

THE USE OF CHEWING STICKS AND ORAL HEALTH



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FOREWORD

In the present paper the use and knowledge of the chewing sticks are discussed. The chewing stick is a traditional tool used as one of the common aides for keeping the oral hygiene, in many developing countries. Considering its wide use and that the tradition goes back many centuries, the aim of this study was to understand the traditional practice of this oral hygiene aid. The hypothesis was that understanding the nature of the tradition could contribute to the modern day dentistry.

In the first section, the accessible literatures in the database were reviewed. The focus was on the history of the chewing sticks and the roles it play in the oral health. In the second section, primary data regarding the use of the chewing sticks at present time is presented. The data were collected from two African countries, Addis Ababa, Ethiopia and Cape Town, South Africa. In the last section, we attempted to give a brief discussion on the findings of the study in relation to the literature in general.

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I would also like to direct my thanks to the persons who helped me in distributing and collecting the survey: Derartu Getachew and Lidya Senbeto (Dental student at the Atlas Dental Hospital, Ethiopia) and Prof. R B Barrie of the Department of Community Oral Health; UWC, the Faculty of Dentistry in Cape Town, South Africa.

As this Masters thesis marks the end of my five-year Dentistry study at the University of Oslo, I would like to take this opportunity to thank my parents Kebede Hordofa and Netsanet Ofgaa, my brothers Feyu, Natoli and Gedion Kebede's for their continuous up lifting support through out my study years.

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1 Introduction

Basic step in fighting the most common oral diseases is by sufficient oral hygiene. Human beings have been concerned about having clean teeth for centuries. We understand this from different tools that are used for the purpose of cleaning teeth over the years in the past (Dahiya, Kamal, Luthra, Mishra, & Saini, 2012).

One of the methods still in use in many developing countries for keeping oral hygiene is chewing sticks. This indigenous method of cleaning teeth has been in use for about 7000 years with a long historical background. The chewing sticks have mainly been used as tradition and as part of religious practices. The chewing sticks have different names in different parts of the world. Moreover, it is the cheapest available alternative to the modern toothbrush and toothpaste in many developing countries (Sukkarwalla, Ali, Lundberg, & Tanwir, 2013)



Picture 1 - Pencil sized chewing stick

A given chewing stick (Picture1) is a pencil- sized branch of a tree and this is chewed on at one of its ends until it is frayed and then used to brush against the tooth surfaces. There are

different types of trees that are used for the purpose. Trees known by the scientific names *Salvadora persica* and *Neem* (*Azadirachta indica*) can be cited for examples. This is further reflected in the following quotation:

In the Middle East, the most common source of chewing sticks is Arak (Salvadora persica). In West Africa, the lime tree (Citrus aurantifolia) and the orange tree (Citrus sinensis) are used. The roots of senna (Cassia vinnea) were used by black Americans, and those of African laburnum (Cassia sieberiana) were used in Sierra Leone. Neem (Azadirachta indica) is widely used in the Indian subcontinent (A Hooda, 2009).



(Courtesy of Derartu Getachew)

Picture 2-The chewing stick in use

In addition to *Salvadora perseca*, there are many different kinds of chewing stick trees that have been used for the purpose of cleaning the teeth in different parts of the world. One article mentions that there are about 182 species of plants that have been used as chewing sticks (A. Sofrata, Brito, Al-Otaibi, & Gustafsson, 2011).



(Courtesy of Derartu Getachew)

Picture 3-Different types of the chewing sticks used in Ethiopia

Among these different types of trees, a number of publications refer to the specific type of tree called *Miswak* also known by the scientific name *Salvadora persica* (Halawany, 2012). The *Salvadora perseca* tree is used in different ways. The fresh leaves are eaten as salads and also used as medicine for cough, rheumatism, asthma scurvy, piles, and its berries are eaten both fresh and dried. Studies have discovered that the tree contains different kinds of chemical components that are good for maintaining oral health (Chaurasia, Patil, & Nagar, 2013), (Khatak et al., 2010).

The oil extract of this tree have been associated with different medical conditions. For example, it has been used to cure gallbladder diseases, pile, polio, intestinal worm gonorrhoea and rheumatic joint pain. It is also said that the fresh cut bark can be used against catarrh, gonorrhoea and as a tonic for low fever. In addition, the bark extract has also been used to relief gastric and spleen pain. The leaves of *Salvadora perseca* are bitter in taste and they have also been used as liver tonic, diuretic, analgesic and astringent. When it comes to oral health, *Miswak* or *Salvadora perseca* is claimed to have components that exhibit antibacterial effect (Sukkarwalla et al., 2013) (Hardie & Ahmed, 1995).

To understand the roll of using chewing sticks, it's important to know what kind of impact it has on the different pathological conditions that one can encounter in the oral cavity such as caries, periodontitis, gingivitis, on the microorganisms of the oral cavity, and also the impact on oral tissue in general. Another important issue is the effectiveness of chewing sticks compared to traditional toothbrush.

In this review the aim was to refer to the most recent, accessible literature and discuss the different aspects and effects of the chewing sticks.

2 Chewing stick and it's ingredients

The constituents of *Salvadora persica* have previously been investigated. Among the chemical constituents is silica, which is said to have an abrasive property making the chewing stick helpful in removing stains and deposits from the surface of the tooth. Tannic acid; another constituent has an astringent property that helps to prevent plaque formation and gingivitis and Vitamin C, which contributes in repairing damages. Fluoride and other chemical compositions like calcium and chloride are also found to be the constituents of the chewing stick tree (Dahiya et al., 2012). In addition different anti-microbial components like alkaloids (Salvadoran), Sulphur and Benzyl Isothiocyanate can be mentioned (Sukkarwalla, 2013).

The chemical compositions and contents in the *Salvadora perseca* are different depending on whether the extract tested is taken from the stem, the root or the bark of this tree. Different methods are used to study the effect of *Salvadora perseca* extract by taking extractions from different parts of these plants.

A study showed that extracts from different parts of the plant gave different levels of efficacy on the antibacterial activity and also whether the extract was ethanol extract, stem water extract or crud extract. The ethanol extract was found to be highly potent while the stem water extract had the lowest potency. Compared with the 0.2% CHX solution and tea oil, crud extract showed low to moderate potency. The root extract is found to be more potent than the twig, which is found in the ethanol extract. It has also been observed that higher concentrations of the *Miswak* extracts gave a higher antibacterial activity (Haque & Alsareii, 2015). Furthermore, the study showed that there is no difference between a fresh cut and a month old *Miswak* extracts in their effect.

3 Antimicrobial effects

It is claimed that there are more than 700 different types of bacteria in the oral micro flora (Jørn A. Aas, November 2005). Some of them are more common in certain types of oral diseases than others. The types of bacteria found in the gingival pockets or the types of bacteria found in a plaque are different from the types of bacteria found in an infected pulp or an infected root apex.

There are microbiological investigations done to study the effect of chewing stick on these different oral microorganisms, which will be reviewed briefly in the following section.

A review on the therapeutic effects of *Miswak* shows the antibacterial effect of *Miswak* extracts when used as mouthwash, in toothpaste and as an irrigation solution in the endodontic treatment of necrotic pulp. Using an extract concentration of 10% and 50%, from the bark and the pulp of *Salvadoran Persia*, the antimicrobial activity is observed on the bacteria such as *S.faecalis* and *S.mutans*. Out of the selected oral microbes, the *S. mutants* are observed to be susceptible to all kinds of the extracts, that means the aqueous, ethanol or crud extracts, while the *Lactobacillus acidophilus* is observed to be resistant to all extracts except ethanol root extract (Haque & Alsareii, 2015).

Another review shows that ethanol *Miswak* extracts in 25% and 50% concentrations have growth inhibiting effects on oral pathogens, like *S.mutans*, *E.corrodes*, *S.salivarius*, *S.sangius*, *S.constellatus*. According to this study *P. gingivalis* is the most susceptible bacteria followed by *Aggregatibacter Actinomycetemcomitans* (AA), and *S.mutans* is less affected while *L. acidophilus* is the least affected bacteria by the antimicrobial activities of the components in a *Miswak* extract (Sukkarwalla et al., 2013).

A study on the effectiveness of aqueous extract of the commonly used chewing sticks, *Neem* and *Salvadoran persica* are compared in their antimicrobial activities against the bacteria, *S. faecalis* and *S.mutans*. The result shows that *S.mutans* and *S.faecalis* are affected at a concentration level of 50% by both *Neem* and *Salvadora persica* extract, while *S.faecalis* is observed to be affected in a lesser concentration of *Salvadora persica* (K. Almas, 1999).

A mouthwash of two different types of *Miswak* extract, an ethanol and an aqueous extract were prepared with the concentrations of 10%, 15%, 25% and 50%. The bacteria tested were *S. mutans*, *E.corrodens*, *S.salivarius*, *S.constellatus* and *S.sanguis*. A total inhibition was observed on all these bacteria by the 25% and 50% of ethanol *Miswak* extract, while bacterial

growth was observed for all the bacteria listed when using the aqueous extract (10%, 15%, 25% and 50%) (Sukkarwalla et al., 2013).

In another study, *Miswak* was also said to have an effect of antimicrobial activity on *Staphylococcus Aureus* (with a MIC-minimum inhibitory concentration value of 69 mg/100cc (Al lafi & Ababneh, 1995).

In comparison between the antibacterial effect of a 50% extract of chewing stick with CHX mouth rinse and cetylpyridinium chloride mouth rinse, the chewing stick extract showed a lower effect (K. Almas, Skaug, & Ahmad, 2005).

As mentioned earlier there are different chewing stick trees being used around the world and another study from India compares the antimicrobial effect of the chewing sticks including Neem, Mango and Banyan on the *S.mutans* and *L. acidophilus*. The result of this study shows that, Neem has a greater effect on *S. mutans*, while *Miswak* on *L. acidophilus*. This double-blinded randomized controlled trial of 68 patients with gingivitis, found no difference between the active and the inactive chewing stick, in reducing proximal plaque and the sub-gingival micro biota. The inactive chewing stick, is prepared by boiling the chewing stick in water for 2hr, to deactivate its content, and then controlled on cultured Influenza bacteria. (Elangovan, Muranga, & Joseph, 2012).

4 Anti-cariogenic effect

Caries is a disease caused by bacterial metabolism. The elimination of bacteria from the oral cavity, supply of fluoride and low cariogenic diet would be the best way to prevent the establishment and progression of caries activity. When we take a look at the role which the chewing sticks may play in preventing caries, the first important aspect can be analyzing its ability to fight against microorganisms in the oral cavity, that are commonly associated with caries.

S. mutans and *Lactobacillus* are, for example, the most common bacteria mentioned in relation to caries pathogenesis. Studies show that *S. mutans* is one of the bacteria in the oral flora that is susceptible to the chewing sticks extract. However, *Lactobacillus* seems not to be affected by the chewing sticks extract as we have seen earlier in the discussed studies above (El Rahman HF, 2002), (K. Almas & Al-Zeid, 2004)).

Benzyl Isothiocyanate (BITC), which is extracted from the root of *Salvadora persica*, is found to be the main bactericidal and growth inhibitor of different micro pathogens, including the cariogenic bacteria residing in the oral cavity (Kumar, 2012), (J. Akhtar, Siddique, Bi, & Mujeeb, 2011). In addition to this, a study by Eid and co-workers confirms the antibacterial effect of this component (Eid, al-Shammery, & Selim, 1990).

Miswak users had significantly lower caries experience than toothbrush users, according to the results obtained in a clinical examination, showing that among the group of people who regularly used *Miswak*, 53.3% had primary or recurrent caries, while in the group of people that used toothbrush, it was observed that about 76.9% had recurrent or primary caries. Different bacteria that may reside in the oral cavity were reduced in the *Miswak* user group compared to the toothbrush users, while a significant higher level of some other types of bacteria were detected on the *Miswak* user group as well. The study used biological samples collected from saliva and sub gingival plaque. These were assessed through a check board DNA hybridization technique, using 28 different bacteria probes (Darout, Skaug, & Albandar, 2003).

Miswak releases substances into the saliva that stimulate the saliva flow rate. Therefore, another aspect of the anti-cariogenic roll of the chewing stick could be its ability to stimulate salivary flow and thereby resulting in the elevation of plaque pH (A. H. Sofrata, Claesson, Lingstrom, & Gustafsson, 2008). The bitterness taste of *S.persica* stimulates as well to

increased production of saliva acting as a buffering agent (Halawany, 2012). Calcium and chlorine are observed to be in a higher level after the use of chewing sticks compared to control group. These components help towards the maintenance of oral health, by increasing the oral pH and contributing to the re-mineralization of the tooth. A review also discuss the anti-decay effect of the chewing stick since it has fluoride content (Haque & Alsareii, 2015). When the saliva is saturated with calcium, it prevents demineralization of the tooth. On the other hand, chloride could inhibit calculus formation. An additional study shows that these components are released in saliva and give an immediate to medium term effect (Gazi, Davies, al-Bagieh, & Cox, 1992).

In 1984 the World Health Organization (WHO) recommended the chewing sticks as alternative to tooth brush and tooth paste (WHO; 1984).



(Courtesy of Derartu Getachew)

Picture 4-The chewing stick selling on the streets of Addis Ababa, Ethiopia

5 The effect on plaque removal

Considering the mechanical plaque removal and cleaning function, toothbrush and chewing sticks have similar effects. While in addition to the mechanical effect, *Miswak* fibers contain significant amounts of chemotherapeutic components as previously mentioned (M. S. Akhtar & Ajmal, 1981), (Halawany, 2012). A recent study compares the gingival score and plaque removal effectiveness after the use of chewing sticks and toothbrush. A total of 50 subjects participated in this study and they were divided in two groups, one consisting of manual toothbrush users and one, consisting Neem tree chewing stick users (Neem tree chewing stick is said to have a similar property to the *Salvadora Perseaca* tree).

The excluding criteria for the individuals who participated were individuals with systemic or oral disease, dental prosthesis, poor manual dexterity, recent or current antibiotic coverage and non-consenting cases. Before the trial started both of the groups were demonstrated how to use the manual toothbrush or chewing stick appropriately. The toothbrush group was demonstrated to use full-length fluoride toothpaste on the toothbrush and brush the teeth twice a day, after breakfast and before going to bed, for about 2 minute. The chewing stick group was demonstrated how to prepare the chewing stick-end and the technique how to use it. In addition to that it was advised to make new brushing end every day and brush the teeth twice a day, before going to bed and after breakfast for 2-5 minutes.

Two blinded, trained and calibrated examiners performed the dental examination at base line and later after one month, to assess the dental plaque and gingival status. A significant difference between the chewing stick user group and toothbrush user groups was observed on the final mean plaque scores (<0.0001), while Non-significant difference (0.166) was observed on the final mean gingival scores of the two respective interventional groups. The result of this study shows that chewing stick is equally effective as to using toothbrush on the gingival score. Regarding its plaque removal effectiveness, chewing sticks have proved to be even more effective than toothbrush (Malik, Shaukat, Qureshi, & Abdur, 2014).

A similar study comparing toothbrush and *Miswak* use shows significantly more plaque and gingival index reduction among *Miswak* users than the former, toothbrush users; given that the users are instructed beforehand on how to use the chewing sticks (al-Otaibi, 2004).

Danielsen et al. show in a study comparing two groups of children divided into chewing stick users and chewing stick plus toothpaste users that there is no additional effect of toothpaste on removing established dental plaque compared to the chewing stick user group (Danielsen, Baelum, Manji, & Fejerskov, 1989).

6 The effect on gingival and periodontal health

An early report from year 2000 indicated that a better periodontal status is observed on the Sudanese population who regularly used the chewing stick in comparison to toothbrush users (Darout, Albandar, & Skaug, 2000). A retrospective study on 264 patients indicated that *Miswak* may have an influence on periodontal health while it can also be a factor for gingival retraction (Eid & Selim, 1994).

The microorganisms, commonly related to the destructive periodontitis condition, are mostly the gram-negative bacteria such as *A.A.*, *P.gingivalis*, *P.intermedia*, and *Treponema denticola*. Having dental plaque and gingivitis under control are essential for a healthy periodontal tissue and different investigations have been done to understand how chewing stick affects the oral micro flora related mainly to the periodontal tissues, and what roll it may play in removing dental plaque and prevent inflammation of the gingiva.

One of these investigations was carried out in 2002 (Darout, Albandar, Skaug, & Ali, 2002). The study compares two groups of people that used the toothbrush and the chewing stick. The result showed that there was a higher level of bacteria such as *A.A.*, *P. gingivalis*, and lower level of *P. Intermedia* in the group using chewing stick compared to those who used toothbrush. However, in another study done in 2004 it is shown that there is a significant reduction of the bacteria *AA* in the subgingival plaque of those who used the chewing stick, indicating that there might be ingredients in the *Salvadora persica* that interfere with and inhibits the growth and leucotoxicity of these bacteria (Al-Otaibi et al., 2004).

The effect of using *Miswak* or toothbrush in relation to a patient's periodontal status depends on the probing pocket depth and the type of bacteria that is found sub gingival. According to a study, the bacteria types that are more significantly influenced by *Miswaks* than by the toothbrush are *S.sputigena*, *S.salivarius*, *A.naeslundii*, and *S.oralis* (Darout et al., 2003).

A single blind randomized-cross over study done on 15 male patients showed that there is a similar effect of using toothbrush and *Miswak* on subgingival microbiota, except for the

significant reduction of the *Aggregatibacter Actinomycetemcomitans* (AA) in the *Miswak* group. The participants had a chewing stick period, where they only used chewing sticks and a toothbrush period where they only used the toothbrush without toothpaste. The chewing stick users were allowed to clean their teeth 5 times a day, which is according to their religious tradition. The toothbrush users group however, brushed their teeth twice a day. The use of *Miswak* showed a significant reduction on AA bacteria. In addition to this clinical trial, a study has examined *Miswak* inhibition zones of AA on a blood agar plate, where a piece of *Miswak*, taken from the bark, was inserted. The agar plate was then incubated, for 48 hr. in a temperature of 37 degree Celsius. This in vitro study showed that there is a significant inhibition of the bacteria indicating that *Miswak* may have an effect on reducing AA in the sub gingival pocket. (Al-Otaibi et al., 2004).

A more recent study was performed to test the antibacterial activity of *Miswak* without extraction, by using *Miswak* pieces embedded in an agar plate and other pieces suspended above the agar plate. The results showed that a strong antibacterial effect on the periodontal involved bacteria (*P.gingivalis*, AA.) and the reference bacteria (*H.influenzae*), but while less effect on *S.mutans* and least effect on *L.acidophilus* are observed. The study mentions also that a 3mm suspended *Miswak* above the agar plate showed bacterial inhibition. The Gram-negative bacteria are strongly inhibited by the suspended *Miswak* pieces, than the embedded *Miswak* pieces, while the gram-positive bacteria were not strongly inhibited by the suspended pieces(A. H. Sofrata et al., 2008).

7 The disadvantages related to chewing sticks

Gingival recession and difficulties to reach the distal and lingual surfaces of the tooth are the kinds of disadvantages mostly mentioned in the literature.

Studies show one of the disadvantages of using *Miswak* to be gingival recession (Halawany, 2012). A group of 238 patients are divided into *Miswak* users group, toothbrush users group and a group using both *Miswak* and toothbrush. The result indicates that there is a significant gingival recession resulting from the use of chewing sticks compared to the toothbrush users.

Among the people that utilize this form of tooth cleaning, it is both a habit and a tradition that it is used several times a day. It is, therefore, suggested that both the gingival recession and

tooth wear maybe the result of the repeatedly brushing of tooth during the day (Eid & Selim, 1994; Eid, Selim, & al-Shammery, 1991).

A study is carried out on the abrasive effect of the filaments of chewing sticks on the outer layer of teeth, the enamel. The study compares two types of toothbrush, Butler toothbrush, Aqua fresh toothbrush and *Miswak*. They were used for 60 sec. and an electro microscopic examination was done on the tooth surfaces of the central incisors. The study concludes that the effect of the abrasive activity is lower in using Butler 311 and the chewing sticks than the Aqua fresh 311 tooth brush (Eid et al., 1991).

Another dilemma in relation to the use of the chewing stick is the fact that it can be difficult to reach all surfaces of the tooth compared with the modern toothbrush. Earlier studies mention the disadvantage in relation to its design that it makes the chewing sticks hard to reach the lingual surface of the tooth efficiently. Besides, the axial angle of the chewing stick to tooth makes it difficult to clean the distal surface of the teeth in comparison to the toothbrush. In another study from 1987 (Eid et al., 1991; Ra'ed I. Al Sadhan & 1999), it was not found any difference in plaque and in gingival bleeding between the toothbrush user and the chewing stick user.

The chewing sticks are usually purchased already cut into different length, and a study recommended that the length of the chewing stick should be 23 cm for adults and 15 cm for children. It also gives a guideline on how to grip the chewing stick and move the wrist or arm in order to reach different areas of the teeth surfaces (Hollist, 1981).

It is important to use a freshly cut end of the *Miswak* after it has already been used for 24 hr. It has been argued that cytotoxic ingredients of the stick, could affect the structure in the periodontal and gingival tissues (A. K. Almas & Almas, 2014).

Another finding in reference to *S.Persica* tree points out that it's constituents may reduce fertility in rats. This antifertility activity is seen more pronounced on the male mice than female (Darmani, Al-Hiyasat, Elbetieha, & Alkofahi, 2003).

8 Other related rolls

In addition to the well-documented antibacterial activity of *Miswak* having volatile active antibacterial component (A. H. Sofrata et al., 2008), the fluoride content that is said to be found in *S.persica* chewing stick might contribute to prevention of caries pathogenesis. (Ezoddini-Ardakani, 2010) (Hattab, 1997). There are few studies concerning the fluoride content. The studies show that the *S.persica* soaked in water released very low amounts of fluoride.

It has been demonstrated that *Miswak* contains different compounds that are found to have antioxidants properties and are active as vitamin E. (Haque & Alsareii, 2015).

The antiulcer activity of *Miswak* is mentioned in a study after this property was observed on the mucosal tissue of a rat's gastrointestinal mucosa (Sanogo et al., 1999).

Hypolipidemic activity is observed in a study done on rats with induced diabetes, by administrating *Miswak* extract orally for 21 days. In this study the blood glucose, LDL, HDL, VDL and glucose tolerance test were analyzed (Khan, Ali, Ali, & Mir, 2014).

A study dealing with the antimutagenic activity shows that at a concentration of at least 15% *S.persica* is claimed to have an antimutagenic activity and that the inhibition activity lasts for up to 36 hours (Ali, Konig, Khalid, Wright, & Kaminsky, 2002).

A study that has investigated the effect of Benzyl Isothiocyanate (BITC), one of the main antibacterial components found in *Miswak*, on damaged hamster tongue-epithelia shows that this content of *Miswak* has an effect of delaying the evolution of neoplastic changes provoked by trauma (A. Al-Dosari, 1992).

Another study assessed the antiviral activity of *Miswak* on the Herpes simplex virus indicating that the component, Benzyl Isothiocyanate, at a concentration of 133 microgram per ml, has a virucidal activity (Haque & Alsareii, 2015). The study also mentioned that *Miswak* has a natural analgesic and anti-inflammatory agent.

8.1 Aim of study

The aim of the following questionnaire study was to collect data on oral health and the use of the chewing stick in two African countries. Further aim was to investigate the people's knowledge of the chewing sticks, reason for its use and how many people utilize this tool as an aide for the oral hygiene.

9 Material and Method

The study is based on a questionnaire consisting of 28 multiple-choice questions regarding knowledge about the general dental healthcare and use of the chewing sticks. In this questionnaire we wanted to obtain background information of the participants such as: age, gender, educational background, profession, average income, religion and their residence. We wanted also to know about their general knowledge concerning the dental healthcare. Data about the participants' drinking and eating habits, dental visit and reason for the visit, experience of tooth pain, whether they think they have enough knowledge about their dental healthcare and if so, where they got the information, were collected. Furthermore, the oral hygiene habits and knowledge about the chewing stick were assessed, such as: what kind of method they use for cleaning their teeth, how often they clean their teeth, whether or not they use the chewing sticks and if so how they learned about it, how often they use the chewing sticks, whether they like to use it, and if they would recommend it for non-users (more details of the questions assessed are given in the questionnaire in the attachment 1).

The questionnaire was presented to the participants selected from two African counties: in Cape Town, South Africa and in Addis Ababa, Ethiopia. In Cape Town, the subjects enrolled in the study were mainly the patients undergoing treatment at the Faculty of dentistry at the University of Western Cape. The questionnaire administered in Ethiopia was translated into the local language, Amharic, and the participants were selected randomly from the street and people seated at hairdresser salons. In both Cape Town and in Addis Ababa, the faculty staff and students were also enrolled in the study. If needed, the participants were provided with the explanations and clarifications while completing the questionnaire.

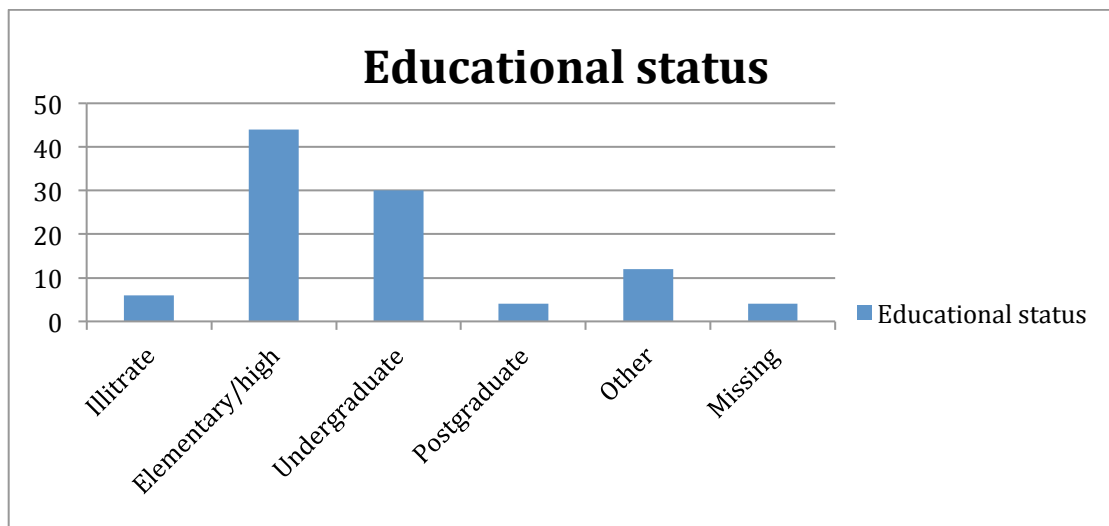
10 Statistical analyses

The statistical analyses were performed by, IBM Statistical Package for the Social Sciences (SPSS) version 20. A descriptive analysis with frequency distributions were calculated by Chi-square, used to test possible associations between the variables (5% significance level).

11 Results

The responses from the questionnaire were obtained from 187 participants (129 from Ethiopia and 58 from South Africa) aged 15 - 60, with a mean age of 37.2 years, 106 females and 76 males (five persons did not respond to this question and were therefore defined as missing).

Of the participants, 43.9% attended elementary/high School, 29.9% were undergraduates, 4.3% postgraduates, 6.4% illiterates and 15.5% answered “other” as their educational status (Fig.1). Regarding profession and employment, 42.2% were students, 14.4 % were working in the private sectors; while 31% had their own businesses, 10.7% were unemployed, while about 9.6% were government employees. Three (1.6%) of the participant did not answer this question.

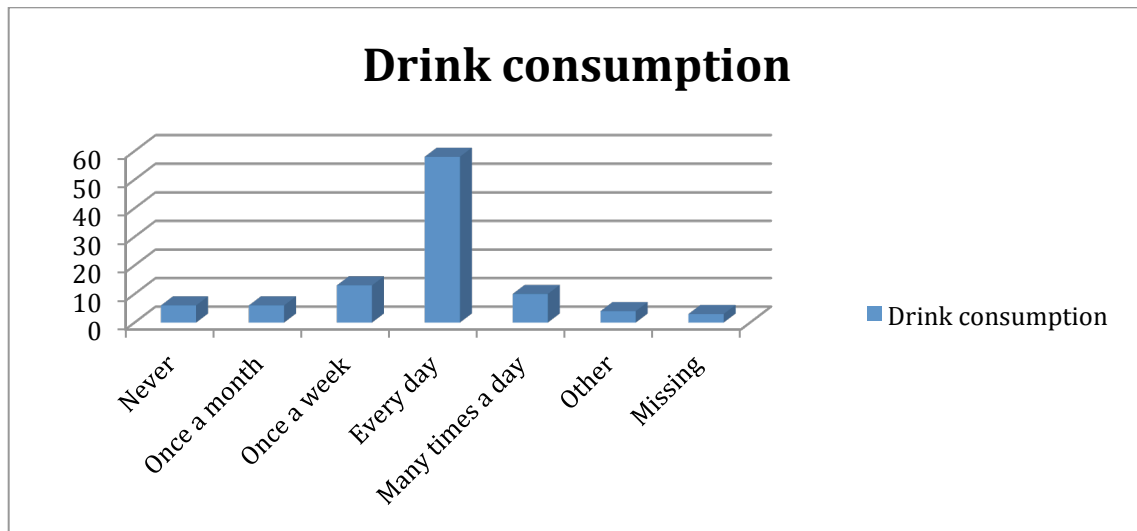


Figur 1 - Educational status

When it comes to the income, 8.5% of the participants from South Africa earned below 1500 Rand (847.65 NOK) per month, followed by 1500-19000 Rand (7.3%) and 20000-29000 Rand a month (5.6%), while 3 persons earned 30000 Rand (around 2,138 NOK) or more. In Ethiopia, about 70% of the participants earned below 1500 birr (576 NOK), 12% earned 1500 Birr a month. About 7.6% earned between 1500 and 10000 (around 400 NOK), while 6.1% earned between 10000- 30000 Birr (around 1,160 NOK). Three percentages earned above 30000 Birr.

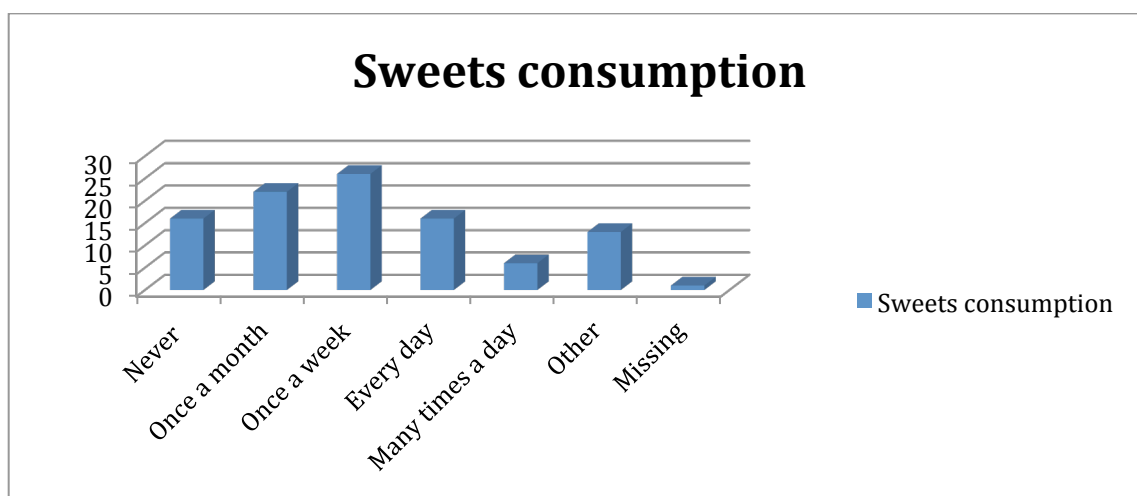
Regarding religion, 80.7 % of the participants were Christians, 14. 5% were Muslims, and the remaining 4.8% defined their religion either as followers of Hinduism or other religions.

Responses referring to the general knowledge about the dental healthcare showed that 59.3% of the participants used soft drinks or sugar beverages (like Tea & coffee with sugar) every day. About 10.4% of the participants consumed soft-and/or sugary drinks many times a day, 13.2 % once a week and 12.6% once a month or more seldom (Fig. 2).



Figur 2 - Consumption of drinks with acidic or sugar content

Regarding the consumption of sweets: 5.9% used sweets several times per day, 16% every day, 25.8% used them once a week, 22.6% once a month, while 29.5% used them seldom or never (Fig. 3).

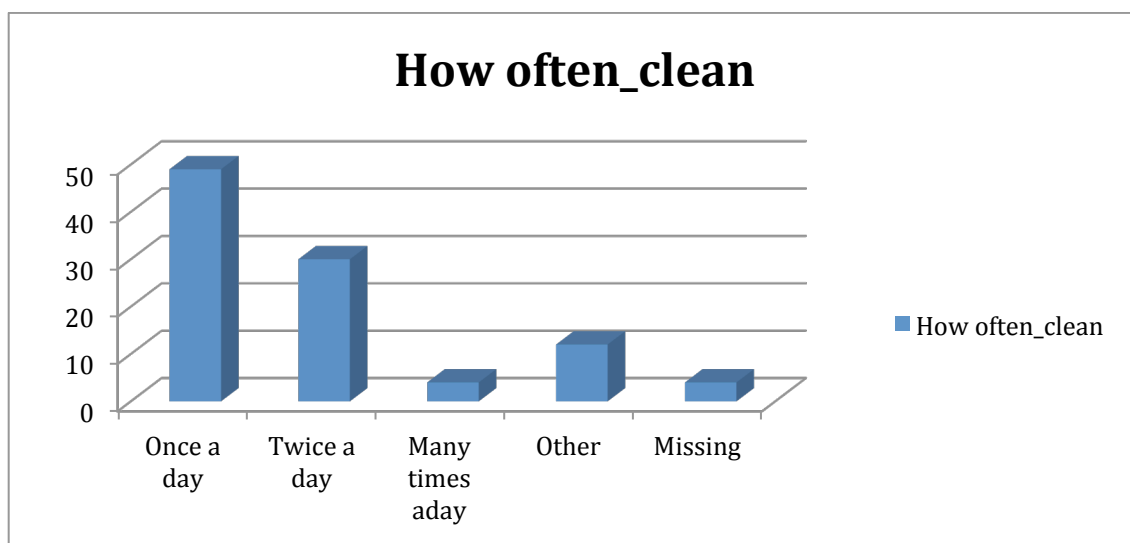


Figur 3 - Sweet consumption

For the question asked how often they visit the dentist, 55.1% of the participants answered that they have been to the dentist, while 41.7% said that they have never visited the dentist in their life, while 3.2% did not respond to this question. Among those who responded, 27.5% said it was for a routine checkup, while the majorities (72.5%) reported the reason to be the pain of their teeth. Among those who answered ‘for routine check ups’, 29.8% answered they visit the dentist once a year and about 24.6% answered twice a year and 55.6% once every two-year or more seldom. About 58.4% of the participants reported that they have had tooth pain previously, while 41.6% reported that they have never had tooth pain.

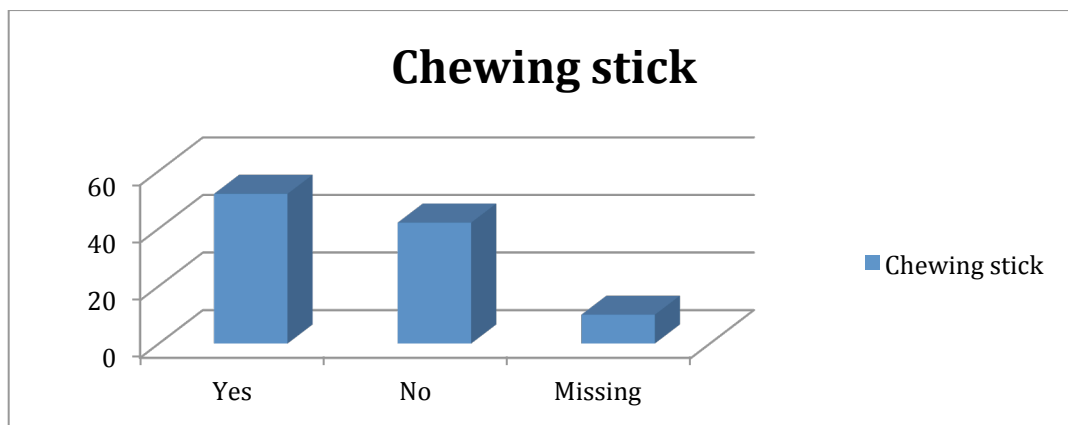
The final question in the questionnaire was whether the participants think that they have enough knowledge about the dental healthcare or not, and 70.8% of them answered that they have, while 27.8% answered that they don’t think that they have enough knowledge. Among those who reported that they have enough knowledge, we asked how they got the knowledge, and 56.9% answered from the school, followed by the media (19%) and health center/other (23.1%).

Looking at the oral hygiene habits in general (Fig. 4), most of the participants, (51.4%) cleaned their teeth once a day, and followed by 31.8% who cleaned twice a day, 3.9% cleaned many times a day and 12.8% reported “other”. Further, most of the participants used toothbrush and toothpaste (61.7%), while 17.1% used in addition interdental brush, 13.7% used interdental brush and tooth floss in addition.



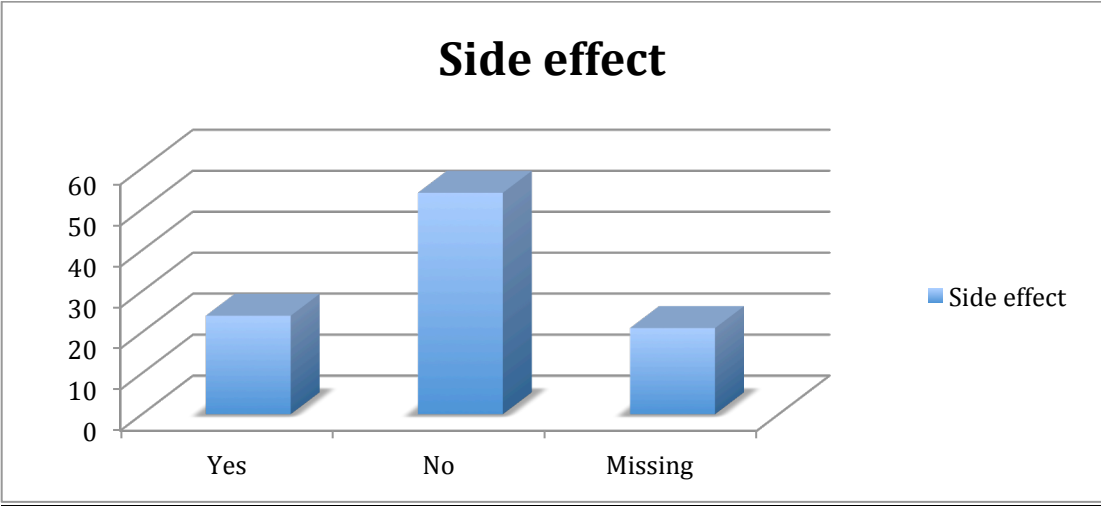
Figur 4 - Teeth cleaning frequency

Regarding the use of the chewing stick, out of the 177 participants who answered this question, 51.9% said that they use the chewing sticks as a tool for cleaning their teeth, while 42.2% did not (Fig. 5). Further, about 32.7% of those who use the chewing stick said that they use it because it is passed on to them by tradition, while 8.2% use it due to religion, and 5.1% due to both tradition and religion. About 54.1% of the participants use it because it is cheap and easily available. Most of the participants use the chewing stick twice a day (44.5%) or once a day (42.3%), followed by those who use it many times a day (13%). The chewing stick was recommended by 55.8%, while 44.2% would not recommend it.



Figur 5 - Use of chewing sticks

Among those who reported to like to use the chewing sticks (58.2%), about half of them (53.5%) liked it since it cleans, whiten or gives fresh breathe, followed by those who said it was cheap and easily available (30.3%), and by those who reported to prefer the chewing stick because it is easy to use (9.1%). Among those who do not like to use the chewing sticks (41.8%), 57.7% prefer toothbrush, and 22.5% said that the chewing sticks doesn't clean properly. There were also individuals (7%) who did not like to use the chewing sticks because it was difficult to use them, and the rest (12.7%) reported other reasons for not using the sticks. Of those who answered the questions about the side effects of the chewing stick (n=53), 30.6% reported side effects, which were that it dries out quickly and it is difficult to use (Fig. 6).



Figur 6 - Experience with side effects of chewing stick use

12 Regression analysis

The results showed that those who used the chewing stick had rarely been to the dentist ($p=0.001$).

We have also looked at the difference in the use of chewing sticks between the genders, and we could not find any significant association: 40 out of 74 males and 55 out of 99 females used the chewing sticks ($p=0.508$).

We found no significant relationship between those individuals who said that they had enough knowledge about dental health and the use of chewing stick ($p=0.768$).

Among those who used the chewing sticks for teeth cleaning, a significant higher number of the individuals had the habit of cleaning their teeth once a day, that is 59 out of the 96 participants ($p<0.001$).

We observed that there was no significant relationship between those who have had tooth pain or problems and use of the chewing stick for cleaning their tooth ($p=0.294$).

Concerning the income levels of the participants and those who choose chewing stick as their oral hygiene aid, the results showed a significant correlation ($p<0.001$) between those who had a lower income and those who used the chewing sticks as an oral hygiene aid.

13 Discussion and conclusion

The use of the chewing sticks, to keep the teeth healthy, is believed to be introduced 3500 years BC. At present, using the chewing sticks is said to relate to traditions, religion or simply accessibility depending on the society. The trees from which the chewing sticks come are also known as ‘the teeth brush trees’ among the users according to the literature (Halawany, 2012).

The purpose of this study was to investigate people’s knowledge of the chewing sticks, reasons behind using them and spreading across the world as an aide for oral hygiene.

The literature shows that the use of chewing sticks is seen to be common in a number of societies around the world: Asia, Africa, South America and the Middle East are given as examples (Halawany, 2012). However, taking into consideration the cost and time-limit of conducting the present questionnaire survey, the present study was limited to a few localities selected in Addis Ababa Ethiopia, and the Cape Town, in South Africa; where the questionnaires were distributed and responses were elicited from the targeted population. Since all data from the questionnaire were self-reported, the estimates might be affected by the individual participant’s selective reporting and recall bias.

Various reasons are given for the popularity of the chewing sticks, such as easily available and cheap, especially in those countries where it is frequently in use. As the survey shows, using the chewing sticks is inherited by the tradition for most of the participants. According to the literature, the use of the chewing sticks in some parts of the world is also related to the religious practices (Haque, 2015). The Sikh and Islam religions are mentioned in this regard ("Teeth cleaning twing," n.d).

From 187 subjects included in this study from Addis Ababa, it was found that more than half of the population uses the chewing sticks. In the sample from the Cape Town, South Africa, the numbers of participants who use the chewing sticks is very low. We assume this may be due to the smaller sample collected from here compared with the sample from Addis Ababa, Ethiopia. Moreover, the participants from the Cape Town were patients that came to the UWC Faculty of Dentistry for treatments. Those may have got recommendations for using toothbrushes from the dental health personnel. In fact, the literature shows that the plant *Salvadoran Persia* grows in South Africa (Orawa et al, 2009). It is, however, observed that the use of the chewing sticks is minimal among the population. In contrast, the responses obtained from the sample taken from Addis Ababa, Ethiopia, reveals that a significant number

of the population use the chewing sticks on regular bases. This also corresponds to the traditions observed in many parts of the Eastern and Western African, the Middle East and other Asian countries where the chewing sticks are used widely for cleaning the teeth as already noted above.

In Europe the tradition of teeth cleaning habit was introduced around the 17th century, with the invention of the modern day toothbrush. It is recorded that around 1780, the first modern day toothbrush was invented in England, although a similar toothbrush was produced in China earlier in the 1400 century (“Tooth brushing” n.d).

In Norway my personal registration at dental school is that chewing sticks use nowadays, occur mainly by immigrants from other parts of the world that originally use the chewing sticks and these chewing sticks seem to be accessible through the Internet for purchase. (<http://www.miswakstick.com>). Advertisement on the chewing sticks, as one of the ecological tooth-brushing aides is also observed (Kilden nyheter, 2013,14.04.).

In the sample taken from Addis Ababa, Ethiopia, the chewing stick users earned 1500 ETB or less per month (that is about 576 Norwegian kroner per month). This corresponds to the 43 participants who use the chewing sticks out of the total of 58 participants who earn the least per month. We may conclude that those who earn less use the chewing sticks regularly compared to those who earn higher amounts per month, which corresponds to those who use the sticks rarely. However, we should point out for the sample taken from the Cape Town, South Africa that it is again inconclusive whether or not there is a significant relationship between the chewing sticks users and their income levels since the number of participants who use the chewing stick included in the survey was low. A recent article has also mentioned the use of chewing stick being common among those who have a lower income (Chaurasia et al., 2013).

The literature shows that the chewing stick has a significant antimicrobial activity, which makes it beneficial for keeping the oral hygiene. Microbiological investigations have confirmed that the chewing sticks have an antimicrobial activity in addition to their mechanical rinsing effect (Haque & Alsareii, 2015). It is also known that it has different ingredients that may contribute to the wellbeing of the oral cavity. Also among the participants in this survey with the tradition of using the chewing sticks, most of them reported they like to use the chewing stick since it cleans and whitens the teeth, as well as give fresh breath.

Those who are accustomed to the traditional use of the chewing sticks tend to clean their teeth frequently. The statistical analysis shows also a significant correlation between the frequencies of teeth cleaning and the use of the chewing sticks. This might explain the reason why the chewing sticks result in gingival recession as it is mentioned in the literature. As such, the gingival recession is associated with its frequent use, which is 5 times a day, and the lack of instruction on how to use Miswak (Dahiya, 2012). According to the results of this study, those who use the chewing sticks have rarely been to the dentist. This could be due to the frequent use of the chewing sticks since the group is less exposed to the dental health problems. Otherwise, assuming the income level of this group, it may be due to that they could not afford the modern dental services available. To put it differently, since those who use the chewing sticks are less exposed to tooth pain, this could reflect the efficacy of using the chewing sticks as an oral hygiene aide.

Looking at the general oral health, many of the participants use drinks with sugar content every day. These are mainly drinks like coffee and tea with sugar. The intake frequency of other types of sweets is observed not to be so frequent. Among the selected population, we found that it is common to clean the teeth once a day; although the sufficiency of this oral hygiene habit remains in question. But, there are quite a significant number of participants who responded that they have little knowledge about the dental health care. Thus, an awareness program on the multiple factors related the dental health problem should be introduced to the population of the users. For instance, awareness to reduce the frequency of sugar-based drink, as well of regular and sufficient oral hygiene habit could lead to the optimal dental health care.

In the literature it has been shown that the chewing sticks have an anti-plaque and an anti-microbial effect with a comparable effectiveness to the conventional toothbrush (Malik et al., 2014). If so, use of the chewing sticks should be promoted further especially in those parts of the world where the accessibility and availability of the toothpaste and toothbrush are limited. In other words, further investigation should be undertaken on the chewing sticks tradition in light of the oral hygiene. For example, one area of future research should be to focus on the many types of trees from which the chewing sticks come across the world. Examining the chemical components of these trees in relation to the oral hygiene can be useful discovery for the consumers worldwide.

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Pictures

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<https://ecotoothbrush.wordpress.com/2015/12/18/miswak/>

Cover;Al Mubarak 2016, Scientific Studies, sourced 3 may.2016 from

http://www.almubarakimpex.com.pk/?page_id=43

Litterature

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<p>5. Average monthly income</p> <p><input type="checkbox"/> Below 1,500 birr <input type="checkbox"/> 1,500 birr</p> <p><input type="checkbox"/> 10,000-20,000 birr <input type="checkbox"/> 20,000-30,000 birr</p> <p><input type="checkbox"/> Above 30,000 birr <input type="checkbox"/> 1,500-10,000 birr</p>	<p><input type="checkbox"/> A routine check-up</p> <p><input type="checkbox"/> Because of problem with a tooth or pain</p> <p><input type="checkbox"/> Other_____</p> <p>10b. If you have answered “for a routine check-up”, how often do you go to the dentist?</p> <p><input type="checkbox"/> Once a year <input type="checkbox"/> Once every two-year</p> <p><input type="checkbox"/> Twice a year <input type="checkbox"/> Other_____</p>
<p>6. What is your religion?</p> <p><input type="checkbox"/> Christian <input type="checkbox"/> Buddhism</p> <p><input type="checkbox"/> Hinduism <input type="checkbox"/> Muslim <input type="checkbox"/> Other_____</p>	<p>11. Have you ever had tooth pain?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>
<p>7. where are you from</p> <p><input type="checkbox"/> Ethiopia <input type="checkbox"/> Other_____</p>	
<p>12. Do you think that you have enough knowledge about dental health?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>12a. If ‘yes’ how did you learn it? (You may choose more than one alternative)</p> <p><input type="checkbox"/> The school <input type="checkbox"/> The media <input type="checkbox"/> A health centre <input type="checkbox"/> Other_(specify)_____</p>	
<p>Knowledge of traditional chewing stick toothbrush</p>	
<p>13. What do you use to clean your teeth? (You may choose more than one alternative)</p> <p><input type="checkbox"/> Toothbrush and toothpaste <input type="checkbox"/> Flossing</p> <p><input type="checkbox"/> Interdental brush <input type="checkbox"/> All <input type="checkbox"/> Other_____</p> <p>14. How often do you clean your teeth?</p> <p><input type="checkbox"/> Once a day <input type="checkbox"/> Twice a day</p> <p><input type="checkbox"/> Many times a day <input type="checkbox"/> Other_____</p>	<p>18. Do you like to use chewing sticks?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>18a. If yes, why?</p> <p>(You may choose more than one alternative)</p> <p><input type="checkbox"/> It cleans and whitens teeth and gives fresh breathe</p> <p><input type="checkbox"/> It is easy to use</p> <p><input type="checkbox"/> It is easily available and/or cheap</p> <p><input type="checkbox"/> Other_____</p>
<p>15. Do you use chewing sticks?</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>15 a. If yes, how was it introduced to you?</p>	<p>18b. If no, why?</p> <p>(You may choose more than one alternative)</p>

<input type="checkbox"/> It has to do with my religion <input type="checkbox"/> It has not to do with religion but tradition <input type="checkbox"/> Both <input type="checkbox"/> Other _____	<input type="checkbox"/> It doesn't clean properly <input type="checkbox"/> I prefer tooth brush <input type="checkbox"/> It is not easy to use <input type="checkbox"/> Other _____
16. How often do you use chewing sticks? <input type="checkbox"/> Once a day <input type="checkbox"/> Twice a day <input type="checkbox"/> Many times a day <input type="checkbox"/> Other _____	19. Have you experienced any side effect or problem of using the chewing stick? <input type="checkbox"/> Yes <input type="checkbox"/> No 19a. If yes, what was the problem/ side effect?
17. Would you recommend it to others? <input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> It dries out quickly <input type="checkbox"/> It is difficult to use <input type="checkbox"/> Other _____
Comments:	

-----Thank you-----