DENTAL FLUOROSIS: IMPACT ON QUALITY OF LIFE AND TREATMENT NEED AMONG ADOLESCENTS WITH DENTAL FLUOROSIS IN AN ENDEMIC AREA-KILIMANJARO REGION, TANZANIA

Francis Roman, DDS

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DENTAL FLUOROSIS: IMPACT ON QUALITY OF LIFE AND TREATMENT NEED AMONG ADOLESCENTS WITH DENTAL FLUOROSIS IN AN ENDEMIC AREA-KILIMANJARO REGION, TANZANIA

By

Francis Roman

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

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for examination of dissertation entitled ***Dental fluorosis: impact on quality of life and treatment need among adolescents with dental fluorosis in an endemic area-Kilimanjaro region, Tanzania,*** in fulfillment of the requirements for the degree of Master of Dentistry (Restorative Dentistry) of Muhimbili University of Health and Allied Sciences.

Prof. L. Mabelya
(Supervisor)

Date: 8th November 2010

Dr. P.T.N Sarita
(Supervisor)

Date: 8th Nov 2010

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I **Francis Roman**, 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.

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ABSTRACT

Background

Dental fluorosis is the hypomineralization of dental enamel caused by chronic ingestion of fluoride during the formative stages of the dental hard tissues. Fluoride in excess of 1.5 mg/L in water is the principle cause of endemic dental fluorosis. Other causes of dental fluorosis are fluoride supplements (e.g. toothpaste) and food additives like traditional salt "trona". Dental fluorosis has social and psychological effects, whereby individuals affected even with the mild form demonstrate significant dissatisfaction over their appearance thus affecting their ability to interact and form relationships leading to exclusion, loneness, long term depression and other undesirable social behaviors.

Aim

The aim of this study was to determine the impact of dental fluorosis on quality of life using OIDP index, to determine the normative and subjective oral treatment need among individuals with dental fluorosis, the relationship between clinically defined dental fluorosis at different diagnostic cut-off points and self-rated appearance among adolescents.

Methodology

This cross-sectional study was conducted at Kibosho, a known area for endemic dental fluorosis in Kilimanjaro between August and September 2009. A sample of 269 secondary school students aged 15-18 years with dental fluorosis was involved. Data were collected using self administered questionnaire and clinical examination forms, OIDP questions were used to assess the impact of dental fluorosis on quality of life. Clinical examinations were carried out by one calibrated dentists (Kappa = 0.90) under natural light. Prior to examination the front teeth and first premolars of both maxilla and mandible were cleaned and dried with gauze. Dental fluorosis was diagnosed according to TF index. Data analysis was done using SPSS version 15 and statistical level of significance was $p< 0.05$.

Results

Total of 269 students with dental fluorosis aged15-18 years (mean age 17.3) were involved in this study where 62.5% were female. Majority of the participants (65.4%) had severe dental fluorosis (TFI6-9), while (29.4%) had TFI 4-5 and (5.2%) had dental fluorosis of TFI 1-3. Most of the students (92.6%) perceived at least one oral impact on daily performance. The performances most affected were smiling 88.1%, emotional stability (81.4%), and having contact with others (75.5%). Brown discoloration of teeth was the most frequent perceived actual cause of oral impact on all eight performances. The treatment most frequently perceived was removal of brown discoloration 95.2% and 72.0% required esthetic veneer for treatment.

Conclusions

Dental fluorosis has impact on quality of life especially on smiling, emotional stability and having contact. Treatment of dental fluorosis at Kibosho is highly desired as expressed by subjective and objective treatment need. Low awareness of the role of "magadi" as a principal cause dental fluorosis at Kibosho was observed.

Recommendations

Oral health education programme on causes, prevention and treatment of dental fluorosis should be initiated in Kibosho. Efforts should be made to identify alternative salt for tenderization. Esthetic veneer should be promoted among dentists especially in endemic dental fluorosis area.

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ABBREVIATIONS

MUHAS	Muhimbili University of Health and Allied Sciences
OIDP	Oral Impact of Daily Performance
DF	Dental Fluorosis
TFI	Thylstrup-Fejerskov Index
M.Dent	Masters of Dentistry
ICIDH	International Classification of Impairment Disabilities and Handicaps
MoHSW	Ministry of Health and Social Welfare
DDS	Doctor of Dental Surgery
TFDA	Tanzania Food and Drug Authority

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DEDICATION

Dedicated to my dear wife Fainessy and our beloved son Roman Francis (Junior)

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Figure 1. Photograph showing teeth of an individual with severe dental fluorosis Thylstrap and Fejerskov Index (TFI $\geq$ 5)

1.0. INTRODUCTION

1.1. Background

Dental fluorosis is the hypomineralization of dental enamel, caused by chronic ingestion of fluoride that is above optimal levels during the formative stages of the dental hard tissues (Dean, 1942, WHO, 1984, Rahmatulla, 1995). The safe level for daily fluoride intake is 0.05-0.07 mg F/Kg/day, and above this level, the individual is at risk of developing dental fluorosis (Burt et al., 1992). It is conventionally understood that fluoride in excess of 1.5 mg/L in drinking water is the principle cause of endemic dental fluorosis (Dean, 1942, Thylstrup et al., 1978, Chritie et al., 1980, WHO, 1984, Driscoll et al., 1986). However severe categories of dental fluorosis have been reported in areas with negligible levels of fluoride in drinking water. Such findings have been associated with excessive ingestion of fluoride from tooth paste (Rozier, 1999, Whitford, 1990) and food additives like "trona" /"magadi" (Sodium Carbonate and Sodium Bicarbonate), (Mabelya et al., 1992, van Palenstein et al., 1993, Mabelya et al., 1997). Magadi, commonly used as tenderizers and for speeding cooking time may contain fluoride ions ranging from 29 to 9000 mg/L depending on the source (Mabelya et al., 1997).

The occurrence and the severity of dental fluorosis are influenced by fluoride dose, age of individuals and duration of exposure. Individuals aged 1 to 4 years are most at risk of developing dental fluorosis when exposed to excess fluoride as this is the age at which the formation and development of permanent dentition takes place (Jenny et al., 2009). The risk starts to decline gradually from the age of 4-6 years when most permanent teeth matured. Other factors reported to influence the occurrence and severity of dental fluorosis are high altitude (Manji et al., 1986), malnutrition and renal insufficiency (Porcar et al., 1998).

Clinically dental fluorosis is classified as mild, moderate and severe. In the mild forms the enamel surface is usually hard and smooth and fluorosis appears as faint white lines or streaks visible only to trained examiners under controlled examination conditions. In moderate forms dental fluorosis manifests as white mottling of teeth in which noticeable white lines or streaks have colleased into larger opaque areas. Brown staining or pitting of enamel may also be present. In severe forms actual breakdown of enamel may occur with loss of anatomical

morphology (Thylstrup et al., 1978, Weatherall et al., 1972, Burt et al., 1999 Aoba et al., 2002).

2.0 LITERATURE REVIEW

2.1. Prevalence of dental fluorosis

The prevalence of dental fluorosis varies in different parts of the world, being higher in populations whose drinking water has fluoride level above 1mg/L, though it has as well been reported in areas with negligible fluoride level in drinking water (Rozier, 1999, Whitford, 1990, Akpata et al., 1997, Rodd et al., 1997, McKnight, 1998).In Saudi Arabia Akpata reported the prevalence of dental fluorosis of 90% among school children of which 24% had severe dental fluorosis with pitting (Akpata etal., 1997). A study among young adults in Nalgonda India reported a prevalence of 100% (Sudhir et al., 2009) whereas in João Pessoa Brazil 35% of the adolescent had dental fluorosis (Thiago et al., 2007).

In Eastern Africa, dental fluorosis is reported to be widespread and in some areas it constitutes a public health problem (Grench and Latham, 1964, Grench et al., 1966, Awadia et al., 1999, Rwenyonyi et al., 1999). The prevalence reported in Addis Ababa and Nazreth Ethiopia is up to 100% (Wondwossen, et al., 2000). Studies in Kenya showed that dental fluorosis affects 76-100% of the population in the rift valley (Manji, et al., 1986, Ng'ang'a et al., 1993), while in Mbale Uganda the prevalence ranged from 36-84% (Margaret et al., 2003).

In Tanzania studies pointed at the very high prevalence of dental fluorosis in several regions. In Arusha, the Northern part of Tanzania severe endemic dental fluorosis was reported affecting 60-90% of the population ((Grech et al., 1964, Mabelya et al., 1992 and Åstrøm et al., 2002). In Singida, over 62% of the adolescents and young adults had dental fluorosis while in Iramba the prevalence of moderate to severe dental fluorosis was over 90% (Mabelya et al., 1992). Furthermore, a study of children aged 9-19 years in Kilimanjaro reported that 98% had dental fluorosis (Yorder et al., 1998). Considering the above the Tanzania Food and Drugs Authority (TFDA) has categorized dental fluorosis as the 5th most common nutritional disorder in the country (National Plan for Oral Health, 1988- 2002).

2.2. Impact of dental fluorosis on quality of life

The social and psychological consequences of dental fluorosis have been reported in several populations in the developed countries, whereby individuals affected even with the mild forms demonstrate significant dissatisfaction over their appearance (Clark et al.,1993, Lalumandier et al,. 1998, Levy et al.,2002). In some studies dental fluorosis was reported to impair individual's ability to interact and form relationships leading to exclusion, loneness, long term depression and other undesirable social behaviors (Spencer et al., 1996, Rodds et al., 1997, Westland et al., 2007). Similar findings were reported from studies in Africa. In Zimbabwe majority of adolescents with dental fluorosis expressed high levels of dissatisfaction with their dental appearance (Tobayiwa et al., 1991). In Kenya, individuals with moderate and severe dental fluorosis felt that the condition of their dentition induced shyness and impaired their personalities while 77% of young mothers considered dental fluorosis to be an embarrassing condition (Nyaoro et al., 2002). The disfiguring and disabling effects of dental fluorosis have also been reported in a number of studies in Tanzanians. Focusing on adolescents in a high fluoride area in Arusha, Åstrøm and Mashoto (2002) reported that 66% of boys and 79% of girls having moderate and severe dental fluorosis were dissatisfied with their dental appearance In a study of children aged 9-19 years Yorder et al,. 1998 observed profound discomfort among those with moderate and severe dental fluorosis. They further reported that more than half of the children abraded their front teeth with stone in order to remove the discoloration. Similarly felings of distress, worries and embarrassment among adolescents with moderate to severe dental fluorosis was reported in Northern Tanzania, and more than 90% of participants with severe dental fluorosis were reluctant to smile due to discolored teeth (van Palenstein et al., 1993).

In spite of the aforementioned social and psychological effects of dental fluorosis little practical efforts have been made to prevent the occurrence of this condition. Likewise strategies of treatment for affected individuals have not been established. Perhaps impact of dental fluorosis on life of the afflicted individuals is not known. Being a deformity rather than a disease dental fluorosis should be assessed by the extent it impairs the quality of life. This has not been done.

Over the last two decades a number of instruments have been developed to assess the oral health –related quality of life. These instruments are designed to document the functional, psychological and social impacts of disease or disorders affecting the oral cavity and related structures basing on the conceptual framework of the International Classification of Impairment Disability and Handicaps (ICIDH). The ICIDH is built up in three key levels (WHO, 1980). The first level is the impairment which refers to the immediate biophysical outcome of the condition and is commonly assessed by clinical indicators. The second level is the 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 the instruments derived from ICIDH 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 (Fig 2). This instrument has potential to provide information about the subjectively experienced consequences of oral diseases and to facilitate appropriate assessment for dental treatment (Gherumpong, 2004). OIDP has been adopted and proved to be reliable and valid for studies of populations of various ages conducted in Tanzania (Masalu, et al., 2002, Kida, et al., 2006, Mtaya, et al., 2007).

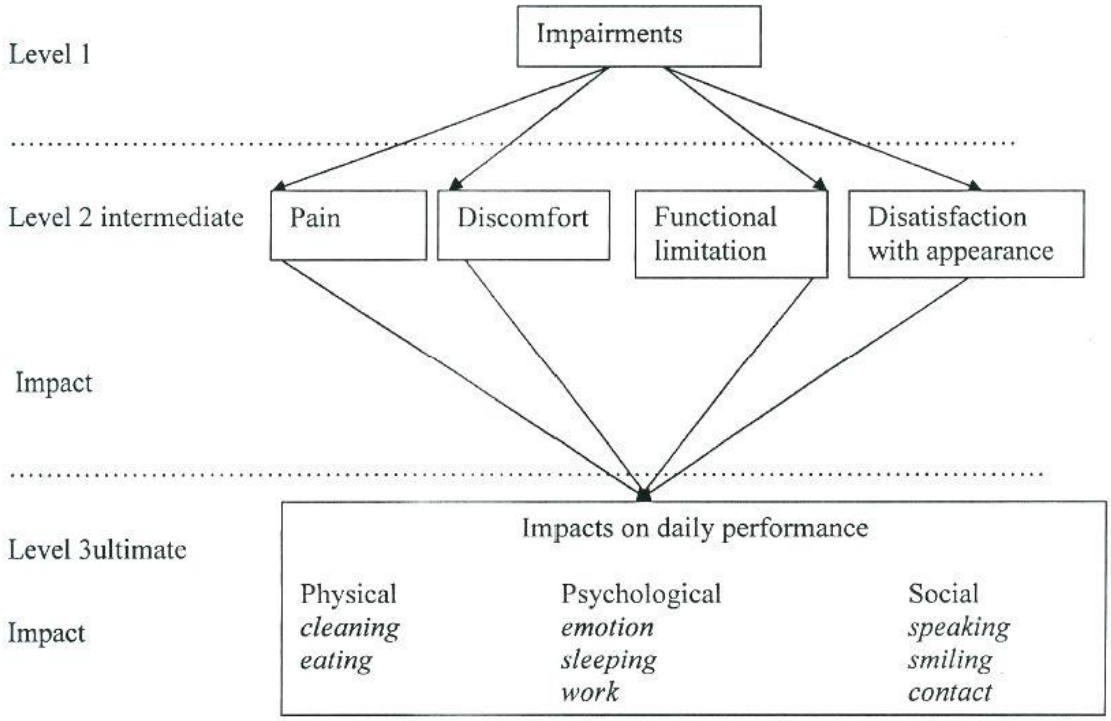


Fig 2. Theoretical framework of consequences of oral impact

2.3. Knowledge on causes, prevention and treatment of dental fluorosis

It is generally agreed that knowledge of causes of a particular health problem is necessary for the success of prevention strategies as well as compliance of patient to treatment. The fact that excessive fluoride in drinking water, food additives "trona", fluoride suppliments (eg. tooth paste) is the cause of dental fluorosis is an important knowledge for planning a successful program of prevention and treatment of dental fluorosis.There is scarcity of literature on whether people in areas with endemic dental fluorosis are aware of the cause of discoloration and mottling of their teeth. Two studies have highlighted on knowledge of people in East Africa concerning the causes of dental fluorosis. Wondwossen et al., 2000 reported that although majority of the students in Addis Ababa and Nazareth in Ethiopia were dissatisfied with the appearance of even mildly fluorotic teeth a great majority did not know the causes. In

Kenya majority of the participants of a study among school children were reported to have no knowledge on the cause or treatment for dental fluorosis (Nyaoro, et al., 2002). We could not retrieve information about knowledge of dental fluorosis among people living in endemic dental fluorosis area in Tanzania. Consequently it was considered important to determine if the adolescents living in endemic dental fluorosis area have correct understanding of the causes and possibilities of preventing dental fluorosis.

2.4. Treatment need of dental fluorosis

The advent of adhesive dental materials with non invasive techniques has advanced the management of tooth discolorations and the associated deformities (Cristian et al., 2007). Today aesthetically objectionable discoloration of fluorosed teeth can be managed by bleaching, micro-abrasion, and veneering or crowning. The choice between these treatment modalities depends on the severity of the fluorosis as determined by the Thylstrup and Fejerskov index (Akpata, 2001, Clark et al., 1993). Bleaching and enamel micro-abrasion techniques are recommended for TFI =1-4, and composite resins veneers for TFI 5-7. For severe dental fluorosis such as TFI 8-9 prosthetic crowns are considered to be the treatment of choice (Akpata, 2001). Although studies have revealed that people afflicted with dental fluorosis were discontented with their appearance there is very little data about the subjective need for treatment of dental fluorosis.

3.0. PROBLEM STATEMENT

Extensive studies have been done to establish the prevalence of dental fluorosis in various parts of Tanzania as well as possible determinants. Most studies have reported high prevalence of severe endemic dental fluorosis in Arusha, Kilimanjaro, Shinyanga, Singida and Tabora regions. However, relatively few studies have, considered the influence of dental fluorosis on the daily life of the affected individuals. Being a deformity rather than a disease, dental fluorosis can best be assessed by the extent it impairs the quality of life. The most recent instrument for carrying out this assessment is the OIDP index which was particularly developed to determine how oral conditions can affect the quality of life and consequently the need for care. This has not yet been done in Tanzania despite the high prevalence of severe dental fluorosis in the aforementioned regions.

The advent of adhesive dental materials with non invasive techniques has advanced the possibilities for management of dental fluorosis. The choice between the types of treatment depends on the severity of the fluorosis as determined by the TF Index. To date no study has reported on the treatment needs for the discoloration and disfigurement of dentition caused by dental fluorosis in Tanzania

To address the gaps highlighted above, this study was carried out among adolescents with dental fluorosis to determine the impact of dental flluorosis on their quality of life by using OIDP index and to establish treatment needs for the deformity according to TFI levels.

4.0. RATIONALE

The government has made deliberate efforts to improve the quality and scope of oral health care in line with development of technology in dental sciences. The number of dental personnel is increasing, and the availability of dental materials and modern equipments has advanced the management of oral health. There are now possibilities for treatment of dental fluorosis than has been in the past.

This study will attempt to substantiate the relevance of esthetic and restorative dentistry in a population with endemic dental fluorosis in Tanzania. This study will identify different levels of dental fluorosis and appropriate treatment needed. In this way it will be possible to plan for acquisition of the materials, instruments and human resources.

5.0. OBJECTIVES

5.1. Broad objective

To determine the impact of dental fluorosis on the quality of life, treatment need, knowledge, attitude, practiced and self-rate appearance among adolescents with dental fluorosis at Kibosho, Kilimanjaro.

5.2. Specific objectives

1. To assess knowledge, attitude and practice on dental fluorosis among adolescents with dental fluorosis.
2. To determine the impact of dental fluorosis on quality of life among adolescents with dental fluorosis.
3. To determine oral subjective treatment need among adolescents with dental fluorosis.
4. To determine objective treatment need of dental fluorosis (in different treatment categories) among adolescents with dental fluorosis.
5. To assess self-rated appearance among adolescents with different levels of dental fluorosis

6.0. MATERIAL AND METHODS

6.1. Study area and design

A Cross-sectional descriptive study was carried out at Kibosho division, an endemic dental fluorosis area in Kilimanjaro region between August and September 2009. Kibosho was purposively selected for this study because it is an endemic dental fluorosis area with high prevalence and severity of brown staining of teeth among residents. The level of fluoride in water at Kibosho is negligible (0.18 ±0.32 mg/L) however, majority of the residents use "magadi", a "trona" composed of Sodium Carbonate and Sodium Bicarbonate, as a tenderizer in cooking. "Magadi" has a high level of fluoride ranging from 29 to 9000mg/L) (Mabelya et al., 1998).

6.2. Sample size and sampling technique

Kibosho division is administratively divided into six wards each with three secondary schools: one boarding and two day schools. One ward with dynamic residents was excluded because most of the students were originated from other areas of Kilimanjaro region. From the remaining five wards all boarding schools were excluded because most of the students were not born and or brought up at Kibosho. One day secondary school from each of the five wards was randomly selected by tossing a coin and all fourth year students aged 15-18 years (N=384) were invited to participate in the study. The ratio of male to female was 1:2. From the 384 students 29 (7.6%) were excluded because they were migrants. Following clinical examination 86 (24.2%) students were excluded because they did not have dental fluorosis thus remaining with 269 (75.8%) participants with dental fluorosis (Fig 3).

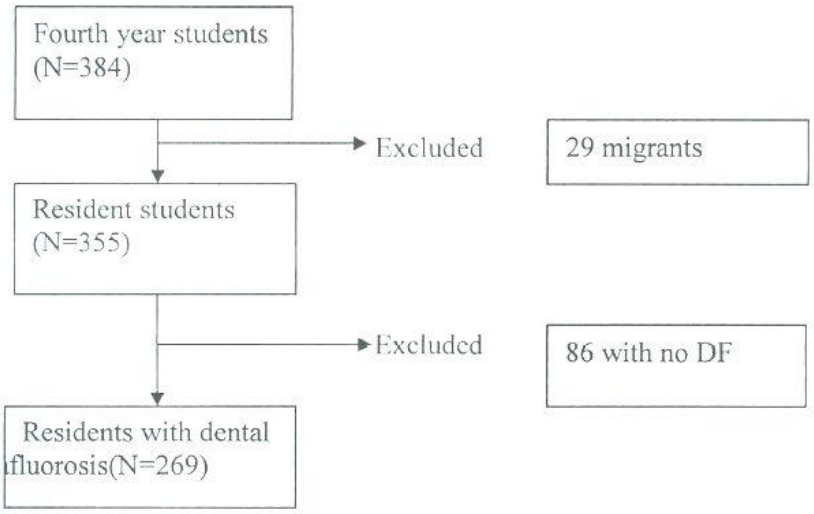


Figure 3: Sampling tree which was used to recruit study participants with dental fluorosis

6.3. Inclusion criteria

Adolescents with dental fluorosis aged 15 to 18 years, born and or brought up at Kibosho during the first 8 years of life.

6.4. Exclusion criteria

Presence of incisors and premolars surfaces obscured by grossly dental caries and or multiple restorations.

6.5. Questionnaire

A structured questionnaire was constructed in English (Appendix IIa) and translated to Kiswahili (Appendix IIb) before being administered to the participants by the principal researcher. The questionnaire contained items about socio-demographic particulars: age, sex and location of residence. Six dichotomous questions were used to assess participant's knowledge on causes, prevention and treatment of dental fluorosis. Attitudes towards dental fluorosis were measured with items on a 5-point scale: 1= strongly agree; 2= agree; 3= neither agree nor disagree; 4= disagree; 5= strongly disagree. Satisfaction with dental appearance was assessed using the statement "As a result of the status of your brown teeth you are not satisfied with your physical appearance" with options: 1 = strongly agree; 2 = agree; 3 = neither agree

nor disagree; 4 = disagree; 5 = strongly disagree. In addition participants were asked if they ever attempted to remove the brown discoloration from their teeth. The response categories were: 0 = no; 1 = yes, grinding teeth with stones; 2= yes, scrubbing teeth with sand; 3=yes, professionally by dentist.

The OIDP consisted of 8 items measured on four point scales ranging from 0-3. The OIDP frequency index referred to difficulty carrying out eight daily life activities namely eating, cleaning mouth, speaking, sleeping, smiling, school work, emotion and social contact for the past three month, with scores 0–3 where 0= never, 1= once or twice a month, 2= once or twice a week, 3= every day/nearly every day. Score of 2 and 3 indicated an impact on daily performance. One question on severity of the impact/problem was asked to each OIDP item, this was four scale (1) very severe (2) severe (3) less severe (4) not severe at all. Total OIDP score was constructed by simple count (SC) score (range 0–8) and summing the dichotomized frequency items of (1) affected and (0) not affected. In addition to above participants were asked to identify the oral condition that caused the specific impacts by answering for each reported item 1 = yes or 0 = no to the following: "toothache, sensitive teeth, problems with arrangement of teeth, ulcer in mouth, bleeding gum, swollen gums, bad breath, problems with color of teeth, problems with spaces of teeth, other problems".

6.6. Clinical examinations

The examinations were conducted in a classroom using dental mouth mirrors with natural light as a source of illumination and examinee seated on a wooden office chair. For each subject the teeth of aesthetic importance, the anteriors and first premolars, were examined for dental fluorosis. Prior to examination, the buccal and facial surfaces of the maxillary and mandibular anteriors and first premolars (14-24, 34-44) were cleaned and dried with gauze in order to remove debris and biofilms. Diagnosis and classification of dental fluorosis was done according to the TF- Index (Thylstrup and Fejerskov, 1978) (Appendix IV).



Figure 4. Teeth which were involved in clinical examination (incisors and premolars) of upper and lower jaws

6.7. Reproducibility

Duplicate clinical examinations were carried out on 29 (10%) randomly selected participants and the recordings gave kappa statistics of 0.90.



Figure 5. Diagnosis of dental fluorosis according to Thylstrup and Fejerskov Index (TFI). Tooth 13, TFI =4; teeth 11, 21 TFI =6; teeth 42, 41, and 31 TFI =5



Figure 6. Diagnosis of dental fluorosis according to TF Index. Teeth 14, 13, TFI =8; teeth 12, 11, 21, 44 and 43 TFI =7

6.8. Data management and analysis

. The attitude questions were re-corded into two categories: 0= disagree (3, 4 and 5) 1=agree (1 and 2). Responses to self-rate appearance question was also re-corded and dichotomized into 1=satisfied (4 and 5) and 2 =dissatisfied (1- 3)

OIDP summative index was computed and dichotomized into those with impact (OIDP≥1) and without impact (OIDP=0). The Thylstrup and Fejerskov Index (TFI) (Thylsrupt et al., 1978) was used to classify individuals into the levels: mild (TFI = 1-3), moderate (TFI = 4-5) and severe (TFI = 6-9). The classification was based on the highest TF value assigned to one or more teeth of the subject (Marcelo et al., 2007). The participants were again categorized according to treatment required for the severity of dental fluorosis. The cartegories of treatment were "bleaching and microabration with or without composite filling TFI=1-4", microabration with "esthetic veneer TFI=5-7" and "prosthetic crown" TFI=8-9 (Akpata, 2001).

Data cleaning and analysis was done using SPSS version 15 and Chi-square was used to compare proportions. Level of statistical significance was 0.05.

6.9. Ethical issues

Ethical clearance for this study was obtained from the Director of Research and Publications of the Muhimbili University of Health and Allied Science (MUHAS) and permission to conduct research in secondary schools at Kibosho was obtained from the education office for Moshi district. The aims, possible risks and benefit of the study were explained to all participants and informed consent was signed by each of them in advance of recruitment to the study. The participants were specifically informed that they were free to refuse to participate in the study or withdraw at any moment during the study.

7.0. RESULTS

7.1. Participants demographics

Of the 269 students who participated in the study about two thirds (62.5%) were females and the great majority (82.5%) were 17 to 18 years old (Table1).

Table 1. Distribution of participants by age and sex (N=269)

Age (Yrs)	Male	Female	Total
	n (%)	n (%)	n (%)
15	4 (1.5)	9 (3.3)	13(4.8)
16	12 (4.5)	22 (8.2)	34(12.6)
17	31 (11.5)	44 (16.4)	75 (27.9)
18	54 (20.0)	93 (34.5)	147 (54.6)
Total	101(37.5)	168 (62.5)	269 (100.0)

Table 2 describes the distribution of participants according to level of dental fluorosis. Among all participants 14 (5.2%) had mild dental fluorosis (TFI 1-3), 79 (29.4%) moderate dental fluorosis (TFI 4-5) and 176 (65.4%) had severe dental fluorosis (TFI 6-9). There was no statistically significant association of severity of dental fluorosis with gender.

Table 2. Distribution of participants by clinical level of dental fluorosis

Clinical level	Male	Female	Total
of fluorosis	n (%)	n (%)	n (%)
TFI 1-3	7 (6.9)	7 (4.2)	14 (5.2)
TFI 4-5	31 (30.7)	48 (28.6)	79 (29.4)
TFI 6-9	63 (62.4)	113 (67.3)	176 (65.4)
Total	101 (100.0)	168 (100.0)	269 (100.0)

7.2. Knowledge attitude and practice.

Table 3 shows the distribution of answers to questions about the causes, prevention and treatment of dental fluorosis. Most of the participants agreed that excessive fluoride in water causes dental fluorosis while slightly more than half of them also indicated that "magadi" causes dental fluorosis. Regarding prevention most participants agreed that dental fluorosis is prevented by avoiding consuming water with high fluoride content. On the other hand more than half of the participants (55.5%) did not agree with the statement that dental fluorosis is prevented by avoiding consumption of "magadi". For treatment of dental fluorosis a great majority of the participants (94.4%) agreed with the statement that "browning of teeth is appropriately treated in a dental clinic by dentist". However none of the participants ever attended dental clinic for the discolored teeth while 96 (35.7%) participants reported they attempted to remove the discoloration by grinding the front teeth with stone / sand.



Figure 7. Photograph of an individual who attempted to grind the central incisors to remove brown discoloration

Table 3. Knowledge on causes, prevention, and treatment of dental fluorosis

Variable	Yes n (%)	No n (%)
Causes		
Drinking water	241(89.6)	28 (10.4)
Magadi	150 (55.8)	119 (44.2)
Prevention		
Avoid drinking water with excess fluoride	227(84.4)	42 (15.6)
Avoid using "magadi" with excess fluoride	118(43.9)	151 (56.1)
Treatment		
Grinding with stone/sand	3(1.1)	266 (98.9)
In the dental clinic/ hospital	254(94.4)	15 (5.6)

In relation to attitude, most participants (85.1%) indicated that they consider dental fluorosis a health problem in their area. Most of them strongly agreed that teeth with brown discoloration affects the ability of an individual to socialize and have fun with others (81.2%), are difficult to clean (57.6%), and may become sensitive during eating (68.0%). Majority of the participants (96.3%) agreed that teeth affected with dental fluorosis need to be treated (Table 4)

Table 4. Attitude towards dental fluorosis

Specific question	Response to specific questions	
	Agree	Disagree
Brown teeth is a problem	85.1	14.9
Brown teeth affects smiling freely	81.8	18.2
Brown teeth are difficult to clean	57.6	42.4
Brown teeth may cause sensitivity	68.0	32.0
Brown teeth need to be treated	96.3	3.7

7.3. Impact of dental fluorosis on quality of life

As shown in Table 5 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 (Table 5).

In relation to intensity of impacts performances with high prevalence of impact also had high proportion of individuals with very severe and severe impact compared to other performances (Table 5)

Table 5. Percentage distribution of the eight Oral Impacts on Daily Performance (OIDP) frequency items and intensity of impact of the participants

Overall OIDP	Eating	Speaking	Cleaning	Sleeping	Smiling	Emotion	Work	Contact
92.6	26.4	16.4	52.0	17.1	88.1	81.4	13.4	75.5
Intensity of impacts (%)								
Very severe	5.6	2.2	6.3	2.2	24.5	14.9	5.9	13.0
Severe	15.2	8.9	19.7	8.2	26.4	26.0	8.2	32.7
Less severe	35.7	27.9	39.8	28.3	30.9	38.3	23.0	26.4
Not severe at all	43.1	61.0	34.2	61.3	18.2	29.0	62.8	27.9

As shown in Fig 8, brown discoloration of teeth was the most frequent perceived actual cause of oral impact for all the eight performances followed by bleeding gums and toothache

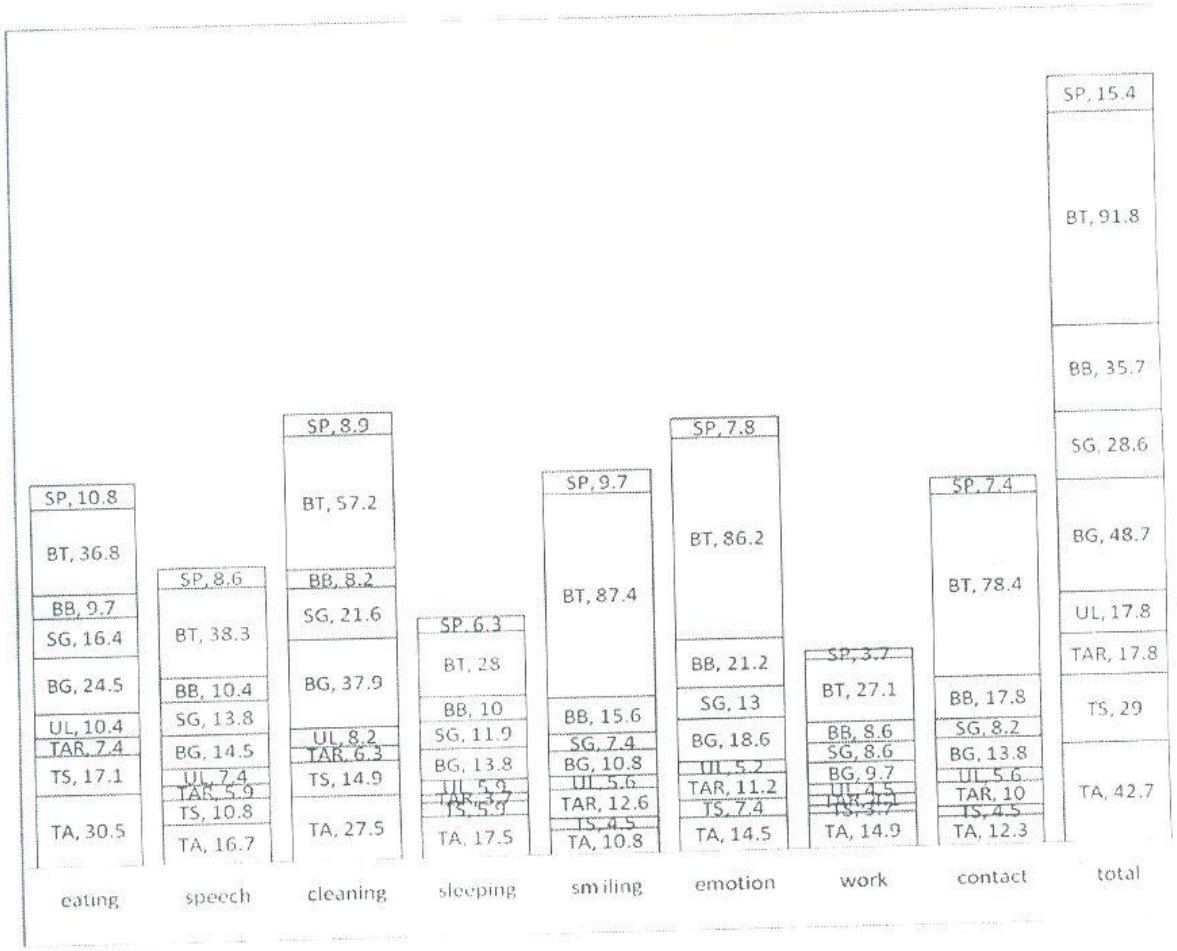


Figure 8. Perceived oral problems associated with oral impacts of the participants

TA=toothache, TS= tooth sensitivity, TAR= tooth arrangement, UL=ulcer, BG= bleeding gum, SG= swollen gum, BB= bad breath, BT= brown discoloration of teeth, SP= space between teeth

7.4. Subjective oral treatment need

Table 6 shows the distribution of participants according to their perceived oral treatment needs. The great majority (95.2%) perceived removal of brown discoloration as their most treatment need while about one quarter of the participants needed analgesics for oral related pains. High proportion of participants with severe dental fluorosis (38%) perceived the need for analgesics compared to those with mild (7%) or moderate levels of dental fluorosis (2.5%)

Table 6 .Distribution of participants according to oral subjective treatment need

Treatment need	Male n (%)	Female n (%)	Total n (%)
Pain relief by analgesics	25(25.8)	41(24.4)	66(24.5)
Removal of brown discoloration	93(92.1)	163(97.0)	256(95.2)
Tooth extraction	5(5.0)	10(6.0)	15(5.6)
Filling of cavities	22(21.8)	18(10.7)	40(14.9)

7.5. Objective treatment need for dental fluorosis

Table 7 shows the objective distribution of the TFI treatment categories related to subjective treatment needs. 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% required minimally invasive categories of treatment for dental fluorosis namely bleaching and composite veneer. Of these two categories the indications for composite veneers were more than three times the indications for the bleaching.

Table 7. Distribution of participants by subjective and objective treatment need of dental fluorosis

Subjective treatment need	Objective treatment need			
	Bleaching N (%)	Veneer N (%)	Crown N (%)	Total N (%)
Yes	54 (21.1)	186 (72.7)	16 (6.3)	256 (100.0)
No	5 (38.5)	8 (61.5)	0 (0)	13 (100.0)
Total	59 (21.9)	194 (72.1)	16 (5.9)	269 (100.0)

7.6. Relationship between TFI and self-rated appearance

As demonstrated in Table 8, majority of the participants with severe dental fluorosis (TFI 6-9) reported that they were dissatisfied with appearance of their teeth. Significantly high proportion of participants with severe dental fluorosis was dissatisfied with their appearance than those with mild to moderate dental fluorosis.

Table 8. Relationship between TFI and self-rated appearance

TFI classification	Self-rate appearance		
	Dissatisfied n (%)	Satisfied n (%)	Total n (%)
TFI ≤ 5	13 (8.5)	80 (69.0)	93 (34.6)
TFI ≥ 6	140 (91.5)	36.(31.0)	176 (65.4)
Total	153 (100.0)	116 (100.0)	269 (100.0)

$X^2 = 6.905$, ($p < 0.05$)

8.0. DISCUSSION

The sample of this study involved adolescents attending day secondary schools at Kibosho in Kilimanjaro region and may not represent adolescents of Kibosho. However majority of adolescents are expected to be in day secondary schools as secondary school education was mentioned to be essential to all eligible children since 2006. We also expected that majority of adolescents at Kibosho enrolled into day secondary schools in their locality in 2006 were now in fourth year hence can represent adolescents of Kibosho.

Students aged 15-18 years were selected, because this is adolescent age at which individuals are expected to be highly critical with their appearance. Furthermore at this age the individuals will have been exposed to fluoride for long time, probably with cumulative high fluoride dose which can result into severe dental fluorosis with pitting (Jenny et al., 2009).

The use of self administered questionnaire was reported to have some limitations such as misunderstanding, and none-response to some questions by the participants. However, in this study the researcher was available to clarify misunderstanding and the participants were encouraged to ask questions in case of doubt.

The major cause of dental fluorosis at Kibosho has been reported to be excess fluoride in "magadi" (Mabelya et al., 1992, van Palenstein et al., 1993, Mabelya et al., 1997). However nearly half (44.2%) of the participants in this study were not aware of this fact, and 56.1% did not know that avoiding "magadi" with excess fluoride is the way of preventing dental fluorosis. On the other hand while the fluoride level in water at Kibosho was reported to be negligible majority mentioned excess fluoride in drinking water the cause of dental fluorosis and avoiding consumption of water with excess fluoride the way of its prevention. This may explain the misconception of causes and prevention of dental fluorosis at Kibosho. It shows that education regarding causes, prevention and treatment of dental fluorosis was not given to the people of Kibosho after the previous research findings. However these findings differ with the previous study in Kenya where 74% of the participants were reported to have no knowledge regarding to neither the cause nor the treatment of dental fluorosis (Nyaoro, et al., 2002), and in Ethiopia where majority of students with mild to severe dental fluorosis did not know the causes (Wondwossen et al., 2000).

Dental fluorosis is a public health problem especially in endemic areas; afflicted individuals avoid free smiling or speaking in public, and demand for its treatment. In this study great majority of the participants were aware that it is best treated in the dental clinic and expressed need for removing the brown discoloration of their teeth. However no student was reported to have sought treatment of dental fluorosis in the hospital. About one third of the participants in this study had reported to have attempted to remove the brown discoloration by grinding their anterior teeth with stone / sand. Similar findings were reported in previous studies in Tanzania (van Palenstein et al., 1993, Yorder et al., 1998) and in Ethiopia (Wondwossen et al., 2000). Large proportion of participants with severe dental fluorosis in this study needed pain relief; probably this was due to sensitivity or pain of the exposed dentine which is common in severe fluorosed teeth. This implies that dental fluorosis was perceived to be an aesthetic and desperate problem, but the best treatment is not available.

Clinically all participants in this study needed at least one kind of treatment modalities for dental fluorosis. However majority required minimally invasive treatment categories (microabration /beaching and composite veneer), because they had dental fluorsis of TFI 1-4 and 5-7, of which microabration /bleaching and esthetic composite veneer are recommended (Akipata, 2001).

Severe dental fluorosis was most prevalent in this study, 65.4% had dental fluorosis of TFI 6-9. this was expected in an endemic dental fluorosis area. A significant different in self-rate appearance between participants with TFI ≤ 5 and those with TFI ≥ 6 was observede. Severe dental fluorosis causes discoloration and severe pitting which result into morphological disfigurement of teeth compared to mild/moderate forms of the condition. Similar findings were previously reported in Tanzania which reported that the likelihood of being dissatisfied, increased with increasing severity of dental fluorosis (Åstrøm. et al., 2002). This differs with previous studies in Ethiopia (Wondwossen, et al., 2000), Kenya (Mwaniki, et al., 1994) and in America (Spencer et al., 1996), levy et al., 2002), where there was no different in self-rate appearance between individuals with mild and severe dental fluorosis. These differences probably were due to different in location and age, since the current study involved adolescents in a bit higher age in secondary school, unlike the previous studies.

Dental fluorosis was perceived the main cause of impacts of all the eight oral daily performances. Most of the participants in this study reported at least one impact on oral daily performances. The performances reported to be most affected were smiling, emotional stability, contact with other people and cleaning of teeth all of which brown discoloration was reported to be the most actual cause. This can be explained by the fact that dental fluorosis affects physical, psychological, and social wellbeing of individuals (Fig 1) (Locker, 1988, WHO, 1980). However in this study dental fluorosis has shown great social and psychological (smiling, emotional stability and having contact) impact on quality of life These findings are in line with previous studies done using subject perception questionnaire where the impact of dental fluorosis on smiling, contact and emotional stability was reported (Clark et al.,1993, Spencer et al., 1996, Lalumandier et al,. 1998, Levy et al.,2002, Nyaoro et al., 2002, van Palenstein et al., 1993). There was no significant difference in oral impact of daily performance between participants with TFI $\leq$ 5 and TFI $\geq$ 6. This agrees with previous study (Rodds et al., 1997, Welbury et al., 1990, Mwaniki, et al., 1994, Wondwossen, et al., 2000, Clark et al., 1994). This can be explained by the fact that the impact of dental fluorosis can be very wide depending on severity or individual perception. The chalk to brown discoloration in mild dental fluorosis can cause shyness, and inferiority which has impacts on smiling, speaking and eating in public. In moderate and severe cases enamel is porous and prone to wear and/ or fracture, which can cause sensitivity or pain during eating or drinking. Discoloration and pitting due to dental fluorosis may cause, shyness, decreased self confidence all of which has impact on individuals' wellbeing. Discoloration due to dental fluorosis cannot be removed by tooth brush; therefore the affected individuals may feel that their teeth remain dirty even after brushing.

9.0. CONCLUSIONS

Dental fluorosis has great social and psychological (smiling, emotional stability and having contact) impact on quality of life. Treatment of dental fluorosis at Kibosho is highly required as expressed by both subjective and objective treatment need. Low awareness of the role of "magadi" as a principal cause of dental fluorosis at Kibosho was observed. Dissatisfaction with self appearance is increasing with increasing level of dental fluorosis,

10.0. RECOMMENDATIONS

Oral health education programme on causes, prevention and treatment of dental fluorosis should be initiated in endemic dental fluorosis area like Kibosho. Other means of cooking or alternative salt for tenderization should be considered. Esthetic veneer should be promoted among dentists especially in endemic dental fluorosis area.

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