

**TOOTH LOSS, ASSOCIATED FACTORS AND PROSTHETIC
TREATMENT NEED AMONG PATIENTS RECEIVING METHADONE
MAINTENANCE THERAPY IN DAR ES SALAAM, TANZANIA**

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Tooth loss, associated factors and prosthetic treatment need among patients receiving methadone maintenance therapy in Dar es Salaam, Tanzania

By

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**A Dissertation Submitted in Partial Fulfillment of the Requirement for the
Degree of Master of Dentistry in Restorative Dentistry of
Muhimbili University of Health and Allied Sciences**

October, 2021

CERTIFICATION

The undersigned certify that this is the original work of the investigator and they have read and hereby recommend for acceptance of a dissertation entitled; *'Tooth loss, associated factors and prosthetic treatment need among patients receiving methadone maintenance therapy in Dar es Salaam, Tanzania'* in partial fulfillment of the requirements for the degree of Master of Dentistry (Restorative Dentistry) of Muhimbili University of Health and Allied Sciences.

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Date

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(Co-Supervisor)

Date

DECLARATION AND COPYRIGHT

I, **Robert Kamugisha Francis**, declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature..... Date.....

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Robert Kamugisha Francis

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DEDICATION

This dissertation work is dedicated to my family; my wife Godliver, our daughters Theresia, Mercy, Catherine and our son Francis

ABSTRACT

Background

Tooth loss is common among the public in Tanzania. It may result from dental caries, periodontal diseases or trauma. Substance use disorder patients are at increased risk of losing teeth due to their altered characteristics of impaired oral hygiene practices, dry mouth and sugar craving. Those characteristics lead to dental caries and periodontal diseases which ultimately may lead to tooth loss. But also Substance use disorder patients are frequently involved in violence and sustain injuries which may lead to tooth loss. Tooth loss has several consequences including; impaired mastication, speech and aesthetics. Tooth loss may be treated by removable and fixed partial dentures, complete dentures or dental implants. The government is investing resources including methadone therapy in the process of treating substance use disorder patients so as to restore their health, but those strategies do not involve oral health services. This may be due to lack of oral health data especially in disadvantaged groups including substance use disorder patients. Findings of this study will provide guidance for the oral health planners and policy makers to plan and implement preventive, curative and rehabilitative oral health care programs for individuals who are affected by substance use.

Aim

The aim of this study was to determine the prevalence of tooth loss, their associated factors and prosthetic treatment need among substance use disorder patients receiving methadone maintenance therapy in Dar es Salaam.

Methodology

This was a hospital based cross section study conducted in methadone maintenance therapy clinics in Dar es Salaam involving about 427 study participants. **The study period was since December, 2019 to June, 2021. Systematic sampling method was used to obtain study participants. Participants were interviewed using a structured questionnaire and intra-orally examined with dental mirror and probe then findings were entered on clinical examination sheet.** Study Data was analyzed by using computer system SPSS, version 23. Frequency tables were used to describe the distribution of variables. Proportion, mean and

standard deviations were calculated for continuous variables. Chi-square test and student t-test were used to compare proportions and means respectively.

Logistic regression analysis was performed to evaluate any association between variables. Statistical significance difference was assumed when p-value was less than 0.05.

Results

A total of 427 study participant aged 22 to 68 years (mean age = 41 yrs) who attended methadone maintenance therapy clinics in Dar es Salaam were enrolled in this study. Majority of the participants were males (80.8%), aged ≤ 44 years (67.4%) and have primary education or less (61.4%). About 88.8% of study participants have lost one or more teeth, and there is a significant difference of tooth loss between age groups ($p=0.001$). Mean number of tooth loss among study participants is 8.95, SD = 7.772 and mandibular molars are the most lost teeth (74%) followed by maxillary molars (64.9%) while mandibular canines are the least lost teeth (8.4%) followed by maxillary canines (21.1%). Dental caries is the predominant cause of tooth loss (58.3%) followed by periodontal diseases (39.6%) and traumatic injuries (26.9%). On both jaws, upper and lower, Kennedy class III is dominant (52.5% and 49.8% respectively) while only 6.3% have dental prostheses and acrylic removable partial denture is the leading type of prosthesis on both jaws (upper jaw 81.8% and lower jaw 88.9%).

Conclusion

Prevalence of tooth loss among substance use disorder patients is high and common causes of tooth loss among these patients are dental caries, periodontal diseases and traumatic injuries. Only small percent of the participants are having dental prosthesis thus prosthetic treatment is highly needed in this particular group.

Recommendations

1. Oral health services should be established in methadone maintenance therapy clinics.
2. Oral health education and promotion should be initiated among SUD patients.
3. More studies are required to evaluate other oral health conditions among SUD patients.

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List of abbreviations

ACP	American College of Prosthodontics
AIDS	Acquired Immunodeficiency Syndrome
DMFT	Decayed, Missing, and Filled teeth
FDI	Fédération Dentaire Internationale
HIV	Human Immunodeficiency Virus
IRB	Institution Review Board
MAT	Medically Assisted Treatment
MNH	Muhimbili National Hospital
MUHAS	Muhimbili University of Health and Allied Sciences
PEPFAR	President's Emergency Plan for AIDS Relief
PI	Principal Investigator
RA	Research Assistant
SD	Standard Deviation
SDA	Shortened dental arches
SPSS	Statistical Package for Social Sciences
SUD	Substance Use Disorder
WDF	World Dental Federation
WHO	World Health Organization

Definition of terms

Tooth loss / edentulism

Is when one or more teeth fall out or are extracted due to injury or disease such as trauma, tooth decay or gum diseases.

Dental caries

Is the microbial and multifactorial disease of calcified tissues of teeth characterized by demineralization of the inorganic portion and destruction of organic content.

Periodontal diseases

Are inflammation of supportive tissues of the teeth caused by bacteria leading to formation of periodontal pockets, gum recession, tissue destruction, and alveolar bone loss.

Substance use disorder

Is a chronic, relapsing brain disease that is characterized by compulsive drug seeking and use, despite harmful consequences. Also referred to as drug use disorder or Drug addiction

Denture

Is prosthetic device constructed to replace missing tooth, and is supported by the surrounding soft and hard tissues of the oral cavity.

CHAPTER ONE

INTRODUCTION

1.1. Background

Patients receiving methadone maintenance therapy are those who have a condition termed as substance use disorder also known as drug use disorder (1). The condition is characterized by an array of mental, physical and behavioral symptoms that may cause problems related to loss of control, strain to one's interpersonal life, hazardous use, tolerance and withdrawal (2). This disorder is associated with a wide range of short- and long-term health effects. These effects vary depending on the type of substance, how much and how often it's taken and the person's general health (3). Overall, the effects of substance use and dependence can be far-reaching impacting almost every organ in the human body including oral health (4).

The effects of substance use on oral health result from altered mental, physical and behavioral characteristics of an individual which include impaired oral hygiene practices like tooth brushing and reduced visit to dental services, but also cause dry mouth (5). As a result dental caries and periodontal diseases predominate leading to tooth loss (5).

The methadone maintenance treatment is designed to help individuals stop or reduce harmful substance misuse, improve their health and social function, and manage their risk for relapse. In this regard, the treatment is effective and has a positive economic impact (6). Research show that treatment also improves individuals' productivity, health, and overall quality of life (7). In 2011, the Tanzania government launched the first methadone maintenance therapy clinic in Tanzania, at Muhimbili National Hospital in Dar es Salaam. Other clinics in Dar es Salaam are at Mwananyamala hospital which was opened in 2013 and at Temeke hospital. Country wide, clinics are in Mwanza, Mbeya and Zanzibar (8).

Basically, these clinics provide methadone to clients seven days a week by offering integrated services such as counseling and testing for HIV and hepatitis, tuberculosis testing, plus support for mental and psychosocial health (9). About 30 000 people were believed to be using

injectable drugs in Tanzania's main city, Dar es Salaam and were aimed for the treatment program (10). Country wide, about 5000 people are benefiting from the methadone maintenance program. These include 1600 at MNH, 800 Temeke referral hospital and 1100 at Mwananyala (8).

However, methadone like other opioids reduce salivary flow i.e causes xerostomia (5). But also people who are on methadone treatment seem to like a high intake of sugars i.e increased sugar craving (11). Further, patients on methadone maintenance therapy have co-occurring mood, personality and anxiety disorders (5). These characters contribute to incidence of dental anxiety and fear of needles, discouraging regular dental visits (12).

Tooth loss among these patients may be associated with common dental diseases like dental caries and periodontal diseases (13) or physical violence and injuries due to their altered mental status (14).

Inadequate dentition leads to poor mastication (15). Masticatory abilities have been known to play an important role in digestive system and overall health condition (16). Also tooth loss can affect speech, a condition which can be embarrassing and diminish self-confidence. As well aesthetics and general physical appearance of an individual are diminished. Tooth loss compromises mental health by causing both depression and anxiety (17).

Individuals feel embarrassed and avoid smiling due to their missing teeth status (17). Jaws affected by tooth loss undergo bone resorption which together with type of teeth lost may lead to change in the facial profile (17). Furthermore, missing teeth can lead to missed job opportunities; whereby some people feel that the appearance of their teeth affect their ability to get a job (18).

Partially tooth loss has been classified by various methods. The aim of classification is to facilitate the communication about the combination of missing teeth to edentulous ridges among practitioners and laboratory technicians for better fabrication of prostheses (19). There are several methods of partially tooth loss classification including Kennedy, Applegates,

Avant, Neurohar, Eichner, American College of Prosthodontics etc. However, Kennedy's classification is widely studied and clinically accepted by the Dental Community (20). This classification is widely accepted due to its advantages of immediate visualization and recognition of prosthesis support (21). Kennedy classified partially edentulous arches into four main types Class I, Class II, Class III and Class IV. Class I indicates bilateral posterior edentulous areas, class II is the unilateral posterior edentulous area, class III shows a unilateral tooth bound edentulous area and Class IV indicates an anterior tooth bound edentulous area which crosses the midline (22). Each class determines the prostheses design.

Missing teeth can be replaced by artificial teeth-like devices in order to restore teeth functions, which basically are mastication, aesthetics, and speech (23). There are several methods of replacing lost teeth, but the most common available are; removable partial denture, removable complete denture, fixed bridge, resin-retained bridge and dental implant (24). Removable partial dentures are the most demanded and delivered dentures in developing countries including Tanzania due their low cost and easy of fabrication (25).

The government of Tanzania initiated several strategies to treat and maintain the health of SUD patients including methadone maintenance therapy which was launched in 2011 (8). With these strategies it is expected that the general health of SUD patients will be improved. However, these governmental strategies do not involve oral health services. This may lead to unimproved general health of these patients because oral health is a gateway to general health. If oral health is not maintained, the general health of an individual may be compromised (26).

Unfortunately, oral health information concerning tooth loss and associated factors regarding SUD patients is sparse especially in Tanzania. Thus, this study is aimed at generating baseline information regarding tooth loss, reasons for tooth loss, classification and prosthetic treatment need among SUD patients receiving methadone maintenance therapy in Dar es Salaam, Tanzania.

1.2. Problem statement

Tooth loss is very common among the public in Tanzania whereby, frequencies of tooth loss approximate 83% (27). Tooth loss may be a result of dental caries, periodontal diseases, trauma, orthodontic treatment or neoplasm. SUD patients are at increased risk of losing teeth due to their altered characteristics of impaired oral hygiene practices like tooth brushing, dental anxiety, dry mouth and sugar craving, conditions which predispose to dental caries and periodontal diseases (5). Also SUD patients are commonly involved in physical violence and sustain injuries due to their altered mental status which may lead to tooth loss (14). There is no documented data on tooth loss regarding SUD patients in Tanzania.

Therefore, the aim of this study was to determine the prevalence of tooth loss and associated factors among SUD patients receiving methadone maintenance therapy in Dar es Salaam.

1.3. Conceptual frame work

Socio-demographic factors influence the use of elicits substance leading to SUD. SUD and methadone therapy cause dry mouth, sugar craving, violence, injuries and impair oral hygiene practices. As the result, dental caries and periodontal diseases develop which may lead to tooth loss.

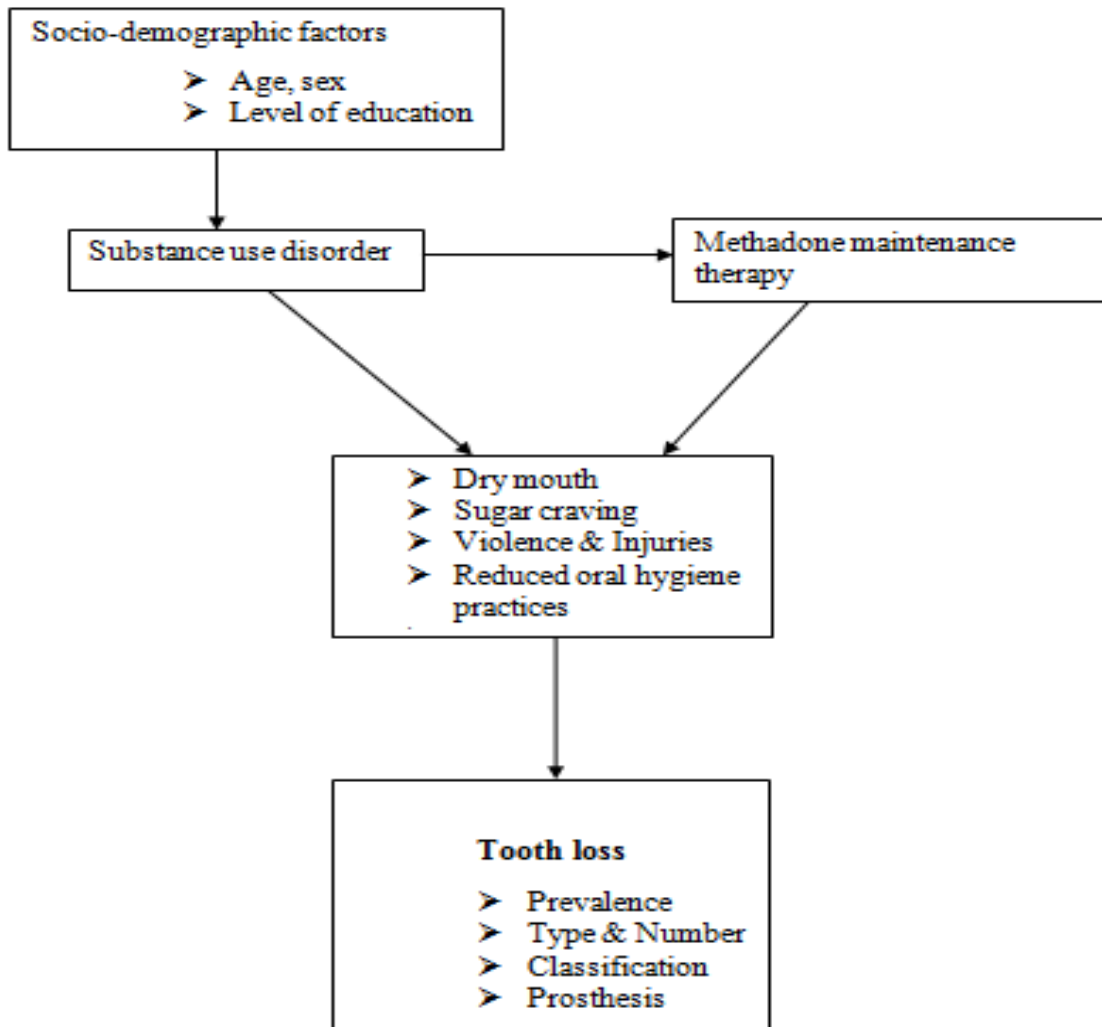


Figure 1: Conceptual Framework:

“Tooth loss and associated factors among SUD patients”. Source: Kamugisha FR – Self designed (2020)

1.4. Rationale of the study

Findings of this study will form the bases for professional awareness regarding oral health status of SUD patients. On the other hand the study will provide guidance for the oral health planners and policy makers to plan and implement oral health care programs (preventive, curative and rehabilitative) in this area. But also, the information obtained will be used to

improve oral health care services and thus improve oral and general health of SUD patients. **By being interviewed and examined, study participants will have an opportunity to be informed of their oral health status and then be advised accordingly.**

1.5. Research questions

Overall question: What is the prevalence of tooth loss, their associated factors and prosthetic treatment need among patients receiving methadone maintenance therapy in Dar es Salaam?

Specific questions

1. What are the prevalence, number and types of tooth loss among patients receiving methadone maintenance therapy in Dar es Salaam?
2. What are the reasons for tooth loss among patients receiving methadone maintenance therapy in Dar es Salaam?
- 3. What is the distribution of tooth loss pattern according to Kennedy's classification among patients receiving methadone maintenance therapy in Dar es Salaam?**
4. What is the prosthetic treatment need among patients receiving methadone maintenance therapy in Dar es Salaam?
- 5. What are the common types of dental prosthesis among patients receiving methadone maintenance therapy in Dar es Salaam?**

1.6. Broad objective

To determine the prevalence of tooth loss, its associated factors and prosthetic treatment need among patients receiving methadone maintenance therapy in Dar es Salaam.

1.7 Specific objectives

1. To determine the prevalence, types and number of tooth loss by sex, age groups and levels of education among patients receiving methadone maintenance therapy in Dar es Salaam
2. To determine the reasons for tooth loss by sex, age groups and levels of education among patients receiving methadone maintenance therapy in Dar es Salaam
3. To determine tooth loss pattern according to Kennedy classification for partially tooth loss by sex, age groups and levels of education among patients receiving methadone maintenance therapy in Dar es Salaam
4. To determine the prosthetic treatment need and prosthesis types by sex and levels of education among patients receiving methadone maintenance therapy in Dar es Salaam

1.8.Literature review

Prevalence of tooth loss

Specific information on prevalence of tooth loss with regard to substance use disorder patients is scarce. But generally, global data indicates that the global age-standardized prevalence of edentate people is decreasing from 4.4% in 1990 to 2.4% in 2010 and no differences between sexes (28). In Brazil, a study by Susin et al in 2005 shows that tooth loss is highly prevalent in urban Brazilian population whereby 94% of the subjects studied have experienced tooth loss and females are more affected than males (29). The prevalence of partial and complete edentulism in the Polish senior population was estimated to be 45.7% and 47.1% respectively (30).

About 12.3% of Nigerian hospital attendees aged 4–102 years had extracted their teeth and significantly female preponderance was observed (31). Prevalence of tooth loss in Sudanese adults attending out patients clinics in Khartoum was about 78% (25). Sarita and colleagues in their study done in the year 2004 show that ‘missing’ component of the DMFT was dominant and women were affected more than men (32). Tooth loss in Mtwara, southern part of Tanzania, among the subjects studied, 93.2% were partially edentulous, while 2.4% were completely edentulous and those with no tooth loss were 4.4% (33). In Dar es salaam, Tanzania, prevalence of tooth loss was 83.5%, females being more affected than males (27).

However, data on the prevalence of tooth loss regarding SUD patients who are on methadone maintenance therapy are irretrievable globally and Tanzania. Thus, this study aimed at determining the prevalence of tooth loss by sex and age groups among patients receiving methadone maintenance therapy in Dar es Salaam.

Types of tooth loss

The pattern of tooth loss among SUD patients is not documented. But among the general population in Iraq, a study done by Talabani et al in 2014 shows that first molars are the most common missing teeth (36.16%) in both arches led by lower first molars (11.5%) and the canines are the least lost teeth (3.98) on both arches (34). Similarly, in Pakistani studies show that maxillary first molars (28.38%) and mandibular first molars (21.45%) are the most commonly missing teeth while canines are the least (5%) but no differences between left and right sides of the arches (35).

The type of tooth loss among Nigerian general population is that over half (69.2%) of the extracted teeth are molars preceded by lower molars (31). And in Kenya a study by Sanya and colleague shows that the most commonly missing teeth are lower molars followed by upper molars (36).

In Tanzanian general population the real situation is not different from other countries as is indicated by Sarita and colleagues in a study done in 2004 which shows that molars are more missing teeth (32). Also Unguja and Pemba in all age groups the molars are the most frequently missing teeth (37). Data on types of tooth loss among SUD patients globally and in Tanzania is not retrievable. Therefore, this study aimed at determining the type of tooth loss by sex and age groups among patients receiving methadone maintenance therapy in Dar es Salaam.

Number of tooth loss

World health organization's oral health policy insists of retaining at least 20 teeth at the age of 80 years. This has not yet been met but is being approached in some European countries among the general population (38). The mean number of lost teeth in general population increases with age and in several European countries many dentate subjects aged 60 years and over still have reduced dentitions (38). In Sweden the mean number of tooth loss is approximately 5 in all age groups of 15, 20, 30 and 40 years old which become higher above the age of 50 and approximates 12 at the age of 80 years (39). In a representative sample of

35–44-year old examined in French, the mean number of tooth loss is about 5 (40). In Indonesian population studies show that in age group of 35-44 years old, the average number of tooth loss was about 2.89 in 2007 and reached 3.35 in 2013. Also shows that there is a tendency to incline percentage of people who has tooth loss along with the increasing age. In group of elderly group aged 65 or older, the mean number of missing teeth was about 16.99 per person reported in 2007 and continued to increase to about 17.05 in 2013 (41). In Brazil, about 24.9% of the studied individuals have lost 13- 31 teeth and 6.6% are completely edentulous (42)

The mean number of missing teeth among Sudanese adults is about 3.6, while among the age groups is about 1.9 in 25-34 years group, 4.2 in 35-44 years group, 5.5 in 45-54 years, 8 in 55-64 years, 11.3 in 65-74years and 11.8 in 75 years and above (25). Among Kenyans the mean number of missing teeth in the population is 1.60. and among those with missing teeth, the mean number of missing teeth is 3.35 (36).

In Tanzania, the mean number of remaining teeth among the population ranges from 27 (lost 5 teeth) in the youngest (20-29 years) to 20 (lost 12 teeth) in the oldest age group (above 60 years) (32). Also Sarita and colleagues reported a prevalence of shortened dental arches (SDA) (reduced number of posterior occluding units) of 15% in the adult population (32). Furthermore, Kida and colleagues in their study found that mean tooth loss in the total population of Dar es Salaam and Pwani regions is approximately 5.8 teeth (SD = 6.4). The report indicates that adults in the age groups 50–59 years, 60–69 years and 70+ years have lost on average 5.5, 5.9 and 6.7 teeth respectively (27).

Data from Zanzibar and Pemba islands indicates that the mean number of missing teeth ranges from 3.9 in the youngest group (30-34 years) to 8.4 in the oldest age group (50 years and above) (37). **However, the information regarding the number of tooth loss among patients attending methadone maintenance therapy is irretrievable particularly Tanzania.** Therefore, this study aimed at determining the number of tooth loss by sex and age groups among patients receiving methadone maintenance therapy in Dar es Salaam, Tanzania.

Reasons for tooth loss

Tooth loss is predominantly due to dental caries and periodontal diseases. Other causes include traumatic injuries, orthodontic treatment, tumors and inflammations like pericoronitis (43) (44). Data on reasons for tooth loss among SUD patents is not available; therefore the situation shown here regarding reasons for tooth loss is among the general population. A study done in the North Afghanistan shows that caries is the most frequent reason for tooth extraction (59.2%), followed by periodontal disease (35.3%), surgical indications (4.9%) and patient request (0.5%). Also this study indicates that caries is the main reason for tooth loss up to 50 years of age while periodontal disease is the principal reason in 51 years old and above (44).

In Japan, a study done by Aida and colleagues indicates that dental caries (43.3%) and periodontal diseases (41.8%) are the main reasons for teeth extractions. Also these findings show that extraction due to caries or fracture is common in all age groups over 15 years of age, while periodontal disease is predominant in the groups over 45 years of age (45). In Greece, the main reasons for teeth extraction are caries (45.6%), periodontal disease (32.1%), failed root canal treatment (7.3%) and root fracture (4.4%) (46). Also the same study shows that caries is the main reason for extraction in patients up to 44 years old (64.7%), while periodontal disease is the main reason for extraction in patients over 45 years of age (77.6%) (46). The situation in Brazil is not different from other parts of the world, a study done by Montandon and colleagues indicates that dental caries is the most prevalent reason for tooth extraction among young and adults up to 44 years old, while the periodontal disease is the main reason for extractions from 45 years old until range of 81 years (47).

Dental caries is the leading cause of tooth loss (56.4%) in Nigeria followed by periodontal disease (24.6%) (31). Another study done in Nigeria indicates that caries related extractions (65.6%) are the most common cause of tooth loss followed by periodontal disease in 13.1% of cases and symptomatic impacted tooth in 9.8%. Also the study shows that there is a significant association between age and the pattern of tooth loss with tooth loss due to periodontal

diseases occurring in the older age groups (13). Among Kenyans, dental caries is the predominant cause of tooth loss (52.6%), followed by periodontal disease (27.6%). Extractions, as a form of traditional practice, contribute about 12.3% of total tooth loss. Orthodontic treatment and trauma account for 2.2% and 2.0% respectively of total tooth loss (48).

In Tanzania, a study done by Mumghamba and Fabian in Mtwara shows that the leading causes of tooth loss are dental caries (74.9%), periodontal and trauma (20.3%) and mutilation (4.8%) (33). Another study done by Kida and colleagues indicates that the prevalence of tooth loss due to caries is about 63.4% and due to other reasons than caries is 32.5% (27). **Despite the reasons for tooth loss among the general public being studied and documented particularly in Tanzania, no documented data on the reasons for tooth loss among substance use disorder patients.** Therefore, the aim of this study was to assess the reasons for tooth loss by sex and age groups among patients receiving methadone maintenance therapy in Dar es Salaam city, Tanzania.

Kennedy classification for partial tooth loss

The aim of classifying partially edentulous arches is to facilitate the communication among practitioners and laboratory technicians for better fabrication of prostheses (19). No documented data regarding pattern of tooth loss according to Kennedy's classification among SUD patients, but for the general population the information is available.

A study done in Hyderabad Pakistan, shows that Kennedy class IV is the most prevalent (32%) among the subjects studied followed by Class I (23.3%), II (19.2%) and III (12.7%). (49). Another study done in Islamabad, shows that majority (53%) of the subjects present with Kennedy Class III. No significant association is found between arch type (maxillary/mandibular) and Kennedy's classification. However, a significant difference is observed between males and females, while class III and class I are similar between the two sex, more women (10.8%) present with class IV as compared to men (2.2%) and higher number of males (32.9%) present with Class-II as compared to females (21.6%) (50). In India,

Bharhati and colleagues on their study done in Andhra Pradesh show that Kennedy class III is the most frequent encountered (62%) followed by Kennedy class I (18%), class II (11%), and class IV (9%) (51). Also Devishree and colleagues on their study done at Saveetha Dental College and Hospital indicate that the prevalence of Class III is more in both the genders of about 70% followed by the prevalence of Class I accounting for about 16% in female and 11% in males (52).

Among Jordanians, study indicates that Kennedy class III is the most common classification encountered in maxilla (47%) and in the mandible (45%) (53). A study done in Saudi Arabia shows that Class III is the most prevalent pattern in maxillary and mandibular arches (67.2% and 64.1% respectively). Class II follows in both arches maxilla and mandible (16.3% and 14.8% respectively) (54).

In Egypt, a study show that among the subjects studied 45% of them are partially edentulous and according to Kennedy classification the most common type is Kennedy class III (34.8%), followed by class II (6.2%), class I (2.9%), and the least is class IV (1%) (55). In Edo state Nigeria, a study indicates that the most edentulous space restored is Kennedy class III (57.3%), followed by class IV (26.2%), I and II (0.9%). Complete edentulous is 6.0% (56).

However, in East African countries specifically in Tanzania, the pattern of tooth loss according to Kennedy's classification have not been documented. Therefore, this study aimed at determining pattern of tooth loss by sex according to Kennedy's classification among patients receiving methadone maintenance therapy in Dar es Salaam city, Tanzania.

Prosthetic need

Missing teeth can be replaced by artificial teeth-like devices that are called dentures in order to restore teeth functions, which basically are mastication, aesthetics, and speech (23). Among SUD patients' prosthetic need has not been documented, therefore the reviewed literature is from the general population. A study done in Saud Arabia shows that in males, the need for any type of prosthesis in upper and lower arch was 68.51% and 75.92%, respectively and in females, the need for prosthesis in upper and lower arch was 57.25% and 72.58%, respectively

(57). Another study in Saud Arabia shows that the highest percentages of patients with no prosthesis were from the 35–44 years group and prosthetic treatment need was recognized to be 56.4% for the upper and 57.2% for the lower arches, respectively (58). Among green marble mine laborers in India, the study shows that the overall prosthetic treatment needs is 15.5% and prosthetic needs increased as the age increased with the age group 45-54 showing the greatest. Prosthetic needs in the lower arch were found to be greater than that of the upper arch (59). In Poland, a study shows that among respondents with tooth loss 75.6% are having dentures with higher education levels, while low education is associated with not wearing dentures (30). Two studies which were done in Sri Lank show that among those with tooth loss only 22% and 16% have prosthesis respectively (60, 61). The level of Prosthodontic treatment among adults in Iraq is very low as is indicated by Talabani and his colleagues in their study which show that patients with prosthetic devices among all patients with missing teeth are 19.1% for maxillary and 13.9% for mandibular arches (34). In Switzerland, the situation is better whereby almost 50% of studied subjects have prosthetic treatment (62).

The study in Nigeria shows that the demand for complete dentures increased with age while the demand for removable partial dentures also increased with age until the 3rd decade and then started to decline (63). Another study in Nigeria by Olabisi and colleagues shows that most of the respondents (75.0%) needed prosthetic replacement (64).

Prosthetic replacement of missing teeth in Sudanese adults is evident only in 3% whereas a need for prosthetic replacement was evident in 57% (25). Among refugees in Burundi refugee camps, findings indicate that about 65% of studied participants require restorative services including prosthetic treatment. A study done in Zambia among psychiatric patients at Ndola Central Hospital shows that majority (82.7%) of patients needed dentition treatment and prosthetic treatment required by 36.5%.

In Tanzania, oral health survey which was conducted in 2004, shows that there are very few prosthetic appliances among the population and the prosthetic treatment need is about 11% (65). A study done by Quaker in 2011 among patients attending Muhimbili dental clinic, shows that less than half of the subjects with tooth loss have prosthetic appliances (66). **Also a study**

done by Astrom and Kida among Tanzanian adults shows that 39.5% were in need for partial dentures (67). Among motorcycle crash victims in Tanzania, findings show that majority, 79.7% of the patients with dental trauma needed dental treatment and the most common treatment needed was provision of prosthesis (67).

Information on the dental prosthetic need in Tanzania is so scarce, discrete and not documented especially among disadvantaged groups like patients with SUD. Therefore, the aim of this study was to assess the prosthesis need by levels of education among substance use disorder patients receiving methadone maintenance therapy in Dar es Salaam, Tanzania.

Types of prosthesis

There are several methods of replacing lost teeth, but the most common available are; removable partial denture, removable complete denture, fixed bridge and dental implant (24). Data on types of prostheses among SUD patients is not retrievable, but the obtained are from the general population. All types of fixed and removable prostheses are highly prevalent, especially among older age groups, in most European countries (68). In these countries a higher frequency of removable restorations is present in subjects with less education (68). In this systematic review of literature, Zitzmann and colleagues shows that frequency of removable partial denture among adults varied between 13% and 29%, while 3–13% of edentulous subjects are wearing complete dentures in both jaws. Also the study shows that the prevalence of fixed prostheses including crowns and bridges is the highest in Sweden with 45% and Switzerland (34%) (68). In United States of America, the prevalence of dental implants is about 5.7% of all prostheses and is more prevalent in individuals who have greater than high school education (69).

Among Georgian population with tooth loss, about 8.3% have replaced with fixed dentures, 4.7% replaced with removable dentures and 0.1% have replaced with dental implants (70).

Ogunninde and colleagues on their study of partially edentulous patients in a Nigerian teaching hospital show that among the subjects wearing prostheses, majority (97.3%) have removable partial dentures, 1% have fixed bridge and 1.7% have implant supported dentures

(71). Another study in Nigeria among elderly population, all 7.1% of individuals with prostheses are using removable acrylic partial dentures (72). Despite prosthetic treatment for tooth loss among Tanzanian population being done, no documented study which indicates the types of those prostheses among the general population or disadvantaged groups. Therefore, the aim of this study was to determine the types of prosthesis by levels of education among substance use disorder patients receiving methadone maintenance therapy in Dar es Salaam, Tanzania.

CHAPTER TWO

MATERIAL AND METHODS

2.1. Study area

The study was conducted in three methadone maintenance clinics in Dar es Salaam. Those clinics are at Muhimbili National Hospital, Mwananyamala Regional Referral Hospital and Temeke Regional Referral Hospital.

2.2. Study period

The study period was from December, 2019 to June, 2021.

2.3. Study design

This was the descriptive cross section hospital based study.

3.4. Study population

The study population for this study was SUD adult patients receiving methadone maintenance therapy in Dar es Salaam, Tanzania.

2.5. Sample size

The minimum number of subjects to be involved in the study was obtained through the following calculations

$$\text{Formula: } n = \frac{Z^2 p (100-p)}{e^2}$$

Where by: n = sample size

z = Standard normal deviation which is 1.96 at 95% confidence level

p = 50% - as the proportion of tooth loss among these patients is not known

e = maximum error accepted, set at 5%

Therefore, $n = \frac{1.96 \times 1.96 \times 50 (100 - 50)}{5 \times 5}$

5x5

$$n = 384$$

Adjusting for non-response

Adjusted sample size = $n \times 1/R$

Whereby, R= response rate, set at 90% (0.9) non response expected to be 10%

Thus, adjusted sample size = $384 \times 1/0.9 = 427$

Therefore, the estimated sample size for this study was 427 subjects.

2.6. Sampling procedures

Dar es Salaam was purposely selected due to the fact that majority of patients who are taking methadone maintenance therapy reside in this city and about 3 of the six methadone maintenance clinics in the country are in this city.

All of 427 subjects to be involved in the study were obtained by systematic sampling method from the list of all 3600 registered patients receiving methadone in Dar es Salaam. This sample size is about 12% of all 3600 registered patients, thus 12% of registered SUD patients from each center was obtained. MNH with 1500 registered SUD patients contributed 177 subjects, Mwananyamala with 1200 registered SUD patients contributed 140 subjects and Temeke with 900 registered SUD patients, 110 subjects were obtained from that center. Male and female lists were created separately at each center and 12% of each sex was recruited. A sampling interval (k) was generated by calculation $k = 3600/427 = 8$. Therefore, from the list every 8th subject was picked for involvement in the study. If the 8th person was not present for any reason, the next person on the list was recruited.

2.7. Inclusion criteria

All registered SUD adult patients receiving methadone maintenance therapy in Dar es Salaam clinics namely Muhimbili National Hospital, Mwananyamala Regional Referral hospital and Temeke Regional Referral hospital were included in the study.

2.8. Exclusion criteria

Seriously sick, mentally affected and cognitive impaired individuals who could not cooperate properly with the researcher were excluded from the study. Also patients who were not able to open their mouth properly for intraoral dental examination were not included in the study.

2.9. Data collection

2.9.1. Variables

Socio-demographic variables were measured in the following categories

- (a) Sex: 1 = male, 2 = female
- (b) Age: was recorded in years as per last birthday
- (c) Levels of education: 1 = no formal education, 2 = primary education , 3 = ordinary secondary education, 4 = advanced secondary education, 5 = college/university education

Clinical variables were tooth loss, type and number of tooth loss, reasons for tooth loss, Kennedy classification, prevalence of prostheses and types of prostheses provided. These were measured through the following codes;

- 1) Tooth loss: 0 = no tooth loss, 1 = lost tooth
- 2) Number of tooth loss: total number of absent teeth in the mouth
- 3) Type of tooth loss: incisor, canine, premolar or molar (according to WDF)
- 4) Reasons for tooth loss: 1 = caries, 2 = periodontal diseases, 3 = trauma, 4 = others
- 5) Kennedy classification for tooth loss: 1 = class I, 2 = class II, 3 = class III, 4 = class IV
- 6) **Prosthetic treatment need:** 0 = no prostheses, 1 = prostheses present
- 7) Type of prostheses 1 = removable partial denture, 2 = removable complete denture, 3 = fixed denture, 4= dental implant

2.9.2. Data collection procedures

At each study center (Mwananyala, Temeke and MNH) study participants were called in one by one using their hospital registration numbers (MAT no.) after being obtained through systematic sampling. While seated on the office chair the participant was interviewed by the research assistant then shifted to the movable dental chair to be examined by the principle researcher using probe and dental mirror under natural day light. Answers and findings were recorded on the questionnaire and clinical sheet accordingly. After examining each subject quality checks was done to ensure that the information obtained was properly recorded.

At the end of the day, the gathered information was entered in a computer program of Statistical Package for Social Sciences (SPSS, version 23.0).

2.9.3. Validation of research tools

The data collection tools (structured questionnaire and clinical examination sheet) were tested in a pilot study to ensure that they are specific and correctly collect the intended information. The pilot study included 10% of expected sample size i.e 43 study subjects. Intra-examiner consistence was ensured by a researcher being calibrated against a renowned clinical expert.

2.9.4. Calibration of the examiner and reliability of the research data

Before the study begun the clinical examiner was calibrated against a renowned clinical expert familiar with the concepts of prosthodontics using patients attending the MUHAS dental clinic for prosthetic treatment. Agreements between examiner and expert together with Cohen's Kappa coefficient indices were recorded and measure of agreement (Kappa score) was 0.727.

2.10. Data management and analysis

Data analysis was done by using a computer program of Statistical Package for Social Sciences (SPSS, version 23.0). After data entry frequency was run for all variables to identify any missing and was cleaned accordingly. Some variables were transformed and coded into different variables to suit data handling and analysis. Statistical significance difference was assumed when p-value was less than 0.05.

Re-coding of some variables was done as follows:

1. Age groups (yrs)
 - a. 1 = 20-29
 - b. 2 = 30-39
 - c. 3 = 40-49
 - d. 4 = 50-59
 - e. 5 = 60 and above

2. Age groups (yrs) dichotomized
 - a. 1 = ≤ 44
 - b. 2 = ≥ 45

3. Levels of education
 - a. 1 = \leq primary education
 - b. 2 = \geq secondary education

4. Tooth loss
 - a. 0 = none
 - b. 1 = lost ≥ 1 teeth

Analysis was done as follows;

Objective one; prevalence, number and types of tooth loss

- Independent variables were sex, age groups and levels of education,
- Dependent variables were tooth loss, number and types of tooth loss.
- Frequency table and pie charts were used to describe study participants.
- Cross tabulation of tooth loss by sex, age groups and levels of education was performed.
- Chi – square was used to compare proportions of tooth loss between sexes, age groups and levels of education
- Student t-test was used to compare mean number of tooth loss between sexes, age groups and levels of education,
- Logistic regression was used to evaluate any relationship of tooth loss with sex, age and education.

Objective two; Reasons for tooth loss:

- Independent variables are sex, age groups and levels of education
- Dependent variable are reasons for tooth loss (dental caries, periodontal diseases, trauma, others)
- Frequency table was used to describe distribution of causes of tooth loss
- Cross tabulation of reasons for tooth loss by sex, age groups and levels of education was performed
- Chi – square test was employed to compare proportions of reasons for tooth loss between sexes, age groups and between levels of education

Objective three; Kennedy's classification for partial tooth loss

- Independent variables are sex, age groups and levels of education
- Dependent variable are Kennedy classes (I-IV)
- Frequency table was used to describe distribution of Kennedy classes on lower and upper jaws
- Cross tabulation of Kennedy classes by sex, age group and levels of education was performed
- Chi-square test was used to compare prevalence of Kennedy classes between sexes, age groups and levels of education

Objective four; prosthesis need and prosthesis types

- Independent variables are sex, age groups and level of education
- Dependent variables are prosthesis and their types
- Frequency tables were used to describe distribution of prostheses among sex, age groups and levels of education
- Cross tabulation of prosthesis by sex, age groups and levels of education was performed
- Chi-square test was used to compare presence of prostheses between sex, age groups and levels of education

2.11. Ethical issues

Ethical clearance for this study was obtained from the Directorate of Research and Publications of the Muhimbili University of Health and Allied Science. The permission to conduct research in methadone maintenance therapy clinics at Muhimbili, Mwananyamala and Temeke hospitals were obtained from the respective authorities. Participants were requested to provide informed consent by signing after being informed of the aims, possible risks and benefits of the study and their right to participate and withdraw from the study at any stage.

2.12. Study limitations and mitigations

Due to limited resources, the study was conducted in one region of Tanzania main land i.e Dar es Salaam, thus generalization of the results to the SUD patients population may be jeopardized. This was mitigated by proper sampling procedures and recruiting subjects from all methadone therapy centers in Dar es Salaam.

CHAPTER THREE

RESULTS

Socio-demographic distribution of study participants

A total of 427 adult patients aged 22 to 68 years (mean age = 41 yrs, median age = 41yrs) attending methadone maintenance therapy clinics in Dar es Salaam were enrolled in this study. Table 1 show that majority were males (n=345, 80.8%), and aged 44 years or less (n=288, 67.4%). Few of them (n=35, 8.2%) have no formal education but some of them (n= 10, 2.3%) had university education while majority (n= 227, 53.25%) had primary education (fig.3).

Table1: Distribution of study participants according to socio-demographic factors (n = 427)

Socio-demographic variables	n	%
Sex		
Male	345	80.8
Female	82	19.2
Age group (yrs)		
≤ 44	288	67.4
≥ 45	139	32.6
Levels of education		
≤ primary	262	61.4
≥ secondary	165	38.6

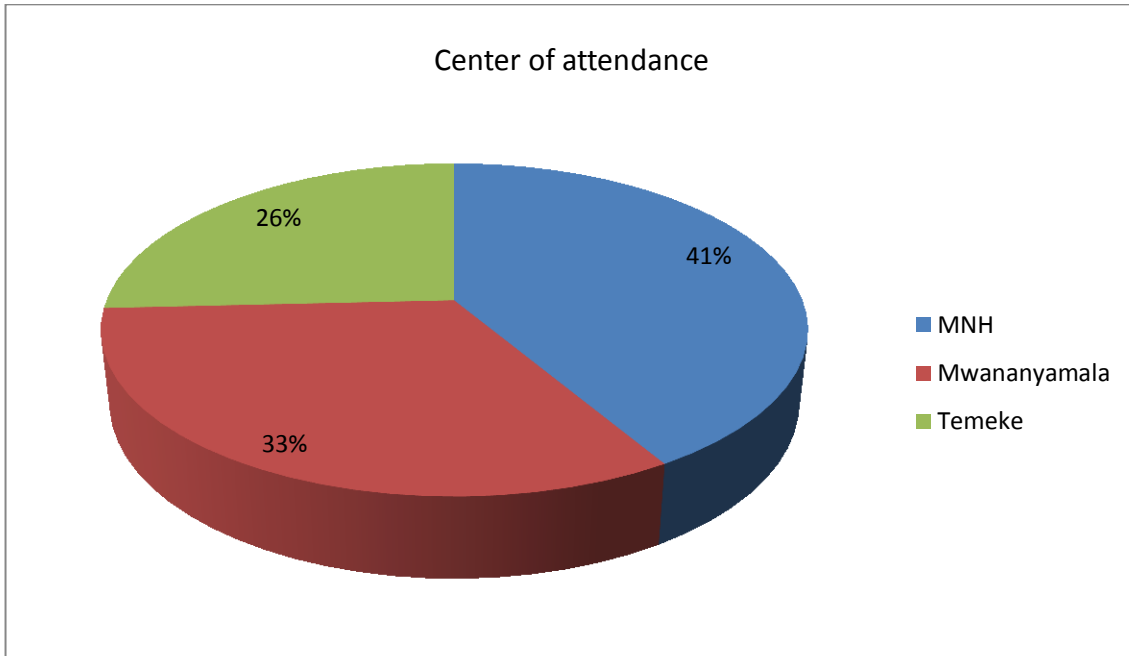


Figure 1: Distribution of study participants by center of attendance

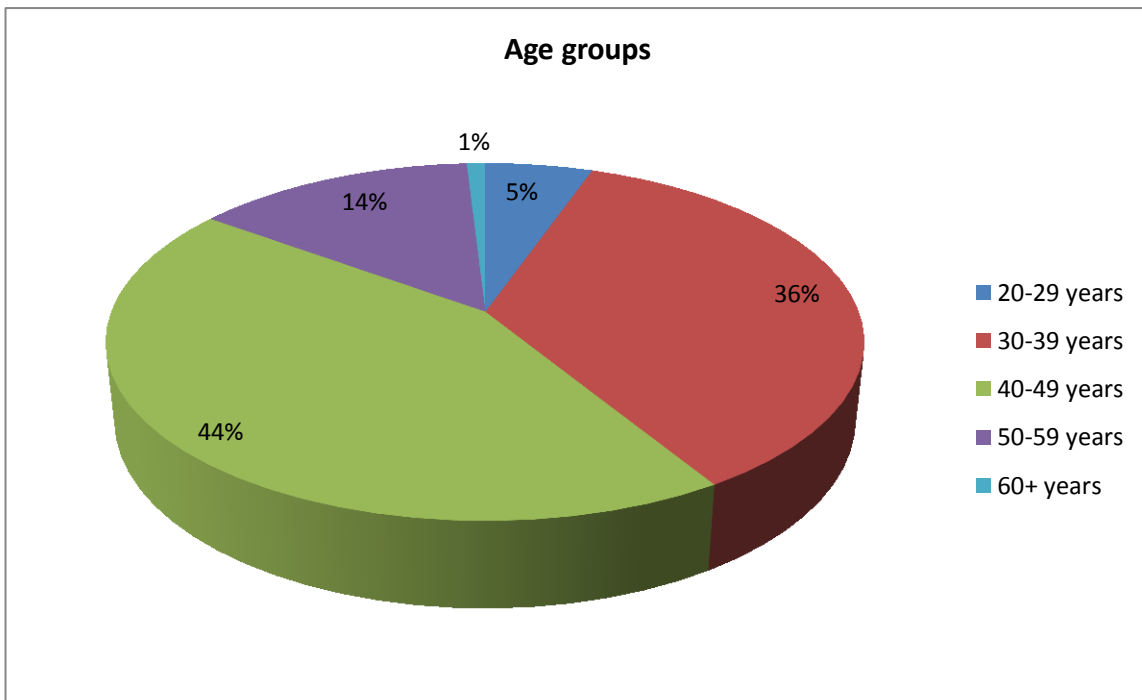


Figure 3: Distribution of participants by age groups

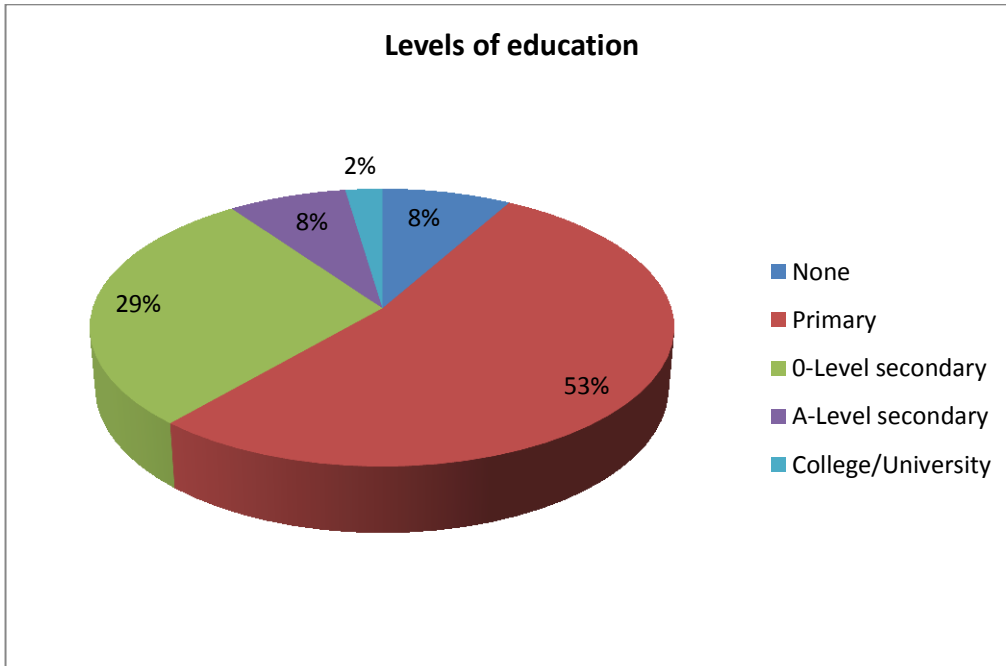


Figure 4: Distribution of study participants by levels of education

Prevalence of tooth loss

About 88.8% (n= 307) of study participants had lost one or more teeth. Majority of both males and females (n=303, 87.8% & n=76, 92.7% respectively) had lost one or more teeth but the difference of tooth loss between them is not statistically significant ($p= 0.211$). About 84.7% (n=244) of participants aged 44 years and below had lost one or more teeth and 97.1% (n=135) of those aged 45 years and above had lost one or more teeth. There was statistical significant difference of tooth loss between age groups ($p=0.001$). Considering the level of education, majority of the participants had lost one or more teeth (primary education and below n=229, 87.4%, secondary education and above n=150, 90.9%), but no true difference between these levels ($p=0.264$) (table 2).

Table 2: Distribution of study participants according to tooth loss and socio-demographic factors (n=427)

Socio-demographic factors	Tooth loss		
	None n (%)	Lost ≥ 1 n (%)	Statistics (χ^2 , <i>p-value</i>)
Sex			
Male	42 (12.2)	303 (87.8)	
Female	6 (7.3)	76 (92.7)	1.566, 0.211
Age groups (yrs)			
≤ 44	44 (15.3)	244 (84.7)	
≥ 45	4 (2.9)	135 (97.1)	14.448, 0.001
Levels of education			
\leq primary	33 (12.6)	229 (87.4)	
\geq secondary	15 (9.1)	150 (90.9)	1.246, 0.264,

Number of tooth loss

A total of 3820 teeth were lost among all study participants with mean lost teeth of 8.95, SD = 7.772. About 27.0% (n=93), of males and 19.5% (n=16) of females had lost 13 to 31 teeth, while few males (n=4, 1.2%) had lost all teeth and none of the females had lost all teeth (Table 3). However, there was no statistical true difference in mean of number of tooth loss between males (mean= 9) and females (mean= 8.7) ($p=0.763$). The study showed that there was true mean difference in number of tooth loss between age groups ($p=0.001$). On the other hand, no difference in mean number of tooth loss between levels of education ($p= 0.260$).

A binomial logistic analysis reveals that there was statistical significance in association of age and tooth loss ($p=0.001$) (Table 4). Whereby, older age group (45yrs and above) were six times more likely to lose teeth than young groups. Sex and levels of education had no statistical significance association with tooth loss ($p=0.216, 0.266$ respectively) (Table 4).

Table 3: Distribution of study participants according to number of lost teeth and socio-demographic factors (n=3820)

Socio-demographic factors	Number of tooth loss				Statistics (t-test)
	None n (%)	Lost 1-12 n (%)	Lost 13-31 n (%)	Lost all 32 n (%)	
Sex					
Male	42 (2.2)	206 (59.7)	93 (27.0)	4 (1.2)	0.763
Female	6 (7.3)	60 (73.2)	16 (19.5)	0 (0.0)	
Age groups (yrs)					
≤ 44	44 (15.3)	188 (65.3)	55 (19.1)	1 (0.3)	0.001
≥ 45	4 (2.9)	78 (56.1)	54 (38.8)	3 (2.2)	
Levels of education					
≤ primary	33 (12.6)	161 (61.5)	68 (26.0)	0 (0.0)	0.260
≥ secondary	15 (9.1)	105 (63.6)	41 (24.8)	4 (4.4)	

Table 4: Binomial logistic regression for tooth loss according to socio-demographic factors

Socio-demographic factors	95% C.I. for EXP(B)			Wald	Significance
	Exp(B)	Lower	Upper		
Sex	1.756	0.720	4.282	1.531	0.216
Age groups	6.086	2.141	17.304	11.475	0.001
Levels of education	0.694	0.364	1.321	1.236	0.266

Types of tooth loss

Mandibular molars are the most lost teeth (n=318, 74%) among study participants followed by maxillary molars (n=277, 64.9%) (Table 5). The mandibular canines are the least lost teeth (n=36, 8.4%) followed by maxillary canines (n=90, 21.1%).

Table 6 shows that 73.6% (n=254) of males and 78.0% (n=64) of females had lost at least 1 or more mandibular molars, statistically, no difference on losing lower molars between males and females ($p=0.409$). On the maxilla, 63.8% (n=220) and 69.5% (n=57) of males and females respectively had lost molars, but also no statistical differences between males and females ($p=0.327$).

Seventy three point three percent (n=192) and 76.4% (n=126) of participants with primary education and secondary education respectively had lost at least 1 or more mandibular molars, but no statistical difference between the levels of education ($p=0.477$). Loss of maxillary molars by participants with primary education and below is 58.4% (n=153) and those with secondary education and above is 75.2% (n=124).

Statistically, there is a true difference of losing maxillary molar between levels of education ($p=0.001$) (Table 6). There is a significant difference in losing different types of teeth between age groups ($p < 0.05$).

Table 5: Distribution of study participants according to tooth loss and tooth types (n=427)

Type of teeth	Participants lost ≥ 1 teeth	
	n	%
Maxillary molars	277	64.9
Maxillary premolars	182	42.6
Maxillary canines	90	21.1
Maxillary incisors	221	51.8
Mandibular molars	318	74.5
Mandibular premolars	137	32.1
Mandibular canines	36	8.4
Mandibular incisors	116	27.2

Table 6: Distribution of types of tooth loss according to sex, age groups and levels of education (n= 427)

Type of teeth	Sex		Age groups (yrs)		Levels of education	
	Male n (%)	Female n (%)	≤ 44 n (%)	≥ 45 n (%)	≤ Primary n(%)	≥Secondary n (%)
Upper molars	220 (63.8)	57 (69.5)	158 (54.9)	119 (85.6)	153 (58.4)	124 (75.2)
$\chi^2, p\text{-value}$		0.959, 0.327		38.901, 0.001		12.471, 0.001
Upper premolars	148 (42.9)	34 (41.5)	101 (35.1)	81 (58.3)	104 (39.7)	78 (47.3)
$\chi^2, p\text{-value}$		0.056, 0.813		20.641, 0.001		2.377, 0.123
Upper canines	77 (22.3)	13 (15.9)	51 (17.7)	39 (28.1)	51 (19.5)	39 (23.6)
$\chi^2, p\text{-value}$		1.665, 0.197		6.036, 0.014		1.059, 0.304
Upper incisors	183 (53.0)	38 (46.3)	146 (50.7)	75 (54.0)	132 (50.4)	89 (53.9)
$\chi^2, p\text{-value}$		1.192, 0.275		0.400, 0.527		0.513, 0.474
Lower molars	254 (73.6)	64 (78.0)	202 (70.1)	116 (83.5)	192 (73.3)	126 (76.4)
$\chi^2, p\text{-value}$		0.683, 0.409		8.742, 0.003		0.506, 0.477
Lower premolars	107 (31.0)	30 (36.6)	76 (26.4)	61 (43.9)	77 (29.4)	60 (36.4)
$\chi^2, p\text{-value}$		0.944, 0.331		13.170, 0.001		2.260, 0.133
Lower canines	29 (8.4)	7 (8.5)	21 (7.3)	15 (10.8)	21 (8.0)	15 (9.1)
$\chi^2, p\text{-value}$		0.001, 0.969		1.487, 0.223		0.152, 0.697
Lower incisors	100 (29.0)	16 (19.5)	64 (22.2)	52 (37.4)	79 (30.2)	37 (22.4)
$\chi^2, p\text{-value}$		3.005, 0.083		10.930, 0.001		3.056, 0.080

Causes of tooth loss

Dental caries was the commonest cause of tooth loss, mentioned by 58.3% (n= 192) of the participants who had lost teeth followed by periodontal disease (n= 130, 39.6%) and traumatic injuries (n= 89, 26.9%). None of the participants mentioned any other reason for loss of their teeth.

Majority of males (n=227, 65.8%) and females (n=58, 70.7%) mentioned dental caries as the leading cause of their tooth loss and there was no statistical difference between males and females ($p= 0.531$). About age groups majority of them mentioned dental caries as a cause of tooth loss and there is a true difference between age groups (0.009). Among education levels the difference is not significant ($p=0.186$) (Table 7).

Concerning periodontal diseases there is a significant difference between age groups ($p= 0.001$). Traumatic injuries exhibit statistical true difference between all socio-demographic factors (Table 7).

Table 7: Distribution of reasons for tooth loss according to socio-demographic factors (n=379)

Causes of tooth loss	Socio-demographic factors					
	Sex		Age groups (yrs)		Education	
	Male n (%)	Female n (%)	≤ 44 n (%)	≥ 45 n (%)	≤ Primary n (%)	≥ Secondary n (%)
Dental caries	227(65.8)	58 (70.7)	182 (63.2)	103 (74.1)	167 (63.7)	118 (71.5)
x^2, p - value		1.267, 0.531		9.358, 0.009		3.365, 0.186
Perio diseases	170 (49.3)	47(57.3)	131 (45.5)	86 (61.9)	144 (55.0)	73 (44.2)
x^2, p - value		2.124, 0.346		13.767, 0.001		5.533, 0.063
Traumatic injuries	93 (27.0)	9 (11.0)	67 (23.3)	35 (25.2)	76 (29.0)	26 (15.8)
x^2, p -		12.111,0.00		8.479, 0.014		10.325,

value

2

0.006

Kennedy classification for partial tooth loss

On both jaws, upper and lower, Kennedy class III is dominant (n=157, 52.5% and n=152, 49.8% respectively) followed by class IV on the upper and class I on the lower (Table 8).

Table 8: Distribution of Kennedy classes for partial edentulous

Kennedy class	Upper jaw n= 299		Lower jaw n= 305	
	n	%	n	%
Kennedy class I	43	14.4	73	23.9
Kennedy class II	41	13.7	49	16.1
Kennedy class III	157	52.5	152	49.8
Kennedy class IV	58	19.4	31	10.2

Kennedy class III is dominant across all socio-demographic variables (sex, education and age) These observed data showed that there was no significant difference between sex ($p = 0.417$ upper jaw & 0.980 lower jaw) and education levels ($p = 0.165$ upper jaw & 0.113 lower jaw). However, there was significant statistical differences of Kennedy classes between age groups on both jaws ($p < 0.001$ upper jaw & lower jaw) (Table 9).

Table 9: Distribution of study participants according to Kennedy classes and socio-demographic factors (n= 427)

Kennedy class	Socio-demographic factors					
	Sex		Age groups (yrs)		Education	
	Male n (%)	Female n (%)	≤ 44 n (%)	≥ 45 n (%)	≤ Primary n (%)	≥ Secondary n (%)
Upper jaw						
Class I	37 (10.7)	6 (7.3)	24 (8.3)	19 (13.7)	26 (9.9)	17 (10.3)
Class II	35 (10.1)	6 (7.3)	13 (4.5)	28 (20.1)	29 (11.1)	12 (7.3)
Class III	121 (35.1)	36(43.9)	105 (36.5)	52 (37.4)	85 (32.4)	72 (43.6)
Class IV	50 (14.5)	8 (9.8)	44 (15.3)	14 (10.1)	37 (14.1)	21 (12.7)
χ^2, p - value	3.916, 0.417		37.131, 0.000		6.505, 0.165	
Lower jaw						
Class I	59 (17.1)	14 (17.1)	40 (13.9)	33 (23.7)	53 (20.2)	20 (12.1)
Class II	39 (11.3)	10 (12.2)	24 (8.3)	25 (18.0)	24 (9.2)	25 (15.2)
Class III	124 (35.9)	28 (34.1)	106 (36.8)	46 (33.1)	93 (35.5)	59 (35.8)
Class IV	26 (7.5)	5 (6.1)	21 (7.3)	10 (7.2)	20 (7.6)	11 (6.7)
χ^2, p - value	0.425, 0.980		21.381, 0.000		7.474, 0.113	

Prosthetic treatment need

Out of 379 subjects who have lost their teeth, only 6.3% (n=24) have dental prostheses. Table 10 indicates that dental prosthesis were provided in less than 10% of all participants who have tooth loss across both sexes, levels of education and age groups. The same table indicates that there are no significant differences in availability of prosthesis between sex, levels of education and between age group as their p – values are greater than the cutoff point of $p = 0.05$ (table 13).

Table 11 shows that there is no significant association of presence of prosthesis with sex, level of education or age ($p = 0.281, 0.861, 0.398$, respectively).

Table 10: Distribution of presence of prosthesis according to socio-demographic factors (n= 379)

Socio-demographic factors	Presence of prosthesis		Statistics (χ^2 , p -value)
	Yes n (%)	No n (%)	
Sex			
Male	19 (6.3)	284 (93.7)	0.044, 0.835
Female	5 (6.6)	71 (93.4)	
Age groups (yrs)			
≤ 44	15 (4.0)	232 (96.0)	1.304, 0.861
≥ 45	9 (2.4)	123 (97.6)	
Levels of education			
\leq primary	16 (6.9)	215 (93.1)	0.302, 0.582
\geq secondary	8 (5.4)	140 (94.6)	

Table 11: Binary logistic regression for presence of prosthesis according to socio-demographic factors

Socio-demographic factors	95% C.I. for EXP(B)			Wald	Significance
	Exp(B)	Lower	Upper		
Sex	1.716	0.642	4.582	1.160	0.281
Age groups	0.828	0.336	2.045	0.167	0.683
Education	1.455	0.610	3.472	0.713	0.398

Types of prosthesis

Regarding the types of prosthesis, table 12 shows that removable acrylic partial denture was the leading type of prosthesis on both jaws; upper jaw 81.8% (n=18) and lower jaw 88.9% (n=8). None of the study participants reported to have dental implant or cast metal removable partial denture.

Also from table 13, it is seen that there are no significant differences on the presence of different types of prosthesis between sex and levels of education ($p > 0.05$).

Table 12: Types of prosthesis among study participants with prosthesis (n= 31)

Type of jaw	Type prosthesis				
	ALL	RPD n (%)	CD n (%)	FPD n (%)	IMPLANT n (%)
Upper jaw	22	18 (81.8)	2 (9.1)	2 (9.1)	0 (0.0)
Lower jaw	9	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)
Total	31	26 (83.9)	2 (6.4)	3 (9.7)	0 (0.0)

Table 13: Distribution of types of prosthesis according to sex and levels of education (n = 31)

Sex	Type of prosthesis			
	ALL	RPD n (%)	CD n (%)	FD n (%)
Male	22	18 (81.8)	2 (9.1)	2 (9.1)
Female	9	8 (88.9)	0 (0.0)	1 (11.1)
$\chi^2, p\text{-value}$		0.890, 0.345	0.478, 0.490	1.228, 0.268
Levels of Education				
\leq primary	21	17 (81.0)	1 (4.8)	3 (14.2)
\geq secondary	10	9 (90.0)	1 (10.0)	0 (0.0)
$\chi^2, p\text{-value}$		(0.000, 0.982)	(0.109, 0.741)	(1.265, 0.261)

CHAPTER FOUR

DISCUSSION

This was a cross section study aiming to determine the prevalence of tooth loss and their associated factors, also was to determine prosthetic treatment need among patients receiving methadone maintenance therapy in Dar es Salaam. It was a hospital based study conducted in Dar es Salaam city thus; the findings cannot be generalized to Tanzania general population.

Participants were obtained by systematic sampling from the list of all patients attending methadone maintenance therapy clinics in Dar es Salaam. Each center (Mwananyamala, Temeke and MNH) had its own list and each sex was listed separately. Majority of participants were males compared to females. This may be explained by the fact that males are much more involved in substance use than females.

On the other hand, majority of the participants were aged 44 years or below and had primary education or less. This may be due to that teenagers and young adults are more involved in substance use. On the other hand, people with informal and primary education may not be well knowledgeable about the effect of substance use and therefore are more likely to be subjected to this behavior.

This study shows that about 4 out of 5 of study participants had lost one or more teeth. This prevalence of tooth loss is nearly the same as that of Dar es Salaam and Mtwara general population (27, 33). However, this prevalence slightly differs from that of Sudanese and Brazilian general population (25, 29). This difference may be attributed to differences in study design and the characteristics of the study population involved.

Among sex, majority of the males and females have lost one or more teeth and the difference between them is not statistically significant ($p= 0.211$). This finding differs from that of Coastal region (32), Dar es Salaam region (27) and Nigeria (31) which show that females are more affected than males. This difference may be because of this study being conducted among SUD patients who may have been affected by substance use equally between sex compared to other studies which were conducted in general population.

Majority of participants across all age groups had lost one or more teeth, and there is a significant difference of losing teeth between age groups, older age are losing more teeth than young ones ($p=0.001$). This phenomena is described by the fact that due to aging, dental tissues and periodontium are subjected to different stresses and disease conditions like dental caries and periodontal diseases which lead to tooth loss.

Mean tooth loss in this study is higher than that of the general population of Dar es Salaam and Pwani regions (27). Also this mean number of missing teeth is higher than that of Kenyan and Sudanese general population (36, 25). This may be due to the effect of substance use which are altered mental, physical and behavioral characteristics of an individual leading to reduced dental care thus causing tooth loss (5). In this study only 1.2% of the participants have lost all teeth and all are males. This finding is different from Mtwara general population where 2.4% are completely edentulous (33). This difference may be attributed to the study population of SUD patients of which most of them are young adults and thus less likely to have lost all teeth.

This study shows that there is mean difference in number of tooth loss between age groups, older age group losing more teeth than young ones. A binomial logistic analysis reveals that there is statistical significance in association of age and tooth loss. This finding is similar to that of Zanzibar and Pemba general population which shows that the mean number of missing teeth is low in the youngest group (30-34 years) and higher in the oldest age group (50 years and above) (37). The similarity is also seen in Sudanese, Sweden and Indonesian populations, where the mean number of tooth loss is seen to increase with age (25, 39, 41). However, this study shows that there is no difference in mean number of tooth loss between levels of education and between sexes. This may be due to lack of oral health services like oral health education and oral health promotion affecting equally across sexes and all education levels. But also may be due to patho-physiological effect of substance use which does not consider the education or sex of an individual.

Due to their anatomical features, mandibular molars are the most lost teeth among participants of this study followed by maxillary molars. These teeth have pits and fissures in which food stuffs are trapped and are difficult to clean leading to dental caries and subsequently tooth loss. Canines, due to their strong and long roots are shown in this study to be the least lost teeth. This findings corresponds to that of Unguja and Pemba general population whereby in all age groups the molars are the most frequently missing teeth (37). Also in Kenya the most commonly missing teeth are lower molars followed by upper molars (48). Other similarities to this finding are seen in Nigerian and Iraq general populations where it is shown that greater percent of the extracted teeth are molars led by lower molars (31, 34). Findings of this study show that there is no significant difference in losing molars between sexes, but there is true difference between age groups and between levels of education. This may be due to that age is associated with cumulative effects of dental caries and periodontal diseases leading to losing more molars in elders, and secondary education improves knowledge on dental care which leads to losing fewer molars.

Among study participants who lost their teeth, majority mentioned dental caries as the leading cause of tooth loss followed by periodontal disease and then traumatic injuries. This findings coincides with that of Mtwara general population which shows that the leading cause of tooth loss is dental caries then periodontal diseases and trauma (33). Also in Dar es Salaam, more than half of tooth loss was due to caries (27). The same phenomena is seen in Kenyan, Nigerian, Brazilian and Japanese populations whereby dental caries and periodontal diseases are the main reasons for teeth extractions (48, 31, 47, 45).

The findings of this study shows that between sexes there is no significant difference in dental caries and periodontal diseases as the cause of tooth loss, but there is a significant difference in traumatic injuries. This may be attributed to males being more violent thus losing more teeth by injuries than females. With regard to age groups, the study shows that there is a true difference between age groups in all three causes of tooth loss mentioned by participants. This means that older age group (45 years and above) are losing more teeth due to these causes than the young group. This is because aging is accompanied by experiencing more caries,

periodontal diseases and traumatic injuries. The findings corresponds to that of Japan and Brazil which show that extraction due to caries or fracture is common in all age groups over 15 years of age, while periodontal disease is predominant in the groups over 45 years of age (45, 47).

Between levels of education, dental caries and periodontal diseases show no significant differences but traumatic injuries show a true difference. This may be because less educated individuals are more violent and thus lose more teeth than more educated individuals.

On both jaws and all socio-demographic variables, Kennedy class III is the most dominant class among partially edentulous participants followed by class IV on the upper and class I on the lower. Kennedy class III is the bound edentulous area with remaining teeth on both sides. The teeth in between dentition are much more prone to dental caries and periodontal diseases because of difficulties in cleanliness on proximal surfaces and gingival margins leading to tooth loss. This finding show similarities with that of Indian population which indicates that the prevalence of Kennedy class III is more in both sexes (52). Other studies with similar findings are from Jordanian, Egyptian, Nigerian and Pakistan population showing that Kennedy class III is the most common classification encountered in the maxilla and mandible (53, 55, 56, 50). Findings on this study show that there are no significant differences on the prevalence of Kennedy classes between sexes and levels of education but difference exist between age groups. This may be due to that apart from dental caries and periodontal diseases, older age group may have other co-morbidities like diabetes which weakens periodontal and dental tissues leading to tooth loss in different patterns compared to young age group.

Tooth loss can be treated by replacement with artificial teeth-like prostheses in order to restore mastication, aesthetics, and speech (23), but also to maintain the integrity of the alveolar bone and facial profile. Information on prosthetic need among SUD patients will help to find out the degree of treatment required in this particular group.

This study shows that few of the participants, who had lost their teeth, have dental prosthesis. The need for dental prosthesis is high in this particular group. The findings are different from

that of the general population in Sri Lanka, Iraq, Nigeria, Sudan and Tanzania where prosthetic need is less than fifty percent (61, 34, 72, 25, 67). This scarcity of dental prostheses among the needy population may be attributed to the lack of oral health services in universal health systems and special disadvantaged groups like SUD patients. But also may be due to the high cost of purchasing these dental prostheses.

On the other hand, findings of this study show that there are no significant differences in availability of prosthesis between sex, levels of education and age group. This is contrary to the data from Poland and Nigeria general population, which show that higher education is associated with wearing of dental prostheses while low education is associated with not wearing dental prostheses (30, 72). The reason for this observation may be due to unavailability of oral health services in SUD patient treatment centers affecting all socio-demographic factors in equal proportions. But also substance use affects individual's mental health in equal proportions regardless of their sex, age or education thus leading to impaired ability of recognizing the importance of having dental prostheses. Poor economy of SUD patients across all socio-demographic factors also explain why there is no difference of having prostheses between them.

The most common available dental prostheses are removable partial denture, removable complete denture, fixed bridge and dental implant (24). Demand, fabrication and deliverance of these dental prostheses depend on proper information to the patient, expert availability and economic status of the patient as other types of prostheses are very expensive.

Findings of this study show that removable acrylic partial denture was the leading type of prosthesis on both jaws. This is may be attributed to the fact that in this country and most other developing countries removable acrylic partial dentures are taken as definitive treatment while basically they are intermediate dentures. This may be due to scarcity of resources and lack of expertise to fabricate cast metal dentures.

None of the study participant was found to have dental implants, this may be due to that this type of prosthesis need special expertise and are expensive thus not readily available. This

finding coincides with that of Nigerian general population whereby majority had removable partial dentures and few had implant supported dentures (71). But also among Georgian population only 0.1% have replaced missing teeth with dental implants (70). However, In United States of America, the prevalence of dental implants is high and is more prevalent in individuals who have high education (69). This may be due to the availability of services, experts and high purchasing power of the citizens. Placement of other types of prostheses which are removable complete denture and partial fixed denture depends on clinical presentation of the individual oral condition, presence and status of the remaining teeth.

Findings of this study showed that removable complete denture and partial fixed denture are available in low proportions. This is because few participants were missing all teeth, and other remaining teeth could not support fixed dentures due to poor oral hygiene and periodontal status. But also availability of the service and its cost affects the presence of the fixed prostheses. This observation corresponds to that of Nigerians whereby only 1% had fixed bridge (71). However, in European countries prevalence of fixed prostheses including crowns and bridges is high (62). This difference may be due to scarcity of dental services in our settings compared to European countries, poor socio-economic status and poor oral hygiene status which contraindicate placement of fixed prostheses.

This study shows that there are no significant differences on the presence of different types of prosthesis between sex and levels of education. This observation contradicts findings from European countries where higher frequency of removable dentures is present in subjects with less education (62). Also in United States of America, the prevalence of dental implants is more in individuals who have high education (69). This difference in observation may be due to the study population involved whereby this study was conducted among SUD patients who may have altered mental status and thus not properly knowledgeable regarding types and choice of dental prostheses.

CONCLUSION

Prevalence of tooth loss among SUD patients is high and common causes of tooth loss among these patients are the same as in general population which are dental caries, periodontal diseases and traumatic injuries. Only a small percent of the participants are having dental prosthesis thus prosthetic treatment is highly needed in this particular group.

RECOMMENDATIONS

Based on the findings of this study the following recommendations are made:

1. Oral health services should be established in methadone maintenance therapy clinics in order to provide dental services to SUD patients attending these clinics.
2. Oral health education and promotion should be initiated among SUD patients as preventive strategies.
3. More studies are required to evaluate other oral health conditions like dental caries and periodontal diseases among SUD patients.

REFERENCES

1. Teoh Bing Fei J, Yee A, Habil MH Bin, Danaee M. Effectiveness of Methadone Maintenance Therapy and Improvement in Quality of Life Following a Decade of Implementation. *J Subst Abuse Treat.* 2016;69:50–6.
2. McLellan AT. Substance Misuse and Substance use Disorders: Why do they Matter in Healthcare? *Trans Am Clin Climatol Assoc.* 2017;128:112–30.
3. Bjarnason T, Jonsson SH. Contrast effects in perceived risk of substance use. *Subst Use Misuse.* 2005;40(11):1733–48.
4. Rees TD, Levine RA. The adverse effects of alcohol and drug abuse in the oral cavity. In: *Handbook of the Medical Consequences of Alcohol and Drug Abuse, Second Edition.* 2012. p. 565–78.
5. Titsas A, Ferguson MM. Impact of opioid use on dentistry. Vol. 47, *Australian Dental Journal.* 2002. p. 94–8.
6. Ettner SL, Huang D, Evans E, Ash DR, Hardy M, Jourabchi M HY. Benefit-cost in the California treatment outcome project: Does substance abuse treatment “pay for itself”? *Health Serv Res.* 2006;41(1):192–213.
7. McLellan AT, Lewis DC, O’Brien CP KH. Drug dependence, a chronic medical illness: Implications for treatment, insurance, and outcomes evaluation. *JAMA.* 2000;284(13):1689–1695.
8. PEPFAR. Comprehensive HIV Prevention for People Who Inject Drugs, Revised Guidance. <http://www.pepfar.gov/documents/organization/144970.pdf>. 2017.
9. Bruce RD, Lambdin B, Chang O, Masao F, Mbwambo J, Mteza I ... Kilonzo G. Lessons from Tanzania on the integration of HIV and tuberculosis treatments into methadone assisted treatment. *Int J Drug Policy.* 2014;25(1):22–5.

10. Mbwambo J. New treatment gives hope to East Africa's drug users. *Bull World Health Organ.* 2013;91:89–90.
11. Nathwani NS, Gallagher JE. Methadone: dental risks and preventive action. Vol. 35, *Dental update.* 2008.
12. Robinson PG, Acquah S, Gibson B. Drug users: Oral health-related attitudes and behaviours. *Br Dent J.* 2005;198(4):219–24.
13. Osunde.OD EK. Reasons for loss of the Permanent Teeth in patients in Kano , North Western Nigeria. 2017;7(2).
14. Testa M. The Role of Substance Use in Male-to-Female Physical and Sexual Violence. *J Interpers Violence.* 2004;19(12):1494–505.
15. Gaewkhiew P, Sabbah W, Bernabé E. Does tooth loss affect dietary intake and nutritional status? A systematic review of longitudinal studies. Vol. 67, *Journal of Dentistry.* 2017. p. 1–8.
16. Nakata M. Masticatory function and its effects on general health. *Int Dent J.* 1998;48(6):540–8.
17. Lund AE. Depression and anxiety linked to tooth loss. *J Am Dent Assoc.* 2014;145(5):426.
18. Al-Omiri MK, Karasneh JA, Lynch E, Lamey P-J, Clifford TJ. Impacts of missing upper anterior teeth on daily living. *Int Dent J.* 2009;59(3):127–32.
19. Idrees N, Ghani F. Demands, needs, expectations, patterns and reasons among patients for treatment with fixed dental prostheses. *J Postgrad Med Inst.* 2008;22(4):313–9.
20. McGarry TJ, Nimmo A, Skiba JF, Ahlstrom RH, Smith CR, Koumjian JH, et al. Classification system for partial edentulism. *J Prosthodont.* 2002;11(3):181–93.

21. Zaigham AM, Muneer MU. Kennedy's class III was the most frequent classification encountered (62%) and followed by Kennedy's class I (18%), class II (11%), and class IV (9%) in decreasing order. *Pakistan Oral Dent J.* 2010;30(1):260–3.
22. Skinner CN. A classification of removable partial dentures based upon the principles of anatomy and physiology. *J Prosthet Dent.* 1959;9(2):240–6.
23. Morin A, Lopez I, Coeuriot JL, Millet P. Artificial teeth and removable prosthesis. *EMC-Odontologie.* 2005;1(1):1–12.
24. JADA. Bridges, implants, and dentures. *J Am Dent Assoc.* 2015;146(6):490.
25. Khalifa N, Allen PF, Abu-bakr NH, Abdel-Rahman ME. Factors associated with tooth loss and prosthodontic status among Sudanese adults. *J Oral Sci.* 2012;54(4):303–12.
26. Kane SF. The effects of oral health on systemic health. *Gen Dent.* 2017;65(6):30–4.
27. Kida IA, Åström AN, Strand G V., Masalu JR. Clinical and socio-behavioral correlates of tooth loss: A study of older adults in Tanzania. *BMC Oral Health.* 2006;6(1):5.
28. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJL, Marcenes W. Global Burden of Severe Tooth Loss. *J Dent Res.* 2014;93(7_suppl):20S–28S.
29. Susin C, Oppermann R V., Haugejorden O, Albandar JM. Tooth loss and associated risk indicators in an adult urban population from south Brazil. *Acta Odontol Scand.* 2005;63(2):85–93.
30. Mehr K, Olszanecka-Glinianowicz M, Chudek J, Szybalska A, Mossakowska M, Zejda J, et al. Dental status in the Polish senior population and its correlates—Results of the national survey PolSenior. *Gerodontology.* 2018;35(4):398–406.
31. Oginni FO. Tooth loss in a sub-urban Nigerian population: causes and pattern of mortality revisited. *Int Dent J.* 2005;55(1):1–1.

32. Sarita PTN, Witter DJ, Kreulen CM, Creugers NHJ, Matee MI, Van't Hof MA. Decayed/missing/filled teeth and shortened dental arches in Tanzanian adults. *Int J Prosthodont.* 2004;17(2):224–30.
33. Mumghamba EG, Fabian FM. Tooth loss among habitual chewing-stick and plastic toothbrush users in the adult population of Mtwara, rural Tanzania. *Int J Dent Hyg.* 2005;3(2):64–9.
34. Talabani R mahmood, Bds D, Hama D, Bds G. Pattern of Missing Tooth with Prosthetic Status among Patients Attending To Dental School. *IOSR J Dent Med Sci Ver II.* 2015;14(7):2279–861.
35. Baqar, A., Mirza, D., Ahmad, S., & Hakeem S. Pattern of missing teeth in patients seen in prosthodontic department in a teaching hospital of Karachi. *Pakistan oral Dent J.* 2014;34(2).
36. Sanya BO, Ng'ang'a PM NR. Causes and pattern of missing permanent teeth. *East Afr Med J.* 2004;81(6):322–5.
37. Baelum V, Fejerskov O. Tooth loss as related to dental caries and periodontal breakdown in adult Tanzanians. *Community Dent Oral Epidemiol.* 1986;14(6):353–7.
38. Müller F, Naharro M, Carlsson GE. What are the prevalence and incidence of tooth loss in the adult and elderly population in Europe? Vol. 18, *Clinical Oral Implants Research.* 2007. p. 2–14.
39. Hugoson, A., Koch, G., Gothberg, C. H, A.N., Lundin, S.A., Norderyd, O., Sjodin B&, Sondell. K. Oral health of individuals aged 3–80 years in Jonkoping, Sweden during 30 years (1973–2003). *Swed Dent J.* 2005;29:139–55.
40. Hescot, P., Bourgeois, D. & Doury J. Oral health in 35–44 year old adults in France. *Int Dent J.* 1997;47:94–9.

41. Elisa M, Odang RW, Masulili C. Relationship Between Prosthodontic Treatment Awareness with Number and Position of Tooth Loss. *UI Proc Heal Med*. 2017;1(1):11–4.
42. Batista, M. J., Lawrence, H. P., & de Sousa MDLR. Impact of tooth loss related to number and position on oral health quality of life among adults. *Health Qual Life Outcomes*. 2014;12(1):165.
43. Chukwu G, Adeleke O, Danfillo I, Otoh E. Dental caries and extractions of permanent teeth in Jos, Nigeria. *African J Oral Heal*. 2004;1(1).
44. Da’ameh D. Reasons for permanent tooth extraction in the North of Afghanistan. *J Dent*. 2006;34(1):48–51.
45. Aida J, Ando Y, Akhter R, Aoyama H, Masui M, Morita M. Reasons for permanent tooth extractions in Japan. *J Epidemiol*. 2006;16(5):214–9.
46. Chrysanthakopoulos NA. Reasons for extraction of permanent teeth in Greece: A five-year follow-up study. *Int Dent J*. 2011;61(1):19–24.
47. Montandon A, Zuza E, Toledo BE. Prevalence and reasons for tooth loss in a sample from a dental clinic in Brazil. *Int J Dent*. 2012;
48. Sanya BO, Ng’ang’a PM, Ng’ang’a RN. Causes and pattern of missing permanent teeth among Kenyans. *East Afr Med J*. 2004;81(6):322–5.
49. Soomro MA, Maqsood S, Afaq A, Maqsood QA. Partial edentulism based on Kennedy’s classification. *Med Forum Mon*. 2012;23(11):14–7.
50. Nayyer M, Khan DA, Gul H, Aslam A, Khan NB, Aslam F. Patterns of Partial Edentulism According to Kennedy’s Classification – A Cross Sectional . Vol. 70, *Partial Edentulism Pak Armed Forces Med J*. 2020.

51. Bharathi M, Mahesh Babu KR, Reddy G, Gupta N, Misuriya A, Vinod V. Partial edentulism based on Kennedy's classification: An epidemiological study. *J Contemp Dent Pract.* 2015;15(2):229–31.
52. Devishree RA, Sangeetha S, Jain AR. Prevalence of partial edentulism according to Kennedy's classification based on age, gender, and arch. *Drug Invent Today.* 2018;10(1):108–10.
53. AL-Dwairi ZN. Partial edentulism and removable denture construction: a frequency study in Jordanians. *Eur J Prosthodont Restor Dent.* 2006;14(1):13–7.
54. Fayad MI, Baig MN, Alrawaili AM. Prevalence and pattern of partial edentulism among dental patients attending College of Dentistry, Aljouf University, Saudi Arabia. *J Int Soc Prev Community Dent.* 2016;6(9):S187–91.
55. Moussa A, Ibrahim E, Esmat A, Eissa S, Ramzy M. An overview of oral health status, socio-economic and behavioral risk factors, and the pattern of tooth loss in a sample of Egyptian rural population. *Bull Natl Res Cent.* 2020;44(1).
56. Ehikhamenor EE, Oboro HO, Onuora OI, Umanah AU, Chukwumah NM, Aivboraye IA. Types of removable prostheses requested by patients who were presented to the University of Benin Teaching Hospital Dental Clinic. *J Dent Oral Hyg.* 2010;2(2):15–8.
57. AlZarea BK. Dental prosthetic status and prosthetic needs of geriatric patients attending the College of Dentistry, Al Jouf University, Kingdom of Saudi Arabia. *Eur J Dent.* 2017;11(4):526–30.
58. Peeran SA, Al Sanabani F, AL-Makramani BMA, Elamin EI. Dental prosthetic status and treatment needs of adult population in Jizan, Saudi Arabia: A survey report. *Eur J Dent.* 2016;10(4):459–63.
59. Kumar S, Tadakamadla J, Tibdewal H, Prabu D, Kulkarni S. Dental prosthetic status and treatment needs of green marble mine laborers, udaipur, India. *Dent Res J (Isfahan)*

60. Pallegedara C, Ekanayake L. Tooth loss, the wearing of dentures and associated factors in Sri Lankan older individuals. *Gerodontology*. 2005;22(4):193–9.
61. Thilakumara Malshani L Pathirathna Sanjeewa Kularatna Ruwan D Jayasinghe IP. Effect of Tooth Loss and Denture Status on Oral Health Related Quality of Life in Institutionalized Older Individuals in Sri Lanka. Vol. 47, *Dental Journal*. 2017.
62. Zitzmann NU, Marinello CP, Zemp E, Kessler P, Ackermann-Liebrich U. Tooth loss, dental restorations and dental attendance in Switzerland. *Schweiz Monatsschr Zahnmed*. 2001;111(11):1288–94.
63. Esan TA, Olusile AO, Akeredolu PA, Esan AO. Socio-demographic factors and edentulism: The Nigerian experience. *BMC Oral Health*. 2004;4.
64. Olabisi AA, Ifeanyi CE. Teeth Retention, Prosthetic Status and Need among a Group of Elderly in Nigeria. *Dentistry*. 2012;02(01).
65. Mosha H, Senkoro A, Masalu J, Kahabuka F, Mandari G, Mabelya L, et al. Oral health status and treatment needs among Tanzanians of different age groups. *Tanzania Dent J*. 2006;12(1).
66. Quaker AS. Consequences of Tooth Loss on Oral Function and Need for Replacement of Missing Teeth Among Patients Attending Muhimbili Dental Clinic. *Dr Diss Muhimbili Univ Heal Allied Sci*. 2011;(November):27–9.
67. Åström AN, Kida IA. Perceived dental treatment need among older Tanzanian adults - A cross-sectional study. Vol. 7, *BMC Oral Health*. 2007.
68. Zitzmann NU, Haggmann E, Weiger R. What is the prevalence of various types of prosthetic dental restorations in Europe? *Clin Oral Implants Res*. 2007;18(SUPPL. 3):20–33.
69. Elani HW, Starr JR, Da Silva JD, Gallucci GO. Trends in Dental Implant Use in the

- U.S., 1999–2016, and Projections to 2026. *J Dent Res*. 2018;97(13):1424–30.
70. Makhviladze G, Tsitaishvili L, Kalandadze M, Margvelashvili V. Evaluation of edentulism, prosthetic status and prosthodontics treatment needs among the adult population of Georgia. *Georgian Med News*. 2016;(253):30–4.
 71. Ogunrinde TJ, Gbadebo SO, Sulaiman AO. Trend in prosthetic rehabilitation of partially edentulous patients in a Nigerian teaching hospital. *J West African Coll Surg*. 2015;5(2):84–99.
 72. Ibiyemi O, Lawal FB. A short report on tooth replacement in an older suburban population in Nigeria. *Gerodontology*. 2017;34(4):508–11.

APPENDICES

Appendix 1(a): Informed Consent form – English version

**MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
DIRECTORATE OF RESEARCH AND PUBLICATIONS**



INFORMED CONSENT FORM

ID. No. [][][]

Age (yrs) Sex: (M=1, F=2) []

Consent to Participate in a Study

Greetings! My name is Dr. Francis Robert Kamugisha; I am doing a research on tooth loss - prevalence, classification and treatment among patients attending methadone maintenance therapy clinics in Dar es Salaam.

Purpose of the study

The study is conducted in partial fulfillment of the requirements for the degree of Master of Dentistry in Restorative dentistry of MUHAS.

You are kindly requested to participate in this study as part of major stakeholders in the field and information obtained will provide great contribution in the process of improving services and science. Kindly please be honest and true for betterment of the results that could lead to better intervention and recommendations for future.

Your participation will involve the following

If you agree to join the study, you will first be asked some questions concerning your personal particulars. Secondly, a researcher will perform a brief examination on your mouth, and then a summary of the findings will be offered to you with some advices and referral for possible treatment if necessary.

Confidentiality

All information collected on forms will be entered into computers with only the study identification number. Confidentiality will be observed and unauthorized persons will have no access to the data collected.

Risks: There no any harm expected to happen to you because of participating in this study.

Right to participate and withdraw

Taking part in this study is completely voluntary. You can stop participating in this study at any time, even if you have already given your consent. Refusal to participate or withdrawal from the study will not involve penalty or affect your scheduled treatment.

Benefits

If you agree to participate in this study, you will be offered oral health education on how to take care of your teeth. You will be given advice according to oral examination results and referred for treatment if necessary.

The result of the study will give information that will enable creation of awareness on the magnitude of tooth loss, the classification of tooth loss and the proportion of prostheses among patients on methadone maintenance therapy. Also will enable oral health stakeholders and policy makers to plan and integrate oral health services with methadone maintenance therapy.

Who to Contact

For any concern about this study, you may contact the following:

- Principal researcher: Dr Francis Kamugisha of Muhimbili University of Health and Allied Sciences, P. O. Box 65001, Dar es Salaam. (mob: 0753679030/0714421179)
- Chairperson of MUHAS IRB research and ethics committee, Dr, Bruno Sunguya - P. O. Box 65001 Dar es Salaam, Tel: +255 22 2152489
- Supervisor - Dr. Elifuraha Mumghamba (mob: 0716176478/0788422245)
- Supervisor - Dr. Tumaini Simon (mob: 0713503879)

Participant agrees Participant does NOT agree

Participant declaration

I have read the contents in this form. My questions have been answered. I agree to participate in this study.

Signature of participant

Date of signed consent

Appendix 1(b): Informed Consent form – Swahili version

**CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI
KURUGENZI YA TAFITI NA UCHAPISHAJI**



FOMU YA RIDHAA YA KUSHIRIKI KWENYE UTAFITI

Nambayautambulisho[] Umri: (*miaka*); Jinsia: (*me=1, ke=2*) []

Ridhaayakushirikikwenyeutafiti

Hujambo! Ninaitwa Dr. Francis Robert Kamugisha, nafanya utafiti kuhusiana na hali ya kutokuwa na meno, aina, madaraja pamoja na matibabu yake kwa wagonja wanaopata matibabu ya methadone katika hospitali za Dar es salaam.

Malengo ya utafiti

Utafiti huu unafanyika katika kutimiza sehemu ya matakwa ya shahada ya uzamili ya matibabu ya kurekebisha na kuziba meno ya Chuo Kikuu cha Afya na Sayansi ya Tiba Muhimbili.

Unaombwa kushiriki katika utafiti huu kutokana na ukweli kwamba wewe ni mdau muhimu kwenye sekita hii ya kinywa na meno. Taarifa zitakazopatikana zitatoa mchango mkubwa kwenye kuboresha huduma za kinywa na meno na katika sayansi kwa ujumla. Tafadhali kuwa mkweli na muwazi ili tupate matokeo mazuri yatakayotoa maamuzi na mapendekezo ya baadaye.

Ushiriki wako utakuwa kama ifuatavyo

Ukikubali kushiriki katika utafiti huu, kwanza, utasailiwa kuhusu taarifa zako binafsi, pili mtafiti atafanya uchunguzi mfupi kwenye kinywa chako. Badae utapewa muhtasari wa matokeo ya uchunguzi huo na utapewa ushauri pamoja na rufaa kwa ajili ya matibabu kama itaonekana kuna ulazima.

Usiri

Taarifa zote zitakazokusanywa kupitia dodoso zitaingizwa kwenye ngamizi kwa kutumia namba za utambulisho tu. Kutakuwa na usiri na hakuna mtu yeyote asiyehusika atakayepata taarifa zilizokusanywa.

Madhara na faida za utafiti huu

Hakuna madhara yoyote yanayotarajiwa kukutokea kwa kushiriki kwenye utafiti huu. Faida za utafiti huu, ni kuwa utapewa ushauri namna ya kutunza meno yako, utashauriwa kulingana na matokeo ya uchunguzi wa kinywa chako pamoja na kupewa rufaa ya matibabu kama itaonekana ni muhimu. Matokeo ya utafiti huu yatasaidia kuongeza uelewa kuhusu hali ya kutokuwa na meno, ukubwa wake, aina ya meno yaliyotoka, madaraja na matibabu yake kwa wagonjwa wanaopata matibabu ya methadone. Lakini pia, matokeo yatasaidia wadau na watunga sera kuweka mikakati na kuunganisha huduma za afya ya kinywa na meno pamoja na matibabu ya methadone.

Uhuru wa kushiriki na haki ya kujitoa

Kushiriki kwenye utafiti huu ni hiari, unaweza kujitoa wakati wowote hata kama umeshajaza fomu ya ridhaa ya kushiriki. Kukataa kushiriki au kujitoa kwenye utafiti huu hakutakuwa na masharti yoyote.

Mawasiliano

Kama una maswali kuhusiana na utafiti huu, wasiliana na hawa wafuatao:

- Mtafiti mkuu: Dr Francis Robert Kamugisha wa Chuo Kikuu cha Afya na Sayansi ya Tiba Muhimbili, (MUHAS) S. L. P. 65001, Dar es Salaam. Simu: 0753679030/0714421179
- Mwenyekiti wa kamati ya maadili na utafiti (MUHAS IRB) Dr. Bruno Sunguya S.L.P 65001, Dar es Salaam Simu: +255 22 2152489
- Msimamizi: Dr. ElifurahaMumghamba (simu: 0716176478/0788422245)
- Msimamizi: Dr. Tumaini Simon (simu: 0713503879)

Mshiriki amekubali Mshiriki hajakubali

Mimi nimesoma na kuelewa maelezo ya fomu hii.

Maswali yangu yamejibiwa.Nakubali kushiriki katika utafiti huu.

Sahihi ya mshiriki

Tarehe ya kutia sahihi ya idhini ya kushiriki.....

Appendix 2: Investigation tools

Appendix 2 (a); Questionnaire – English version

1. Identification Number:

2. **Date:** year month day

3. **Sex:** 1= male, 2= female

4. **Age:** Years

5. **Education level:** 1= no formal education, 2 = primary education, 3 =ordinary secondary education, 4 = advanced secondary education, 5 = college/university education

6. Have you ever visited a dentist? 1 = yes, 2 = no

7. If yes for question 6, what was the reason?

1. Dental pain 1 = yes, 2 = no

2. Trauma 1 = yes, 2 = no

3. Bad breath 1 = yes, 2 = no

4. Check up 1 = yes, 2 = no

5. Bleeding gums 1 = yes, 2 = no

6. Oral ulcers 1 = yes, 2 = no

7. Others (mention)

8. If no for question 6, why?
- 1= scared of dentist, 2 = no need, 3 = economic reasons
9. Do you experience dry mouth? 1 = yes, 2 = no
10. How frequently do you clean your teeth per day?
- 1= not every day, 2 = once, 3 = twice, 4= thrice
11. Do you use plastic tooth brush for cleaning your teeth?
- 1 = yes, 2= no
12. Do you use chewing stick for cleaning your teeth?
- 1 = yes, 2= no
13. Do you use sand for cleaning your teeth?
- 1 = yes, 2= no
14. Do you use fluoridated toothpaste for cleaning your teeth?
- 1 = yes, 2= no
15. Do you use charcoal for cleaning your teeth?
- 1 = yes, 2= no
16. How often do you consume sugary food or drinks per day?
- 1= never, 2 = once, 3 = twice, 4 = thrice, 5 = more than 4 times
17. Have you ever lost any teeth? 1 = yes, 2 = no
18. What were the reasons for loosing teeth?
1. cavities on the teeth, 1 = yes, 2 = no
 2. excessive mobility of the teeth, 1= yes, 2= no
 3. traumatic injuries, 1 = yes, 2 = no
 4. Others (mention)

19. Do you have any artificial teeth 1 = yes, 2 = no

20. Have you ever been involved in any violence in a past 12 months? 1 = Y, 2 = N

21. If yes for question 27, what impact did it cause on your teeth?

1. Caused no any impact 1 = yes, 2 = no

2. Fractured the teeth, 1 = yes, 2 = no

3. Made the teeth to be loose 1 = yes, 2 = no

4. Extracted the teeth 1 = yes, 2 = no

5. Displaced the teeth 1 = yes, 2 = no

22. Have you ever fall down due to substance use and sustain injuries on your teeth?
1 = yes, 2 = no

23. Have you ever got an accident due to substance use and sustain injuries on your teeth?
1 = yes, 2 = no

Appendix 2 (b); Questionnaire – Swahili version

1. **Number ya utambulisho:**

2. **Tarehe:** mwaka mwezi siku

3. **Jinsia:** 1= mme, 2= mke

4. **Umri:** miaka

5. **Kiwango cha elimu:** 1= sina elimu maalum, 2 = elimu ya msingi, 3 = secondary kidato cha nne, 4 = secondary kidato cha sita, 5 = chuo au chuo kikuu

6. Ulishawahi kuhudhuria kwa daktari wameno? 1 = ndio, 2 = hapana

7. Kama ni ndio kwa swali la 6, sababu ilikuwa ni nini?

1. maumivu ya jino 1= ndio, 2 = hapana

2. majeraha kwenye mdomo 1= ndio, 2 = hapana

3. harufu mbaya 1= ndio, 2 = hapana

4. kufanya uchunguzi 1= ndio, 2 = hapana

5. Kutoka damu kwenye fizi 1= ndio, 2 = hapana

6. vidondamdomoni 1= ndio, 2 = hapana

7. Mengineyo (taja)

8. Kama ni hapana kwa swali la 6, kwanini?

1= kuogopa daktari wa meno, 2 = sioni haja ya kwenda

9. Je, uwa unapata tatizo la kukauka mdomoni?

1 = ndio, 2 = hapana

10. Mara ngapi unasafisa meno yako kwa siku?

1= sio kila siku, 2 = mara moja, 3 = mara mbili, 4= mara tatu

11. Je, unatumia mswaki wa plasitic unaposafisha meno yako?

1= ndio, 2= hapana

12. Je, unatumia mswaki wa kijiti unaposafisha meno yako?

1= ndio, 2= hapana

13. Je, unatumia mchanga unaposafisha meno yako?

1= ndio, 2= hapana

14. Je, unatumia dawa ya meno yenye fluoride unaposafisha meno yako?

1= ndio, 2= hapana

15. Je, unatumia mkaa unaposafisha meno yako?

1= ndio, 2= hapana

16. Mara ngapi unatumia vyakula au vunywaji vyenye sukari kwa siku?

1= situmii kabisa, 2 = mara moja, 3 = mara mbili, 4 = mara tatu, 5 = zaidi ya mara 4

17. Je, ulishawai kung'olewa jino? 1 = ndio, 2 = hapana

18. Sababuzakung'oailikuwanini?

1. menoyalikuwayametoboka, 1 = ndio, 2 = hapana

2. Menoyalikuwayamelelea, 1 = ndio, 2 = hapana

3. Menoyalikuwayameumizwa, 1 = ndio, 2 = hapana

4. mengineyo (taja)

19. Je, una meno ya bandia? 1 = ndio, 2 = hapana

20. je, ulishawahi kujihusisha kwenye ugomvi katika kipindi cha miezi 12 iliopita ?

1 = ndio, 2 = hapana

21. Kama ndiokwenyeswali la 27, ilisababishamadharaganikwenyemenoyako?

1. Haikusababishamadharayoyote 1 = ndio, 2 = hapana

2. Iisababishamenokuvunjika 1 = ndio, 2 = hapana

3. Iisababishamenokulegea 1 = ndio, 2 = hapana

4. Iisababishamenokutoka, 1 = ndio, 2 = hapana

5. Iisababishamenoyakaamakwenyemsitari wake 1 = ndio, 2 = hapana

22. Ulishawahikuangukakwasababuyakutumiamadawayakulevyanaukaumi ameno?
1 = ndio, 2 = hapana

23. Ulishawahikupataajalikwasababuyakutumiamadawayakulevyanaukaumi ameno?
1 = ndio, 2 = hapana

Appendix 2 (c); **Clinical oral examination sheet**

1. **Identification Number:**

2. **Date:** year month day

3. **Sex:** 1= male, 2= female

4. **Age:** Years

5. **Education level:** 1= no formal education, 2= primary education, 3 = ordinary secondary education, 4 = advanced secondary education, 5 = college/ university education

6. **Tooth loss:** 0 = present, 1 = extracted, 2 = root remant, 3 = unerupted

Code																
Tooth	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
Tooth	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
Code																

7. **Total number of lost teeth:**

8. **Kennedy classes:** Upper jaw modification

Lower jaw modification

1 = class I, 2 = class II, 3 = class III, 4 = class IV

9. **Prostheses:** Upper jaw

Lower jaw 0 = no prostheses, 2 = prostheses present

10. **Type of prostheses:** Upper jaw

Lower jaw

1 = removable partial denture

2 = removable complete denture

3 = fixed denture

4 = dental implant