Dental fluorosis: prevalence, severity, treatment need and impact on quality of life among secondary school students in Arusha, Tanzania

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DENTAL FLUOROSIS: PREVALENCE, SEVERITY, TREATMENT NEED AND IMPACT ON QUALITY OF LIFE AMONG SECONDARY SCHOOL STUDENTS IN ARUSHA, TANZANIA

By

Thomas Lujuo

A Dissertation Submitted in (Partial) Fulfillment of the Requirements for the Degree of Master of Dentistry (Restorative Dentistry) of Muhimbili University of Health and Allied Sciences October, 2017

CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation titled; "***Dental Fluorosis: Prevalence, Severity, Treatment Need and Impact on Quality Of Life among Secondary School Students in Arusha, Tanzania",*** in partial fulfillment of the requirements for the degree of Master of Dentistry (Restorative Dentistry) of the Muhimbili University of Health and Allied Sciences.

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Date

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Date

DECLARATION

AND

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I, **Dr. Thomas Lujuo**, 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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DEDICATION

This dissertation is dedicated to my beloved wife Nuru

and our daughter Nicole-Mbeyu

ABSTRACT

Background: Dental fluorosis is very common in Tanzania especially in fluoride endemic areas. Dental fluorosis presents clinically as a chalk-like discoloration of teeth with white spots or lines on tooth enamel. People who are affected by high levels of fluoride present with brown teeth discoloration and mottled teeth, hence their esthetic are compromised. The most commonly employed method of assessing dental fluorosis treatment need is clinically defined by dental professionals. Using the established fluorosis indexes alone as the basis for treatment need estimation may lead to overestimation of the need if general health and social impacts related to dental fluorosis are not taken into consideration.

Objective: This study aimed to determine prevalence, severity and treatment need of dental fluorosis and its impacts on oral health quality of life among secondary school students in Arusha, Tanzania.

Methodology: This study was a cross-sectional analytical study which was conducted between January and February, 2017 among secondary school students in Arusha City. It involved 426 students who were selected among secondary school students in Arusha City. A cluster sampling method was used for selection of secondary schools, which was followed by random sampling of students from the selected schools. The subject's socio-demographic particulars, subjective treatment need and their perceived impacts were gathered through self-administered structured questionnaires. Clinical examination form was used to assess dental fluorosis according to Thylstrup and Fejerskov Index (TFI), clinical examinations were carried out by one calibrated dentists (Kappa = 0.86) under natural light, further TFI scores were categorized to determine treatment need groups. All the information collected were coded, entered in a computer and analyzed using SPSS version 20.0 software and statistical level of significance was put to $p < 0.05$. Chi-square test was used to compare proportions for any association and Pearson correlation coefficient was used to find correlation between Oral Impacts on Daily Performance (OIDP) scores and TFI scores. Linear logistic regression was used for multivariate analysis between severity of dental fluorosis and perceived impacts.

Results

A total of 426 students aged 13-18 years were involved in this study with 50.2% being males. The prevalence of dental fluorosis was high (85.4%). Majority of the participants (37.1%) had moderate dental fluorosis (TFI 4-5), 34.9% severe dental fluorosis (TFI 6-9) and 28% mild dental fluorosis (TFI 1-3). Overall prevalence of oral impacts on daily performance among students with dental fluorosis was 76.2% while for those without dental fluorosis was 8.8%. The most perceived dental treatment was removal of brown teeth discoloration 70.7%, followed by pain relief 25.4%, filling of cavities 14.8%, correction of arrangement of teeth 14.1% and 3.5% needed extractions. The study showed also that there was a very big difference in perceived impacts on oral health quality of life between students with dental fluorosis and those without dental fluorosis (p<0.001).

Conclusion

The prevalence of dental fluorosis was high. Moderate and severe forms of dental fluorosis were the commonest. Majority of the students perceived at least one oral impact and dental fluorosis was the main cause of the perceived impacts. The prevalence of oral impacts increases with an increase in the severity of dental fluorosis. Majority of the participants perceived removal of brown tooth discoloration as their most perceived dental treatment need.

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LIST OF ABBREVIATIONS

DF   Dental fluorosis

ICIDH   International Classification of Impairment Disability and Handicaps

MDent   Master of Dentistry

MoHCGEC   Ministry of Health, Community Development, Gender, Elderly and Children

MUHAS   Muhimbili University of Health and Allied Sciences

OIDP   Oral Impacts on Daily Performance

OHRQoL   Oral Health Related Quality of Life

SPSS   Statistical Package for Social Sciences

TFI   Thylstrup-Fejerskov Index

TSI   Tooth Surface Index

WHO   World Health Organization

DEFINITION OF TERMS

Subjective treatment need is the medical care needed by a patient for an illness or injury based on or influenced by personal feelings or opinions.

Objective treatment need is the medical care needed by a patient for an illness or injury that is not influenced by personal feelings or opinions, it is determined by professionals.

Dental fluorosis is the hypo-mineralization of dental enamel caused by ingestion of fluoride above optimal levels of concentrations during tooth formation.

Oral health related quality of life (OHRQoL) is a multidimensional construct that reflects people's comfort when eating, sleeping, and engaging in social interaction; their self-esteem; and their satisfaction with respect to their oral health (Sischo & Broder 2011).

CHAPTER ONE

1.0. INTRODUCTION

1.1 Background

Dental fluorosis is the hypo-mineralization of dental enamel caused by ingestion of fluoride above optimal levels of concentrations during tooth formation. Fluoride is known to play a key role in the prevention and control of dental caries when available in accepted concentrations (<1.5 mg/L). In excess, during tooth developing stages (age 1-6 years), it causes irreversible damage to ameloblasts resulting into mineralization disorder of the teeth and porosity of the sub-surface enamel (Mullane et al., 2016; Pérez et al., 2013; Sarvaiya et al., 2012). Dean, (1934) in his study showed that this condition can cause significant discoloration of teeth ranging from white specks, splotches and streaks in the "mild" form of the condition to extensive brown and black staining in the "severe" form.

Dental fluorosis is worldwide distributed with varying degrees of severity. It is more common in areas with natural soil fluoride where the water fluoride content is more than 1mg/L (Ahmed et al. 1998). Dental fluorosis severity varies with variation in concentration of fluoride in drinking water and the duration of exposure. Individuals leaving in areas with high concentration of fluoride in soil water show high prevalence and severity of dental fluorosis. Clinical assessment of dental fluorosis severity can be done using Thylstrup-Fejerskov Index (TFI), Deans Index (DI), or Tooth Surface Index of Fluorosis (TSIF). Classification of the severity of dental fluorosis by the Thylstrup and Fejerskov index (TFI) is the most suitable for determining the type of treatment because it is based on the biological changes in fluorosed enamel (Thylstrup & Fejerskov, 1978; Mabelya et al., 1994).

Consequences of dental fluorosis are far reaching. They include embarrassment, distress and humiliation about individual's unattractive dental physical-facial appearance and have lead to significant concerns on individual's psychological damage, self-esteem and confidence (among adolescents) (Williams et al., 2006; Lalumandier & Rozier, 1998). The affected individuals are susceptible to social, academic and employment discrimination including

inability to interact and form relationships, leading to exclusion, loneliness, and long-term depression (McKnight et al., 1998; Clark, 1995; Riordan, 1993).

Oral impact on daily performance (OIDP) scale which assesses an individual's perceived oral impacts on eight daily life activities namely eating, cleaning mouth, speaking, sleeping, smiling, work, emotion and social contact will be used to assess perceived oral health related impacts on quality of life among individuals with dental fluorosis. In this study dental fluorosis is assumed to have both positive and negative impacts on oral impact on daily performance (OIDP) and in turn may influence dental fluorosis treatment needs which are the outcome of perceived negative impacts of dental fluorosis. Despite availability of information for action on the problem of dental fluorosis in Arusha, no treatment plans/strategies have been put in place (Vuhahula et al., 2009; Åstrøm & Mashoto, 2002; Awadia et al., 2000; Awadia et al., 1999). This lack of action may probably be due to the fact that the high level of dental fluorosis treatment need objectively defined is too much for the provider to handle or it is unrealistic. Also, the affected individuals are not demanding care because important subjective socio-dental elements have not been addressed in the treatment need. The need to conduct this study was driven by the wish to identify and merge socio-dental and objective elements that are related to dental fluorosis with a purpose of developing a more realistic treatment need as well as stimulate treatment demand.

1.2 Theoretical and Conceptual framework

1.2.1 Theoretical framework

Theoretical framework for oral impacts was developed in line with the International Classification of Impairment Disability and Handicaps (ICIDH) (WHO, 1980) Fig. 1, which consist of three key levels; the first level: the impairment, refers to the immediate biophysical outcome of the condition, commonly assessed by clinical indicators. The second level is the intermediate functional limitation which is concerned with functioning of the body parts including dental appearance. The third level is the ultimate impact which refers to any difficulty in performing activities of daily living. One of its instruments is the Oral Impact on Daily Performance (OIDP) scale (Locker 1988; WHO, 1980). This index focuses on the third level of ICIDH (i.e. disability and handicap) thus demonstrating strong theoretical coherence and reduced possibility of double scoring of the same oral impacts at different levels. OIDP has been adopted and proved to be reliable and valid for studies of populations of various ages conducted in Tanzania (Masalu & Astrøm 2003; Astrøm & Kida 2007; Mtaya et al., 2007).
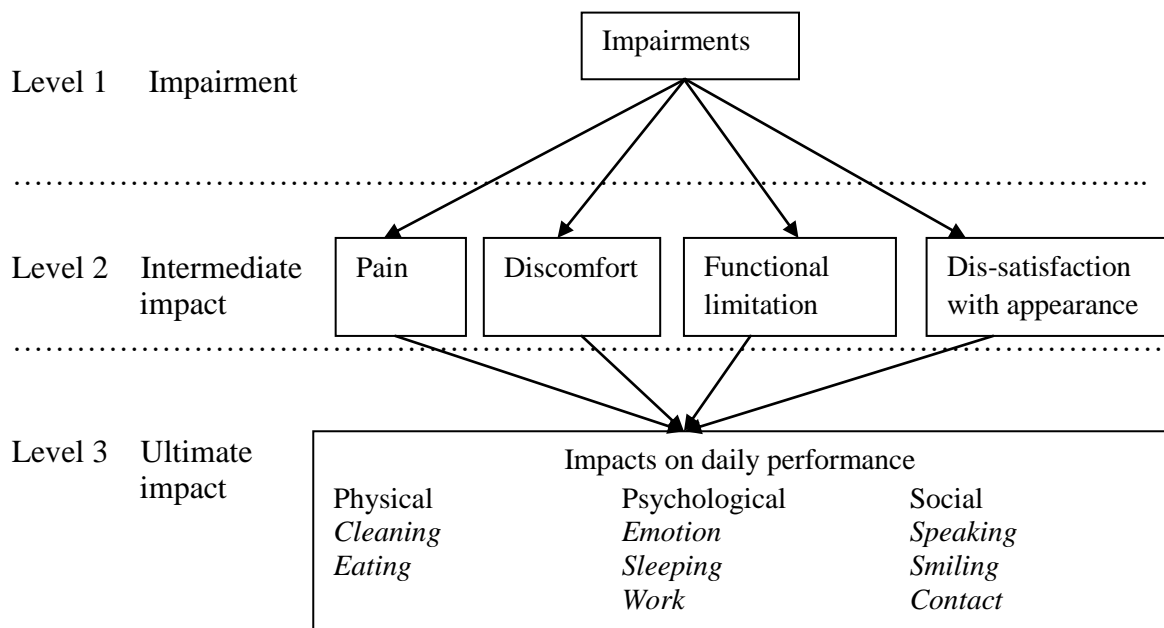
Figure 1. Theoretical framework of consequences of oral impact (WHO).

1.2.2 Conceptual framework

Figure 2 shows study conceptual framework. This framework shows relationship between dental fluorosis and its impacts on oral health related quality of life (OHRQoL). Since treatment need for this condition is influenced by dental fluorosis and its perceived impacts, an appropriate treatment need is best defined when both severity and impacts of the condition on OHRQoL are addressed together.
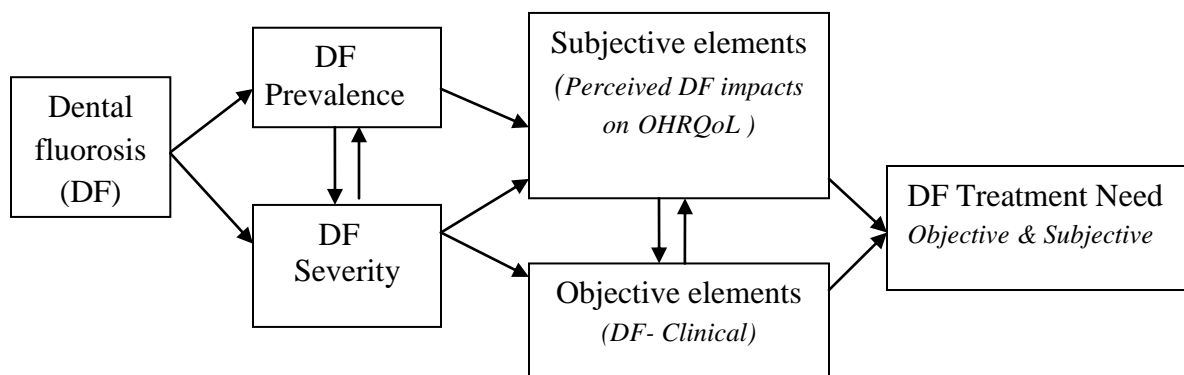
Figure 2. Conceptual framework (Self invented).

1.3 Literature Review

1.3.1 Prevalence of dental fluorosis

Dental fluorosis is worldwide distributed with varying degrees of severity(Thylstrup & Fejerskov 1978). Dental fluorosis can be found in areas with natural soil fluoride where the water fluoride content is more than 1mg/L, it is also found in some areas with negligible concentration of fluoride in water (Ahmed et al., 1998; Yoder et al., 1998; Mabelya et al., 1997).

A study done in Jordan showed that 18.5% of the children examined had dental fluorosis (Hamdan 2003). Büchel et al., (2011) in Switzerland showed that 31.9% of the examined school children had fluoride-associated opacities, while the prevalence of dental fluorosis in Colombia reached 100% in endemic areas for general population (Tellez et al., 2012). In Brazil the prevalence of 25% among teenagers attending schools was reported (Lilian et al., 2010).

Dental fluorosis is also very common in Africa. Grobler et al., (2001) in South Africa reported a dental fluorosis prevalence of 50% among school children in low fluoride areas, and 95% in high fluoride areas. A study done in Nigeria aimed to examine the prevalence of dental fluorosis in relation to fluoride levels in water among children reported a prevalence of 51% (Ahmed et al., 1998).

In East Africa dental fluorosis is very common especially along the Great Rift Valley. Ibrahim (1995) reported a prevalence of 91% to 100% among Sudanese children. A similar finding (100% prevalence) was reported by Manji et al., (1986) from a study among children in Kenya. In Uganda Wandera & Twa-Twa, (2003) reported a prevalence of 16.6% among secondary school children. Several studies conducted in Tanzania reported prevalence ranging from 74% to 96% (Yoder et al., 1998; Åstrøm & Mashoto, 2002; Vuhahula et al., 2009). The current study need to update the prevalence of dental fluorosis among secondary school students in Arusha.

1.3.2 Severity of dental fluorosis

Dental fluorosis severity varies from one place to another and depends on concentration of fluoride especially in drinking water and also the duration of exposure. A study done in Brazil among teenagers attending schools showed that a very mild form of fluorosis was most common with only 18.3% of the students being affected (Lilian et al., 2010).

A study in Sudan (Ibrahim, 1995) showed that 46.6% of children aged 7-16 years had moderate dental fluorosis, while in Kenya a study by Manji et al., (1986) conducted among children aged 10-15 years showed that 92% of examined teeth exhibited a TFI score of 4 or higher, and 50% of the children had pitting or more severe enamel damage.

Dental fluorosis in Tanzania exists with varying severities. In coastal villages dental fluorosis is mild while in villages consuming trona, it is very severe (Mabelya et al., 1994). In Arusha, one of the dental fluorosis endemic area, a study reported that 21% of the school children had severe form of dental fluorosis with TFI score ≥5 in vegetarian group and 35% in non-vegetarian group (Awadia et al., 1999). Another study, also done in Arusha among school children, showed the severe form of dental fluorosis to be 42% and 43% between right and left maxillary incisors respectively (Åstrøm & Mashoto 2002). Also study done in Kibosho Kilimanjaro among secondary school students aged 15-18 years 65.4% of the students had severe dental fluorosis while 29.4% and 5.2% had moderate and mild dental fluorosis respectively (Francis, 2010). The current study aimed at determining severity of dental fluorosis among secondary school students in Arusha which will objectively determine their treatment need.

1.3.3 Impacts of dental fluorosis on quality of life

Researchers have repeatedly found that "physical appearance is the best predictor of self-esteem" in adolescents, and that facial attractiveness, particularly the appearance of one's teeth, is a key component of one's physical appearance (Williams et al., 2006; Lalumandier & Rozier, 1998).

A study done in Brazil found that fluorosis did not have influence on the quality of life of the schoolchildren (Michel-crosato et al., 2005). While a study in Arusha, Tanzania showed that social and personal factors are as important in shaping the responses of school children to oral condition and dental appearance (Åstrøm & Mashoto 2002).

Francis, (2010) in a study among secondary schools in Kilimanjaro showed that the overall prevalence of oral impact on daily performance was 92.6%. Impacts on smiling were the most prevalent 88.1%, emotion stability 81.4%, contact with others 75.5% and cleaning teeth 52%. There is scarcity of retrievable literature which indicates that the relationship between dental fluorosis and its impact on quality of life in Africa and Tanzania in particular have received little investigation. This again expressed the importance of this study.

1.3.4 Dental fluorosis treatment need

Dental fluorosis treatment need is objectively assessed basing on the severity of the condition using different methods including commonly, the Thylstrup-Fejerskov Index (TFI) (Thylstrup & Fejerskov 1978), Deans Index (DI) (Dean 1934), and Tooth Surface Index of Fluorosis (TSIF) (Horowitz et al., 1984).

Akpata (2001) observed in a study done in Saudi Arabia that, classification of fluorosis according to the TFI, appeared to be adequate for determining the type of treatment for discoloured fluorosed teeth. In this study treatment groups according to severity of dental fluorosis are TFI=1-4 "bleaching and micro-abrasion", TFI=5-7 "veneer" and TFI=8-9 "prosthetic crown". In Brazil TFI was used to classify severity of dental fluorosis and subjects with TFI of ≥5 were given preference in management (Santa-Rosa et al., 2014).

In India, Khandelwal et al., (2013) used Deans Index to classify severity of dental fluorosis and treatment modalities. Another study done in Brazil by Alvarez et al., (2009) suggested also the use of the Thylstrup and Fejerskov Index (TFI) in classifying individuals into categories of dental fluorosis according to severity: mild (TFI = 1-3), moderate (TFI = 4-5) and severe (TFI = 6-9); and determining the type of treatment.

A study to compare normative and socio-dental estimates of need in Thailand concluded that socio-dental approach decreased the estimates of conventionally assessed dental treatment needs and introduced a broader approach to care (Gherunpong, Tsakos, et al., 2006; Gherunpong, Sheiham, et al., 2006). Similar findings were reported in a study done in Brazil, where it was suggested that a comprehensive approach using individual clinical and subjective measures of oral health as well as the socioeconomic conditions of the family is a helpful tool for organizing oral health care and defining priorities (Alves et al., 2015). Another study in Brazil with similar findings observed that subjective assessment needs were lower than those identified by the standard normative estimate of need (Prado et al., 2015). It was also observed in study from Brazil among students aged 12-19 years that other factors like parents education, occupation and family income can also influence dental fluorosis treatment need (Lilian et al., 2010).

1.4. PROBLEM STATEMENT

Dental fluorosis is a long standing problem among Arusha residents. The unattractive dental appearance of people with dental fluorosis can severely limit their academic performance, employment choices, future prospects, ability to interact and form relationships leading to exclusion, loneliness, and long-term depression. Though these problems of dental fluorosis are known, still most of affected individuals do not seek for treatment or management of dental fluorosis. Reasons for unattended dental fluorosis may be due to lack of information or motivation, ignorance, unfavorable socio-economic status and lack of services for management of dental fluorosis.

There is limited data on dental fluorosis prevalence, severity, perceived impacts and treatment need among individuals with dental fluorosis in Arusha. The information that will be obtained from this study will help in understanding the magnitude of the problem, know the perceived oral health related impacts on quality of life among students with dental fluorosis, and establish subjective and objective treatment.

The aim of this study is to determine the prevalence, severity, impacts on quality of life and chart out the development of a dental fluorosis treatment need that takes aboard objective elements and perceived subjective impacts on dental fluorosis in order to stimulate demand for treatment among Arusha residents.

1.5. RATIONALE OF THE STUDY

This study will provide useful information that will contribute to the existing knowledge regarding dental fluorosis: prevalence, severity, impacts on quality of life. The study will also come up with findings on dental fluorosis treatment need which has included objective and subjective-perceived impacts of the condition on quality of life. The established treatment need will provide the magnitude of the need which will be obtained from the impacted individuals who are really in need for treatment. The outcomes of this study will be utilized in planning and budgeting for dental fluorosis treatment at different levels, as well as improve the oral health related quality of life among affected individuals. The study is also mandatory as a partial fulfillment of the requirements for the degree of Masters of Dentistry in Restorative Dentistry of Muhimbili University of Health and Allied Sciences (MUHAS).

1.6. RESEARCH QUESTIONS

This study intended to collect information that answers to the following questions about dental fluorosis among secondary school students in the Arusha City.
1. What is the current prevalence?
2. How severe is dental fluorosis?
3. What are the perceived oral health impacts?
4. What is the subjective dental fluorosis treatment need?

1.7. STUDY OBJECTIVES

1.7.1. Broad Objective

To determine the prevalence and severity of dental fluorosis, its impacts on quality of life and the objective-subjective dental fluorosis treatment need among secondary school students in Arusha city, Tanzania.

1.7.2. Specific Objectives

1. To determine the prevalence of dental fluorosis, using TFI, among secondary school students in Arusha city.
2. To determine severity of dental fluorosis, using TFI, among secondary school students in Arusha city.
3. To determine the impacts of dental fluorosis on oral health related quality of life, using OIDP, among secondary school students in Arusha city.
4. To determine perceived dental fluorosis treatment need among secondary school students in Arusha city.
5. To assess relationship between impacts of dental fluorosis on oral health related quality of life and severity of dental fluorosis among secondary school students in Arusha city.

CHAPTER TWO

2.0. MATERIALS AND METHODS

2.1. Study Design

This was a cross-sectional analytical study.

2.2. Study area

This study was conducted in Arusha one of fluorosis endemic area located on the Northern part of Tanzania. Fluoride content of soil water in Arusha ranges from 3.5 to 3.8 mg F/L with a mean of 3.6 mg F/L (Awadia et al., 1999). This is above the safe range of 1mgF/L (Mullane et al. 2016).

2.3. Study population and participants

The study population included secondary school students in Arusha city. According to 2012 National Housing and Population census, Arusha City population was 416,442 people. The population of youth aged 13 to 18 years was 58,789 where 25,488 were males and 33,301 females.

2.4. Sample size and Sampling technique

Sample size was computed from the formula n= [n_0N/n_0 + (N-1)]*de, will be used

Where;

$$n_0 = \frac{Z^2 P (1-P)}{e^2}$$

n = Sample size

N = Population size

n_0 = Sample size for proportion

Z = Standard normal deviation, set at 95% (1.96)

P = Prevalence of dental fluorosis is estimated to be around 74% from previous studies (Åstrøm & Mashoto 2002)

e = Marginal error allowed, set at 5% (0.05)

de = Design effect, set at 1.5

Sample size,

$$n_0 = \frac{1.96 \times 1.96 \times 0.74(1-0.74)}{0.05 \times 0.05}$$

$n_0 = 295.65$

$n = 295.65 \times 58,789/295.65 + (58,789 - 1)$

$n = 294.5 \times 1.5$ (adjusted for design effect)

$n = 441.75 \sim 442$

The estimated sample size for this study was, therefore, 442 students.

Sampling was conducted in two stages. The first stage involved selection of secondary schools within Arusha city. A list of 26 public secondary schools in the city was obtained, from the list six (6) secondary schools were selected by lottery. The selected schools were Kaloleni, Elerai, Ngarenaro, Arusha Secondary, Arusha day and Olasiti. The second stage involved selection of study participants whereby in each of the school students were asked to pick numbers from the box and those who picked a paper with number 1 were selected while those who picked number two were not selected to participate in the study. Estimated sample size for this study was 442 students, but the obtained sample size was 426 students aged 13 to 18 years with mean age of 15.4 years. From the 442 students 16 (3.6%) were excluded due to anterior edentulism and restorations thus remaining with 426 (96.4%) participants.

2.5. Inclusion and Exclusion Criteria

2.5.1. Inclusion criteria
The participant was a student (form I – IV) in a secondary school within the Arusha City who read, understood and signed the written consent.

2.5.2. Exclusion criteria
Presence of grossly carious teeth, anterior edentulism, teeth with multiple restorations, student was using braces. These conditions interferes with scoring of the severity of dental fluorosis.

2.6. Study variables and Data collection

2.6.1. *Study variables*

Independent variables were age, sex, occupation of parent or guardian and where and with whom was the student living with. Dependent variables were dental fluorosis prevalence, severity, perceived impacts and treatment need.

2.6.2. *Validity of research tools*

A pilot study was conducted at MUHAS dental clinic to assess the validity and reliability of data collection tools (the questionnaire, Appendix IIa). The questions in the questionnaire were found to be able to assess what was intended to assess and the responses were the same when the questionnaires were re-administered.

2.6.3. *Calibration of examiner and Reliability of the clinical data*

Calibration of the examiner against an experienced researcher (supervisor) was done in a pilot study at MUHAS dental clinic. Intra-examiner variability and reproducibility testing of the clinical examination was carried out and the kappa indices/values were recorded. Ten subjects were re-examined by the principal investigator (Thomas Lujuo) after two weeks, for intra-examiner agreement on TF-Index values. The inter and intra-examiner Kappa value was 0.86 which is considered substantial to almost perfect (Landis & Koch, 1977).

2.6.4. *Data collection procedure*

Information on age, sex, perceived oral impact and perceived treatment need was gathered using a self-administered structured questionnaire. Self perceived oral treatment need was assessed using one question: If you perceive any dental treatment need at the moment, what kind of treatment you need, please tick to "YES" *or* "NO" to each of the following oral problems pain release, removal of brown tooth discoloration, tooth extraction, filling of tooth cavities, and correcting arrangement of teeth. For analysis dummy variables were constructed yielding response alternatives 0 = 'YES' and 1 = 'NO'. Perceived oral impacts were assessed using OIDP, which consist of 8 items, measured on five-point scale ranging from 1 to 5. The

OIDP frequency index refers to difficulty in carrying out eight daily life activities namely eating, cleaning mouth, speaking, sleeping, smiling, school work, emotion and social contact for the past six months, each score 1–5 where 1 = 'affected less than once a month or never', 2 ='once or twice a month', 3 = 'once or twice a week', 4 = '3–4 times a week' and 5 ='every or nearly every day'. For the purpose of cross-tabulation analysis, each item was dichotomized into categories 0 = 'affected less than once a month or never' and 1 = 'perceived impacts at least once a month' (including the categories 2, 3, 4 and 5). The total OIDP score was constructed in two ways. First, by adding the 8 performance scores as originally scored (1–5) into an OIDP additive score (ADD) (range 8–40). Second, the OIDP simple count (SC) score (range 0–8) was constructed by summing the dichotomized frequency items of (1) affected and (0) not affected.

Clinical examinations were carried out by a calibrated examiner using the TF-Index (TFI). The TFI was chosen because it is more sensitive than the Dean's index in assessing very mild forms of fluorosis (Mabelya et al. 1994). The examinations were conducted in a classroom with natural light as a source of illumination and using dental mouth mirrors. The examinee was seated on a wooden office chair for examination. Teeth with aesthetic importance (incisors, canines and first premolars) were examined for dental fluorosis. Prior to examination, the buccal and facial surfaces of the mandibular and maxillary incisors and first premolars (Tooth number 14-24, 34-44) were cleaned and dried with gauze in order to remove debris and biofilms. Score for severity were done according to the TF- Index ranging from score zero (0) to nine (9). TFI scores were categorized into mild for scores 1-3, moderate for scores 5-6 and severe for scores 6-9. The TFI scores were also classified into treatment groups according to severity of dental fluorosis. The classifications were TFI=1-4 "bleaching and micro-abrasion with or without composite filling", TFI=5-7 micro-abrasion with "esthetic veneer" and TFI=8-9 "prosthetic crown" (Akpata, 2001).

2.7. Data management and analysis

Quality checks were carried out at the end of the working day to ensure that the information obtained was properly recorded. All the gathered data were entered in a computer using Statistical Package for Social Sciences (SPSS, version 20.0., 2011) before data analysis in line with each specific objective was carried out. The characteristic of variables were described using frequency distribution. Chi-square test was used to compare proportions for association, Pearson correlation coefficient was used to find correlation between OIDP scores and TFI scores between oral impacts and dental fluorosis and linear logistic regression was used for multivariate analysis between severity of dental fluorosis and perceived impacts. Level of statistical significance was set at *p< 0.05*.

2.8. Ethical clearance and ethical considerations

Ethical clearance was obtained from the Directorate of Research and Publications of the Muhimbili University of Health and Allied Science (MUHAS), attached appendix V. Permission to conduct research in secondary schools in Arusha was obtained from respective municipal authorities. Each participant received detailed oral explanation on the nature and purpose of the study, following which they were requested to fill a consent form. The participants were assured of confidentiality, and right to withdraw without any condition and strict usage of the data for intended purpose only. Those who consented to participate were given oral health education and information. During clinical examination those who were found with oral problems were advised and referred to dental clinic for management.

CHAPTER THREE

3.0. RESULTS

3.1. Demographic pattern of the study participants

A total of 426 secondary students in Arusha city aged 13-18 years (mean: 15.4 years, SD 1.4) with male to female ratio of almost 1:1 participated in the study. Majority of the participants (79.3%) were in the age group 13-16 years with 63.6% of them at 15-16 years. A greater majority of the participants (88.7%) live at home with their parents. More than half (60.1%) of the students' parents or guardians were in the business sector.

3.2. Prevalence of dental fluorosis

The prevalence of dental fluorosis was 85.4% with almost equal experience by sex (male 50.8%, female 49.2%). Table 1 shows that there was a strong statistical significant difference in dental fluorosis prevalence among students who live at home with parents and those who live at home with guardians p=0.001.

Table 1. Distribution of participants according to dental fluorosis status and social demographic characteristics. N=426

Socio-demographic characteristics	Dental fluorosis			Statistics
	Yes n (%)	No n (%)	Total n (%)	
Sex				
Male	185 (43.4)	29 (6.8)	214 (50.2)	χ^2 =0.348
Female	179 (42.0)	33 (7.8)	212 (49.8)	p=0.555
Where and with whom student live				
Live home with parents	332 (77.9)	46 (10.8)	378 (88.7)	χ^2 =15.341
Live home with guardian	32 (7.5)	16 (3.8)	48 (11.3)	p=0.001
Parental/guardian occupation				
Employed	92 (21.6)	20 (4.7)	112 (26.3)	χ^2 =2.306
Business	223 (52.3)	33 (7.7)	256 (60.1)	p=0.511
Peasant	29 (6.8)	4 (1)	33 (7.7)	
Unemployed	20 (4.7)	5 (1.2)	25 (5.9)	

3.3. Severity of dental fluorosis

Table 2 shows the distribution of participants according to dental fluorosis TFI scores. TFI scores 5 and 6 were more prevalent (17.1% and 16%, respectively). A mean TFI score of 3.99 with a standard deviation (SD) of 2.32 was observed which falls in the moderate dental fluorosis category.

Table 2. Distribution of participants by TFI score and sex. N=426

| TFI score | Sex | | Total |
	Male	Female	
0	29 (13.6)	33 (15.6)	62 (14.6)
1	7 (3.3)	5 (2.4)	12 (2.8)
2	16 (7.5)	17 (8)	33 (7.7)
3	27 (12.6)	31 (14.6)	58 (13.6)
4	23 (10.7)	38 (17.9)	61 (14.3)
5	45 (21)	28 (13.2)	73 (17.1)
6	42 (19.6)	26 (12.3)	68 (16)
7	15 (7)	28 (13.2)	43 (10.1)
8	10 (4.7)	5 (2.4)	15 (3.5)
9	0 (0.0)	1 (0.5)	1 (0.2)

Table 3 shows the distribution of participants by severity of dental fluorosis and sex. Mild and moderate forms of dental fluorosis were the most common (55.6%) which is more than half of the participants. Statistically there was no significant association between severity of dental fluorosis and sex (*p=0.861*).

Table 3. Distribution of participants by severity of dental fluorosis and sex. N=426

Dental fluorosis severity (TFI Scores)	Male n (%)	Female n (%)	Total n (%)	Statistical tests
Normal (0)	29 (6.8)	33 (7.7)	62 (14.6)	χ^2 =0.752
Mild (1-3)	50 (11.7)	53 (12.4)	103 (24.2)	p=0.861
Moderate (4-5)	68 (16)	66 (15.5)	134 (31.5)	
Severe (6-9)	67 (15.7)	60 (14.1)	127 (29.8)	
Total	214 (50.2)	212 (49.8)	426 (100)	

3.4 Impact of dental fluorosis on oral health related quality of life

As shown in Fig. 3 the overall prevalence of oral impacts on daily performance (OIDP) among subjects with dental fluorosis was 76.2% while for those without dental fluorosis was 8.8%. Impacts on smiling were the most prevalent 60.3%, followed by contact 54.5% and cleaning 54%. Impacts on sleeping 30.57% and work 27.2% were the least prevalent among students with dental fluorosis. The difference in perceived impacts among those with dental fluorosis and those without dental fluorosis were statistically highly significant for smiling, emotion and contact (p<0.001).
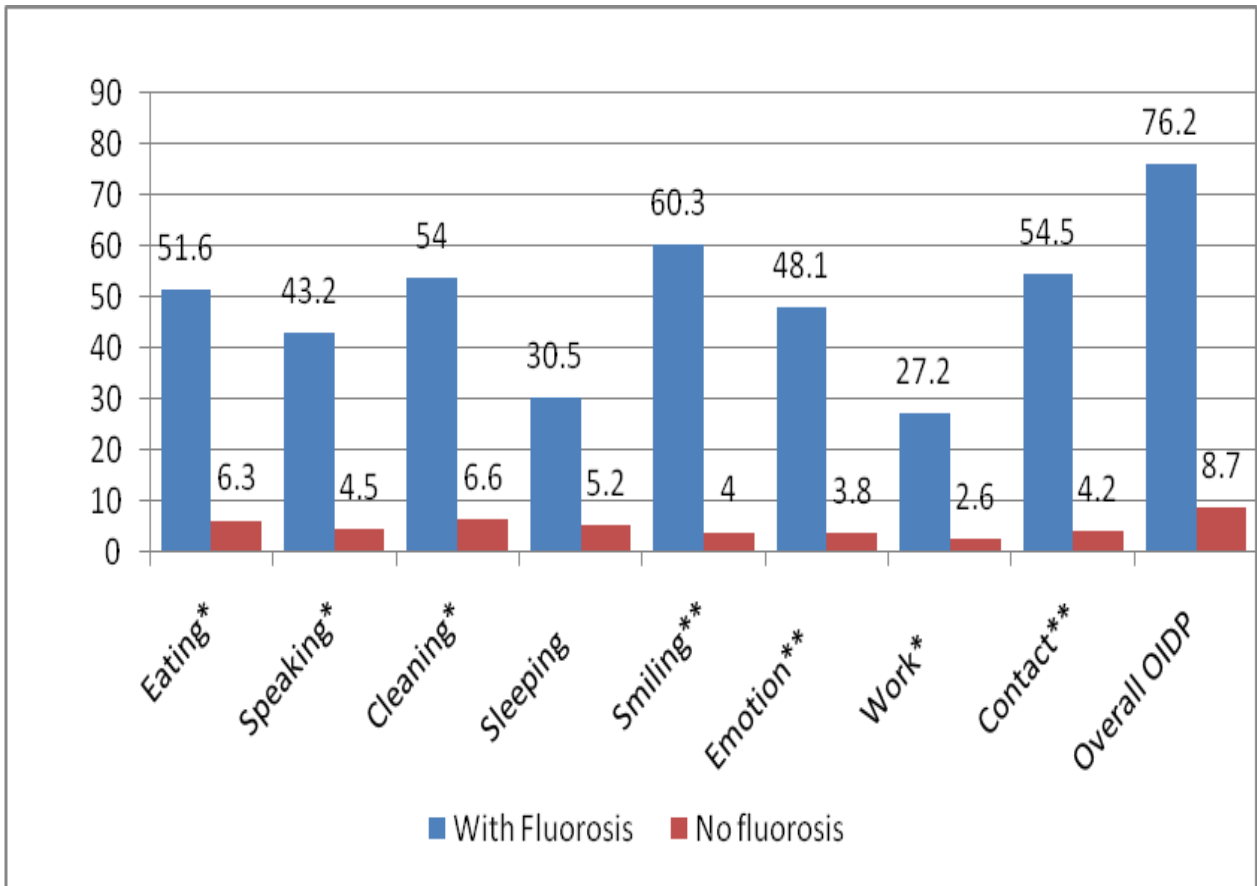
*p<0.05, **p<0.001

Figure 3. Percentage distribution of the eight Oral Impacts on Daily Performance (OIDP) frequency items among subjects with dental fluorosis and those without dental fluorosis. N=426

The most frequently mentioned actual causes of oral impacts on daily performance were brown tooth discoloration, toothache, bleeding gum and bad breath (Fig 4). Brown discoloration of teeth was the most frequently perceived actual cause of oral impact for seven performances while toothache was the most frequently perceived actual cause of eating problems.
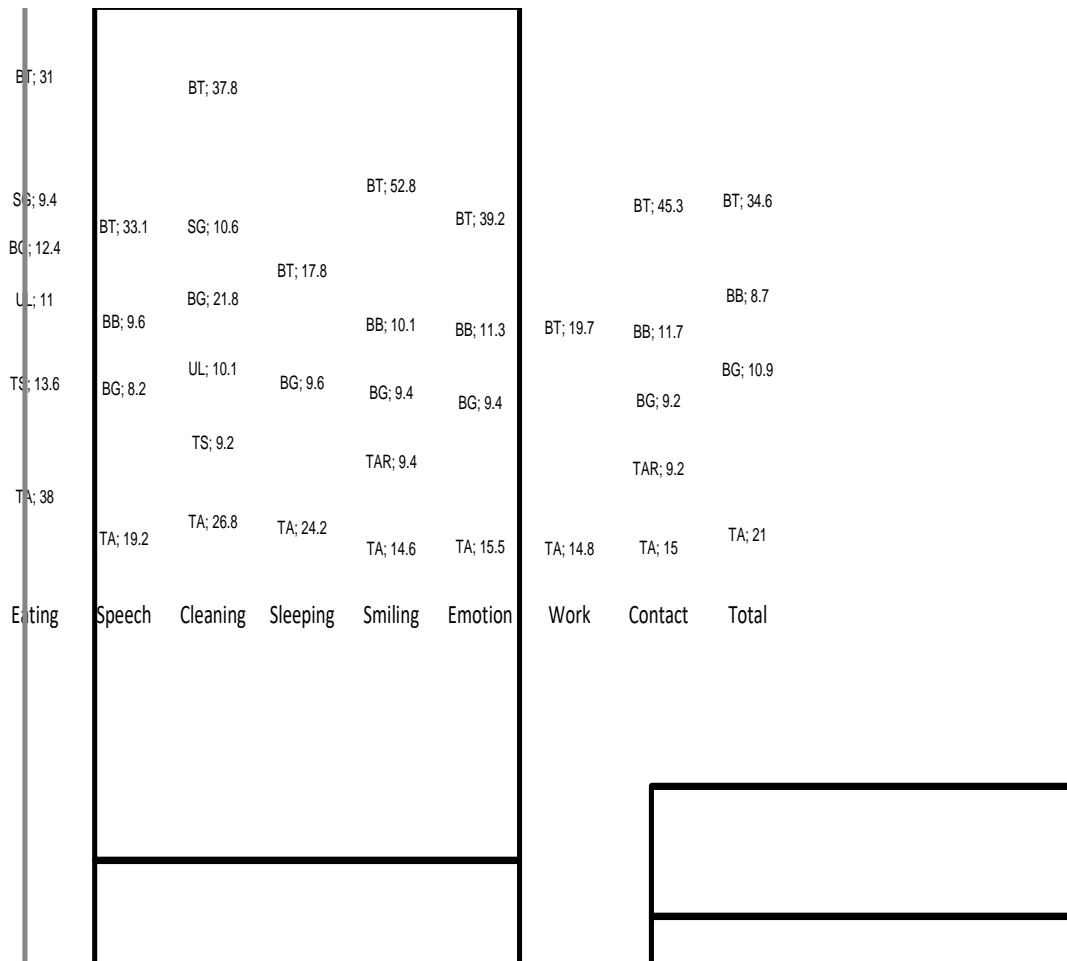
Abbreviations: TA- Toothache; ST-Sensitive teeth; TAR-Tooth arrangement; UL- Ulcer; BG-Bleeding gum; SG-Swollen gum; BB-Bad breath; BT-Brown discoloration of teeth; SP- Space between teeth.

Note: Unmarked spaces and causes of impacts not presented in the figure had value <8%

Figure 4.Perceived oral problems associated with oral impacts. N=426

3.5. Perceived dental fluorosis treatment need

Majority (70.7%) of students perceived removal of brown discoloration of teeth as their most needed oral treatment (Table 4), while about one quarter of the participants needed analgesics for releasing oral related pain.

Table 4. Distribution of subjects by dental fluorosis status and perceived treatment needs. N=426

Perceived Treatment Need		Dental Fluorosis		Total	Statistics
		Yes	No		
		n (%)	n (%)	n (%)	
Pain relief by analgesics	Yes	85 (20)	23 (5.4)	108 (25.4)	p=0.021
Removal of brown teeth discoloration	Yes	293 (68.8)	8 (1.9)	301 (70.7)	p=0.001
Tooth extraction	Yes	13 (3)	2 (0.5)	15 (3.5)	p=0.891
Filling of cavities	Yes	54 (12.7)	9 (2.1)	63 (14.8)	p=0.948
Correction of teeth arrangement	Yes	49 (11.5)	11 (2.6)	60 (14.1)	p=0.37

Table 5 below shows the objective distribution of the TFI treatment categories related to perceived treatment need among students with dental fluorosis. Overall frequency distribution of students who perceived need for treatment of dental fluorosis match closely the corresponding distribution of students according to objective treatment needs. According to TFI treatment categories a great proportion of the participants 95.6% required bleaching and composite veneer, of the three objective treatment categories 50.5% of students need composite veneer.

Table 5. Distribution of participant with dental fluorosis by their objective treatment categories related to perceived treatment need. N=364

Perceived Treatment Need	Objective Treatment Need			Total n (%)	Statistics
	Bleaching n (%)	Veneer n (%)	Crown n (%)		
Yes	118(40.3)	161(54.9)	14(4.8)	293(100)	χ^2=13.875
No	46(64.8)	23(32.4)	2(2.8)	71(100)	p=0.001
Total	164(45.1)	184(50.5)	16(4.4)	364(100)	

Table 6 shows the proportion of students with dental fluorosis who perceived need for removal of brown discolouration was 80.5% while 74.5% of them had also perceived at least one oral impact, the difference was statistically significant with p-value 0.001. Also of 74.5% students with dental fluorosis who also perceived need for dental fluorosis treatment 40.6% needed bleaching, 55% needed veneering and only 4.4% needed crown as their objective treatment need.

Table 6. Impacts versus perceived treatment need among students with Dental fluorosis. N=364

Oral impact	Perceived Treatment need		Total n (%)	Statistics
	Yes n (%)	No n (%)		
No impact	22 (6)	17 (4.7)	39 (10.7)	χ^2=16.137
Have impact	271 (74.5)	54 (14.8)	325 (89.3)	p=0.001
Total	293 (80.5)	71 (19.5)	364 (100)	

3.6 Relationship between perceived oral impacts with the severity of dental fluorosis

Table 7 (below) shows the distribution of students with dental fluorosis against oral impacts. There was a significant relationship between the prevalence of perceived oral impacts with the severity of dental fluorosis. The prevalence of oral impacts increases with an increase in the severity of dental fluorosis and the vice versa is true for those students who have no any perceived oral impacts. The difference is statistically significant (p=0.001).

Table 7. Relation between perceived oral impacts with the severity of dental fluorosis. N=426

Dental fluorosis severity (TFI Scores)	Oral Impacts		Total	Statistics
	No impact	Have impact		
Normal (0)	25 (5.9)	37 (8.7)	62 (14.6)	χ^2=41.701
Mild (1-3)	18 (4.2)	85 (20)	103 (24.2)	p=0.001
Moderate (4-5)	12 (2.8)	122 (28.6)	134 (31.5)	
Severe (6-9)	9 (2.1)	118 (27.7)	127 (29.8)	
Total	64 (15)	362 (85)	426 (100)	

The results for Pearson correlation coefficient was statistically significant (r=0.192, p=0.001) when a correlation test between OIDP sum index with TFI scores was performed.

Logistic regression analysis (table 8) shows that the risk of having impacts increases with an increase in severity of dental fluorosis. Compared with students without clinically defined dental fluorosis (TFI-0)(OR = 1), the odds ratio for the outcome of having impacts was 3.2 for those having mild dental fluorosis (TFI 1-3), 6.9 for those having moderate dental fluorosis (TFI 4-5) and 8.9 for those having severe dental fluorosis (TFI 6-9).

Table 8. Logistic regression results in terms of odds ratio (OR) and 95% confidence interval (CI) for respondents perceived oral impacts according to TFI score. N=426

Dental fluorosis severity (TFI Scores)	Odds Ratio (OR)	95% C.I		p-value
		Lower	Upper	
Normal (TFI-0)	1			
Mild (1-3)	3.2	1.5	6.5	0.002
Moderate (4-5)	6.9	3.1	15	0.001
Severe (6-9)	8.9	3.8	20.7	0.001

CHAPTER FOUR

4.0 DISCUSSION

This was a cross-sectional analytical study seeking to determine the prevalence and severity of dental fluorosis among secondary school students in Arusha city, and how the condition impacts on quality of life of the students. Furthermore, the study aim at establishing treatment need using objective and subjective elements of individuals with dental fluorosis, considering that individuals' perceived impacts from the condition are strongly addressed in the treatment need.

The study selected students aged 13 to 18 years old because they are at the critical adolescent age at which individuals are expected to be highly concerned with their appearance. At this age also individuals living in an endemic dental fluorosis area are expected to have been exposed to fluoride for long time, probably with a cumulative high fluoride dose which can result into severe dental fluorosis with pitting hence severity of dental fluorosis can be assessed (Alvarez et al., 2009). The estimated sample size was 442 students but the study managedged to get 426 students (96.4%) with a 100% response. This can be regarded as very good selective and non-response experience.

The study finding shows that dental fluorosis is a problem in Arusha and students affected showed that dental fluorosis impacted their daily life. The clinical examination revealed that most of the participants have dental fluorosis (85.4%). The observed high prevalence of dental fluorosis may be due to the fact that Arusha is an endemic area for dental fluorosis, the sources of drinking water in Arusha has high fluoride content due to high fluoride content of its soil water. However, it was observed in this study that a substantial proportion of participants did not have dental fluorosis (14.6%), this can be due to population immigration some of the students were not born and raised up in Arusha during tooth development ages. Previous studies done in Arusha show similar results, one study done among school children found that the prevalence of dental fluorosis was 74% (Åstrøm & Mashoto, 2002) while (Awadia et al., 1999) found the prevalence of dental fluorosis was 67% among vegetarians and 95% among

non-vegetarians. A study done by Vuhahula et al., (2009) reported a prevalence of up to 100% dental fluorosis in Arusha. The prevalence of dental fluorosis in Colombia was reported to be 100% in endemic areas (Tellez et al., 2012). A study by Hamdan, (2003) in Jordan reported a prevalence of 18.5% of dental fluorosis among children. In Brazil the prevalence of 25% among teenagers attending schools was reported (Lilian et al., 2010). The observed differences in dental fluorosis prevalence are due to variations in content of fluoride in drinking water.

In the present study severe dental fluorosis at TFI score ≥ 6 was 34.9%. Åstrøm & Mashoto, (2002) in Arusha reported almost similar findings of severe dental fluorosis (42% and 43%) between right and left maxillary incisor respectively. A study done in Kilimanjaro revealed high prevalence of severe dental fluorosis 65.4% (TFI 6-9) among secondary school students (Francis, 2010). The observed difference in prevalence of severe dental fluorosis may be due to the differences in sources of fluoride, in Arusha the source of fluoride is from soil water while the source of fluoride in Kibosho Kilimanjaro is magadi (Trona). This was also observed by Mabelya et al., (1997) where the prevalence of severe dental fluorosis of TFI ≥ 5 was high (86% - 97%) in Iramba district due to use of high fluoride-containing Trona.

In this study 85% of the students perceived at least one oral impact, the most affected daily performances were smiling 64% and cleaning 60.6%, other performances with more than 50% prevalence were contact 58.7%, eating 58% and emotion 51.9%. The proportion of students with dental fluorosis and at least one perceived oral impact was 76.2% which is very high compared to 8.7% among those not affected with dental fluorosis. These findings are higher to those found by (Åstrøm & Mashoto, 2002) where 35% of boys and 38% of girls had at least one daily activity affected. The results are also lower compared to those found by Francis, (2010) where the prevalence of oral impact on daily performance was 92.6%. Impacts on smiling were the most prevalent 88.1%, followed by emotional stability 81.4%, having contact with others 75.5%, and cleaning of teeth 52.0%. Impacts on sleeping, work, speaking and eating were the least prevalent, these finding are contributed by the fact that the form of dental fluorosis in Kibosho is more of a severe type, while in Arusha the mild form is dominant. In

Brazil the impact of oral condition on daily performances was low (10.2%) and the study concluded that the impacts were not related to dental fluorosis (Michel-crosato et al., 2005). From these study results majority of the students are affected hence affecting their quality of life, the chance of having impacts increases with an increase in the severity of dental fluorosis. Also as it is shown in the results that brown tooth discoloration was the most mentioned cause of the oral perceived impact among the students it is obvious that measures to manage dental fluorosis discolorations of teeth have to be taken especially the use of direct composite veneer and micro abrasion.

Dental fluorosis treatment is expensive, and as it is known that the prevalence of dental fluorosis in endemic areas is high, therefore thorough dental fluorosis treatment need should be made in order to obtain the real dental fluorosis treatment need. The current study shows that 70.7% of the interviewed students perceived removal of brown teeth discoloration as their most preferred dental treatment need. The findings are lower compared to study done by Francis, (2010) in Kilimanjaro where 95.2% of the students perceived removal of brown tooth discoloration as their perceived oral problem. Dental fluorosis treatment need is frequently restricted to clinical measures or professionally determined. This is not a good method since it tends to exaggerate a true need. In order to obtain a true need it is advised to combine objective dental fluorosis treatment need and subjective treatment need through perceived impact of dental fluorosis on quality of life (Gherunpong, Tsakos, et al., 2006; Gherunpong., et al., 2006; Alves et al., 2015; Prado et al., 2015). The present study shows that 85.4% of the students who had dental fluorosis needed at least one of the three modalities of dental fluorosis management prescribed by professionals namely bleaching (38.5%), veneer (43.2%) and crown (3.7%) (Akpata 2001). Furthermore the students were analyzed for perceived impacts, 76.3% of the participants had dental fluorosis and perceived at least one oral impact, while 63.6% of the participants with dental fluorosis needed treatment for removal of tooth discolorations. From these results it can be seen that treatment need for dental fluorosis is 63.6% of the students. Though both normative (objective) and subjective treatment need methods for establishing dental fluorosis treatment need among secondary school students in

Arusha were used, still dental fluorosis treatment need obtained is high. Therefore in order to manage this established dental fluorosis treatment need proper planning for management of dental fluorosis is required in terms of skilled dental personnel, infrastructures and materials. This approach for estimating dental treatments need have been used in different dental conditions but not dental fluorosis (Prado et al., 2015; Alves et al., 2015; Sheiham et al., 2015; Gherunpong., et al., 2006).

CHAPTER FIVE

5.0 CONCLUSIONS

From this study the prevalence of dental fluorosis among secondary school students in Arusha is high. Moderate and severe forms of dental fluorosis were the commonest. Majority of the students perceived at least one oral impact and dental fluorosis was the main actual cause of the perceived impacts. The prevalence of oral impacts increases with an increase in the severity of dental fluorosis. Majority of the participants perceived removal of brown tooth discoloration as their most perceived dental treatment need and 81.7% of the subjects required minimally invasive dental fluorosis treatment namely bleaching and veneer.

5.1 RECOMMENDATIONS

- Find other water supply sources with optimal levels of fluoride to ovoid excess fluoride ingestion.
- Provide affordable means of tooth whitening procedures such as bleaching and veneering.
- Oral health education to the communities with endemic dental fluorosis on possible professional ways of managing dental fluorosis discolorations.

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7.0 APPENDICES

7.1. APPENDIX I 'a'   INFORMED CONSENT FORM - English version
(DIRECTORATE OF RESEARCH AND PUBLICATIONS, MUHAS)

ID. No. [__|__|__]   Age ……. (years)   Sex: (*M=1, F=2*) [__]

Consent to Participate in a Study

Greetings! My name is Dr. Thomas Lujuo; I am doing a research on dental fluorosis - prevalence, severity, treatment need and its impact on oral health related quality of life among secondary school students in Arusha city, Tanzania.

Purpose of the study

This study is aiming to determine dental fluorosis prevalence, severity, treatment need and its impact on oral health quality of life among secondary school students in Arusha city, Tanzania.

You are kindly requested to participate in this study as part of major stakeholders in the field and information will contribute value important information for 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.

What Participation Involves

If you agree to join the study, you will first be given a questionnaire in order to answer some questions. Secondly, a dentist will perform a brief examination of your mouth. The examiner will provide you with a summary of the findings offer advice and refer for suitable treatment.

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. Some questions could potentially make you feel uncomfortable or raise your consciousness about dental appearance. However, you are to answer or not to answer them.

Right to Withdraw and Alternatives

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 you scheduled treatment.

Benefits

If you agree to participate in this study, you will be advised on what to do (management) with accordance to the examination findings so as to prevent further negative perceived impacts on dental fluorosis. The information you provide will help to determine the prevalence of dental fluorosis, assess; severity, perceived impact and treatment need among secondary school adolescents in Arusha city

The result of the study will give information that will enable creation of awareness on how prevalent is dental fluorosis, understand the perceived impact of dental fluorosis among pupils with dental fluorosis, and also will enable oral health stakeholders to plan for oral health services as per need and intervene on the reported problems.

Who to Contact

If you ever have questions about this study, you should contact the Principal Investigator, Dr Thomas Lujuo of Muhimbili University of Health and Allied Sciences, P. O. Box 65001, Dar es Salaam (Tel: 0713632748). If you ever have questions about your rights as a participant, you may call **Prof. Said Aboud,** Chairperson of the Senate Research and Publications Committee, P. O. Box 65001, Telephone : 255 22 2152489 Dar es Salaam or Supervisors of this study Dr. Godbless. J. Mandari (Tel: 0754817424/0654817428) and Dr. Tumaini Simon (Tel: 0713503879).

Signature: ……………………………………………… Do you agree?

Participant agrees ………………….. Participant does NOT agree ………...………………….

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 ………………………………….

7.1. KIAMBATANISHO I 'b' FOMU YA RIDHAA- *Kiswahili*

(KURUGENZI YA TAFITI NA UCHAPISHAJI CHUO KIKUU CHA
SAYANSI ZA AFYA MUHIMBILI)

FOMU YA RIDHAA

Namba ya utambulisho [__|__|__]   Umri: .…. (*miaka*);   Jinsia: (*me=1, ke=2*) [__]

Ridhaa ya kushiriki kwenye utafiti

Hujambo! Ninaitwa Dr Thomas Lujuo, nashughulika kwenye utafiti huu wenye lengo la kutathmini ukubwa wa tatizo la meno yenye wingi wa florin na madhara yanayohusiana na afya ya kinywa na meno na uhitaji wa matibabu kwa wanafunzi wa sekondari za Arusha mjini.

Utafiti unalenga kutathmini ukubwa wa tatizo la meno yenye wingi wa florin na madhara yanayohusiana na afya ya kinywa na meno na uhitaji wa matibabu kwa wanafunzi wa sekondari za Arusha mjini. Unaombwa kushiriki katika utafiti huu kutokana na upeo na ufahamu ulio nao ambavyo ni muhimu kwa utafiti huu. Tafadhali kuwa mkweli na muwazi kwa vile matokeo ya utafiti huu yanaweza yakatoa maamuzi na mapendekezo ya baadaye.

Jinsi ya kushiriki

Ukikubali kushiriki katika utafiti huu, utasailiwa ili kuweza kujibu maswali toka kwenye dodoso lililoandaliwa kwa ajili ya utafiti huu.

Usiri

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

Hatari

Hatutegemei madhara yoyote kukutokea kwa kushiriki kwako kwenye utafiti huu.

Faida

Kama utakubali kushiriki kwenye utafiti huu taarifa utakazotoa zitatuwezesha kutupa mwanga zaidi juu ukubwa wa tatizo la uwingi wa madini ya fllorini kwenye meno, kutambua uwingi wa madini ya florin kwenye meno, athari ya uwingi wa madini ya floridi kwenye meno na pia utafiti utasaidia kufahamu uhitaji wa matibabu ya mwonekano mzuri wa meno kwa waathirika. Matokeo ya utafiti huu yanaweza kutoa taarifa ambazo zitaweza kusaidi katika kuonyesha na kuongeza uelewa kuhusu kuwepo tatizo la uwingi wa madini ya floridi kwenye meno hivyo kuwezesha kujua mapema uwepo wa tatizo na kulitibu. Pia, itasaidia wadau mbali mbali ikiwemo watunga sera kuchukua hatua.

Athari na kukitokea madhara

Hutegemewi kupata madhara yoyote kutokana na ushiriki wako katika utafiti huu. Baadhi ya maswali yanaweza yasikupendeze, unaweza kukataa kujibu swali lolote la aina hiyo.

Uhuru wa kushiriki na haki ya kujitoa

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

Nani wa kuwasiliana naye

Kama una maswali kuhusiana na utafiti huu, wasiliana na Mtafiti mkuu wa utafiti huu, Dr Thomas Lujuo wa Chuo Kikuu cha Afya na Sayansi ya Tiba Muhimbili, S. L. P. 65001, Dar es Salaam. Simu 0713632748.

Kama una swali kuhusu stahili zako kama mshiriki unaweza kumpigia simu **Prof. Said Aboud**, Mwenyekiti wa kamati ya Utafiti na Uchapishaji, S.L.P 65001, Simu: 255 22 2152489 Dar es Salaam au msimamizi wa utafiti huu Dr. Godbless. J. Mandari (Simu: 0754817424) au msimamizi msaidizi Dr. Tumaini Simon (Simu: 0713503879).

Sahihi:...

Je umekubali?

Mshiriki amekubali ……........................... Mshiriki hajakubali ………….................

Mimi .... nimesoma maelezo ya fomu hii.

Maswali yangu yamejibiwa.Nakubali kushiriki katika utafiti huu.

Sahihi ya mshiriki……………………………………………………

Sahihi ya mtafiti msaidizi……………………………………………

Tarehe ya kutia sahihi ya idhini ya kushiriki…………………………

7.2. APPENDIX II 'a' - QUESTIONNAIRE – *English version*

(Structured personal interview for students)

A. Identification details

ID No. [_ | _ | _]   Date of interview *(d,m,y)* [__|__/__]

Name of school …………………………………….. Class *(1-4)* [_]   Stream [_]

Age. *(years)* [_ | _]   Sex *(1 female, 2 male)* [__]

Tick only one answer for each question.

A. Where and with whom do you live now?

1 Home with parents   [ ]   2 Home with guardian [ ]

3   Hostel   [ ]   4 Other (specify)…………………..

4. What is the occupation of your parent/guardian (Please mention)
…………………………………………………………

B. The following questions are about your teeth

(Please tick to "YES" or "NO" for each statement)

1. Think back on the previous 6, months have you experience the following?

Condition	Yes	No
C. Toothache		
B. Sensitive teeth		
C. Problem with arrangement of your teeth		
D. Ulcer in the mouth		
E. Bleeding gums		
F. Swollen gums		
G. Bad breath		
H. Problem with the color of your teeth		
I. Problem with spaces between your teeth		

Please answer the following questions irrespective of the answers to the above problems (tick only one category)

2. During the past six months how often have problem with your teeth (for example such as mentioned above or others) caused you difficulty with **eating or enjoying food?**

   1 [ ] Never

   2 [ ] Once or twice a month

   3 [ ] Once or twice a week

   4 [ ] 3–4 times a week

   5 [ ] Everyday/ nearly every day

3. What was the actual oral problem(s) that caused you difficulty with **eating or enjoying food?**

Condition	Yes	No
Toothache		
Sensitive teeth		
Arrangement of your teeth		
Ulcer in the mouth		
Bleeding gums		
Swollen gums		
Bad breath		
Brown color of your teeth		
Spaces between your teeth		

4. During the past six months how often have problem with your teeth (for example such as mentioned above or others) caused you difficulty with **speaking or pronouncing words?**

     1 [ ] Never

     2 [ ] Once or twice a month

     3 [ ] Once or twice a week

     4 [ ] 3–4 times a week

     5 [ ] Everyday/ nearly every day

5. What was the actual oral problem(s) that caused you difficulty with **speaking or pronouncing words?**

Condition	Yes	No
Toothache		
Sensitive teeth		
Arrangement of your teeth		
Ulcer in the mouth		
Bleeding gums		
Swollen gums		
Bad breath		
Brown color of your teeth		
Spaces between your teeth		

6. During the past six months how often have problem with your teeth (for example such as mentioned above or others) caused you difficulty with **cleaning teeth?**

    1 [ ] Never

    2 [ ] Once or twice a month

    3 [ ] Once or twice a week

    4 [ ] 3–4 times a week

    5 [ ] Everyday/ nearly every day

7. What was the actual oral problem(s) that caused you difficulty with **cleaning teeth?**

Condition	Yes	No
Toothache		
Sensitive teeth		
Arrangement of your teeth		
Ulcer in the mouth		
Bleeding gums		
Swollen gums		
Bad breath		
Brown color of your teeth		
Spaces between your teeth		

8. During the past six months how often have problem with your teeth (for example such as mentioned above or others) caused you difficulty with **sleeping or relaxing?**

   1[ ] Never

   2 [ ] Once or twice a month

   3 [ ] Once or twice a week

   4 [ ] 3–4 times a week

   5 [ ] Everyday/ nearly every day

9. What was the actual oral problem(s) that caused you difficulty with **sleeping or relaxing?**

Condition	Yes	No
Toothache		
Sensitive teeth		
Arrangement of your teeth		
Ulcer in the mouth		
Bleeding gums		
Swollen gums		
Bad breath		
Brown color of your teeth		
Spaces between your teeth		

10. During the past six months how often have problem with your teeth (for example such as mentioned above or others) caused you difficulty with **smiling or laughing?**

    1 [ ] Never

    2 [ ] Once or twice a month

    3 [ ] Once or twice a week

    4 [ ] 3–4 times a week

    5 [ ] Everyday/ nearly every day

11. What was the actual oral problem(s) that caused you difficulty with **smiling or laughing?**

Condition	Yes	No
Toothache		
Sensitive teeth		
Arrangement of your teeth		
Ulcer in the mouth		
Bleeding gums		
Swollen gums		
Bad breath		
Brown color of your teeth		
Spaces between your teeth		

12. During the past six months how often have problem with your teeth (for example such as mentioned above or others) caused you difficulty with **maintaining usual emotional stability?**

    1 [ ] Never

    2 [ ] Once or twice a month

    3 [ ] Once or twice a week

    4 [ ] 3–4 times a week

    5 [ ] Everyday/ nearly every day

13. What was the actual oral problem(s) that caused you difficulty with **maintaining usual emotional stability?**

Condition	Yes	No
Toothache		
Sensitive teeth		
Arrangement of your teeth		
Ulcer in the mouth		
Bleeding gums		
Swollen gums		
Bad breath		
Brown color of your teeth		
Spaces between your teeth		

14. During the past six months how often have problem with your teeth (for example such as mentioned above or others) caused you difficulty with **studying?**

      1 [ ] Never

      2 [ ] Once or twice a month

      3 [ ] Once or twice a week

      4 [ ] 3–4 times a week

      5 [ ] Everyday/ nearly every day

15. What was the actual oral problem(s) that caused you difficulty with **studying?**

Condition	Yes	No
Toothache		
Sensitive teeth		
Arrangement of your teeth		
Ulcer in the mouth		
Bleeding gums		
Swollen gums		
Bad breath		
Brown color of your teeth		
Spaces between your teeth		

16. During the past six months how often have problem with your teeth (for example such as mentioned above or others) caused you difficulty with **playing or having fun with other people?**

    1 [ ] Never

    2 [ ] Once or twice a month

    3 [ ] Once or twice a week

    4 [ ] 3–4 times a week

    5 [ ] Everyday/ nearly every day

17. What was the actual oral problem(s) that caused you difficulty with **playing or having fun with other people?**

Condition	Yes	No
Toothache		
Sensitive teeth		
Arrangement of your teeth		
Ulcer in the mouth		
Bleeding gums		
Swollen gums		
Bad breath		
Brown color of your teeth		
Spaces between your teeth		

D. QUESTIONS FOR ASSESSING TREATMENT NEEDS.

If you perceive any dental treatment need at the moment, what kind of treatment you need, *please tick to* **"YES"** *or* **"NO"**

Treatment need	Yes	No
1. Pain release		
2. Removal of tooth discoloration		
3. Tooth extraction		
4. Filling of tooth cavities		
5. Correcting arrangement of teeth		

7.2. KIAMBATANISHO II 'b' - DODOSO - Kiswahili

Usaili binafsi kwa wanafunzi wa sekondari

A. Maelezo ya utambulisho

Namba ya utambulisho [__|__|__]   Tarehe ya usaili *(d,m,y)*

[__|__/__]

Jina la shule…………………………………   Darasa *(1-4)* [_]   Mkondo [_]

Umri *(miaka)* [_ | _]   Jinsi *(1 ke, 2 me)* [__]

Tick only one answer for each question.

___

Tafadhali chagua jibu linalo kufaa zaidi. Tia tiki jibu moja tu kwa kila swali

1. Sasa unaishi wapi na unaishi na nani

     1[ ] Nyumbani na wazazi

     2[ ] Nyumbani na walezi

     3 [ ] Hosteli

     4 [ ] Kwingineko (taja)……….

2. Kazi ya mzazi au mlezi (tafadhali taja)

     ....

B. YAFUATAYO NI MASWALI KUHUSU KINYWA NA MENO YAKO

Tafadhali tia tiki moja tu kwa kila kauli.

1. Fikiria nyuma katika miezi sita iliyopita, umeshapata lolote kati ya haya yafuatayo

	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Matatizo ya namna meno yalivyokaa		
Kidonda kwenye mdomo		
Fizi kutoa damu		
Fizi kuvimba		
Harufu mbaya mdomoni		
Matatizo ya rangi ya meno yako		
Matatizo ya nafasi kwenye meno yako		

Tafadhali jibu maswali yanayofuata bila kujali majibu uliyotoa kwa maswali ya hapo juu (tiki jibu moja tu)

2. Katika miezi sita iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno (kwa mfano kama yale yaliyotajwa hapo juu au mengine) yaliyokusababishia taabu wakati wa **kula au kutafuna chakula**?

      1[ ] Kamwe

      2[ ] Mara moja au mbili kwa mwezi

      3[ ] Mara moja au mbili kwa wiki

      4[ ] Mara 3-4 kwa wiki

      5[ ] Kila siku/ au karibu kila siku

3. Ni matatizo gani hasa ya kinywa yaliyo kusababishia taabu wakati wa **kula au kutafuna chakula?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Namna meno yalivyokaa		
Kidonda kwenye mdomo		
Fizi kutoa damu		
Fizi kuvimba		
Harufu mbaya mdomoni		
Rangi ya kahawia kwenye meno yako		
Nafasi kwenye meno yako		

4. Katika miezi sita iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu wakati wa **kuzungumza au kutamka maneno?**

> 1[ ] Kamwe
>
> 2[ ] Mara moja au mbili kwa mwezi
>
> 3[ ] Mara moja au mbili kwa wiki
>
> 4[ ] Mara 3-4 kwa wiki
>
> 5[ ] Kila siku/ au karibu kila siku

5. Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu wakati wa **kuzungumza au kutamka maneno?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Namna meno yalivyokaa		
Kidonda mdomoni		
Fizi kutoa damu		
Fizi kuvimba		
Harufu mbaya mdomoni		
Rangi ya kahawia kwenye meno yako		
Nafasi kwenye meno yako		

6. Katika miezi sita iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu wakati wa **kuyasafisha meno yako?**

       1[ ] Kamwe

       2[ ] Mara moja au mbili kwa mwezi

       3[ ] Mara moja au mbili kwa wiki

       4[ ] Mara 3-4 kwa wiki

       5[ ] Kila siku/ au karibu kila siku

7. Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu wakati wa **kusafisha meno?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Namna meno yalivyokaa		
Kidonda mdomoni		
Fizi kutoa damu		
Fizi kuvimba		
Harufu mbaya mdomoni		
Rangi yakahawia kwenye meno yako		
Nafasi kwenye meno yako		

8. Katika miezi sita iliyopita ni mara ngapi matatizo katika kinywa chako au meno yalikusababishia taabu wakati wa **kulala au kupumzika?**

        1[ ] Kamwe

        2[ ] Mara moja au mbili kwa mwezi

        3[ ] Mara moja au mbili kwa wiki

        4[ ] Mara 3-4 kwa wiki

        5[ ] Kila siku/ au karibu kila siku

9. Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu wakati wa **kulala au kupumzika?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Namna meno yalivyokaa		
Kidonda mdomoni		
Fizi kutoa damu		
Fizi kuvimba		
Harufu mbaya mdomoni		
Rangi ya kahawia kwenye meno yako		
Nafasi kwenye meno yako		

10. Katika miezi sita iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu katika **kutabasamu, kucheka, au kuonyesha meno bila kuona aibu?**

> 1[ ] Kamwe
>
> 2[ ] Mara moja au mbili kwa mwezi
>
> 3[ ] Mara moja au mbili kwa wiki
>
> 4[ ] Mara 3-4 kwa wiki
>
> 5[ ] Kila siku/ au karibu kila siku

11. Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu katika **kutabasamu, kucheka, au kuonyesha meno bila kuona aibu?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Namna meno yalivyokaa		
Kidonda mdomoni		
Fizi kutoa damu		
Fizi kuvimba		
Harufu mbaya mdomoni		
Rangi ya kahawia kwenye meno yako		
Nafasi kwenye meno yako		

12. Katika miezi sita iliyopita ni mara ngapi umekuwa na mataitizo katika kinywa chako au meno yaliyokusababishia taabu katika **kuendelea kuwa na hali ya kawaida ya mhemko bila ya kukereka?**

        1[ ] Kamwe

        2[ ] Mara moja au mbili kwa mwezi

        3[ ] Mara moja au mbili kwa wiki

        4[ ] Mara 3-4 kwa wiki

        5[ ] Kila siku/ au karibu kila siku

13. Ni matatizo gain hasa ya kinywa yaliyokusababishia taabu katika **kuendelea kuwa na hali ya kawaida ya mhemko bila ya kukereka?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Namna meno yalivyokaa		
Kidonda mdomoni		
Fizi kutoa damu		
Fizi kuvimba		
Harufu mbaya mdomoni		
Rangi ya kahawia kwenye meno yako		
Nafasi kwenye meno yako		

14. Katika miezi sita iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu katika **kufanya kazi kubwa za shule?**

        1[ ] Kamwe

        2[ ] Mara moja au mbili kwa mwezi

        3[ ] Mara moja au mbili kwa wiki

        4[ ] Mara 3-4 kwa wiki

        5[ ] Kila siku/ au karibu kila siku

15. Ni matatizo gani hasa ya kinywa yaliyokusababishia taabu katika **kufanya kazi kubwa za shule?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Namna meno yalivyokaa		
Kidonda mdomoni		
Fizi kutoa damu		
Fizi kuvimba		
Harufu mbaya mdomoni		
Rangi ya kahawia kwenye meno yako		
Nafasi kwenye meno yako		

16. Katika miezi sita iliyopita ni mara ngapi umekuwa na matatizo katika kinywa chako au meno yaliyokusababishia taabu **kufurahia kukutana na watu?**

  1[ ] Kamwe

  2[ ] Mara moja au mbili kwa mwezi

  3[ ] Mara moja au mbili kwa wiki

  4[ ] Mara 3-4 kwa wiki

  5[ ] Kila siku/ au karibu kila siku

17. Ni matatizo gain hasa ya kinywa yaliyokusababishia taabu **kufurahia kukutana na watu?**

Hali	Ndiyo	Hapana
Maumivu ya jino		
Meno hisishi (meno kufa ganzi)		
Namna meno yalivyokaa		
Kidonda mdomoni		
Fizi kutoa damu		
Fizi kuvimba		
Harufu mbaya mdomoni		
Rangi ya kahawia kwenye meno yako		
Nafasi kwenye meno yako		

C. **UHITAJI YA MATIBABU** *(Tafadhali tiki jibu moja tu katika kila aina ya matibabu)*

Kama unadhani unahitaji matibabu, ni matibabu ya aina gain unahitaji?

Matibabu	Ndiyo	Hapana
1. Kuondoa maumivu.		
2. Kuondoa randi ya kahawia kwenye meno		
3. Kung'oa jino.		
4. Kujaza matundu kwenye meno		
5. Kurekebisha mpangilio wa meno		

7.3. APPENDIX III. CLINICAL FORM

Dental fluorosis survey form (TFI score)

A. Identification details

ID No. [_|_|_]   **D**ATE [__|__|__|__|__|__]

Name of school…………………………………………………………………….

Class……………………….   Stream……………………..

Name of respondent ………………………………………………

Residence/Street …………………………………………….

Tooth / Surface	17	16	15	14	13	12	11	21	22	23	24	25	26	27
Buccal	■	■	■									■	■	■
Tooth / Surface	47	46	45	44	43	42	41	31	32	33	34	35	36	37
Buccal	■	■	■									■	■	■

TFI score categorization.

1. Normal 0

2. Mild 1-3

3. Moderate 4-5

4. Severe 6-9

7.4. APPENDIX-IV Thylstrup-Fejerskov Index

Clinical Criteria and Scoring for the TF (Thylstrup-Fejerskov) Index Modified Criteria (Fejerskov *et a/.*, 1988)	
Score	Criteria
0	The normal translucency of the glossy, creamy-white enamel remains after wiping and drying of the surface.
1	Thin white opaque lines are seen running across the tooth surface. The lines correspond to the position of the perikymata. In some cases, a slight "snowcapping" of cusps/incisal edges may also be seen.
2	The opaque white lines are more pronounced and frequently merge to form small cloudy areas scattered over the whole surface. "Snowcapping" of incisal edges and cusp tips is common.
3	Merging of the white lines occurs, and cloudy areas of opacity occur spread over many parts of the surface. In between the cloudy areas, white lines can also be seen.
4	The entire surface exhibits a marked opacity or appears chalky white. Parts of the surface exposed to attrition or wear may appear to be less affected
5	The entire surface is opaque, and there are round pits (focal loss of the outermost enamel) that are less than 2 mm in diameter.
6	The small pits may frequently be seen merging in the opaque enamel to form bands that are less than 2 mm in vertical height. In this class are also included surfaces where the cuspal rim of facial enamel has been chipped off, and the vertical dimension of the resulting damage is less than 2 mm.
7	There is a loss of the outermost enamel in irregular areas, and less than half the surface is so involved. The remaining intact enamel is opaque.
8	The loss of the outermost enamel involves more than half the enamel. The remaining intact enamel is opaque.
9	The loss of the outermost enamel involves more than half the enamel. The remaining intact enamel is opaque. The loss of the major part of the outer enamel results in a change of the anatomical shape of the surface/tooth. A cervical rim of opaque enamel is often noted

7.5. APPENDIX-V Ethical clearance

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES

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Ref. No. MU/ PGS/SAEC/Vol. XVI/   7th November, 2016

Dr. Thomas Lujuo
M.Dent Restorative Dentistry
MUHAS.

RE: APPROVAL OF ETHICAL CLEARANCE FOR A STUDY TITLED:"DENTAL
       FLUORASIS-TREATMENT NEED AND ITS IMPACT ON QUALITY OF LIFE
       AMONG SECONDARY SCHOOL STUDENTS IN ARUSHA, TANZANIA

Reference is made to the above heading.

I am pleased to inform you that, the Chairman has, on behalf of the Senate, approved ethical clearance for the above-mentioned study. Hence you may proceed with the planned study.

The ethical clearance is valid for one year only, from 2nd September, 2016 to 1st September, 2017. In case you do not complete data analysis and dissertation report writing by 1st September, 2017, you will have to apply for renewal of ethical clearance prior to the expiry date.

Prof. Andrea B. Pembe
DIRECTOR OF POSTGRADUATE STUDIES

cc: Director of Research and Publications
cc: Dean, School of Dentistry

Noted.
8.11.2016