AN ASSESSMENT OF THE ORAL HEALTH STATUS OF PRIMARY SCHOOL CHILDREN IN ADDIS ABABA, ETHIOPIA

By

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By

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DEDICATION:

I dedicate this thesis to all the children
of Ethiopia.
May they have a happy childhood
and a bright future ahead!

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LIST OF ABBREVIATIONS

AIDS	Acquired Immunodeficiency Syndrome
CI	Cofidence Interval
DMFT	Decayed, Missing and Filled Permanent Teeth
dmft	Decayed, Missing and Filled Primary Teeth
Gov't	Government
HIV	Human Immunodeficiency Virus
NGO	Non Governmental Organization
mg/L	milligrams per litre
OR	Odds Ratio
Ppm	Parts per million
Pub	Public
Pvt	Private
South. N.	Southern Nationalities
WHO	World Health Organization

ABSTRACT

Although oral disease is a major public health problem, there is little epidemiological research in Ethiopia. This study is designed to provide base-line information on the major oral health problems among primary school children in Addis Ababa.

A school-based cross-sectional study to assess the oral health status of primary school children aged 12 years and above, was conducted in Addis Ababa, in April 2000. A total of 1736 study subjects were chosen by multi-stage selection procedures from three different (private, public and government) types of schools, proportionate to their size of student population.

The overall prevalence of dental caries was 21.1%, with no significant variation between the different types of schools. In this study, dental caries significantly increased with increasing age, high consumption of sweets and in those who do not clean their teeth.

Periodontal disease affected more than half (53.4%) of the study subjects. Periodontal disease was significantly high in males, in public school children, in those whose consumption of sweets was high, in children having 'enjera' as staple diet and those with poor oral hygiene.

The prevalence of malocclusion was 23.7% (22% mild and 1.7% moderate). Crowding of teeth was seen in 413 (23.8%) of children. The prevalence of spacing of teeth was 18.3%. More analytic studies have to be done to shed light on the determinant factors of malocclusion, spacing and crowding of teeth. The prevalence of dental fluorosis was low (1.6%), affecting only 28 children. The knowledge and understanding of oral health and it's prevention was high but dental service utilisation was low.

Initiation and strengthening of health education programmes in schools to include information about healthy diet and practice of adequate oral hygiene are recommended. Other recommendations are integration of oral health into primary health service and further studies to elucidate risk factors and treatment requirements for oral diseases.

I. INTRODUCTION

With our mouth and teeth, we are able to talk, to smile, to express emotions and to enjoy eating (1). Teeth may be the only recognizable feature of a human body after a disaster (such as a fire), so that identification of individuals may rely upon the characteristics recorded from their surviving teeth (2). Although oral problems are rarely life threatening they may cause debilitation, pain and infection. Missing, decayed or abnormally positioned teeth may be a handicap to the functional needs and psychosocial health of an individual, causing serious concern especially among children who may suffer from low esteem (3).

Oral health is a significant component of general health and oral disease is an important public health problem because of its high prevalence, public demand and its impact on individuals and society in terms of pain, discomfort, social and functional limitation and handicap and the effect on people's quality of life. People who are poor and living in difficult circumstances continue to be neglected, even though preventive methods, which are simple and cheap, are available (4). While oral health has considerably improved in industrialized countries, mainly due to primary preventive methods such as the widespread use of fluorides, a change in dietary patterns, a reduction in smoking and improvement in oral hygiene habits, it is deteriorating in developing countries especially among children due to changes in socio-economic conditions, dietary habits and lack of education. The challenge early in the twenty-first century is to initiate these preventive measures and life styles in developing countries and to maintain them in developed countries (5).

Some of the constraints in improving oral health in developing countries are the enormous economic, social, health and educational problems, the low priority of oral health, shortage of oral health manpower, lack of appropriate oral health policy, inadequate and scarce resources, growing problems of HIV/AIDS, hepatitis B and other life threatening problems (6).

In Africa, oral health has always had a low priority in the health activities. The main reasons being that most resources devoted to health have to be directed towards the control of communicable diseases and also because oral health had been relatively good

and thus the need for oral health services had been limited. However, in the past 25 years, major changes have occurred in the oral disease pattern in African countries, indicating a general deterioration in oral health in urban areas (7).

In Ethiopia, with many other pressing medical and financial problems to be dealt with, oral diseases and their treatment have received little attention in public health planning. The average person's understanding of oral health problems and their prevention is very minimal. The number of people who maintain an acceptable standard of oral hygiene is low. Formal dental training began in Ethiopia only in 1991. In 1992, there were only 45 dentists, 17 of whom were in Addis Ababa. The dental health services consist of a few government and several private dental clinics confined mainly to Addis Ababa. Treatment is often based on extractions and restorations, and costs are far beyond the reach of most Ethiopians (3).

Among the leading causes of hospital morbidity in Addis Ababa, 6305 diagnosed cases of dental caries accounted for 6.2% of cases in the Out-Patient Department while other diagnosed diseases of tooth and gums contributed to another 3004 cases in 1998. The dentist : population ratio is 1:3.5 million in Ethiopia, while it is 1:400,000 in Addis Ababa (8). An earlier oral health survey in 1976-77 among 232 participants showed the prevalence of dental caries to be 53%, while 68% had periodontal disease and 45% had malocclusion. Adequate oral hygiene was reportedly practiced only by 24% of the study subjects (9). Harmful traditional practices like unnecessary removal of primary canine tooth are still prevalent (10).

Over the past several decades, there has been a gradual shift in focus from treatment of oral diseases to prevention. The eventual goal of eliminating the two main oral diseases namely dental caries and periodontal disease, now seems reasonable and attainable (11).

The World Health Organization (WHO) recommends that an oral health survey be done at least once in 5 years to collect information about the oral health status and treatment needs of a population and subsequently to monitor changes in the level and pattern of oral diseases. The recommended index ages for studying dental caries and periodontal disease of children's permanent dentition are 12 and 15 years (12). The school years being a formative time in the development of human being, the school setting provides an efficient means of improving young people's health, self-esteem, life skills

and behaviour. Health is linked to educational achievement, quality of life and economic productivity necessitating a comprehensive approach to school health. Also today's school children are tomorrow's parents and should carry forward good health, knowledge and practices to the next generation (13).

In Ethiopia, except for a pilot study (14) conducted in Wonji and Metehara among 1876 school children, the broad spectrum of oral diseases comprising of dental caries, periodontal diseases, malocclusion and dental fluorosis have not been studied together. Therefore, it is relevant and timely to carry out this oral health study among school children in the age group 12-18 years because the adolescent age group comprises a sizeable proportion (33.72%) of the total population of Ethiopia (8).

II. LITERATURE REVIEW

The two major oral diseases namely dental caries and periodontal disease affect almost every man, woman and child. These two highly prevalent diseases cause an enormous amount of pain and suffering, but they are preventable. Many people are handicapped due to their oral health problems. The social and psychological toll of oral diseases includes pain and discomfort, restrictions on diet and other functions such as laughing, chewing, talking and even yawning (15).

Malocclusion denotes the irregularity in the articulation of teeth and jaws and it's study and treatment is called orthodontics. Apart from the obvious cosmetic advantages of well-aligned teeth, orthodontic treatment can play a preventive role in dental caries and periodontal disease (2).

Dental Fluorosis or mottled enamel is the condition in which defective calcification of teeth results from excessive fluoride intake during the development and mineralization of teeth. It causes mottling of the enamel of the tooth which in mild cases, appear as white horizontal patches (opacities), as distinct brown staining in moderate cases and as considerable pitting all over the enamel in severe cases (16).

1.0 Dental Caries

The World Health Organization (WHO) has defined dental caries as a localized post eruptive pathological process of external origin involving softening of the hard tooth tissue and proceeding to the formation of a cavity (17). Dental caries once initiated, will either progress to complete destruction of tooth if the same environmental conditions which induced the lesion are allowed to continue, or will be arrested if corrective methods are employed. The index most widely accepted for compiling data on the permanent dentition is based on the number of decayed (D), missing (M), and filled (F) teeth (DMFT) per individual on the basis of a full complement of teeth (18).

1.1 Occurrence

Dental caries is prevalent worldwide. In ancient times, dental caries occurred infrequently but major increases occurred during the middle ages in Europe, where the caries rate climbed steadily from 1850 to 1950s. The most outstanding feature of this increase was the rapid destruction of children's teeth, leading to edentulousness in a high proportion of the adult population (19). In the 1960s and 1970s caries prevalence was higher in the industrialized countries but for the first time, in 1982 frequency of caries was found to be greater among children in the third-world countries (20).

In the United Kingdom, in 1973, the national oral health survey of children showed that caries prevalence was 93% and 96% among 12 and 14 year olds respectively, while in the 1993 national oral health survey, it was found that 50% of 12 year olds and 41% of 14-year-old children were caries free (21). Among developed countries like Canada, there is one dentist for every 5 medical practitioners treating all other diseases combined, and the cost of dental care (mainly caries repair and control) is about 7% of health expenditure, and the caries prevalence is 20-25% among children belonging to lower socio-economic groups and minority communities (19).

Among South American countries, the National DMFT of 12 year olds in Brazil in 1986 was 6.65 and 72% of 50-59 year olds were edentulous because the sugar consumption of 45 to 50 kg/head/year is high (22).

The recent WHO (1994) report for mean National DMFT scores at 12 years of age shows wide differences in caries experience among the developing countries. Among South-Asian countries, it was found to be 1.0 in Pakistan in 1991 and 3.5 in Bangladesh in 1990, while it ranged from 0.9 to 4.5 in India between 1985-1991 (23). A study done among 1019 rural school children in the age group 12-16 years in the northern Indian State of Haryana showed that caries prevalence was 39.4% and the mean DMFT per affected child was 2.6, and significant increase in prevalence of dental caries with age was also observed (24).

In Zimbabwe, the mean National DMFT was 1.3 in 1991 while it was 0.9 in Nigeria and 0.6 in Tanzania in 1990 (23). A dental study conducted between February and September 1996 in Zambia among 1814 young, well educated, well motivated and

comparatively rich people between the ages of 13 and 30 years showed that caries prevalence was found to be 38% and over 97% had less than 4 DMF teeth (25). In a study of 1473 people in Niger, it was shown that 56% of 6 year olds had caries while the DMFT was 1.3 in 12 year olds and 5.7% in 35-44 year age group (26).

In Ethiopia, in the Wonji study, the prevalence of dental caries among children was 26.4% (14). In a study done in 1985 on dental caries in a rural highland community in Ethiopia on a population of 815 persons above 5 years of age, the prevalence of dental caries was 47.1% and the DMFT was 1.5 per person (27).

In another study on twins/triplets of destitute mothers from 300 families conducted during a 2-week period in May 1990 showed the prevalence of dental caries to be 15% in 6-8 year olds, 33% in 9-11 year olds and 49% in 12-18 year olds. The DMFT index was 1.6 in 12-18 year olds, while it was 0.3 in the 6-9 year age group (28).

A cross sectional community based survey done in Shashemene Woreda in south-eastern Ethiopia in 1994 on 1228 individuals showed overall dental caries prevalence rate to be 51.4%, it being higher among rural residents (53.7%) than urban residents (46.4%). Dental caries prevalence showed an increase with increase in age (29). Another study done in the Red Sea port of Massawa on the medical problems found there showed that dental caries was one of the health problems, which was universal among the study subjects who hailed from Harar. This was related to their long-term consumption of "khat", tobacco and sugar. Often the caries affected all teeth and required extraction (30). A study in 1981 done in a Children's Village (a large-scale Ethiopian institution set up for orphans and deprived minors) showed that dental problems were common and that the prevalence of dental caries was 7.5%. A follow-up study done on the same children in 1984 indicated that prevalence of caries increased up to 9.0% (31). In a 12-month analysis (1977-78) of disease patterns in 2145 bank employees seen at the Out-Patient Health Service Clinic of the National Bank of Ethiopia, dental caries accounted for an average of 15 patients per month (32).

1.2 Etiological Factors

Dental caries is a pathological process of localized destruction of tooth tissue by microorganisms, indigenous within the oral cavity. (Caries in Latin means rottenness).

Many theories (chemical theory, parasitic theory, nutritional deficiency theory, chelation theory, proteolytic theory) were put forward during the 19th and 20th century to explain the etiology of dental caries. The current concept of caries etiology is that it is a multifactorial disease in which there is interplay of agent (oral microflora), host (saliva and teeth), and environment (dietary carbohydrate substrate) along with the time factor (33).

The four major etiological factors, which when present simultaneously contribute to dental caries are (a) a caries susceptible tooth (newly erupted immature tooth with deep pits and fissures); (b) dental plaque with predominance of cariogenic oral flora, mainly Streptococcus Mutans; (c) Fermentable carbohydrate food substrate (sugars) in solid/liquid form in intimate contact with bacterial plaque on tooth surface; and (d) Length of time, the above three factors are repeated, particularly if carbohydrate is ingested frequently producing acid demineralization defect on tooth surface (33).

The chemistry of dental decay is thought to be a 2-stage process comprising of (a) a chemical phase consisting of demineralization of the inorganic hydroxy apatite structure of the enamel by the acid derived from bacterial fermentation of carbohydrate food, and (b) a bacterial phase consisting of dissolution of organic proteins by bacteria. The first stage of demineralization is reversible because only one-tenth of calcium is made soluble and it involves only a part of the enamel. The second stage of demineralization is irreversible due to increasing acidity as more sugar is ingested leading to repeated bouts of acid formations resulting in further demineralization of enamel initially and later dentine to form cavity (34).

A) Diet: Nutrition is highly influential in the development of host resistance to oral diseases as well as it can enhance or retard the disease process depending on the quantity, quality and frequency of food consumed. Nutrient composition of foods in the diet can influence teeth at two distinct stages: (a) Pre-eruptively when it can affect normal structure, chemical composition and eruption time of teeth if adequate nutrients are not included in the diet of the child, and (b) Post-eruptively when nutrients in the diet especially carbohydrates influence micro-organisms by facilitating acid plaque formation by modifying the rate of flow of saliva, influence multiplication, implantation and metabolism of plaque flora and enhance/inhibit process of tooth remineralization (35).

A special factor with regard to role of nutrition and dental caries that varies from one individual to the other is the distribution of food within the family, which in turn depends on the sex, age, economic status, social norms and life styles (35).

The most informative experiment on caries in humans was the classical Vipeholm Dental Caries Study. The effect of frequency and amount of sugar (sucrose) intake on caries activity among institutionalized patients (for whom diet composition and eating schedule were well controlled) was studied and the results showed that the initial caries activity is low on a standard diet while in those who ate sweets (especially in the form of toffee/caramel) between meals, a striking increase of dental caries up to 10-fold occurred. The Vipeholm Studies showed that if a small part of daily sugar intake was consumed between meals and in a slowly soluble form (sticky form like caramel/toffee) the caries rate increased dramatically (34).

B) Bacterial Plaque: It is one of the most important etiologic agents for dental diseases. It begins as a clear film (pellicle) that sticks to tooth and is made up of bacteria, salivary products and dead cells from the oral mucosa. It is sticky and so foods containing refined sugars are easily trapped in it. The bacteria in the plaque breaks down the sugar to form acids, which combine with plaque to form acid plaque. This attacks teeth to form cavities (36).

A study on the use of chewing gum (sugared and sugar-free) for 20 minutes after a carbohydrate meal or snacks showed that the fall in plaque pH which followed a meal/snack was reduced by the chewing gum probably by stimulating increased salivary flow. It was also found that even though both sugared and sugar-free chewing gums could significantly decrease the acid response and cariogenesis, the sugar-free gum was more effective (37).

C) Fluoride: Extensive epidemiological studies have been conducted over a period of several decades of population living in naturally and controlled fluoridated areas. These studies have established that a dramatic decrease in caries was associated with drinking water containing the recommended optimum level of fluoride (0.8-1ppm). Controlled water fluoridation remains the most effective and least expensive method of caries

prophylaxis. Fluoride has both systemic and topical actions that are important in preventing dental caries. Systemically, it acts on teeth pre-eruptively by being incorporated into enamel, making it more resistant to dental caries and is most effective during tooth maturation. Topically, it acts directly on erupted teeth by promoting remineralization and providing antibacterial action (38).

It costs less to provide a lifetime of fluoridation to an individual than it costs for a dental filling for that same individual. There is no acceptable alternative to community water fluoridation as a public health measure for the prevention of dental caries (39). Fluoride supplementation should continue from birth to at least until the child is 12 years old, thereby covering the period when most teeth erupt, to have maximum effect through the teenage years because uptake is very rapid during tooth mineralization. Fluoridated salt was found to be only two-third as effective as water fluoridation on caries decline (40).

A study done on 664 eight-year old school children in Harrow (U.K.), which does not have fluoridation, shows toothache to be a sizeable problem. Nearly 50% had suffered from toothache, which interfered with eating in 25% cases, led to disturbed sleep in nearly one third and caused school absenteeism in 11% (41). A study done in 1994 to compare the dental health of 496 five-year old children living in continuously fluoridated (1mg of fluoride/litre) Newcastle in U.K. with that of 436 children of the same age in a non-fluoridated area in the U.K. showed that the caries prevalence and dmft of children was 39% and 1.33 in the fluoridated area while it was 55% and 2.41 in the non-fluoridated area respectively (42).

In another study in 1993 in Anglesey (where fluoridation had begun in 1955 and maintained till 1987 when it became intermittent and then terminated in 1991) among 725 five-year old children showed that the dmft was 1.8 in children who had experienced fluoridation during 35% of their lives, while it was 2.28 for those who had fluoridation less than 10% of their lives (43).

D) Socio-Economic Status: Although oral health has dramatically improved overall in the last 20 years, oral health inequalities have widened. The most stark oral health inequalities are found in dental caries levels in pre-school children and so oral health

promotion policies should focus on underlying social, economic and environmental courses of dental caries (44). In the U.K. the association between deprivation and dental decay studies in children older than 5 years in deprived areas show a higher increase in tooth decay experience and severity in these children than in their peers in less deprived areas (45).

Caries experience in primary dentition is higher in children of Asian origin than in white children in U.K. but when matched for social class and mother's literacy status, there were no differences. There were also no differences in oral health among minority ethnic populations of Asia and Afro-Caribbean origin in the permanent teeth (46). Studies of caries level in different groups of children in the U.K. showed that geographic and social class difference at 5 years appeared to even out to some extent between 1983 and 1993, while in 12-year olds caries prevalence had reduced from 93% in 1973 to 50% in 1993 (47).

E) Time Factor: Caries is widely considered to be a chronic disease in man, a lesion developing over a period of months or years. It generally varies widely from person to person but the average time of progress through stage of incipient to clinical caries is 18+/- 6 months. In the absence of oral hygiene procedures, and by ingesting sweet foods a number of times daily, the caries process can be greatly accelerated. In patients with decrease salivary secretion (xerostomia), due to any cause, a total carious destruction of teeth has been observed even within two months (33).

F) Multifactorial Etiology: The multifactorial etiology of caries allows a number of different interpretations to account for changes in the prevalence of the disease with time in both developing and developed countries. These changes are variously ascribed to alterations in dietary habits, variations in patterns of oral hygiene, changes in ecology, virulence of oral and dental plaque microflora, immune status of individual and increase contact with trace elements especially fluoride. Epidemiologic evidence available on the relationship of all these social, environmental, genetic and other factors do not explain all all changes that have been observed (18).

2.0 Periodontal Disease

Periodontium consists of gums (gingiva) and the supporting structures. In health, the gum margin is sharp, not enlarged and should not bleed spontaneously or during normal tooth brushing (2).

Periodontal disease ranks with dental caries as a matter of immediate concern in the practice of oral public health. While dental caries is the major cause of extractions up to the age of 20, periodontal diseases become the major cause in later life. At 40 years it is responsible for more than 60% extraction and more than 80% extraction at 60-65 years. But since periodontal disease is generally painless, 80% of periodontal disease goes untreated (48). Epidemiologic studies indicate that chronic gingivitis (inflammation of gum tissue only) is the most prevalent periodontal inflammatory disease. While gingivitis and early periodontal diseases can be reduced significantly by oral hygienic measures, advanced periodontal diseases will not be arrested unless treated (49). The treatment and prevention of periodontal disease is complicated by the present inability of any clinical test to predict whether gingivitis will progress to periodontal disease (50).

2.1 Occurrence

Periodontal diseases occur in 25% of 40 year old North Americans and increase to 50% in 70 year olds and its severity is inversely related to socio-economic factors among which education levels showed strongest relationship (49). In the Niger study, calculus was found in 99% of 18 year olds and 87% of 35-44 year olds (26).

In Ethiopia, periodontal disease was already seen as being widespread in 1958 and later studies have supported this view (3). In the 1981 study of child health in a large scale Ethiopian institution, the prevalence of periodontal disease was 11.4% while in the follow-up study in 1984, it had reduced due to use of toothbrushes and regular mouth rinse in the institution (31). In the study on twins/triplets, the prevalence of periodontal disease was 27% in 6-9 year old children and 80% in 12-18 year old children respectively (28).

2.2 Etiological Factors

Even though the enormity of periodontal disease as an oral health problem has been established, the definitive cause is still not fully understood due to the multiplicity of etiological factors (51). The etiology of the inflammatory periodontal lesion represents the interaction of extrinsic and intrinsic factors, which result in periodontal disease. Some of the factors related to etiology are anatomy, bacteria and carbohydrate food substrate (2).

A) Anatomical factor: The gum surface normally is keratinised and this shields against inflammation and infection. But at the sites of attachment to tooth, there is no keratin and this weak area when subjected to different noxious stimuli undergoes successive inflammatory and degenerative changes eventually leading to their destruction. The anatomy and integrity of the dental arch is also important. Mal-positioned, missing or overcrowded teeth are associated with inadequacy of supporting bone and reduced blood supply thus promoting periodontal disease (2).

B) Bacteria: Bacterial plaque tends to accumulate particularly between the teeth and gum margin. This provokes an inflammatory reaction leading to red swollen gum (gingivitis), which result in disappearance of the normal stipples of the gum. Bacterial enzymes degrade natural keratin and minute ulcers form which deepen causing spontaneous bleeding and a space (pocket) is formed between the inflamed gum and enamel which get thinned out. The patient may not be worried at this stage because it is not painful and bleeding may be minimal, but this is the principal indicator of periodontal disease and is never normal. Later the plaque at these sites hardens to form calculus. These changes, if not treated, become chronic and finally affect the bony support of teeth and it becomes irreversible. If the initial gingivitis (reversible) is treated, there is less likelihood of periodontal disease (irreversible) developing (2).

C) Dental Calculus: Calculus is basically plaque, which hardens by absorbing certain salivary minerals like calcium, phosphorus, and magnesium in crystalline hydroxy apatite form. Calculus promotes periodontal disease by being covered with bacterial plaque,

promoting further plaque formation, retaining bacterial close to tissues where it does most harm, blocking the drainage from disease sites, and preventing access by saliva and oral hygiene devices (2).

D) Role of Oral Hygiene: Oral hygiene is the maintenance of a state of normal health in the mouth taken as a whole enabling its functions namely mastication, deglutition, phonation and aesthetic properties to be carried out with maximum efficiency (52). Early man had a diet with a coarse and fibrous texture that helped clean teeth and so dental diseases were non-existent. Later man began to refine food. This altered the texture and reduced the size of the food particle and so foods became more sticky, necessitating the brushing of the teeth (36).

Studies have clearly established a relationship between frequency of brushing and severity of periodontal disease. Previously twigs were used (from a black gum tree) in South-Eastern USA and were chewed till the end is frayed. Different types of chewsticks are still used in some Asian and African countries (53). A study done in the U.K. on the effectiveness of oral hygiene in treating subjects with chronic periodontal disease showed that even such patients can improve their periodontal conditions by oral hygiene alone, even in moderately advanced stage of disease (54).

In Ethiopia, teeth cleaning are mainly done using a chewing stick ("mefakiya") made from a local twig while only a few use tooth brushes (9).

F) Other Factors: Chronic gingivitis also predisposes to periodontal diseases. This is specially seen in puberty, diabetes and pregnancy. Intrinsic factors like the host resistance, nutritional status and age play a secondary role. All available data indicate that periodontal lesion is extrinsic in nature, most likely of bacterial origin but can be modified by intrinsic factors, which can alter the host resistance. Other predisposing factors are mouth breathing and tooth grinding habit. Environmental factors like socio-economic status and smoking habits also play an important role (55).

3.0 Dento-Facial Anomalies (Malocclusion, Spacing and Crowding)

Malocclusions are not generally painful and while they occasionally cause functional difficulties, they mainly constitute an aesthetic problem and so they carry low priority as far as treatment needs are concerned. Often a malocclusion can be improved simply by the extraction of a misplaced tooth (3).

According to severity, malocclusion is of two types. In the (mild) class I type, the relationship of upper and lower jaws to each other is normal but the teeth within the jaws are in abnormal relationship. This is acquired and is called dental malocclusion. This occurs as a result of disturbances in the timing or sequence of normal growth, muscular balance, eruption forces and occlusion forces. It accounts for the largest proportion (50-60%) of malocclusion in child population at any age and responds favourably to interceptive treatment. In class II type the teeth may be or may not be in acceptable relation within each jaw but the jaws are not in normal relationship. This is related to skeletal growth pattern and is regarded as hereditary. This is the more severe form and is called skeletal malocclusion. It is difficult to prevent and needs corrective treatment. The prevalence of class II ranges from 30-45% in children (56).

Other types of dento-facial anomalies include incisor crowding and incisor spacing. Incisor crowding is a normal part of early dental development during emergence of permanent incisors, which are larger and wider than primary incisors. This is usually temporary. It may become permanent if abnormal muscular pressure is exerted by lips as in lip wetting or thumb sucking habits. Incisor spacing is due to various oral habits (like tongue thrusting, lip biting, mouth breathing), which can be corrected. Abnormal swallowing pattern causing muscular imbalance also can produce spacing in upper and lower jaw teeth (56).

Not all minor orthodontic problems should or even be treated. The major reasons parents desire orthodontic care for their children is cosmetic. But the other important reasons are that an acceptable occlusion related to caries and periodontal disease prevention has to be maintained. Orthodontic treatment consists of preventive measures, which are emphasized for caries and periodontal diseases, elimination of long-term thumb sucking, mouth breathing and extraction of supernumerary tooth or mal-positioned

permanent tooth or application of fixed or removable dental braces. Prevention, detection and control of severe malocclusion in children is important to prevent disability associated with enjoyment of eating, speaking or laughing (56).

3.1 Occurrence

The prevalence of malocclusion varies greatly in different parts of the world, in different ethnic groups and people of different races. The data on the prevalence of malocclusion and orthodontic treatment needs are scarce for the developing countries.

In India, studies done in 1995 showed that the prevalence of malocclusion in North Indian (Delhi) children aged 12-13 years was 44.9%, while in South India it was 49.2% and among tribal children in central India (Madhya Pradesh), it was 14.4% in 10-14 year olds, showing a definite ethnic trend in malocclusion from north to south (57). A study of orthodontic treatment needs of 15-16 year old children in the United Kingdom showed that 30.4% of them had malocclusion, which needed orthodontic treatment (58).

The primary abnormality among orthodontic abnormalities in the student population in Ethiopia according to Kitaw was displaced teeth (9). In the study on twins/triplets of destitute mothers from 300 families in Ethiopia, the prevalence of malocclusion was 44% in 10-14 year olds and 48% in 15-19 year olds (28). In a study on the prevalence of the traditional practice of primary canine removal among children and adolescents aged 2-18 years from 300 poor families in Addis Ababa, it was found that 15% of primary canine tooth was removed, the sequelae being malocclusion and damage of 7% of erupting permanent canines (59).

3.2 Etiological Factors

Malocclusion is now considered to be the result of a multifactorial etiology, which includes endocrine factors (gigantism), dietary factors (chewing hard fibrous food), deficiency diseases (calcium and vitamin D), genetic factors (racial), soft tissue factors (muscular force exerted by cheeks, tongue and lips), and functional factors (mouth breathing and premature loss of primary canine tooth). Malocclusion can also be affected

by the patient's facial habits and swallowing and speech. Teeth displaced by such habits as thumb sucking recover rapidly and automatically if the habit stops before five years of age. Intervention may be needed if it persists beyond 6 years. Speech deviation (lisp) can be caused by disarrangement of the front teeth. Space between the teeth of the two arches permit air leakage and cause the lisp, which if minor needs no dental treatment (56).

4.0 Dental Fluorosis

Fluorosis is the condition resulting from excess fluoride in the body and is of environmental origin. Fluorosis is of two types; endemic and occupational (non-endemic). Endemic flourosis is due to chronic ingestion of fluoride in drinking water and is endemic is some tropical and sub-tropical areas of the world with high fluoride concentration in soil or water In non-endemic areas, it occurs as a result of acute occupational hazards in aluminum production sites, magnesium foundries and super phosphate manufacture. Endemic fluorosis can be of two forms, skeletal and dental fluorosis (60). Dental fluorosis is a livelong handicap cosmetically (due to chalk-white opacities on the incisors) and functionally (due to severe abrasion of the biting surfaces of the molars) affecting the quality of life of millions of persons, mostly in some of the poorest developing countries and is not amenable to treatment. The cause can however be lifted at it's source, which is the local drinking water (61).

Dental fluorosis is caused by a very high plasma fluoride level during the pre-eruptive mineralization of the enamel of the teeth and is manifested clinically as mottling of the enamel. In the mild form it is seen as fine white lines across the enamel surface by daily peaks in the plasma fluoride levels. In the moderate to severe form, there is continuous high fasting fluoride plasma level of 0.1 to 0.3 ppm manifested clinically as extensive white opacities or brown staining of enamel. Mottling is best seen on the incisors of the upper jaw. It is almost entirely confined to the permanent teeth and develops only during their period of formation (62).

4.1 Occurrence

Endemic fluorosis occurs in India, China, Argentina, East and South Africa where water supply may contain more than 10 ppm of fluoride (60).

Studies on fluorosis have been carried out in Ethiopia since 1970. A study done by Olsson among 478 children in high fluoride areas of Wonji and Awassa showed the prevalence of dental fluorosis to be 99% among 6-7 year old children and all 13-14 year olds, born in these two regions had moderate to severe fluorosis (63). In another study by Olsson in Arsi Province among 1700 persons in the age group 6-54 years, the prevalence of dental fluorosis, mainly in the mild form, was seen to be 18%. The fluoride content of the water was 0.2-0.3 ppm but high tea consumption was assumed to be the cause of low caries prevalence (64). A prevalence rate of 69%-98% (mean 84%) among the resident children was reported in another study on 1456 people in 14 communities in the Central Rift Valley. Of these, 32.5% had severe dental fluorosis (65). Endemic fluorosis is widespread in the Ethiopian Rift Valley where it is associated with highly fluoridated drinking water in areas of acidic volcanic rocks. Concentrations of more than 5 ppm are found in all parts of the rift system. Indigenous defluoridation methods are by the use of bone meal and bone-char. Other methods include the use of local clay pottery, which can also decrease fluoride content of drinking water (66).

In the Wonji and Metahara study among sugar plantation workers and their families, 80%-87% of school-aged children were found to be affected. The degree of dental fluorosis was associated with the water fluoride level, age of the child and duration of stay in the sugar plantations. Mild dental mottling was seen with fluoride levels of 2 ppm and severe dental mottling was associated with levels above 4 ppm (14).

Another study on fluorosis done in Nazareth town in Ethiopia among high school students showed a prevalence rate of 38.2% where the water samples showed a high fluoride level of 5.30 mg/litre of water (67).

4.2 Etiological Factors

The basis of fluorosis is the formation of strong bonds with calcium and phosphate in the human body. Fluoride is beneficial in small quantities (up to 0.5-1.5mg/day) by

stimulating stronger enamel formation and repair of initial dental caries, but at higher plasma fluoride levels, it interferes with normal formation of bones and teeth. Joints are affected by high flouride exposure for more than 10-20 years (62).

Some of the factors which influence the occurrence of dental fluorosis are the chemical composition of water (presence of calcium salts), duration of exposure, occupation, poor nutritional status, hot climatic conditions and geologic variations (68).

This study has been done to focus on all these four aspects of oral health problems namely dental caries, periodontal disease, dento-facial anomalies and dental fluorosis together, because most of the recent studies in Ethiopia have not done so. Moreover, in most oral health studies, data for primary and permanent dentition have been aggregated together. Thus there is a need for a more comprehensive oral health study.

II. OBJECTIVES

General Objectives :

To determine the prevalence and to assess the determinants of oral health problems among primary school children in Addis Ababa.

Specific Objectives :

1. To determine the prevalence and assess the potential risk factors of dental caries among primary school children in Addis Ababa.
2. To determine the prevalence and examine the potential risk factors of periodontal diseases among primary school children in Addis Ababa.
3. To determine the prevalence of dento-facial anomalies, namely malocclusion, crowding and spacing among primary school children.
4. To determine the prevalence of dental fluorosis among primary school children.
5. To describe the oral health practices among primary school children in Addis Ababa.

IV. METHODS

A. Study Design :

This study is a cross-sectional descriptive study with internal comparison.

B. Study Area :

The study was conducted in Addis Ababa which is the capital city of the Federal Democratic Republic of Ethiopia (FDRE) and the Addis Ababa City Administration, with an estimated population of 2.43 million, located in the heartland of the country in an area of 540 sq.kms. It is situated in a plateau at an altitude of 2200-2800 metres above sea-level and has nine months of summer and three months of rainfall. The average maximum and minimum temperature is 22.9°C and 10.8°C respectively and the total mean rainfall is 11.95 cms. The staple food is "tef", wheat, maize and sorghum. For administrative purposes, Addis Ababa is divided into six zones, 28 Woredas and 328 Kebeles (10).

Of the total population of 2.43 million in Addis Ababa, 49% are males and 51% are females. The adolescent age group constitutes 33% of the total population. The major ethnic groups are the Amharas (48%), Oromos (19%) followed by the Tigrays and Southern Nationalities. About 90% of the population speak Amharic. The main religion is Orthodox Christianity (81.3%) while Muslims constitute 12.6% of the total population. The average household size is 5.2 and the average number of persons is 2.1 per room. The per capita income is 110 $ (10).

The over-all literacy status in Addis Ababa is 82.5% (89.1% in males and 76.4% in females). There are 12 hospitals, 18 health centres, 339 health stations and 21 health posts along with 137 pharmacies and 30 drug shops. The per capita health expenditure in 1996/1997 was 15.66 Birr (10).

C. Population:

(i) Source Population

All primary school children in Addis Ababa constituted the source population in this study and they were 351,735 in number and were studying in 248 primary schools in the 6

administrative zones of Addis Ababa. Of this total, 52% were females. Of the total children studying, 56.2% are from government schools, 32.4% from public schools and the rest 11.4% are from private schools (69).

There are a total of 67 government schools, 115 public schools and 66 private schools run by individuals/NGOs/missionaries/international organizations in Addis Ababa. The distribution of schools in the different zones are as follows :

Zones	No. of Students	No. of Schools	(No. of the three types of schools) Government	Public	Private
Zone 1	46,655	29	5	20	4
Zone 2	72,143	46	12	25	9
Zone 3	65,856	46	14	16	16
Zone 4	90,823	73	23	31	19
Zone 5	57,399	43	6	21	16
Zone 6	18,859	11	7	2	2
Total	351,735	248	67	115	66

(ii) Study population and sampling procedure :

The study population consisted of children who were 12 years and above studying in the government, public and private schools. Study subjects were chosen by multi-stage sampling. In the first stage, one of the 6 zones (namely zone 4) was chosen by random sampling. In Zone 4, there are 73 elementary schools of which 23 are government-owned, 31 are public schools and 19 are private schools run by individuals/NGO/ missionary and/or international communities (69).

In the second stage, one government school (Menelik II Government School), one public school (New Era Public School), and one private school (School of Tomorrow) were chosen by random sampling from zone 4. Due to lack of adequate sample size in the selected private school (School of Tomorrow), one more private school (Ethio-Parents Private School) was later chosen to get the total required number of 198 private school

children. In the third stage, children aged 12 years and above were chosen from grades 6, 7 and 8 of these schools, their numbers being proportionate to their population size in each of the three types of schools (i.e. 56.2% from government school, 32.4% from public school and 11.4% from private school (Fig 1).

(iii)Sample Size

The required sample size was calculated as for case control study to get adequate number of cases of dental caries and also to analyze the risk factors involved in those with and without dental diseases. Based on 95% confidence interval, 25% relative precision, an odds ratio of 2.5 and a probable overall exposure (ie. intake of refined sweets) rate of 25%, the sample size (n) was 434. With an expected prevalence of 25%, to get 434 cases of dental caries, the required sample size was 1736 (Annex C).

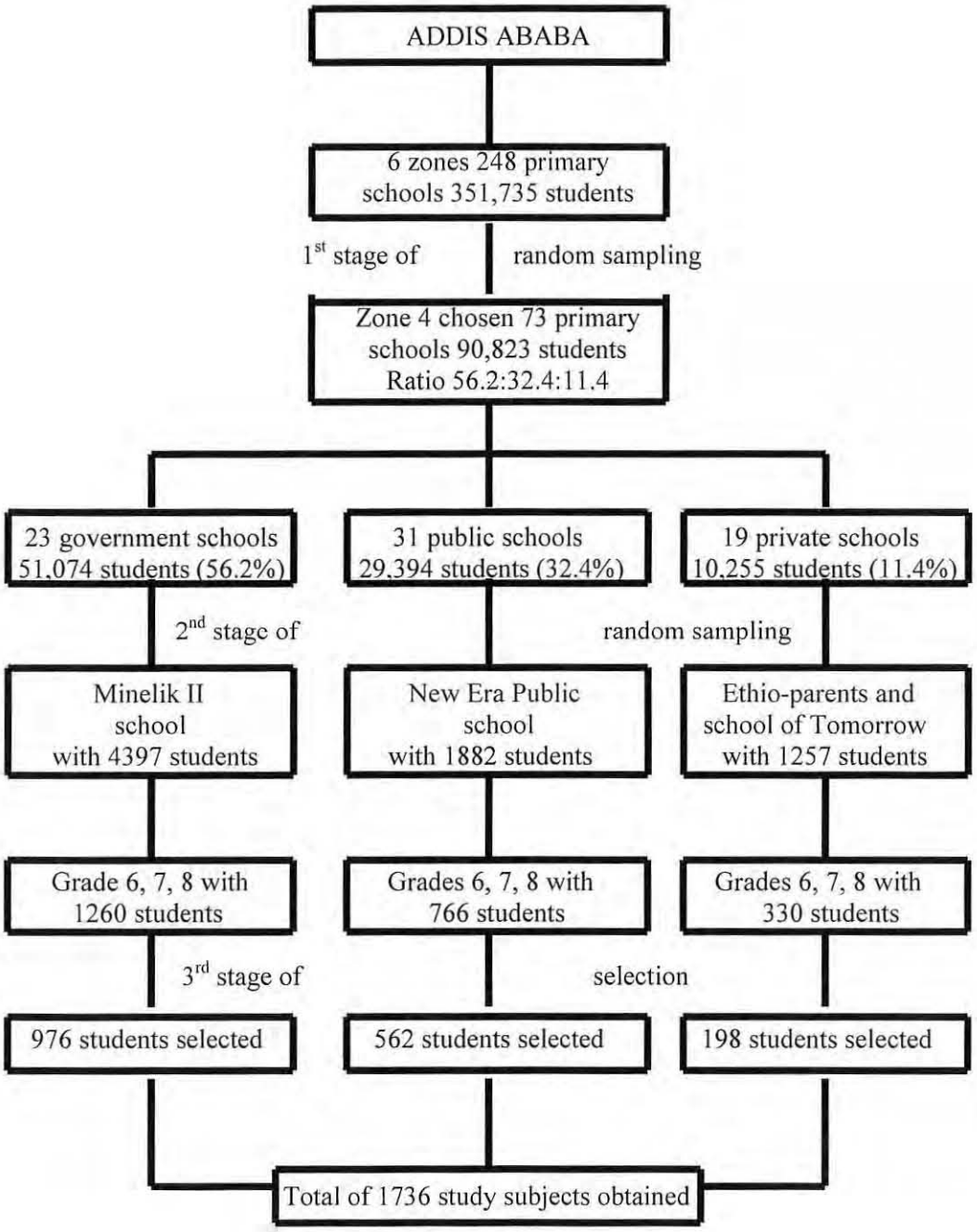
To allow a representative proportion of private, public and government school children to be studied, this sample size of 1736 was divided according to the proportion (56.2 : 32.4 : 11.4) of school children in the government, public and private schools respectively. Thus out of the total sample size of 1736 children, 198 were from private, 562 were from public and 976 from government schools. Only children 12 years and above were chosen because 12 years is the minimum age at which all the primary teeth have disappeared and all permanent teeth (except third molars/wisdom teeth) are present.

D. Measurements:

(a) Dental examination

Dental examination was carried out on all the study subjects by two experienced dental therapists (one male and one female) working in the dental unit of the government (Yekatit 12) hospital. They were given a brief reinforced training session by a dental specialist in Addis Ababa to maintain uniform standard of dental assessment. The principal investigator was present in all the subsequent surveys to supervise the dental examination and endeavoured to maintain constant standards. Both inter and intra observer consistency were tested (annex-E) and found to be in good agreement and within the acceptable range as recommended by WHO (11).

Fig. I Architecture of Sampling Framework



The dental examination was essentially a visual inspection in daylight supplemented by a torch and disposable wooden spatula. Each child's teeth were examined for dental caries by the presence of decayed (D), missing (M) and filled (F) teeth. Periodontal health was recorded for the six index teeth (one incisor and first molars of each jaw) by the presence or absence of bleeding and/or calculus. The presence of mottled enamel was taken as positive for dental fluorosis. Malocclusion was noted as the irregularity in the articulation of teeth in the upper and/or lower jaw. Spacing / crowding was noted according to the space available which was more / less than needed to accommodate all four incisor teeth. The findings were charted on the oral health assessment form.

(b) Questionnaire

A self-administered questionnaire (to assess the socio-Demographic characteristics, dietary habits and oral health practices of the child) was developed in English, then translated to Amharic and again translated back to English to confirm its consistency.

(c) Pre-testing

A pre-testing was performed in March 2000, on 40 children chosen randomly from a government school in Addis Ababa and it showed that the questionnaire was effective and could be answered by most children with a reasonable knowledge of Amharic in no more than 20 minutes.

Following the pretesting, the questionnaire was further simplified by framing questions which required only "Yes"/"No" answers rather than by asking the child to give a score. Some questions were modified to include "I don't know". The questions where the response rate decreased were from those who claimed that their parents were literate but did not know the parent's level of education.

E. Conduct and Management :

The study was conducted in the month of April 2000. The survey in the private schools was done in the first week of April, while that in the public school was done in the second week of April. In the government school data collection was done in the third and fourth week of April. An average of 60 students were examined daily by each dental therapist (35 by each in the morning and 25 by each in the afternoon) in two separate

classrooms which were allotted by the school authorities. There were two assistants, one in each classroom for checking for the completeness and accuracy of the filled questionnaire. The purpose of the study was made known to the children at the start of the survey each day, and involvement in the study was on the basis of an informed consent.

After the children filled in the questionnaire, each was called in numerical order by the dental therapists for the dental assessment, which was then charted in a separate oral health assessment form. Both the questionnaire and the oral health assessment forms were then attached together for each child. Supervision was done by the principal investigator throughout the study period regularly. At the end of each survey, the questionnaires and physical examination forms were checked for completeness and accuracy of the records.

F. Data Analysis :

The data were entered and stored into the computer. Data cleaning was done meticulously. Frequency tables and charts were used to present the results. EP1-INFO (Version 6) and SPSS statistical packages were used to analyze the data. The odds ratio and 95% confidence intervals were used to show the significance of the associations. Both the bivariate analysis and multivariate (logistic regression) analysis of the variables were done. Proxy scoring was done to ascertain the economic status of the study subjects because children may not be aware of the exact family income or feel uncomfortable about disclosing them.

Ethical considerations :

Written permission was obtained from the school authorities who informed the parents/guardians of children studying in the sixth, seventh and eighth grades of the chosen schools before the commencement of the study. Involvement of the children in the study was on a voluntary basis. Five children who expressed reservations about dental examinations were not included. No invasive procedure was done and so no harm was inflicted on the study subjects by the dental examination. Arrangements were made to benefit the study subjects who had dental diseases to be referred to the dental unit of Yekatit 12 Hospital. Health education about oral health was given (after completion of the survey each day) to the study subjects.

V. RESULTS

1. Socio-demographic Characteristics of Study Subjects

A total of 1736 primary school children, 767 (44.2%) males and 969 (55.8%) females participated in the study. The children were in the age group 12-18 years with the mean age being 13.7 years. This included 819 (47.2%) children in the 12-13 year age group and 741 (42.7%) study subjects in the 14-15 year age group, while the rest were between 16-18 years of age. Of the total number of subjects, 198 (11.4%) were from the private schools, 562 (32.4%) were from the public school and 976 (56.2%) were from the government school. Grade-wise, 681 (39.2%) were from 8th grade, 734 (42.3%) were from grade 7, and 321 (18.5%) were from grade 6.

The majority of the students were Orthodox Christians constituting 1474 (84.9%), followed by 174 (10.0%) Muslims while the rest, 88 (5.1%) belonged to other religions. The major ethnic group was Amhara which constituted 970 (55.9%) of the total. Tigrays were 202 (11.6%) and Oromos were 237 (13.7%), while the Southern Nationalities constituted 327 (18.8%) of the study population.

Of the 1736 study subjects, 1315 (75.8%) were staying with both parents, while 334 (19.2%) children were living with a single parent. The rest of the 87 (5.0%) children were staying with relatives who were the guardians.

The scored economic status (Annex D) showed that 642 (37.0%) of children were in the low-income group, 677 (39.0%) were in the middle income and 417 (24.0%) were in the high-income group (Table 1).

2. Socio-demographic Characteristics of Parents/Guardians

The father's employment status showed that fathers of 1094 (63.0%) children were employed. Of the remaining 642 (35.0%) children, 277 (16%) reported that their fathers were unemployed while the rest 365 (21.0%) of the children reported that their fathers were deceased. Regarding the mother's employment status, 544 (31.3%) of children had

Table 1. Socio-demographic characteristics of primary school children in Addis Ababa, Ethiopia, April 2000.

Variable (n=1736)	Number	Percentage
Sex		
Male	767	44.2
Female	969	55.8
Age (years)		
12-13	819	47.2
14-15	741	42.7
16+	176	10.1
School		
Government	976	56.2
Public	562	32.4
Private	198	11.4
Grade		
Grade 6	321	18.5
Grade 7	734	42.3
Grade 8	681	39.2
Religion		
Orthodox	1474	84.9
Muslim	174	10.0
Others	88	5.1
Ethnicity		
Amhara	970	55.9
Oromo	237	13.7
Tigray	202	11.6
Southern Nationalities	327	18.8
Parentage (Guardianship)		
Both parents	1315	75.8
Single parent	334	19.2
No parents	87	5.0
Economic Status*		
Low Income	642	37.0
Middle Income	677	39.0
High Income	417	24.0

* - Refer Annex D.

mothers who were employed, 1049 (60.5%) were housewives or unemployed while 143 (8.2%) of children answered that their mothers had died. Among the 87 relatives who were the guardians of children without parents, 61 (70.1%) were employed while the rest 26 (29.9%) were unemployed.

When asked about their father's literacy status, 1237 (71.3%) of children claimed that their fathers were able to read and write while 134 (7.7%) were illiterate. The literacy rate among the mothers was claimed to be 71.5%. There were 352 illiterate mothers who formed 22.1% while 576 (33.1%) of children reported that their mothers were educated but the level of education was unknown (Table 2).

3. Magnitude and Distribution of Oral Health Problems

The overall prevalence of dental caries was found to be 21.1%, 367 subjects being affected. It was found to steadily increase with age affecting 151 (18.4%) of 12-13 year olds, 64 (22.1%) of 14-15 year olds and 52 (29.5%) in the16+ age group. It was slightly higher among males (22.3%) as compared to females (20.2%). The disease was slightly more prevalent among the private school children (22.7%), than in government (21.9%) and public (19.2%) schools children respectively.

The overall prevalence of periodontal disease was 53.4%, affecting 927 study subjects, of which 442 (53.9%) were among the 12-13 year olds, 394 (53%) were among the 14-15 year olds and 91 (51.7%) were in 16+ age group. It was found more in males (56.4%) than females (50.8%). It affected more children in the public school (59.8%) and government (57.5%) respectively than in the private school (14.6%).

Table 2. Socio-demographic characteristics of parents/guardians of primary school children in Addis Ababa, Ethiopia, April 2000.

Variable (n = 1736)	Number	Percentage
Father's Job Status		
Government employed	478	27.5
Private employed	427	24.6
Self-employed	189	10.9
Unemployed	277	16.0
Unknown/Deceased	365	21.0
Mother's Job Status		
Government employed	287	16.5
Private employed	177	10.2
Self employed	80	4.6
Unemployed/Housewife	1049	60.5
Unknown/Deceased	143	8.2
Guardian's Job Status (n=87)		
Government employed	31	35.6
Private employed	27	31.0
Self employed	3	3.5
Unemployed	26	29.9
Father's Literacy status		
Primary school	295	17.0
Secondary School	320	18.4
University educated	299	17.2
Educated but not sure	323	18.7
Uneducated	134	7.7
Unknown/Deceased	365	21.0
Mother's Literacy Status		
Primary school	400	23.0
Secondary school	170	9.8
University educated	95	5.5
Educated but not sure	576	33.2
Uneducated	352	20.3
Unknown/Deceased	143	8.2

The overall prevalence of malocclusion was 23.7%, steadily increasing with age. The prevalence of malocclusion was almost equal in both the sexes. It was higher among the government school (30.1%) and public school (25.1%) children while it was lower (17.7%) among private school children.

Overall prevalence of fluorosis was found to be 1.6%. It was higher in 14-15 year old (2.1%) and seen more in public school students (2.5%). More males (1.9%) than females (1.3%) were affected by dental fluorosis (Table 3).

4. Consumption Patterns of Sweet Food Items

When asked whether they drink tea, milk or soft drink, 1592 (91.7%) reported that they frequently (Annex B) drink tea, 923 (53.2%) drink milk and 1067 (61.5%) consume soft drinks. Of these, 820 (88%) use sugar to sweeten their milk, while 1578 (99.1%) use sugar to sweeten the tea. Among the frequent sweet food consumers, there were 866 (49.9%) who eat chocolates, 1277 (73.6%) who eat candy, 934 (53.8%) who eat cake, 694 (42.0%) who eat cookies, and 579 (33.4%) who eat ice-cream (Table 4).

All the drinks and sweet food items (Annex D) were consumed most by the private school children while consumption of these food items among the government school children was the lowest (Figure 2).

5. Oral Hygiene Practices

Of the 1736 study subjects, 1637 (94.3%) claimed to clean their teeth. There were 195 (98.5%) children in the private school, 524 (93.2%) in the public school, and 918 (94.1%) in the government school who reported that they clean their teeth. While 6.8% of the study subjects in the public and 5.9% of those in the government schools do not clean the teeth, there were only 3 children in the private school who did not do so.

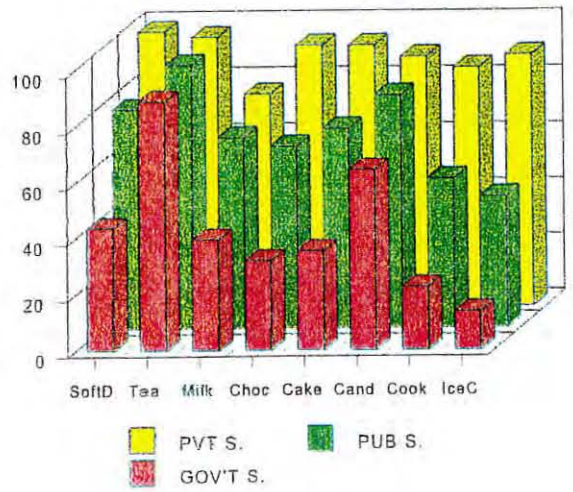
Table 3. The distribution of oral health problems among primary school children in Addis Ababa, Ethiopia, April 2000.

Dental problems (n=1736)	Dental caries No.(%)	Periodontal disease No.(%)	Mal-occlusion No. (%)	Flourosis No.(%)
Over-all				
Yes	367(21.1)	927(53.4)	412 (23.7)	28 (1.6)
No	1369(78.9)	809(46.6)	1324 (76.3)	1708 (98.4)
By Age (years)				
12-13(n=819)	151 (18.4)	442 (53.9)	184 (22.5)	10 (1.2)
14-15 (n=741)	64 (22.1)	394 (53.0)	183 (24.7)	16 (2.1)
16+ (n=176)	52 (29.5)	91 (51.7)	45 (25.5)	2 (1.1)
By Sex				
Male (n=767)	171 (22.3)	433 (56.4)	181 (23.6)	15 (1.9)
Female (n=969)	196 (20.2)	494 (50.8)	231 (23.8)	13 (1.3)
By School				
Gov't.(n=976)	214 (21.9)	562 (57.5)	263 (26.9)	11 (1.1)
Public(n=562)	108 (19.2)	336 (59.8)	120 (21.3)	14 (2.5)
Private(n=198)	45 (22.7)	29 (14.6)	29 (14.6)	3 (1.5)

Table 4. Consumption patterns of food items possibly related to dental caries and periodontal disease among primary school children in Addis Ababa, Ethiopia, April 2000.

Variable (n=1736)	Frequently No.(%)	Rarely No.(%)
Tea	1592 (91.7)	144 (8.3)
Milk	923 (53.2)	813 (46.8)
Soft drink	1067 (61.5)	669 (38.5)
Chocolate	866 (49.9)	870 (51.1)
Candy	1277 (73.6)	459 (26.4)
Cake	934 (53.8)	802 (46.2)
Cookies	694 (42.0)	1042 (58.0)
Ice-cream	579 (33.4)	1157 (66.6)

Fig 2. Reported consumption patterns of sweet food items possibly related to dental diseases by school types among primary school children in Addis Ababa, Ethiopia, April 2000.



SoftD= Soft drink
Choc= Chocolate
Cand= Candy
Cook= Cookies
IceC=Ice Cream

Concerning the method of cleaning, the majority 169 (85.4%) in the private school use toothbrush with toothpaste to clean their teeth, while most children 358 (63.7%) in the public school and 829 (84.9%) in the government school use "mefakiya" (local twigbrush) for teeth cleaning. When asked about the frequency of teeth cleaning, majority 165 (83.3%) of the children in the private schools clean their teeth once or more than once daily while most of the children 371 (66.0%) in the public school and 677(69.4%) in the government school do not clean the teeth on a daily basis but only whenever it was convenient for them (Table 5).

6. Oral Health Knowledge and Practice

Of the 552 (31.8%) study subjects who had suffered from tooth pain in the past, 51.6% did not seek help anywhere, while 43.1% visited the dentist. Of the 473 (27.2%) children who had experienced bleeding from the gums, only 17.8% made a visit to the dentist while majority (77.0%) did not seek help anywhere. When asked about the seriousness of dental diseases, 1540 (88.7%) of the children gave an affirmative reply, while the rest 58 (3.3%) disagreed and 138 (7.9%) did not know about it.

Tooth decay was attributed by 505 (29.1%) of study subjects to merely not cleaning the teeth while 273 (15.7%) and 23 (1.3%) cited the reason for tooth decay as due to consumption of sweet foods and sweet drinks respectively. Majority 823 (47.4%) cited all the above three reasons as leading to tooth decay while 112 (6.5%) did not know what caused tooth decay.

When asked about the importance of dental check-up, about 1341 (77.2%) of the children replied that they think it is important, 209 (12.0%) gave a negative reply, while 186 (10.7%) did not know about the importance. The majority 773 (57.6%) cited, removal of germs from teeth as the reason for undergoing a dental check-up while 18.2% mentioned that dental check up is for getting the teeth cleaned while 19.8% were of the opinion that a dental check-up is needed for the removal of decayed teeth (Table 6).

Table 5. Reported Oral Hygiene Practices of primary school children in private, public and government schools in Addis Ababa, Ethiopia, April 2000.

Variable (n=1736)	Private School (n=198) No.(%)	Public School (n=562) No.(%)	Govt. School (n=976) No.(%)
Teeth Cleaning			
Yes	195 (98.5)	524 (93.2)	918 (94.1)
No	3 (1.5)	38 (6.8)	58 (5.9)
Method of Cleaning			
Mefakiya	22 (11.1)	358 (63.7)	829 (84.9)
Toothbrush only	4 (2.1)	29 (5.2)	25 (2.6)
Toothbrush & paste	169 (85.4)	116 (20.6)	34 (3.5)
Charcoal	0 (0.0)	21 (3.7)	29 (3.0)
Salt	0 (0.0)	0 (0.0)	1 (0.1)
Do not clean	3 (1.5)	38 (6.8)	58 (5.9)
Frequency of cleaning			
<7 times in a week	30 (15.2)	371 (66.0)	677 (69.4)
7 times in a week	82 (41.4)	141 (25.1)	225 (23.1)
>7 times in a week	83 (41.9)	12 (2.1)	16 (1.6)
Do not clean	3 (1.5)	38 (6.8)	58 (5.9)

7. Socio-demographic Determinants of Dental Caries

The magnitude of dental caries was found to be higher with increase in age. This association between age and dental caries was revealed to be significant among the 14-15 year olds (adjusted OR=1.91; 95% CI=1.28, 2.86) and in the 16+ age group (adjusted OR=1.52; 95%CI=1.05, 2.22). However, other socio-demographic factors like gender, school, ethnicity, religion and economy did not show a significant association with dental caries either in the bivariate or the multivariate analysis (Table 7).

8. Food and Related Determinants of Dental Caries

Out of the total study subjects, "Enjera" ('tef') was the staple food of 1542 (88.8%) children, while 194 (11.2%) consumed other varieties of food. The prevalence of dental caries was found to be equal (21.1%) in both groups showing no significant association between "enjera" intake and dental caries in both the bivariate and multivariate analysis. The consumption of drinks was scored (Annex D) according to the frequency of intake of soft drinks, milk and/or tea with or without sugar and found not to have significant association with dental caries. Consumption of sweet food was also scored (Annex D) according to the ingestion of chocolate, cake, cookies, candy and ice-cream, and it revealed a significant association between high intake of sweets and dental caries in the multivariate analysis, (OR=1.69; 95% CI=1.12, 2.57).

Another important factor which was found to be significantly associated with dental caries was the habit of not cleaning teeth. The prevalence of dental caries was higher (29.3%) among the non-cleaners as compared to 20.7% among the teeth cleaners. This association was not significant in the bivariate analysis (OR=1.59; 95%CI=0.99, 2.55), but the multivariate analysis (OR=1.89; 95%CI=1.19,3.02), revealed that the association was significant (Table 8).

Table 6. Reported Oral Health Knowledge and Practice of primary school children in Addis Ababa, Ethiopia, April 2000.

Variable (n = 1736)	Frequency	Percentage
Past history of tooth pain		
Yes	552	31.8
No	1184	68.2
Type of treatment taken (n=552)		
Did not go anywhere	285	51.6
Visited Dentist	238	43.1
Visited traditional healer	15	2.7
Visited pharmacy/drug vendor	13	2.4
Home remedy	1	0.2
Past history of bleeding gums		
Yes	473	27.2
No	1263	72.8
Type of treatment taken (n=473)		
Did not go anywhere	364	77.0
Visited Dentist	84	17.8
Visited traditional healer	13	2.7
Visited pharmacist/drug vendor	11	2.3
Home remedy	1	0.2
Seriousness of dental diseases		
Yes	1540	88.7
No	58	3.3
Do not know	138	7.9
Cause of tooth decay		
Not cleaning teeth	505	29.1
Eating sweet foods	273	15.7
Having sweet drinks	23	1.3
All the above reasons	823	47.4
Do not know	112	6.5
Importance of dental check-up		
Yes	1341	77.2
No	209	12.0
Do not know	186	10.7
Reason for dental check-up (n=1341)		
To remove germs	773	57.6
To remove bad tooth	265	19.8
To clean teeth	244	18.2
To fill cavities in teeth	39	2.9
For braces	20	1.5

Table 7. Socio-demographic determinants of Dental Caries among primary school children in Addis Ababa, Ethiopia, April 2000.

Variable (n=1736)	Dental caries Yes No. (%)	No No.	Odds Ratio (95% C.I.) Crude	Adjusted**
Age in Years				
12-13 (819)	151 (18.4)	668	1.00	
14-15 (741)	164 (22.1)	577	1.26 (0.97, 1.62)	1.91 (1.28, 2.86)
16+ (166)	51 (30.7)	124	1.82 (1.23, 2.68)	1.52 (1.05, 2.22)
Sex				
Male (767)	171 (22.3)	596	1.00	
Female (969)	196 (20.2)	773	0.88 (0.70, 1.12)	1.13 (0.89, 1.43)
School				
Gov't (976)	214 (21.9)	762	1.00	
Public (562)	108 (19.2)	454	0.85 (0.65, 1.11)	1.21 (0.81, 1.81)
Private (198)	45 (22.7)	153	1.05 (0.71, 1.53)	1.24 (0.83, 1.86)
Ethnicity				
Amhara (970)	192 (19.8)	778	1.00	
Tigray (202)	45 (22.3)	157	1.16 (0.79, 1.70)	1.09 (0.78, 1.53)
Oromo (237)	58 (24.5)	179	1.31 (0.93, 1.86)	0.97 (0.62, 1.51)
South. N.(327)	72 (22.0)	255	1.14 (0.83, 1.57)	0.83 (0.54, 1.26)
Religion				
Orthodox (1474)	311 (21.1)	1163	1.00	
Muslim (174)	43 (24.7)	131	1.23 (0.84, 1.80)	0.58 (0.31, 1.07)
Others (88)	13 (14.7)	75	0.65 (0.34, 1.22)	0.49 (0.25, 1.01)
Economy				
Low (642)	146 (22.7)	496	1.00	
Medium (677)	136 (20.1)	541	0.85 (0.65, 1.12)	0.98 (0.71, 1.36)
High (417)	85 (20.3)	332	0.87 (0.64, 1.19)	1.09 (0.79, 1.49)

C.I. = Confidence Interval

**-Adjusted for all the variables in the table.

9. Socio-demographic Determinants of Periodontal Disease

Periodontal disease was not found to be significantly associated with age. Gender was found to have a significant association with periodontal disease. Males had higher prevalence (56.4%); both the bivariate (OR=1.25; 95%CI=1.03,1.51) and multivariate (OR=1.35; 95%CI=1.09,1.65) analyses showing significant association between male sex and periodontal disease. It was more prevalent among public (59.8%) school children than private (14.6%) school children; this association was seen to be significant in both the bivariate (OR=8.66; 95%CI=5.54,13.62) and multivariate (OR=6.04; 95%CI=3.52,10.36] analyses.

Prevalence of periodontal disease was found to be lower in Tigrays (46.0%) and Southern Nationalities (45.5%) as compared to Amharas (56.5%) and Oromos (57.4%), and this association was found to have a significant protective effect for the Tigrays (OR=0.68; 95%CI=0.51, 0.91) and Southern Nationalities (OR=0.69; 95%CI=0.48,0.99) in the multivariate analyses. The results of our study revealed that periodontal disease was higher among Orthodox Christians (55.7%) than Muslims and other religions and this showed a significant protective effect for the Muslims (OR=0.51; 95%CI=0.31,0.85) and for the other religious groups (OR=0.51; 95%CI=0.28,0.93) in the multivariate analysis. Even though periodontal disease was more prevalent among the low income group (59.9%), as compared to the high income group (39.3%), the economic status was not found to have a significant association (Table 9).

10. Food- related Determinants of Periodontal Disease

Among the 1542 study subjects who consumed enjera as their staple food, the prevalence of periodontal disease was 54.8%, as compared to 41.2% prevalence in children who took other kinds of food. Having "enjera" as staple food was significantly associated with periodontal disease, in the bivariate (OR=1.74; 95%CI=1.27, 2.39) and multivariate (OR=1.41; 95%CI=1.01,1.95) analyses.

Table 8. Possible food related determinants of Dental Caries among primary school children in Addis Ababa, Ethiopia, April 2000.

Variable (n = 1736)	Dental Caries Yes No.(%)	No No.	Odds Radio (95% C.I.) Crude	Adjusted**
Staple Food				
Enjera (1542)	326 (21.1)	1216	1.00 (0.68, 1.46)	0.94 (0.64, 1.37)
Others (194)	41 (21.1)	153	1.00	
Drinks*				
High (372)	76 (20.4)	296	1.11 (0.77, 1.59)	0.94 (0.64, 1.39)
Moderate (929)	209 (22.5)	720	1.25 (0.93, 1.68)	0.82 (0.60, 1.12)
Low (435)	82 (18.8)	353	1.00	
Sweets*				
High (310)	72 (23.2)	238	1.47 (1.01, 2.14)	1.69 (1.12, 2.57)
Moderate (962)	216 (22.5)	746	1.41 (1.05, 1.90)	1.11 (0.80, 1.54)
Low (464)	79 (17.0)	385	1.00	
Teeth Cleaning				
No (99)	29 (29.3)	70	1.59 (0.99, 2.55)	1.89 (1.19, 3.02)
Yes (1637)	338 (20.7)	1299	1.00	

* - Refer Annex D

**-Adjusted for all the variables in the table.

High consumption of drinks/beverages (milk or tea with/without sugar and/or soft drinks) was not found to have an association (adjusted OR=0.92; 95% CI=0.59, 1.42) with periodontal disease.

High consumption of sweets (chocolate, candy, cake, cookies and ice-cream) was found to have a significant association (OR=1.86; 95%CI=1.18, 2.94) with periodontal disease in the multivariate analysis.

Not cleaning the teeth was very strongly associated with periodontal disease. Of the 99 children who did not clean the teeth, 74.7% had periodontal disease, while it was found only in 52% of the 1637 children who cleaned the teeth, and this association was revealed to be significant in both the bivariate (OR=2.73; 95%CI=1.68, 4.46) and multivariate (OR=2.46; 95%CI=1.52, 3.97) analyses (Table 10).

11. Magnitude and Types of Dento-Facial Anomalies

Of the 412 (23.7%) children who had malocclusion, 382 (22.0%) had mild malocclusion (Annex B), while only 30 (1.7%) had moderate malocclusion. The overall prevalence of spacing of teeth was 18.3% and 318 children were affected. Of these, the mild type (spacing of teeth in one jaw only) was seen in 230 (13.2%) study subjects, while the moderate type (spacing of teeth in both jaws) was seen in 88 (5.1%) of the children Crowding of teeth was seen in 413 (23.8%) of study subjects, the mild type (15.9%) being more common than the moderate (7.9%) form (Table11).

12. Demographic Determinants of Dento-Facial Anomalies

Higher prevalence of malocclusion was seen in the 16+ year age group (27.1%) as compared to the lower age groups. But this association was not significant (adjusted OR= 1.05; 95%CI=0.72,1.53). Gender was also not found to have an association with malocclusion, both in the bivariate and multivariate analyses.

Table 9. Socio-demographic determinants of Periodontal Disease among primary school children in Addis Ababa, Ethiopia, April 2000.

Variable (n=1736)	Periodontal Disease Yes No.(%)	No No.	Odds Ratio (95% C.I.) Crude	Adjusted**
Age in Years				
12-13 (819)	442 (53.9)	377	1.00	
14-15 (741)	394 (53.0)	347	0.96 (0.79, 1.18)	0.81 (0.57, 1.17)
16+ (166)	91 (54.8)	85	0.91 (0.65, 1.28)	0.93 (0.66, 1.32)
Sex				
Female (969)	494 (50.8)	475	1.00	
Male (767)	433 (56.4)	334	1.25 (1.03, 1.51)	1.35 (1.09, 1.65)
School				
Private (198)	29 (14.6)	169	1.00	
Public (562)	336 (59.8)	226	8.66(5.54,13.62)	6.04 (3.52, 10.36)
Gov't (976)	562 (57.5)	414	7.91(5.14, 12.24)	0.81 (0.59, 1.09)
Ethnicity				
Amhara (970)	549 (56.5)	421	1.00	
Tigray (202)	93 (46.0)	109	0.65 (0.48, 0.90)	0.68 (0.51, 0.91)
Oromo (237)	136 (57.4)	101	1.03 (0.77,1.39)	0.87 (0.59, 1.28)
South. N.(327)	149 (45.5)	178	0.64 (0.49, 0.83)	0.69 (0.48, 0.99)
Religion				
Orthodox (1474)	822 (55.7)	652	1.00	
Muslim (174)	79 (45.4)	95	0.66 (0.48, 0.92)	0.51 (0.31, 0.85)
Others (88)	26 (29.5)	62	0.33 (0.20, 0.54)	0.51 (0.28, 0.93)
Economy				
Low (642)	386 (59.9)	256	1.00	
Medium (677)	377 (55.7)	300	0.83 (0.67, 1.04)	0.72 (0.49, 1.07)
High (417)	164 (39.3)	253	0.43 (0.33, 0.56)	0.92 (0.66, 1.28)

**Adjusted for all the variables in the table.

Table 10. Possible food related determinants of Periodontal Disease among primary school children in Addis Ababa, Ethiopia, April 2000.

Variable (n=1736)	Periodontal Disease Yes No.(%)	No No.	Odds Radio (95% C.I.) Crude	Adjusted**
Staple Food				
Enjera (1542)	847 (54.8)	695	1.74 (1.27, 2.39)	1.41 (1.01, 1.95)
Others (194)	80 (41.2)	114	1.00	
Drinks*				
High (372)	176 (47.3)	196	0.68 (0.51, 0.91)	0.92 (0.59, 1.42)
Moderate (929)	504 (54.3)	425	0.90 (0.71, 1.14)	0.93 (0.69, 1.26)
Low (435)	247 (56.8)	188	1.00	
Sweets*				
High (310)	117 (37.7)	193	0.41 (0.30, 0.56)	1.86 (1.18, 2.94)
Moderate (962)	533 (55.4)	429	0.84 (0.67, 1.06)	1.04 (0.76,1.44)
Low (464)	277 (59.6)	187	1.00	
Teeth Cleaning				
No (99)	74 (74.7)	25	2.73 (1.68, 4.46)	2.46 (1.52, 3.97)
Yes (1637)	853 (52.0)	784	1.00	

* -Refer Annex D

**-Adjusted for all the variables in the table.

Spacing of teeth was seen to be higher in with the 14-15 year age group, but there was no significant association (adjusted OR=1.46; 95%CI=0.96, 2.21) between spacing of teeth and age. Gender was also not found to reveal a significant association (adjustedOR=1.14; 95%CI=0.89,1.46) with spacing of teeth.

There was no association between crowding of teeth and gender. Crowding of teeth was found to be higher in 12-13 year old (26.1%) than other age group but was found to have a significant (adjusted OR=0.65; 95%CI=0.43, 0.97) protective effect among the 14-15 year age group (Table 12).

Table 11. Distribution of different types of Dento-Facial Anomalies (Mal-occlusion, Spacing and Crowding) by severity among primary school children in Addis Ababa, Ethiopia, April 2000.

Variable (n = 1736)	Overall No. (%)	Mild* No. (%)	Moderate* No. (%)
Malocclusion*	412 (23.7)	382 (22.0)	30 (1.7)
Spacing*	318 (18.3)	230 (13.2)	88 (5.1)
Crowding*	413 (23.8)	276 (15.9)	137(7.9)

* -Refer Annex B.

Table 12. Possible demographic determinants of Dento-Facial anomalies among primary school children in Addis Ababa, Ethiopia, April 2000.

Variable (n = 1736)	Dento-Facial anomalies Yes No.(%)	No No.	Odds Ratio (95% CI) Crude	Adjusted*
Malocclusion (n=412)				
Age in Years				
12-13 (819)	184 (22.4)	635	1.00	
14-15 (741)	183 (24.7)	558	1.13 (0.89, 1.44)	1.18 (0.81, 1.72)
16+ (166)	45 (27.1)	131	1.19 (0.80, 1.75)	1.05 (0.72, 1.53)
Sex				
Male (767)	181 (23.6)	586	1.00	
Female (969)	231 (23.8)	738	1.01 (0.81, 1.27)	0.98 (0.78,1.23)
Spacing (n=318)				
Age in Years				
12-13 (819)	125 (15.2)	694	1.00	
14-15 (741)	157 (21.1)	584	1.49 (1.14, 1.95)	1.46 (0.96, 2.21)
16+ (166)	36 (20.4)	140	1.43 (0.92, 2.20)	0.97 (0.64, 1.46)
Sex				
Male (767)	150 (19.5)	617	1.00	
Female (969)	168 (17.3)	801	0.86 (0.67, 1.11)	1.14 (0.89, 1.46)
Crowding (n=413)				
Age in Years				
12-13 (819)	214 (26.1)	605	1.00	
14-15 (741)	166 (22.4)	575	0.82 (0.64, 1.04)	0.65 (0.43, 0.97)
16+ (166)	33 (18.7)	143	0.65 (0.42, 1.00)	0.79 (0.53, 1.21)
Sex				
Male (767)	183 (23.8)	584	1.00	
Female (969)	230 (23.7)	739	0.99 (0.79, 1.25)	0.99 (0.79, 1.25)

*Adjusted for sex and age.

VI. DISCUSSION

The results of this school-based cross-sectional study point to the multi-factorial etiology of oral diseases. Many factors in combination and when present at the same time will have a cumulative effect on the occurrence of oral diseases.

In this study, the overall prevalence of caries was found to be 21.1% among school children aged 12-18 years and the DMFT index in those children with Decayed, Missing and Filled permanent Teeth was 1.55. This is lower than the 49% caries prevalence among destitute children of the same age group found in the 1990 study done in Addis Ababa (28). This difference can be attributed to the fact that deprived children show higher prevalence of dental caries as compared to their peers who are school going and so are less deprived (45).

In other studies done in Ethiopia on dental caries, children in this age group (12-18 years) were not included as a separate entity but clubbed together with younger children or with young adults. In the 1994 Shashemene study (29), the caries prevalence was 24.4% among 5-18 year age group while it was 47.1% in persons above 5 years of age in the 1985 rural highland community study (27). Since the age groups are different, the caries prevalence will also vary, as age has a very important association with dental caries, which shows an increase with increasing age (9,24,29,33). This significant increasing trend in dental caries with increase in age was also observed in our study in which it was 18.4% in 12-13 year olds, 22.1% in 14-15 year olds and 29.5% in 16+ year olds.

National Oral Health Surveys done in other African countries show wide variations in the caries prevalence and/or DMFT index in the same age groups. In Tanzania, the DMFT was low (0.6) in 1990, while in Zimbabwe it was 1.3 in 12 year olds (23). Studies on dental caries done in South Asian countries also showed wide variation in the caries prevalence and DMFT index (23). These changes can be attributed to the multi-factorial etiology of caries, which includes factors (like life-styles, living conditions, traditional practices, dietary habits and access to health services) that vary from one country to the other.

In our study, private school children had only a slightly higher prevalence of dental caries as compared to public and government school children. This may be explained due to the fact that higher consumption of sweets by the private school children was also accompanied by maintenance of better oral hygiene.

The higher prevalence of dental caries in government school (21.9%) as compared to public school (19.2%) may be due to the fact that while children in public and government schools did not vary much with regard to the various environmental factors studied, had narrow socio-economic differences and similar dietary pattern, their oral hygiene practices differed because less children in the government school used toothpaste or cleaned their teeth on a daily basis as compared to the public school children.

Intake of sweetened beverages was not associated with dental caries. This may be explained based on the fact that liquids do not stick to the tooth surface as well as solids and hence may not be acted upon by acid producing bacteria (34). High consumption of tea by most children in the three types of schools may have contributed to the low prevalence of dental caries in this study group because tea is a rich source of fluoride which protects against dental caries. However, the quantity of sugar added to the tea could not be ascertained.

High intake of refined sweet foods in the form of chocolate, cake, cookies, candy and ice-cream was associated significantly with dental caries. This is a well-established association seen in earlier studies (34).

Gender, ethnicity and / or religion were not found to be associated with dental caries because they may not directly influence the occurrence of dental caries (72). Rather, it may be the individual behaviour, habits and practice that has a bearing on the development of dental caries. Not cleaning the teeth was also found to have a significant association with dental caries. This is in agreement with other studies (9,33).

In this study the overall prevalence of periodontal disease was 53.3%. This includes bleeding of gums (4.9%) and calculus (48.4%). The prevalence is lower than that (99%) among 12-18 year olds deprived children observed in the Ethiopian study (28) and higher than the 11.4% in the Children's Village study (31). These differences may be due to the multiplicity of etiological factors of which the extrinsic (environmental) factors are more important than the intrinsic ones. Prevalence of calculus was higher than bleeding of gums

and this may point to the inadequacy of teeth cleaning (9) which is often done by a chewstick in 73.9% of subjects, while only 19.5% of children used toothbrush with toothpaste. Of the total 1736 subjects, 5.7% reportedly do not clean their teeth and this was significantly associated with higher prevalence of periodontal disease. This is in agreement with the established association between poor oral hygiene practices and periodontal disease (36).

Periodontal disease was significantly associated with gender. Being male was seen to be a significant factor in the occurrence of periodontal disease. The higher prevalence of periodontal disease in the public school as compared to that in the private schools and government school was statistically significant. This may not be directly related to the socio-economic status, as economy was not seen to be significantly associated with periodontal disease. It may be due to the fact that more children in the public school consumed sweet food and maintained poor oral hygiene than those in the government school. In the same way, the significance found among the government school children was lost in the multivariate analysis as these children consumed the least amount of sweets and practised better oral hygiene as compared to the public school children.

Ethnicity and religion were found to be associated with periodontal disease. The significant protective effect seen in Tigrays and Southern Nationalities as also among Muslims and other religious groups may be attributed to cultural differences which are beyond the scope of this study but recent studies have confirmed that race, ethnicity and gender per se do not make substantial variations in the prevalence or severity of periodontal diseases (72). This association may have to be further studied.

Having 'enjera' as staple food was also seen to be significantly associated with periodontal disease. This may be due to the consistency of this staple diet which is soft/slightly sticky and hence remnants may remain in between the tooth and gum margin. Food which is soft and sticky can easily get trapped in between teeth and gum margins and form dental plaque and later calculus, especially if adequate oral hygiene is not practised. More studies have to be undertaken to confirm this finding. While intake of sweet drinks was not associated with periodontal disease, high consumption of sweet food items had a statistically significant association with periodontal disease. This is in agreement with earlier studies (50).

Not cleaning the teeth was also associated with periodontal disease, this association being highly significant. This may explain the higher prevalence of periodontal disease in government and public school compared to private school children where 85.4% of children use tooth brush with toothpaste for cleaning the teeth, while 63.7% of the public school and 84.9% children in government school use the "mefakiya". This is in agreement with earlier studies (9).

The prevalence of malocclusion was 23.7% and the mild form was seen to be more common than the moderate type of malocclusion. Age and sex were not found to be significant factors in the occurrence of malocclusion. Not many studies have been done on malocclusion in Ethiopia, except for the Kitaw study (9) and the pilot study in Wonji and Metahara (14) which showed the prevalence of malocclusion among children to be 45% and 19.5% respectively.

The prevalence of spacing of teeth was found in 318 (18.3%) study subjects, of which the mild and moderate types of spacing was prevalent in 13.2% and 1.7% respectively. The prevalence of crowding of teeth was 23.8% affecting 413 children, of which the mild and moderate types were found in 276 (15.9%) and 137 (7.9%) respectively. This is similar to the findings of various studies undertaken previously in the U.K. and other countries where the milder form of spacing and crowding was more prevalent than the moderate (56). Age and sex were not associated with spacing of teeth. Being in the 14-15 year age group showed a significant protective effect on crowding of teeth while gender was not found to have a significant association with crowing of teeth. These findings cannot be compared in Ethiopia because no such study on spacing and crowding has been undertaken here recently.

In this study fluorosis was not found to be a health problem in Addis Ababa, as fluorosis was present only in 28 (1.6%) of the study subjects because the water supply in Addis Ababa contains 0.3-0.9mg per litre of fluoride (71). These 28 children who had fluorosis may have come from some other parts of the country but this could not be verified separately.

Even though 1637 (94.3%) children claimed to clean their teeth, the majority (69.6%) still use the "mefakiya" or local twigbrush for teeth cleaning, while only 18.4% reported using toothbrush with toothpaste. This is in agreement with the findings by Kitaw (9).

Only 43.1% of the 552 children who suffered from tooth pain reportedly visited the dentist, while 51.6% did not seek help anywhere. Of the 473 children who suffered from bleeding gum, only 17.8% consulted the dentist, while 77.0% did not seek treatment. It shows that tooth pain may be a more compelling factor to visit the dentist and bleeding gums was not considered serious enough to make a dental consultation. Even though dental disease in this age group is not given much importance and most children manage with minimum professional dental care, the level of understanding of dental health and its prevention was quite high in this study group. These findings are similar to those of the Zambia study (25).

Validity

The results of this study are assumed to be internally valid. A multi-stage random sampling procedure was used to select the zone and schools in this study. There was no bias shown in selecting the study subjects, as almost all children (excluding those below 12 years) had to be included in the study to get adequate sample size. Compliance was excellent and response rate was very good as appropriate arrangements were made with the school authorities so that the children could attend the survey.

Reliability

This was maintained by utilising the services of two experienced dental therapists who underwent a further one-week of reinforced training by the dental specialist (former director of the dental training institute) and were constantly supervised by the principal investigator and the dental specialist. Most of the questions were closed ended and simple to comprehend and this questionnaire was pre-tested a month earlier, on children of the same age group and found to be satisfactory.

Inter-observer and intra-observer bias was minimised by methods recommended by WHO, using the Kappa statistic (annex E) which showed good agreement between the inter- and intra observer assessments of oral examination (12).

Generalizability

The study subjects chosen from zone 4 may not be markedly different from the primary school children studying in the other 5 zones of Addis Ababa as they come from similar socio-economic background. However, these findings may not be generalizable to the out-of-school children in Addis Ababa, as the latter are exposed to environmental factors which are different from that of the school-going children.

The findings of this study may not be generalizable to the country as a whole because of the multifactorial etiology of dental diseases and because of the socio-economic, cultural and ethnic diversity, dietary habits and hygiene practices, which vary from region to region in a vast country like Ethiopia. However, under socio-demographic conditions which are similar to those in this study, these findings may hold good.

Limitations

- In this study, only subjects with clinical caries (Annex B) were identified. The actual prevalence may have been more if radiological examinations were also done.
- The determinant factors were not exhaustive.
- Age and economic status were recorded as told by the children. There were no official school records of age in the public and government schools and so errors may have occurred.
- The metal probe was not used for dental examination due to the objection by parents/school authorities against invasive procedures. This may have led to under-reporting of spontaneous gum bleeding and hence to underestimation of periodontal disease.
- Only the usual pattern/frequency of intake of food/drinks were assessed. Duration of such intakes in terms of weeks/months and quantity/amount of intake were not assessed.
- In the 3rd stage of sampling, the children were not chosen by random sampling, because the total number of study subjects needed was large and almost same as their number in the chosen schools. Almost all children in grades 6, 7 & 8 had to be included.

VII. CONCLUSION AND RECOMMENDATIONS

CONCLUSION

More than 75% of children studying in the government, public and private schools in Addis Ababa were found to be caries free and so the prevalence of dental caries in this study can be considered to be low (21.1%). The slightly higher caries prevalence in the private school children may indicate that the problem is more associated with the higher socio-economic strata of society. The increase in dental caries with increasing age was also confirmed in this study. The sweet food items commonly consumed by school children were found to be important risk factors for dental caries. Poor oral hygiene was also a significant risk factor in the development of dental caries.

Periodontal disease was found to affect more than half (53.4%) of the study population. The only socio-demographic determinant factor for periodontal disease was gender (being male). "Enjera", which was the staple food of the majority of children, was a significant risk factor for periodontal disease. The high consumption of sweet food items was also a significant factor associated with periodontal disease. The role of tooth brushing in preventing periodontal diseases was confirmed in our study.

Baseline data on the types and prevalence of malocclusion, spacing and crowding was obtained in this study. Prevalence of malocclusion was 23.7%, the mild type was found to be higher than the severe form in our study. The prevalence of spacing and crowding was 18.3% and 23.8% respectively, the mild form being more than the moderate type.

The prevalence of dental fluorosis was low (1.6%), as it is not a public health problem in Addis Ababa. There was remarkably little use of dental health services but the knowledge and understanding of oral health and it's prevention was high.

RECOMMENDATIONS

1. Health education about practicing good and adequate oral hygiene and effective techniques of tooth cleaning can be reinforced in elementary schools, as children can spread these messages to their families and to their communities and thus dental caries and periodontal diseases can be prevented.

2. Health education about a healthy diet and the advantages of consuming non-sucrose containing carbohydrate food and fibre containing natural foods by highlighting the adverse effects of a faulty diet / fast food on the occurrence of diabetes, heart diseases, obesity, certain cancers and also oral diseases like dental caries and periodontal diseases.

3. There is considerable scientific support to recommend restriction of sugar containing snacks, preferably in association with the main meal and not in between the meals. This regimen not only decreases cariogenic demineralization to a minimum but also maximizes the time available for remineralization of any early caries lesion.

4. Oral health care can be integrated into the primary health services in health centers without overburdening the existing economy or health manpower.

5. Further studies are recommended to elucidate determinant factors for periodontal disease, malocclusion, spacing and crowding of teeth.

VIII. REFERENCES:

1. Mouth, Teeth and Dental Caries. A.R.T. Man. 9402. Pg. 7-32.

2. Smith, R.G. et al (editors). Dental Anatomy and Physiology. In : Dental Surgery Assistant's Handbook. 2nd ed. London: Mosby, 1993; Pg. 34-105.

3. Stretton-Downes, S. Dental Health. In: Kloos, H., and Zein, A.Z. (eds). The Ecology of Health and Disease in Ethiopia. Oxford: Westview Press, 1993; 463-71.

4. Mautsch, W., Sheiham, A. (eds). Introduction. In: Promoting Oral Health in Deprived Communities. Berlin : German Foundation for International Development, 1993; 13-19.

5. Barnes, D.E. The oral health challenges at the dawn of the third millenium (Lecture Article). British Dent. J. 1994; 177: 387-90.

6. Akpabio, S.P., Constraints in improving oral health in developing Commonwealth countries. In: Mautsch, W., Sheiham, A.(eds). Promoting Oral Health in Deprived Communities. Berlin: German Foundation for International Development, 1993; 429-32.

7. Thorpe, S.J. Improving the oral health of all Africans through the African Health Development Framework. In: Mautsch,W., Sheiham, A.(eds). Promoting Oral Health in Deprived Communities. Berlin: German Foundation for International Development, 1993; 459-64.

8. Ministry of Health. Health and Health Related Indicators. Ethiopia: MOH, 1999.

9. Kitaw, Yoyehyirad, Asmelash Gebray, Bedru Busheen, Bekele Asfaw. Dental health conditions of students in Ethiopia: Findings from the development through cooperation campaign, 1976-1988. In: Ethiop. Med. J. 1982; 20: 9-14.

10. Health Bureau. Health Sector Development Programme – a 5-Year Plan, 1997/1998-2001/2002. Addis Ababa City Administration, May 1998; Addis Ababa.

11. Recent Advances In Oral Health – WHO Technical Report Series 826. Geneva, WHO, 1988.

12. World Health Organization. Oral Health Surveys: Basic Method. 4th ed. Geneva, WHO, 1997.

13. Howes, H. (ed.) Introduction. In: Health Promotion in our Schools. UK: UNICEF, 1997; 1-4.

14. Neway, M., Kifle, D., et al. Prevalence of dental caries and periodontal disease in two endemic areas of fluorosis in Ethiopia. A pilot study. J. Dent. And Oral Surg. 1997, 1: 5-14.

15. Cowell, C.R., Sheiham, A. (eds.). Epidemiology of dental diseases In: Promoting Dental Health. London: King's Fund, 1981; 9-12.

16. Jolly, S.S., Singh, B.M., Mathur, O.C. Endemic Fluorosis In Punjab, India. American Journal of Medicine.1969; 47: 553-563.

17. World Health Organization. The etiology and prevention of dental caries. WHO technical report series. 1972; No: 494 (Abstract).

18. Finn, S.B. The epidemiology of dental caries. In: Caldwell and Stallard (eds). A Textbook of Preventive Dentistry, Philadelphia: Saunders, 1977; 17-28.

19. Burgess, R.C. Dental Caries. In: Canadian Family Physician. 1988 June; 34: 1341-47.

20. Sheiham, A. Changing trends in dental caries. In: International Journal of Epidemiology 1984; 13(2): 142-47 (Abstract).

21. Downer, M.C. The 1993 National Survey of Children's dental health : a commentary on the preliminary report. Br. Dent. J. 1994; 176: 209-14.

22. Baldisserrotto, J. Community Participation In A Decision Making Process In Brazil. In: Mautsch, W., Sheiham, A. (eds). Promoting Oral Health in Deprived Communities. Berlin: German Foundation for International Development, 1993; 253-62.

23. Gandhi. L.K., Akpabio, S.P., Ariffu, H.M. In: Oral Guidelines Health For Common-Wealth Countries: a report on the CDA-IDA workshop, New Delhi, 2000.

24. Singh, A.A. et al. A study of dental caries in school children from rural Haryana. J.of Ind. Soc. Pedo. Prev. Dent.1999; 17(1): 24-28.

25. Sims, P.A., Mtolo, P. Dental health and dental disease in young Zambians. Oral and Dental Health in Africa. 1998; 2: 7-10.

26. Peterson, P.E., Kaka, M. Oral Health Status of Children and Adults in Niger, Africa. Int. Dent. J. 1999; 49: 159-64 (Abstract).

27. Okubagzhi, G.S. et al. Epidemiology of Dental Caries in a rural highland community, North-Western Ethiopia. Ethiop. Med J. 1987; 25: 127-32.

28. Nunn, J.H., Welbury, R.R., Gordon, Stretton-Downes, S., Green Abate. Dental Health of Children in an integrated urban development programme for destitute mothers with twins in Addis Ababa. Int. Dent. J. 1992; 42: 445-50.

29. Andemichael, G. Prevalence and determinants of dental caries in Shashemene Woreda (MPH Thesis), Addis Ababa: University of Addis Ababa, 1995.

30. Tibebu, M. Selected medical problems encountered in Massawa. Ethiop Med J. 1980; 18: 27-32.

31. Bagerholm, G., Kristianson, B. Child health in a large scale Ethiopian Institution: The Children's Village - Somatic Health. Ethiop. Med. J. 1987; 25:1-7.

32. Teklu, B. Disease Patterns among Civil Servants in Addis Ababa: An analysis of OP visits to a Bank Employees' Clinic. Ethiop Med J. 1987; 18: 1-6.

33. Newbrun, E. Etiology of dental caries. In: Caldwell and Stallard (eds). A Textbook of Preventive Dentistry, Philadelphia: Saunders, 1977; Pg. 30-63.

34. Nizel, A.E.(ed). Carbohydrates – Dental Caries Promotion. In: Nutrition in Preventive Dentistry. 2nd ed. Saunders. 1981; 53-80.

35. Navia, J.M. Nutrition and Oral Disease. In: Caldwell and Stallard (eds). A Textbook of Preventive Dentistry, Philadelphia: Saunders, 1977, 118-150.

36. Foster, M.S. (ed). Dental Plaque - Age one to two. In: Protecting our children's Teeth: A guide to quality dental care from infancy through age twelve. New York: Plenum Press, 1992; 77-78.

37. Manning, R.H., Edgar, W.M. pH changes in plaque after eating snacks and meals and their modification by chewing sugared or non-sugar-free gum. Br. Dent. J. 1993; 174 (7): 241-44.

38. Nikiforuk, G. Fluoride and Dental Health. In: Canadian Family Physician. 1988 June; 34: 1333-36.

39. Easley, M.W. Celebrating 50 years of fluoridation: a public health success story. Br. Dent. J. 1995; 178: 72-75.

40. Nizel, A.E. (ed). Fluorides – Dental Caries Prevention. In: Nutrition in Preventive Dentistry – Science and Practice. 2nd ed. Philadelphia: Saunders, 1981. 262-84.

41. Shepherd, M.A., Nadenovsky, P., Sheiham, A. The prevalence and impact of dental pain in 8 year old school children in Harrow, England. Br. Dent. J. 1999; 187: 38-41.

42. Evan, D.J., Rugg-Gunn, A.J., Tabari, E.D. The effect of 25 years of water fluoridation in New Castle assessed in four surveys of 5 year old children over an 18-year period. Br. Dent. J. 1995; 178: 60-64.

43. Thomas, F.D., Kassab, J.Y., Jones, B.M. Fluoridation in Anglesey 1993: a clinical study of dental caries in 5-year old children who had experienced sub-optimal fluoridation. Br. Dent. J. 1995; 178: 55-58.

44. Watt, R., Sheiham, A. Inequalities in Oral Health – A review of the evidence and recommendations for action. In: Br Dent J, 1999 July; 187(1): 6-11.

45. Monaghan, N., Heesterman, R. Dental caries, social deprivation and enhanced capitation payments for children. In: Br.Dent. J. 1999; 186: 238-40.

46. Bedi, R.; Uppal, R. The oral health of minority ethnic communities in the United Kingdom. In: Br. Dent J. 1995; 179: 421-425.

47. Downer, M.C. The changing pattern of dental disease over 50 years. In: British Dental Journal. 1998; 185: 36-41.

48. Cooper, R.(ed). Periodontal Disease. In: Dental Problems in Medical Practice. London: Heinemann, 1976; 70-77.

49. Deporter, D.A. Periodontal disease-Part II. Overview of treatment modalities. Canadian Family Physician 1988; 34: 1391-92.

50. Anderson, D.L. Periodontal disease-Part I. Types, Etiology and Epidemiology. In: Canadian Family Physician. 1988; 34: 1341-47.

51. Stallard, R.E. Epidemiology of periodontal disease. In: Caldwell and Stallard. (eds). A Textbook of Preventive Dentistry. Philadelphia: Saunders. 1977; 68-73.

52. Cooper, R. (ed). Preventive Dentistry II. In: Dental Problems in Medical Practice. London: Heinemann, 1976; 56-68.

53. Wallace, V., Mann, Jr. Oral hygiene techniques and home care. In: Caldwell and Stallard (eds). A Textbook of Preventive Dentistry. Philadelphia: Saunders. 1977; 214-239.

54. Turner, Y., Ashley, F.P., Wilson, R.E. Effectiveness of oral hygiene with and without root planning in treating subjects with chronic periodontitis. Br. Dent. J. 1994; 77(10): 367-71.

55. Shapiro, L.; Stallard, R.E. Etiology of periodontal disease. In: Caldwell and Stallard. (eds). A Textbook of Preventive Dentistry. Philadelphia: Saunders. 1977; 74-80.

56. Barber, T.K. Prevention of malocclusion and minor orthodontics. In: Caldwell and Stallard (eds). A Textbook of preventive dentistry. Philadelphia: Saunders. 1977; 351-89.

57. Kharbanda, O.P., Sidhu, S.S., Sundaram, K.R., Shukla, D.K. Prevalence of malocclusion and its traits in Delhi children. In: J. Orthod. Soc. 1995; 26(3): 98-103.

58. Burden, D.J., Mitropoulos, C.M, Shaw, W.C. Residual orthodontic treatment need in a sample of 15-16 year olds. Br. Dent. J. 1994; 176: 220-24.

59. Wellbury, R.R., Nunn, J.H., Gorden, P.H., Green-Abate. "Killer" canine removal and its sequelae in Addis Ababa. Quintessence International 1993; 24(5): 323-26.

60. Park, J.E., Park, K.(eds). Fluoride (Nutrition and Health). In: Textbook of Preventive and Social Medicine. 11th ed. Jabalpur, India, 1986; 400-403.

61. Schuiling, R.D. Flourosis. In: Frencken. J.E. (ed). Endemic Fluorosis In Developing Countries: Causes, Effects and Possible Solutions: A report of a symposium; 1990 April 27; Delft (TNO). Leiden, Netherlands, 1992; 92-94.

62. Backer-Dirks, O. Bio-kinetics Of Fluoride In Relation To Dental And Skeletal Fluorosis. In: Frencken, J.E. (ed.) Endemic Fluorosis In Developing Countries: Causes, Effects and Possible Solutions: A report of a symposium; 1990 April 27; Delft(TNO), Leiden Netherlands, 1992; 20-30.

63. Olsson, B. Dental Findings In High Fluoride Areas In Ethiopia. Commun. Dent. Oral Epidemiol. 1979; 7: 51-56.

64. Olsson, B. Dental Caries And Fluorosis In Arsi Province, Ethiopia. Commun. Dent. Oral Epidemiol. 1978; 6: 338-343.

65. Tekle-Haimanot, R., Asmerom, Fekadu, Bushira, B. Endemic Fluorosis in the Ethiopian Rift Valley. Trop. Geog. Med. 1987; 39: 209-17.

66. Kloos, H., Tekle-Haimanot, R. Fluorosis. In: Kloos, H. and Zein, A. (eds). The Ecology of Health and Disease in Ethiopia. Oxford: West-view Press, 1993; 455-61.

67. Gillamichael, F. Prevalence of dental fluorosis among high school students in Nazareth, Ethiopia (MPH Thesis), Addis Ababa, University of Addis Ababa, 1986.

68. Jolly, S.S., Singh, B.M., Mathur, O.C., Malhotra, K.C. Epidemiological, Clinical and Biochemical Study Of Endemic and Skeletal Fluorosis In Punjab. British Med.J.1968; 4: 427-429.

69. Education Bureau. Annual Educational Booklet 1998/99. Plan and Project Service, Addis Ababa City Administration, Addis Ababa.

70. World Health Organization. Sample size determination in Health Studies, A Practical Manual. WHO, Geneva 1991.

71. Adam, A., Mohammed, N. Quality Of Addis Ababa City's Water Supply And It's Challenges. A Paper Presented On The 15th Annual Congress Of Chemical Society Of Ethiopia, Addis Ababa, 1998.

72. Pilot, T. Periodontal Diseases. In: Pine, C.M. (ed). Community Oral Health. Wright, Oxford: 1997; 82-87.

IX. **ANNEXES**

ANNEX : A Questionnaire Form

Serial Number

Date : _____

Name : _____

(Encircle the number of the most correct answer)

A) Socio-demographic Information

1. Age in Years _____
2. Sex : (1. Male 2. Female) _____
3. Religion:(1. Orthodox 2. Muslim 3. Others {specify}) _____
4. School : _____
5. Grade with section _____
6. Whom do you live with ?
   1. Father alone
   2. Mother alone
   3. Both father and mother
   4. With relatives only
   5. Others (specify) _____
7. What is your father's occupation ?
   1. Government employee
   2. Private employee
   3. No work
   4. Others (Specify) _____
8. What is your mother's occupation ?
   1. Government employee
   2. Private employee
   3. Housewife
   4. No work
   5. Others (Specify) _____

9. If you live with relative only, what is your relative's work?
   1. Government employee
   2. Private employee
   3. No work
   4. Others (Specify) _____

10. Can your father 9.read and write?
   (1. Yes 2. No)

10.1 If yes, up to which grade has he studied?
   1. Grade 1-8
   2. Grade 9-12
   3. College/University/Higher diploma
   4. Don't know

11. Can your mother read and write?
   (1. Yes 2. No)

11.1 If yes, up to which grade has she studied?
   1. Grade 1-8
   2. Grade 9-12
   3. College/University/Higher diploma
   4. Don't know

12. Does your family have a radio?
   (1. Yes 2. No)

13. Does your family have a TV?
   (1. Yes 2. No)

14. Is the house you live in :
   (1. Owned by your family,
   2. Rented from government,
   3. Rented from private owner)

15. How many rooms are there in your house?_____

16. How many people are there in your house?_____

17. Do your parents own a vehicle?
   (1. Yes 2. No) _____

18. How do you come to school?
   1. Walking,
   2. Taxi / private car
   3. Public Bus

4. Others (specify) _____

19. From where do you get your water supply?
    1. Own pipe
    2.From community pipe
    3. From private pipe
    4. Others (specify)_____

B) Food Habits

20. What food do you eat usually for breakfast?
    1. Bread with tea/milk,
    2. Injera and Wot,
    3. Firfir,
    4. Kinche,
    6. Others (specify) _____

21. What food do you eat usually for lunch?
    1. Injera and Wot
    2. Rice
    3. Pasta
    4. Sandwich
    5. Soup
    6. Others (specify) _____

22. What food do you usually eat for dinner?
    1. Injera and Wot
    2. Rice
    3. Pasta
    4. Soup
    5. Salad
    6. Others (Specify) _____

23. Do you drink milk?
    (1. Yes 2. No)
    (If No, go to Question 24)

23.1 If Yes, How many cups of milk do you drink in a week:_____

23.2 Do you use sugar to sweeten the milk?
    (1. Yes 2. No)

24. Do you drink tea?
    (1. Yes 2. No)

24.1 If Yes, How many cups of tea do you drink in a week?_____

24.2 Do you use sugar to sweeten the tea?
(1. Yes 2. No)

25. Do you drink soft drinks like Coca, Pepsi, 7UP?
(1. Yes 2. No)
(If No, go to Question 26)

25.1 If Yes, How many soft drinks do you drink in a week? _____

26. Do you eat Chocolates?
(1.Yes 2. No)

26.1 If Yes, how many times in a week? _____

27. Do you eat candy?
(1.Yes 2. No)

27.1 If Yes, how many times in a week?_____

28. Do you eat cake?
(1.Yes 2. No)

28.1 If Yes, how many times in a week?_____:

29. Do you eat cookies?
(1.Yes 2. No)

29.1 If Yes, how many times in a week?_____

30. Do you eat ice-crean?
(1.Yes 2. No)

30.1 If Yes, how many times in a week?_____

31. What is your usual food arrangement in school?
1. Bring from home
2. Buy food from school cafeteria
3. Buy food from food vendors
4. Go home and eat
5. Others (Specify) _____

C) Oral Hygiene (Knowledge, Attitude and Practice)
32. Do you clean your teeth? (1. Yes 2.No)

32.1 If Yes, how many times do you clean your teeth in a week? _____

32.2 If yes, when do you clean your teeth?
1. Before food
2. After food
3. No fixed time (whenever convenient)
4. Others (specify)_____

32.3 What do you use to clean your teeth?
1. Mefakiya (Chew Stick)
2. Tooth brush without paste
3. Tooth brush with paste
4. Charcoal
5. Others (Specify) _____

32.4 Why do you clean your teeth?
1. To keep teeth white and nice
2. To prevent tooth decay
3. To prevent going to a dentist
4. Others (Specify) _____

33. Do your parents clean their teeth?
(1. Yes 2. No 3. I don't know)

34. Do your siblings clean their teeth?
(1. Yes 2. No 3. I don't know)

35. Have you suffered from toothache in the last one year?
(1. Yes 2. No)

35.1 If Yes, where did you go for treatment?
1. To dentist
2. To traditional healer
3. To pharmacy / drug vendor
4. Did not seek help anywhere
5. Others (Specify) _____

36. Have you suffered from bleeding from the gums in the last one year?
(1. Yes 2. No)

36.1 If Yes, where did you go for treatment
1. To dentist
2. To traditional healer
3. To pharmacy / drug vendor

4. Did not seek help anywhere
5. Others (Specify)_____

37. Do you believe that going for regular check-up to a dentist is good?
(1. Yes 2. No)

37.1 If Yes, give one reason for visiting a dentist :
1. For removing germs from teeth
2. For cleaning teeth
3. For removing decayed teeth
4. For filling cavities in teeth
5. Others(Specify)_____

38. What do you think is the cause of tooth decay? (more than one correct answer is possible)
1. Not cleaning teeth
2. Eating sweet food stuffs
3. Drinking sweetened drinks
4. Eating too many ice creams
5. I don't know
6. Others (Specify) _____

39. Do you think diseases of teeth can become serious?
(1. Yes 2. No 3. I don't know)

40. Has anyone taught you to keep your teeth clean?
(1. Yes 2. No)

40.1 If Yes, who? (more than one correct answer is possible)
1. Father and mother
2. Father only
3. Mother only
4. Elders
5. Teacher
6. Friends
7. No one
8. All of them

ORAL HEALTH ASSESSMENT FORM
(Adopted from WHO Oral Health Assessment Form – 1997)

Date _____ Identification Number ☐☐☐☐

Examiner _____

General Information :

Age in years ☐☐ Name _____

Sex (M=1, F=2) ☐ School _____

Ethnic Group
(Amhara=1, Tigray=2, Oromo=3, Kembata=4, Welaita=5, Others=6) ☐ Grade with Section ☐☐

Religion
(Orthodox=1, Muslim=2, Others=3) ☐

Dentition Status - (Permanent)

0 – Sound (Normal)
1 – Decayed
2 – Filled & Decayed
3 – Filled & No Decay
4 – Missing due to caries

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

Periodontal Status (CPI)

16	11	26
46	31	36

0 – Healthy
1 – Bleeding
2 – Calculus

Flourosis ☐

0 – Normal
1 – Mild
2 – Moderate
3 - Severe

Dentofacial Anomalies

I.

(a) Spacing

☐

0 – Normal
1 – Mild
2 – Moderate

(b) Crowding

☐

0 – Normal
1 – Mild
2 – Moderate

II. Mal-Occlusion

Normal = 0
Class I = 1
Class II = 2

☐

Consent Form

This is to inform you that a dental study is to be conducted in some schools in Addis Ababa. The school, your child / children is / are studying in, has been chosen.

This study will be conducted through a written questionnaire and a dental examination in the school. Your child / children may be selected to participate in this study. There will be no invasive procedures involved in the dental examination and so no harm will occur to your child / children by participating in this study.

You have a right to decide whether or not, your child / children can participate in this study.

Will you allow your child to participate in the study?

Please tick the appropriate answer.

Yes _____

No _____

Thank you.

ANNEX : B

Operational Definitions

(I) Dentition Status :

0 - Sound tooth: A tooth is recorded as sound if it shows no evidence of treated or untreated clinical caries.

1 - Decayed tooth: Caries is recorded as present when a lesion in a pit or fissure, or on a smooth tooth surface, has a detectable softened floor, undermined enamel or softened wall. A tooth with a temporary filling should also be included in this category. In case of any doubt, caries should not be recorded as present.

2 - Filled tooth with decay: A tooth is scored as filled with decay when it contains one or more permanent restorations and one or more areas that are decayed.

3 - Filled tooth with no decay: A tooth is considered to be filled without decay when one or more permanent restorations are present and there is no secondary (recurrent) caries or other area of the tooth with primary caries.

4 - Tooth missing due to caries: This score is used for permanent teeth that have been extracted because of caries.

Clinical caries : Clinical caries is defined as a cavity diagnosed by visual examination / probing of the mouth.

DMF index per person : It is the average number of permanent teeth per person which are decayed (D), missing (M),or filled (F) because of caries. It is a quantitative expression of the life time caries experience of an individual. The numerator is the total number of DMF teeth and the denominator is the total number of persons examined.

DMF per affected person: It is a quantitative expression of the

the magnitude of dental caries in diagnosed cases. It is calculated using the total number of DMF teeth as the as the numerator, and the total number of persons diagnosed as having clinical caries in the denominator.

(II) Periodontal Status :

0 - Healthy/Sound.

1 - Bleeding : Bleeding observed directly by visual examination using a disposable wooden spatula.

2 - Calculus : Hardened plaque detected by visual examination using a disposable wooden spatula.

(III) Fluorosis :

0 - Normal : The enamel surface is smooth, glossy and pale cream or creamy - white colour.

1 - Mild: Small opaque , white opacities of the enamel extending to more than 25% but less than 50% of the outer tooth surface.

2 -Moderate : The enamel surfaces of the teeth show marked wear and brown stain is seen.

3 -Severe : The enamel surfaces are badly affected and the enamel is thinned out markedly. Pitted or worn out areas and brown stains are widespread and the general form of the tooth is affected, thus giving a corroded appearance.

(IV) Dentofacial Anomalies :

Crowding : Crowding in the incisal segment is the condition in which the available space between the right and left canine canine teeth is insufficient to accommodate all four incisor in normal alignment.

0 - No crowding (Normal)

1 - One segment crowded (either in upper or lower jaw)

2 - Two segments crowded (in both upper and lower jaw)

Spacing : Spacing in the incisal segments is the condition in which the amount of space available between the right and left canine teeth exceeds that required to accommodate all four incisors in normal alignment.

0 - No Spacing (Normal)

1 - One segment spaced (either in upper or lower jaw)

2 - Two segments spaced (in both upper and lower jaw)

Malocclusion : Irregularity in the articulation of upper and lower teeth or upper and lower jaws. Malocclusion is classified according to severity :

0- Normal: Normal alignment between upper and lower teeth and jaws.

1 - Mild : Irregularity in the articulation of upper and lower teeth.

2 - Moderate : Irregularity in the articulation of upper and lower jaw with or without irregularity in articulation of upper and lower teeth.

Zones : These are the administrative divisions which are further sub- divided into smaller administrative units having their own local governments, staffed by representatives who are elected by the people.

Consumption Patterns:

Frequent : Any food item which is consumed once or more in a week.

Rare : Any food item which is consumed less than once a week.

Levels of Education:

Primary Education: Grade 1 to Grade 8

Secondary Education: Grade 9 to Grade !2

Annex : C

Sample Size Calculation:

The required sample size was calculated as for a case-control study on the following assumptions;

Odds ratio (OR) = 2.5 (ref.30) and Confidence Interval = 95%

$n = z^2_{1-\alpha/2} \{1/(p_o q_{o)} + 1/(p_1 q_1)\}/\{ \log_e (1- \varepsilon)\}^2$

n = sample size

p_o = Probability of exposure among controls

= overall exposure rate = 25%=0.25

p_1 = Probability of exposure among cases

$= p_o$ x OR=0.25x2.5=0.62

$q_o = 1-p_o = 1-0.25=0.75$

$q_1 = 1-p_1 = 1-0.62=0.38$

$z_{1-\alpha/2}$ = value of standard normal distribution corresponding to a significance level of α at 0.05=1.96

ε = relative precision= 25% = 0.25

$\{ \log_e (1-\varepsilon) \}^2 = \{ \log_e (1-0.25)\}^2 = \{ \log_e (0.75)\}^2 = (0.29)^2 = 0.084$

$n = (1.96)^2 \{1/(0.25x0.75)+1/(0.62x0.38) \} / 0.084$

$=3.84 \{(1/0.19)+(1/0.24)\} / 0.084$

$= 3.84 (5.3+4.2) / 0.084$

$= 3.84x9.5 / 0.084$

$=36.48 / 0.084 = 434.29$

Sample size = 434

Since caries prevalence is 25%, in order to get 434 cases,

Sample size n is multiplied by 4 = 434 x 4 = 1736 subjects.

Annex D: Summary of Scoring

i) Economy Scores

Items	Label	Score
1.Radio	yes	1
	no	0
2.Television	yes	2
	no	0
3.Vehicle	yes	4
	no	0
4. House-ownership	self-owned	1.5
	rented(private)	1
	rented(gov't)	0.5
5. School transport	by car	1
	by bus	0.5
	by walking	0
6. Water supply	self-owned pipe	1
	community pipe	0.5
7. Job status		
Father/Mother/Guardian	yes	1(each)
	no	0
8. Overcrowding	2 or <2 occupants per room	1
	>2 occupants per room	0

Total scores	**Economic status**
If 3.5 or<3.5/person	= low
If 4-8/person	= medium
If >8/person	= high

ii) **Drinks Scores**

Items	Label	Score
1.Milk	< 7 times / week	1
	7 times or more/week	2
	if sugar is added	0.5
2.Tea	< 7 times / week	1
	7 times or more/week	2
	if sugar is added	0.5
3. Soft drinks	< 7 times/week	1
	7 times or more/week	2

Total Scores	Drinks Grading
2.5 or less / child	= Low
3 - 5 / child	= Moderate
5.5 or more / child	= High

iii) Sweets Scores

Items	Label	Score
1.Chocolate	< 7 times/week	3
	7 times or more/week	4
2.Cake	< 7 times/week	3
	7 times or more/week	4
3.Candy	<7 times/week	2
	7 times or more/week	3
4.Cookies	<7 times/week	2
	7 times or more/week	3
5.Ice-cream	< 7 times/week	2
	7 times or more/week	3

Total Scores	**Sweets Grading**
4 or less per child	= Low
5 – 10 per child	= Moderate
11 or more per child	= High

ANNEX: E

Kappa-Statistic: Inter- and intra-examiner consistency was assessed by the Kappa Statistic (k) which is the actual measure of agreement with the degree of agreement which would have occurred by chance.

Examiner2	Examiner1		
	Sound	Carious	Total
Sound	a	c	a+c
Carious	b	d	b+d
Total	a+b	c+d	a+b+c+d=1

a = proportion of teeth found normal by both examiners.=0.84

b = proportion of teeth examiner 1 found normal and examiner 2 found carious = 0.02

c = proportion of teeth examiner 1 found carious and examiner 2 found normal = 0.02

d =proportion of teeth found carious by both examiners.=0.12

$k = p_o - p_e / 1 - p_e$

p_o= proportion of observed agreement = a+d

p_e=proportion of agreement that could be expected by chance.

= (a+c)x(a+b) for the sound teeth and

(b+d)x(c+d)for the carious teeth

$p_e=(a+c)x(a+b)+(b+d)x(c+d)/(a+b+c+d)^2$

$=\{(0.86x0.86)+(0.14x0.1\ 4)\}/1=0.76$

$k = \{ (a+d)- [(a+c)x(a+b)+(b+d)x(c+d)]/(a+b+c+d)^2 \} /1-p_e$

$k = \{ (0.84+0.12)- (0.76) \} /1 - 0.76=0.20/0.24=0.83.$

A score of >0.8 = good agreement; 0.6-0.8 = substantial agreement ; and 0.4-0.6 = moderate agreement.

Annex :-E

ADDIS ABABA CITY ADMINSTRTION

Key

Regional Boundary	_____	x
Zonal boundary	_____	---
Wereda Boundary	_____	—
Zone Code	_____	④
Wereda Code	_____	17

DECLARATION

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in this or any other university, and that all sources of material have been duly acknowledged.

Name Katherine Simon

Signature Katherine

Place Addis Ababa

Date of submission December, 2000.

This thesis has been submitted for examination with my approval as University advisor.

Dr. Fikru Tesfaye
Advisor's Name

Signature