the American Dental Association, 136*(11), 1619. doi:10.14219/jada.archive.2005.0095

Torrance, G. W. (1987). Utility approach to measuring health-related quality of life. *Journal of chronic diseases, 40*(6), 593-600.

Varenne, B., Petersen, P. E., Fournet, F., Msellati, P., Gary, J., Ouattara, S., . . . Salem, G. (2006). Illness-related behaviour and utilization of oral health services among adult city-dwellers in Burkina Faso: evidence from a household survey. *BMC health services research, 6*(1), 164.

Wall, T. P., Vujicic, M., & Nasseh, K. (2012). Recent Trends in the Utilization of Dental Care in the United States. *Journal of Dental Education, 76*(8), 1020-1027. Retrieved from http://www.jdentaled.org/content/jde/76/8/1020.full.pdf

Walter, M. H., Schuette, U., Raedel, M., Koch, R., Wolf, B., Scheuch, K., & Kirch, W. (2011). Oral health- related quality of life and oral status in a German working population. *European journal of oral sciences, 119*(6), 481-488.

Wang, H., Otoo, N., & Dsane-Selby, L. (2017). *Ghana national health insurance scheme : improving financial sustainability based on expenditure review (English).* Washington, D.C. : World Bank Group, Retrieved from http://documents.worldbank.org/curated/en/493641501663722238/Ghana-national-health-insurance-scheme-improving-financial-sustainability-based-on-expenditure-review

Willet, M., Dorstyn, D., Due, C., & Li, W. (2018a). Applying Andersen's Model to Explain Service Use and Quality of Life Among Australian Caregivers of Children with Autism Spectrum Disorder. *Journal of Developmental and Physical Disabilities, 30*(3), 339. doi:10.1007/s10882-018-9589-x

Willet, M., Dorstyn, D., Due, C., & Li, W. (2018b). Applying Andersen's Model to Explain Service Use and Quality of Life Among Australian Caregivers of Children with Autism Spectrum Disorder. *Journal of Developmental and Physical Disabilities*, 1-16.

Williams, K. B., Gadbury-Amyot, C. C., Krust-Bray, K., Manne, D., & Collins, P. (1998). Oral health related quality of life: A model for dental hygiene. *Journal of Dental Hygiene, 72*, 19-26.

Wilson, I. B., & Cleary, P. D. (1995). Linking clinical variables with health-related quality of life: a conceptual model of patient outcomes. *Jama, 273*(1), 59-65.

Wood-Dauphinee, S. (1999). Assessing quality of life in clinical research: from where have we come and where are we going? *Journal of clinical epidemiology, 52*(4), 355-363.

World Bank. The World Bank in Ghana. Retrieved from https://www.worldbank.org/en/country/ghana/overview

World Bank. (2011). Ghana Looks to Retool Its Economy as it Reaches Middle-Income Status. Retrieved from https://www.worldbank.org/en/news/feature/2011/07/18/ghana-looks-to-retool-its-economy-as-it-reaches-middle-income-status

World Bank. (2019). County profile: Ghana. Retrieved from https://databank.worldbank.org/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=GHA. https://databank.worldbank.org/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=GHA

World Bank Group. (2019). Literacy rate, adul total. Retrieved from https://data.worldbank.org/indicator/SE.ADT.LITR.ZS?end=2010&locations=1W-GH-NG-TG-BJ-CV-GM-GN-GW-LR-ML-NE-SN-SL-CI&start=2010&view=bar. Retrieved 2019 https://data.worldbank.org/indicator/SE.ADT.LITR.ZS?end=2010&locations=1W-GH-NG-TG-BJ-CV-GM-GN-GW-LR-ML-NE-SN-SL-CI&start=2010&view=bar

World Health Organization. (1946). Constitution of the World Health Organization.

World Health Organization. (1995). The World Health Organization quality of life assessment (WHOQOL): position paper from the World Health Organization. *Social science & medicine, 41*(10), 1403-1409.

World Health Organization. (1996). What quality of life? The WHOQOL Group. World Health Organization Quality of Life Assessment. *World Health Forum, 17*(4), 354-356.

World Health Organization. (2013). *Oral health surveys: basic methods*: World Health Organization.

World Health Organization. (2016a). Promoting Oral Health in Africa: Prevention and control of oral diseases and noma as part of essential noncommunicable disease interventions.

World Health Organization. (2016b). Regional oral health strategy 2016–2025: addressing oral diseases as part of noncommunicable diseases: report of the Secretariat. Retrieved from http://www.who.int/iris/handle/10665/250994

World Health Organization. (2017). Sugars and dental caries. Retrieved from https://www.who.int/nutrition/publications/nutrientrequirements/sugars-dental-caries-keyfacts/en/

Yang, D.-S., Cho, U., Jeong, C.-M., Jeon, Y.-C., & Yun, M.-J. (2009). Evaluation of clinical status of removable partial dentures. *The Journal of Korean Academy of Prosthodontics, 47*(3), 320-327.

Yawson, A., Malm, K., Adu, A., Wontumi, G., & Biritwum, R. (2012). Patterns of health service utilization at a medical school clinic in Ghana. *Ghana medical journal, 46*(3), 128.

Appendix A. Indicators used in the previous studies of dental utilization (Designed the table for the study with what Aday and Eichhorn (1972) described in the previous study)

Categories	Variables
Preceding	· Age · Sex · Education · Marital status · Family size and composition · Race or ethnicity, Religious preference · General Health care attitudes[iv] · Knowledge and sources of health care information · Situation-specific stresses · Generalized stresses · Previous health behavior
Enabling	· Financing[v] · Organization[vi] · Availability of services[vii]
Need	· Health and mobility status · Perceived symptoms of illness · Physician-rated urgency · Chronic activity limitation status · Disability days · Diagnosis · Surgery
Dental Utilization	· Volume of services[viii] · Type of service[ix] · Type of dentist specialty

[iv] Health beliefs and medical orientation, Perceived availability of care, Tendency to use services of a physician, Skepticism of medical care and physicians

[v] Socio-economic status and occupation, Income, Price of medical services, Methods of financing

[vi] Alternative organization forms, Type of practice

[vii] Region, Residence (rural-urban), Distance, Supply of medical personnel and facilities, Regular source of care

[viii] Time interval since last dentist visit, Dentist visit within past twelve months, mean number of dentist visits per person per year, Number of persons using services per 100 person-years, Number of dentist visits per family or unrelated individuals per year, Total expenditures per family (or per individual) for dentist services

[ix] Restorative, Preventive

Appendix B. Predisposing, Enabling, Need and Health behavior variables on the previous studies

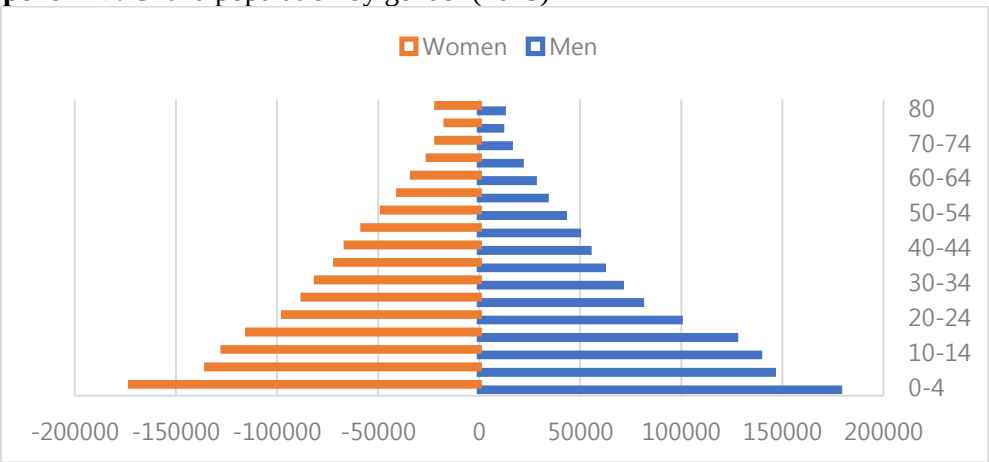
Author	Variables			
	Preceding	**Enabling**	**Need**	**Health behavior**
R. Andersen and Davidson (1997)	· **Age** · **Gender** · Marital status · Length of time in the community · Acculturation · Language · Educational level · Values · Knowledge of dental care delivery system	· **Income** · Insurance · Usual source of dental care · Availability of dental care personnel in the community · Community health prog rams · Prices for dental care in the community	· **Perceived needs**	· **Toothbrushing** · Dental floss use · **Diet** · **Tobacco use**
Baker (2009)	· Qualification · Household weekly income · Social class	· **Oral health education advice** · Type of services · Treatment expense · Dental anxiety scale	· Number of decayed per ceived treatment	· **Toothbrushing** · **Dental attendance in last 12 months** · Dental attendance orientation
Stapleton et al. (2016)	· **Age** · Marital status · **Educational attainment**	· **Employment status** · Annual income · Health insurance · Usual place of care · Frequency of social/em otional support	· Perceived health status · Life time smoking · Self-rated health status · Poor mental health days · Social/emotional support	· **Daily fruit consumption** · **Daily vegetable consumption**

Appendix C. Population in Volta region and Ghana

Area	Men (N, %)	Women (N, %)	Total (N, %)
Ghana	12,955,959(48.97)	13,500,294(51.03)	26,456,253(100)
0-14	5,009,003(38.66)	4,893,936(36.25)	9,902,939(37.43)
15-29	3,615,123(27.90)	3,755,167(27.82)	9,902,939(27.86)
30-49	2,825,303(21.81)	3,120,908(23.12)	5,946,211(22.48)
50-64	1,013,067(7.82)	1,106,694(8.20)	2,119,761(8.07)
65+	493,463(3.81)	623,589(4.62)	1,117,052(4.22)
Volta region	1,166,593	1,211,472	2,378,065
0-14	462,471(39.64)	434,035(35.83)	896,506(37.70)
15-29	306,687(26.29)	298,416(24.63)	605,103(25.45)
30-49	235,386(20.18)	274,718(22.68)	510,104(21.45)
50-64	102,711(8.80)	120,705(9.96)	223,416(9.39)
65+	59,338(5.09)	83,598(6.90)	142,936(6.01)
Volta region by district			
Nkwanta South district	65,398(5.61)	67.835(5.60)	133,233(5.60)
Hohoe Municipality	92,245(7.91)	95,692(7.90)	187,937(7.90)
Ho west district	52,547(4.50)	54,503(4.50)	107,050(4.50)
Ketu South district	88,748(7.61)	92,064(7.60)	180,812(7.60)
Others	867,655(74.38)	901,378(74.40)	1,769,033(74.36)

Resource from: Ghana Statistical Service (2013); (Ghana Statistical Service, 2018)

Appendix D. Ghana population by gender (2015)



Designed with the resource from: Ghana statistical services

Appendix E. The Literacy Rate of West African Countries

Countries	Literacy rate*	Year
Benin	33	2012
Cabo Verde	87	2015
Cote	44	2014
Gambia	42	2013
Ghana	71	2010
Guinea	32	2014
Guinea-Bissau	46	2014
Liberia	43	2007
Mali	33	2015
Niger	31	2012
Nigeria	51	2008
Senegal	52	2017
Sierra Leone	32	2013
Togo	64	2015
World	86	2016

*% of people ages 15 and above (Most recent value) Resource from: (World Bank Group, 2019)

Appendix F. Morbidity of Hypertension

	2017 (N, %)			2018 (N, %)		
	Male (n=2865)	**Female (n=8206)**	**Total (n=11071)**	**Male (n=3492)**	**Female (n=10050)**	**Total (n=13542)**
Age						
18-34	109(3.80)	410(5.00)	519(4.69)	181(5.18)	604(6.01)	785(5.80)
35-49	570(19.90)	1730(21.08)	2300(20.77)	721(20.65)	2432(24.20)	3153(23.28)
50-69	1421(49.60)	3678(44.82)	5099(46.06)	1675(47.97)	4610(45.87)	6285(46.41)
70+	765(26.70)	2388(29.10)	3153(28.48)	915(26.20)	2404(23.92)	3319(24.51)
Place of residence						
Nkwanta south	1223(42.69)	3014(36.73)	4237(38.27)	1446(41.41)	4662(46.39)	6108(45.10)
Ho West	484(16.89)	1639(19.97)	2123(19.18)	243(6.96)	639(6.36)	882(6.51)
Hohoe	497(17.35)	1483(18.07)	1980(17.88)	964(27.61)	2370(23.58)	3334(24.62)
Ketu South	661(23.07)	2070(25.23)	2731(24.67)	839(24.03)	2379(23.67)	3218(23.76)

Appendix G. Morbidity of Diabetes

	2017 (N,%)			2018		
	Male (n=568)	**Female (n=1,194)**	**Total (n=1,762)**	**Male (n=922)**	**Female (n=1,865)**	**Total (n=2,787)**
Age						
18-34	37(6.51)	64(5.36)	101(5.73)	107(11.61)	160(8.58)	267(9.58)
35-49	116(20.42)	286(23.95)	402(22.81)	183(19.85)	444(23.81)	627(22.50)
50-69	309(54.40)	622(52.09)	931(52.84)	469(50.87)	953(51.10)	1422(51.02)
70+	106(18.66)	222(18.59)	328(18.62)	163(17.68)	308(16.51)	471(16.90)
Place of residence						
Nkwanta south	321(56.51)	564(47.24)	885(50.23)	435(47.18)	814(43.65)	1249(44.82)
Ho West	39(6.87)	161(13.48)	200(11.35)	33(3.58)	74(3.97)	107(3.84)
Hohoe	87(15.32)	207(17.34)	294(16.69)	206(22.34)	449(24.08)	655(23.50)
Ketu South	121(21.30)	262(21.94)	383(21.74)	248(26.90)	528(28.31)	776(27.84)

Appendix H. Morbidity of Dental caries

	2017 (N,%)			2018		
	Male (n=152)	**Female (n=273)**	**Total (n=425)**	**Male (n=156)**	**Female (n=281)**	**Total (n=437)**
Age						
18-34	54(35.53)	95(34.80)	149(35.06)	54(34.62)	96(34.16)	150(34.32)
35-49	36(23.68)	53(19.41)	89(20.94)	37(23.72)	63(22.42)	100(22.88)
50-69	38(25.00)	67(24.54)	105(24.71)	39(25.00)	77(27.40)	116(26.54)
70+	24(15.79)	58(21.25)	82(19.29)	26(16.67)	45(16.01)	71(16.25)
Place of residence						
Nkwanta south	19(12.50)	40(14.65)	59(13.88)	49(31.41)	66(23.49)	115(26.32)
Ho West	13(8.55)	35(12.82)	48(11.29)	19(12.18)	40(14.23)	59(13.50)
Hohoe	75(49.34)	121(44.32)	196(46.12)	52(33.33)	100(35.59)	152(34.78)
Ketu South	45(29.61)	77(28.21)	122(28.71)	36(23.08)	75(26.69)	111(25.40)

Appendix I. Morbidity of Dental swellings

	2017 (N, %)			2018 (N, %)		
	Male (n=36)	**Female (n=73)**	**Total (n=109)**	**Male (n=45)**	**Female (n=79)**	**Total (n=124)**
Age						
18-34	17(47.22)	27(24.77)	44(40.37)	20(44.44)	26(32.91)	46(37.10)
35-49	4(11.11)	9(8.26)	13(11.93)	6(13.33)	21(26.58)	27(21.77)
50-69	11(30.56)	20(18.35)	31(28.44)	14(31.11)	20(25.32)	34(27.42)
70+	4(11.11)	17(15.60)	21(19.27)	5(11.11)	12(15.19)	17(13.71)
Place of residence						
Nkwanta south	2(5.56)	7(9.59)	9(8.26)	5(11.11)	12(15.19)	17(13.71)
Ho West	10(27.78)	13(17.81)	23(21.10)	15(33.33)	16(20.25)	31(25.00)
Hohoe	18(50.00)	46(63.01)	64(58.72)	20(44.44)	38(48.10)	58(46.77)
Ketu South	6(16.67)	7(9.59)	13(11.93)	5(11.11)	13(16.46)	18(14.52)

Appendix J. Health facilities in each region

Area	CHPS	Clinic	District hospital	Health Center	Hospital	Midwife, Maternity	Others
Ashanti	1,041(24.87)	130(12.96)	25(18.25)	135(15.79)	96(35.96)	73(22.26)	1(2.50)
Brong Ahafo	458(10.94)	102(10.17)	18(13.14)	90(10.53)	12(4.49)	41(12.50)	4(10.00)
Central	235(5.62)	67(6.68)	12(8.76)	61(7.13)	16(5.99)	35(10.67)	3(7.50)
Easter	611(14.60)	116(11.57)	17(12.41)	99(11.58)	14(5.24)	25(7.62)	2(5.00)
Greater Accra	201(4.80)	283(28.22)	6(4.38)	28(3.27)	76(18.46)	85(25.91)	15(37.50)
Northern	386(9.22)	56(5.58)	15(10.95)	96(11.23)	13(4.87)	9(2.74)	4(10.00)
Upper East	225(5.37)	50(4.99)	6(4.38)	53(6.20)	1(0.37)	2(0.61)	0(0.00)
Upper West	208(4.97)	14(1.40)	3(2.19)	68(7.95)	8(3.00)	5(1.52)	5(12.50)
Volta	350(8.36)	40(3.99)	17(12.41)	161(18.83)	11(4.12)	16(4.88)	3(7.50)
Western	470(11.23)	145(14.46)	18(13.14)	64(7.49)	20(7.49)	37(11.28)	3(7.50)
National	4,185	1,003	137	855	267	328	40

Resource from: Ghana statistical services

Appendix K. CHPS Data by District In Volta Region

District	Number of Demarcated CHPS Zones	Number of functional CHPS Zones	Number of functional CHPS with basic equipment	Number of CHPS Compounds
Adaklu	15	15	15	10
Afadjato South	34	12	12	12
Agortime Ziope		13	13	13
Akatsi North	3	12	7	12
Akatsi South	29	29	29	9
Biakoye	21	21	12	12
Central Tongu	29	15	15	14
Ho	47	46	46	13
Ho west	29	10	10	10
Hohoe	33	32	32	10
Jaskan	28	15	14	14
Kadjebi	36	25	25	11
Keta	50	16	7	7
Ketu North	37	11	4	7
Ketu South	39	16	16	3
Kpando	19	7	7	3
Krachi East	27	20	11	12
11Krachi Nchumuru	19	15	15	10
Krachi West	25	19	19	10
Nkwanta North	15	10	10	12
Nkwanta South	30	24	24	24
North Dayi	23	23	23	6
North Tongu	29	26	7	7
South Dayi	21	15	15	5
South Tongu	41	41	16	20
Grand Total	630	448	364	231

Appendix L. Dentist to population ratio in Ghana

Region	Dentist-to-population ratio
Ashanti	1:205,437
Brong Ahafo	1:326,018
Central	1:191,564
Eastern	1:259,601
Greater Accra	1:41,593
Northern	1:2,468,557
Upper East	1:1,031,478
Upper West	1:677,763
Volta	1:1,049,928
Western	1:290,700
Total	1:104,000

Resources retrieved from: (Hewlett et al., 2015)

Appendix M. Dental Staff in Volta Region by district as at April 2019

District	No. of CHNs	No. of Dental Technician	No. of Dental Clinic Assistant	No. of Dental Surgeon	No. of Specialist(Dental Surgeon)	No. of Medical Officier-Dental
Adaklu	48					
Afadjato South	70					
Agortime Ziope	43					
Akatsi North	35					
Akatsi South	60					
Biakoye	51	1				
Central Tongu	32					
Ho	139	5			1	2
Ho west	48					
Hohoe	74	3		1		
Jaskan	52					
Kadjebi	53	1				
Keta	64		1			
Ketu North	46					
Ketu South	69					
Kpando	57					
Krachi East	52					
Krachi Nchumuru	33					
Krachi West	29					
Nkwanta North	44					
Nkwanta South	48					
North Dayi	49					
North Tongu	40					
South Dayi	53					
South Tongu	43	1	1			1
Grand Total	1332	11	2	1	1	3

국 문 요 약

가나 성인의 치과의료이용 및 구강건강관련 삶의 질에 영향을 미치는 요인

구강은 씹기, 말하기, 삼키기, 얼굴 표정을 통한 감정 전달 등을 가능케 함으로써 전신건강 및 삶의 질에 관련이 있다. 불량한 구강상태의 결과로 인한 구강질환은 단순히 통증 유발뿐 아니라, 기능적, 심리적, 사회적인 영역의 삶의 질을 감소시킬 수 있으며, 이로 인한 의료서비스는 경제적 부담까지 안길 수 있다. 개발도상국의 경우, 의료시설 및 인력 부족 등으로 인해 의료서비스 접근에 어려움이 있다는 점에서 삶의 질에 더욱 큰 영향을 미칠 것으로 보인다. 이중, 서아프리카에 위치한 가나에서는 보건의료시설 및 인력 부족, 높은 미 충족 수요 문제가 구강건강에 영향을 미치는 것으로 확인된다. 이에 따라 가나 주민들의 전반적인 구강건강 및 삶의 질 개선을 위하여, 관련 요인을 파악하고 근거에 기반한 정책마련이 필요하다. 특히, 의료서비스 이용 여부에 따라 나타나는 삶의 질을 확인하고, 의료서비스 이용에 취약한 계층에 대하여 추가적인 대책이 마련되어야 한다.

본 연구는 가나 볼타지역 성인들의 치과의료 이용 및 구강건강관련 삶의 질에 관한 요인을 파악하고자 하였다. 또한, 치과의료 이용 여부에 따른 구강건강관련 삶의 질 차이를 확인하고, 의료이용 취약계층의 구강건강관련 삶의 질을 위협하는 요인을 탐구하고자 하였다.

가나 볼타지역 18 세 이상 거주민을 대상으로 설문조사를 진행하였다. 앤더슨 행동모형에 따라 구강건강 삶의 질과 치과 의료 이용에 영향은 미치는 요인을 소인성, 기능, 필요 및 건강행태 요인으로 구분하였다. STATA 14.0 프로그램을 사용하여 카이제곱 검정, Mann -Whitney U test, 위계적 로지스틱 회귀분석을 실시하였다.

구강건강 관련 삶의 질에 대하여 전체 요인 그룹 중 필요 요인이 가장 영향이 높았다. 하위 변수에서 영향을 미친 요인은 높은 연령과 고혈압 유병상태, Hohoe 혹은 Ketu South 에 거주하는 군, 통증이 있는 군, 의치를 사용하는 군, 주관적 치아건강이 좋은 군, 주관적 치주건강이 좋은 군, 당 섭취빈도에 따라 삶의 질이 낮았다. 이중에서도 통증경험 여부 및 치과의료이용의 영향이 높은 것으로 확인되었다.

이상의 연구결과를 종합하여 볼 때, 가나 볼타지역 주민들의 구강건강 관련 삶의 질 증진을 위한 정책 개발 시, 수행을 위한 보건의료기관 및 인력이 부족하다는 점을 고려하여 1 차 보건의료의 인력을 통한 중재가 필요하다. 중재 프로그램 개발 시 다음과 같은 사항이 고려되어야 한다. 높은 연령군, 고혈압 혹은 당뇨 진단받은 군, 통증이 있는 경우, 의치를 착용한 경우, 주관적 치아 및 치주 건강이 좋지 않은 경우, 적절한 처치가 이뤄질 수 있도록 1 차 보건의료에서 응급 시 간단한 처치가 가능하도록 기반 마련이 필요하다. 응급 이외의 처치 필요시 전원 할 수 있도록 전원체계 구축, 평상시 통증 및 치아 예방 관리와 당 섭취 빈도에 대한 교육이 필요하다. 특히, 치과의료를 이용한 적이 없는 그룹에서는 통증이 있거나, 의치를 사용하거나, 주관적 치아 건강이 좋지 않은 경우, 의료이용 서비스의 중요성을 인지시키고, 실제로 이용할 수 있도록 접근성을 개선하여야 한다. 또한, 당 섭취 빈도에 대한 교육이 필요하다.

핵심되는 말: 구강보건, 구강건강관련 삶의 질, 구강건강영향지수, 치과의료이용, 앤더슨 행동모형, 로지스틱 회귀분석, 가나, 중저소득국가, 국제보건