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Assessment on Knowledge, Attitude and Practice Towards Dental Fluorosis and its Impact Among Goro Secondary School Students in Adama Town, Ethiopia, June 2016

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Objectives

Background: Dental fluorosis is Hypo-mineralization of tooth enamel and dentin caused by ingestion of excessive fluoride during tooth formation. It is endemic in the region of Ethiopian Rift Valley, and the maximum prevalence of fluorosis was observed on children at the age of 10 to 15 years.

Objective: The aim of this study was to determine the Knowledge, Attitude and Practice towards dental fluorosis and its impact among students of Goro secondary school in Adama town, Ethiopia

Methods: Household based cross sectional study design and simple random sampling technique was used and samples of 200 students were interviewed during data collection period. The collected data was entered and analyzed in SPSS Version 16. Results was presented by graphs, tables, pie charts and written summaries.

Results: Most of the respondents' (91%) of respondents related drinking water as having direct relation to dental fluorosis. Of 98.5% respondents have awareness on esthetic impact of dental fluorosis but systemic impacts were not known. Of 59.5% respondents believe dental fluorosis can be treated but their awareness on methods of treatments and their success rate remains negative. Of 89.5% respondents do not have any idea whether the tooth paste they had been using was fluoridated or not.

Conclusion: Knowledge, perception and health seeking behavior of adolescents on causes, impact and treatment of dental fluorosis are low. So, community-based health awareness, promotion and, prevention and control strategies need to design to save communities at large and future generations from fluoride poisoning.

Keywords: Fluoride; Fluorosis; Oral health; Dental health; Public health impact, Impact of dental fluorosis

Abbreviations: CDC: Center for Disease Control; EPA: Ethiopian Environmental Protection Authority; EU: European Union; HF: Hydrogen Fluoride; IQ: Intelligence Quotient; KAP: Knowledge Attitude and Practice; MoWE: Ethiopian Ministry of Water and Energy; NIEHS: National Institute of Environmental Health Sciences; NRC: National Research Council; OH: Hydroxide ion; PPM: Parts Per Million; SNNPR: Southern Nations, Nationalities and Peoples Regions; US: United States; WHO: World Health Organization

Introduction

Oral health, an inseparable component of an individual's general health has in recent times being advocated in all situations in order to ensure the maximum preservations of one's self-esteem as well as general wellbeing of an individual [1]. Because of certain factors ranging from oral health misconceptions to negligent oral health attitudes, various diseases afflict the oral cavity, thus affecting the achievement of optimal oral health [2]. The occurrence of these diseases brings upon the individuals affected as well as health care providers a burden which requires a multi-axial management approach in order to restore optimal oral health [3,4].

Dental fluorosis, an aesthetic condition as well as a window to systemic fluorosis; arises as a result of problems occurring during

tooth development. It involves the incorporation of excessive amounts of fluoride in the enamel and dentin of the tooth as it develops. This inadvertently leads to the destruction of ameloblasts, odontoblasts and formation of abnormal looking pitted enamel surface. This appearance is however dependent on the severity as well the timing of exposure to excessive fluoride levels [4].

Dental fluorosis with its attendant complication of aesthetic distortion of the teeth has now become another focus of public health intervention worldwide [5]. Fourteen countries in Africa, eight in Asia and the Middle East and six in the Americas face the problem of fluoride concentration above 1.5mg/l in drinking water. Many of these countries are confronted with the problems of endemic dental and skeletal fluorosis [6,7]. 71% of republic of Ireland, 10% of England and 60% of America are fluoridated [8-10].

The fluoride added to drinking water is hydroflourosilicic acid which is a byproduct from nuclear, fertilizers and aluminum industries [9]. It is toxic waste product and the industries that produce it pay millions to dispose of it. When dumped into drinking water supplies, they paid for it [9,10]. The region of rift valley which lies between 500 to 1800m above sea level, hot and dry; in most parts contain ground water with very high concentration of naturally occurring fluoride possibly due to geometrically active volcanic eruption in the region [11]. Volcanic rocks particularly young basal salt contains high concentration of fluoride and flouro-appetite. The floor of the rift valley which is characterized by high hydrothermal activity accelerates the solubility of fluoride [9]. The hot climate and high fluoride waterbed; therefore, favor the development of endemic fluorosis [10,11].

If fluoride damage the growing enamel and dentin, without damaging any other tissue at the same time is very unlikely. Fluoride is added to drinking water, dentifrices, mouth rinses and professional application to tooth for prevention of dental caries. In contrast to this in addition to dental fluorosis, there are plenty of dangers to our health related to increased fluoride intake; some of these includes increased lead absorption, dementia, genetic damage, disruption of synthesis of collagen, bone fracture, increased tumor and cancer rate, thyroid gland dysfunction, disrupt immune system, muscle disorder, damage to sperm, increased risk of infertility, brain damage, lowers IQ, inactivation of 62 enzymes, impairs sleep by impairing melatonin production by our pineal gland, arthritis, impairs formation of antibodies, etc. [10].

Although the primary determinants of dental fluorosis are quantity and timing of fluoride intake, the exact mechanisms that underlie dental fluorosis are unknown. Studies have shown that there is poor correlation between the tooth fluoride level and severity of dental fluorosis. The current literature suggests that there is considerable variation in predisposition to fluorosis. It has also been shown that there is great variation in severity of fluorosis within a given category of estimated fluoride intake [12].

Ethiopian Rift Valley Region covers all or parts of Afar, Oromia and SNNPR.42% of groundwater sources tested in Oromia Region have excessive fluoride concentrations as compared to 30% in SNNPR and 12% in Afar Region. In this region, dental mottling has been recognized even in areas with fluoride concentrations in water as low as 2mg/L [13]. As noted by NRC (2006), the weight of evidence indicates that the threshold for severe dental fluorosis occurs at a water fluoride level of about 2mg/L. In warmer areas, because of the greater amounts of water consumed, dental fluorosis can also occur at lower concentrations of fluoride in the drinking water [14].

In general, higher fluoride intake affects the health of young children, adolescents, adults and even elderlies. There is no adequate safety margin for fluoride. Therefore, NO FLOURIDE IN DRINKING WATER, NOT NOW, NOT EVER! No or low fluoride in tooth paste and other dental products, and foods and beverage we daily use. This study aims to determine level of knowledge regarding dental fluorosis and its impact, attitudes and practices in preventing/mitigating its consequences and saving the future generation.

Dental Fluorosis is the major form of intrinsic staining of tooth affecting the Ethiopian population [13]. It is a developmental disturbance of dental enamel and dentin caused by excessive exposure to high concentrations of fluoride [14]. It is characterized by an opaque white appearance in the mild stages, a brown stain in the moderate stage, leaving pitted, rough enamel that darkens over time in severe fluorosis [14,15].

The main causative agents of dental fluorosis are overexposure to high levels of fluoride in drinking water, fluoridated mouth rinses and dentifrices, ingestion of foods with high fluoride contents such as potatoes, bananas, fish, tea and public water fluoridation [14,16].

While the global prevalence of dental fluorosis is not entirely clear, it is estimated that excessive fluoride concentration in drinking water have caused tens of millions of dental fluorosis cases worldwide over a range of years [9,14]. According to data from the national and nutrition examination survey, 1999-2004 and the 1986-1987 national survey of oral health in US school children less than one-quarter (25%) of persons aged 6 to 49 in US had some form of dental fluorosis [9]. The prevalence of dental fluorosis was higher in adolescents than in adults and highest among those aged 12 to 15 years (41%). Adolescents aged 12 to 15 in 1999 to 2004 had a higher prevalence of dental fluorosis (41%) than adolescents aged 12 to 15 in 1986 to 1987 (22.6%). According to research conducted in Pakistan (2011) the prevalence of dental fluorosis was 98%. Researches conducted in Saudi Arabia and Nairobi, Kenya shows dental fluorosis prevalence of 90% and 76% respectively [15-17].

Besides the fluoride in the drinking water factors such as temperature, altitude of residence, diet, nutritional status and dentifrice have been reported to influence dental fluorosis [14,15]. Most of the reports on dental fluorosis in rift valley area are from Kenya, Tanzania and Ethiopia [15].

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Between 1977 to1985, the fluoride content of drinking water and incidence of endemic fluorosis were assessed and correlated in 16 large farms, villages and towns in the Ethiopian Rift valley [7,18]. The fluoride level of drinking water collected from wells ranged from 1.2mg/l to 36mg/l [17-19]. Dental fluorosis was observed in more than 80% of sampled children resident in the rift valley since birth, with maximum prevalence in the age group 10 to 14 years; 32% of children show severe dental fluorosis [17,18]. Three areas Wonjishoa, Alemtena and Samiberta were identified as having cases of skeletal fluorosis. The highest incidence was at Wonji-shoa sugar estates where a linear relationship was observed between the development of crippling fluorosis, fluoride concentration of drinking water and period of exposure to it. The first cases of skeletal fluorosis appeared among workers (98% males) who had been consuming water with fluoride content of more than 8ppm for over 10 years. Among 30 workers with crippling skeletal fluorosis, cervical myelopathy was found to be the commonest neurologic complications [17-19].

Dental and skeletal fluorosis are endemic in Ethiopian Rift Valley. According to MoWE, the region is one of the worst affected by surface freshwater scarcity in the country and hence, the population in this region is dependent up on ground water sources [17]. On the other hand, as this region is found in hot and dry climatic zone of the country, the daily intake of water and, therefore, that of fluoride could be much higher. Besides, drinking water may not be the only source of fluoride, other sources like beverages and food consumption may increase the risk of fluorosis [17]. However, less is known about the relative importance of food as sources of fluoride. Especially, there is no information about the dietary fluoride intake of children aged 10 to 15 years, an age when maximum prevalence of fluorosis was observed [18]. Hence, adequate documentation to identify priority areas for further intervention and to determine an estimated average requirement and maximum tolerable limit for fluoride is not available [18,19].

Alternatively, dietary fluoride intake assessment could lead to identification of key factors responsible for fluorosis, followed by development of an appropriate strategy for effective mitigation of fluorosis [17,18]. This includes water management solutions, domestic level de-fluoridation of drinking water as well as nutrition supplementation [17,18]. Therefore, to mitigate these contaminants there is a need to identify priority areas for further intervention, followed by appropriate risk management strategies [18,19].

In general, most of the communities living in Adama and surrounding Rift valley area are affected by dental fluorosis because of consumption of high fluoride via different sources and routes especially drinking water. The purpose of this study was to evaluate the Knowledge, Attitude and Practice towards dental fluorosis and its impact among students of Goro Secondary School in Adama town.

Fluorine is a chemical element with atomic number 9 and is usually found in its ionic form [17,18]. It is the lightest member of the halogens. It is the most electronegative and reactive of all the elements and as a result, elemental fluorine does not occur in nature, but is found as fluoride mineral complexes [17,18].

Unlike some of the other halogens, most of the fluoride in the Earth's surface is derived from rock minerals, soil, air, water and food [7,17]. In groundwater, for example concentrations vary with the type of rock and the water flows through [17]. The major causes for the distribution, transportation and transformation of fluoride in the environment are weathering and dissolution of minerals in water, emissions from volcanoes, marine aerosols, coal combustion and process, waste from various industrial processes [20].

Fluoride in water derived mainly from dissolution of natural minerals in the rocks and soils with which water interacts and found in arid climatic conditions. Water consumption increases with temperature, humidity, exercise and state of health, and is modified by other factors including diet. Roughly, the closer to the Equator is the higher will be the water consumption. Because of this total daily fluoride exposure can vary markedly from one region to another. However, from several studies, a rough estimate of total daily fluoride exposure in a temperate climate would be approximately 0.6 mg per adult per day in an area in which no fluoride is added to the drinking-water and 2 mg per adult per day in a fluoridated area [17,20].

Most epidemiological studies concerning the effect of fluoride on teeth and bone have correlated the effects with the concentration of fluoride in the drinking water consumed rather than total fluoride exposure [17,19]. On the other hand, different studies indicated that although drinking water is epidemiologically the most important source of fluoride in most areas, considerable exposure risk is also associated with food and drinks (especially tea), toothpaste, mouth rinses and fluoride gel [17,19,20].

Food is the main causative factor for fluorosis in areas with low fluoride in drinking water. Food items such as Teff flour, Tea plants, barely and rice (about 2mg/kg) contain high amount of fluoride. The fluoride content of tea leaves is about 1,000 times the soluble fluoride content of soil. 2-3 cups of tea contain approximately 0.4-0.8 mg fluoride. Fish (0.2mg/day), milk (0.02mg/l), vegetables and fruits (about 0.1 to 0.4mg/kg) and meat contains low levels of fluoride, thus usually responsible for only a small fraction of total fluoride exposure [17,19,20].

Air is typically responsible for only a small fraction of total fluoride exposure [17]. In non-industrial areas, the fluoride concentration in air is quite low (0.05-1.9μg/m3 fluoride) [17,19]. Even if the fluoride concentration in urban air occasionally rose to 2μg/m3, the amount of fluoride inhaled would only be 0.04 mg/day [17,20].

Fluoride gels are the most hazardous fluoride products currently used in dentistry. They are highly acidic and contain about 12,300ppm fluoride [17,20]. A single ml of this gel contains 12.3mg of fluoride. When applied topically because of high acidic nature (PH 3.5), saliva flow is highly increased during treatment,

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thus increasing the percentage of the gel that is ingested [17,18]. The high acidity also enables the fluoride to cross directly through the gum membrane easily and helps the fluoride to incorporate into the developing tooth and join systemic circulation [18]. While few measures were used in the past to limit the amount of fluoride ingested dentists are now advised to use suction device and to encourage the patient to spit at the end of the treatment [17,20]. Even when precautionary measures are taken, children swallow an average of 7.7mg per treatment. Adults swallow an average of 10.3mg per treatment [20].

Self-applied fluoride gels prescribed by dentists contain 5000ppm of fluoride. Each ml contains 5mg of fluoride [20]. Without taking extraordinary precaution to limit the amount of gel that is applied and reduce the amount of gel that is ingested, self-application can result in dangerously high fluoride exposure [20].

Fluoride varnish contains about 22,600ppm of fluoride. Since the varnish eventually wears off the teeth all the fluoride that is applied is ingested. Fluoride supplements are also available by prescription. Despite being prescribed for over 50 years the Food and Drug Administration (FDA) has never approved fluoride supplements as safe and effective [20].

Over 95% of the toothpaste sold in the US contains fluoride. The use of fluoride tooth paste particularly during early childhood presents health risks [17,20]. Fluoride tooth paste generally contains 1450 ppm fluoride equivalent to 1mg of fluoride for each gram of paste. Numerous studies found that many children ingest a significant amount of fluoride each day from tooth paste alone. According to the journal of public health dentistry virtually all authors have noted that some children could ingest more fluoride from tooth paste alone than is recommended as total daily fluoride ingestion [20].

Although it is believed that many poisoning incidents from fluoride toothpaste go undiagnosed and unreported, the number of calls to poison control centers in US for fluoride poisoning from toothpaste has skyrocketed since the FDA issued its poison warning. Indeed, in the early 1990s there were about 1000 poisoning reports each year from fluoride toothpaste. Today there are over 23,000 reports a year, resulting in hundreds of emergency room treatments [20].

Some mouth rinses contain fluoride. A single ml of fluoride mouth rinse contains roughly 0.25mg of fluoride. Between 5 to 15ml are generally used per rinse which equates to 1.25 to 3.75mg of fluoride [20].

Absorption of fluoride varies from 100% on a fasting stomach, to 60% when taken with a Calcium-rich food, magnesium and aluminum. Fluoride crosses the placenta and is found in mother's milk at levels essentially equal to those in blood. Approximately 90% of fluoride ingested in water is absorbed in the gastrointestinal tract compared to only 30-60% of fluoride in food [17,20,21].

Fluoride is capable to cause dental and skeletal fluorosis by exchanging with OH- in the hydroxyl appetite crystal of teeth and bone. The only known health benefit of fluoride is it helps in reducing dental caries at its low concentration (<1ppm). But its health threat overweighs much than its benefit [19,21]. The severity of the threat depends on the amount ingested and the duration of the intake [19,20]. Some groups of population are more susceptible to the poisonous effects of fluoride than others. These include: Pregnant women, lactating mothers, young children, Malnourished children, People with low intake of calcium, People with cardio-vascular, endocrine and kidney problems; People who do hard manual labor work in hot climates, as it necessitates a high intake of drinking water [20,21].

The most sensitive population to dental fluorosis is children under the age of eight particularly during the pre-eruptive formation and maturation of enamel and dentin in teeth. Excessive fluoride intake by peoples older than 7 years will not cause dental fluorosis. Dental fluorosis is more prevalent in formula fed children than in breast-fed children. The earliest signs of dental fluorosis be small white lines on the enamel surface. Dental fluorosis can develop in children but not adults. Dental fluorosis in an adult is a result of high fluoride exposure when the adult was a child or adolescent [19-21].

Fluoride is very biologically active even at low concentrations. It interferes with hydrogen bonding and inhibits numerous enzymes; when complexed with aluminum it interferes with G-protein, and it has been shown to be mutagenic and cause chromosome damage. Such interactions give aluminum-fluoride complexes the potential to interfere with many hormonal and neurochemical signals [17,21]. Rats fed for one year with 1 ppm fluoride in their water, using either sodium fluoride or aluminum fluoride, had morphological changes to their kidneys and brains, an increased uptake of aluminum in the brain, and the formation of beta amyloid deposits which are characteristic of Alzheimer's disease. Aluminum fluoride was recently nominated by the Environmental Protection Agency and National Institute of Environmental Health Sciences for testing by the National Toxicology Program [21,22]. Animal experiments show that fluoride accumulates in the brain and exposure alters mental behavior in a manner consistent with a neurotoxic agent. Rats dosed prenatally demonstrated hyperactive behavior. Those dosed post-natally demonstrated under activity. More recent animal experiments have reported that fluoride can damage the brain and impact learning and behavior. Five studies from China show a lowering of IQ in children associated with fluoride exposure. One of these studies indicates that even just moderate levels of fluoride exposure (e.g. 0.9ppm in the water) can exacerbate the neurological defects of iodine deficiency [21,22].

Dental decay is the destruction of the mineralized portion of the tooth through the action of bacteria in the dental plaque. Fluoride-caries relationship seems to occur at a drinking water concentration between 2 to 3mg/L. Nevertheless, the weight of evidence does support under some circumstances, severe fluorosis maybe associated with an increased prevalence of caries. Although not all members of the NRC panel agreed with the clas-

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sification of severe fluorosis as an adverse health effect, all agreed that it should be avoided. NRC (2006) considered the relationship between severe dental fluorosis and increased dental caries to be a plausible one [19,21].

A study conducted in Ethiopian children shows that second molars were the teeth type most frequently affected by dental fluorosis and there is direct relationship between the severities of dental fluorosis with that of dental caries. Some of the factors which might account for differences in the fluorosis/caries relationship between the US and other countries include differences in dental care, dental hygiene practices, dietary habits (i.e. Consumption of sugars), and nutrient intakes [17,19,22].

Hazard identification, exposure assessment, determination of toxicity and risk characterization are the most important steps in the human health risk assessment procedure (on dose response relations). To characterize the risk quantitatively, one need to know the exposure to the chemical, and the potency of the adverse effect of the chemical. In general, the health risk of a chemical is entirely related to the dose, duration of exposure to the chemical, its bioavailability and the potency of its adverse effect [19,21,22].

WHO, 1970 report stated that Fluoride in drinking water and food at 1ppm it decreases dental caries, at 2ppm it can cause dental fluorosis, at 8ppm it can cause osteosclerosis, at 20 to 80ppm it can cause crippling skeletal fluorosis, at about 50ppm it results in thyroid damage, at about 100ppm it can cause growth retardation of most body organs, at about 125ppm it can leads to kidney damage and at about 2.5 to 5gram per liter it can cause death [23].

Even if many studies had been done on dental fluorosis, most of these studies focus on its prevalence and water as its source and fail to show knowledge, attitude and practice towards other sources for dental fluorosis, its impact, and the prevention and treatment modalities to combat the problem. So, the intention of this study was focus on the level of knowledge, attitude and practice towards dental fluorosis causes, impact, prevention and treatment and, to provide community promotion to decrease the prevalence and impact of dental fluorosis.

Methods and Materials

Study area and period

Goro secondary school is in Adama town, Oromia regional state which is about 99km away from Addis Ababa; the capital city of Ethiopia. According to 2007 census conducted by central statistical agency of Ethiopia, the city has a total population of 220, 212 an increase of 72.25% over the population recorded in 1994 census. According to the 1994 census total population of 127,842 of whom 61,965 were males and 65,877 were females. The weather condition of the town is hot and dry. Adama town is administratively divided in to 18 kebeles and having 8 secondary schools and one boarding school. The town is 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 bore-hole water at Adama town and nearby areas like Wonji Shoa is about 0.8 to 3.3mg/l and 2.5 to 14mg/l respectively. The study period was from June 28 to 30, 2016.

Study design

A cross sectional study design had been conducted on students of Goro Secondary School in Adama town from June 28 to 30, 2016.

Population

Source population: Goro secondary school students.

Study population: Goro secondary school students of grade 9 born or brought up to Adama town during the first 8 years of life. The study excludes grade 10 students because at the time the study planned to be conducted grade 10 students left the school as they already took grade 10 National examination before data collection period.

Inclusion and exclusion criteria

The study had been conducted on Goro Secondary school students aged 15 to 18 years born or brought up at Adama and nearby catchment area during the first 8 years of life. But those who are not willing to respond, those speaking non-local language and those having gross dental caries and/or multiple restorations on tooth surface are excluded.

Sample size and sampling technique

A simple random sampling technique was used to determine the sample size of this descriptive cross-sectional study. To choose the right sample size for a simple random sampling defining the following input is important.

a. Specifying margin of error which is the measure of precision

b. Specifying alpha. Since this is an estimation problem alpha is 1-confidence level. 1-.95= 0.05

c. Finding the critical standard score z. For an estimation problem it is the value for which the cumulative probability is 1-alpha/2= 1-0.05/2= (2(1)-0.05)/2= 0.975. Based on this we need to find the distribution of standard score which has a mean of 0 and standard deviation of 1, the value of the standard score Z is 1.96.

d. The size of study population (N) is 1673 which is less than 10,000. Hence the need to use population fraction formula is necessary.e. The study excludes grade 10 students because at the time the study planned to be conducted grade 10 students left the school as they already took grade 10 National examination before data collection period.

f. Since the study population is known the sample size is determined by

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$$n=\frac{\left(z^2pq+e^2\right)}{e^2+\frac{z^2pq}{N}}$$

g. Study conducted in St. Joseph school in Adama town in 2013 shows dental fluorosis prevalence of 78%. Hence the p value is 0.78. Assuming a confidence level of 95%, margin of error (e) is 5% which is 0.05 and q is 1-p= 1-0.78= 0.22

$$n=\frac{(1.96)^2(0.78)(0.22)+(0.05)^2}{(0.05)^2+\frac{(1.96)^2(0.78)(0.22)}{1673}}$$

n= 228 Subjects

$$nf = n/1 + n/N = 228/1 + 228/1673 = 200$$

The sample size of the study population was 200 students of grade 09.

Data collection and measurements

Data collection instruments: Data was collected by self-administer interview technique using pretested structured questionnaire consisting of both close and open-ended questions constructed in English and translated to local language before being administered to participants by principal investigator and / data collectors.

Variables

1. Independent variables

a. Age, ethnicity, religion

b. Educational status,

2. Dependent variables

a. Knowledge of Dental fluorosis and its impact

b. Attitudes towards dental fluorosis causes, prevention and treatment

c. Knowledge and Practice and self-care to prevent and treat dental fluorosis and its impact

Operational definition

1. Aesthetic: The art of beautifulness/appreciation of beauty or good taste

2. Alzheimer's disease: Irreversible progressive brain disorder that slowly destroys memory and thinking skill and eventually the ability to carry out simplest tasks.

3. Ameloblasts: Cells that forms tooth enamel.

4. Bioavailability: A fraction of an administered dose of unchanged drug or chemicals that reaches systemic circulation.

5. Cosmetic dentistry: Any dental work that improves the appearance of a person's teeth, gums and bite

6. Dental decay: Breakdown of teeth due to activities of bacteria.

7. Dental fluorosis: Hypo-mineralization of tooth enamel and dentin caused by ingestion of excessive fluoride during tooth formation.

8. Dentine: Hard calcified tissue similar but denser than bone that forms major portion of tooth surrounded by tooth enamel in the crown region and cementum in the root region of tooth.

9. Dentists: A surgeon who specializes in dentistry

10. Enamel: The hardest and highly mineralized substance in our body that covers outer layer of each teeth and most visible part of teeth.

11. Fluorine: Is a chemical element with symbol F, atomic number 9 and is the lightest halogen that exists as a highly toxic pale-yellow diatomic gas at standard conditions. As it is the most electronegative element, it is extremely reactive almost to all other elements including some noble gases.

12. Fluorosis: pathological condition resulting from an excessive intake of fluorine.

13. Halogens: Reactive nonmetallic Group 7 elements in the periodic table. The term halogen means salt former and compounds containing halogens are called salts. All halogens have 7 electrons in their outer shell. These elements are fluorine, chlorine, bromine, iodine and astatine

14. Restorative dentistry: Is the study, diagnosis and integrated management of diseases of the teeth and surrounding structures and the rehabilitation of the dentition to functional and aesthetic requirements of the individual.

15. Skeletal fluorosis: Is a bone disease caused by excessive accumulation of fluoride in the bones.in advanced cases it can cause pain, damage to bone, ligaments and joints.

Data compilation and analysis: The collected data was cleared and checked for its completeness and internal consistency and analyzed by using SPSS version 16. The analyzed data had been presented with appropriate methods like tables, figures, graphs or narratives based on the nature of data obtained.

5.6.5. Data quality control: The completeness of the questionnaire, process of data collection, completeness and accuracy of collected data had been checked by principal investigator.

5.6.6. Ethical clearance: Permission to carry out this study was sought from Atlas Health Science College publication and Research Office and the Director of Goro Secondary School. The aim, possible risks and benefit of the study had been explained to all participants and informed consent was obtained from 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. All students who wish to respond to questions only under the guidance of one of the schoolteachers had been allowed to have their

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schoolteacher with them during data collection. All students who wish to respond to questions but only under the presence of the family were included in the study through home visit with them. The information collected from the respondents had been kept confidential. Therefore, the data collectors and other personnel were oriented about the sociocultural background of the study community, on keeping confidentiality of information obtained from them, their privacy and the respect they should require from them; before the start of data collection.

Limitation of The Study

a. Shortage of resources like access to internet, well organized literatures and reviews especially those done in our country.

b. The data collection time coincides with the time for student's early vacation due to national exam. As a result, the study was limited to grade 9 students.

c. The use of self-administered questionnaire was reported to have some limitations such as misunderstanding and non-response to some questions by the participants.

d. Most of the students came from the same area. As a result, generalization of the results to communities at large was done with caution.

e. Not using radiograph to assess the degree of hypo mineralization of tooth enamel and dentin by dental fluorosis may affect assessment of severity of dental fluorosis.

f. Recall bias especially while assessing attitude and self-care on dental fluorosis.

Results

A total of two hundred questionnaires were used to collect data from the respondents by principal investigator from June 28 to 30/2016.

Table 1 shows that among 200 respondents, females 102 (51.0%) vs males 98 (49.0%) proportional. The age of the respondents ranged from 10 to 24 years with the majority 139 (69.5%) of the respondents was between 15 to 19 years. Out of 200 respondents 33 (16.5%) of them were 14 years old adolescents. Majority of the respondents 140 (70%) place of birth was in Adama town (study place) whereas about 48 (24%) of respondents were born nearby Adama town followed by 12 (6%) far from Adama town but brought to Adama before 8 years of age. All respondents were currently residing in Adama (study place) town.

Table 1: Socio (demographic characteristics of mothers attending MCH clinic at Torhayiloch hospital, Addis Ababa, Ethiopia, 2017.

Variables		Frequency(f)	Percentage (%)
Gender	Male	98	49
	Female	102	51
Age	10 to 14	33	16.5
	15 to 19	139	69.5
	20 to 24	28	14
Place of birth	Adama (study place) town	140	70
	Nearby Adama (study place) town	48	24
	Far from study place but brought to Adama before 8 years	12	6

Figure 1 & 2 Distribution of respondent's knowledge on dental fluorosis sources of knowledge causes, timing of occurrence and professional's role in its occurrence among Goro Secondary School students in Adama Town, June 28 to 30/2016.

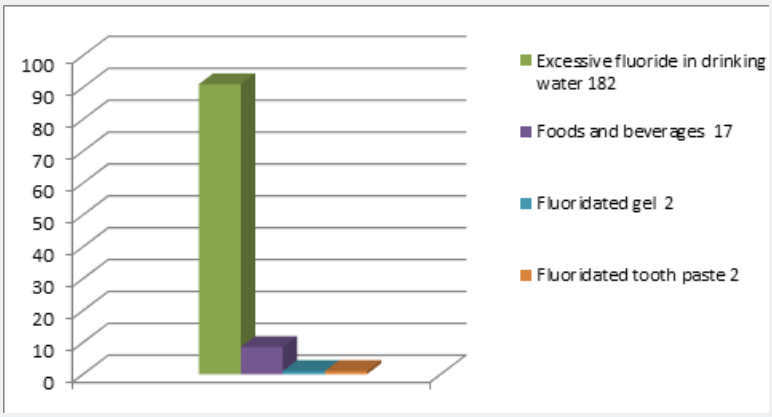

Figure 1: Distribution of Respondents knowledge on causes of dental fluorosis.

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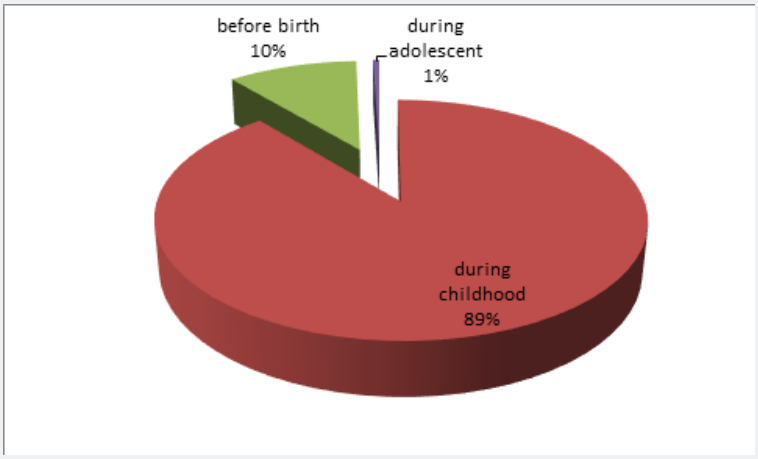

Figure 2: Distribution of respondent's knowledge on timing of dental fluorosis occurrence.

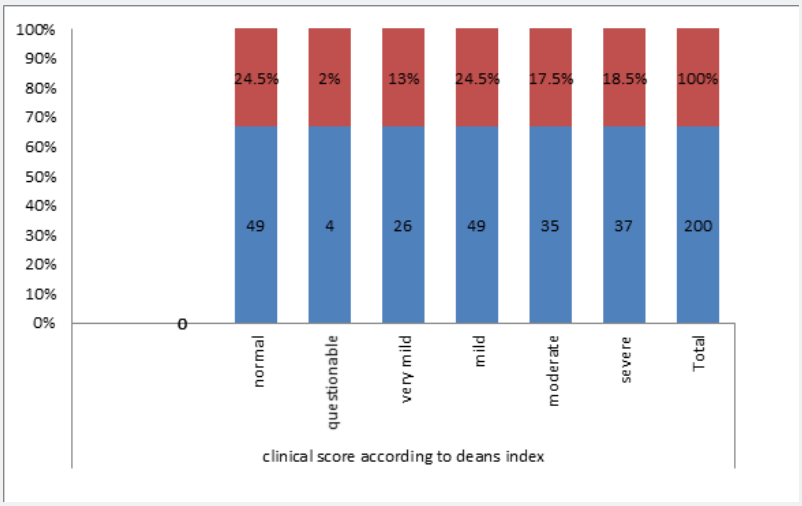

Figure 3: Prevalence of dental fluorosis among respondents of Goro Secondary school students in Adama town, June 28 to 30/2016.

Figure 1-3 shows all the respondents have awareness about dental fluorosis. Most of the respondents 129 (64.5%) heard about dental fluorosis from their friends followed by those red about it from the internet 91 (45.5%). About 72 (36%) of the respondents know about dental fluorosis or mottled teeth because simply they see their own teeth and their friend's teeth having mottling. Majority of respondents named dental fluorosis was a result of excessive fluoride in drinking water 192 (91%), 17 (8.5%) associated it with foods and beverages and 2 (1%) associating it with fluoridated toothpaste. All the respondents do not know other sources of fluorosis such as air and mouth rinses. Majority of the respondents 178 (89%) know dental fluorosis occurs during childhood followed by 21 (10.5%) before birth. About 196 (98%) of the respondents know dentists has no role in dental fluorosis occurrence whereas only 4 (2%) of the respondents said they play some role in dental fluorosis occurrence such as improper use of fluoridated gel and fluoridated toothpaste.

Table 2 shows about 197 (98.5%) of the respondents have knowledge on esthetic impact of dental fluorosis. About 124 (62%) of respondents knows impact of dental fluorosis on emotional stability whereas 63 (31.5%) of respondents do not have idea whether dental fluorosis have impact on emotional stability. Only 74 (37%) of respondents know impact of dental fluorosis on oral hygiene maintenance and 124 (62%) of the respondents did not have idea whether dental fluorosis affect oral hygiene maintenance. About 188 (94%) of respondents do not have idea whether fluorosis affects sleeping, 5 (2.5%) said fluorosis affects sleeping and 7 (3.5%) said fluorosis didn't affect sleeping. About 115 (57.5%) of respondents do not know whether dental fluorosis have impact on work or not,83 (41.5%) know impact of dental fluorosis on work. About 178 (89%) of the respondents know impact of dental fluorosis on speaking followed by 21 (10.5%) of respondents who didn't know whether dental fluorosis affects speaking or not. Table 3 also shows that about 138 (69%) of respondents said dental fluorosis has impact on social relation and 10 (5%) said fluorosis also has impact on other body system including soft tissue.

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Table 2: Proportion of study participants who responded correctly to Self(Assessment knowledge questions toward tooth pest and oral health among mothers who attending MCH clinic at TH, Addis Ababa, Ethiopia, 2017.

Variables		Frequency(f)	Percentage (%)
Awareness about impact of dental fluorosis		200	100
Esthetic impact	yes	197	98.5
	I don't know	3	1.5
Impact on emotional stability	Yes	124	62
	No	13	6.5
	I don't know	63	31.5
Impact on oral hygiene maintenance	Yes	74	37
	No	2	1
	I don't know	124	62
Impact on sleeping	Yes	5	2.5
	No	7	3.5
	I don't know	188	94
Impact on speaking	Yes	178	89
	No	1	0.5
	I don't know	21	10.5
Impact on work	Yes	83	41.5
	No	2	1
	I don't know	115	57.5
Impact on social relation		138	69
Impact on general body system		10	5

Table 3: Source of oral Health Information and proportion of mothers who correctly answered about daily frequency of tooth brushing, TH Addis Ababa, 2017.

Variables	Frequency(f)	Percentage (%)
Brown teeth are a problem	197	98.5
Brown teeth affect smiling	197	98.5
Brown teeth difficult to clean	48	24
Brown teeth cause tooth sensitivity	11	5.5
Brown teeth is a manifestation of systemic problem	6	3
Total	200	100

Table 4 shows that all the respondents 200 (100%) knows dental fluorosis cannot be cured, 119 (59.5%) knows dental fluorosis can be treated and 65 (32.5%) knows tooth whitening is successful form of treatment. Out 119 (59.5%) respondents who said dental fluorosis can be treated majority of respondents mentioned prophylactic scaling and polishing, bleaching and jacket crown as treatment for dental fluorosis which is 85 (71.4%), 14 (11.8%) and 20 (16.8%) respectively and the respondents didn't mention other methods like veneering, micro-abrasion technique, etc. as treatment modalities for dental fluorosis. Table 5 also shows that treating dental fluorosis can improve self-esteem, esthetic appearance, social relation and mood of an individual which is 110 (92.4%), 92 (77.3%), 75 (63.02%) and 62 (52.1%) respectively. About 188 (94%) of respondents knows dental fluorosis can be prevented and mention water de-fluoridation 188 (94%) as main preventive methods.

Table 4: Proportion of study participants who responded correctly to knowledge assessment questions among mothers attending MCH clinic at TH, Addis Ababa, Ethiopia, 2017.

Variables	Number	%
Knowledge on dental fluorosis cannot be cured?	200	100
Dental fluorosis can be treated(whitened)	119	59.5
Tooth whitening is successful form of treatment	65	32.5

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Tooth whitening methods for fluoresced teeth	Prophylactic scaling and polishing	85	71.4
	Jacket crown	20	16.8
	bleaching	14	11.8
Importance of whitening fluorosed tooth	Improve self esteem	110	92.4
	Improve esthetic appearance	92	77.3
	Improve social relation	75	63.02
	Improve mood	62	52.1
Knowledge of prevention of dental fluorosis		188	94
Knowledge on dental fluorosis preventive methods	Water de-fluoridation	188	94
	Others	12	6

Table 4 shows that about 197 (98.5%) believe mottled teeth (dental fluorosis) is a problem, 197 (98.5%) also believe dental fluorosis affect smiling, 48 (24.0%) believe fluorosed teeth is difficult to clean, 11 (5.5%) believe dental fluorosis can leads to tooth sensitivity and only 6 (3.0%) believe dental fluorosis is a manifestation of systemic problem.

Table 5 shows that about 118 (59.0%) of respondents have visit to dentist and the major reason for visiting was tooth pain 117 (58.5%). Only 1 (0.5%) of respondent visited dentist for dental fluorosis and none of the respondents have routine visit to dentist. All the respondents 200 (100%) said that they brush their teeth. Majority of the respondents 110 (55.0%) brush their teeth when they take a shower followed by 88 (44.0%) once per day. About 152 (76%) of the respondents uses Miswak to clean their teeth followed by 123 (61.5%) who uses tooth brush with tooth paste, 112 (56.0%) uses tooth picks, 46 (23%) uses gargling with water especially after food and 30 (15.0%) uses mouth wash to clean their teeth. None of the respondents mentioned use of dental floss to clean their teeth.

Table 5: Distribution of respondents practice with dental fluorosis in keeping their oral hygiene among students of Goro secondary school in Adama town, June 28 to 30/2016.

Variables		Frequency(f)	Percentage (%)
Visit to dentist	yes	118	59
	No	82	41
	Because of tooth pain	117	58.5
Reason for visiting dentist	Dental fluorosis	1	0.5
Reason for not visiting dentist	Going to Dentist is not useful	81	40.5
	Others	1	0.5
Frequency of visit to dentist	Only when there is tooth pain	117	58.5
	Once a year	1	0.5
	Never	82	41
Total		200	100
Brushing teeth		200	100
Frequency of toothbrush	Once per day	88	44
	Twice per day	2	1
	Only when I take shower	110	55
Total		200	100
Tooth cleaning agents	Toothbrush with toothpaste	123	61.5
	Miswak	152	76
	Toothpicks	112	56
	Gargling with water	46	23
	Mouth wash	30	15

Table 6 shows that out 123 respondents who uses tooth brush with tooth paste 110 (89.4%) do not have any idea either tooth paste they use was fluoridated or not, 10 (8%) said they don't use fluoridated tooth paste followed by 3 (2.6%) said they use fluoridated tooth paste.

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Table 6: Distribution of respondents on use of fluoridated tooth paste among Goro secondary school students in Adama town, June 28 to 30/2016.

Variables		Number	%
Use of fluoridated toothpaste	Yes	3	2.6
	No	10	8
	I have no idea	110	89.4

Table 7: Prevalence of dental fluorosis among respondents of Goro Secondary school students in Adama town, June 28 to 30/2016.

Variables		Frequency(f)	Percentage (%)
Dental fluorosis scores according to dean's index	Normal (0)	49	24.5
	Questionable (0.5)	4	2
	Very mild (1)	26	13
	Mild (2)	49	24.5
	Moderate (3)	35	17.5
	Severe (4)	37	18.5
	Total	200	100

Table 7 & Figure 3 shows among 200 respondents 49 (24.5%) were not affected by dental fluorosis whereas 49 (24.5%) had mild dental fluorosis, 35 (17.5%) had moderate and 37 (18.5%) of respondents were affected by severe dental fluorosis.

Discussion

The age of the respondents ranged from 10 to 24 years with the majority 139 (69.5%) of the respondents fall in between 15 to 19 years mainly because the study was carried out on grade 9 adolescent students whose age expected to be in this range.

The study shows that all the respondents have awareness about dental fluorosis (mottled teeth). Most of the respondents 129 (64.5%) heard about it from their friends followed by those who red about dental fluorosis from the internet 91 (45.5%). This is in contrary to study conducted in Kenya Nairobi on KAPs towards tooth discoloration in 2013 [2] which shows 40.6% of respondents mentioned internet as source of information followed by 28.6% mentioned friends as source of information. This difference in source of information was mainly because of two reasons; the first was the difference in age group of respondents as the later study conducted in health among 10 to 79 years old subjects. The second was may be the difference in development of information technology and information accessing trends among the two city residents.

Most of the respondents 192 (91%) named the cause for dental fluorosis or mottled teeth was drinking public water. Although 50 (26%) of these respondents mentioned the chemical in water was fluoride; others 142 (75.0%) out of 192 respondents didn't mention either the chemical in water was fluoride or not (some mentioned chlorine added to drinking water was responsible for its cause). This shows that even if the respondents blame water as major source for mottled teeth, they fail to mention the responsible chemical as it was fluoride. This result was in line with study conducted in Kenya Nairobi on KAPs towards tooth discoloration by in 2013 [2] which shows most of the subjects (89.6%) mentioned public drinking water as the major source of dental fluorosis.

Though most of the respondents 192 (91%) mentioned public drinking water as a cause for dental fluorosis their awareness on other sources for fluorosis like foods, beverages and dental products were very limited. Study conducted in Dibibisa and Bidara Fuka Kebeles in SNNPR and Oromia Regions Ethiopian Rift Valley [17] showed that relative concentration of fluoride ingested from all food stuffs excluding drinking water was found to be about 50% of total fluoride intake.

Different studies show processed food may have higher fluoride content than unprocessed food (Zohous and Regg Gunn 2000). From the perspective of Ethiopian traditional way of cooking, there is a trend of adding unknown amount of water to foods as it tends to evaporate during cooking process. This may lead to considerable amounts of fluoride to be retained in the prepared food. Tea contains 5.48±0.01mg/L was the highest and milk 0.12±0.02mg/L, with the least. Respondent's knowledge on this food stuffs are very limited.

Fluoride containing dental products like fluoride gel (5000 to 12,300ppm), fluoride varnish (22,600ppm), mouth rinses (230ppm) and fluoride containing tooth pastes (1,000 to 1,500ppm) also contain high amount of fluoride but adolescents and professional's knowledge on this product and their fluoride concentration is very low. Different studies also show that fluoridated dental products were responsible for fluorosis. It is now widely acknowledged that exposure to non-water sources of fluoride has significantly increased since the water fluoridation program first began [21].

The study also shows that all the respondents know dental fluorosis had an impact on human health. About 197 (98.5%) mentioned it has esthetic impact which is nearly comparable with

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study conducted in Kenya (92.6%) (2). 178 (89%) mentioned its impact on speaking which is high as compared to study conducted in Kenya [2] mainly because of the age group of current study was sensitive than the latter study. 138 (69%) mentioned its impact on social relation, 124 (62%) mentioned its impact on emotional stability which is low as compared to study done in Kenya [2] (82%). Respondent's knowledge on fluorosis impact on general body system was very low which is also similar Kenya study [2]. Recent research showed that exposure to high concentration of fluoride does have deleterious effect on the mental ability of the children [24]. In a meta-analysis performed in China, to review studies on fluoride and IQ between 1988 and 2008, a steady and a strong association between exposure to fluoride and low IQ was found and it was also noted that children who live in fluorosis prevalent areas have five times higher chances of developing a low IQ than those who live in having less fluorosis areas [25]. On the contrary, from an epidemiological study it was found that a high-fluoride area had one-fifth the Alzheimer's that a low-fluoride area had [26]. This inverse relationship between the possibility of the onset of Alzheimer's disease and the IQ changes need further clarification to understand whether fluoride alone involved or in addition other factors come in to play too for such outcomes.

All the respondents know dental fluorosis cannot be cured but 119 (59.5%) said it can be treated. Out of 119 study subjects who mentioned dental fluorosis can be treated 85 (71.4%) mentioned scaling and polishing, 20 (16.8%) mentioned jacket crown, 14 (11.8%) mentioned bleaching as treatment modalities and failed to mention abrasion and veneering as treatment methods. This shows that respondent's awareness on dental fluorosis treatment and methods used were negative.

Most of the respondents 196 (98%) mentioned Dentists have no role in dental fluorosis occurrence which is in line with studies conducted IN Kenya which was (92%). This was mainly related with the study subjects had limited awareness on dental materials or products used by Dentists or other Dental professionals in daily clinical practice.

The study shows that most of the respondents 197 (98.5%) agree dental fluorosis is a problem and affect smiling which was in line with study conducted in Tanzania Kilimanjaro Region in 2010, 85.1% and 82% respectively [11]. About 48 (24%) of the study subjects agree it is difficult to clean fluorosed teeth which was low as compared to studies conducted which was 57.6% [11]. Only few 11 (5.5%) and 6 (3%) of study subjects agree fluorosed teeth can be liable to tooth sensitivity and consider it as a manifestation of systemic problem respectively.

Out of 200 study subjects all of them brush their teeth with majority of them 110 (55%) brush their teeth only when they take shower followed by 88 (44%) brush once daily. The most common tooth cleaning agent used by respondents was Miswaks 152 (76%) followed by toothbrush with tooth paste 123 (61.5%). None of the respondents used dental floss as tooth cleaning agent [27,28].

Dental fluorosis in the study participants were assessed using Dean's classification system by researcher. Among students of Goro Secondary school the case of incidence of dental fluorosis was 147 (73.5%) of the study adolescents. Among the respondents 49 (24.5%) were not affected by dental fluorosis, 49 (24.5%) had mild dental fluorosis, 35 (17.5) were affected by moderate dental fluorosis and 37 (18.5%) of respondents were affected by severe dental fluorosis. The prevalence of moderate dental fluorosis of current study was lower than the prevalence of moderate dental fluorosis in Dibibisa Kebele (39%) and that of Bidara Fuka (37%) in SNNP and Oromia region [17]. Current study shows that dental fluorosis can be preventable with the major method being water de-fluoridation. According to WHO 2006 excessive amounts of fluoride in drinking water was exposing millions around the world to risks ranging from crippling skeletal fluorosis to dental fluorosis. The report issued in Geneva says that widespread effects of fluoride in drinking water, though preventable, remains largely unrecognized and neglected. WHO also admits that removing excessive fluoride from water can be very difficult and expensive to communities and recommends low cost options such as use of absorptive filters, bone charcoal and crashed clay Pots [25]?

Conclusion

a. The respondents had lack of scientifically and professionally supported knowledge on sources, causes, and impact; treatment and prevention modalities about dental fluorosis or fluorosis in general. Almost none of the respondents have awareness on professional's role in dental fluorosis occurrence.

b. Attitudes of respondents on methods used for dental fluorosis treatment and their successfulness; its impact, prevention, care and support were negative

c. Most respondents visit Dentist only when they had tooth pain and believe going to Dentist is not useful if there is no tooth pain. Almost none of the respondents visited Dentists for dental fluorosis treatment. Many of the respondents brush their teeth only when they took a shower by using Miswak and toothbrush with toothpaste. However almost all of them do not have idea whether the tooth paste they use was fluoridated or not.

Recommendation

a. Promoting the awareness of adolescents and communities at large on causes and impact (especially systemic impact) which helps to create future generation free from cosmetic, psychological and systemic impact of fluorosis. Providing aggressive advocacy to communities at large on treatment modalities available to treat dental fluorosis and improving accessibility and affordability of those methods.

b. Water de-fluoridation is the hall mark of prevention of fluorosis, but it is very difficult to implement and expensive. So fluorosis prevention program should also include imple-

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menting oral health care strategy to infants and children's less than 8 years; limiting using fluoridated tooth paste in Ethiopian Rift Valley for children's, adolescents and communities at large; providing basic and refreshment training for Dentists and other Dental professionals on proper use of fluoride containing dental products; and also using low cost absorptive filters, bone charcoal and crashed clay pots to filter fluoride from water.

c. Promoting health seeking behavior and self-care of communities on dental fluorosis treatment and oral hygiene maintenance

d. Similar dental and systemic fluorosis survey should be carried out in collaboration with national and international organizations in all Ethiopian Rift Valley corridors. Incorporating preventive, promotive and treatment strategies of dental fluorosis into countries health care program as public health priority. National guideline should also need to be developed on dental fluorosis treatment modalities, prevention and promotion strategies

e. Community based innovation ideas and projects should be designed and implemented to save the communities' at large and future generations free from the impacts of fluorosis. Experimental studies need to be done on systemic impact of fluorosis especially its impact on pineal gland, brain, bone, thyroid gland, reproductive organ, etc. in areas with high dental fluorosis prevalence in the context of our country.

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