DETERMINANTS OF DENTAL CARIES AMONG PATIENTS ATTENDING MALINDI SUB-COUNTY DENTAL CLINIC, KENYA

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Determinants of Dental Caries among Patients Attending Malindi Sub-County Dental Clinic, Kenya

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DECLARATION

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

Signature……Date……..…

Hossan Dennis Ajuck

This thesis has been submitted for examination with our approval as the University Supervisors

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DEDICATION

This thesis is dedicated to almighty God for his blessings, care and protection. Further, to my wife Linda Nyamvula Telle for her support and sacrifice. To my sons' John and Josh for an enduring stay in my absence for a long period while I worked day and night. I dedicate this Thesis to my father Eric Lok Olekete for his guidance, financial support in my career.

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ACRONYMS AND ABBREVIATIONS

ADA	American Dental Association
CDC	Centre of Disease Control
CHSFP	Community Health Strategy Focal Person
CI	Confidence Interval
DHIS	District health information system
DHIS	District Health Information System
DMFT	Decay Missing Filled Teeth
FGD	Focused Group Discussion
JKUAT	Jomo Kenyatta University of Agriculture and Technology
HIV	Human immunodeficiency syndrome
IDI	Informed Depth Interview
KCG	Kilifi County Government
KEMRI	Kenya Medical Research Institute
KNOHS	Kenya National Oral Health Survey
KOHSR	Kenya Oral Health Survey Report
LMICs	Low and Middle-Income Countries
MOH	Ministry of health

MSCH	Malindi Sub-County Hospital
NCD	Non Communicable Diseases
OR	Odds Ratio
TUM	Technical University of Mombasa
W.H.O	World Health Organization

DEFINITION OF OPERATIONAL TERMS

Access To a healthcare service also means getting the required service at the right time to enhance the health outcomes

Acute necrotizing ulcerative gingivitis is a painful infection in the gums, characterized by acute pain, bleeding, and foul breath.

Carious crown A crown that has a lesion in a pit or fissure, or on a smooth tooth surface, has an unmistakable cavity

Dental attendance The use of preventive and restorative dental services

Dental caries A multifactorial, preventable disease that begins below the surface of the tooth affecting the mineralized tissue, etiology is related to interactions over time between tooth substances, certain micro-organisms, and dietary carbohydrates producing plaque acids.

Dental Floss A soft thread made of silk or similar material used to clean in between the teeth.

Dental outcome presence/absence of oral diseases. The oral diseases include; dental caries, periodontal disease, or oral ulcers.

Dental Team Concept These are practical ways that dental teams can become involved in the action to reduce oral health iniquities

Filled crown, with caries when a participant has one or more permanent restorations.

Fluoride A mineral compound of the element fluorine used to reduce dental decay

Leukoplakia	Thickened, white patches on the gums, cheek, or bottom of the mouth. They are normally non-cancerous but show early signs of cancer.
Litchen planus;	It is an inflammation condition of the mucosa membrane characterized by a purplish, itchy flat-topped membrane in the mouth.
Pits and Fissure sealants	These are a protective plastic coating that is put on biting small holes or on the biting surface of the back teeth by the dentist that forms a smooth protective barrier that stops food and bacteria from getting into the tiny grooves and causing decay.
Teeth Brushing	It is an act of scrubbing teeth with either a conventional brush or stick intended to clean teeth to get rid of food debris in the mouth disorders that affect the oral cavity
Utilization of dental health care services	The proportion of the general population that have received dental services for the past year.
Validity	The accuracy and meaningfulness of inference, which are based on research results. It is the degree to which the results obtained from the analysis of the data represent the phenomenon under study.

ABSTRACT

Good oral health is one of the essential building blocks of living well. Oral health is fundamental to the ability to breathe, eat, swallow, speak or even smile. Despite importance of this oral diseases are on the rise with 47.3% of adults and 23.9% of children suffer from dental caries in Kenya. Most of the oral conditions are largely preventable by simple, effective, and low-cost measures. There is untreated dental diseases especially dental caries which leads to severe physical, social, and psycho-biological disorders. The aim of this study was to establish determinants of dental caries among patients attending Malindi sub-county dental clinic, Kenya. A mixed cross-sectional analytical study design was used. Study data were collected using standard questionnaire and cleaned before analysis. Regression analysis to determine socio-demographic factors, reported underlying medical conditions and dental risk behavior factors associated with presence of dental caries was conducted using generalized linear models and a logit link function. All categorical variables were reported as counts with their respective percentages. The regression coefficients from the regression models were log-transformed and reported as Risk Ratios and their respective 95% confidence intervals. Univariable analysis was conducted for each independent variables and crude Risk Ratios reported. The multivariable regression model included independent variables with a p-value <0.1 in the univariable model. Statistical significance was evaluated using 95 % confidence interval and a two-tailed p-value <0.05. In-depth interviews were conducted, translated into English then later transferred to Nvivo qualitative data management software version 12 for thematic analysis International, Melbourne, Australia) for management, cleaning and coding. The coded data was analyzed verbatim. The study recruited 223 participants, 117 (52.5%) female and 106 (47.5%) males. Majority of participants were aged 30 to 49, 76 (34.1%) and the least were aged ≥50 years that is 35 (15.7%). The prevalence of dental caries was 72.6% with majority aged 18 to 29 years old. This study found out that socio-demographic factors such as low income and cash as mode of payment of hospital fees are associated with dental caries among patients attending Malindi sub-county dental clinic, Kenya. Dental risk behavior factors associated with dental caries among patients were found to be the patients who had never visited the dental clinic having a higher likelihood of dental caries compared to those who visit when necessary (OR = 2.05, 95% CI: 1.15–3.65, p = 0.014). Clinical factor associated with dental caries were statistically significant among patient who had diabetes as indicated by an odds ratio (OR) of 6 (95% CI: 2.50 - 15.00, p < 0.001). Socio-demographic factors such as low income and cash as mode of payment of hospital fees are associated with dental caries. This study found out that those who had never visited the dental clinic had a higher likelihood of dental caries compared to those who visit dental clinic when necessary. Clinical factor associated with dental caries were statistically significant among patient who had diabetes. This study recommends Ministry of Health to increase access to affordable dental care services by lowering the cost of care. Integrating Social Health Authority, subsidies with other insurance scheme and out of pocket to provide wide coverage and increase campaign on important of regular dental checkup.

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Globally dental cavities, severe gum disease and significant tooth loss causes important oral health issues that impair quality of health (CDC, 2019). According to the CDC's 2019 Global Report, one out of every four individuals 20 – 64 years had dental cavities and 525 million children had cavities in their primary teeth. Low-income children are twice likely as high-income children to have primary teeth cavities (CDC 2019). In high-income countries, such as the United States, Canada and Western European nations, prevalence has decreased due to improved oral hygiene practices, widespread use of fluoride and better access to dental care. In United States, the prevalence of dental caries among children has decreased significantly over the past few decades (Dye B. A.-E., 2015). Poor oral hygiene, dry mouth and high intake of sweets increase the chances for cavities. Numerous studies have revealed the prevalence of dental caries was reported as 43.6% in Thailand, (Prismasari S, 2018) 70.4% in China (Zhou N, 2019), 63.4% in India (Maj Saravanan S, 2014).

Africa's oral health burden is 400 million people spread across 47 countries (WHO 2019) though changing, owing to rising urbanization and changes in living conditions, increased sugar consumption, inadequate fluoride exposure, tobacco use and increased alcohol usage. In Africa dental carries is prevalent at 86.63% in Egypt (Abbass MMS, 2019) 83.7% in Uganda (Kalanzi D, 2019) and 67.7% in Eritrea (Abdelhamid N, 2019) .Furthermore, there is an unequal distribution of oral health person, lack of acceptable and functioning facilities within the primary health care system, resulting in limited or no access to effective oral health care services (WHO, 2017). Dental caries is frequently overlooked in health planning and lack of a dedicated oral health budget leading to out-of-pocket costs for oral health care (WHO, 2017). The problem has resulted in a high

incidence of untreated oral diseases, large needs and demands for basic oral health care services, posing a challenge to the region's primary health care systems.

In Kenya, the dentist-to-population ratio is low (1:42000), considerably below the WHO-recommended ratio of 1:7,000 with limited dental equipment and material supply. To improve dental services in Kenya, the government created a National Oral Health Policy in the reduction of oral health burden, equitable, cost-effective quality services and healthy lifestyle follow-up. According to the Alma Ata Convention, Kenya has accepted oral health as a fundamental component of primary healthcare. Kenya there is an increase of dental caries due to increased socio-economic development, increase in sugar consumption (Wamiti,2020). In Kenya, it has been demonstrated that dental caries is the principal cause of tooth loss in all age groups, for both children and adults, and these observations have been made in community and hospital settings. Health services have been fully devolved, and basic statistics in Kilifi show that over 1.5 million people live in the county, with only ten dentists, six community oral health officers, and ten dental technologists working at the county's three main hospitals, resulting in a ratio of 1: 57,000, below WHO standards as of April 2021.

1.2 Statement of the Problem

Dental caries, a prevalent and significant public health issue, continues to pose a considerable challenge, particularly in low- and middle-income countries such as Kenya. Despite advancements in dental care and preventive measures in high-income nations, dental caries remains prevalent and inadequately addressed. Prevalence of dental caries is 47.3% children and 23.9% among adults in Kenya (Wamiti is,(2020.) Dental carries is a multifactorial disease where socio-economic demographic factors, clinical and behavioral factors play a key role. (Butera et al., 2022). Previous studies have identified various factors contributing to dental caries, including socioeconomic status, dietary habits, oral hygiene practices, and access to dental care. In Kenya there is limited published studies regarding determinants factors associated with dental caries among patients attending

dental clinic at Malindi sub-county. Therefore, this study aimed to determine factors associated with dental caries among patients attending dental clinic at Malindi.

1.3 Justification of the Study

Understanding the prevalence and impact of dental caries is important for developing effective prevention and intervention strategies. In areas such as Kilifi County, where health services are limited and the oral health burden is high, targeted research is essential for public health leadership and resource allocation. Kilifi County coastal Kenya has demographic and health characteristics with a mix of urban and rural population. This can improve oral health outcomes, reduce health care costs, and improve quality of life in the community. This study will shed light on interaction between socioeconomics, nutrition, oral traditions, and access to dental care in a specific area. It can serve as a reference for future research and comparative studies in similar areas in Kenya and other developing regions. The cases at health facilities are a tip of the iceberg. There is paucity of information on prevalence and risk factors of dental caries in Malindi and Kenya in general. Studies on dental caries has not been done in Malindi County, Kenya. The prevention of caries complications such as dentoalveolar abscess can reduce the cost of treatment and pressure on health care system. The selection of dental caries over other oral diseases is due increasing trend untreated complications. The findings of the current study are critical for decision making to informs public oral health care interventions and proactive strategies to protect oral health to improve dental care. Further help policy makers and health professionals develop sensitization campaigns for prevention of dental caries for effective treatment strategies.

1.4 Study Objectives

1.4.1 Broad Objective

To establish determinants of dental caries among patients attending Malindi sub-county dental clinic, Kenya:

1.4.2 Specific Objectives

1. To determine the socio-demographic factors associated with dental caries among patients attending Malindi sub-county dental clinic, Kenya
2. To establish dental risk behavior factors associated with dental caries among patients attending Malindi sub-county dental clinic, Kenya
3. To determine clinical factor associated with dental caries among patients attending Malindi sub-county dental clinic.

1.5 Research Questions

1. What are the socio-demographic factors associated with dental caries among patients attending Malindi sub-county dental clinic, Kenya?
2. Which are the dental risk behaviour factors associated with dental caries among patients attending Malindi sub-county dental clinic, Kenya?
3. What are the clinical factor associated with dental caries among patients attending Malindi sub-county dental clinic?

1.6 Null Hypothesis

H_{01}. There is no statistically significant association between socio-demographic factors and the occurrence of dental caries among patients attending Malindi sub-county dental clinic, Kenya

H_{02}. There is no statistically significant association between dental risk behaviour factors and the occurrence of dental caries among patients attending Malindi sub-county dental clinic, Kenya

H_{03}. There is no statistically significant association between clinical factor and the occurrences of dental caries among patients attending Malindi sub-county dental clinic, Kenya

1.7 Alternative Hypothesis

H_1: There is significant association between socio-demographic factors and the occurrence of dental caries among patients attending Malindi Sub-County Dental Clinic, Kenya.

H_2 There is significant association between dental risk behavior factors and the occurrence of dental caries among patients attending Malindi Sub-County Dental Clinic, Kenya.

H_2 There is significant association between clinical factors and the occurrence of dental caries among patients attending Malindi Sub-County Dental Clinic, Kenya.

1.8 Theoretical Framework

This study conceptual framework was based on the integration of the social ecological model which state that a person behavior is influenced at multiple levels, including the intrapersonal, interpersonal, organizational, community and policy levels. Individual factors are very important in defining association with dental carries. This framework is important in understanding relationship between individual factors and their association with dental carries. The study will focus on the socio-demographic factors, clinical and behavioral factors associated with dental caries among patients attending Malindi sub-county dental clinic. The study examines the association between socio-demographic factors (gender, age, marital status, religion, education level, distance to the clinic, and medical insurance) clinical factors (Diabetes, HIV status, Depression, Cancer, Teeth Status) and Risk Behaviors (Dental hygiene, sugar intake, awareness, frequency of dental attendance, smoking, alcohol, Tobacco use associated with the prevalence of dental caries among patients attending the Malindi Sub-County Dental Clinic in Kenya.

1.9 Conceptual Framework

This Conceptual framework figure 1 shows the relationship between independent variables and dependent variables. the dependent variable was dental caries while

independent The study examines the association between independent variables (socio-demographic factors (gender, age, marital status, religion, education level, distance to the clinic, and medical insurance) clinical factors (Diabetes, HIV status, Depression, Cancer, Teeth Status) and Risk Behaviors (Dental hygiene, sugar intake , awareness, frequency of dental attendance, smoking, alcohol, Tobacco use associated with the dependent variable (dental caries)among patients attending the Malindi Sub-County Dental Clinic in Kenya.

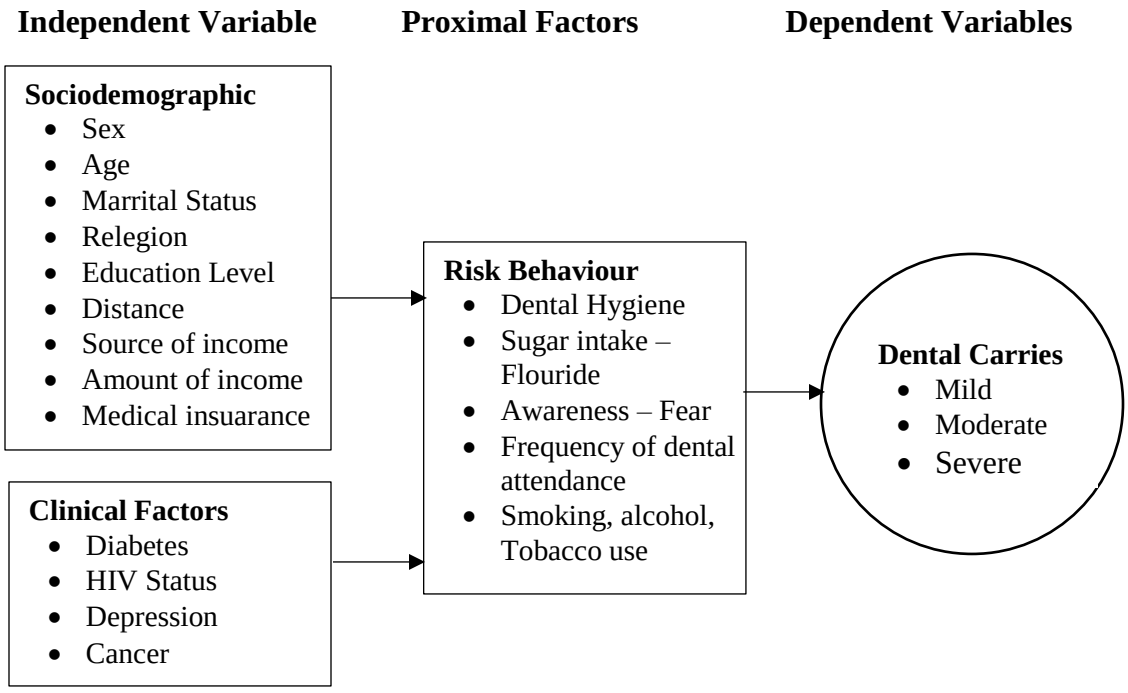

Figure 1.1 Conceptual Framework

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter is about literature review for the study. It presents literature on overview of factors influencing dental caries development and contains empirical literature, theoretical framework of the study. Dental services are services aimed at ensuring that the general public is free of discomfort, oral cancer, oral sores, and birth deformities such as cleft palate, periodontal diseases, tooth decay, tooth lessness, and other oral cavity illnesses (Tonetti et al.,2017). Dental caries can be avoided with effective diagnosis and early case management. Dental caries has a direct impact on people's quality of life, self-esteem, and physical appearance. (Odegua et al., 2018)

2.2 Social Demographic Factors Associated with Dental Carries

According to the World Health Organization (WHO), dental caries is common or severe among underprivileged groups of children around the world because access to dental care is inequitable. Dental carries are frequently manifests in children from poor families or living in poor environmental settings (WHO, 2019). Adults are at danger of dental illnesses, particularly dental caries, according to another WHO report, but children and adolescents are the most vulnerable. Because dental disease is a cumulative disease, the majority of cases develop in adults. Sugar consumption and dental disorders such as dental caries have a clear dose-response association. The disease is also linked to socioeconomic level, with significant rates of prevalence among the poor and disadvantaged (WHO 2017). Dental carries affects both men and women depending on their behavior on oral health care. Men have significantly higher chances of tooth loss than women, as women are more likely to attend dental oral clinic than men. In developed countries, a report titled "The Surgeon General's Report" described tooth decay as a "silent epidemic," stating that 78 percent of 17-year-olds had tooth decay with an average of 7 affected tooth surfaces,

and 98 percent of 40–44-yearolds had tooth decay with an average of 45 affected tooth surfaces. According to the survey, three out of every ten Americans over the age of 65 had no teeth at all (CDC, 2019). Poverty is a major risk factor for poor oral health, as low socioeconomic position is typically associated with the highest prevalence of oral disorders (WHO,2019). Increased access to sugar-containing foods and beverages, which are major risk factors for dental caries, is linked to an increase in the prevalence of various oral disorders among working class group of young adults. Increased alcohol consumption by employed youth and young adult is linked to a higher rate of facial and dental injuries as a result of violence and accidents (WHO, 2017). Dental care is costly to treat and therefore prevention is better in improving quality of life. Poor dental health causes millions of people to experience excruciating pain, increases society's out-of-pocket financial burden, and negatively impacts people's quality of life and well-being (WHO, 2017).

2.3 Risk Behaviour Factors Associated with Dental Carries

According to the study done among children in Eritrea found out three-quarters of the research participants (75%) cleaned their teeth with toothpaste while 85%) cleaned on their own and 9% had mothers' assistance. (Andegiorgish *et al*., 2017). Cigarette-smoking family members had a higher rate of dental caries non-smoking family members (Watanabe *et al*., 2014).

This is in line with extensive research documenting the role of dietary sugars as a major risk factor for dental caries development (Sheiman& James, 2015). Inadequate teeth brushing frequency (twice a day) was linked to frequent intake of soft drinks, not seeing a dentist in the previous 12 months, and a lack of conviction in the benefits of tooth cleaning. The lack of dietary micronutrients such as vitamin D, calcium, phosphates, and vitamin K has a detrimental impact on dental mineralization and thus increases tooth decay, according to a consensus report on the boundaries between caries and periodontal disorders (Chapple *et al*., 2017). Persons with a low education background, poor living conditions, bad eating habits and high sugar consumption, and people with a limited

tradition of dental care have a high prevalence of dental illnesses (Petersen and Ogawa, 2016) For topical exposure, tooth brushing twice a day with a fluoride-containing toothpaste is the most effective preventive measure for dental caries in many nations (WHO, 2019).

Health literacy or knowledge impacts the motivation and ability of individuals to obtain access to, understand, and use information in ways that promote and maintain good health (WHO, 2016). Oral health literacy is connected with greater consumption of services and allows patients to find value in the treatments delivered and establish a culture of giving oral health priority.

Children's caries experience during their first four years of life is significantly increased in children whose mothers smoke compared to children whose mothers do not smoke, according to a consensus report on the boundaries between caries and periodontal diseases exposure to smoke is associated with mechanisms relating to alterations in saliva and that children's caries experience during their first four years of life is significantly increased in children whose mothers smoke compared to children whose mothers do not smoke (Chapple *et al*., 2017) Tobacco use has been linked to an increased risk of periodontitis in those who use it, regardless of the type of tobacco used, and studies consistently show a dose-response relationship for periodontal risk (Chapple *et al*., 2017) Tobacco usage, whether smoked, sucked, chewed, or snuffed, is harmful to one's overall health and a risk factor for oral disorders.

The Study findings were found in a cross-sectional study of 319 individuals in India, where about a third of the participants, the majority of whom were female, reported dread of dental services. The study done India found that adult dental patients sought services on an ad hoc basis, and those with poorer oral health reported being more afraid of seeking dental care than those who sought services on a regular basis. (Andegiorgish *et al.*, 2017). In Nigeria, one-fifth of survey participants were terrified of going to the dentist because of a bad dental experience caused by parental/sibling/peer pressure, professional ineptitude, and dental settings and procedures. Participants who had extraction under

anesthesia experienced discomfort or side effects of drugs tended to avoid subsequent dental service appointments among older adults. (Popovici *et al*., 2016).

The study done in Udupi District; India found nearly a third of the people in the research (32%) had never attended dental clinic to be treated by the dentist. (Singla *et al*., 2020) Furthermore, dental visit frequency (P 0.001), brushing frequency (P = 0.02) and overall lifestyles (P 0.001) statistically affected dental caries (Singla, *et al*., 2020). Similarly, in rural communities in Brazil 23% of the population had visited the dentist in the previous year while7% had never been reviewed. The majority 44 % of those attended had their last visit 2 to 5 years ago (Popovici *et al*., 2016).

2.4 Clinical Factors Associated with Dental Carries

Diabetes is a disease that affects several parts of the body and has psychological and social consequences. While evaluating the impact of gingivitis treatment on oral health and quality of life in general alterations caused by diabetes both at the clinical and immunological levels. (Cortelli *et al*., 2017). Studies have found out that diabetic patients have high probability of developing dental caries and gingivitis. Study found out periodontitis, dental caries, and peri-implant disease is high among patients with diabetes. (Cortelli *et al*., 2017).

HIV/AIDS is related with development of dental carries (Lauritano *et al*.,2016).HIV-related oral lesions have a significant impact on oral health outcomes in both HAART and non-HAART patients while pseudomembranous candidiasis and erythematous candidiasis are the most common types of oral candidiasis. Oral hairy leukoplakia, a lesion caused by EBV, is another common HIV-related oral symptom. Many studies have found it to be common (Moodley *et al*., 2015), and it accounts for about 6-7 percent of all HIV-related oral lesions, with a higher prevalence in Western nations and among homosexual men Oral health issues could possibly be linked to the epithelium of the oral mucosa's greater vulnerability to Epstein- Barr virus (EBV) in HIV-positive people (Nittayananta et al., 2016). Another HIV-related oral manifestation is periodontal disease. Linear gingival

erythema (LGE), necrotizing gingivitis (NUG), and necrotizing periodontitis are all diseases induced by changes in the oral flora in seropositive patients (NUP). The HIV-related neoplasia with the highest prevalence is Kaposi's sarcoma.

Psychiatric disorders are well known to affect the Oro-facial region but they often are unrecognized because of the common as well as the restricted nature of their presenting aspects. Mentally ill people have worse oral health as a result of their sickness, lack of dental hygiene, and a larger consumption of carbonates. Poor perception of the world as a result of low serotonin levels self-needs for oral health, time of psychotropic therapy, and Dental care is less accessible (Nittayananta et al., 2016). People who are depressed are more likely to develop periodontal infections and are more likely to develop periodontal disease. More harmful bacteria are produced as a result of increased immunological response. Periodontal tissue damage, gingivitis, and tooth decay are all symptoms of gingivitis. Mentally ill people have worse oral health as a result of their sickness. a lack of dental hygiene and a larger consumption of carbonates Poor perception of the world as a result of low serotonin levels self-needs for oral health, time of psychotropic therapy, and Dental care is less accessible. People who are depressed are at a higher risk of getting dental caries due to a lack of interest in maintaining good dental hygiene and increased consumption of sugary foods. carbs, a strong desire for sweets due to a loss of taste sensitivity, decreased salivary production, and a high lactobacillus count. As a result, oral mucosal disorders might arise as a direct result of emotional expressions or as an indirect outcome of psychological changes.

According to the National Institute of Dental and Craniofacial Research, more than a third of all cancer patients have oral problems. Mouth sores, infection, dry mouth, sensitive gums, and jaw pain are some of the mild to severe adverse effects. This makes them prone to dental caries. The immune system of the patient might be weakened by cancer and its therapies, such as chemotherapy. The patient is more prone to infection if his/her mouth isn't as healthy as it may be before your cancer treatment. If the infection is severe enough, it may cause the cancer treatment to be delayed. Furthermore, radiation therapy, particularly in the head and neck area, can damage salivary glands, resulting in thick,

sticky saliva and acute dry mouth. Tooth decay and dental caries are more likely if the patient has a dry mouth.

Patients with kidney disease have a compromised immune system, making them more susceptible to infections caused by severe gum disease. This can cause discomfort, gum disease, eating difficulties, mouth odor, and chronic inflammation, which can lead to serious illnesses like heart disease. The severe gum disease may is a contributing factor to poor cleansing and will result to dental caries. (Honarmand et al 2017). Sjogren's syndrome patients may have difficulty eating solid foods, and brushing can be painful. Patients acquire tooth caries, gum disease, and even periodontal disease as a result of a lack of self-cleaning, negatively impacting their oral health. This is an autoimmune illness that targets the salivary glands, and some of the medications used to treat it can cause dry mouth. This leads to a lack of self-cleaning, which can lead to food packing, gum inflammation, and finally periodontal disease. (Tonetti et al 2017)**.**

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Site

The study took place at Malindi sub county hospital dental clinic which is in Malindi Sub County, Kilifi County a former administrative district in the Coast province of Kenya. Dental Clinic is the sole referral dental clinic that services both Malindi and Magarini Sub-counties, as well as neighboring counties Lamu, Tana River, and Garissa. Private dental clinics within and outside of Malindi Town refer patients to the facility. The Malindi Sub County Hospital serves a huge portion of the region that is predominantly rural. Every day, the clinic sees around 30 dental patients, both new patients and those returning for treatment.

3.2 Research Design

A cross-sectional analytical mixed method study design was used.

3.3 Study Variables

3.3.1 Dependent Variables

The presence or absence of dental caries was determined after the researcher examined the patient. The severity of the dental caries was be recorded using WHO standard assessment forms and was recorded as mild, moderate and severe.

3.3.2 Independent Variable

Individual related factors- age, gender, education, ethnicity, occupation source of income, amount of income, medical insurance, risky behavioral factors: Dental hygiene, sugar intake, Fluoride use, Awareness, frequency of dental attendance, Dental check-ups,

smoking, alcohol, and Tobacco use. Clinical characteristics related factors: HIV status, diabetes, cancer, among other condition that result to dental carries.

3.4 Target Population

The target population were dental clients seeking dental services in Malindi hospital.

3.5 Study Population

The study population was dental health clients seeking services in Malindi Sub County Hospital dental clinic.

3.6 Eligibility criteria

3.6.1 Inclusion Criteria

a) Residents of Malindi Sub-county in the past one year.
b) Individuals who were willing and voluntarily consented for the study.
c) Aged 18 years and above
d) Presence of dental condition

3.6.2 Exclusion Criteria

a) Very sick and those unable to give sound judgment like the mentally challenged.
b) Edentulous persons.
c) Not consented for the study
d) Less than 18 years
e) Lived in Malindi less than 6 month
f) Absence of dental carries

3.7 Sampling

3.7.1 Sample Size Determination

Slovin's formulae for known population was used as follows;

n=N/ (1+N (e) ^2)

n=Population/1+population (0.05) ^2

Where n=sample size,

N =Population (Monthly attendance at dental clinic= 680 as per hospital records

e=Error tolerance level= 0.05

n=680/ (1+ (680 *0.05*0.05) =680/1.32=251

Therefore, a sample size of 251 participants.

3.7.2 Sampling Technique

This study used a systematic sampling technique carried on at the Malindi Sub-County Dental Clinic. The sampling frame consisted of all clients attending the dental clinic during the data collection period.The unit of sampling and analysis was an individual client. During data collection, the first participants was selected randomly from the list of clients present at the clinic using simple random selection where drawing lots was done. Then a systematic random sampling method was used to pick the participants using the following formula

k=N/n, where *k* is the sampling interval, N is the number of households in the sampled community units sampled.

k= 680/251= 2.7

This means that every 3rd patient was picked as participant until the sample size was reached

3.8 Data Management

3.8.1 Data Collecting Tools

A semi-structured questionnaire with open and close-ended questions was used to collect quantitative data. The questionnaire was in English and also translated to Kiswahili as it is widely understood and spoken in this study area and the responses were then back-translated to English. The Questionnaire comprised of four sections **(Appendix 2)** that are in line with the objectives, i) Socio-demographic characteristics, ii) Dental health risky behavioral factors and iii) Clinical related factors.

3.8.2 Pre-Testing of the Tools

The data collection tools were pretested at Kilifi Sub County Hospital using 10 percent of participants at least 2 weeks before actual data collection. A sample of 25 participants was recruited using the same eligibility criteria. After pretesting, all problematic questions were identified and modified accordingly.

3.8.3 Validity

Validity of the questionnaire was checked through checking on the clarity of words to ensure respondents understood all questions in similar manner. The questions which were not clear were corrected in the final questionnaire. Content validity was verified by the expert and supervisor inputs.

3.8.4 Reliability

Research assistants with English, Kiswahili, and local language who are trained collected data. The questionnaire was also standardized to minimize external variations. The study used Cronbach's Alpha to determine the reliability of the instruments. A Cronbach's Alpha value of 0.7 or higher was considered acceptable, indicating that the items in the scale are sufficiently correlated and measure the same construct.

3.8.5 Data Collection Procedure

Four trained research assistants qualified community oral health officers, assisted in data collection and dental examination respectively. The research assistants were trained by the researcher on use of the tools and generally on the purpose of the study. Eligible participants were recruited at the Malindi sub county dental clinic and interviewed separately to give independent answers to questions. The survey involved a semi-structured questionnaire to collect data, followed by an oral examination to identify the presence, severity or absence of dental caries cases. After completion of the questionnaire, the dental examination was performed afterward. A dental examination was carried out for participants to consent. The dental examination procedure was conducted at the dental chair. Disposable wooden spatulas, disposable mirrors and disposable probe was used to check the presence of decay or infection. The presence or absence of dental caries was recorded and severity of dental decay recorded using decayed teeth, missing teeth filled teeth, and decayed missing and filled teeth (DMFT) (DMFT). There after individual interview and FGD followed.

During IDI and FGD, two facilitators lead the discussion and note taking. A total of 4 in-depth interviews and 4 FGDs were conducted at the hospital. In quantitative arm, a questionnaire was administered to obtain socio-demographic related factors, dental risk behavior factors associated with dental caries and determines the clinical characteristics associated with the dental caries among patients seeking dental services in Malindi Sub County. In qualitative arm, 8 in-depth interviews were conducted among clients attending Malindi sub county hospital to gain their opinion towards dental carries.

The objective of the study was explained; Informed consent was taken from all participants in advance as well as expectations from all participants explained. Participants who met eligibility criteria were approached by the researcher and interviewed or enrolled in the discussion. The discussion with community was in Kiswahili, or local language then transcribed in English. Interviews were audio-recorded, transcribed and translated from Swahili and local language into English. The questionnaires were filled manually using

pen and paper and stored in a secured place. The researcher ensured that data collection is done as scheduled and are complete.

3.8.6 Data Analysis

Quantitative approach: The data was collected using standard questionnaire and cleaned before analysis. All data errors flagged were corrected by checking correct values in participant records. Data were assumed not to be missing at random, an extra category `missing/unknown' was added to each variable with missing values to ensure all participants were included in the regression models. All categorical variables were reported as counts with their respective percentages. The study exposures were socio-demographic factors, reported underlying medical conditions and dental risk behavior factors. The outcome/dependent variable was presence of dental caries.

Regression analysis to determine socio-demographic factors, reported underlying medical conditions and dental risk behavior factors associated with presence of dental caries was conducted using generalized linear models (GLM) assuming a binomial probability distribution for dependent variable (because the dependent variable was binary) and a logit link function. The generalized linear models were preferred because the commonly used logistic regression model overestimates the risk ratios (RR) for common events. The regression coefficients from the regression models were log-transformed and reported as Risk Ratios (RR) and their respective 95% confidence intervals (CI). Univariable analysis was conducted for each independent variables and crude Risk Ratios (CRR) reported. The multivariable regression model included independent variables with a p-value <0.1 in the univariable model.

Statistical significance was evaluated using 95 % confidence interval and a two-tailed p-value <0.05. Statistical analyses were conducted using STATA Version 17.0 (College Station, TX, USA) and R statistical software (version 4.0.2 (2020-06-22)).

Qualitative approach, in-depth interviews were audio recorded with participants' permission and then transcribed verbatim to ensure precision in capturing participants' responses by research assistants. Transcripts / transcript sections in Swahili were translated to English. All collected data, in both written and digital audio format was later transferred to Nvivo qualitative data management software version 12 (QSR International, Melbourne, Australia) for management and coding. This included field notes and session notes which were linked to transcripts of each session. The qualitative data was analyzed using thematic analysis.

3.9 Ethical Consideration

Approval to carry out research was sought from the Pwani University research and ethics committee; the approval number was ISERC/MSc/041/2022. The study was approved by NACOSTI, License No: NACOSTI/P/23/22847.The permission to carry out the study was sort from Kilifi County's research and ethics committee and site approval from the sub-county medical officer of health. Participants were also informed before the commencement of the interview on their confidentiality. The participants were informed they can refuse to participate or withdraw from the study at any time and this will not affect the services they are receiving (Appendix 1). Written informed consent was obtained before data collection. Data was stored securely using codes and no personal identifiers linked to the participants was collected. Clients found with dental or other oral conditions were advised and referred accordingly.

CHAPTER FOUR

RESULTS

4.1 Sociodemographic Characteristics among Respondents Attending Malindi Sub-County Dental Clinic

The study recruited 223 participants, 117 (52.5%) female and 106 (47.5%) males. Majority of participants were aged 30 to 49, 76 (34.1%) and the least were aged ≥50 years that is 35 (15.7%). Majority of participants had primary lever of education113 (50.7) while 89 (39.9%) respondents who were single while 128 (57.4%) were married. Approximately two-thirds (n=146, 65.5%) were Christians and 73 (n=32.7%) were Muslim. Overall, 102 (45.7%) lived ≥10 KM from the nearest dental health facility. Only one-quarter (n=55, 24.7%) were employed, 72 (32.3%) were self-employed and 33 (14.8%) were not working. Slightly higher than one-fifth (n=48, 21.5%) were earning ≥20000 KES per month. A total of 192 (86.1%) paid for the dental services using cash, only 31 (13.9%) paid via insurance. Approximately two-thirds (n=145, 65.0%) paid between KES 500 to 1000 for the dental services (Table 4.1).

Table 4.1: Social-Demographics Characteristics among Respondents Attending Malindi Sub-County Dental Clinic

Variables	N (%)
Sex	
Female	117 (52.5)
Male	106 (47.5)
Age in years	
18	49 (21.9)
19 to 29	63 (28.3)
30 to 49	76 (34.1)
≥50	35 (15.7)
Highest level of education	
None	20 (8.9)
Primary	113 (50.7)
Secondary	65 (29.2)
Tertiary	25 (11.2)
Marital status	
Single	89 (39.9)
Married	128 (57.4)
Divorced/widowed	6 (2.7)
Religion	
Christian	146 (65.5)
Muslim	73 (32.7)
Traditional	4 (1.8)
Distance to dental facility (Km)	
<5	65 (29.2)
5 to 9	56 (25.1)
≥10	102 (45.7)
Occupation	
Student	63 (28.3)
Not working	33 (14.8)
Self-employed	72 (32.3)
Employed	55 (24.7)
Monthly income (Kes)	
None	112 (50.2)
<10000	33 (14.8)
10000 to 19000	30 (13.5)
≥20000	48 (21.5)
Payment for dental services	
Cash	192 (86.1)
Insurance	31 (13.9)
Cost of dental services (Kes)	
None	4 (1.8)
1 to 500	44 (19.7)
500 to 1000	145 (65.0)
>1000	30 (13.5)

4.2. Medical Condition among Respondents Attending Malindi Sub-County Dental Clinic

Majority of participants had hypertension (n=18, 45.0%) and followed by diabetes (n=11, 27.5%) as shown in the Table 4.2.

Table 4.2: Medical Condition among Respondents Attending Malindi Sub-County Dental Clinic

Variables	N (%)
Medical conditions	
None	183 (82.1)
Yes	40 (17.9)
Underlying conditions present (N=40)	
Hypertension	18 (45.0)
Diabetes	11 (27.5)
Cancer	2 (5.0)
Orthogenic cyst	2 (5.0)
Arthritis	1 (2.5)
Unknown	6 (15.0)
On medication	
No	196 (87.9)
Yes	27 (12.1)

4.3 Behavioral Factors among Respondents Attending Malindi Sub-county Dental Clinic

This study found out more than two-thirds (n=160, 71.8%) reported to brush teeth once in a day, 46 (20.6%) twice and 17 (7.6%) thrice. Reported use of toothpicks were rare, only 8 (3.6%) and 19 (8.5%) reported use of toothpicks once and twice or more a day respectively. Overall, 182 (81.6%) reported never to have used floss while 35 (15.7%) and 6 (2.7%) reported to use floss rarely and once respectively (Table 4.3).

Table 4.3: Behavioral Factors among Respondents Attending Malindi Sub-County Dental Clinic

Behavioural factors	n (%)
Dental services	
Never	114 (51.1)
2 to 6 months	25 (11.2)
7 to 12 months	6 (2.7)
>12 months	78 (34.9)
Visit to dental clinic	
Never	60 (26.9)
Rarely	66 (29.6)
When necessary	97 (43.5)
Met dental needs	
No	13 (5.8)
Yes	210 (94.2)
Never sought dental services	
Had no dental problem	83 (72.8)
Got relieved by using painkillers	27 (23.7)
Referred to other health facility	3 (2.6)
Cost	1 (0.9)
Dental problem interventions	
Buy painkillers	131 (58.7)
Visit a dentist	53 (23.8)
Use herbals	13 (5.8)
Use salt water	7 (3.1)
Unknown	19 (8.5)
Family member oral problem and needed oral health services	
No	147 (65.9)
Yes	76 (34.1)
If YES above reasons	
Cost of care	35 (46.1)
Used painkillers	15 (19.7)
Use herbals	14 (18.4)
Fear of extraction	8 (10.5)
Far distance	4 (5.3)
Tobacco use	
No	193 (86.6)

Behavioural factors	n (%)
Yes	30 (13.4)
Frequency of sugary food	
Occasionally (1sugar exposure/day)	138 (61.9)
Moderately (2-3 sugar exposures/day	72 (32.3)
More than 4 sugar exposures/day	8 (3.6)
Not using sugary food	5 (2.2)
Frequency of teeth brush	
Once	160 (71.8)
Twice	46 (20.6)
Thrice	17 (7.6)
Teeth brush	
Toothpaste	221 (99.1)
Stick	2 (0.9)
Use of toothpicks	
Never	49 (21.9)
Rarely	147 (65.9)
Once	8 (3.6)
Twice or more a day	19 (8.5)
Dental Floss	
Never	182 (81.6)
Rarely	35 (15.7)
Once	6 (2.7)

4.4 Proportion of Dental Caries among Respondents Attending Malindi Sub-County Dental Clinic

Overall, 162/223 had dental caries after oral assessment, a prevalence of 72.6% as shown in Figure 4.4 below.

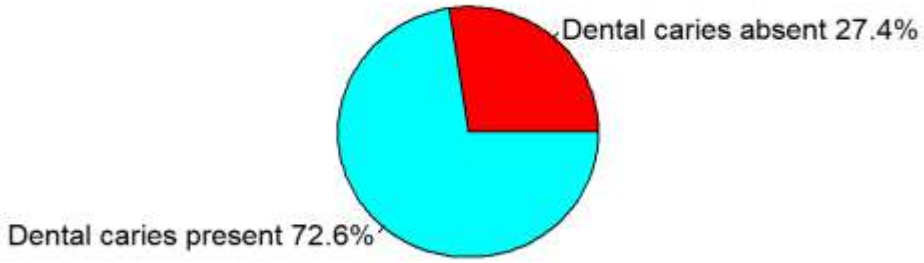

Figure 4.1: Proportion with Dental Caries after Oral Assessment among Respondents Attending Malindi Sub-County Dental Clinic

4.5. Proportion with decayed teeth among patients with dental caries.

Among the 162 with dental caries, 107/162 (66.0%) had one decayed tooth while 35/162 (21.6%) had two decayed teeth (Figure 4.5).

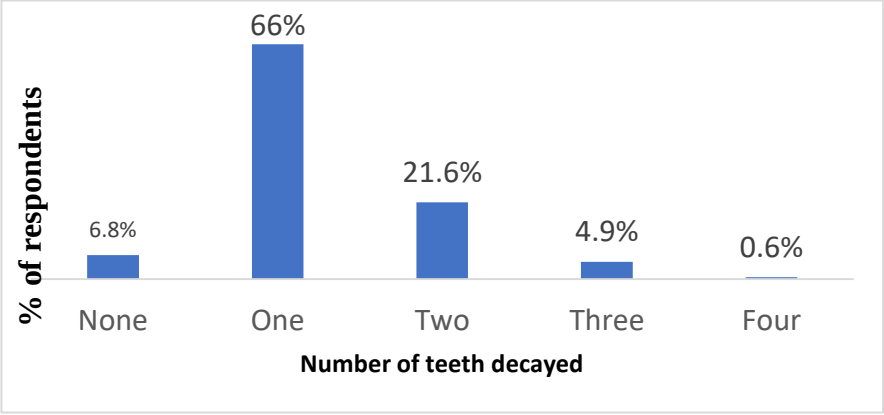

Figure 4.2: Proportion with Decayed Teeth among Patients with Dental Caries

4.6. Oral Health Assessment among Respondents Attending Malindi Sub-County Dental Clinic

Overall, 162/223 had dental caries after oral assessment, a prevalence of 72.6% as shown in Figure 4.6 below. Among the 162 with dental caries, 107/162 (66.0%) had one decayed tooth while 35/162 (21.6%) had two decayed teeth.

Table 4.4: Oral Health Assessment among Respondents Attending Malindi Sub-County Dental Clinic

Variables	N (%)
After examination is what the state of dental?	
Dental caries absent	61 (27.4)
Dental caries present	162 (72.6)
If dental carries present, how many teeth were:	
Decayed (N=162)	
None	11 (6.8)
One	107 (66.0)
Two	35 (21.6)
Three	8 (4.9)
Four	1 (0.6)
Missing (N=162)	
None	113 (69.8)
One	37 (22.8)
Two	12 (7.4)
Filled (N=162)	
None	158 (97.5)
One	2 (1.2)
Two	2 (1.2)

4.5. Proportion of Type of Dental Caries among Patients with Dental Caries

Among 162 patients who had dental caries, majority of patient had mild type of dental caries 41.4% while 27.8% had moderate dental caries as shown in Figure 4.3.

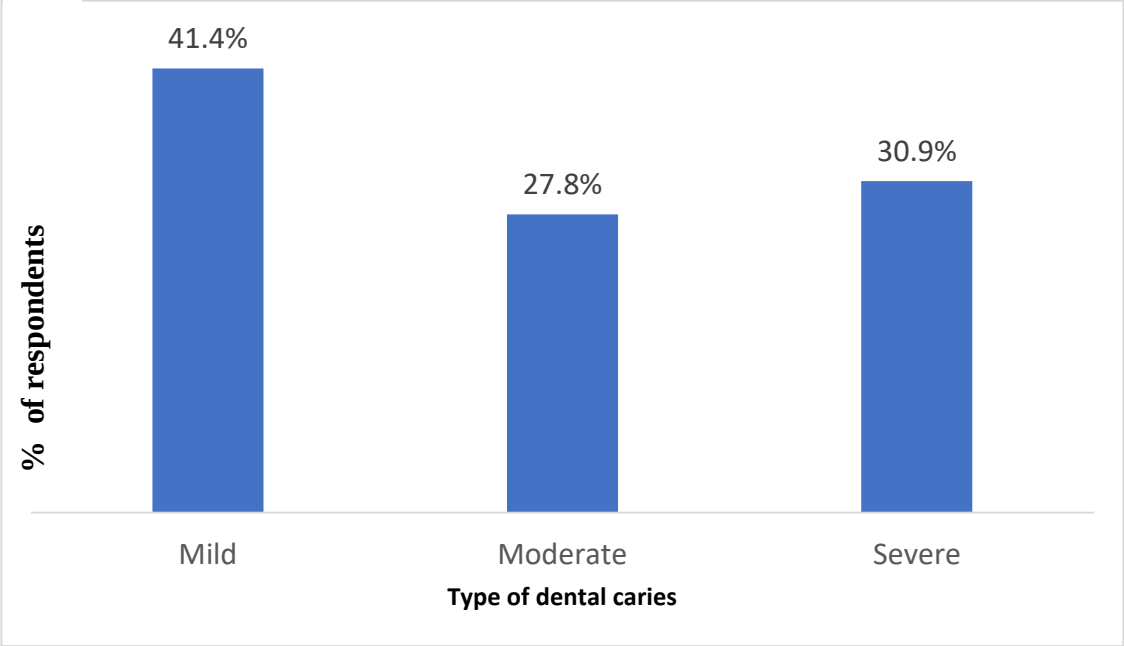

Figure 4.3: Proportion of Type of Dental Caries among Patients with Dental Caries

4.6 Socio-Demographic Factors Associated with Dental Caries among Patients Attending Malindi Sub-County Dental Clinic

Individuals with no income (OR = 0.16, P = 0.001), income below 10,000 (OR = 0.20, P = 0.009), and income between 10,000 and 19,000 (OR = 0.22, P = 0.016) have significantly lower odds of more dental caries compared to those with income above 40,000. People who pay cash for dental services have significantly lower odds (OR = 0.31, P = 0.001) of having severe caries compared to those who use insurance. Females show a higher percentage in mild caries, while males have more moderate and severe caries. The odds ratio (OR) of 1.18 for females compared to males is not statistically significant (P = 0.489). The ORs for Christianity and Islam compared to Traditional religion are not significant. P-values are high (0.935 and 0.747). Individuals with no education or primary education tend to have higher caries severity compared to those with college education However, the effect of education level on caries severity is not statistically significant (P-values > 0.1). Married individuals have slightly higher odds of more severe dental caries compared to single or divorced/widowed people, but this difference is not statistically

significant (P = 0.444 and 0.722). Unemployed people have lower odds (OR = 0.48) of severe caries compared to formally employed individuals, though this result is not statistically significant (P = 0.062). Other occupations show non-significant differences. Income shows a strong relationship with caries severity.

Table 4.5: Socio-Demographic Characteristics Associated with Dental Caries among Patients Attending Malindi Sub-County Dental Clinic

		Severity				95%CI			
	N	**None**	**Mild**	**Moderate**	**Severe**	**OR**	**Lower**	**Upper**	**P-Value**
Sex									
Female	117	24.8%	28.2%	23.1%	23.9%	1.18	0.74	1.89	0.489
Male	106	26.4%	32.1%	20.8%	20.8%	Ref			
Religion									
Christian	146	23.3%	30.1%	24.7%	21.9%	0.93	0.16	5.50	0.935
Muslim	73	30.1%	30.1%	16.4%	23.3%	0.74	0.12	4.51	0.747
Traditional	4	25.0%	25.0%	25.0%	25.0%	Ref			
Education Level									
None	20	15.0%	30.0%	30.0%	25.0%	1.03	0.36	2.96	0.953
Primary	113	33.6%	24.8%	20.4%	21.2%	0.57	0.26	1.23	0.152
Secondary	65	23.1%	30.8%	23.1%	23.1%	0.77	0.34	1.75	0.529
College	25	4.0%	52.0%	20.0%	24.0%	Ref			
Marital Status									
Single	89	39.3%	27.0%	13.5%	20.2%	0.76	0.17	3.38	0.722
Married	126	16.7%	30.2%	28.6%	24.6%	1.78	0.41	7.78	0.444
Divorced/Widowed	6	0	83.3%	16.7%	0	Ref			
Occupation									
Unemployed	99	37.4%	30.3%	16.2%	16.2%	0.48	0.22	1.04	0.062
Self employed	69	10.1%	26.1%	29.0%	34.8%	1.82	0.82	4.06	0.143
Informally employed	28	35.7%	25.0%	21.4%	17.9%	0.58	0.22	1.50	0.260
Formally employed	27	11.1%	44.4%	25.9%	18.5%	Ref			
Income									
No income	112	33.9%	28.6%	17.9%	19.6%	0.16	0.05	0.48	**0.001**
Below kshs.10000	33	24.2%	36.4%	21.2%	18.2%	0.20	0.06	0.66	**0.009**
10000 -19000	30	23.3%	33.3%	23.3%	20.0%	0.22	0.06	0.75	**0.016**
20000 -39000	35	11.4%	34.3%	25.7%	28.6%	0.36	0.11	1.20	0.097
40000 and above	13		7.7%	46.2%	46.2%	Ref			
Dental payment method									
Cash	191	27.2%	33.0%	20.9%	18.8%	0.31	0.15	0.15	**0.001**
Insurance	32	15.6%	12.5%	28.1%	43.8%	Ref			

4.6 Dental Risk Behavior Factors Associated with Dental Caries among Patients Attending Malindi Sub-County Dental Clinic

This study found out that those who had never visited the dental clinic (40.0% none, 30.0% mild, 15.0% moderate, 15.0% severe) have a higher likelihood of dental caries compared to those who visit when necessary (OR = 2.05, 95% CI: 1.15–3.65, p = 0.014). Those who had a dental visit 2 to 6 months ago (18.0% none, 24.0% mild, 30.0% moderate, 28.0% severe) showed non-significant likelihood of dental caries (OR = 1.75, 95% CI: 0.98–3.10, p = 0.051). Regular, necessary dental visits (20.0% none, 25.0% mild, 35.0% moderate, 20.0% severe) appear to be protective against the development of severe caries. Individuals whose dental needs were not met (10.0% none, 40.0% mild, 30.0% moderate, 20.0% severe) had a (OR = 2.15, 95% CI: 0.95–4.89, p = 0.058) were not statistically significance.

A dose-response relationship is observed with increasing sugary food intake. Those who had more than 4 sugar exposures per day (25.0% none, 25.0% mild, 25.0% moderate, 25.0% severe) had elevated odds of severe caries (OR = 1.90, 95% CI: 0.75–4.85, p = 0.189), while those with moderate sugar exposure (15.0% none, 30.0% mild, 35.0% moderate, 20.0% severe) also had higher risks. Frequent brushing was associated with lower caries severity. Those who brushed twice daily (20.0% none, 35.0% mild, 30.0% moderate, 15.0% severe) had lower odds of severe caries (OR = 1.75, 95% CI: 0.95–3.22, p = 0.065) compared to those who brushed once (25.0% none, 30.0% mild, 25.0% moderate, 20.0% severe). Individuals brushing thrice daily (30.0% none, 20.0% mild, 25.0% moderate, 25.0% severe) did not show a significant significance.

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Table 4.6: Dental Risk Behavior Factors Associated with Dental Caries among Patients Attending Malindi Sub-County Dental Clinic

		Dental caries					95%CI		
	N	None	Mild	Moderate	Severe	OR	Lower	Upper	P-Value
Dental services received									
Never	114	22.8%	25.4%	26.3%	25.4%	1.45	0.87	2.42	0.125
2 to 6 months	25	18.0%	24.0%	30.0%	28.0%	1.75	0.98	3.1	0.051
7 to 12 months	6	15.0%	35.0%	20.0%	30.0%	1.22	0.54	2.78	0.637
>12 months	78	30.7%	22.6%	26.4%	20.3%	Ref			
Frequency of dental visit									
Never	60	40.0%	30.0%	15.0%	15.0%	2.05	1.15	3.65	0.014
Rarely	66	25.0%	27.0%	30.0%	18.0%	1.55	0.85	2.83	0.152
When necessary	97	20.0%	25.0%	35.0%	20.0%	Ref			
Dental care needs met									
No	13	10.0%	40.0%	30.0%	20.0%	2.15	0.95	4.89	0.058
Yes	210	25.0%	28.0%	26.0%	21.0%	Ref			
Dental problem interventions									
Buy painkillers	131	15.0%	35.0%	30.0%	20.0%	1.85	0.95	3.6	0.068
Visit a dentist	53	30.0%	25.0%	25.0%	20.0%	Ref			
Use herbals	13	20.0%	30.0%	40.0%	10.0%	1.65	0.45	2.78	0.41
Use salt water	7	30.0%	30.0%	10.0%	30.0%	1.9	0.75	4.88	0.18
Unknown	19	25.0%	35.0%	25.0%	15.0%	1.22	0.6	2.5	0.582
Family member oral health services unmet									
No	147	30.0%	28.0%	22.0%	20.0%	Ref			
Yes	76	20.0%	30.0%	25.0%	25.0%	1.5	0.78	2.88	0.221
Reasons									
Cost of care	35	25.0%	30.0%	25.0%	20.0%	1.55	0.75	3.2	0.23
Used painkillers	15	15.0%	30.0%	35.0%	20.0%	2	0.9	4.45	0.089
Use herbals	14	20.0%	35.0%	20.0%	25.0%	1.35	0.6	3	0.49
Fear of extraction	8	30.0%	25.0%	20.0%	25.0%	1.8	0.7	4.6	0.203
Far distance	4	35.0%	30.0%	20.0%	15.0%	2.05	0.75	5.55	0.153
Tobacco use									
No	193	22.0%	30.0%	28.0%	20.0%	Ref			
Yes	30	35.0%	25.0%	25.0%	15.0%	1.65	0.88	3.08	0.119
Sugary food consumption per day									
Occasionally (1 sugar exposure/day)	138	20.0%	30.0%	30.0%	20.0%	Ref			
Moderately (2-3 sugar exposures/day)	72	15.0%	30.0%	35.0%	20.0%	1.5	0.85	2.65	0.158
More than 4 sugar exposures/day	8	25.0%	25.0%	25.0%	25.0%	1.9	0.75	4.85	0.189
Not using sugary food	5	30.0%	30.0%	20.0%	20.0%	2.1	0.85	5.2	0.093

		Dental caries				95%CI			
	N	None	Mild	Moderate	Severe	OR	Lower	Upper	P-Value
Brushing teeth per day									
Once	160	25.0%	30.0%	25.0%	20.0%	Ref			
Twice	46	20.0%	35.0%	30.0%	15.0%	1.75	0.95	3.22	0.065
Thrice	17	30.0%	20.0%	25.0%	25.0%	1.4	0.6	3.25	0.43
Tooth brushing method									
Toothpaste	221	22.0%	28.0%	30.0%	20.0%	Ref			
Stick	2	35.0%	25.0%	20.0%	20.0%	1.85	0.45	7.55	0.39
Use of toothpicks per day									
Never	49	35.0%	25.0%	25.0%	15.0%	1.95	0.85	4.5	0.112
Rarely	147	22.0%	30.0%	25.0%	23.0%	Ref			
Once	8	30.0%	25.0%	25.0%	20.0%	1.35	0.55	3.2	0.58
Twice or more a day	19	20.0%	35.0%	30.0%	15.0%	1.8	0.85	3.88	0.174
Flossing per day									
Never	182	20.0%	30.0%	30.0%	20.0%	Ref			
Rarely	35	25.0%	25.0%	35.0%	15.0%	1.5	0.8	2.8	0.195
Once	6	30.0%	20.0%	20.0%	30.0%	1.85	0.6	5.7	0.294

4.7 Clinical Characteristics Associated with Dental Caries among Respondents Attending Malindi Sub-County Dental Clinic

Among the participants, 61 individuals were identified as having no dental caries, while 162 individuals were found to have dental caries. The odds of having a dental caries are significantly higher for those with dental caries present, as indicated by an odds ratio (OR) of 6 (95% CI: 2.50 - 15.00, $p < 0.001$). This suggests that individuals with dental caries are six times more likely to exhibit dental caries compared to those without.

For those with dental caries, the number of decayed teeth varies significantly: Individuals with one decayed tooth have an OR of 3.5 (95% CI: 1.00 - 12.00, $p = 0.045$), indicating they are more likely to have mild to severe caries compared to those with no decayed teeth. Similarly, those with two decayed teeth show a significant association (OR = 5.08, $p = 0.020$), suggesting that as the number of decayed teeth increases, so does the likelihood of severe dental caries. The odds of having severe caries further increase for those with three decayed teeth (OR = 6, $p = 0.015$), reflecting a clear trend where more decayed teeth

correlate with greater severity of caries. Other variable are not associated with dental caries.

Table 4.7: Clinical Characteristics Associated with Dental Caries among Patients Attending Malindi Sub-County Dental Clinic

Variables	N	Severity of dental caries				OR	95%CI		P-Value
		None	Mild	Moderate	Severe		Lower	Upper	
After examination state of dental state									
Dental caries absent	61	60.0%	25.0%	10.0%	5.0%	Ref			
Dental caries present	162	10.0%	25.0%	30.0%	35.0%	6.00	2.50	15.11	**0.001**
Teeth state									
Decayed									
None	11	0.0%	0.0%	0.0%	100.0%	Ref			
One	107	5.0%	25.0%	40.0%	30.0%	3.51	1.17	12.37	**0.045**
Two	35	0.0%	20.0%	30.0%	50.0%	5.08	1.50	16.00	**0.020**
Three	8	0.0%	12.5%	25.0%	62.5%	6.45	1.25	30.47	**0.015**
Four	1	0.0%	0.0%	0.0%	100.0%	10.00	1.00	100.28	0.500
Missing (N=162)									
None	113	30.0%	40.0%	20.0%	10.0%	Ref			
One	37	5.0%	35.0%	40.0%	20.0%	2.36	0.53	10.48	0.150
Two	12	0.0%	20.0%	40.0%	40.0%	2.80	0.40	19.94	0.370
Filled (N=162)									
None	158	30.0%	40.0%	20.0%	10.0%	Ref			
One	2	0.0%	50.0%	50.0%	0.0%	0.80	0.10	6.58	0.850
Two	2	0.0%	25.0%	50.0%	25.0%	1.55	0.22	10.15	0.610

4.8 Qualitative Results among Respondents Attending Malindi Sub-County

4.8.1 Socio-Demographic Characteristics Associated with Dental Caries among Respondents Attending Malindi Sub-County

The qualitative analysis of the current study also tried to examine the correlation between the different socio-demographic characteristics of the patients attending the dental clinic and the development of dental carries. Socio-demographic characteristics explored by the participants included age, and residence. All the interviewed participants were between

the ages of 20 to 40 years with a majority being married. All the interviewed participants were either self-employed involving themselves in small businesses such as retail shops or selling fried fish. In terms of residence, all the interviewed participants lived far away from Malindi town and they would require an average of Ksh. 300 on transport to access dental care services.

Table 4.8: Summary of Results Themes and Sub-Themes among Respondents Attending Malindi Sub-County

Themes	Subthemes
Individual factors in dental Caries	- Oral hygiene practices - Dietary habits - Genetic predisposition/other family members having caries - Socioeconomic status - Access to dental care - Oral health knowledge
Dental risk behavior Factors in dental caries	- Frequency of sugary food and beverage consumption -Irregular brushing and flossing habits eg use of toothpicks - Lack of dental check-ups or preventive care - Habits such as smoking or substance use
Medical Conditions and dental caries	- Diabetes - Eating disorders - Hypertension
Other Factors for Dental Caries	- Community water fluoridation/ source of water -Environmental factors (e.g., fluoride levels in drinking water) - Cultural practices related to oral hygiene and diet - Marketing and advertising of sugary products - Stress and its impact on oral health habits - Education level and health literacy

4.8.2 Individual Factors Associated with the Development of Dental Caries among Respondents Attending Malindi Sub-County

The study further tried to explore individual factors associated with the development of dental carries. These factors explored included oral hygiene practices, dietary habits, genetic predisposition, socioeconomic status, access to dental care, oral health knowledge,

and habits like smoking or substance use. It was observed in this qualitative analysis that these factors play a significant role in determining the likelihood of developing dental caries or not. For instance, all participants interviewed with poor oral hygiene practices, a diet rich in sugary foods and beverages, and a family history of caries were more likely to develop dental caries. Similarly, those with lower socioeconomic status and limited access to dental care were also at a higher risk of developing caries.

4.8.3 Socio Economic Status among Respondents Attending Malindi Sub-County

The socio-economic status of the participants played a crucial role in their ability to access dental care. Many participants reported difficulties in accessing dental care due to financial constraints, with some stating that they had to prioritize their own needs over dental care. For instance, IDI Participant 2 mentioned,

> *"Money, ...you know, hospitals require money, so when I'm at home, if I use that ten shillings on medication, I might get relief, but if I go to the hospital, I'll be asked to pay just to see the doctor, I don't know what else might be done, maybe they'll say I need extraction... so when I saw that, I said let me give myself some time, maybe it will stop."*

4.8.4 Access to Dental Care among Respondents Attending Malindi Sub-County

Access to dental care among the interviewed participants was another critical factor influencing caries development. Participants reported difficulties in accessing dental care due to long waiting times, lack of availability of dentists, and financial constraints. For example, IDI Participant 3 mentioned that,

> "*The timing here at the hospital; there's a very long queue. You can come here and stay until eleven o'clock, you know. You have to look after the children, you have to find food, and then you come and stand in the queue here. Everyone struggles at this hospital, so the timing is a factor. When you can't find the time? You might*

say, 'Let me come tomorrow,' and when tomorrow comes, you say you'll go the next day. So, it's about timing."

Certainly, several individuals noted that financial constraints served as a significant barrier to accessing dental care, while others identified the distance to healthcare facilities as the primary issue in accessing dental care.

IDI participant 3 noted that,

"Mmnh, I can see it's more common in our rural areas because when we get sick, we tend to endure it for a long time due to financial constraints. But those in urban areas, they have money, you see, so when they're in town and they feel a little pain, they come immediately without waiting for the tooth to rot."

4.8.5 Oral Hygiene Practices to Dental Care among Respondents Attending Malindi Sub-County

The participants' oral hygiene practices varied, with some using toothpaste and others using sticks to brush their teeth. One participant mentioned using salt to brush their teeth, stating,

"Brushing with salt can kill those bacteria that cause such problems, so that's also one of the ways where regularly brushing your teeth can help protect yourself from that."

However, another participant noted that they used to use hard toothbrushes, which they believed could harm their gums. This highlights the importance of proper oral hygiene techniques and the use of appropriate oral care products.

4.8.6 Dietary Habits on Dental Care among Respondents Attending Malindi Sub-County

The participants' dietary habits were characterized by a significant consumption of sugary foods and beverages. They often consume sugary foods in the morning for breakfast, such as with tea, and sometimes in the evening. Additionally, they drink sugary beverages like tea and juice. The participants also mention using sugar in their tea and sometimes with bread or buns. This frequent consumption of sugar is believed to contribute to dental issues, as seen in the case of one participant's child who was advised against eating sugary foods and now has fewer dental problems. For instance, IDI participant 3 mentioned that

> *"Eating sugary foods because I consume a lot of sugar [mmh], yes, I consume a lot of sugar, and also, I've noticed it's sugar because my child also started having dental issues, but he was advised against sugar, and until now, whenever he sees a cake, he says, 'Mom, the doctor said I shouldn't eat it,' but his teeth don't hurt.*
>
> *So, I strongly believe it's sugar [mmh], eating sugary foods, cakes, and such because my child was advised against it, and now he doesn't want it at all, even if you beg him, and his teeth don't hurt much. So, I think it's sugar*.".

4.8.7 Genetic Predisposition/Other Family Members Having Caries among Respondents Attending Malindi Sub-County

Among the participants interviewed there was a perceived link between family history and dental caries. For instance, one participant mentions that their mother also has dental problems, specifically with the front teeth, which implies that there may be a genetic component to their dental issues. While this participant's experience is not explicitly linked to caries development, it does indicate that family history can influence oral health.

Another participant mentioned that in their Giriama culture, dental problems are believed to be hereditary, implying that there is a cultural understanding of a genetic link between family members having dental issues.

"*In short, in our Giriama culture, it could be hereditary, like if someone in the family has a tooth problem, they say it's because of so and so, but for me, I just felt pain in my head and then felt that the tooth had erupted"* IDI participant 4.

In terms of gender differences in caries development, one participant believes that women tend to have more tooth decay, although there is no clear explanation provided for this belief.

"I think it's women." IDI participant 3

4.8.8 Dental Risk Behaviour Factors Associated with Dental Caries among Respondents Attending Malindi Sub-County

The study also focused on the dental risk behavior factors associated with dental caries. These included irregular brushing and flossing habits, lack of dental check-ups or preventive care, tobacco use, alcohol consumption, and other oral habits such as nail biting. This qualitative analysis only found a preference for cold drinks as one of the dental risk factors as mentioned by IDI participant 1.

"Yeah, I think it's because I like cold things, you know, like cold drinks. I think that's why it's hurting now. I might end up having three teeth extracted soon"

None of the interviewed participants was consuming alcohol or smoking cigarettes

I don't use alcohol or cigarettes, I don't use anything, No, I've never used since I was born..-IDI Participant 6

4.8.9 Clinical Characteristics Associated with Dental Caries among Respondents Attending Malindi Sub-County

The study sought to examine the clinical characteristics associated with dental caries. These included medical conditions such as diabetes, eating disorders, hypertension, immunodeficiency disorders, and medications that could cause dry mouth or affect oral

health. All the participants interviewed reported not to have any of the underlying medical conditions. For instance, IDI participant 2 mentioned that

> "*Oh, I don't have diabetes or high blood pressure, maybe just ulcers that bother me sometimes.*

However, one participant mentioned having developed a dental abscess as a result of the dental carries.

> *Yes, even let's say that week, there was pus coming out until the medication I was given helped.*

4.9. Other Factors Influencing the Development of Dental Caries

Cultural Practices

Cultural practices also played a significant role in the development of dental caries. Participants reported using traditional methods for oral hygiene, such as brushing with salt, which may not be as effective as modern methods.

For instance, Participant 1 mentioned,

> "*Brushing, I usually brush in the morning [mmnh], afternoon, and evening, But mostly, I used to use hard toothbrushes, which I heard can harm the gums."*

Participants also mentioned using sticks from trees to brush their teeth instead of buying commercial toothbrushes. This practice reflects a traditional approach to oral hygiene where individuals utilize natural resources for dental care.

Also, the qualitative analysis pointed out some cultural or traditional methods of treating caries or gum diseases. For instance, it was mentioned by one participant that in the community there is a specific technique that involves heating a substance, applying it to

the affected area, and allowing the heat to enter the mouth. This method is believed to reduce pain and discomfort by killing bacteria that are thought to cause toothache.

> *"So, back home, there's this method where you heat something, you apply it, you see, so when the heat enters the mouth, it reduces the pain or discomfort in that tooth because some people say that the smoke from those substances kills the bacteria because it's said that where there's pain, there are bacteria that cause it, and the end of the smoke helps kill those bacteria, thus reducing the pain and discomfort". IDI Participant 1.*

Use of traditional remedies to treat caries, one specific tree mentioned by the participants is the use of neem tree.

> *"while others strongly believe in traditional herbal remedies. Even I, at times, have tried these because they believe that there are insects that enter inside, causing tooth decay and a lot of pain. They believe that certain trees, when placed in the cavity kill these insects inside. But for me, it didn't help, though some say it was helpful for them. On my side, I didn't see.*
>
> *Perhaps it's just about trying to prevent [mmnh] they say trying to avoid using toothpaste from the store, there are trees like the neem [eeh] they say if you use it, because it's bitter [mmh], it helps at least.* IDI-Participant-2

Another tree mentioned was the papaya tree

> *"They take, I don't know if it's a papaya tree, a papaya tree has a hole, I don't know if it's its hole [mmh], it has that hole [mmh], they put it on the affected tooth and then they soak it in a basin of water [mmh], and later they light a fire, and you see insects coming out. I don't know if it's true or if those insects are already in that papaya tree, I don't know, I don't know how that [mmh] works, but that's what they.* IDI-Participant-3

Cultural factors play a significant role in shaping attitudes and behaviors towards preventive dental care, such as regular check-ups. For instance, IDI participant 7 mentioned how culture affects early checkups. *"So it's not easy for people, especially us Africans, to embrace the culture of check-ups and such."*

Fear and Anxiety Related to Dental Treatment

Fear and anxiety related to dental treatment were also significant factors influencing career development. Participants reported feeling anxious about dental procedures, which can lead to avoidance of dental care. For example, IDI Participant 4 mentioned,

"Fear is like for me now [mmh], I say okay, I'm an adult, but if I come to the hospital and I'm told I'll have another tooth removed, you see, so when I start getting scared, my teeth will start falling out, and you're afraid to tell the doctor to stop, you don't want it, and you can't refuse the doctor's advice, so it's the fear of the doctor's decisions."

Prevention Strategies

The study explored different prevention strategies for dental caries and some of the mentioned strategies are highlighted in the table below The participants in this study discussed various methods they use to prevent dental problems, including avoiding certain foods and using alternative remedies. These methods are rooted in their cultural practices and beliefs about oral health.

Avoiding Sugary Foods

The participants emphasized the importance of avoiding sugary foods and drinks to prevent dental problems. They mentioned that sugary foods can cause problems and that it's essential to limit the consumption of such items. For example, one participant stated,

"Okay, let's say the methods that help involve avoiding certain things because, for example, sugary foods can cause problems, and extremely cold foods, that's why some

foods like very cold water after eating hot food, can sometimes cause problems. So, people need to avoid those things, and I believe that can help prevent such issues from occurring" IDI Participant 1

Using Salt for Oral Hygiene

Another method mentioned was using salt for oral hygiene. Participants believed that brushing with salt can kill bacteria that cause dental problems. For instance, one participant said,

"Brushing with salt can kill those bacteria that cause such problems, so that's also one of the ways where regularly brushing your teeth can help protect yourself from that, although you find that sometimes in certain areas, like in rural areas, people don't pay much attention to such things [i: okay] yeah." IDI Participant 1.

Using Herbs and Garlic

Some participants mentioned using herbs and garlic to prevent dental problems. They believed that these substances have healing properties and can help alleviate pain. For example, one participant mentioned,

"I would say garlic [mmnh], yes, garlic and ginger [mmhm]. And others, I don't know, I see people using herbs, but I don't know because I believe they involve witchcraft, and I'm a Christian [mmnh], yes, so they say they calm you down, some I don't know which trees they use until you see insects coming out of that tooth [mmh], yes, but I'm afraid; it seems like witchcraft, I've never tried it, everyone has their own beliefs." IDI-participant 3.

Regular Dental Check-Ups

The participants believed that visiting the dentist regularly can help prevent dental problems. For example, one participant stated, *"We were told to visit the dentist [mmh], yes, regularly, I don't know if it's every month or every three months? See the dentist, and*

have them check your teeth [mmh], but when you come, you'll have to wait in line. I don't follow that advice." IDI- participant-3\.

Chewing Sugarcane and Bone Soup

Some participants mentioned chewing sugarcane and consuming bone soup as ways to promote oral health. They believed that these foods could help strengthen teeth. For example, one participant mentioned, *"I remember bone soup, yes, I remember in the old days, but I don't follow these."* IDI- participant-3.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1: Discussion

5.1.1 Socio-Demographic Characteristics Associated with Dental Caries among Patients Attending Malindi Sub-County Dental Clinic

The analysis of socio-demographic characteristics associated with dental caries among respondent offers insights on factors like gender, education, marital status, occupation, income, and payment methods towards oral health care outcomes. Females had a higher proportion of mild caries case while males had a moderate to severe cases. The Odds Ratio (OR) of 1.18 for females was not statistically significant (P = 0.489), indicating no gender association with severity of dental caries. This concurs with previous research findings that caries severity may vary by gender while oral hygiene practices, dietary habits and access to dental car are more influential (Wamiti. et. Al., 2020).Religious affiliation had no significant association with dental caries; neither Christianity nor Islam was associated with caries compared to traditional religions cultural and dietary practices were linked with religion hence religion alone may not affect caries risk. (Butera. et. Al., 2022).

The low level of education lead to severe caries than respondents with college education. Despite the lack of statistical significance (P > 0.1), the findings are consistent with those inking higher education to increased health literacy, dietary choices, frequent dental visits, which reduces carries risk (Petersen P. E., 2005). This study found that marriage is not associated with dental caries, other studies found that marriage provides social support, the advantage is not extended to oral health outcomes that is linked to personal health practice (Mehrtash,2017**).**

The type of employment and income had an association with the severity of dental caries. The unemployed individuals have marginally lower odds (OR = 0.48, P = 0.062) of severe caries than those in formal employment. The economic constraints limit access to sugary

foods and beverages. Hence regular employment time constraints limit regular oral hygiene routines. (Davies et al., 2018).

5.1.2 Dental Risk Behavior Factors Associated with Dental Caries among Patients Attending Malindi Sub-County Dental clinic

The findings of this study highlight the importance of regular dental visits, appropriate responses and proper oral hygiene preventive measures. Patients who never received dental services or delayed their visits demonstrated a slightly higher prevalence of moderate to severe dental caries. The findings are consistent with prior studies where individuals who neglect routine dental checkups develop severe dental conditions (Tafere, 2018). For instance, those who visited the dentist 2 to 6 months prior had OR of 1.75 for moderate to severe caries, indicating an increased risk when compared to individuals who received services within 12 months or more (P=0.051). The trend of higher caries severity among those who do not regularly attend dental visits is consistent with research findings emphasizing the role of preventive dental care to reduce dental caries risks (**Liu, 2018**)

There was an association between dental caries severity and infrequent dental care. Patients who attended the clinic when necessary or rarely had a higher likelihood of severe caries, with those who never visited being at the highest risk (OR = 2.05, P = 0.014). This finding aligns with studies showing that preventive care and routine checkups contribute to reduction of dental caries severity (Dye et al., 2015)**.** Additionally, patients who had unmet dental care needs had higher odds (OR = 2.15, P = 0.058) of developing moderate caries, highlighting the potential impact of healthcare accessibility on oral health outcomes.

For respondents who experienced dental problems, self-treatment behaviors like using painkillers had higher odds of severe caries (OR = 1.85, P = 0.068), while those who attended to a dentist had better outcomes. Similarly, findings reveal self-medication to be associated with delayed dental care worsening underlying dental conditions**.** The use of traditional remedies like herbals or saltwater, though common in rural settings, was also

linked to varying levels of caries, but had no significant associations with dental caries severity. This concurs with findings that suggest alternative treatments provides temporary relief insufficient to address the root causes of caries. (Peres. et. Al., 2019).

Socioeconomic factors such as the cost of care and fear of extraction were significant barriers, with 35% citing cost as a reason for unmet dental needs. This is similar to findings that indicate financial constraints to limit access to essential dental are among the underserved populations (Peres et al., 2019).Tobacco use was associated with worse dental outcomes, consistent with studies linking tobacco use to increased plaque accumulation and reduced salivary flow which contribute to caries (Bergström, 2016)**.** However, the OR of 1.65 (P = 0.119) was not statistically significant, indicating a need for larger samples to draw definitive conclusions.

Dietary habits, particularly sugary food consumption, showed a dose-response relationship, with higher sugar exposure correlating with increased caries severity. This is in line with extensive research documenting the role of dietary sugars as a major risk factor for caries development (Sheiman& James, 2015). Patients consuming more than four sugar exposures per day had elevated OR = 1.90 of severe caries, suggesting that high sugar intake without proper dental care can exacerbate caries risk.

Reduced frequency of tooth brushing contributes to dental caries severity. Respondents who brushed twice daily had lower odds of severe caries, while those who brushed thrice daily had no additional benefits. The findings differ on the importance of brushing frequency to control plaque and reduction of caries risk**.** Additionally, flossing was associated with better outcomes, albeit with no statistically significant advantage. The findings concur with other studies on the interdental cleaning to prevent dental caries between teeth, an area susceptible to plaque buildup. **(**Wamiti 2020**).**

5.1.3 Clinical Characteristics Associated with Dental Caries among Patients Attending Malindi Sub-County Dental Clinic

The findings of the current study reveal significant associations between clinical characteristics and the dental caries severity, showing a clear trend of increased caries severity with a higher number of decayed teeth. For instance, patients with one decayed tooth had OR of 3.5 for mild to severe caries compared to those without decay. This risk escalates further with two and three decayed teeth (OR = 5.08 and OR = 6, respectively), suggesting a dose-response relationship where the presence of more decayed teeth aligns with a higher likelihood of severe caries.

This aligns with studies emphasizing the correlation between decay severity and the number of untreated lesions. For instance, findings from the United States had untreated caries as a precursor to severe dental outcomes, as the absence of treatment allows decay to progress affecting additional teeth (Dye et al., 2015).Other study findings in low-income populations in Sub-Saharan Africa, had similar higher counts of decayed teeth that correlate with caries severe, due to limited access to restorative dental services (Peres et al., 2018).The results of the current study concur with other findings, underscoring the need for preventive measures and timely interventions to curb the progression of decay. The current study findings on missing teeth shows that while patients with one or two missing teeth have higher OR (2.36 and 2.80, respectively) for severe caries, the results were not statistically significant. This finding partially reflects patterns noted in studies on the influence of tooth loss on caries severity. Findings from a study in Brazil highlighted that missing tooth due to untreated dental caries is an indicator of severe caries in low-resource settings. The relationship between initial tooth loss and subsequent caries severity can vary depending on oral hygiene practices and healthcare accessibility**.** (Tonetti et al., 2017).

Regarding filled teeth, the study found no significant association between the presence of fillings and caries severity (OR = 0.80 for one filled tooth and OR = 1.55 for two). This lack of association may suggest that filling alone does not reduce the risk of subsequent

caries severity, especially if oral hygiene habits remain unchanged. The findings concurs with those of a similar study that filling carious lesions does not necessarily reduce future caries risk without concurrent behavioral and hygiene improvements. The results of the current study, underscore the importance of comprehensive dental care beyond restorative treatment.

In the current study, 51.1% of participants had never sought dental care, with cost identified as a major barrier. The findings are consistent with that of Nigeria Similarly, In an Indian population 68% of participants delayed dental visits due to financial constraints. (Gambhir, 2013).

The frequent use of painkillers (23.7%) instead of seeking professional dental care mirrors the situation in Kenya, where a study revealed reliance of over-the-counter medications due to the high cost and inaccessibility of dental care (Masiga, 2014). The findings underscore the significant financial and accessibility barriers that dental care populations face in low- and middle-income countries (LMICs).

In the current study, 71.8% of participants brushed their teeth only once a day while 81.6% never used dental floss. This concurs with other findings in Tanzania, where 79% of respondents brushed once a day with minimal dental floss use (Gamboa, 2016). In contrast, the U.S. National Health and Nutrition Examination Survey (NHANES) majority of Americans brushed twice daily and a significant proportion used dental floss regularly (Dye B. A.-E., 2012).The disparity between oral hygiene practices in LMICs and high-income countries points to the need for public health interventions aimed at improving knowledge and oral hygiene habits in LMIC populations.

The findings of the current study show, the prevalence of dental caries at 72.6%, with a significant portion classified as severe (30.9%). This aligns with results from a South African study by (Mbokazi, 2014) which found that 68.8% of adults had dental caries, with severe cases being common due to delayed treatment. In contrast, studies from high-

income countries such as Denmark, reported lower caries prevalence due to better access to preventive care and widespread fluoride use.

The low percentage of filled teeth (2.5%) is a concern and highlights a gap in restorative care, consistent with findings from a study by (Moynihan, 2004) who noted untreated caries as a significant problem due to limited access to dental services. Findings from the current study found income to be significantly associated with the severity of dental caries, with lower-income individuals less likely to have severe caries. These finding contrasts with research from high-income countries, where lower socioeconomic status is typically associated with poorer oral health outcomes. In contrast, in high-income countries, individuals with lower incomes are likely to suffer from severe dental caries due to barriers in accessing care and a lack of preventive measures (Peres M. A., 2019).

In terms of behavioral factors, findings from the current study demonstrate that higher sugar intake was associated with more severe caries. Other studies highlights the strong link between sugar consumption and the prevalence of dental caries. Higher sugar exposure significantly increases the risk of caries development (Sheiham A. &., 2015). This supports the current study findings that participants with more than four sugar exposures per day had higher odds of severe dental caries.

The current study findings reveal that females have higher rates of mild caries, while males experience more severe forms. However, the gender difference was not statistically significant (OR = 1.18, p = 0.489). In contrast, females have a higher prevalence of dental caries due to biological factors such as hormonal fluctuations and dietary habits (Lukacs, 2006). The findings are consistent with those of other studies where men are more likely to experience severe caries while women tend to develop more frequent and milder caries earlier in life.

Qualitative finding, found that individual factors, such as oral hygiene practices, dietary habits, genetic predisposition, and socioeconomic status, significantly influenced the likelihood of developing dental caries. Additionally, dental risk behavioral factors such as

irregular brushing, lack of dental check-ups, and consumption of sugary foods and beverages also contribute to the development of dental caries. This finding is supported by a review on parental behavior in the habit of brushing preschool children's teeth against early childhood caries study which revealed that, the knowledge and skills of parents about the habit of brushing teeth, time and frequency of brushing teeth influenced early childhood caries in preschool children.

Individuals with lower education levels (none or primary) tended to have higher caries severity compared to those with college education, although this was not statistically significant ($P > 0.1$). This aligns with findings from a study by (Peres M. A., 2019), which showed that lower educational attainment is linked to poorer oral health outcomes due to limited health literacy and reduced access to preventive care. Similarly, unemployment was associated with lower odds of severe caries in this study (OR = 0.48, p = 0.062), possibly due to limited access to high-sugar diets or more frequent use of home remedies instead of formal dental care. This relationship has also been observed in other studies, where lower income and unemployment are linked to lower caries rates, although their impact varies by geographic location and healthcare systems.

Findings from the current study found a significant inverse relationship between income and dental caries severity. The respondents with less income or income below KSH 10,000 had lower odds of severe caries compared to those earning over KSH 40,000 (OR = 0.16, p = 0.001). The income the study setting may be influenced by dietary differences or the cost barriers to preventive dental care. Moreover, paying for dental services in cash was linked to lower odds of severe caries (OR = 0.31, p = 0.001), which may reflect disparities in access to comprehensive care covered by insurance versus emergency treatments paid in cash.

Routine dental visits were protective against severe caries, a finding consistent with studies emphasizing the importance of preventive care. The current study revealed that individuals who had never visited a dentist or rarely did so had significantly higher odds of severe caries compared to those who visited when necessary (OR = 2.05, p = 0.014).

Notably, dental care neglect is a risk factor for advanced dental caries. The connection between painkiller use and severe caries (OR = 1.85, p = 0.068) indicates a reactive approach to oral health, which often leads to worsened outcomes, as seen in similar studies across low-resource settings.

The findings related to dietary habits and oral hygiene reinforce known trends in dental health (Cepeda *et al*., 2017). Individuals with higher sugary food intake had elevated risks of severe caries (OR = 1.90, p = 0.189). This concurs with findings of a study where dental caries was adversely linked with past teeth cleaning procedures. Frequent tooth brushing was associated with better oral health, although brushing three times a day did not show significant benefits compared to brushing twice, possibly due to small sample sizes. Regular flossing and lower use of toothpicks were also associated with better outcomes, aligning with previous research that underscores the importance of effective oral hygiene. This concurs with other study findings on transition from health to dental caries and periodontal disease (Valm, 2019).

5.2 Conclusions

The prevalence of dental caries is high among the patient attending Malindi sub-county dental clinic, Kenya. This study found out that socio-demographic factors such as low income and cash as mode of payment of hospital fees are associated with dental caries among patients attending Malindi sub-county dental clinic, Kenya. Barriers of access to dental care, due to financial constraints and the distance to the facilities. The barriers affected the seeking of ought dental care services since the majority paid out of pocket for services instead of using insurance. Individuals who paid in cash for dental services had lower chances of dental caries, indicating that some level of financial management can make a difference. Lack of income and poor dietary habits contributed to severity of dental caries.

This study has found out that dental risk behavior factors are associated with dental caries among patients attending Malindi sub-county dental clinic, Kenya. This study found out that those who had never visited the dental clinic had a higher likelihood of dental caries compared to those who visit dental clinic when necessary.

This study found out clinical factor are associated with dental caries among patients attending Malindi sub-county dental clinic. The patient with clinical diseases such as diabetes, mouth cancer are significantly associated with higher likelihood of development of dental caries.

5.3 Recommendations

1. There is urgent need for improved dental care interventions through outreach services for equitable dental services and access. Ministry of Health to increase access to affordable dental care services by lowering the cost of care. Integrating Social Health Authority, subsidies with other insurance scheme and out of pocket to provide wide coverage

2. This study recommends public awareness campaigns by ministry of health focusing on promoting professional regular dental visits in diagnosis treatment and management where services such as nutrition counselling interventions to reduce sugar intake coupled with oral hygiene care and frequent brushing are emphasized.

3. The patient with clinical diseases such as diabetes, mouth cancer are to be focused by health care workers and Ministry of health for early identification and treatment of diseases such as diabetes and mouth cancer. Integrating dental care with general healthcare for conditions like diabetes and oral health. Create awareness on dental care preventing early dental problems and instilling good habits.

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APPENDICES

Appendix I: Information Sheet and Consent

PART I: INFORMATION

Dear Participant,

My name is_____, am a research assistant/researcher I would like to invite you to participate in this research. I am conducting a study on dental carries and its associated factors among dental patients attending Malindi Sub-County Dental Clinic, Kilifi County

Participation: Thank you very much for taking the time to participate in this study. Before we begin kindly go through the following information that details what this study is about to enable you to give voluntary, informed consent to participate in this study. After carefully going through the information, please sign the consent form (part II) to indicate that you fully understand what the study is about and the implications of participation.

Aim: The study aims to assess dental service delivery factors, socio-demographic, socio-economic, and behavioral factors associated with dental health outcomes in Malindi Sub County.

What it entails: Clients seeking dental services will be invited in depth interview and well as f focus group discussions (FGD) in which 4 focus group discussions will be conducted. The FGD will consist of approximately 8-10 people. A semi-structured interview guide will be used to guide the discussions. The FGD will be conducted by an experienced facilitator who is fluent in Kiswahili, Kigiriyama and English. These discussions will take approximately 30 to 40 minutes. The data will be audio taped to assist later in fully writing up the information. No one will be identified by name in the recording.

Confidentiality: All the information obtained will be kept confidential and will only be used for the intended study aim. No write-up or publication of this study where your name or another identity will be displayed.

Withdrawal right: Your participation in this study is voluntary and you may walk out of the study at any moment you desire after you have consented, and no penalty shall be imposed on you.

Benefits: There is no financial incentive upon your participation in this study. The findings of this study will help us to assess factors influencing dental health outcomes in the Malindi sub-county and after the assessment, you will be advised accordingly or referred to the nearest dental clinic for management of any oral condition present and the ultimate aim of the study to improving capacity and service delivery in terms of management of dental diseases in the sub-county.

Injury/Harm: The study will not in any way affect your plan of management for your condition. We do not expect any harm to you as a result of your participation in this study.

Procedures- I will ask a few questions and later we will check your mouth and teeth status. The dental examination will be done and disposable wooden spatulas, single-use dental mirror, disposable probe, and the spotlight will be used to visually check the presence of the dental condition.

Who to contact: For any questions regarding this study please contact:

Ajuck Hossan, Student JKUAT, Mombasa Campus

Mobile 0720352215, Email: hossanan504@gmail.com or supervisor: Dr. Cromwell Mwiti 0719427414 or Dr Dennis Magu 0722574388

PART II: CERTIFICATE OF CONSENT

I have had the study explained to me. I have understood all that has been read/explained and had my questions answered satisfactorily.

□ **Yes** *please tick* **I agree to take part in this research**

□ **Yes** *please tick* **I agree for the interview/discussion to be recorded**

I understand that I can change my mind at any stage and it will not affect me in any way.

Participant's signature……Date……...

I certify that I have explained the study to the volunteer and consider that she/he understands what is involved and freely consents to participation.

Researcher's name…….…….....

Researcher's signature……. Date…….

Appendix II: Interview Questionnaire

DENTAL CARRIES AND ITS ASSOCIATED FACTORS AMONG DENTAL PATIENTS ATTENDING MALINDI SUB-COUNTY DENTAL CLINIC, KILIFI COUNTY

Study Number_____ Date_____ Residence_____

Instructions

Tick or fill in the correct response

Section 1: Individual factors

1. How old are you? _____ (In years) a) 0-5 years b) 5-10 years c) 10-15 years d)15-20 years e) 18-50 years f) >50 years

2.What is your gender 1)Male 2) Female

3.What is the highest level of education you have attended or currently attending? ___

1. No education
2. Primary
3. Secondary
4. Tertiary

4.What is your current marital status? 1)Married 2) Single 3) Cohabiting 4)Widowed 5)widower 6) Others (Specify)_____

5.Which religious group do you belong to? 1)Christian 2)Muslim 3)Others (Specify)_____

6.How far is the nearest dental facility from your residence?

1. Less than 5km [ ]
2. 5-10km [ ]
3. More than 10km [ ]
4. Don't know [ ]

7.What means of transport would you use to get dental services?

1. Walk [ ]
2. Use public transport [ ]
3. Use own vehicle [ ]
4. Use Bike (Bajaj) [ ]
5. Other [ ] Please specify ……

8.Which symptom did you have that made you seek dental clinic services?

1. I had a toothache [ ]
2. Fever [ ]
3. My mouth was swollen [ ]
4. Bleeding gum [ ]
5. Others [ ] Please specify ……

Section 2: Socio-economic factors

9.What do you do for a living/occupation?

1. Employed
2. Unemployed
3. Self-employed
4. Student
5. Other, specify_____

10.How much do you earn per month (in Kenya Shillings)

a. Less than Shs 3,000 per month
b. Shs 3000 to shs 10,000
c. Shs 10,000 to shs 50,000
d. More than shs 50,000

11.At your last dental visit in the past year, how much (KES)did you pay for the following:

i. Registration/consultation fees

Amount Shs: _____

Didn't pay - _____

Can't remember/Don't know - _____

ii. Drugs [ ]

Amount shs: _____

Didn't pay - _____

Can't remember/Don't know - _____

iii. X-ray [ ]

Amount shs: _____

Didn't pay - _____

Can't remember/Don't know - _____

iv. Treatment received [ ] specify type of treatment ……...

Amount shs: _____

Didn't pay - _____

Can't remember/Don't know - _____

v. Others [ ] Please specify …….

Amount Kshs: _____

Didn't pay - _____

Can't remember/Don't know - _____

vi. Total treatment cost [ ]

Amount Kshs: _____

Didn't pay - _____

Can't remember/Don't know - _____

12.If you received dental services in the past year, how did you pay for treatment? *(Enumerator may read options for respondent)*

1. Out of pocket with reimbursement [ ]
2. Out of pocket without reimbursement [ ]
3. Insurance [ ]
4. Instalment [ ]
5. Others [ ] Please specify …….

13.If you paid out of pocket for dental services, what was the source of your funds? *(Respondent can either answer yes or no to each option and multiple answers are allowed)*

- Own money [ ]
- Borrowed money [ ]
- Someone else paid [ ]
- Others [ ] Please specify

  ……

Section 3: underlying conditions

14.Do you have a condition that you have to take drugs regularly? If not jump to question section 4. 1)Yes 2) No

15 if it is *yes* for question 14; which condition/ disease?

i. …….
ii. ……
iii. ……

16. Are you currently on medication?

- Yes
- no

17. if *yes* for question n16; which medicines?

Section 4: Behavioral and lifestyle-related factors

18. Which of the following ways are useful in preventing dental diseases? *(Tick all that apply)*
    1. health education
    2. using fluoride
    3. using pit and fissure sealants
    4. Brushing teeth
    5. professional tooth cleaning
    6. flossing teeth
    7. using mouth wash
    8. periodic check-ups

9. reduction in sugar intake
10. smoking cessation

19. When was the last time you received dental services?

- 2 – 6 months ago
- Between 7- 12 months ago
- More than 13 months ago

20. How often do you visit the dental clinic? If you have not, jump to question 22.

1. Regular 6 monthly check-ups [ ]
2. Only when I have a toothache [ ]
3. Other [ ] Please specify ……

21. Do you think your needs were met at the dental clinic the last time you visited?

1)Yes 2) No

22. If you have NEVER sought dental services what are the reasons?

1. It is unnecessary since I do not have any signs and symptoms.
2. Fear of the drill
3. I did not know where to get services
4. I prefer alternative treatment
5. The costs are too high
6. Other, specify …….

23.What do you do when you have a dental problem especially pain or abscess (*Mark all that apply)*?

1.I buy medication from the nearest pharmacy. 2)Use herbal medicine.

24.Is there any family member you know who had an oral problem and needed oral health services and did not get it? If yes what were the reasons? (*Mark all that apply*)

1. Lack of funds to pay for treatment
2. Lack fare to the dental clinic
3. Lack of proper dental equipment to effect treatment
4. Lack of the specialist to address the problem

25.Have you ever or are you currently use one or more of the following tobacco products (cigarettes, snuff, chewing tobacco, cigars, etc.)? 1. Yes, ☐ 2. No ☐

26.How frequently do you take sugary food per day?

1. More than 4 sugar exposures/day ☐
2. Moderately (2-3 sugar exposures/day☐
3. Moderately (2-3 sugar exposures/day) ☐
4. Occasionally (1sugar exposure/day). ☐

27.How many times per day do you brush your teeth?

☐ Once ☐ twice or more a day ☐ rarely ☐ never

28.If brush, what do you use? ☐ Fluoride toothpaste ☐ Plain water ☐ other specify_____

29.How often per day do you use toothpicks? 1. Once ☐ 2. twice or more a day ☐ 3.rarely ☐ 4.never☐

30 How often per day do you Floss? 1. Once ☐ 2.twice or more a day ☐ 3.rarely ☐ 4.never☐

Dentition status	**Permanent teeth**
28 27 26 25 24 23 22 21 11 12 13 14 15 16 48 47 46 45 44 43 42 41 31 32 33 34 35 36	**Status** 0 = Sound 1 = Caries 2 = Filled 3 = Missing 4 Filled w/caries 5 unerupted

Appendix III: Oral Health Assessment

Intervention urgency

0 = No treatment needed

1 = Preventive or routine treatment needed

2 = Prompt treatment (including scaling) needed

3 = Immediate (urgent) treatment needed due to pain or infection of dental and/or oral origin

4 = Referred for comprehensive evaluation or medical/dental treatment (systemic condition)

1. After examination is what the state of dental is

   ☐ Dental caries absent

   ☐ Dental caries present

2. If dental carries present please record **NUMBER** with

   Decayed teeth _____

   Missing teeth _____

   Filled teeth _____

3. Type of dental caries

- ☐ Severe
- ☐ Moderate
- ☐ Mild

4. Any other finding……..

   _____

Appendix IV: Focus Group Discussion Guide

Welcome to our discussion. Please feel free to share anything you wish

1. What do you think are the individual related factors that has influenced the development of caries?
   Probe: What are these specific factors?

2. What are the dental risk behavior factors that you can associate with the development of dental carries? Please tell me more

3. Which are the medical conditions do you associate with the development of dental caries? Why do you feel so?

4. What do you think are other factors influencing dental caries?

Thank you