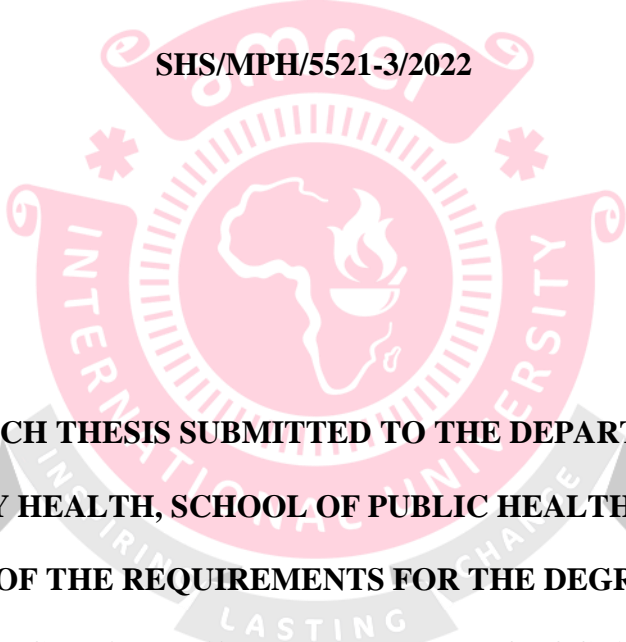


**PREVALENCE AND DETERMINANTS OF ORAL HEALTH CONDITIONS  
AMONG SICKLERS AGED 10-18 IN KISUMU COUNTY, KENYA**

**CLIFFLAND MARK MOSOTI**

**SHS/MPH/5521-3/2022**



**A RESEARCH THESIS SUBMITTED TO THE DEPARTMENT OF  
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OF PUBLIC HEALTH (APPLIED EPIDEMIOLOGY) AMREF  
INTERNATIONAL UNIVERSITY**

**JULY 2025**

## DECLARATION AND APPROVAL

### Declaration by Candidate:

This thesis is my original work and has not been presented for a degree in any other learning institution.

Signature



**Cliffland Mark Mosoti**

**SHS/MPH/5521-3/2022**

**Date: 04/06/2025**

### Approval by Supervisors:

This thesis has been submitted with our approval as university supervisors.

Signature:



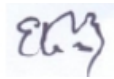
**Dr. Micah Matiang'i**

**School of Medical Sciences**

**Amref International University**

**Date: 05/06/2025**

Signature:



**Prof. Elizabeth Dimba BDS, MBA, PhD.**

**Department of Dental Sciences,**

**Faculty of Health Sciences, University of Nairobi**

**Date: 07/06/2025**

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## DEDICATION

I dedicate this thesis to my beloved family. A special dedication to my beloved mother and teacher Sophiah Bonareri Mageka who believed in me as a little boy and dreamt an accomplished academic path for me. To my friends and family your support has been invaluable.



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## ABSTRACT

**Introduction:** Sickle Cell Disease (SCD) poses a significant public health challenge in sub-Saharan Africa, with high prevalence among children in Kenya. Although oral health complications are common among individuals with SCD, they remain poorly documented, particularly in resource-limited settings. This study examined the prevalence and determinants of oral health conditions among children with SCD in Kisumu County.

**Methodology:** A descriptive cross-sectional study was conducted among 355 children aged 10–18 years with SCD across six clinics in Kisumu County. Participants were selected through systematic sampling. Data were collected using structured questionnaires and clinical oral examinations, assessing caries through the DMFT/dmft index and plaque via Turesky's modified plaque index. Analysis was performed using SPSS v30, with logistic and multiple regression models used to identify significant predictors.

**Results:** Dental caries prevalence was 40%, and 98% of participants had plaque with a mean plaque score of 1.74 (0.8 SD), with 68.7% exhibiting moderate to severe levels. The mean DMFT score was 1.09, primarily driven by decayed teeth. Notably, 79.4% had never visited a dentist, and only 6.2% had received professional cleaning. Barriers to care were reported by 89.6% of participants, mainly due to high cost (51.8%) and facility inaccessibility (35.2%). Significant predictors of caries included sleep interference (OR = 0.04), limited access to dental facilities (OR = 0.25), and motivation to maintain healthy teeth (OR = 11.06). Plaque scores and DMFT were significantly associated with caregiver occupation, brushing frequency, fluoride use, and dental visit history.

**Conclusion:** Oral health conditions are highly prevalent among children with SCD in Kisumu County and are strongly associated with limited access to care, low socioeconomic status, and inadequate self-care practices. Integrated oral health promotion and service delivery within SCD care programs are urgently needed.

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## **SYMBOLS/ABBREVIATIONS /ACRONYMS**

<b>BWC</b>	Biological Weapons Convention
<b>CF</b>	Cystic Fibrosis
<b>CI</b>	Confidence Interval
<b>CBRN</b>	Chemical, Biological, Radiological, and Nuclear
<b>CTBTO</b>	Comprehensive Nuclear-Test-Ban Treaty Organization
<b>CTSA</b>	Clinical and Translational Science Awardees
<b>DMFT/dmft</b>	Decayed, Missing, Filled Teeth index (uppercase for permanent teeth, lowercase for deciduous teeth)
<b>HbSS</b>	Hemoglobin SS genotype (severe form of sickle cell disease)
<b>HbSC</b>	Hemoglobin SC genotype (a variant of sickle cell disease)
<b>HBM</b>	Health Belief Model
<b>HCT</b>	Health Care Transition
<b>NACOSTI</b>	National Commission for Science, Technology and Innovation (Kenya)
<b>OR</b>	Odds Ratio
<b>PMTCT</b>	Prevention of Mother-To-Child Transmission
<b>SCA</b>	Sickle Cell Anemia
<b>SCD</b>	Sickle Cell Disease
<b>SPSS</b>	Statistical Package for the Social Sciences

## DEFINITION OF TERMS

<b>Age Group 10–18</b>	Individuals aged 10 to 18 years, inclusive. This age range represents the study’s target population.
<b>Associated Care Practices</b>	Healthcare interventions, behaviors, or treatments related to preventing, managing, or treating oral health conditions in individuals with sickle cell disease (SCD).
<b>Caregiver</b>	An individual, often a parent, guardian, or family member, who provides support for someone dependent—such as a child, older adult, or person with special needs—in maintaining oral hygiene and accessing dental care services (Ohara, Yoshino, & Nomura, 2021).
<b>DMFT/dmft Index</b>	A standardized tool to measure dental caries experience. DMFT (Decayed, Missing, Filled Teeth) applies to permanent teeth; dmft (lowercase) applies to deciduous (primary) teeth.
<b>Health Belief Model (HBM)</b>	A psychological framework used to predict health behaviors based on perceived susceptibility, severity, benefits, barriers, and cues to action.
<b>Oral Health</b>	The state of the oral cavity, including teeth, gums, and mucosal tissues, free from disease, pain, or dysfunction.

<b>Oral Health-Related Condition</b>	Pathologies affecting the oral cavity, such as dental caries (cavities), periodontal (gum) disease, mucosal lesions, or infections.
<b>Prevalence</b>	The proportion of a population with a specific disease or condition at a given time (e.g., 40% caries prevalence in the study).
<b>Sicklers</b>	Individuals diagnosed with sickle cell disease (SCD), a genetic disorder causing abnormal hemoglobin (HbS) and sickle-shaped red blood cells, leading to chronic complications.
<b>Socioeconomic Status (SES)</b>	A measure of an individual's or family's economic and social position, determined by factors like income, education, and occupation. In this study, SES influences access to dental care and oral hygiene.
<b>Turesky's Plaque Index</b>	A clinical tool to assess oral hygiene by quantifying plaque accumulation on teeth surfaces. Scores range from 0 (no plaque) to 5 (heavy plaque).
<b>Vaso-occlusive Crisis</b>	A common SCD complication where sickle-shaped red blood cells block blood flow, causing tissue damage and severe pain. Oral infections may trigger such crises.
<b>Osteomyelitis</b>	A bone infection (e.g., mandible) linked to reduced blood supply

in SCD patients, often exacerbated by untreated dental infections.



## CHAPTER 1: INTRODUCTION

### 1.1 Overview

This study explores prevalence and determinants of oral health conditions among children adolescents with Sickle Cell Disease (SCD) in Kisumu County. In this chapter we outline the global and local burden of SCD, highlighting the oral health complications associated with the conditions. The chapter defines the research problem, articulates the study's objectives, questions, and hypotheses, and justifies the need for localized evidence to inform interventions. It also explains the significance of integrating oral health into SCD care and delineates the study's scope and limitations.

### 1.2 Background of the Problem

Globally, sickle cell disease (SCD) affects over 300,000 newborns each year, with the most common and severe form attributed to the HbSS genotype (Kato et al., 2018). Although only about 2% of SCD births occur in high-income countries such as the United States and Europe, the vast majority arise in developing regions—especially sub-Saharan Africa—where the World Health Organization estimates that 230,000 HbSS births occur annually. Over 75% of all reported sickle cell anemia (SCA) cases are found in Africa, contributing to a significant disease burden, with an estimated 6–9 million children affected annually (Esoh et al., 2021). In Kenya, SCA distribution varies widely across ethnic groups and regions. The highest prevalence has been documented in coastal communities, reaching up to 35%, followed by populations residing in the Lake Victoria basin, where prevalence rates range between 20% and 30%. There is a higher concentration of haemoglobinopathies in areas near Lake Victoria compared to areas

further away from the Lake (Mutua et al., 2022). Beyond its systemic health implications, SCD leads to pathological changes in the oral cavity, affecting both soft and hard tissues. Reported dental manifestations include hypercementosis, enamel hypoplasia, hypomineralization, delayed tooth eruption, and pulp necrosis linked to vascular occlusion (Kalbassi et al., 2018). The relationship between SCD and dental caries remains debated: some studies report no significant difference in caries prevalence between SCD patients and healthy controls, while others document higher caries rates associated with enamel defects. Additional barriers, such as limited access to dental care—particularly among low-income populations—and dentist hesitancy due to perceived treatment risks, further complicate oral health outcomes (Kalbassi et al., 2018). A study by (Kowe et al., 2022) reported a dental caries prevalence of 58.8%, gingival inflammation prevalence of 73.2% and 14.4% dental structure anomalies, these findings were similar to those of (Agbor, 2025) in Major Hospital in Cameroon that reported a higher prevalence of periodontal disease, dental caries and oral mucosal lesions.

Caries development is influenced by multiple factors, including frequent use of antibiotics like penicillin in young children, polypharmacy, and recurrent hospitalizations. While penicillin prophylaxis has been shown to reduce *Streptococcus mutans* colonization and caries incidence in the short term, these benefits tend to be temporary. A study in Recife, Brazil, involving 160 children aged 3 to 12 years with SCD, demonstrated that socioeconomic status significantly influences both caries prevalence and severity (Kalbassi et al., 2018; Brandão et al., 2018). Brandão et al. (2018) further highlighted that lower income levels were strongly correlated with higher dmft indices, emphasizing the compounded effect of socioeconomic disadvantage on oral

health. Maintaining optimal oral hygiene is critical for individuals with SCD to prevent dental infections that may precipitate vaso-occlusive crises or escalate into severe complications such as osteomyelitis of the mandible a condition characterized by impaired blood supply and heightened infection risk (Haile et al., 2023).

Although global and regional studies have established key insights into the intersection of SCD and oral health, there remains a notable gap in localized data for Kisumu County. This study seeks to bridge that gap by providing context-specific evidence on the prevalence and determinants of oral health conditions among sicklers aged 10–18 years, thereby informing targeted interventions and healthcare planning.

### **1.3 Statement of the Problem**

Sickle Cell Disease (SCD) is a prevalent genetic blood disorder among Kenyan children and adolescents, with the western region reporting that approximately 16% of children are born with the sickle cell trait, and 4.5% develop full-blown SCD (Arishi et al., 2021). While SCD primarily manifests through systemic complications, mounting evidence highlights its significant impact on oral health. Children and adolescents with SCD face an increased risk of oral diseases due to both intrinsic factors such as structural enamel and dentin defects that predispose them to dental caries (DaSilva et al., 2023). Extrinsic factors, including immune suppression, which heightens susceptibility to periodontal and mucosal infections like gingivitis and oral candidiasis (Bhatnagar et al., 2019).

The consequences of oral health problems in this population extend beyond physical discomfort, affecting critical functions such as eating, speech, and social interaction. Moreover, poor oral health can contribute to psychosocial challenges, including reduced

self-esteem and emotional distress, further compounding the burden of chronic illness (Kakkar et al., 2021).

Despite these risks, there is limited empirical data on the prevalence and determinants of oral health conditions among children with SCD in Kisumu County. The lack of localized evidence hinders effective planning, resource allocation, and the development of targeted interventions tailored to the needs of this vulnerable group.

This study aims to address this knowledge gap by establishing the prevalence and identifying the key determinants of oral health conditions—specifically dental caries, periodontal disease, and mucosal lesions—among adolescents aged 10–18 years living with SCD in Kisumu County.

## **1.4 Objectives**

### ***1.4.1 Broad Objective***

To establish the prevalence and determinants of oral health conditions among sicklers aged 10-18 in Kisumu County.

### ***1.4.2 Specific Objectives***

The following specific objectives, research questions, and hypotheses were formulated to guide the study and address the identified research gaps.

1. To determine the prevalence of caries, periodontal disease, and mucosal disease among sicklers aged 10-18 years in Kisumu County -Kenya.
2. To assess the knowledge of sicklers aged 10-18 years on prevention of oral health-related conditions in Kisumu county-Kenya.

3. To assess self-care practices and how they are associated with caries, periodontitis and mucosal diseases among sicklers aged 10-18 years in Kisumu county-Kenya.
4. To investigate the contribution of household socio- economic factors to oral health related conditions among sicklers aged 10-18 years in Kisumu County -Kenya.

## **1.5 Hypothesis**

### ***Null Hypotheses:***

1. There is no association between self-care practices and oral health conditions among sicklers aged 10- 18 years in Kisumu County.
2. There is no contribution of household socio-economic factors to oral health related conditions in sicklers

## **1.6 Justification of the Study**

This study carries strong cost-saving potential. By identifying oral health problems in children with sickle cell disease (SCD) and promoting preventive strategies, it has the capacity to substantially reduce long-term treatment costs. Early detection and health promotion lessen the financial burden on families and ease the overall strain on healthcare systems, contributing to more efficient and sustainable care. In validating these objectives, the study underscores the need for a holistic understanding of the burden of dental caries, periodontal disease, mucosal conditions, and their broader impact on oral health-related quality of life particularly within the complex context of SCD in Kisumu County. This study looked at oral health condition whose prevalence have been attributed to the pathophysiology of Sickle Cell Disease and chose a lower age limit that would allow cooperation for clinical exam and response to the questionnaire by participants and a highest limit that considers loss to follow up as indicated by existing clinical records

and previous experience.

The research will also generate critical data to assist government policymakers and healthcare authorities in developing targeted policies and allocating resources effectively. By quantifying the prevalence of chronic oral diseases among people living with SCD, the findings will enable health promoters to design specific interventions and treatment strategies. Moreover, the results will deepen understanding of the broader implications of SCD on quality of life, equipping policymakers with the evidence needed for well-informed decision-making in healthcare delivery.

Importantly, the study provides a foundation for improving clinical care. Its findings will guide collaborative consultations between dentists and hematologists, fostering integrated management plans that enhance patients' overall health and help prevent or mitigate oral complications associated with SCD. Finally, this research offers a valuable starting point for further academic inquiry in hematology, dentistry, and public health. It opens avenues for future research into various dimensions of the relationship between SCD and oral health, while also contributing meaningfully to the existing body of knowledge—thereby advancing education, clinical practice, and scientific progress in these intersecting fields.

### **1.7 Significance of the Study**

This research has the potential to significantly enhance multidisciplinary healthcare and improve the quality of life for children and adolescents living with sickle cell disease (SCD). By focusing on oral health problems specifically dental caries, periodontal disease, and mucosal conditions it aims to alleviate pain and discomfort, restore essential

functions such as eating and speaking, and ultimately improve daily wellbeing for this vulnerable population at a formative stage of life.

Moreover, the study reinforces the understanding that optimal health is multidimensional, encompassing social, mental, and physical wellbeing. It advances a paradigm shift that positions oral health as a critical component of overall health, advocating for healthcare strategies that recognize and address the broader implications of oral health on an individual's holistic wellness.

A key emphasis of the research is the promotion of preventive healthcare. By prioritizing early intervention and routine oral hygiene practices, the study supports cost-effective and sustainable approaches to managing chronic health conditions.

Importantly, the research contributes to healthcare equity by highlighting the needs of a historically underserved and marginalized group. It calls for the equitable provision of care, ensuring that access to quality oral health services is not determined by socioeconomic or health status. The insights generated by this study will inform the development of targeted health promotion programs, equipping individuals living with SCD and their families with the knowledge and tools to proactively manage oral health challenges. Policymakers can leverage these findings to craft evidence-based healthcare policies that prioritize oral health within SCD management, fostering comprehensive programs that integrate dental services into routine care.

Although this study is conducted within Kisumu County, its implications extend beyond local boundaries. SCD is a global health concern, and the findings have the potential to inform best practices and improve care for affected populations internationally. In

essence, the study's value transcends academic inquiry, offering tangible benefits for individuals, families, healthcare systems, and society at large—providing a pathway to transformative improvements in the care of people living with SCD.

### **1.8 Scope of the Study**

The study is geographically confined to Kisumu County in Kenya, focusing specifically on individuals aged 10–18 years diagnosed with sickle cell disease (SCD). This target population will be assessed using validated clinical tools to evaluate the prevalence and severity of dental caries, periodontal disease, mucosal conditions, and oral hygiene practices. In addition, the study will explore the influence of socioeconomic factors on oral health outcomes within this group. Based on the findings, evidence-based recommendations for interventions and preventive strategies will be proposed to enhance oral health and overall wellbeing among adolescents living with SCD in Kisumu County.

### **1.9 Assumptions of the Study**

This investigation into the oral health of adolescents with Sickle Cell Disease (SCD) in Kisumu County was guided by several underlying assumptions about the research process. Firstly, the study operated on the premise that the target population exhibited some degree of consistency in characteristics peculiar to this group. It was assumed that adolescents with SCD in Kisumu County shared similar attributes and experiences regarding their diagnosis and oral health status, although individual cases may have differed. Secondly, the study's methodology was based on the assumption of the validity of self-reported information. It was assumed that respondents provided truthful and consistent accounts of their experiences and perceptions concerning oral health-related

quality of life. This assumption acknowledged the inherent limitations of self-reported data, including the potential for inaccurate or biased responses.

The study further assumed uniformity in dental care practices among participants. It was presumed that all respondents received consistent supportive dental care and complied with oral hygiene recommendations, despite potential disparities in access and adherence. Additionally, the research assumed that the severity of SCD was relatively consistent across participants, with similar clinical presentations and complications. It also assumed uniform access to healthcare services for children and adolescents with SCD in Kisumu County.

The study assumed the absence of significant unmeasured confounding variables that could have influenced the observed outcomes, despite efforts to control for known confounders. Although the research acknowledged variations in healthcare infrastructure and cultural practices across regions, the findings were considered valid for the broader SCD population and were expected to offer insights into wider issues. Finally, it was assumed that participants' oral health conditions did not undergo substantial changes during the study period.

These assumptions informed the conduct of the research and were acknowledged to enhance transparency regarding methodological limitations and the interpretation of results.

## **CHAPTER 2: LITERATURE REVIEW**

### **2.1 Introduction**

This chapter explores key oral health-related issues affecting individuals with sickle cell disease (SCD). Specifically, it examines the prevalence of oral diseases, the level of knowledge sicklers possess regarding the prevention and management of these conditions, their oral hygiene practices, and the broader impact of oral health on their overall wellbeing. The chapter also presents a conceptual framework that contextualizes the study and reviews relevant hypotheses underpinning the observed prevalence of oral health disorders within this population.

Although awareness of the importance of oral health in individuals with SCD is increasing, there remains a notable gap in the literature concerning the prevalence and determinants of oral health conditions particularly across different age groups and geographic regions. This study addresses these gaps by investigating the prevalence and determinants of oral health conditions among sicklers aged 10 to 18 years in Kisumu County. The findings aim to generate actionable insights that will inform the development of targeted interventions and strategies to improve oral health outcomes for this vulnerable group.

### **2.2 The Theoretical Framework**

#### ***2.2.1 Health Belief Model (HBM)***

The Health Belief Model (HBM) serves as a unified theoretical framework that explains how individuals perceive health risks and adopt health-related behaviors. Public health traditionally plays a crucial role in both disease prevention and treatment; however, early

detection and screening are particularly emphasized as cost-effective strategies for mitigating public health challenges (Anwar et al., 2020). The HBM provides a versatile framework applicable to both communicable and non-communicable diseases (Wang et al., 2023). According to Anwar et al. (2020), perception is defined as the psychophysical evaluation of the quality of a phenomenon based on personal experience, and it plays a pivotal role in shaping health behavior. The foundational constructs of the HBM, originally outlined by Bartlett in 1928, include perceived seriousness, perceived susceptibility, perceived benefits, and perceived barriers. Research has established that among sickle cell patients, illness perception significantly influences treatment adherence, mental health outcomes, and mortality risks.

Ecker and Rosenstock. (1984) expanded the HBM to include six domains: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. Although initially designed to explain preventive health behaviors, the model has evolved to encompass broader health-supportive actions and has provided a robust framework for empirically validated studies on health behavior. In the context of assessing the oral health knowledge and practices of sicklers aged 10–18 years in Kisumu County, the HBM offers critical insights into how perceived severity, susceptibility, and attitudinal factors influence health behaviors (Aliabadi et al., 2020). The key components of the HBM relevant to this study are outlined below:

**Perceived Susceptibility:** This component assesses individuals' perception of their risk of developing a specific health condition. For sicklers, it is essential to understand their perceived vulnerability to oral health disorders, particularly given their elevated risk profile. Awareness of the link between SCD and oral health complications is a key factor

influencing preventive behaviors.

**Perceived Severity:** This component assesses how individuals perceive the seriousness of a health condition and its potential consequences. For sicklers, it is important to recognize that oral health issues—such as dental caries, periodontal disease, and mucosal lesions—can have serious implications (Alamri, 2022). These problems may exacerbate complications related to sickle cell disease and negatively impact overall health and quality of life (Alamri, 2022).

According to the HBM, individuals are more likely to adopt preventive or management behaviors when they perceive clear benefits. For sicklers, understanding the value of regular dental checkups, proper oral hygiene, and medication adherence is essential to encourage proactive oral health practices.

**Perceived Barriers:** The approach acknowledges that individuals are unlikely to adopt health-promoting behaviors if they perceive significant barriers. Potential challenges that may hinder sicklers in Kisumu County from effectively managing their oral health include financial constraints, limited access to dental care, and complications associated with sickle cell disease (Kakkar et al., 2021).

**Cues to Action:** Cues to action are external triggers that encourage individuals to engage in health-related behaviors. For sicklers' oral health, these cues include public awareness campaigns, information drives, and educational initiatives that inform participants about treatment processes and highlight the importance of maintaining good oral hygiene.

**Self-Efficacy:** The HBM emphasizes the critical role of individuals' confidence in their ability to carry out recommended health behaviors. Enhancing self-efficacy among

sicklers requires providing sufficient knowledge, practical tools, and strong support systems to help them overcome barriers and maintain effective oral hygiene practices (Holderle et al., 2021).

This study will evaluate the knowledge, attitudes, and practices of sicklers aged 10–18 years regarding oral health using a cross-sectional design. Data will be gathered through surveys, interviews, and focus group discussions, addressing key HBM constructs such as perceived susceptibility, perceived severity, perceived benefits, and perceived barriers. ed severity, perceived benefits, perceived barriers, and cues to action.

## **2.3 Review of Related and Empirical Literature**

### ***2.3.1 Prevalence of Caries, Periodontal, Mucosal Diseases***

One of the most frequently observed oral manifestations in patients with sickle cell disease (SCD) is mucosal pallor. This clinical sign, although indicative of underlying anemia, is typically less severe than the decline in hemoglobin levels suggests. The pallor observed in the oral mucosa is primarily due to the chronic hemolysis characteristic of SCD. Additionally, the mucosa may occasionally take on a yellowish hue as a result of increased bilirubin production from ongoing red cell breakdown, a hallmark of hemolytic anemias, including autoimmune types (Tonon et al., 2018). These signs, while non-specific, are nonetheless important indicators of systemic involvement and can be seen across various forms of hemolytic anemia.

SCD is caused by a point mutation in the  $\beta$ -globin gene that results in the substitution of valine for glutamic acid at the sixth position, producing hemoglobin S (HbS). This

genetic alteration leads to the polymerization of hemoglobin under deoxygenated conditions, which distorts red blood cells into a characteristic sickle shape. These deformed cells contribute to vaso-occlusion, chronic hemolysis, and multiple systemic complications. Variants of this disorder include homozygous HbSS and compound heterozygous forms such as HbSC and HbSD, all of which may contribute differently to the disease phenotype (Tonon et al., 2018).

Oral health in individuals with SCD is a growing area of interest due to the potential impact of systemic disease on the oral environment. A systematic review by da Silva et al. (2023) explored the relationship between periodontal disease and SCD. While most periodontal parameters did not significantly differ between patients with SCD and healthy controls, the gingival index was notably higher among sickle cell patients. This finding may suggest a heightened inflammatory response or decreased oral hygiene associated with systemic illness. The authors emphasized the need for more robust, well-controlled studies to further elucidate this association.

Moreover, children and adolescents with SCD may be particularly vulnerable to oral health challenges due to factors such as frequent hospitalizations, reduced access to dental care, and systemic complications affecting oral tissues. Brandão et al. (2018) conducted a study comparing dental caries and salivary parameters between individuals with SCD and their healthy peers. The findings demonstrated that SCD patients had higher decayed, missing, and filled teeth (DMFT) indices, along with significantly reduced salivary buffer capacity. These results underscore the importance of integrating

dental care into the broader management plan for individuals with SCD, especially during the developmental years.

In addition to dental caries and periodontal conditions, SCD is also associated with various mucosal lesions. These may arise from chronic anemia-related tissue ischemia or opportunistic fungal infections, particularly in the context of long-term antibiotic usage (Chekroun et al., 2019). For example, oral candidiasis is more commonly reported in immunocompromised states, including those seen in chronic hemolytic conditions like SCD. Despite the recognition of these issues, there remains a significant gap in the literature focused specifically on the prevalence and clinical management of oral lesions among SCD patients.

Given the systemic nature of SCD and its multisystem complications, oral manifestations should not be overlooked. Routine dental examinations and preventive strategies tailored to this patient population are essential. Interdisciplinary collaboration between dental and medical professionals can help in the early identification and management of oral complications, thereby improving overall quality of life for individuals with sickle cell disease.

### ***2.3.2 Knowledge of Sicklers on Prevention and Management of Oral Health Related Conditions***

Oral health plays a fundamental role in an individual's overall well-being, encompassing physical, emotional, and social dimensions. Diseases affecting oral health such as chronic orofacial pain, oral cancer, infections, periodontal (gum) disease, dental caries, and tooth

loss—can significantly impair a person’s ability to bite, chew, smile, speak, and interact socially. These conditions, if left untreated, may result in diminished quality of life and have been linked to broader systemic diseases such as cardiovascular disease and diabetes (Naseri-Salahshour et al., 2019). Therefore, maintaining optimal oral health is not merely a matter of aesthetics or localized comfort but a critical component of holistic health.

The global burden of oral diseases has been rising steadily, especially in low- and middle-income countries. This trend has been attributed to multiple factors, including urbanization, dietary changes, and increased consumption of sugars and processed foods—a phenomenon often described as the “nutrition transition” linked to the adoption of Western lifestyles (Naseri-Salahshour et al., 2019). Even high-income countries are not immune, facing significant public health challenges related to the management and prevention of dental caries, periodontal disease, and tooth loss. The increase in prevalence is particularly concerning in younger populations, underscoring the urgent need for preventive interventions.

Dental caries, in particular, remains the most prevalent oral health issue worldwide, affecting 60% to 90% of school-aged children, according to global epidemiological data (Minja et al., 2024). Caries, if not addressed, can lead to pain, infection, difficulties in eating and speaking, and absenteeism from school, all of which can affect a child's development. The prevention of such conditions is closely tied to behavioral factors. Numerous studies have shown that the incidence of dental caries and periodontal disease declines significantly when individuals adopt effective oral hygiene habits, such as regular tooth brushing and flossing, as well as reducing sugar intake (Minja et al., 2024).

Good oral health practices can be grouped into two major behavioral domains: professional dental care and personal self-care. The former includes routine dental visits, professional cleaning, and preventive treatments like fluoride applications and sealants. The latter involves daily habits such as brushing twice a day with fluoride toothpaste, flossing at least once a day, reducing the intake of sugary snacks and beverages, and using mouthwash or other oral care products as needed (Yue et al., 2020). These habits, when consistently practiced, significantly contribute to maintaining healthy teeth and gums across the lifespan.

Health education plays a central role in promoting these behaviors, especially when introduced early in life. Structured oral health education programs aim to empower individuals with the knowledge and skills necessary to make informed decisions about their dental health. As Calcagnile et al. (2019) assert, these programs are not only intended to initiate new health behaviors but also to reinforce and sustain them within families and communities over time. Longitudinal studies have shown that school-based oral health education programs lead to measurable improvements in children's oral hygiene, attitudes toward dental care, and even clinical outcomes such as reduced plaque and gingival bleeding.

Incorporating oral health education into school curricula is particularly important, as early exposure helps foster lifelong healthy behaviors. Educational programs should be designed based on the existing level of awareness and behaviors among children to ensure relevance and efficacy. According to Minja et al. (2024), targeted interventions when adapted to cultural and contextual factors can lead to significant improvements in

oral hygiene practices, reduction in caries prevalence, and better overall oral health among school-aged populations.

Ultimately, improving oral health on a population level requires a multifaceted approach that includes public policy initiatives, professional dental care accessibility, and robust health education strategies. A shift toward preventive care and community-based interventions can alleviate the growing burden of oral diseases and promote health equity globally.

### ***2.3.3 Oral Health Care and Practices among Sicklers***

Advances in modern medicine and comprehensive pediatric care have significantly improved survival rates among individuals with severe, chronic childhood-onset disorders conditions that were once considered uniformly fatal. Today, many individuals born with complex chronic diseases such as sickle cell disease (SCD), cystic fibrosis (CF), congenital heart defects, and metabolic disorders are living well into adulthood (Poudel et al., 2018). However, the extension of lifespan also brings new challenges, particularly in ensuring that these individuals continue to receive age-appropriate, coordinated, and specialized care as they transition from pediatric to adult healthcare systems.

Unlike their healthy counterparts, young adults with chronic illnesses often remain under the care of pediatric healthcare providers well into their late adolescence or even early adulthood. This delay reflects both the complexity of their medical needs and the strong patient-provider bonds often formed during years of intensive pediatric care. However,

long-term reliance on pediatric services is neither feasible nor optimal, as adult healthcare settings are better equipped to address the evolving physical, psychological, vocational, and social needs of adults living with chronic conditions (Kramer, 2020). For these individuals, the transition from pediatric to adult healthcare represents not merely a change in provider but a significant developmental milestone requiring strategic planning and support.

This process, formally referred to as Health Care Transition (HCT), is defined as a purposeful, planned movement of adolescents and young adults with chronic medical conditions from child-centered to adult-oriented healthcare systems (Poudel et al., 2018). HCT is a multifaceted process involving not only the transfer of clinical responsibility but also the empowerment of patients to assume increasing autonomy in managing their health. Core components of effective HCT include early planning (often beginning in early adolescence), structured assessments of transition readiness, individualized care plans, patient and family education, and the coordinated transfer of medical records and communication between pediatric and adult care teams.

According to Poudel et al. (2018), a primary objective of HCT initiatives is to ensure continuity of care and improve long-term health and psychosocial outcomes across the lifespan—not just during the transitional years. This is especially critical for diseases such as SCD and CF, which require continuous, multidisciplinary management to avoid severe complications. The National Center for Advancing Translational Sciences (NCATS) recognized this need and, through the Institute of Medicine (now the National Academy of Medicine), emphasized the role of HCT as a determinant of long-term

outcomes in adults who survive severe childhood disorders. The Clinical and Translational Science Award (CTSA) Lifespan Task Force further reinforced this by identifying HCT as a priority area for intervention and innovation (Poudel et al., 2018).

Despite growing awareness and the development of transition frameworks and guidelines by professional organizations, implementation of HCT remains inconsistent. A study by Lebrun-Harris et al. (2021) utilizing national survey data revealed persistent gaps in the planning, coordination, and execution of HCT for youth with chronic health conditions. Many adolescents report not receiving the recommended components of transition planning, such as having time alone with providers, discussions about future adult care, or support in self-management skills. These deficiencies can have particularly negative consequences for patients with progressive conditions, where interruptions in care or poorly managed transitions may result in health deterioration, increased emergency department use, and avoidable hospitalizations.

In response to these concerns, the Single Disease Workgroup of the CTSA Lifespan Task Force conducted a focused review of HCT processes in two well-studied progressive conditions—Sickle Cell Disease (SCD) and Cystic Fibrosis (CF). These diseases were selected due to their predictable disease trajectories, complex care requirements, and availability of longitudinal data, making them ideal models for studying and refining HCT approaches (Lebrun-Harris et al., 2021). Findings from this review highlighted the importance of disease-specific transition protocols, early engagement with adult care teams, and the involvement of multidisciplinary transition coordinators to facilitate communication and continuity.

In conclusion, Health Care Transition (HCT) is a critical yet often under-implemented component of care for adolescents and young adults with chronic childhood-onset disorders. As survival continues to improve for these populations, the healthcare system must evolve to support not only their medical needs but also their broader social and developmental challenges. By investing in structured, evidence-based transition models—especially for high-priority conditions like SCD and CF—healthcare systems can bridge the pediatric-adult care divide and ensure better long-term outcomes for this vulnerable group.

#### **2.4 Identification of Knowledge Gap**

The literature reviewed in preceding sections reveals substantial research on the oral health of individuals with sickle cell disease (SCD); however, several critical gaps persist. These gaps limit the effectiveness of current interventions and highlight priority areas for future research and policy development.

Firstly, most studies have focused on young people as a broad category, without adequately addressing potential disparities across different age groups. Given that dental healthcare needs may vary significantly between early and late adolescence, this presents a gap that warrants deeper exploration. As Minja et al. (2024) and Naseri-Salahshour et al. (2019) emphasize, oral health interventions must be tailored to the specific developmental stages and behavioral patterns of the target population to be effective.

Secondly, while socioeconomic barriers such as affordability are briefly mentioned in frameworks like the Access to Healthcare Framework, there is a lack of detailed investigation into the financial challenges faced by families of children and adolescents with SCD when accessing dental care. Studies by Calcagnile et al. (2019) and Babatunde-

Sowle et al. (2020) underscore the importance of understanding economic constraints and their direct impact on health-seeking behavior. Addressing this gap is crucial for developing financial support mechanisms and improving equity in service delivery.

Thirdly, in the context of rapid technological advancement and the growing use of telehealth services, there is a need to examine how digital health solutions might enhance access to dental care for young people with SCD, especially in underserved and remote areas. Although digital health has been broadly explored, its application in oral health care for this demographic remains under-studied (Lebrun et al., 2021; Poudel et al., 2018).

Furthermore, while much of the existing literature focuses on the experiences and perspectives of children and adolescents with SCD, the role of caregivers—who are central to the management of these children’s oral health—remains underexplored. As noted by Holderle et al. (2021), self-efficacy and effective oral health maintenance are often facilitated by caregivers, making their insights critical for the design of holistic interventions.

Addressing these knowledge gaps through targeted research will deepen understanding of the unique oral health challenges faced by children and adolescents with SCD and will contribute to the development of more effective, inclusive interventions and policies.

Advancing research in these areas presents a valuable opportunity to enhance health equity and improve the quality of life for this vulnerable population.

## 2.5 Conceptual Framework

The conceptual framework illustrates the hypothesized indirect relationship between socio-demographic and socio-economic factors and oral health outcomes, mediated by health-related behaviors and access to care. It emphasizes the role of both structural and behavioural determinants in shaping oral health status among adolescents. Figure 1 below summarises this conceptual framework.

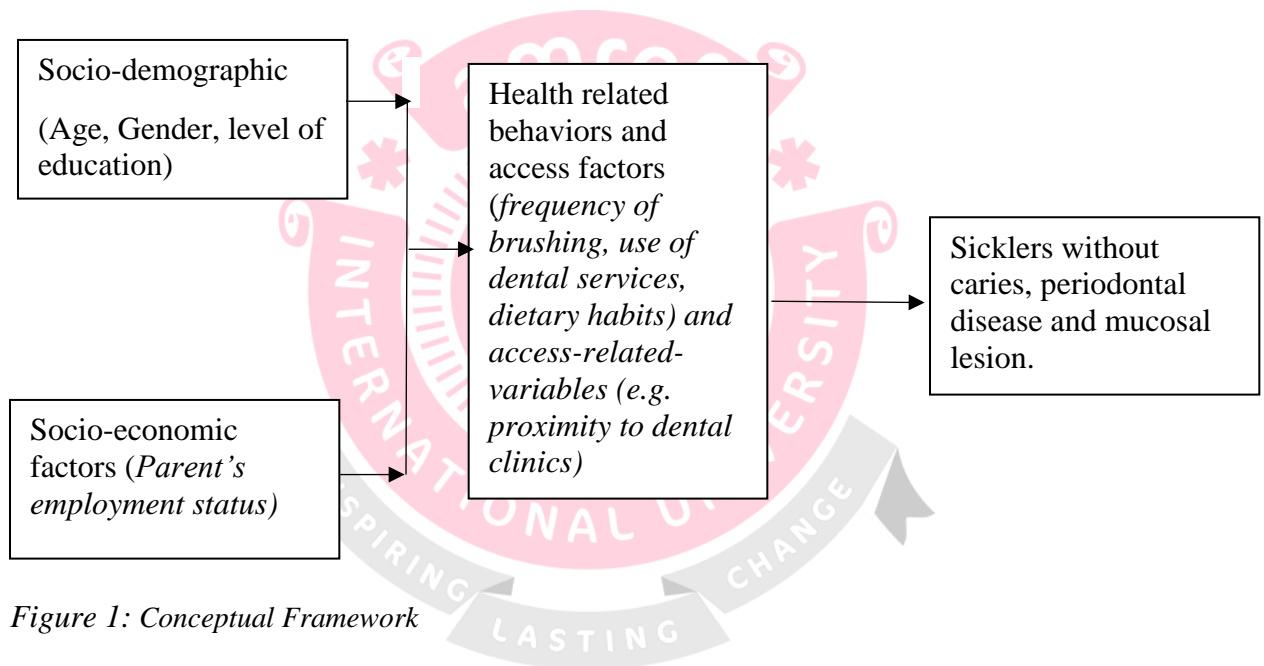


Figure 1: Conceptual Framework

## CHAPTER 3: METHODOLOGY

### 3.1 Introduction

The study adopted a systematic methodology that outlined key elements of the research design, including the study location, identification of the target population, the sampling approach employed, data collection strategies, analytical techniques, and the ethical considerations addressed within the study context. Adherence to these methodological principles enhanced the reliability, transparency, and ethical integrity of the research, ensuring the provision of valuable insights into the specific oral health challenges faced by this group of individuals.

### 3.2 Research Design

The study employed a descriptive analytical cross-sectional design targeting children and adolescents aged 10-18 years attending Sickle Cell Disease (SCD) clinics in Kisumu County.

### 3.3 Study Area

This research was conducted in Kisumu County, an administrative unit in the Western part of the Republic of Kenya. The study was conducted in Sickle Cell Disease clinics within Kisumu County. The study targeted six sickle Cell clinics in Kisumu County. All clinics that manage Sickle Cell were purposively selected. These were Salama Cancer Centre, Synergy clinics, Taiba Hospital, Kisumu Specialists Hospital, Kisumu County Referral Clinic, Jaramogi Oginga Odinga Teaching and Referral Hospital and Katito Sub-county SCD clinic.

### **3.4 Study Population**

The study population included sicklers aged 10- 18 years attending the six Sickle Cell (SCD) within Kisumu County. The lower age limit ensured ease of administration of questionnaire and cooperation for clinical examination while the upper limit considered loss to follow up as established in the clinical records at the Sickle Cell Clinics from past experience.

#### **3.4.1 Inclusion Criteria**

1. Sicklers aged 10- 18 years
2. Sicklers willing to participate and consent to take part in the study

#### **3.4.2 Exclusion Criteria**

Patient under in patient care

### **3.5 Sample Size Calculation**

The sample size for the study was calculated based on several parameters, including the desired confidence level, margin of error, and estimated population size. There being no study that looked at oral health aspect of Sickle Cell Disease locally that was specific to this group, a Tanzanian study was selected, and the prevalence reported was used to calculate sample size. The calculation followed a formula anchored on the study by Minja et al. (2024), which examined dental caries in children with Sickle Cell Disease and its association with the use of hydroxyurea and penicillin prophylaxis in Dar es Salaam.

$$n = \frac{Z^2 \times p(1 - p)}{E^2}$$

The formula applied was as follows:

Where:

$n$  = sample size

$Z$  = Z-score (corresponding to the desired confidence level (1.96 for 95% confidence))

$p$  = estimated proportion of the population with the attribute of interest (in this case 0.3 will be used based on cross-sectional study in Tanzania with a prevalence of 30%.

$E$  = margin of error 0.05

Substituting the values:

$$n = \frac{(1.96)^2 \times 0.3 \times (1 - 0.3)}{(0.05)^2}$$

An adjustment for a 10% attrition rate was included, increasing the base sample size from 323 to 355 participants.

### 3.6 Sampling Procedures

Systematic sampling was employed within the Sickle Cell Disease clinics. Every third patient attending the clinic was selected, beginning from a randomly chosen starting point within each clinic's schedule. The principal investigator enrolled participants, with research assistants administering the questionnaire in the participants' preferred language, followed by a clinical dental examination while maintaining participant privacy. The

research assistants received training on study objectives, methodology, data collection (quantitative surveys and qualitative interviews), and ethical considerations, including informed consent and confidentiality. Training also emphasized cultural sensitivity to ensure respectful engagement with the local community. All personnel handling data signed confidentiality agreements before the study commenced.

### Sampling frame

A probability proportionate to size (PPS) approach was used to develop the sampling frame based on the patient registers of each clinic.

*Table 1: Sampling frame*

SCD Clinic	Number of Patients Follow-up	of on	Number Targeted	Average Weekly Reviews
Jaramogi Hospital Clinic	600	Odinga	200	50
Kisumu Hospital	240	County Referral	50	20
Katito Sub-County Hospital	145		30	12
Kisumu Specialist Hospital	110		20	9
Synergy Clinics	88		20	7
Salama Care Center	95		20	8
Taiba Hospital	63		15	5
<b>Total</b>	<b>1,341</b>		<b>355</b>	<b>111</b>

### Variables

This section outlines the key variables assessed in the study, detailing both the dependent and independent variables along with their corresponding measures. The table below provides a summary of these variables and their operational definitions as applied during data collection and analysis.

Table 2: Variables

Variables	Measures
Social Demographics	
Age	Number
Gender	Male, Female
Birth Order	Number
Socioeconomic Factors	Family income, Literacy
Dependent Variables	
Y	Mean DMFT
Periodontitis	Mean Plaque Index
Mucosal Disease	Present, Absent
Modifier Variables	
Oral Hygiene Practices	Frequency of brushing and interdental cleaning
Knowledge	Scores
Quality of Life	Access to care, form of schooling, physical activity
Dietary Habits	Consumption of sugary foods

### 3.7 Data Collection Instrument

Data were collected using structured, interviewer-administered questionnaires alongside clinical examinations of oral tissues. The clinical assessments were conducted with the participant seated in a standard chair in a well-illuminated room, and strict adherence to participant privacy was maintained throughout the dental examination.

1. A revised World Health Organization (WHO) clinical examination form was utilized to record information regarding the oral hygiene and oral health conditions of participants. The following indices were applied to evaluate oral hygiene and oral health status:

Table 3: Indices

Index	Oral disease/ condition(s)
Turesky's modification of Quigley and Hein 1970	Oral hygiene status
Decay Missing and Filled Teeth DMF(T)/dmft	Caries experience

2. A modified WHO questionnaire was also used to gather quantitative data, including oral health-seeking behaviors and oral hygiene practices.

### 3.8 Validity and Reliability

To ensure validity and reliability, a pilot study of the data collection tool was conducted prior to the main data collection phase. Only respondents meeting the inclusion criteria participated in the pilot. Intra-examiner calibration was performed to confirm consistency in assessments.

Cohen's kappa statistic was employed to measure agreement between the examiner and a secondary reviewer, quantifying inter-rater reliability. This coefficient considers both the observed agreement and the agreement expected by chance. A value close to 1.0 indicates high agreement.

The pilot study followed all procedures of the main study, with 5% of the anticipated sample size (17 participants) completing the questionnaire twice over a ten-day interval. This interval allowed for refinement of methods, instruments, and procedures. A correlation coefficient was calculated to compare the two sets of responses; a coefficient above 0.70 was considered acceptable.

In addition to the test-retest method, Cronbach's alpha was calculated to assess internal consistency. According to Cooper and Schindler, a Cronbach's alpha value of 0.7 or higher indicates good reliability, while values below 0.7 suggest unsatisfactory consistency.

To maintain high-quality data collection, research assistants received comprehensive training on data collection procedures, study objectives, and ethical considerations, including informed consent and confidentiality. The clarity and consistency of all questionnaire items were reviewed. Double verification of data was conducted before entry to minimize errors and uphold data integrity. Notably, data from the pilot study were excluded from the final analysis and used solely to validate the research instruments.

### **3.9 Data Collection Procedures**

Training of competent research assistants was supervised to ensure proper data collection at Sickle Cell Disease (SCD) clinics in Kisumu County. Engagement with study participants diagnosed with SCD involved a thorough explanation of all study procedures. Written informed consent and assent were obtained from participants, and only those who provided signed consent were included. The data collection phase spanned six weeks. The first participant was selected from the initial SCD patient who attended a routine consultation and whose parent or guardian gave informed consent.

Oral examinations were conducted with strict attention to privacy by a qualified dental surgeon using a modified WHO clinical data collection tool to assess oral health status. During these examinations, patients received disclosing tablets and were instructed to

rinse once. Caries experience was assessed using the DMFT/dmft index and Turesky's modification of Quigley and Hein (1970). Infection control measures were rigorously enforced, with research assistants equipped with appropriate personal protective equipment. Data consistency was ensured by employing only qualified and trained research assistants. Additionally, a subset of sickle cell patients was randomly selected for re-examination to evaluate intra-examiner reproducibility. These re-examinations were conducted by the same dental surgeon while maintaining participant privacy. To ensure accurate identification during follow-up, research assistants recorded both participant codes and initials. For children under 18 years of age, clinical examinations and data collection were performed in the presence of a parent or guardian.

### **3.10 Data Analysis and Presentation**

Data was entered using the Kobo Collect Toolbox version 1.30.1 and subsequently analyzed using the Statistical Package for the Social Sciences (SPSS) software (IBM SPSS Statistics version 30). Normality of continuous variables was assessed using the Shapiro-Wilk test. Sociodemographic data were analyzed using univariate descriptive statistics. Categorical variables were presented as proportions, percentages, and ratios, while continuous variables were summarized as means with standard deviations and displayed in tabular form. Depending on the distribution of the data, appropriate tests were applied, and reporting was based on either median or mean values. Relationships between variables were examined through cross-tabulations, and statistical significance was assessed using Pearson's Chi-Square test, with a significance level set at  $p < 0.05$ .

**Data Analysis Plan**

The table below summarizes the key study variables, their corresponding measures, and the analytical methods applied. This structured overview highlights how the data were organized and the specific statistical approaches used to examine the prevalence of oral health-related conditions, assess knowledge and practices, and explore associations between sociodemographic factors, oral health outcomes, and care practices

*Table 3:Analysis plan*

Attribute	Variables	Measures	Analysis methods
Prevalence of oral health related conditions	Caries Periodontitis Fluorosis Mucosal disease	Mean DFMT Mean plaque Index Mean Dean’s Index Present, absent	Descriptive statistics
Knowledge – prevention	Oral hygiene practices Dietary intakes	Yes or no	Descriptive statistics and Simple proportions
Dental care practices and oral health conditions	Association	Self-care vs DFMT, Plaque Index, Mucosal disease	Descriptive statistics and multilinear Regression
Household socio-economics and oral health conditions	Association	SES vs DFMT, Plaque Index, Mucosal diseases	Descriptive statistics and multilinear Regression
Association-Social economic status and Knowledge of care practices	Association	SES vs Knowledge	Descriptive statistics and Correlation
Social economic Status Self-care Practices	Association	SES vs Self care	Descriptive statistics and Correlation

The prevalence of oral health conditions was calculated and presented as the proportion of participants diagnosed with the conditions relative to the total number enrolled in the study. Knowledge regarding prevention of oral health-related conditions was analyzed descriptively, with proportions or total responses reported based on predefined categories in the data collection tool. To enhance the visualization of results, graphs and tables were utilized where appropriate.

To assess associations between dental care practices and oral health conditions, univariable logistic regression was first performed to explore individual variable relationships. This was followed by multivariable logistic regression, incorporating additional variables identified as potential confounders or effect modifiers to adjust for their influence. This approach provided a robust assessment of whether an independent association existed between dental care practices and oral health outcomes. Similarly, to investigate the relationship between socioeconomic status and oral health conditions, univariable logistic regression was initially applied, followed by multivariable logistic regression to determine if socioeconomic status was independently associated with oral health conditions.

The results were organised in tables, charts and graphs and the report submitted to the University, the county offices and the hospitals involved, a close out report was submitted to the Ethical Review Committee. A presentation was made to the clinic staff and a representative group of parents and participants.

### **3.11 Ethical Considerations**

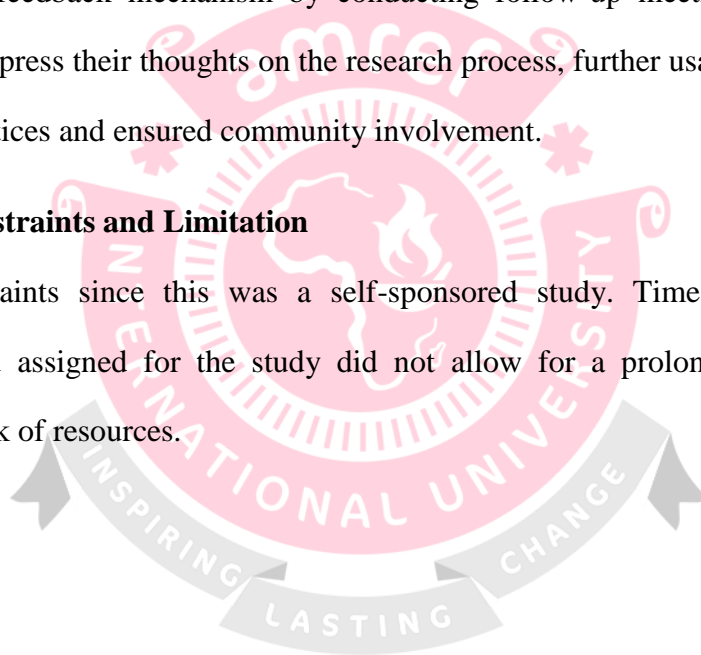
Ethical clearance was obtained from Amref International University (AMIU) Ethics Committee and research permit from National Commission for Science, Technology and Innovation (NACOSTI). Furthermore, the Principal researcher obtained authorization

from the head of the respective medical institution where the study was conducted.

Participation in the study was voluntary. Assent was signed by minors and the Parental consent form was signed by the parent/ guardian of the participant. Participants aged 18 years signed their consent before the study. Information obtained was kept confidential by assigning unique identifiers and there were no third-party disclosures. Further respondents did not indicate their names in the research tools used in the study. The participants were free to decline from taking part in the study at any moment. The study implemented a feedback mechanism by conducting follow-up meetings that allowed participants to express their thoughts on the research process, further usage of feedback to adapt study practices and ensured community involvement.

### **3.12 Study Constraints and Limitation**

Financial constraints since this was a self-sponsored study. Time constraints. The academic period assigned for the study did not allow for a prolonged study period coupled with lack of resources.



## CHAPTER 4: RESULTS

### 4.1 Introduction

This chapter presents the data obtained from questionnaires and clinical evaluations. Key areas covered include descriptive results, socio-demographic characteristics, dietary patterns, oral health features, and clinical findings among children aged 10 to 18 years in Kisumu County. The response rate was 100%. The key variables are summarized through descriptive analysis, followed by bivariate and multivariate analyses.

### 4.2 Socio-demographic Characteristics

Descriptive statistics indicated that the age of participants ranged from 10 to 18 years, with a total sample size of 355 adolescents. The mean age was 13.30 years (SD = 2.47). Male participants (n = 138) had a slightly higher mean age of 13.53 years (SD = 2.51) compared to females (n = 217), whose mean age was 13.15 years (SD = 2.44). Table 5 below summarizes the above details.

Table 4: Age of the Respondent

	N	Range Age	Minimum Age	Maximum Age	Mean Age	Std. Error	Std. Deviation Statistic
Male	138	8	10	18	13.53	.214	2.509
Female	217	8	10	18	13.15	.166	2.442
Total	355	8	10	18	13.30	.131	2.472

Participants were predominantly aged between 10 and 12 years, with the highest representation at age 12 (28.2%). The majority were female (61.1%) and had attained primary-level education (69.6%). Most participants (91.0%) attended school at the time of the study. Regarding caregiver occupation, 62.5% were self-employed, 23.4% were unemployed, and 14.1% were formally employed. All participants were on medication,

with syrup identified as the formulation used. These details are presented in Table 6 below.

*Table 5: Educational, Demographic, and Treatment Characteristics of Study Participants*

Characteristic	Frequency (n)	Percentage (%)
<b>Age (years)</b>		
10	48	13.5
11	26	7.3
12	100	28.2
13	47	13.2
14	37	10.4
15	24	6.8
16	16	4.5
17	16	4.5
18	41	11.5
<b>Gender</b>		
Male	138	38.9
Female	217	61.1
<b>Education Level</b>		
Primary	247	69.6
Secondary	108	30.4
<b>School Attendance</b>		
Yes	323	91.0
No	32	9.0
<b>Caregiver Occupation</b>		
Employed	50	14.1
Self-employed	222	62.5
Unemployed	83	23.4
On Medication Syrup	355	100.0

#### **4.2.1 Oral Hygiene Practices**

Evaluation of the oral hygiene practices among the participants showed that in terms of tooth brushing frequency, the majority of children brushed once daily (n = 233, 65.6%), followed by those who brushed twice daily (n = 110, 31.0%). Only a small number reported brushing three times a day (n = 4, 1.1%) or not brushing at all (n = 8, 2.3%).

Most children used fluoride toothpaste (n = 315, 88.7%), while 40 children (11.3%) did not. Tooth brushing duration varied: 46.2% (n = 164) brushed for two minutes, 42.8% (n = 152) brushed for one minute or less, and 11.0% (n = 39) brushed for three minutes or more. Almost all children reported not flossing (n = 350, 98.6%), with only 1.4% (n = 5) regularly engaging in this practice.

An assessment of mouthwash usage revealed that only three children (0.8%) reported using it, while nearly all children (n = 352, 99.2%) did not use mouthwash as part of their oral hygiene regimen. Only a small percentage of children (n = 22, 6.2%) had ever received professional dental cleaning, with the vast majority (n = 333, 93.8%) reporting no history of professional dental cleaning. Regarding dental visits, the majority (n = 282, 79.4%) had never visited a dentist. Of the remainder, 13.5% (n = 48) had visited within the past year, 6.2% (n = 22) within the past six months, and 0.8% (n = 3) within the last five years. Among those who did visit dentists, 5.1% (n = 18) went once a year, 4.5% (n = 16) visited every three months, and 11.0% (n = 39) only went when necessary (see table 7 below)

*Table 6: Self-Reported Oral Hygiene Practices and Dental Service Utilization*

Indicator	Category	Frequency (n)	Percentage (%)
Tooth Brushing Frequency	Once daily	233	65.6
	Twice daily	110	31.0
	Three times daily	4	1.1
	Does not brush	8	2.3
Use of Fluoride Toothpaste	Yes	315	88.7
	No	40	11.3
Tooth Brushing Duration	One minute or less	152	42.8
	Two minutes	164	46.2
	Three minutes or more	39	11.0
Flossing Practice	Yes	5	1.4
	No	350	98.6
Use of Mouthwash	Yes	3	0.8
	No	352	99.2
Professional Dental Cleaning	Yes	22	6.2
	No	333	93.8
Dental Visit History	Never	282	79.4
	Within past year	48	13.5
	Within past six months	22	6.2
	Within past five years	3	0.8
Frequency of Dental Visits	Once a year	18	5.1
	Every three months	16	4.5
	Occasionally	39	11.0
	(unspecified/other)		

#### **4.3 Prevalence of Oral Health Conditions**

This section presents findings addressing Objective 1, focusing on the prevalence of key oral health-related conditions, including dental caries, periodontal disease (as assessed by plaque accumulation), and mucosal diseases. Clinical examinations were conducted to quantify the burden of these conditions, with stratification by sociodemographic characteristics to reveal any notable patterns.

### ***4.3.1 Dental Caries Prevalence***

The analysis revealed that 40.0% of the 355 children with Sickle Cell Disease had dental caries. Caries prevalence varied significantly by age ( $\chi^2 (8) = 31.761$ ;  $p < .001$ ), with the highest rates observed among 17- and 18-year-olds (62.5% and 61.0%, respectively), and the lowest among 13-year-olds (12.8%). Gender differences were noted, with males exhibiting a slightly higher prevalence (43.5%) than females (37.8%), though this variation was not statistically significant ( $\chi^2 (1) = 1.142$ ;  $p = .286$ ). Education level showed a significant association with caries status ( $\chi^2 (1) = 7.723$ ;  $p = .005$ ), as children with secondary education reported higher prevalence (50.9%) compared to those in primary school (35.2%). Although children with employed caregivers had the highest caries prevalence (50.0%) compared to those with self-employed (41.0%) or unemployed caregivers (31.3%), the difference did not reach statistical significance ( $\chi^2 (2) = 4.781$ ;  $p = .092$ ). Table 8 below summarizes all the above information.

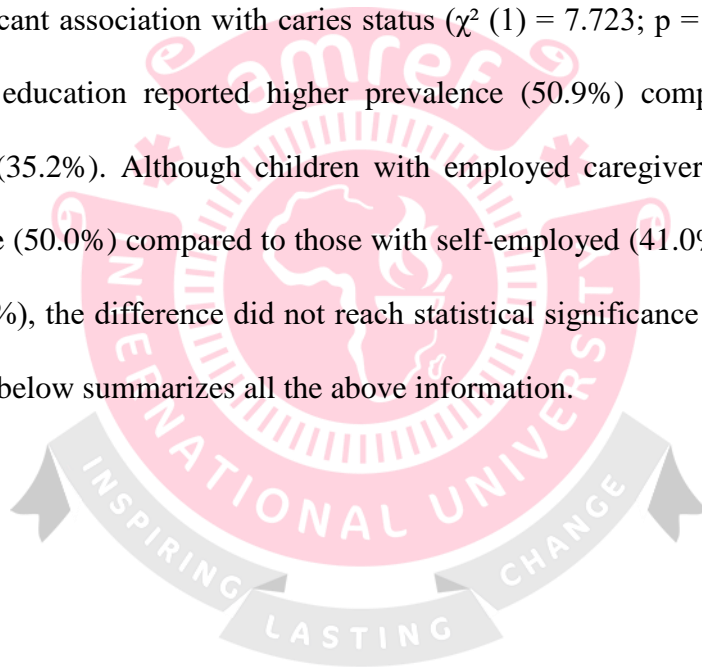


Table 7: Association Between Dental Caries and Demographic Attributes

Attribute	Value	Presence of Caries (n)	No Caries (n)	Total (n)	Prevalence Rate (%)	Test Statistic & p-value
Age	10	16	32	48	33.3	$\chi^2(8) = 31.761; p < .001$
	11	15	11	26	57.7	
	12	37	63	100	37.0	
	13	6	41	47	12.8	
	14	18	19	37	48.6	
	15	10	14	24	41.7	
	16	5	11	16	31.3	
	17	10	6	16	62.5	
	18	25	16	41	61.0	
	Total	142	213	355	40.0	
Gender	Male	60	78	138	43.5	$\chi^2(1) = 1.142; p = .286$
	Female	82	135	217	37.8	
	Total	142	213	355	40.0	
Education Level	Primary	87	160	247	35.2	$\chi^2(1) = 7.723; p = .005$
	Secondary	55	53	108	50.9	
	Total	142	213	355	40.0	
Caregiver Occupation	Employed	25	25	50	50.0	$\chi^2(2) = 4.781; p = .092$
	Self-employed	91	131	222	41.0	
	Unemployed	26	57	83	31.3	
	Total	142	213	355	40.0	

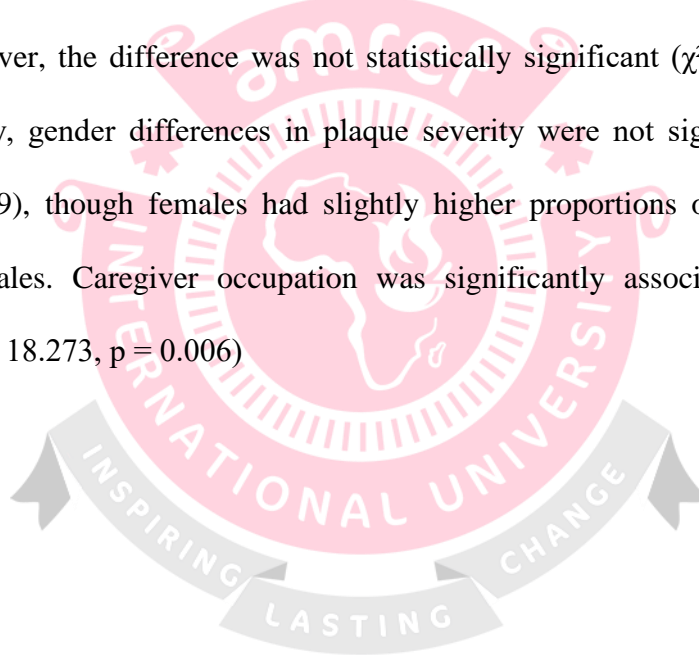
#### 4.3.2 Plaque Scores

Among the participants, 98.0% (n = 348) of participants presented with plaque and a mean plaque score of 1.74 with a standard deviation of 0.8 SD). Table 9 below shows that moderate to severe plaque accumulation was reported in 68.7% (n = 244).

Table 8: Plaque Severity Among Participants

Plaque Severity Category	Frequency (n)	Percentage (%)
No plaque	7	2.0%
Mild	104	29.3%
Moderate	170	47.9%
Severe	74	20.8%
Total	355	100.0%

Table 10 below shows that the distribution of plaque severity varied across education level, gender, and caregiver occupation. Among participants with primary education, 47.8% had a plaque score of 2, compared to 48.1% among those with secondary education; however, the difference was not statistically significant ( $\chi^2 (3) = 1.623, p = 0.654$ ). Similarly, gender differences in plaque severity were not significant ( $\chi^2 (3) = 3.432, p = 0.329$ ), though females had slightly higher proportions of scores 2 and 3 compared to males. Caregiver occupation was significantly associated with plaque severity ( $\chi^2 (6) = 18.273, p = 0.006$ )



*Table 9: Association between Demographic Attributes and Plaque Score Severity among Participants*

Attribute	Group	Plaque Score (%)				Chi-square Test (df, p-value)
		0	1	2		
Education	Primary School	2.8	28.3	47.8	21.1	$\chi^2(3) = 1.623, p = 0.654$
	Secondary School	0.0	31.5	48.1	20.4	
Gender	Male	0.0	34.1	45.7	20.3	$\chi^2(3) = 3.432, p = 0.329$
	Female	3.2	26.3	49.3	21.2	
Occupation	Employed	6.0	38.0	56.0	0.0	$\chi^2(6) = 18.273, p = 0.006^*$
	Self-employed	1.8	32.0	41.9	24.3	
	Unemployed	0.0	16.9	59.0	24.1	

#### **4.3.3 Mucosal Disease Prevalence**

Mucosal diseases were reported in 15.2% (n = 54) of participants. The most commonly observed conditions included gingival inflammation and oral ulcers. The prevalence of mucosal disease was slightly higher among males (15.9%) compared to females (14.7%) and was highest in the 13-year-old group (23.4%). Children with secondary education had a lower prevalence (13.0%) relative to those in primary education (16.2%). Notably, mucosal disease was more prevalent among participants whose caregivers were unemployed (16.9%) compared to those with self-employed (15.3%) or employed caregivers (12.0%). Table 7 below summarizes the above information.

*Table 10: Prevalence and Distribution of Mucosal Disease by Socio-demographic Characteristics*

Attribute	Group	Frequency	Mucosal Disease (%)	Chi-square Test (df, p-value)
Age	10	6	12.5	$\chi^2(8) = 9.812, p = 0.278$
	11	5	19.2	
	12	15	15.0	
	13	11	23.4	
	14	4	10.8	
	15	2	8.3	
	16	5	31.2	
	17	3	18.8	
	18	3	7.3	
	Total	54	15.2	
Gender	Male	22	15.9	$\chi^2(1) = 0.024, p = 0.877$
	Female	32	14.7	
	Total	54	15.2	
Education Level	Primary	40	16.2	$\chi^2(1) = 0.384, p = 0.536$
	Secondary	14	13.0	
	Total	54	15.2	
School Attendance	Yes	46	14.3	$\chi^2(1) = 1.594, p = 0.207$
	No	8	24.2	
	Total	54	15.2	
Caregiver Occupation	Employed	6	12.0	$\chi^2(2) = 0.578, p = 0.749$
	Self-employed	34	15.3	
	Unemployed	14	16.9	
	Total	54	15.2	

#### **4.3: Oral Health Knowledge Levels by Socio-Demographic Characteristics**

The analysis, summarized in Table 9, uses Pearson's chi-square test of independence to determine the extent and significance of associations between age, gender, education, and occupation with oral health knowledge.

### ***4.3.1: Association Between Socio-Demographic Characteristics and Oral Health***

#### ***Knowledge***

As table 12 displays descriptive analysis revealed variations in oral health knowledge across different age groups. Adolescents aged 10 to 12 predominantly reported either “very little” or “limited” knowledge, while moderate knowledge was highest among 11-year-olds (42.3%). As age increased, the proportion of adolescents reporting “good” oral health knowledge also increased, with the highest proportion observed among 18-year-olds (22.0%). Limited knowledge remained the most common response across all age groups. The chi-square test indicated a statistically significant association between age and oral health knowledge ( $\chi^2 (24) = 106.377, p < 0.001$ ).

Descriptively, both male and female respondents most frequently reported “limited” oral health knowledge (42.0% and 48.8% respectively). Males reported higher proportions of “moderate” (24.6%) and “good” (4.3%) knowledge compared to females (14.7% and 2.8% respectively), indicating slightly better outcomes for males in terms of oral health awareness. However, inferential analysis using the chi-square test showed no statistically significant association between gender and oral health knowledge ( $\chi^2 (3) = 6.488, p = 0.090$ ), implying that observed gender differences were not strong enough to establish a meaningful relationship.

Descriptive findings demonstrated that adolescents in secondary school exhibited higher levels of oral health knowledge than those in primary school. Specifically, 21.3% of secondary school respondents reported “moderate” knowledge and 10.2% reported “good” knowledge, compared to 17.4% and 0.4% respectively among those in primary

school. The chi-square test confirmed a statistically significant association between education level and oral health knowledge ( $\chi^2 (3) = 24.012, p < 0.001$ )

Descriptively, employed adolescents reported the highest level of oral health knowledge, with 50.0% indicating “moderate” and 8.0% reporting “good” knowledge. In contrast, the majority of self-employed and unemployed adolescents reported “limited” knowledge (50.0% and 50.6% respectively), with lower levels of “moderate” and “good” knowledge.

Inferential statistics revealed a statistically significant association between occupation and oral health knowledge ( $\chi^2 (6) = 46.823, p < 0.001$ )

*Table 11: Distribution of Oral Health Knowledge by Socio-demographic Characteristics*

Variable	Category	Very Little	Limited	Moderate	Good	Total (%)	Chi-square Test (df, p-value)
Age	10	41.7%	33.3%	25.0%	—	100.0%	$\chi^2 (24) = 106.377, p < 0.001$
	11	26.9%	30.8%	42.3%	—	100.0%	
	12	28.0%	59.0%	13.0%	—	100.0%	
	13	38.3%	48.9%	12.8%	—	100.0%	
	14	51.4%	45.9%	2.7%	—	100.0%	
	15	33.3%	37.5%	29.2%	—	100.0%	
	16	18.8%	68.8%	12.5%	—	100.0%	
	17	12.5%	31.3%	37.5%	18.8%	100.0%	
	18	19.5%	39.0%	19.5%	22.0%	100.0%	
	Total	31.8%	46.2%	18.6%	3.4%	100.0%	
Gender	Male	29.0%	42.0%	24.6%	4.3%	100.0%	$\chi^2 (3) = 6.488, p = 0.090$
	Female	33.6%	48.8%	14.7%	2.8%	100.0%	
	Total	31.8%	46.2%	18.6%	3.4%	100.0%	
Education	Primary School	34.4%	47.8%	17.4%	0.4%	100.0%	$\chi^2 (3) = 24.012, p < 0.001$
	Secondary School	25.9%	42.6%	21.3%	10.2%	100.0%	
	Total	31.8%	46.2%	18.6%	3.4%	100.0%	
Occupation	Employed	20.0%	22.0%	50.0%	8.0%	100.0%	$\chi^2 (3) = 46.823, p < 0.001$
	Self-employed	32.4%	50.0%	15.3%	2.3%	100.0%	
	Unemployed	37.3%	50.6%	8.4%	3.6%	100.0%	
	Total	31.8%	46.2%	18.6%	3.4%	100.0%	

### ***4.3.2 Association between Socio-Demographic Characteristics and Oral Health***

#### ***Knowledge***

Descriptively, oral health knowledge was absent across most age categories, with 100.0% of adolescents aged 10 to 15 years reporting no knowledge. A slight deviation was observed among respondents aged 16 and 18 years, where 12.5% and 12.2%, respectively, reported having some knowledge of oral health. Adolescents aged 17 years continued to report no knowledge.

Inferential analysis indicated a statistically significant association between age and oral health knowledge ( $\chi^2 (8) = 37.338, p < 0.001$ ), suggesting that older adolescents were more likely to report having some oral health knowledge compared to their younger counterparts. From a descriptive perspective, no male respondents reported having oral health knowledge (0.0%), while 3.2% of female respondents did. The chi-square test revealed a statistically significant relationship between gender and oral health knowledge ( $\chi^2 (1) = 4.541, p = 0.033$ ), with females being marginally more likely to report some knowledge compared to males.

Among those in primary school, none reported having oral health knowledge (0.0%). In contrast, 6.5% of adolescents in secondary school reported having such knowledge.

Inferentially, there was a statistically significant association between education level and oral health knowledge ( $\chi^2(1) = 16.331, p < 0.001$ ). This finding indicates that adolescents enrolled in secondary education were more likely to have acquired oral health knowledge than those in primary education. Descriptively, 6.0% of employed respondents reported having oral health knowledge, compared to 0.9% of the self-employed and 2.4% of the unemployed. Although variations were observed across categories, the association

between occupation and oral health knowledge did not reach statistical significance at the 5% level ( $\chi^2(2) = 5.597, p = 0.061$ ). Table 9 summaries the above information.

*Table 12: Association between Socio-Demographic Variables and Oral Health Knowledge*

Variable	Category	Yes (%)	No (%)	Total (%)	Chi-square Test
Age	10	0.0	100.0	100.0	$\chi^2(8) = 37.338, p < 0.001$
	11	0.0	100.0	100.0	
	12	0.0	100.0	100.0	
	13	0.0	100.0	100.0	
	14	0.0	100.0	100.0	
	15	0.0	100.0	100.0	
	16	12.5	87.5	100.0	
	17	0.0	100.0	100.0	
	18	12.2	87.8	100.0	
	Total	2.0	98.0	100.0	
Gender	Male	0.0	100.0	100.0	$\chi^2(1) = 4.541, p = 0.033$
	Female	3.2	96.8	100.0	
	Total	2.0	98.0	100.0	
Education	Primary School	0.0	100.0	100.0	$\chi^2(1) = 16.331, p < 0.001$
	Secondary School	6.5	93.5	100.0	
	Total	2.0	98.0	100.0	
Occupation	Employed	6.0	94.0	100.0	$\chi^2(2) = 5.597, p = 0.061$
	Self-employed	0.9	99.1	100.0	
	Unemployed	2.4	97.6	100.0	
	Total	2.0	98.0	100.0	

#### **4.3.3 Exposure to Oral Health Education**

When asked about receiving oral health education specifically tailored to sickle cell disease (SCD), 98.0% (n = 348) of participants reported no prior exposure, while only 2.0% (n = 7) confirmed receiving such instruction.

#### 4.3.4 Peer-to-Peer Discussions

Social dynamics also appeared to play a limited role in reinforcing oral health knowledge within the peer group. A significant majority of participants (83.4%, n = 296) reported that they did not discuss oral health-related topics with friends who also have sickle cell disease (SCD), while only 16.6% (n = 59) indicated that they engaged in such conversations. Table 14 summarizes the above information.

*Table 13: Oral Health Knowledge and Awareness Among Children with Sickle Cell Disease*

Characteristic	n	Percentage (%)
<b>Knowledge about Importance of Oral Hygiene</b>		
Very little	113	31.8
Limited	164	46.2
Moderate	66	18.6
Good	12	3.4
<b>Discussion of Oral Health with Friends (SCD peers)</b>		
Yes	59	16.6
No	296	83.4
<b>Awareness of Relationship Between SCD and Oral Health</b>		
Yes	27	7.6
No	328	92.4
<b>Received SCD-Specific Oral Health Education</b>		
Yes	7	2.0
No	348	98.0

*Note: Data reflect self-reported knowledge and awareness of oral health issues.*

#### 4.4 Plaque Score and Associated Determinants

This section presents findings on plaque accumulation among participants with Sickle Cell Disease (SCD) in Kisumu County. It includes descriptive statistics on plaque severity and regression analyses examining associations with demographic factors, oral hygiene behaviors, dietary habits, psychosocial indicators, and access to dental care.

#### ***4.4.1 Distribution of Plaque Scores***

Oral hygiene was assessed using a standardized plaque index (scores 0–4), where 0 = no plaque, 1= mild, 2= moderate, 3= severe, and 4 extensive plaque. Table 15 shows that moderate plaque was most common (47.9%, n = 170), followed by mild (29.3%, n = 104) and severe (20.8%, n = 74). Only 2.0% (n = 7) had no visible plaque. In total, 98.0% of participants had some plaque, with 68.7% showing moderate to severe levels. (Table 15).

*Table 14: Plaque Severity Among Participants*

Plaque Severity Category	Frequency (n)	Percentage (%)
No plaque	7	2.0%
Mild	104	29.3%
Moderate	170	47.9%
Severe	74	20.8%
Total	355	100.0%

#### ***4.4.2 Association Between Plaque Scores and Demographic Factors***

Regression analysis revealed that demographic variables collectively explained 6.2% of the variance in plaque scores. As shown in Table 16, socioeconomic status (proxied by caregiver occupation) emerged as the sole significant predictor of plaque severity ( $\beta = 0.244, p = < .001$ ). In contrast, age, gender, and education level showed no statistically significant associations with plaque severity in the final model.

*Table 15: Multiple Regression Results for Demographic Predictors of Mean Plaque Score*

Variable	B	SE B	$\beta$	t	p-value	95% CI
Constant	1.090	0.344	—	3.166	.002	[0.413, 1.767]
Age	-0.011	0.030	-0.033	-0.357	.721	[-0.069, 0.048]
Gender	0.032	0.085	0.019	0.372	.710	[-0.136, 0.199]
Education level	0.050	0.158	0.029	0.316	.752	[-0.262, 0.362]
Socioeconomic status	0.321	0.069	0.244	4.667	<.001	[0.186, 0.456]

Note.  $R = .248$ ,  $R^2 = .062$ ,  $Adjusted R^2 = .051$ ,  $F(4, 350) = 5.750$ ,  $p < .001$

#### 4.4.3 Association Between Plaque Scores and Oral Hygiene Practices

As table 17 displays, oral hygiene behaviors explained 20.2% of the variance in plaque scores. Frequent brushing ( $R^2 = .202$ ,  $\beta = -.191$ ,  $p < .001$ ) and use of fluoride toothpaste ( $\beta = -.171$ ,  $p = .001$ ) were associated with reduced plaque. Unexpectedly, professional dental cleaning ( $\beta = .277$ ,  $p < .001$ ) and recent dental visits ( $\beta = .167$ ,  $p = .007$ ) correlated with higher plaque levels. The table further shows that brushing duration, flossing, and mouthwash use were not significant.

*Table 16: Oral Hygiene Behaviors as Predictors of Mean Plaque Score*

Variable	B	SE B	$\beta$	t	p-value	95% CI
Constant	-1.286	1.210	—	-1.063	.288	[-3.666, 1.093]
Brushing frequency per day	-0.241	0.066	-0.191	-3.642	<.001	[-0.111, 0.371]
Use of fluoride toothpaste	-0.431	0.127	-0.171	-3.401	.001	[-0.182, 0.680]
Brushing duration	0.010	0.067	0.009	0.156	.876	[-0.121, 0.142]
Flossing regularity	0.413	0.327	0.061	1.264	.207	[-0.230, 1.056]
Mouthwash use	-0.453	0.439	-0.052	-1.032	.303	[-1.315, 0.410]
Professional dental cleaning	0.914	0.181	0.277	5.045	<.001**	[0.558, 1.271]
Frequency of dental visits	0.141	0.052	0.167	2.704	.007**	[0.038, 0.244]

Note.  $R = .449$ ,  $R^2 = .202$ ,  $Adjusted R^2 = .186$ ,  $F(7, 347) = 12.550$ ,  $p < .001$  \*\* $p < .01$

#### 4.2.2.4 Association Between Plaque Scores and Dietary Habits.

The relationship between frequency of sugary and acidic food/drink consumption and mean plaque scores was not significant, with the model explaining only 0.1% of the variance ( $R^2 = .001$ ,  $F(2, 352) = 0.215$ ,  $p = .807$ ). Neither sugary ( $\beta = .019$ ,  $p = .717$ ) nor acidic ( $\beta = .031$ ,  $p = .565$ ) consumption significantly predicted plaque scores. Table 18 summarizes these results.

Table 17: Dietary Habits as Predictors of Mean Plaque Score

Variable	B	SE B	$\beta$	t	p-value	95% CI
Constant	1.851	0.180	—	10.283	<.001	[1.497, 2.205]
Frequency of sugary food/drinks	0.015	0.042	0.019	0.362	.717	[-0.097, 0.067]
Frequency of acidic food/drinks	0.027	0.047	0.031	0.576	.565	

Note.  $R = .035$ ,  $R^2 = .001$ , Adjusted  $R^2 = -.004$ ,  $F(2, 352) = 0.215$ ,  $p = .807$

#### 4.5 Dental Caries Prevalence as Measured by the DMFT Index

The dental caries experience was measured using the DMFT index, yielding a mean score of 1.09 (SD = 1.41, range: 0–6). Decayed teeth had the highest prevalence (mean 0.86, SD = 1.21), affecting 40.0% (n = 142) of participant, missing teeth (mean 0.16, SD = 0.43) were observed in 13.8% (n = 49), while filled teeth (mean 0.06, SD = 0.28) were present in 5.6% (n = 20). (see table 19 below)

Table 18: DMFT Index and Caries Components in the Study Population

Component	Mean (SD)	Range	Prevalence (%)	Number of Participants (n)
Total DMFT	1.09 (1.41)	0–6	—	—
Decayed Teeth	0.86 (1.21)	0–5	40.0	142
Missing Teeth	0.16 (0.43)	0–2	13.8	49
Filled Teeth	0.06 (0.28)	0–2	5.6	20

#### 4.5.1 Association Between DMFT Scores and Demographic Factors

A regression analysis was conducted to assess the association between DMFT scores and demographic variables, namely age, gender, education level, and caregiver's occupation (used as a proxy for socioeconomic status). The model accounted for 5.6% of the variance in DMFT scores ( $R^2 = .056$ ,  $F(4, 350) = 5.161$ ,  $p < .001$ ). Among the predictors, age ( $\beta = .209$ ,  $p = .024$ ) and socioeconomic status ( $\beta = -.171$ ,  $p = .001$ ) were statistically significant. An increase in age corresponded to a 0.120-unit rise in DMFT scores (95% CI [0.016, 0.224]), DMFT scores (95% CI [-0.639, -0.158]), Gender ( $\beta = -.008$ ,  $p = .880$ ) and education level ( $\beta = -.094$ ,  $p = .309$ ) did not exhibit significant associations with DMFT scores. These findings are summarized in table 20 below.

Table 19: Multiple Regression Results for Predictors of DMFT Scores

Variable	B	SE B	$\beta$	t	p	95% CI
Constant	0.747	0.612	-	1.219	.224	[-0.458, 1.951]
Age	0.120	0.053	.209	2.264	.024*	[0.016, 0.224]
Gender	-0.023	0.152	-.008	-0.151	.880	[-0.321, 0.275]
Education level	-0.287	0.282	-.094	-1.019	.309	[-0.842, 0.267]
Socioeconomic status (caregiver occupation)	-0.398	0.122	-.171	-3.258	.001**	[-0.639, -0.158]

Note.  $R = .236$ ,  $R^2 = .056$ , Adjusted  $R^2 = .045$ ,  $F(4, 350) = 5.161$ ,  $p < .001$  \* $p < .05$ , \*\* $p < .01$

#### 4.5.2 Association Between DMFT Scores and Oral Hygiene Practices

The relationship between oral hygiene practices and DMFT scores was assessed using seven predictors: brushing frequency, use of fluoride toothpaste, brushing duration, flossing regularity, mouthwash use, history of professional cleaning, and frequency of dental visits. These variables collectively explained 16.9% of the variance in DMFT scores ( $R^2 = .169$ , Adjusted  $R^2 = .151$ ,  $F(7, 347) = 10.086$ ,  $p < .001$ ). Only Frequency of dental visits emerged as a significant predictor ( $\beta = -.460$ ,  $p < .001$ ). Each unit increase

in time since the last dental visit was associated with a 0.688-unit increase in DMFT scores (95% CI [-0.873, -0.502]) as shown in table 21 below.

*Table 20: Oral Hygiene Predictors of DMFT Scores*

Constant	1.670	0.412	–	4.058	<.001	[0.860, 2.481]
Brushing frequency/day	-0.034	0.159	-.011	-0.215	.830	[-0.347, 0.280]
Use of fluoride toothpaste	0.153	0.179	.044	0.857	.392	[-0.198, 0.504]
Brushing duration	-0.057	0.126	-.025	-0.444	.658	[-0.305, 0.191]
Flossing regularity	0.055	0.135	.020	0.408	.684	[-0.210, 0.319]
Mouthwash use	-0.041	0.140	-.015	-0.295	.768	[-0.316, 0.234]
Professional dental cleaning	0.293	0.169	.098	1.738	.081	[-0.039, 0.626]
Frequency of dental visits	-0.688	0.095	-.460	-7.236	<.001**	[-0.873, -0.502]

Note.  $R = .411$ ,  $R^2 = .169$ , Adjusted  $R^2 = .151$ ,  $F(7, 347) = 10.086$ ,  $p < .001$ , \* $p < .05$ , \*\* $p < .01$

#### **4.5.3 Association Between DMFT Scores and Dietary Habits**

The relationship between dietary habits and DMFT scores was evaluated using two predictors: frequency of sugary food/drink consumption and frequency of acidic food/drink consumption. These variables explained 2.2% of the variance in DMFT scores ( $R^2 = .022$ , Adjusted  $R^2 = .016$ ,  $F(2, 352) = 3.924$ ,  $p = .021$ ). Only the frequency of acidic food/drink intake was a significant predictor ( $\beta = .146$ ,  $p = .006$ ), with each unit increase associated with a 0.230-unit increase in DMFT scores (95% CI [0.066, 0.394]) as shown in table 22 below.

*Table 21: Regression Results for Dietary Predictors of DMFT Scores*

Variable	B	SE B	$\beta$	t	p	95% CI
Constant	1.784	0.316	–	5.648	<.001	[1.163, 2.406]
Sugary food/drink frequency	0.015	0.073	.011	0.205	.837	[-0.129, 0.159]
Acidic food/drink frequency	0.230	0.083	.146	2.765	.006	[0.066, 0.394]

Note.  $R = .148$ ,  $R^2 = .022$ , Adjusted  $R^2 = .016$ ,  $F(2, 352) = 3.924$ ,

#### 4.5.4 Association Between DMFT Scores and Attitudes, Perceptions, and Hindering Factors

The model examined six predictors related to dental care access and attitudes—attitudes toward dental care, perception of care quality at dental facilities, motivating factors for seeking oral health care, hindering factors in seeking oral health care, access to dental facilities, and barriers to accessing dental care—explaining 14.3% of the variance in DMFT scores ( $R^2 = .143$ , Adjusted  $R^2 = .128$ ,  $F(6, 348) = 9.655$ ,  $p < .001$ ). Two predictors showed significant associations with DMFT scores: motivating factors for seeking oral health care ( $\beta = -.239$ ,  $p < .001$ ) and access to dental facilities ( $\beta = -.281$ ,  $p < .001$ ). An increase in motivating factors was associated with a 0.349-unit decrease in DMFT scores (95% CI [-0.495, -0.204]), while access to dental facilities corresponded with a 0.818-unit reduction (95% CI [-1.185, -0.451]). Other variables—attitudes toward dental care ( $\beta = -.016$ ,  $p = .750$ ), perception of care quality ( $\beta = .052$ ,  $p = .308$ ), hindering factors ( $\beta = -.010$ ,  $p = .888$ ) as shown in table 23 below.

Table 22: Attitudinal and Access Factors Predicting DMFT Scores

Variable	B	SE B	$\beta$	t	p	95% CI
Constant	3.558	0.633	—	5.624	<.001	[2.314, 4.802]
Attitude toward dental care	-0.050	0.158	-.016	-0.319	.750	[-0.360, 0.260]
Perception of care quality	0.129	0.126	.052	1.021	.308	[-0.119, 0.377]
Motivating factors	-0.349	0.074	-.239	-4.715	<.001***	[-0.495, -0.204]
Hindering factors	-0.020	0.139	-.010	-0.141	.888	[-0.293, 0.254]
Access to dental facilities	-0.818	0.187	-.281	-4.383	<.001***	[-1.185, -0.451]
Barriers to accessing dental care	-0.247	0.255	-.053	-0.967	.334	[-0.749, 0.255]

Note.  $R = .378$ ,  $R^2 = .143$ , Adjusted  $R^2 = .128$ ,  $F(6, 348) = 9.655$ ,

#### ***4.5.5 Access, Perceptions, and Barriers Influencing Oral Health Care Among Participants with Sickle Cell Disease***

Evaluation of factors influencing oral health care revealed that 62.3% (n = 221) of participant reported access to dental facilities, while 37.7% (n = 134) did not. Among those with access, 28.5% (n = 101) indicated facilities were 5–10 km away, 25.6% (n = 91) less than 5 km, 5.9% (n = 21) more than 20 km, and 4.5% (n = 16) between 10–20 km; 35.5% (n = 126) were uncertain about distance. Most participants (94.6%, n = 336) recognized the importance of seeking dental care, with 5.4% (n = 19) unaware of its significance. Regarding care quality perception, 51.8% (n = 184) rated it moderate/fair, 43.9% (n = 156) good, 3.4% (n = 12) poor/low, and 0.8% (n = 3) excellent. The primary motivator for seeking care was maintaining healthy teeth (83.9%, n = 298), followed by having dental problems (10.7%, n = 38). Main barriers included high cost (51.8%, n = 184), difficulty accessing facilities (35.2%, n = 125), dental anxiety (8.5%, n = 30), and absence of dental problems (4.5%, n = 16). A majority (89.6%, n = 318) reported experiencing barriers to care (Table 24).

Table 23: Dental Care Access, Perceptions, and Barriers Among Participants

Characteristic	n	%
<b>Access to dental facility</b>		
Yes	221	62.3
No	134	37.7
<b>Distance to dental facility</b>		
<5 km	91	25.6
5-10 km	101	28.5
10-20 km	16	4.5
>20 km	21	5.9
Not sure	126	35.5
<b>Attitude toward dental care</b>		
Important to seek early/dental care	336	94.6
Don't know importance of seeking dental care	19	5.4
<b>Perception of care quality</b>		
Excellent	3	0.8
Good	156	43.9
Moderate/Fair	184	51.8
Poor/Low	12	3.4
<b>Motivating factors for seeking oral health care</b>		
Having a dental problem	38	10.7
Relatives/friends who visit dentist regularly	4	1.1
Wanting teeth to remain healthy	298	83.9
Other	15	4.2
<b>Hindering factors in seeking oral health care</b>		
Dental anxiety	30	8.5
High cost	184	51.8
Difficulty accessing a dental facility	125	35.2
Not having a dental problem	16	4.5
<b>Experienced barriers in accessing dental care</b>		
Yes	318	89.6
No	37	10.4

## 4.6 Hypothesis Testing

This section presents the statistical testing of the study's two main hypotheses using chi-square analyses drawn from the findings presented in Chapter Four. The aim was to assess the relationship between oral health conditions and selected predictor variables: self-care practices and household socio-economic characteristics.

### 4.6.1 Hypothesis 1

Null Hypothesis ( $H_{01}$ ): There was no association between self-care practices and oral health conditions among sicklers aged 10–18 years in Kisumu County.

Alternative Hypothesis ( $H_{11}$ ): There was an association between self-care practices and oral health conditions among sicklers aged 10–18 years in Kisumu County.

*Variables tested:*

Self-care practices included brushing frequency, use of fluoride toothpaste, and brushing duration. Oral health conditions were measured using DMFT categories, Mean Periodontal Score (and symptom severity).

#### **Statistical results:**

Chi-square tests showed statistically significant associations between age (used as a proxy for developmental differences in self-care behavior) and:

- i. Brushing frequency ( $\chi^2 = 8.914$ ,  $df = 2$ ,  $p = 0.012$ )
- ii. Use of fluoride toothpaste ( $\chi^2 = 16.198$ ,  $df = 2$ ,  $p < 0.001$ )
- iii. Brushing duration ( $\chi^2 = 82.494$ ,  $df = 4$ ,  $p < 0.001$ )

These practices were further reflected in the distribution of DMFT scores and Mean Periodontal Scores, which indicated variations in oral disease burden across age groups with differing behavioral patterns.

**Conclusion:**

Since the chi-square tests yielded statistically significant results, the null hypothesis was rejected. The findings supported the conclusion that self-care practices were significantly associated with oral health outcomes among adolescents with SCD.

**4.6.2 Hypothesis 2**

**Hypothesis 2:**

*There is no contribution of household socio-economic factors to oral health-related conditions among sicklers aged 10–18 years in Kisumu County.*

Regression analysis indicated that caregiver occupation (used as a proxy for socio-economic status) significantly predicted DMFT scores ( $\beta = -0.171$ ,  $p = 0.001$ ). Higher socio-economic status was linked to lower caries prevalence. The model accounted for 5.6% of the variance in DMFT scores ( $R^2 = 0.056$ ,  $F(4, 350) = 5.161$ ,  $p < 0.001$ ).

**Conclusion:**

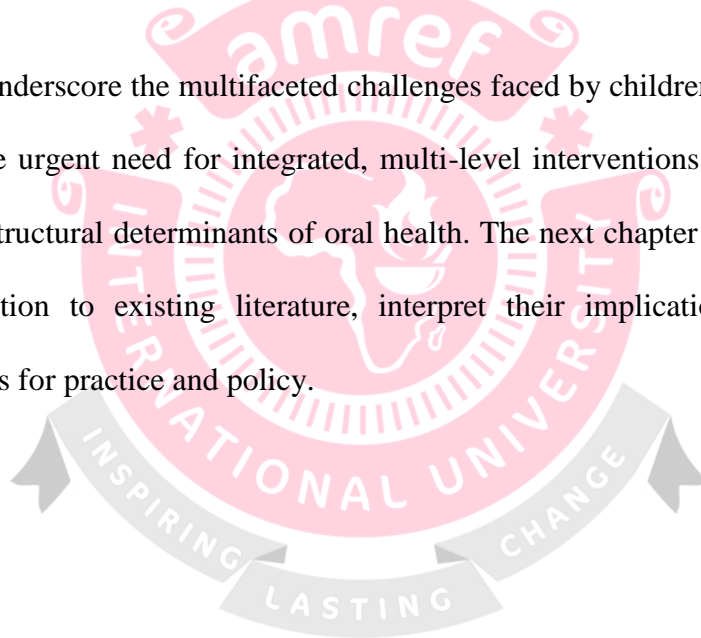
The null hypothesis was rejected, confirming that household socio-economic factors significantly contribute to oral health-related conditions.

**4.7 Chapter Summary**

This chapter has presented the findings of the study, structured around the four main objectives. The results reveal a significant burden of oral health conditions among children with SCD, characterized by high prevalence of dental caries, widespread plaque

accumulation, and notable occurrences of mucosal diseases. Knowledge and awareness of oral health prevention and disease identification were generally low, with minimal exposure to structured oral health education and limited peer-based knowledge sharing. Self-care practices, including toothbrushing frequency, flossing, and dental visits, were largely suboptimal, though better practices were associated with improved oral health outcomes. Socioeconomic status emerged as a critical determinant of oral health, influencing both disease prevalence and access to care, while systemic barriers—such as cost and facility access—further impeded optimal dental care utilization.

These findings underscore the multifaceted challenges faced by children living with SCD and highlight the urgent need for integrated, multi-level interventions that address both behavioral and structural determinants of oral health. The next chapter will discuss these findings in relation to existing literature, interpret their implications, and provide recommendations for practice and policy.



## CHAPTER 5: DISCUSSIONS

### 5.1 Introduction

This chapter discusses the study findings in relation to the stated objectives, relevant empirical literature, and the Health Belief Model (HBM). It interprets the observed prevalence and determinants of oral health conditions among adolescents with Sickle Cell Disease (SCD) in Kisumu County and situates the results within national and global contexts. The discussion is organized thematically around the study's four objectives, focusing on clinical outcomes, knowledge levels, self-care practices, and socioeconomic factors.

### 5.2 Overview of Key Findings

The study identified a substantial burden of oral health conditions among adolescents with SCD in Kisumu County. The prevalence of dental caries was 40.0%, with a mean DMFT score of 1.09, predominantly driven by untreated decay. Plaque was observed in 98.0% of participants, with over two-thirds presenting moderate to severe accumulation, indicating poor oral hygiene and elevated risk of periodontal disease. Knowledge of oral health prevention was generally low, with 98.0% of participants reporting no prior exposure to targeted oral health education. Self-care practices were suboptimal; most children brushed once daily, and very few reported the use of adjunctive hygiene measures. Access to dental services was limited, with 79.4% having never visited a dentist. Multivariate analysis revealed significant associations between oral health outcomes and factors such as age, education level, brushing frequency, fluoride toothpaste use, and caregiver occupation. Socioeconomic status emerged as a key determinant, influencing both behavior and access to care. These findings underscore the

need for integrated interventions addressing both clinical and social determinants of oral health in this high-risk population.

### **5.3 Discussion by Study Objectives**

#### ***5.3.1 Prevalence of Caries, Periodontal Disease, and Mucosal Disease***

The high prevalence of dental caries and plaque accumulation aligns with findings from Kalbassi et al. (2018), who reported elevated oral disease burden among children with SCD due to systemic and immunological vulnerabilities. Similarly, Brandão et al. (2018) and Goyal et al. (2019) observed significantly higher caries indices in SCD populations, attributing this to compromised salivary flow, poor oral clearance, and low treatment rates. The mucosal manifestations observed in this study, including gingival bleeding and sensitivity, are consistent with reports by Chekroun et al. (2018). These outcomes suggest a consistent global pattern where adolescents with SCD are at increased risk for oral health complications. According to the Health Belief Model, these findings may reflect low perceived susceptibility and severity, particularly when oral symptoms are not immediately life-threatening. Interventions should therefore emphasize early screening, caregiver education, and inclusion of oral health within SCD management protocols.

Some studies show no difference in oral health conditions between sicklers and their health counterparts such systematic literature review by Da Silva (2023) examining the association between periodontal disease and SCD found that periodontal parameters were generally similar between sicklers and their healthy counterparts.

### ***5.3.2 Knowledge of Oral Health Prevention***

The study confirmed widespread knowledge deficits among participants, consistent with prior research by Nguyen and Le (2019), who found poor oral health awareness among adolescents with chronic diseases. The lack of structured health education identified here supports similar observations by Anwar et al. (2020), who emphasized the role of perception in shaping health behaviors under the HBM framework. Improving health literacy through school-based programs and integrating oral health education into chronic disease counseling can address this gap. Evidence from Poudel et al. (2018) and Yue et al. (2020) demonstrates that self-management education significantly improves oral hygiene practices and quality of life among adolescents with chronic conditions. Tailored interventions should prioritize peer education, visual aids, and mobile messaging to reach adolescents more effectively.

### ***5.3.3 Self-Care Practices and Their Association with Oral Health Outcomes***

Findings showed that poor adherence to self-care practices, such as infrequent brushing, limited flossing, and rare dental visits, was associated with worse oral health outcomes. These patterns are in line with research by Rodriguez et al. (2018), who linked suboptimal hygiene to high plaque levels among adolescents with SCD in the U.S. Asamoah (2021) further emphasized that health-seeking behavior in adolescents is constrained by low motivation, emotional fatigue, and systemic barriers. In this study, barriers included clinic inaccessibility and caregiver burden, reinforcing patterns observed in Lebrun et al. (2020; 2021). Application of the HBM suggests that perceived barriers (e.g., cost, access) and low self-efficacy are critical impediments. Kakkar et al. (2021) noted that children with special health care needs often experience compounded

challenges in maintaining oral hygiene. Programs aimed at behavior change must address these barriers using culturally appropriate health promotion strategies. Evidence from Anwar et al. (2020) supports the use of guided routines and caregiver involvement to reinforce consistent oral hygiene behavior.

#### ***5.3.4 Influence of Socioeconomic and Environmental Factors***

The association between socioeconomic status and oral health outcomes was statistically significant, consistent with findings by Calcagnile et al. (2019), who linked financial hardship to limited access and increased caries rates. In this study, caregiver occupation influenced DMFT scores, suggesting that household income shapes both preventive behavior and care access. Similar patterns have been documented in other SCD-focused studies, including those by Patel and Patel (2017). Environmental factors, including facility location and perceived quality of care, also affected utilization. Adolescents from remote areas or households with limited transport capacity were more likely to miss checkups or rely on symptomatic treatment. These findings support recommendations by Da Silva et al. (2023), who argued for decentralizing oral health services and expanding school-based care models in under-resourced settings.

#### **5.4 Implication of Findings**

The study's hypothesis testing provides statistical evidence for the relationships between self-care practices, socioeconomic factors, and oral health conditions. The rejection of the null hypothesis regarding self-care practices confirms that these practices are significantly associated with oral health outcomes in adolescents with SCD. This finding reinforces the importance of promoting and improving self-care behaviors to prevent oral

diseases. The analysis of household socioeconomic factors and their contribution to oral health conditions provides valuable insights into the social determinants of health. The statistical significance of these factors highlights the need to address socioeconomic disparities to improve oral health equity.

The study's findings have significant implications for future research and practice in the field of oral health for adolescents with SCD. Future research should focus on longitudinal studies to establish causal relationships between risk factors and oral health outcomes. Interventional studies are needed to evaluate the effectiveness of different oral health promotion strategies. Qualitative research can provide valuable insights into the lived experiences of adolescents with SCD and their perceptions of oral health.

In terms of practice, the study highlights the need for integrated oral health care within SCD management programs. Oral health education and preventive services should be tailored to the specific needs of adolescents with SCD. Addressing socioeconomic barriers to care is crucial for improving oral health equity.

## **5.5 Conclusion**

This chapter has illustrated the significant burden of oral health conditions among adolescents with SCD in Kisumu County, emphasizing how clinical indicators, low knowledge levels, suboptimal self-care practices, and socioeconomic challenges interact to shape oral health outcomes. Framed within the Health Belief Model, the findings highlight both individual and structural barriers to prevention and care. These insights underscore the need for targeted, integrated interventions within chronic disease management programs.

## CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Introduction

This chapter consolidates the study's conclusions, derived from the results discussed in Chapter Five, into key insights regarding the oral health of adolescents aged 10–18 years with Sickle Cell Disease (SCD) in Kisumu County.

### 6.2 Conclusions by Objective

1. Adolescents with SCD exhibited a high prevalence of dental caries and periodontal disease, with younger adolescents (10–12 years) experiencing a greater burden of inflammatory symptoms. This knowledge on prevalence of oral health conditions in sickle cell disease in a local context.
2. Significant gaps exist in both general and SCD-specific oral health knowledge among participants, despite some improvement with age.
3. There was suboptimal adherence to recommended oral hygiene practices.
4. Health-seeking behaviors were influenced by structural and psychological barriers.
5. There is a need to conduct further research to establish causality and implementation studies on strategies to ensure sustainable impact of preventive programs.

### 6.3 Recommendations

#### 1. Integrate Oral Health into SCD Management

County departments of health sickle cell clinics managements should incorporate oral health screening, education, and preventive services into routine care for

adolescents with Sickle Cell Disease at both primary and tertiary health levels. This will facilitate early detection, timely intervention, and coordinated management of oral complications within chronic care pathways.

**2. Implement Age-Appropriate Oral Health Education**

The ministry of education should support develop and deliver structured oral health education programs targeting adolescents with SCD across schools, health facilities, and community settings. These programs should address disease-specific risks, promote preventive behaviors, and strengthen knowledge on the importance of regular dental check-ups.

**3. Promote Behavior Change Through Hygiene Support**

The ministry of education should work with companies dealing in dentifrices to support consistent oral hygiene practices by increasing access to essential hygiene tools (toothbrushes, fluoride toothpaste, floss) and delivering practical demonstrations through caregivers and school-based platforms as corporate social responsibility. Focus on improving brushing technique, frequency, and adherence using tailored messaging and behavioral cues.

**4. Develop Policy and Clinical Guidelines for SCD-Oral Health Integration**

The ministry of health should include oral health in adolescent health and non-communicable disease (NCD) policies. Formulate and implement evidence-based clinical guidelines that address oral health risk assessment, prevention, and referral protocols specific to adolescents with SCD.

**5. Further research to establish cause and effect relationship and implementation studies on preventive programs.**

The ministry of health in collaboration with other industry players should support longitudinal studies to establish the temporal relationship between sickle cell disease and oral health condition.

#### **6.4 Summary**

This chapter has synthesized the study's findings into key conclusions and prioritized recommendations to address the significant oral health gaps identified among adolescents with SCD in Kisumu County. Implementing these recommendations, which span clinical practice, education, policy, and research, holds the potential to substantially improve oral health and overall well-being for this vulnerable population.



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## APPENDIX 1: ENGLISH QUESTIONNAIRE

**SUBJECT TITLE: PREVALENCE AND ASSOCIATED DETERMINANTS OF ORAL HEALTH CONDITIONS AMONG SICKLERS AGED 10-18 IN KISUMU COUNTY:**

### SECTION A: SOCIODEMOGRAPHIC DATA

My Name **CLIFFLAND MARK MOSOTI** from Amref International University in Kenya We are carrying out a project on strengthening mental health awareness among secondary school students in Kenya. I would like to inform you about this project. We are conducting a research study to assess oral health related conditions in sicklers between the age of 10-18 years. Living with Sickle Cell Disease in Kisumu County: Prevalence, Impact on Quality of Life, Factors, and Access to Care and knowledge of oral hygiene practices and management of oral health related conditions. This research aims to gain insights into peoples oral health habits. We are inviting at least ten children to participate in this study. If you choose to participate, you will be asked questions about your oral hygiene routines, including how often you brush your teeth and what motivates or discourages you from taking care of your oral health. Additionally, we will examine your mouth to check for cavities or dental conditions. This examination will take about 20 minutes of your time.

1. Age: [10-18 years]

2. Gender: Male ( )

Female ( )

3. Sickle Cell Disease Status: Do you have sickle cell disease? Yes ( )

No ( )

4. Residence: Where do you currently reside in Kisumu County?  
Specify area or locality \_\_\_\_\_

5. Education: What is your current educational level? [Specify if

in school or not] None ( )

Primary ( )

Secondary ( )

Are you currently in School or not \_\_\_\_\_

6. Socioeconomic Status: What is the occupation of your

primary caregiver? [Employed ( )

Unemployed ( )

Self-employed ( )

**Prevalence of oral health**

7. Are you currently on any medication or treatment for sickle cell disease? Yes ( )

- Have you experienced any complications related to sickle cell disease in the past year? (e.g., pain crises, acute chest syndrome, stroke)

- Have you experienced any of the following symptoms in the past six months? - Toothache Yes ( ) No ( )

- Gum bleeding Yes ( ) No ( )

- Bad breath Yes ( ) No ( )

- Difficulty chewing or swallowing Yes ( ) No ( )

- Sensitivity to hot or cold foods/drinks Yes ( ) No ( )

- Mouth sores (Yes/No)

- How often do you consume sugary foods or drinks in a typical week?

- How often do you consume acidic foods such as (Oranges, mangoes,

tomatoes pineapples or drinks in a typical week?

- Do you have access to dental care services in your area?

Yes ( )

No ( )

- If yes, how far is the nearest dental clinic from your home?

Less than 500m ( )

Less than 1 km ( )

More than 1 Km ( )

- Have you ever faced any barriers in accessing dental care? (e.g., cost, transportation) (Yes/No)

Yes ( )

No ( )

- Does anyone in your immediate family have a history of oral health-

related conditions? Yes ( )

No ( )

- If yes, please specify the condition(s) and relationship(s):

---

### **Management of oral health**

Knowledge and Awareness

- Are you aware of the relationship between sickle cell

disease and oral health? Yes ( )

- Where do you usually seek information about preventing and managing oral health-related conditions?

- Healthcare providers ( )
- School education programs ( )
- Family members ( )
- Internet/online resources ( )
- Others (specify):

Understanding Prevention and Management

- Can you name some preventive measures for oral health-related conditions? Drink fluoridated water and brush with fluoride toothpaste ( )

Brush teeth thoroughly twice a day and floss daily between the teeth ( ) Visit your dentist at least once a year ( )

Do not use any tobacco products ( )  
Limit alcoholic drinks ( )

- How confident do you feel in your ability to manage your oral health as a sickle cell patient?

- Very confident ( )
- Somewhat confident ( )
- Not confident at all ( )

- Do you discuss oral health-related topics with your friends who have sickle cell disease? Yes ( )

No ( )

- If yes, do you exchange tips or advice on oral health practices? Yes ( )

No ( )

- What would be the most effective way to educate sickle cell patients like yourself about oral health?

- Workshops/seminars
- Interactive sessions with healthcare professionals ( )
- Educational materials (e.g., brochures, pamphlets)( )
- Online resources/websites ( )
- Other (please specify):\_\_\_\_\_

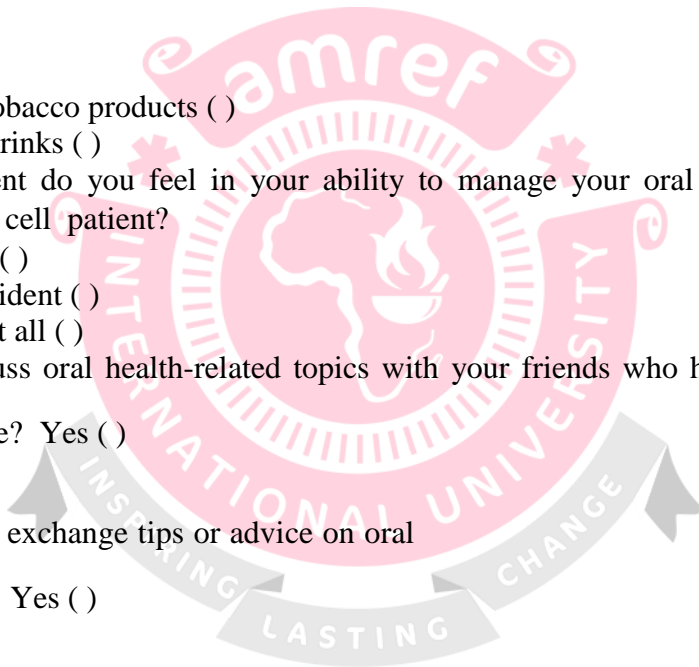
**Hygiene practices**

Oral Hygiene Practice

- How often do you brush your teeth per day?
- Do you use fluoride toothpaste?
- How long do you typically brush your teeth for each session?

Less than one minute ( )

One minutes ( )



Two minutes ( )

Three minutes or more ( )

- Do you floss your teeth regularly? Yes ( )

No ( )

- If yes, how often do you floss? Never ( )

Rarely (once a week or less) ( )

Occasionally (2-3 times a week) ( )

Sometimes (4-6 times a week) ( )

Regularly (daily) ( )

This allows participants to select the option that best reflects their flossing frequency. \_\_\_\_\_

- Do you use mouthwash? Yes ( )

No ( )

- If yes, how often do you use mouthwash?

Never ( )

Rarely (once a week or less) ( )

Occasionally (2-3 times a week) ( )

Sometimes (4-6 times a week) ( )

Regularly (daily) ( )

- How often do you consume sugary foods or drinks in a typical week? Never ( )

Rarely (once a week or less) ( )

Occasionally (2-3 times a week) ( )

Sometimes (4-6 times a week) ( )

Regularly (daily) ( )

- How often do you consume acidic foods or drinks in a typical week?

Never ( )

Rarely (once a week or less) ( )

Occasionally (2-3 times a week) ( )

Sometimes (4-6 times a week) ( )

Regularly (daily) ( )

- Have you ever received professional dental cleanings? Yes ( )

No ( )

- If yes, how often do you receive professional cleanings? Never ( )

Rarely (once a week or less) ( )

Occasionally (2-3 times a week) ( )

Sometimes (4-6 times a week) ( )

Regularly (daily) ( )

- How much do you know about the importance of oral hygiene in preventing oral health related conditions?

Very Little Knowledge ( )

Limited Knowledge ( )

Moderate Knowledge ( )

Good Knowledge ( )

Extensive Knowledge ( )

- Have you received any education on oral hygiene specific to sickle cell disease?

Yes ( )

No ( )

- If yes, where did you receive this education?

School ( )

Healthcare provider ( )

Community organization ( )

**Oral health quality of life**

Oral Health Symptoms

- In the past six months, have you experienced any of the following oral health related symptoms?

- Toothache Yes ( ) No ( )

- Gum bleeding Yes ( ) No ( )

- Bad breath Yes ( ) No ( )

- Difficulty chewing or swallowing Yes ( ) No ( )

- Sensitivity to hot or cold foods/drinks Yes ( ) No ( )

- Mouth sores Yes ( ) No ( )

- If yes to any of the above, please rate the frequency and severity of each symptom on a scale of 1 to 5 (1 being mild, 5 being severe).

Symptom	Severity
Bad Breath	(1 Mild-5Severe)
Tooth decay	(1 Mild-5Severe)
Gum disease	(1 Mild-5Severe)

Tooth sensitivity	(1 Mild-5Severe)
Tooth loss	(1 Mild-5Severe)
Mouth sores	(1 Mild-5Severe)
Bleeding gums	(1 Mild-5Severe)
Dental pain	(1 Mild-5Severe)

- How much do oral health problems affect your daily activities (e.g., eating, speaking, smiling)?

Not at all ( )

Slightly ( )

Moderately ( )

Very much ( )

Extremely ( )

- Have oral health problems ever made you feel embarrassed or self-conscious in social situations? (Yes/No)

- Have you ever avoided smiling or laughing because of oral health

issues? (Yes/No) - How often do oral health problems cause you to

feel stressed or anxious? - Never ( )

- Rarely ( )

- Sometimes ( )

- Often ( )

- Always ( )

- Have oral health problems ever interfered with your ability to sleep?

Yes ( )

No ( )

- If yes, how often does this occur?

Rarely ( )

Occasionally ( )

Sometimes ( )

Frequently ( )

Always ( ) - How easy is it for you to access dental care services

when needed? - Very easy ( )

- Somewhat easy ( )
- Neither easy nor difficult ( )
- Somewhat difficult ( )
- Very difficult ( )

- On a scale of 1 to 10, with 1 being extremely dissatisfied and 10 being extremely satisfied, how satisfied are you with your current oral health?

Extremely dissatisfied ( )

Very dissatisfied ( )

Barely dissatisfied ( )

Slightly dissatisfied ( )

Dissatisfied ( )

Satisfied ( )

Barely satisfied ( )

Slightly satisfied ( )

Very satisfied ( )

Extremely satisfied ( )



**SECTION C: INCIDENCES OF DENTAL CONDITIONS**

Dentition status														Permanent teeth				
	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28		
Crown (45)																	60)	
Root (61)																	(76)	
Crown (77)																	(92)	
Root (93)																	(108)	
	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38		
														<b>Status</b> 0 = Sound 1 = Caries 2 = Filled w/caries 3 = Filled, no caries 4 = Missing due to caries 5 = Missing for any other reason 6 = Fissure sealant 7 = Fixed dental prosthesis/crown abutment, veneer, implant 8 = Unerupted 9 = Not recorded				

**Plaque score:** *Turetsky's modification of Quigley – Hein (1970)*

16– Buccal		11 – Labial		26 – Buccal	
16– Palatal		11 – Palatal		26 – Palatal	
46– Buccal		31 – Labial		36 – Buccal	

46- Lingual		31 – Lingual		36 – Palatal	
-------------	--	--------------	--	--------------	--

**Oral Mucosal Lesions:**

Mucosal lesion / Location of lesion	Tongue	Hard Palate	Soft Palate	Buccal Mucosa	Lips	Gingi
Erythroplakia						
Haemangioma and						

vascular malformations						
Gingivitis						
Kaposi Sarcoma						
Ecchymoses and Petechiae						
Pyogenic granuloma						
Leukoplakia						
Hairy Leukoplakia						

	Actinic Cheilitis						
	Lichen Planus						
	Oral submucous fibrosis						
	Leukoedema						
	Frictional Keratosis						
	Nicotine Stomatitis						
	Oral Thrush						
	Denture Stomatitis						

Any other significant dental condition:

**SECTION D: ORAL HEALTH SEEKING BEHAVIOR**

1. How frequently do you make appointments with the dentist?

- Once annually
- Every six months
- Every three months
- Only when absolutely necessary

2. When did you last visit the dentist?

- In the past six months
- In the past year
- Within the last five years
- I have never visited a dentist

3. What prompted your most

recent dental visit?  Seeking

consultation or advice

Experiencing pain or issues with your

teeth, gums, or mouth  Receiving

treatment or follow-up care

A routine check-up or treatment

I don't know or don't remember

4. If you haven't visited a dentist, what is the

primary reason?  Dental anxiety or fear

High cost of dental care

Lack of access to dental services

Concern about experiencing bleeding

Other:

#### **SECTION E: INFLUENCING FACTORS**

##### **Cost**

##### **Lack of Access to dental care**

1. Do you have access to a dental facility?

Yes

No

2. What is the estimated distance?

<5km

5-10 km

10-20km

>20km

Not sure

3. **Attitude** (Tick where appropriate)

It is important for me to seek early/dental care

Seeking dental care is not important

I don't know the importance of seeking dental care

**Perception towards the level of care at the**

**facility** 4. What is your perception towards the level  
of care at the facility?

- Excellent
- Good
- Moderate
- Low

5. What would be your motivating  
factor to seek oral health?  I have a  
dental problem

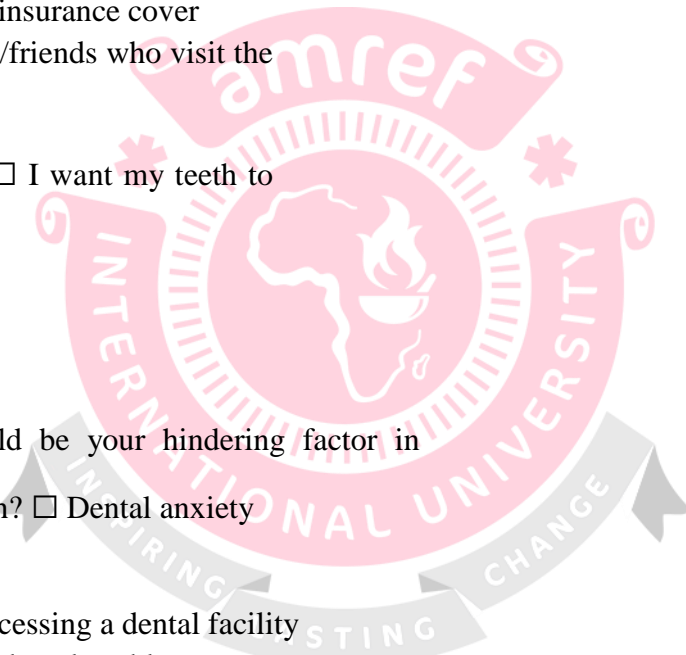
- I have a dental insurance cover
- I have relatives/friends who visit the

dentist regularly  I want my teeth to  
remain healthy

- Any other:

6. What would be your hindering factor in  
seeking oral health?  Dental anxiety

- High cost
- Difficulty in accessing a dental facility
- I do not have a dental problem
- Any other:



## APPENDIX 2: SWAHILI QUESTIONNAIRE

**KICHWA CHA SOMO: KINYWA: Tathmini Kamili ya Afya ya Kinywa na Utunzaji pesa za Watoto na Vijana Wanaoishi na Ugonjwa wa Sickle Cell katika Kaunti ya Kisumu: Matukio, Athari kwa Ubora Unaohusiana na Afya ya Kinywa, Mambo, na Upatikanaji wa Matunzo.**

### SEHEMU A: DATA YA SOCIODEMOGRAPHIC

KITAMBULISHO CHA USHIRIKI:

TAREHE YA UKUSANYAJI WA DATA:

1. Tafadhali bainisha jinsia yako:

Mwanaume

Mwanamke

2. Umri wako wa sasa ni kategoria gani?

Miaka 0-18

Miaka 18-30

Miaka 30-60

Zaidi ya miaka 60

3. Unaishi wapi?

Mjini

Peri-mijini

Vijijini

4. Kiwango chako cha juu cha elimu ni kipi?

Hakuna elimu rasmi

Elimu ya msingi

Elimu ya sekondari

Elimu ya Baada ya Sekondari

5. Hali yako ya ajira ikoje?

Wasio na kazi

Kujiajiri

Kuajiriwa

6. Je, una bima ya matibabu?

Ndiyo

Hapana

7. Ikiwa ndio, je, bima yako inashughulikia gharama matibabu na

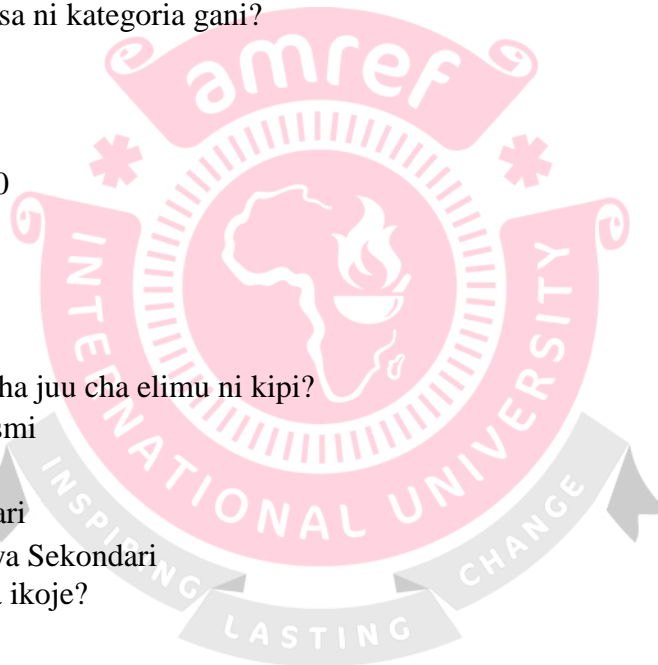
matibabu yako ya kinywa?  Ndiyo

Hapana

Sina uhakika

8. Ikiwa ndio, je, bima yako inashughulikia matibabu ya meno?

Ndiyo



- Hapana
  - Sina uhakika
9. Je, una tatizo gani la meno?
- Ugonjwa wa periodontal
  - Mashimo
  - Kupoteza meno
  - Nyingine (tafadhali taja)

**SEHEMU B: HALI YA USAFI WA KINYWA**

1. Je, unajihusisha na usafi wa meno kwa

kusafisha meno yako?  Ndiyo

- Hapana
2. Ikiwa jibu lako ni hapana, tafadhali taja sababu:
- Ukosefu wa upatikanaji wa vifaa vya kusafisha meno
  - Kutojua umuhimu wa kusafisha meno
  - Ukosefu wa motisha
  - Hakuna sababu maalum
  - Nyingine:

3. Ikiwa unasafisha meno yako, unafanya

hivyo mara ngapi?  Mara moja kwa siku

- Mara mbili au zaidi kila siku
- Kila wiki
- Kamwe

4. Je, unatumia zana au kusafisha meno? (Chagua zote zinazotumika)  Mswaki

- Vijiti vya meno vya mbao
- Uzi wa meno
- Mkaa
- Kijiti cha kutafuna/miswak
- Nyingine:

5. Ikiwa unatumia mbadala ya kubadilisha isipokuwa mswaki,

tafadhali eleza kwa nini:  Kutokuwa na uwezo wa kununua

mswaki



Mucosal lesion Location of lesion	/ Tongue Hard	Palate	Soft Buccal	Mucosa	Lips	Gingiva
Erythroplakia						
Haemangioma and vascular malformations						
Gingivitis						
Kaposi Sarcoma						
Ecchymoses and Petechiae						
Pyogenic granuloma						
Leukoplakia						
Hairy Leukoplakia						
Actinic Cheilitis						
Lichen Planus						
Oral submucous fibrosis						

	Leukoedema						
	Frictional Keratosis						
	Nicotine Stomatitis						
	Oral Thrush						
	Denture Stomatitis						

**SEHEMU YA D: TABIA YA KUTAFUTA AFYA YA KINYWA**

1. Je, huwa unafanya miadi na daktari wa meno mara ngapi?

- Mara moja kwa mwaka
- Kila baada ya miezi sita
- Kila baada ya miezi mitatu
- Inapobidi tu

2. Ulimtembelea daktari wa meno mara ya mwisho lini?

- Katika miezi sita iliyopita
- Katika mwaka uliopita
- Ndani ya miaka mitano iliyopita
- Sijawahi kutembelea daktari wa meno

3. Ni nini kilikufanya utembelee daktari wa

meno hivi majuzi?  Kutafuta ushauri au

ushauri

- Kupata maumivu au matatizo kwenye

meno, fizi au mdomo  Kupokea matibabu

au utunzaji wa ufuatiliaji  Uchunguzi wa

kawaida au matibabu

Sijui au sikumbuki

4. Ikiwa hujamtembelea daktari wa meno,

sababu kuu ni ipi?  Wasiwasi au woga wa

meno

Gharama kubwa ya huduma ya meno

Ukosefu wa upatikanaji wa

huduma za meno  Wasiwasi

kuhusu kutokwa na damu

Nyingine:

**SEHEMU E: MAMBO**

### **YANAYOSHAWISHI**

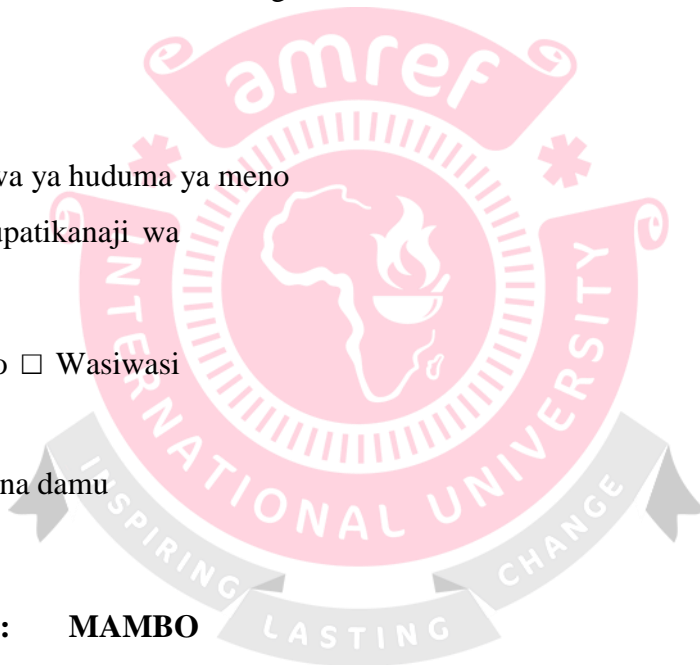
Gharama

1. Nani analipia gharama ya matibabu yako?

Jamii ya Hemophilia ya Kenya

Bima

Kujifadhili mwenyewe



# APPENDIX 3: PLAGIARISM REPORT

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REF: AMREF – ESRC P1757/2024

December 3, 2024

Cliffland Mosoti  
Amref International University  
P.O Box 27691-00506  
Nairobi, Kenya  
Tel: 0716809232  
Email: [mosoticliffland@gmail.com](mailto:mosoticliffland@gmail.com)

Dear Cliffland Mosoti,

**RESEARCH PROTOCOL: PREVALENCE AND ASSOCIATED DETERMINANTS OF ORAL HEALTH CONDITIONS AMONG SICKLERS AGED 10-18 IN KISUMU COUNTY, KENYA**

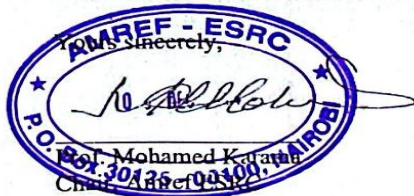
Thank you for submitting your protocol to the Amref Ethics and Scientific Review Committee (ESRC).

This is to inform you that the ESRC has reviewed and approved your protocol. Your application approval number is ESRC P1757/2024. The approval period is from December 3, 2024, to December 2, 2025, and is subject to compliance with the following requirements:

- a) Only approved documents (including informed consents, study instruments, advertising materials, material transfer agreements, etc.) will be used.
- b) All changes including (amendments, deviations, violations, etc.) are submitted for review and approval by Amref ESRC before implementation.
- c) Death and life-threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the Amref ESRC within 72 hours of notification.
- d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to Amref ESRC within 72 hours.
- e) Clearance for export of biological specimen must be obtained from the relevant government authorities for each batch of shipment/export.
- f) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- g) In case of late renewal, the Amref ESRC shall not be held responsible for any serious adverse events (SAEs) that may occur as a result of research activities that were carried out after the expiry of approval.
- h) Submission of an executive summary report within 90 days upon completion of the study to the Amref ESRC.
- i) All government regulations for prevention and control of the spread of COVID-19 including social distancing, provision of personal protective equipment for participants and research assistants should be adhered to during data collection. All research assistants should be monitored for COVID 19 symptoms and referred for testing in case they present with symptoms.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) <https://research-portal.nacosti.go.ke> and also obtain other clearances needed.

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Ref No: **161572** Date of Issue: **11/January/2025** RESEARCH LICENSE



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  - ii. Adversely affect the lives of Kenyans
  - iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
  - iv. Result in exploitation of intellectual property rights of communities in Kenya
  - v. Adversely affect the environment
  - vi. Adversely affect the rights of communities
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