Prevalence of Dental Fluorosis Among High School Students in Nazareath, Ethiopia

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ABSTRACT

A cross-sectional study of the prevalence of dental fluorosis among Nazareath High School student population and determination of the concentration of fluoride in the water supply of the town was carried out in June 1986. Of the 4092 9th, 10th and 11th grades student population 1023 (25%) students were selected for dental examination and interview by the process of random sampling method using table of random numbers. Out of the 1023 students, 821 (80.3%) responded to the study. Of the 821, 334 (40.7%) are born in Nazareath, 58 (7.1%) are born in Wonji, Koka, Nolenchiti and Metehara and the remaining 429 students (52.2%) are born in other places and arrived to live in Nazareath at different year of their ages. The prevalence of dental fluorosis among the High School student population is found to be 38.2% with no statistically significant difference between the males (36.9%) and females (40.9%) (x^2 = 0.77, x^2 95 (1 d.f) = 3.84, x^2 99 (1 d.f) = 6.63, P > 0.01, P 0.05). And the prevalence among those born and brought up in Nazareath is 69.1% with significant difference when compared to those who have come to live in Nazareath at different times of their age (x^2 = 232.19, x^2 99 (3 d.f) = 11.34, (P < 0.01). There is also statistically significant difference among the different age groups with the younger age groups the percent being high (x^2 = 34.22, x^2 99 (4 d.f) = 13.27, P < 0.01).

Water samples from three functioning sources of water supply for the town (9 wells junction-main suppliers of the town for the last 23 years, Deke-Hadi and High way wells - recently dug or on use two wells, 1983, 1984 respectively) are also analysed and the results indicate high fluoride level (5.30, 1.32, and 1.16mg/litre of water, respectively.

Thus there is an association between the fluoride content of the water supply and the prevalence of dental fluorosis in those that are born and brought up in Nazareath and those that have arrived to Nazareath at an earlier age of their life.

1. INTRODUCTION

1.1. Background Information

A cross-sectional study of the prevalence of dental fluorosis among Nazareath High School student population and determination of the concentration of fluoride in the water supply of the town was carried out in June 1986.

Nazareath is the capital town of Yerer-Kereyu Awraja located in Shoa Region at 100kms East of Addis Ababa on the main road to Hararge Region. It is within the Rift Valley (low land) area at an altitude of 1664 meters. Nazareath is one of the modern towns in Ethiopia with warm weather all the year round, and a warm windy weather during the summer time. It had yearly maximum mean temperature of 28.8°C and 28.2°C for the year 1984, and 1985 respectively; and total rainfall of 504.9 and 787.0mm (table 3).

According to the 1984 National census, Nazareath has 76,284 inhabitants. Being the meeting center for the roads that connect Assab, Hararge, Arsi and Bale, it is a fast growing commercial town. It is also the nearest recreational center for many of the State Farms employees of middle Awash. There are a number of thermal springs around the town. Sodere, the well-known National recreational center is located at 18kms South-East of Nazareath. Many people come to these recreational centers from all over the country, mostly from Addis Ababa,

especially during the rainy season for recreation and to seek medical treatment from the thermal waters. Many of the National seminars are also held in Nazareath town.

1.2. Water Supply

At the time of establishment of the town (1926), there was no system of water supply in Nazareath. People were using whatever water source was available around the town (rivers, ponds, rainwater). Many people were transporting water from the Awash river on donkeys and/or car. Some people were earning their living by selling water from Awash river at 10 Birr per 200 litres (31). Soon after the establishment of the town, the Ethio-French Rail-way Authority installed pipe water supply for its employees directly from Awash river. The water was untreated and it was limited to the Rail-way Authority employees and their families.

In 1943 the municipality of the town started the water supply for the town from one hand-dug well and one drilled-well at the boarder of Awash river. The water was piped into a reservoir and was distributed from public water distribution center. In 1963/64, the responsibility of supplying the town with water was taken by the Ethiopian Electric Light Power Authority. Seven additional wells were drilled at the boarder of Awash river, one more modern reservoir constructed and modern pipe system was installed during this time. It must be at around this time that many

of the inhabitants of the town had the accessibility to piped water supply system from the nine deep wells; eventhough what percentage of the inhabitants had the accessibility is not known.

In 1983, the water supply and Sewerage Authority for Urban towns took-over the responsibility of supplying the town with drinking water. This Authority drilled one more well at about 4kms. North of the town. The present water supply system therefore depends on ten wells; and according to the information released from the responsible agency there is almost 100% coverage, eventhough there is shortage of water during sometimes in the year. To overcome this shortage of water, efforts are being made by the water supply and Sewerage Authority, The High Way well which was not on use before, has recently (1984) started functioning. It supplies the Tractor Factory and its employees.

1.3. Location of the Study Areas

Nazareath is located in an area of about 100 sq.kms. on a flat sandy area surrounded by small hills. There are two High Schools in the town, Gelawdious Comperhensive High School and St. Joseph High School, from which the sample population of this study is taken. Both High Schools are located within the town (see appendix No.1) and both have same supply system as that of the town. The main suppliers of water for the town are the nine wells and

are located at the boarder of Awash river about 12kms. South West of the town. The recently dug, Deke-Hadi well (1983) is located about 4kms. North of the town and the High-way well (1984) is within the town (see appendix No.1)

1.4. The Study Subject

The need for the provision of potable water for all citizens in the world is one of the eight essential components of Primary Health Care Programme. Many of the rural and Urban inhabitants in developing countries of which Ethiopia is not an exception do not have potable water. They use rivers, lakes and ponds for their water supply source for drinking, cooking and washing purposes. Even these sources are not available in adequate quantity near their living area. These communities also lack proper excreta and waste disposal system. They dispose of their excreta and other wastes into the open field around their living areas and when rain falls; these wastes, heavily loaded with pathogenic organisms are washed into their unprotected water sources. The water sources in such communities, therefore, are the main source for many of the pathogenic microorganisms, which are the causes for many of the ill-healths of humanbeing. The contaminants are bacteriological or other pathogenic biological agents and priority is given to safegaurding the water sources from these contaminants.

However, serious health problems are recently being observed as a result of consumption of drinking water that contain high concentration of chemicals from certain industries such as mining and smelting or from agricultural practices and mal-practices (eg. the use and misuse of nitrates and other chemicals as fertilizers) or natural resources (eg. iron, fluoride) usually from deep well water sources (2,3,). Monitoring and assessment of these chemicals in water, air, food and in soil (in general in the whole environment) and identifying the diseases caused by consumption of these chemicals at high concentration level; and at what level they can be useful to the health of man are therefore becoming very important issues of epidemiological investigations. Results that can be obtained from these investigations are extremely important for the application of control measures of the diseases that may be caused by the handling and consumption of these chemicals; and safe use of these chemicals. For this reason, the international; programme on chemical safety, a cooperative activity of WHO, International Labour Office and the United Nations Environmental Programme have been created recently. This programme is concerned with health hazards that can result from exposure to these chemicals (4). Guideline values (concentration of the chemical in water at which no significant risk to the health of the consumer could occur) are issued by WHO since 1970/71 (2). A number of health related inorganic and organic chemicals

(9 inorganic and 15 organic chemicals) are considered in the guidelines for drinking water quality (2).

Fluoride, which is the focus of this study, is considered as one of the health related inorganic chemical constituents of water.

1.4.1. The occurence of fluoride (fluorine)

Fluorine is one of the most active electro negative hologens, which is rarely found free in nature in the elemental form. It is found in the combined forms as fluoride representing about 0.06-0.09% of the earth's crust, and stands 17th in the frequency of occurence of the elements of the earth's crust (2,3,6,7,9). It is found in significant amount in volcanic rocks and salt deposite of marine origin, and as trace element in plants, food stuffs and water. It is also added to toothpastes, vitamines and other pharmaceutical products. It is also found in the air emited from industries of gaseous wastes, dusts of fluoride containing soils, burning of coal fires in populated areas and from gases released in areas of volcanic activity (2,6,7).

Fluoride is found in abundance in the soil, but most of it is firmly attached to other chemicals in the soil. Its presence as free fluoride ions is dependent on the acidity of the soil, natural solubility of its compounds and the amount of water present in the soil. Its concentration increases with the depth of the soil.

Superficial soil usually have lower fluoride content than deep soil (6,7). It is most commonly found as fluoride or fluospar (Ca F2) compound. This compound may contain up to 49% of fluoride and produces high fluoride value of the rock. The mineral apatite, a compound which have long been recognized to contain high fluoride concentration (up to 13,500-26,000 ppM) is widely distributed in all igneous rocks (6). Because fluoride is present widely in the soil of the earth's surface and in the atmosphere, all waters containing varying concentration of fluoride. Sea water has relatively high fluoride content (1.0-1.4mg per litre). This fluoride is brought into the sea by the rivers from the different mountainous soils. Rivers and lakes usually have fluoride content of below 0.5mg per litre, but in some superficial water sources (rivers and lakes) high fluoride concentration have been recorded. Lake Nakuru in the Rift Valley in Kenya has the highest fluoride concentration recorded (2800mg per litre) and in the United Republic of Tanzania fluoride concentration recorded of up to 95mg per litre have been found in superficial waters(6,7).

Ground water may have high content of fluoride, depending on the geological condition of the bed of the water. Water in geological deposites of marine origin have high fluoride content. Thermal waters associated with volcanic activities also have high fluoride level (3-6mg per litre). Thermal waters are usually used for medicinal and not for drinking purposes. Examples of geographical belt,

that are of geological deposit of marine origin, are the belt from Syria to Jordan, Egypt, Libyan Arab Jamahireya, and from Algeria to Morocco, and the Rift Valley from Sudan through Ethiopia to Kenya. Another belt stretches from Turkey through Iraq, the Islamic Republic of Iran, and Afghanistan to India Northern Thailand and China. Similar areas are also found in America, Japan and China (6,7).

There are indications that there is a relationship between the fluoride content of water and/or soil of an area and the fluoride content of the plants and vegetables cultivated in that area. Vegetables and fruits usually have low fluoride content (0.1-0.4mg per kg) and are of little concern in the prevention of dental and bone fluorosis. Cereals have high fluoride content (2.0mg per kg), barely and rice (2.1mg per kg) when processed in unfluoridated water and when processed in fluoridated water 4.3 and 6.4mg per kg respectively (4). Tea leaves and fish products (canned fish) also have high fluoride content (1,4,5,23).

The main sources of fluoride to man are therefore;

1. Water
2. Certain edible marine animals
3. Some species of vegetables (cabbage, carrot, onion)
4. Certain industrial processes
5. Dusts in certain parts of the world (4).

But, many of the health effects of fluoride to man come as the result of injestion of water with high fluoride content. This however, depends on:

1. The fluoride level of the water
2. The age of the consumer
3. The climatic condition of the area
4. The dietary habit of the community
5. The socio-economic condition and accessibility of the person to the water (6,7)
6. The duration of exposure to the high fluoride water.

1.4.2. Absorption of Fluoride

The present knowledge we have about the absorption of fluoride is based on the findings obtained from animal experiments and observations in the field investigations in man. According to these findings fluoride is absorbed from the gastrointestinal tract mainly from the stomach (4,5). Other routes of absorption are through the skin and the lungs. The fluoride from the absorption site of the stomach and the lungs is rapid and complete, if it is from soluble fluoride compounds. Fluoride from water, beverages, wines and minerals are completely and rapidly absorbed from these sites (2,6,7,9). Absorption of fluoride from milk, and tea is somewhat less than that of water fluoride. The absorption of fluoride from food stuffs differs from food to food; generally this depends on the solubility of the inorganic compound in the diet and the

calcium content of the diet. Calcium phosphates, calcium carbonates, and aluminium compounds markedly reduce fluoride absorption when added into the food stuff. These compounds are less soluble, and when fluoride is attached to less soluble forms, it is less absorbed and its excretion in the faeces increases. Soluble fluoride compounds are readily absorbed in normal diet. In some experimental animals (rat) increased fat intake in the diet is observed to increase fluoride absorption. Fresh green vegetables and Ascorbic acid intake in food are observed to decrease fluoride absorption (6,14).

1.4.3. Distribution and excretion of fluoride

The absorbed fluoride is distributed from the blood throughout the body. It disappears from the blood in few minutes time to most organs and tissues of the body through the extracellular fluid. The amount of fluoride in the body-fluid is best measured from the blood plasma. It can also be measured in the urine. It may also be measured when excreted in the faeces. There are also indications that the fluoride in the plasma of the mother by-passes placental barrier to reach the fetal blood (6,7,9).

Fluoride has high affinity for bone and teeth tissues. This is not clear why? Almost half of the fluoride absorbed is incorporated and retained by the bones and teeth. The remaining part of the absorbed fluoride is excreted through the urinary system. The fluoride that is combined with

the less soluble components of the food are excreted in faeces unabsorbed. Insignificant amount may be excreted through the skin with sweating and the breast with milk(6,7).

The retention rate of fluoride in the body decreases with age i.e. the younger the individual the more fluoride he will retain in his body and the older the individual the less fluorine he will retain. This may be because during the young age, when bone and tooth development is underway, more fluorine is needed (10,18).

The accumulation of fluoride in the blood to cause toxic effect on the body is therefore controlled by the rate of excretion through the urinary system, and the incorporation of it with the bones and teeth (6,7,9,10,14).

1.4.4. Health effects of fluoride

The health benefits and the adverse health effects that are caused by consumption of water with different concentration of fluoride have attracted many public health and clinical health investigators. From several extensive experimental and analytical studies, carried out in several countries many tangible and quantifiable evidences of the relationship between the fluoride concentration of drinking water and health effects have been obtained. In experimental animals fluoride is observed to improve their fertility and growth rate when it is in optimal level, but, when in large doses, it depresses growth and causes dental and or bone fluorosis (2,6,12,14). The most important benefit of

fluoride to human health is that it decreases the incidence of dental carries when taken at optimum desirable level. It is seen that children born and brought up in an area of approximately 1mg of fluoride level per litre of water developed 50% less dental carries than those children that were born and brought up in an area where the fluoride level in drinking water is less than 0.3mg per litre. Fluoride protects the teeth from dental caries by being incorporated into the teeth structure and making it more resistant to the action of acidic media that may be created by the action of bacteria on the sugar, and/or by the inhibiting the bacterial enzyme action to produce acidic media. It does not cure dental caries, but reduces the incidence in adults and in children. Increasing the fluoride content of the communal water supply up to 1mg per litre of water or decreasing the high fluoride level or water to this decreases the incidence of caries (6-8,10,12-14,18,20-23,25,26,27,28).

It also has been studied that bone fragility and osteoporosis in elderly people are less in a community with fluoridated water up to 1mg per litre of water than in a community of similar economic status with water supply of less than 1mg of fluoride content (9,18,19,28).

One mg of fluoride per litre of water, the level at which health benefits are observed is therefore taken to be the safe level of concentration in the water for

community consumption. The guideline value given by WHO ranges 0.7-1.2 (1.7)mg per litre of water, this being subjective to air temperature, dietary habit and content of fluoride and the duration of exposure (1,6.7,11,13,14,28).

On the other hand many studies have shown that when fluoride is above the desired level, dental fluorosis is observed as faint opoque lines in its mild form and in severe form as extensive brown and dark stains with pitted and frial teeth. In areas where the fluoride content of water is more than 3-6mg per litre of water, depending on the intake of fluoride from other sources, skeletal fluorosis has been observed; and in areas where the fluoride level of water is greater than 10mg per litre of water crippling skeletal fluorosis has been observed in both adults and children (11,14).

Other studies associate the high fluoride content of water with high prevalence of cancer, kidney diseases, cardiovascular diseases and neurological disorders beside the dental and bone fluorosis. But, these are not supported with enough documents. Studies on these lines and on many others are continuing. Many have come out with enough evidences to conclude that these disorders are not associated with fluoride intake at desirable level (9,22). Both, the health benefits and the ill-effects to health, of fluoride have public health implications. Fluoridation of water up to 1mg per litre is advocated to

be the only preventive measure for the decrease of the incidence of dental caries, especially in the developed countries where dental caries disease is very common. But, when it is consumed in higher amount, it has deleterious effects on the enamel of the teeth and bones, and this is posing public health pattern, especially in the developing tropical countries.

Paracelsus said, "All substances are poisons; there none which is not a poison. The right dose differentiates a poison and remedy". So the knowledge of the level of fluoride content of water at which best health benefits can be gained, and the level at which ill-health effects appear, in a country are extremely important in the health planning of a country (4).

1.4.5. The epidemiology of dental fluorosis

Dental fluorosis as defined by many authors is a specific disturbance of tooth formation caused by excessive consumption of fluoride usually from communal water supply system during the period of dental development(3,6,7,13). Dental fluorosis was recognized long before 1902 in U.S.A. Mc kay and G.V. Black did a survey in a number of localities in U.S.A. and observed "brown stain" of the teeth. They associated it with drinking water, but its exact cause was not identified until the invention of the spectrographic instrument in 1931. Since 1931 the cause of dental fluorosis was identified to be "fluoride". Mc kay did

water analysis of many of the localities in U.S.A. and he found out that the fluoride concentration of the water supply of the localities where the brown stain was observed is high. He also observed that the prevalence of dental caries was low in these localities (7,9,13). Ever since these discoveries a number of interested epidemiologists and investigators did a number of studies. Their interest developed out of:

1. The story of harmful effects of fluoride on human health from large dose consumption of fluoride and
2. the story of dental as well as skeletal benefits from small dose consumption of fluoride.

Most of the studies were carried out in the U.S.A. and the Great Britain. The most important epidemiological study that gave standard classification of dental fluorosis was the one carried out by Dean in 1931 in the U.S.A. Dean investigated the degree of fluorosis and the prevalence of dental caries at different concentration of fluoride. He classified the degree of fluorosis into six catagories, described them and gave a score to each degree of fluorosis and corrosponding weight. This classification is the most commonly used classification in most epidemiological surveys of dental fluorosis; eventhough attempts have been made by a number of investigation to develop other types of classifications (6,7,12,13).

Dean's classification of Dental Fluorosis

1. Normal - the usual transluscent, semi-vitriform type structure, with smooth, glossy and usually a pale creamy white colour of tooth. Weight 0.0.

2. Questionable - the enamel of the tooth shows slight change from transluscency of the normal enamel. White spots or flecks are seen. Weight 0.5.

3. Very mild - small, opague, paper - white areas scattered inequlary over the tooth, but involving less than approximately 25% of the surface of the tooth. Weight 1.0.

4. Mild fluorosis - the white and opague areas are more extensive than in the very mild fluorosis involving as much as 50% of the tooth. Weight 2.0.

5. Moderate fluorosis - all enamel surface of the teeth are affected and surfaces subject to attrition show marked wear. Brown stain is frequently a disfiguring feature. Weight 3.0.

6. Severe fluorosis - all enamel surfaces affected and hypoplasia is so marked that the general form of the teeth may be altered. There is discrete or confluent pitting. Brown stains are wide spread and teeth often present a corroded-like-appearance. Weight 4.0.

From this classification and weight, Dean was able to calculate the index of dental fluorosis of a community by averaging the weights allocated to the individuals in the group using the formula of fluorosis index.

He stated that a community of fluorosis index of 0.4 or less is no concern from the public health point of view, but when the fluorosis index rises above 0.6 it is a public health problems that need a solution (6,7,12,13).

Eventhough most of the experimental and epidemiological studies of dental fluorosis were done in the U.S.A. and the European countries, several surveys and data collected show the presence of this chronic fluoride poisoning in Africa and Asia. Surveys in Algeria, Tunisia and Morocco, the data collected from South and South-West Africa, preliminary surveys in Kenya and published and unpublished reports in Ethiopia indicate the presence of dental fluorosis in Africa. Similar studies in Iraq, Jordan, Syria, India, Celon, Japan and China show its presence in the Asian countries (7,12,15, 17,34). Dental fluorosis is therefore widely present in the world affecting millions of people.

In certain regions of Ethiopia, especially in the Rift Valley Regions, the fluoride content of the water supply is said to be above the optimal level. The environmental health division of the Ministry of Health has recorded for Dire-Dawa 3.9mg of fluoride per litre;

for Wonji 6.4mg of fluoride per litre of water and for Awash Valley 6.8mg of fluoride per litre of water for the years 1970-1972 (17). Other unpublished and published reports of the Awash Valley fluoride problem also confirm the presence of high fluoride content of the drinking water; and dental and bone fluorosis have been observed in Wonji and Metehara, and dental fluorosis in Koka, Wolenchiti and Arsi (15,16,28,35). In Nazareath too cases of dental fluorosis have been observed (15). In other parts of Ethiopia mostly in the Rift Valley Regions, where extensive agricultural projects are underway, the problem of dental fluorosis is said to exist. In some of these State Farms in the Rift Valley, a survey have been carried out by a Committee formed by the government, at the request of the union representatives of the workers, to assess the fluoride problem in the Wonji Shoa and Metehara region. This Committee has confirmed the presence of high fluoride content in the water supply of this regions, and dental fluorosis in children brought up in this regions, and crippling skeletal fluorosis in the adults who have lived in this region for a long time are commonly observed (15). They confirmed this by reviewing the clinical records in the health institutions of the workers and examining some patients with crippling skeletal fluorosis. The water supply of the community was analysed from the different wells in and around Wonji, and showed

high fluoride content. The fluoride content of the water analysis ranges from 2.4-18.5mg per litre of water.

1.4.6. The general objective of this preliminary study (survey) is therefore to assess the magnitude of dental fluorosis problem among the high school students in Nazareath and to analyse the water supply for its concentration level for fluoride.

Specific objectives are:

1. To assess the presence of dental fluorosis among the high school students of Nazareath town.
2. To determine (analyse) the fluoride concentration level of the water supply of the town.
3. To recommend alternative safe water supply system for the town.

2. METHODS AND MATERIALS

In this study of dental fluorosis several methods, classifications and procedures are involved to collect the data.

2.1. Definition and Classification

Dean's classification and definition of dental fluorosis is used in this study with slight modification.

Category I. (Normal) - includes all cases with pale pale-creamy white colour that have no signs of dental fluorosis.

Category II. (Mild) - all cases that have questionable, very mild and mild degree of fluorosis are included in this category. These degrees of dental fluorosis are not associated with ill-health effect except for some minor cosmotic feature problems (25).

Category III. (Severe) - all severe and moderate cases are included in this category. These cases are those that have the highest degree of dental fluorosis. They cause undesirable cosmotic features of the teeth with elevated caries destroying the enamel of the teeth (25).

2.2. Training

To reinforce the practical knowledge of the investigator and help in the identification and diagnosis of fluorosed

dental cases, a one-day observation of fluorosed cases was made by the investigator in the dental clinic in Wonji hospital. Similarly three days were spend consulting a dentist about the classification of fluorosed cases. Other possible causes of dental opacity were also discussed with the dentist. These causes may be congenetal, accidental, drugs taken during the teeth developmental period and ideopathic. Opacity due to these causes are commonly observed in areas where the fluoride content of the water supply is low; however, they may also be observed in areas with high fluoride concentration of water supply making the differential diagnosis of opacity of the teeth due to these causes and due to the fluoride alone difficult (3,6,7).

Their differential diagnosis depends on: The distribution of opacity: Opacity on the teeth due to fluoride is symmetrical and generalized, while it is assymmetrical and localized in the ideopathic and other causes. The frequency of opacity involves most of the teeth in the case of fluoride causes, it involves only 1 or 2 teeth in the ideopathic and other causes. The opacity in the case of non-fluoride causes is more opague and oval while in the fluoride causes it is horizontal (3,6,7.).

2.3. The Study Population

The study population includes all 9th, 10th and 11th

grade day students of the two high schools (Gelawdious Comperhensive and St. Joseph High Schools) in Nazareath within the age groups 13 years and above. The total population of the 9th, 10th and 11th grade students was 4029, excluding the 12th grade and the technical unit students. The 12th grade students were excluded from the study because they were out to the villages for Literacy Campaign Service at the time when the study started. The technical unit students were also excluded because most of these students arrived to Nazareath recently (last one or two years) from other Awrajas for vacational training. This population was chosen for the study because:

1. Of their easy accessibility. They are limited to one place (school) hence they can easily be reached.
2. Their age range is considered to be 13 and above years old and by 13 years of age permanent teeth eruption is complete and dental fluorosis is best observed in the permanent teeth except the 3rd molars (31).

2.4. Sampling Process

The two high schools directors were approached through an official letter from the Department of Community Health. The letter was handed over to the directors by the investigator before a month of the time of the research,

after which purpose of the research was explained to them by the investigator. Both of the school directors agreed to give the necessary assistance and cooperation. The study population list was immediately obtained from the schools. Because the study population was so large that it becomes impossible to list down all the names, age and sex of the student population; coding process was started on the list provided by the schools. The coding process started from 0001 and finished with 4092. The required sample population was then computed from the coded list of names by probability sampling technique using random number table. It was decided that a 25% (1023) sample population selected by this technique would adequately represent the study population. This technique of selection gives equal chance for each study population member to be included in the sample population. The selected students were then written down on the sample population list form prepared by the investigator, and ticked infront of their name and code number list of the school. The school list was then returned to the school directors informing them that the ticked students were the ones needed for the study and they were requested to inform the students before the start of the study, June 19, 1986. However, cooperation was not as promised; the process of coding, random number processing and listing took six weeks. Too short a time for all these processes! The major problem faced in this

process was in the random number taking. Since the process was with replacement; numbers were repeating themselves several times! Cancelling off these numbers and looking for other numbers from the random number table to replace the repeated numbers were carried out with care.

Other Institutions Approached: Nazareath health center and the Water Supply and Sewerage Authority Branch office were approached and briefed about the study by the investigator. Nazareath Health Center was asked for cooperation in the provision of transport, whenever a car is available, and for some medical instruments (materials) such as alcohol, cotton and tangue depressors needed for the study. Cooperation from the health center was good.

The Water Supply and Sewerage Authority was needed for the permission and cooperation in the water sample collection. It required an official letter from their Headquarter office in Addis Ababa. This was done by approaching the Water Supply and Sewerage Authority in Addis Ababa, through an official letter from the Community Health Department. After the letter was obtained from their Authority office in Addis Ababa, cooperation was good.

2.5. Interview and Dental Examination

Both the interview and the dental examination were

carried out at the same time. Each student in the sample population (1023) was expected to answer the questions in the questionnaire form (appendix No. 2) part I and then to undergo dental examination according to the questionnaire form of part II. The questions were in English, but were interprated into Amharic (the language the students best understand) during interviewing. Dental examination was also carried out at the same time. Both the interview and the dental examination were carried by the investigator, but the name, age, sex and address were filled by field assistants.

Dental examination was done with naked eye on day light using spatula to see the teeth properly. During the examination, teeth are observed for any opacity of fluorosis (for any degree fluorosis), decayed, missed and/or filled (semented) conditions. Reasons for missed teeth was also asked and the number decayed, filled, and missed were counted and recorded. The whole process of interviewing and dental examination took about 10 minutes per individual. The standard method of dental examination for field dental survey using mouth mirror and probe is not used in this study (26,33,34,35).

Teeth that are extracted during childhood for traditional therapeutic reasons, either because child had frequent diarrhea or for any other belief do not erupt in the period of permanent teeth development. These are not counted as

missing due to caries or any other dental diseases. Teeth that are lost because of accidents are also not included for the DMF count.

2.6. Water Analysis

The town of Nazareath gets its water supply from the nine-wells dug at the boarder of Awash river at about 12kms South-West of the town and from a recently dug-well at about 3kms North of the town. It was decided to take water samples from these two water sources and from three other sources; but water sample from one more site was taken inorder to cover all sources of water supply. Accordingly a total of six water samples were collected for fluoride analysis from different sites. Clean and dry plastic containers with tightly fitting cover were used for water sample collection. The containers were rinsed by the water to be collected at the site of collection. The water was collected directly from the pipe at each site of collection. All water samples were collected on the same day by the investigator in cooperation with the Water Supply and Sewerage Authority Branch office in Nazareath and was handed over to the National Research Institute, the Health Industrial Chemistry analysis department in Addis Ababa on the same day of collection.

2.7. Previous Water Analysis Data Collection

In general water analysis records of Nazareath water

supply are not available. A one year (1983) water analysis record of the nine wells was obtained from the Water Supply and Sewerage Authority in Addis Ababa. The investigator also tried to get data from the Ministry of Mining and Energy, the Ministry of Health, Department of Environmental Health but did not get as anticipated.

2.8. Data Processing

Skeleton table for talley process was prepared and variables to be analysed and measured were tallied on it. The data collected were checked against the previous list of the sample population. Cross checking of the talley was done by sorting, that is by counting the questionnaire from which the variable is tallied (see appendix No.3).

3. FINDINGS

3.1. Response Rate

Out of the 4029 students of the two high schools (3801, 9th, 10th and 11th grade students from Gelawdious and 291 of the same grade from St. Joseph) 1023 (25%) were selected for dental examination and interview. Of the 1023 sampled students only 821 (80.3%) responded to the survey and the remaining 202 (19.7%) did not respond (table I & II). Reasons for this high rate of non-response are:

1. When the survey started, students were taking their end of the academic year examination and it was difficult to have students response during this time. Students and teachers were engaged in the examination and had no time to spare for the survey. It was only some time later when examinations were over that some teachers cooperated by holding the card of the non-responding students and as a result some students responded to the survey.

2. Some of the students, even after finishing their examinations were not willing to respond. They were suspecious of being recruited for the National Millitary Service or some other work assignment.

3. Some of the students with normal teeth (as they think) were reluctant to respond, because they thought that it is only those who were with spoiled (fluorosed) teeth that needed to take the examination.

4. The sample-list was prepared from the student population list of the first semester, and by the time the survey started, some of the students selected were expelled. The student population list was not up-to-date.

Table I. Sex and Age Distribution of the Student Sample

Age-Group	Gelaoalous		St. Joseph		Total Male & Female	% of the Total Sample in each age group
	Male	Female	Male	Female		
13-16	279	257	20	33	569	55.6
17-20	287	139	5	5	436	42.6
21-24	9	2	1	2	14	1.4
> 24	1	3	0	0	4	4
To al	576 (60.2%)	381 (39.8%)	26 (39.4%)	40 (60.6%)	1023	100.0

Table II. Sex and Age Distribution of Students Examined

Age-group	Male	Female	Total	%
13-16	231	208	438	53.3
17-20	242	128	370	45.1
21-24	9	2	11	1.3
24	0	2	2	0.2
Total	481	340	821	99.9

3.2. Weather Temperature and Fluoride Concentration

The maximum and minimum weather temperature of Nazareath were 28.8°C and 14.0°C respectively for the year 1984, and 28.2°C and 14.4°C for the year 1985(Table III). The fluoride concentration of the nine-wells junction, the main suppliers of the town for over 23 years, is 5.30mg per litre while of those that are either recently dug or used or about to be used wells are 1.32, 1.16 and 1.76. Their average is 2.30mg per litre. Awash river has fluoride concentration of 2.09mg per litre. The 6th water analysis result is that of the junction where the Deke-Hudi well and the nine-wells water meet, if the water push of the nine-wells is high enough to reach that area, which most of the time does not reach. Its fluoride concentration is found to be 1.32mg per litre. Eventhough, all these wells and the rivers are the possible sources of water for the town, and are either being explored for use or are recently on use (since 1983, 1984), the main supplier of the town have been the nine-wells whose fluoride concentration is 5.30mg per litre and whatever effect of dental fluorosis is present in the town is due to these water sources.

Table III. Monthly Weather Temperature and Rainfall records of Nazareath for the Year 1984, 1985 (obtained from Institute of Agriculture Research).

Months	1984			1985		
	Temperature		Rainfall	Temperature		Rainfall
	Minimum	Maximum		Minimum	Maximum	
January	9.5°C	27.1°C	0.0	12.1°C	28.5	6.2
February	9.8	28.9	0.0	13.4	28.3	0.0
March	15.4	31.8	7.0	16.5	31.2	13.4
April	16.7	32.8	0.2	16.1	28.5	41.8
May	16.5	30.0	81.2	16.3	29.5	80.1
June	15.3	28.5	42.2	16.9	30.5	26.1
July	15.6	36.6	153.8	15.2	25.6	278.0
August	15.9	26.9	109.9	15.0	24.7	261.4
September	14.2	27.2	96.7	14.3	26.8	79.5
October	12.1	29.6	0.0	12.6	28.6	0.6
December	12.4	26.8	13.9	11.7	27.3	0.0
Average	14.0	28.8	504.9(Total)	14.4	28.2	787.00(Total)

Table IV. Water Analysis Results (Performed in the NIR, Addis Ababa

S.No.	Site of Collection	Collection Date	Analysis Date	Results in mg/l of Water	R e m a r k s
1	9 Wells junction	22/7/86	5/8/86	5.30	Main Supplier for over 23 years
2	Deke-Hadi Well	"	"	1.32	Dug in 1983 of small yild
3	Deke-Hadi and 9 Wells junction	"	"	1.42	
4	High-way Well	"	"	1.16	Supplies to the Tractor Factory
5	Wilma Deresaa Well	"	"	1.76	Under-way to be on use
6	Awash River	"	"	2.09	Not on use for supply

3.3. Source of Water Supply

Almost all the students in the two high schools use pipe water in their houses from the dug-wells. The school water supply is also the same as the public that is they use water from the dug-wells. Out of the 821 students 802 (97.7%) use pipe water and only 19 students (2.3%) use river, pond and rain water sources (table V). All the 19 students that use rivers, ponds, and rain water come from the surrounding villages for their high school education.

Table V. Source of Water Supply Among the Sampled Students

Supply System	No. of Users	% of the Total
Pipe (wells)	802	97.7
Rivers, Ponds and Rain Water	19	2.3
Total	821	100.00

3.4. Assessment of the Health Consciousness of the Students about Dental Fluorosis

Students were asked to answer the pertenant questions concerning dental fluorosis. Only (608) 74.1% of the students recognize dental fluorosis as a health problem and the remaining (213) 25.9% do not recognize it as a health problem.

Only (58) 7.1% students recognize fluoride to be the cause of dental fluorosis (Table VI No. 4), (515) 62.7% students associate it with drinking unclean water i.e. water contaminated with germs or microorganisms or excess minerals dissolved in it or excess chlorine added to the water during chlorination, and (102) 12.4% students have no idea about the cause (Table VI Nos. 1 & 2). (52) 6.3% of the students associate the cause with consumption of too much sugar with food, and the other (94) 11.4% of the students relate the cause with either failure to keep oral hygiene, drinking too much coffee, smoking cigaretts, chewing chat, vitamine deficiency or fever (Table VI Nos. 3 & 5).

As observed by the investigator dental fluorosis seems to have psychological impact on the personality of many of the students. Many are scared about dental fluorosis. Some even cover their teeth with their hands when laughing. Especially, some of the girls, were ashamed (affraid) to show their teeth during the examination. They were not

cooperative for dental examination or if they cooperate; it is by persuasion.

Students were asked to mention, if they know any traditional methods of prevention and/or treatment. However, data on this are not processed, but some of the traditional methods mentioned for treatment are washing with gold acid, brushing the teeth with charcoal and salt mixture soaked in lemon juice left for overnight and brushing the teeth with special type of local brushing stick, sold by traditional healers in the town, which they could not identify by name. Some students claim to have improved the condition of dental fluorosis by using any of these methods, but the other students admitted that they did not improve the condition, infact in some of the students washing the teeth with the gold acid has worsened the condition of the teeth by spoiling the enamel of the teeth as reported by some of the students.

Table VI. Health Knowledge of the Students about the cause of Dental Fluorosis

1		2		3		4		5		Total	
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
515	62.7	102	12.4	52	6.3	58	7.1	94	11.4	821	99.9

Explanation to Table VI:

1. Number of students that associate dental fluorosis with consumption of unclean water, by unclean water is ment contaminated with germs, microorganisms, excess minerals or salts naturally dissolved in it or excess or less chlorine added to kill the germs.
2. Students that did not have any idea about the cause. This are the "I do not know groups".
3. Students that associate dental fluorosis with consumption of food that contains too much sugar.
4. These are students that identify the cause to be fluoride consumption in the water.
5. These are students that associate it with both consumption of unclean water and food with too much sugar; failure to keep oral hygiene, drinking coffee, smoking cigarett, chewing chat, vitamine deficiency and fever.

3.5. Distribution of Students by Birth Place

The highest number of the responding stugents, (344) 40.7% are born in Nazareath (Table VII), the others are born in different places and have come to live in Nazareath at different periods of their age. The highest number of students who have moved to Nazareath come from other places in Shoa region, 98 students (11.9%). These other places in Shoa are Shenkora, Minjar, Chebo-Gurage, Debre-Zeit, Haikoch and Butajira, Debre-Berhane, etc. excluding Nazareath, Wonji, Metehara, Koka and Wolenchiti. Those who are born in Addis Ababa and have moved to Nazareath constitute 97 (11.8%) and those of Arsi 93 (11.3%). From other regions in Ethiopia that is from Eritrea, Tigrai, Wollo, Gondar, Gojjam, Wollega, Sidamo, Jimma, etc. 87 students (10.6%) have moved to Nazareath (Table VII).

Table VII. Distribution of the Students by Birth Place

Place of Birth	No.	% of the Total
Nazareath	334	40.7
Wonji, Metehara, Koka and Wolenchiti	58	7.1
Arsi	93	11.3
Addis Ababa	97	11.8
Hararge	54	6.6
Other places in Shoa region	98	11.9
Other regions in Ethiopia	87	10.6
Total	821	100.0

3.6. Prevalence of Denntal Fluorosis

Out of the 821 responding students (314) 38.2% are with fluorosed enamel of the teeth and (507) 61.8% are with normal enamel of the teeth. This percent(38.2) includes all students in the high schools (9th, 10th and 11th grade) who are born and brought up in Nazareath and who are born in the different regions of the Nation (Ethiopia) and have come to live in Nazareath at different years of their age (Table 8).

The male and female prevalence of fluorosed enamel is (179) 36.9% and (135) 40.2% respectively (Table 7). Their difference is not statistically significant ($P > 0.05\&0.01$). From this it can be concluded that both sexes are equally affected by dental fluorosis.

The prevalence of dental fluorosis in the different age groups is seen to be higher in the younger age group (Table 7). This difference is statistically significant ($P < 0.01$). The statistical significance is calculated with the two last age groups lamped together into 21^{+} using the Yates correction formula. Yates correction formula is used because one of the cells of the table has less than 5 students with fluorosed enamel.

The statistically significant difference could be attributed to the difference of duration of exposure to the high fluoride intake (water) and the intensity of exposure. Water supply from deep wells started in 1963, 23 years ago.

Most of the students are under the age group of 23 years; and they have been exposed to the high fluoride content of the water throughout their life time, from the time of conception. Eventhough water supply from deep wells started 23 years ago, the coverage might have been low at that time. At present, according to the information released from the Water Supply and Sewerage Authority Branch office of Nazareath, and according to this study the coverage is (97.7%) (Table 5) with some shortage of water supply to some parts of the town at some time of the year. This coverage might have increased year by year. Each year, with improved coverage of water supply and the availability of the water in abundance, the rate of exposure and intensity of exposure to the high fluoride content of the water might have increased and these could be the reasons for the difference of the prevalence of dental fluorosis between the younger age groups and elder age groups of the students. If there were other sources of fluoride from which the people could get, than this would not have occured or the difference would have been the other way round, that is more prevalence of dental fluorosis cases would have occured in the elder age groups who have longer time of exposure to the source than the younger ones. But, since the exposure started after 1963 and the intensity and duration of exposure increased subsequently, this difference is seen Eventhough, other population control of similar living

standard and weather condition and with water supply source of low fluoride content is necessary to acertain the association, it is possible to associate these findings to the high fluoride content of the drinking water of the town.

Table VIII. Prevalence of Dental Fluorosis Among Nazereth High School Students by Age and Sex in 1986.

Age-Group	No. Examined	No. with Normal Enamel		No. with Fluorosed Enamel		Total	
		Male	Female	Male	Female	Male	Female
13-16	438	121	107	114 (48.5%)	96 (47.3%)	236	204
17-20	370	178	91	63 (26.1%)	39 (30.2%)	241	129
21-24	11	7	2	2 (22.2%)	0 (0.0%)	9	2
24	2	0	0	0 (0.0%)	0 (0.0%)	0	2
Total	821	306	201	179	135	485	336

3.7. Prevalence of Dental Fluorosis By Birth Place

As could be seen on table 9, the prevalence of dental fluorosis among those that are born in Wonji, Koka, Metehara and Wolenchiti is highest (70.7%). This group of students are born in these places and, either arrived to live in Nazareath at varying years of age or are still living in their respective places and come for their high school education every day. Out of the 334 students born in Nazareath, 229 (68.6%) developed fluorosed enamel. This group of students also include all those born in Nazareath, but may not necessarily be brought up in Nazareath. They include students that are born in Nazareath, but were absent for more than 5 years when under 12 years of age. The third group students are those that are born in other places and who have arrived to live in Nazareath at different times of their age. The differences are statistically significant ($P < 0.01$). The overall prevalence of dental fluorosis is 38.2%.

Table IX. Prevalence of Dental Fluorosis among the high school Students of Nazareath 1986 - by Birth Place

Born in	No.	No. with Normal Teeth	No. with Fluorosed Teeth	% of Fluorosed
Nazareath	334	105	229	68.6
Wonji, Koka Metehara and Wolenchiti	58	17	41	70.7
Other places	429	385	44	10.3
Total	821	507	314	38.2

3.8. Distribution of Dental Fluorosis according to period of stay in Nazareath

Students that are not life long residents of Nazareath, and students that have been born in Wonji, Koka, Metehara and Wolenchiti are excluded from Table X. As seen on Table X, the prevalence of dental fluorosis increases with longer period of stay in Nazareath. Students that are born and brought up in Nazareath show highest prevalence (69.1%) and students that have arrived at earlier years of their age (0 - 8 yrs.) show 2nd high (42.5%). Differences are statistically significant ($P < 0.01$). From this it can be concluded that the earlier the child arrives to live in Nazareath, the higher the chance of developing dental fluorosis. The difference in the number of students is because of the exclusion of students born and brought up in places where dental fluorosis is present (Table X).

Table X. Prevalence of Dental Fluorosis According to Period of Stay in Nazereath.

Period of Stay	No.	No. with Normal Teeth	No. with Fluorosed Teeth	% of Fluorosed Teeth
Since Birth (Life-Long Residents	327	101	226	69.1
Arrived at 8 yrs. of Age	73	41	31	42.5
Arrived at 8-12 yrs of Age	121	113	8	6.7
Arrived at 12 yrs. of Age	241	236	5	2.1
Total	762	492	270	35.4

3.9. Degree of Fluorosis

Almost all the different degree of fluorosis occur in the age groups 13-16 and 17-20 years (Table XI). Of the 313 fluorosed cases 311 (99.4%) occured in these age groups while(2) 0.6% occured in the 21^{+} age group. Of the 26 severe cases 20 occured in the age group 13-16 years while 6 are in the age group of 17-20 years. The difference are statistically significant ($P < 0.01$). Reasons for these differences are the accessibility to the water supply and the duration of exposure time to the water supply. Only 10 of the severe dental fluorosis cases are from Nazareath. The remaining 13 cases are from Wonji and 3 cases from Koka.

Table XI. Degree of Fluorosis by Age

Age-Group	No. of Examined	No. with Normal Teeth	No. with Mild Fluorosis	No. with Severe Fluorosis
13-16	437	229 (52.4%)	188 (43%)	20 4.6%)
17-20	373	270 (72.4%)	97 (26%)	6 (1.6%)
21+	11	9 (81.8%)	2 (18.2%)	0 (0.0%)
Total	821	508 (61.9%)	287 (35%)	26 (3.2%)

3.10. The Missing - Decayed - Filled Index (DMF)

The DMF index indicates the number of decayed, missed and filled teeth per 12 years old child. Fluoride is said to have some protective value to the enamel of the teeth from caries. According to the data collected from many epidemiological investigations it is concluded that fluoridating the drinking water to 1mg of floride per litre of water is the only preventive measure of the teeth from dental caries. In this study the number of decayed missed and filled teeth are counted in each of the three categories of the degree of fluorosis, and divided by the number of individuals in the category. The DMF index is high in the severe cases of fluorosis in the normal, next high and in the mildly fluorosed cases it is low. (Table X). The difference of the normal cases DMF to that of the mild cases is 53% and that of the severe to the mild is 91%. Thus the protective value of fluoride is evidenced by the low DMF index value in the mild cases, while its distructiveness to the enamel of the teeth is seen by the high DMF index value in the severe cases. The need to find out at what concentration fluoride gives maximum benefit to human health is therefore very important.

Table XII. DMF Index in the Different Degrees of Fluorosis

Degree of Fluorosis	No.	No. of Teeth Decayed Missed-Filled	DMF Index	% Difference From the Mildly fluorosed
Normal	508	85	0.17	53%
Mildly Fluorosed	287	23	0.08	
Severely Fluorosed	26	22	0.85	91%
Total	821	130	0.16	

4. DISCUSSION

Many epidemiological and experimental studies so far carried out in different parts of the world, mostly in developed countries have confirmed that fluoride is poisonous to human health, when its concentration in the drinking water is above the optimal level recommended by WHO. The optimal level range is 0.7-1.2mg of fluoride per 1 litre of drinking water, weather temperature and duration of exposure time being taken into consideration. Documents also show that fluoride is present in abundance in nature; and water is the main source for human and animal supply. When fluoride is present in the drinking water in concentration higher than the optimal level, dental fluorosis, the earliest sign of chronic fluoride poisoning is observed. Other complications are skeletal fluorosis and crippling skeletal fluorosis. Neurological disorders associated with rheumatic pain, chronic kidney diseases and kidney stones, carcinogenic and many other health effects of fluoride are also under investigation (3,6,7,9). When these and many other complications are considered, the deleterious health effect of fluoride out weighs its beneficial effect as a preventive measure of dental caries, especially in the developing countries where dental caries is not a major public health problem, eventhough the magnitude of dental caries is not studied very well. The benefits of fluoride for human health as an effective measure for the prevention

of dental caries and osteoporosis, and the exact concentration at which it is beneficial to human health is also not yet determined in the developing countries. But chronic fluoride poisoning that resulted in the irreversible damage to human health from the consumption of water containing high fluoride concentration is becoming a serious public health problem in some areas of the developing countries where the fluoride concentration of the water supply is above the optimal level (3,4,7). Few preliminary studies that have been carried out in Ethiopia, mostly in the areas of the Rift Valley Region show the presence of dental and skeletal fluorosis, and even crippling skeletal fluorosis (15,16,35,36).

In this study the prevalence of dental fluorosis among the high school student population in Nazareath and the analysis of fluoride concentration of the public water supply has been carried out; and the findings indicate that dental fluorosis is present in considerable number of students and the fluoride concentration is much higher than the optimal level recommended by the WHO. The fluoride concentration level of the main public water supply (5.30mg per litre) and the prevalence of dental fluorosis are related to each other; as are in other studies too.

Other unpublished reports by government appointed committee in 1977 did a survey in Nazareath and other towns and State Farm areas in the Rift Valley Region. From

Nazareath they took 64 students in the age group 5-8 years, 41 students in the age group 9-14 years and 50 students in the age group 15-19 years and got prevalence of dental fluorosis of 95-100% (30). In this study the prevalence of dental fluorosis in those born and brought up in Nazareath is found to be 69.1%, much lower than the Committee's finding. The Committee report however does not state how the samples were selected and does not specify whether the prevalences are of that age group population or not. So comparison between the present findings and the Committee findings is not possible.

Water analysis result in this study gives 5.30mg per litre of water. Water sample is taken from the junction of the nine wells, but water analysis by the Committee carried in the same laboratory gives avarage of the nine wells 4.4mg per litre of water. The difference could be due to either in the process of collection or in the process of analysis in the laboratory. In this study water analysis is done directly by spectrophotometer using Spandus Reagent (NRT).

In other countries, epidemiological studies have confirmed the relationship between dental fluorosis and the concentration of fluoride in drinking water. In communities where the fluoride content in their drinking water supply is above 2.6mg per litre, higher prevalence of dental fluorosis have been reported in about 10-20 years

of exposure (26,29). However the prevalence of dental fluorosis is not uniform, it differs from community to community that is two communities of similar fluoride content of their water may have different prevalence of dental fluorosis due to many factors. Some of these factors are weather, living status, food habit and type of activity.

In this study, the prevalence of dental fluorosis in those born in Nazareath is lower than expected when compared to the fluoride content of drinking water. When fluoride content of drinking water is 3mg and above per litre of water, dental fluorosis of 80-90% is expected (26,29). But this does not hold true in this study. This may be because of the differences of the living status, food habit, weather, temperature, accessibility to the water and exposure time differences.

The protective value of fluoride from dental caries have been evidenced by many epidemiological studies carried out in the developed countries. But in developing countries like Ethiopia, this has not been studied well. In a survey by Olsson B. in 1978 in Wonji and Awassa school children (6-7 years and 13-14 years age group) where the mean fluorode content of the water supply is found to be 12.4 PPM and 3.5 PPM respectively, the DMF value is higher in Wonji where severe and moderate dental fluorosis and predominantly found (DMFT 2.46) than the DMFT value in Awassa where the very mild and mild are found (DMFT 1.69). The DMFT value in Ethiopia

in 1958 was 0.2 and in 1975 it was 1.5 (35). The category of DMFT value given by the WHO covering the range from very low to very high are:

very low	0.0 - 1.1
low	1.2 - 2.6
moderate	2.7 - 4.4
high	4.5 - 6.5
very high	6.6 and above (35).

The goal of the WHO dental health service is to attain the DMF DMFT value of 3.0 by the year 2000 using fluoridation of drinking water to 1mg of fluoride per 1 litre of water, and other caries preventive measures. In this particular study the DMFT index is 0.16, lower than any of the DMFT values mentioned above. But, the DMFT value in the mildly fluorosed is by 53% lower than of those that are with normal teeth; and by 91% lower than of those that are severely fluorosed. These findings agree with that of Olsson B; but the overall value of DMFT in this study is much lower than Olsson B.'s. This may be because of the difference of the methods of detection of caries used during the examination.

5. CONCLUSION AND RECOMMENDATIONS

Extensive epidemiological researches on the benefits and the side effects of consuming fluoride with water and other food items have been carried out in many parts of the world, mostly in the developed world. The benefits and side effects of fluoride on human health at different age groups, under different living conditions, and the occurence of fluoride content in varying concentrations in different sources of water, food items, soil, atmosphere and industrial and pharmaceutical products have been analysed. The absorption, distribution and excretion to and through, the different parts of the body have also been anaylsed, mostly in experimental animals. From these studies quantifiable results on the benefits and ill-health effects of fluoride, have been obtained at certain levels of concentration in drinking water. It is now widely accepted, especially among the developed countries, that fluoride at the maximum allowable concentration level os useful to human health, and when above this level (usually 1mg per litre) it causes damage to human health (dental and skeletal fluorosis). Eventhough the problem is not well studied in developing country, endemic fluorosis involving severe debilitation of great proportion of the population, remains to be serious public health problem in some areas of these countries. The disease is preventable if recognized early, but irreversible once the damage has occured.

In Ethiopia, the situation is untouched. The concentration of fluoride (and other chemicals) of almost all public water supplies and staple food are not analysed. In general it can be stated that the magnitude of dental fluorosis in the Nation is not known. The disease is not even reported in the monthly morbidity and mortality statistics report to the Ministry of Health. There are a few Committee reports that have assessed the fluoride problem in and arround the Awash valley State Farm and Factory workers. These studies have been carried out upon the request of the union representatives of the workers. Among some of the State Farm employees, fluorosis is recognized as a health problem of the community and this is why the request has come through the workers union representatives. There are legal disputes between the workers and the factory for farm managers. Some of the workers have developed crippling skeletal fluorosis and this workers have asked for componsations. From disputes and the date gathered by this study, the disease of chronic dental fluorosis is worth considering in the planning of health services programme of a community. The plan should consider both the prevention of dental fluorosis and dental caries protection by the use of optimal level of fluoride, especially in the school age children. Children are more vulnerable both to dental caries and dental fluorosis than other population group. In general the health benefits and ill-health effects of

of fluoride to human health have to be studied further. Its concentration in food items and in communal water supplies should be determined. In this study, the fluoride content of the water supply of the town of Nazareath is determined and is found to be higher than the optimal level. The magnitude of dental fluorosis among the High School student population of the age group 13 and above years is evidenced. This findings are perhaps not conclusive but are indicative for further extensive investigation of dental and skeletal fluorosis in the town. In the process of planning for these extensive investigations the involvement of the community and several other desciplines is very important. Nazareath is a fast growing town and the provision acceptable quality of water supply to this town will have great impact on its development. The possible alternative methods of providing safe water supply for Nazareath are:

1. Soliciting with National and International Organizations for the cooperative approach for extensive epidemiological investigations of fluoride problem in Nazareath and the Rift Valley as a whole; and to seek for solutions of providing safe water supply to the people in that area.

2. Exploration of other water sources of less fluoride concentration.

3. Provision of water supply from surface water sources. Awash river, if treated and protected from industrial wastes pollution, could be the cheapest alternative of providing safe water supply for Nazareath. Another alternative water source is rain water. Since there is enough rainfall in Nazareath, it is possible to build dam for collecting water during the rainy season.

4. Introduction of large scale defluoridation system to reduce the fluoride concentration level from the present 5.30 PPM to 1 PPM, the optimal concentration level. However, this can be quite expensive. In Wonji defluoridating the water supply used for drinking and cooking has been introduced for the last 15 years and effect of it is being studied. However, the method used to defluoridate is said to be very expensive and other cheaper methods are being studied (37).

5. Since diet is also a contributing factor in causing fluorosis, assessment of the fluoride content of the common food items and control of those that contain high fluoride content is one of the preventive measure that should be taken.

6. Giving health education to the community is also important in the efforts to control fluorosis in order to get their involvement in the programme. Health education on the porper use and handling of chemicals (fertilizers), and the danger of the practice of using local herbs and other chemicals to remove the dental stain of fluoride by the community has also to be considered.

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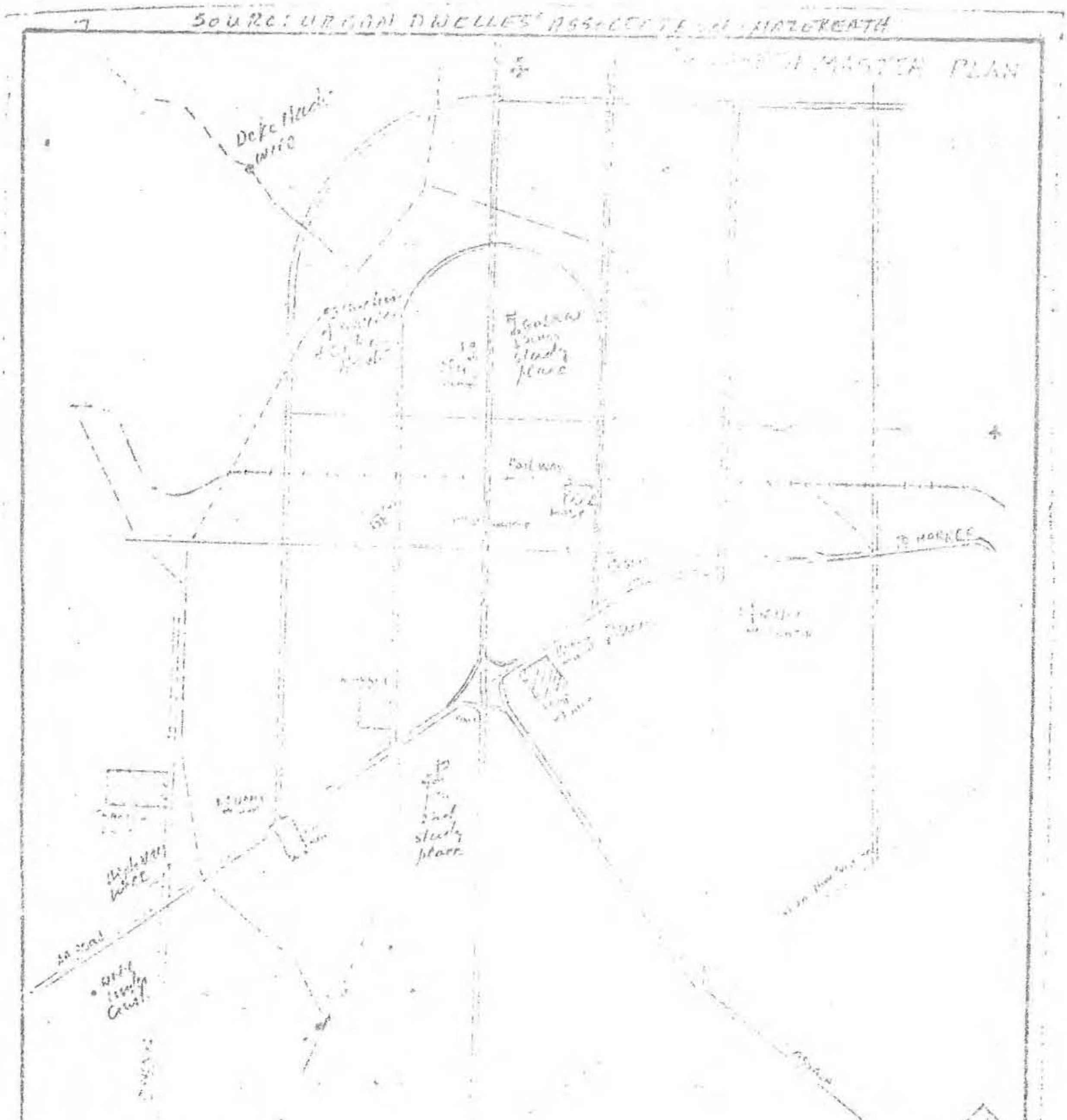

MASTER PLAN
Railway
TO HORRES
Water Source
M COMP
200000

Code No. _____

Date _____

PREVALENCE OF DENTAL FLUOROSIS AMONG HIGH SCHOOL STUDENTS OF NAZARETH TOWN

PART I QUESTIONAIRE

1. Name of student _____
2. Age _____ Sex _____ School _____ Grade _____
3. What do you know or understand about fluorosis? _____

   _____
4. Do you think fluorosis is a health problem?

   Yes _____ No _____
5. What is believed to cause fluorosis? _____

   _____
6. Do you know any method of:

   a. Preventing dental fluorosis Yes _____ No _____

   b. Curing dental fluorosis Yes _____ No _____
7. If yes what is it?

   a. Method of preventing dental fluorosis _____

   b. Method of curing dental fluorosis _____
8. What is your source of water supply for drinking and cooking? _____
9. Where were you born?

   a. Nazareath _____

   b. Other places (specify) _____

10. If you were not born in Nazareath at what age did you come to live in Nazareath?

    a. Under 8 years

    b. 8-12 years

    c. 12 years

11. Have you lived out of Nazareath when under 12 years of age for more than 5 years?

    a. Yes _____

    b. No _____

12. If yes, where and how long did you live?

    a. _____

    b. _____

PART II DENTAL EXAMINATION RECORD FORM

A. Condition of the teeth:	Present	Absent	No. if Present
a. Decayed			
b. Missed			
c. Filled			

B. Reasons for missed(if present)

    a. Accident

    b. Dental diseases

    c. Other

C. Degree of mottling

    a. Normal

    b. Mild

    c. Severe

D. Observation about oral hygiene (a) Acceptable
(b) Unacceptable

E. Any other thing you with to tell about dental fluorosis or about what we discussed? _____

_____

EXAMPLE OF TALLEY SHEET

Age-Group	Male	Female	Degree of Fluorosis					
			Normal		Mild		Severe	
			Male	Female	Male	Female	Male	Female
13-16								
17-20								
21-24								
24								

D E C L A R A T I O N

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other University

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