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**THE ORAL AND DENTAL EFFECTS OF KHAT CHEWING IN THE EASTLEIGH AREA OF NAIROBI.** Nyanchoka IN<sup>1</sup>, Dimba EAO<sup>1</sup>, Chindia ML<sup>1</sup>, Wanzala P<sup>2</sup>, Macigo FG<sup>1</sup>.

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**ABSTRACT**

**Objectives:** To compare the occurrence of oral diseases in a population of khat chewers and non chewers in the Eastleigh, a commercial and residential area in Nairobi. The practice of khat chewing has been shown to be aetiologically associated with several oral and dental diseases including temporomandibular joint dysfunction, dental attrition, oral stomatitis, keratosis and squamous cell carcinoma.

**Material and Methods:** A cross sectional study constituting 72 current khat users, 10 former users and 85 individuals who had never used khat were subjected to a standard clinical examination based on established oral health indices after obtaining their informed consent.

**Results:** The habit of khat chewing was common, particularly among the youth aged 20 – 39 years; and more in males (67.60%) than in females (32.39%). Mean DMFT scores ( $\pm$  SEM) were higher in the group of current khat chewers, while no significant differences were observed between the groups in relation to fluorosis levels, dental attrition and periodontal status. Emerging trends associated with the khat habit included initiation into khat chewing in adolescence and habitual consumption of cariogenic foods and/or soft drinks to counter the bitter after-taste of khat and to relieve thirst resulting from sympathomimetic stimulation.

**Conclusions:** Our results indicate that the traditional modes of khat use are changing, and that the short term use of khat can lead to a variety of oral and dental problems which are mainly associated with accompanying habits.

**KEY WORDS:** khat (miraa), drug abuse, youth, Kenya, oral and dental effects.

**INTRODUCTION**

Khat (*Catha edulis*, Forsk.) chewing is a widespread habit, with an estimated 5 – 10 million users mainly in East Africa and the Middle East<sup>1,2</sup>. The phytoconstituents of the khat plant have been the subject of much research since its scientific description was first published by Swedish botanist Peter Forskal in 1775, and the constituent fractions of khat have not been fully described to date<sup>3</sup>. Khat chewing results in an amphetamine-like euphoric effect which has been attributed to its main phenylpropylamines which include (-)-S-cathinone (S-(-)-aminorppiphenone), cathine (S, S-(+)-norpseudoephedrine) and R, S-(-)-norephedrine<sup>4,5,6</sup>.

Khat grown in Kenya owes its popularity in the international market to high levels of cathinone, which is the most potent phenylpropylamine found in khat<sup>(3)</sup>. Out of the 62 minor alkaloids known cathedulins that are present in khat, only 15 have

had their absolute molecular configurations fully investigated and published<sup>(7)</sup>. The cathedulins are sesquiterpene polyesters of euonyminol that are still the subject of much research as new variants are isolated for different species of khat. Other substances present in khat include essential oils, sterols, triterpenes and proteins; as well as traces of ascorbic acid, tannin, thiamin, niacin, riboflavin, iron and amino acids<sup>3</sup>.

Despite the growing body of literature on the adverse systemic effects of khat, there are few systematic studies on its oral and dental effects. A pioneering study in a Yemeni population<sup>(8)</sup> found little evidence of detrimental oral effects associated with khat chewing. Similarly, a comparative study conducted in Kenya<sup>9</sup> described low caries rates among habitual khat chewers. Epidemiological evidence on the effects of khat on periodontal health is controversial,

with some studies reporting a beneficial effect on the periodontium<sup>8,9</sup> in contradiction to others associating khat chewing with periodontal attachment loss<sup>10</sup>.

The oral mucosa acts as the first absorption segment for khat alkaloids, with the remaining phenylalkylamines being absorbed in the stomach and intestines<sup>11</sup>. Chronic exposure to the phytoconstituents of khat has been linked to genetic damage in buccal cells of khat consumers, with an additive effect observed with alcohol and tobacco consumption<sup>12</sup>. Further epidemiological evidence has associated khat chewing with the development of cancers of the upper aero-digestive tract<sup>12, 13, 14, 15</sup>. This is due to the *in vivo* formation of carcinogenic metabolites from the secondary amines present in the khat plant<sup>16</sup>.

Tannins found in khat have an astringent effect and are believed to control plaque formation on the tooth surfaces of khat chewers. Tannins also have chromogenic potential and their relatively high content in khat could be the reason why habitual khat chewers complain of stained teeth. Studies on the fluoride content of khat are inconclusive, with reported fluoride levels in khat leaf samples varying from negligible amounts 17 to 360 parts per million<sup>8</sup>.

There is a general lack of literature on the toxicity of khat and its constituents<sup>1</sup>. Few studies have been conducted in Kenya to determine the adverse oral effects associated with khat chewing, and those that exist suffer from small numbers and lack of systematization<sup>(18, 19, 20)</sup>. This study aims to determine the oral health status of khat chewers and non-khat chewers.

#### MATERIALS AND METHODS

The study was a comparative cross sectional study conducted in the Eastleigh area of Nairobi, Kenya during the period between August and December 2004. Eastleigh is a commercial and residential area consisting of informal dwellings and low-cost housing projects. This area is registered by the United Nations High Commission for Refugees (UNHCR) as one of the main urban refugee settlements in Kenya and so the socio-economic status of the residents of this area is therefore generally low<sup>21</sup>.

A total of 167 participants were recruited into the study at a series of free dental clinics on the basis

of informed consent, and subjected to a standard clinical examination based on established oral health indices<sup>22</sup>. All clinical measurements were performed by one examiner (I.N.A) and counter checked by a second examiner (E.A.O.D) under natural light, using a sterile mouth mirror and an explorer. Dental fluorosis was assessed using Dean's index while caries experiences was assessed using DMFT.

The periodontal status of the patients was recorded according to adapted Green and Vermilion's calculus index. For this purpose, the findings on the buccal and lingual surfaces of the upper and lower 1st molars and on the upper left central incisor and the lower left central incisor were divided into 4 grades: 0: no calculus; 1: supragingival calculus in the marginal third; 2: supragingival calculus on two thirds of the tooth surface and/or single subgingival deposits; 3: calculus on the entire tooth surface and/or continuous subgingival deposits.

Plaque accumulation was scored as follows: 0- No debris or stains; 1: Soft debris covering up to a third of the tooth surface, or extrinsic stains without debris covering up to the total tooth surface; 2: Soft debris covering one third to two thirds of the tooth surface; 3: Soft debris covering over two thirds of the tooth surface. Statistical computations were done using the SPSS version 12.0 data analysis system and Sigma plot version 8.0.

Demographic data and khat chewing habits of the respondents were investigated by questionnaire with both open-ended and closed questions. Study respondents complaining of specific oral health problems were treated or referred to the University of Nairobi Dental Hospital for further management.

#### RESULTS

Demographic characteristics of the study population of khat chewers and non chewers in Eastleigh.

The habit of khat chewing was common in this area, with 72 (43.37%) of the study participants admitting to either past or current khat use. The mean age of respondents was 29.37 years (range 11 – 59); and the habit was more common in males (67.60%) than in females (32.39%) (Fig 1). Most of the respondents were literate, with 89.5% having received formal education up to

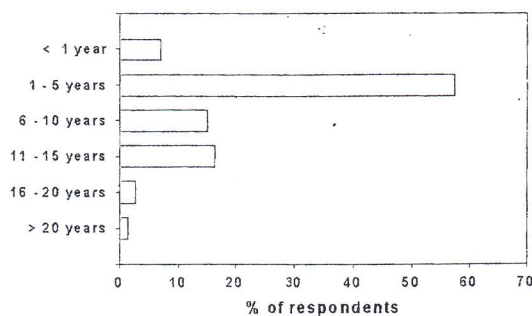
secondary school. 10.6% of the study population had attained college or university education.

Over 60% of the current khat chewers had used the stimulant for less than 5 years (Fig. 2). The majority of participants with a history of khat use (58.75%) confessed to be Muslims, 40.00% claimed to be Christians and 1.25% were affiliated to other religions. Exposure to tertiary education was associated with a significant decrease in khat chewing (Fig. 1).

**Figure 1:** Demographic characteristics of the study population of khat chewers and non chewers in Eastleigh

	Current chewers (% of respondents)	Non-chewers (% of respondents)	Former chewers (% of respondents)
<b>Age</b>			
10 < 19	301	722	0.69
20 < 29	5040	2209	3.61
30 < 39	1445	1024	1.20
40 < 49	421	722	0.60
50 < 59	129	301	6.60
<b>Sex</b>			
Male	59.9%	54.1%	3.01
Female	15.3%	25.9%	3.01
<b>Religion</b>			
Christian	59.2%	32.5%	3.01
Muslim	25.9%	10.4%	2.41
Traditional	0.6%	0.0%	0.0%
<b>Education</b>			
Primary	19.0%	16.0%	3.01
Secondary	21.0%	21.0%	2.41
Tertiary	2.41	7.0%	0.0%

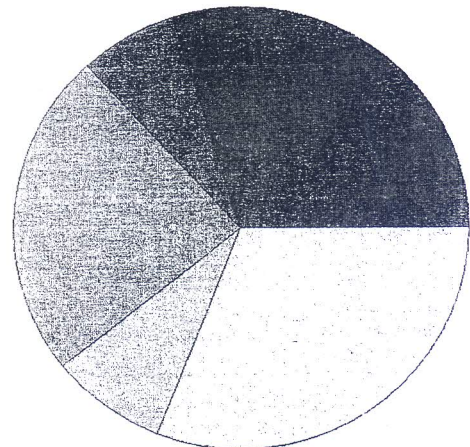
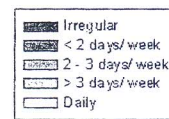
**Figure 2:** Mean duration of use in a group of khat chewers in Eastleigh, Nairobi.



Although there are many sub species of khat grown in Kenya, the majority of respondents (76.74%) did not have any preferences regarding the type of khat that they consumed. Popular types of khat included Kangeta (4.65%), Kasha (6.98%), Murutubu (2.33%) and Mbaine (9.30%). The Giza type was universally popular whenever it was in season. Frequency of khat chewing and the quantities consumed per sitting varied widely

among khat users, depending on the degree of addiction and affordability of khat. 62.50% of khat chewers interviewed in this study reported consumption of 2 or more bandaris than two times or more times a week (Fig. 3). A bandari refers to a bundle of khat shoots weighing approximately 100 – 300 g, packaged in banana leaves for sale.

**Figure 3:** Frequency of use in a group of khat chewers in Eastleigh, Nairobi. The chewers typically reported chewing between 1 – 4 bandaris of khat per session, depending on how much they could afford to buy.



**Adverse dental effects of khat chewing.**

The mean DMFT scores ( $\pm$  SEM) for current chewers, non-chewers and former chewers were  $8.778 \pm 1.1563$ ,  $6.5294 \pm 0.7411$  and  $7.000 \pm 1.7385$  respectively. The significantly higher DMFT scores were representative of the higher caries experience among the khat chewers (Fig. 4) which correlated with consumption of cariogenic foods/drinks with khat. Whereas khat was historically chewed on its own, 32.31% of the khat chewers in this study said that they altered or ‘cut’ the bitter after-taste of khat with sweets or chewing gum. 30.77% reported daily use of soft drinks to remove the after-taste and relieve the thirst caused by sympathomimetic stimulation and only 4.62% reported use of traditional kahawa (concentrated, sugarless coffee) with khat. No significant differences were observed between the groups in relation to fluorosis indices and dental attrition. However, 30.98% of the khat

users were concerned about changes in their tooth colour; while only 11.90% of the non khat chewers presented with similar complaints.

**Figure 4:** Rampant caries and tooth discolouration in a young female khat user.

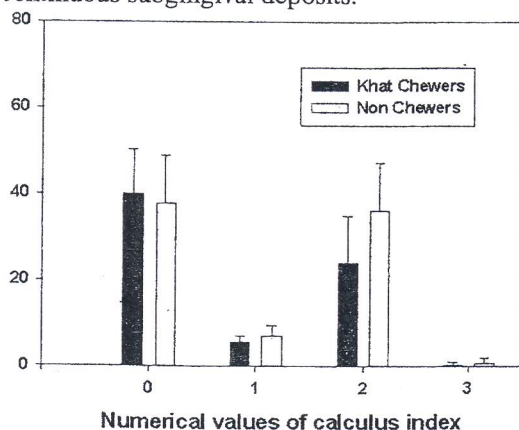


#### Periodontal health status of khat chewers and non chewers.

The differences between self-perceived periodontal health status between khat users and non users showed no statistical significance in tooth mobility, spontaneous bleeding or itching of gums, halitosis and/ or dysgeusia. A comparison of the mean numbers of patients scoring specified values in standard calculus and plaque indices revealed no significant differences between the study groups (Fig 5).

**Figure 5:** Comparison of periodontal health status in khat chewers and non chewers using a numerical calculus index.

Data represents mean number of patients ( $\pm$  SEM) in each group scoring as follows: 0 = no calculus; 1 = supragingival calculus in the marginal third; 2 = supragingival calculus on 2/3 of the tooth surface and/or single subgingival deposits; 3 = calculus on the entire tooth surface and/or continuous subgingival deposits.



#### Treatment seeking behaviour and other oral lesions associated with khat chewing.

The treatment seeking behaviour for oral health problems varied widely in the study population. 29.80% of respondents sought dental treatment from public hospitals or health centres, 34.00% went to private dentists, 2.10% sought treatment from traditional practitioners and 18.20% resorted to herbal remedies. Mucosal lesions including glossitis, candidiasis and hyperkeratosis were comparatively rare (< 1%) in this population of khat chewers.

#### DISCUSSION

Specific cultural oral habits such as snuff dipping and khat chewing have been shown to have a significant impact on oral health<sup>15</sup>. The growing habit of khat chewing has elicited an interest in research to further establish its active ingredients and their medicinal and pharmaceutical effects<sup>18</sup>. The documented oral and dental effects associated with habitual khat use include temporomandibular joint dysfunction, dental attrition<sup>8</sup> oral stomatitis<sup>24</sup>, keratosis<sup>23</sup> and squamous cell carcinoma<sup>16</sup>. Previous studies have demonstrated extremely high prevalences of khat chewing in some areas in Eastern Africa and the Middle East, with up to 80% of adult males reporting having engaged in the khat habit at some point in their lives in countries such as Somalia and Yemen<sup>12,24</sup>. These findings corroborate those of a research study conducted in a rural, nomadic community where khat consumption is entrenched in the local culture<sup>20</sup>. In the urban setting of Eastleigh area in Nairobi, the mixture of different cultures has resulted in the dilution of traditional cultural habits, hence only 43.37% of the study participants admitting to either past or current khat use.

New variations on modes of khat consumption were also noted. Traditionally, khat chewing and tobacco use were habitually enjoyed as social habits among adult males along with consumption of traditional kahawa (concentrated, sugarless coffee) <sup>(3)</sup>. In this study population however, 32.31% of the khat chewers altered or 'cut' the bitter after-taste of khat with sweets or chewing gum; 30.77% used of soft drinks to remove the after-taste and relieve the thirst caused by sympathomimetic stimulation and only 4.62% reported use of traditional kahawa. Khat is known to be non cariogenic due to the mechanical cleansing that takes place during the

chewing process<sup>8,9</sup>. It is therefore evident that the cariogenicity of the substances consumed with or after khat in this population is directly responsible for the users' caries experience (Fig 5).

Differing levels of acceptability of the khat habit to various religious groups was evident with khat users claiming affiliation to the Islamic (58.75%) or Christian (40.00%) faiths. This is consistent with reports derived from predominantly Muslim cultures where khat use is tolerated while alcohol use is strictly forbidden<sup>25</sup>. Investigations of dependence issues are usually viewed with suspicion, and it was not possible in most instances to establish whether or not participants were using other substances of abuse in addition to khat.

Data in this study showed that 67.60% of khat chewers were male and 32.39% were female. Previous studies have indicated up to 76% of khat use amongst females<sup>26</sup>. The apparently lower levels of khat use by females in the study population may be explained by taboos and cultural restrictions on khat use among women, which may have made female respondents more unwilling to admit to khat use. Although most of our respondents had ended their formal education in secondary school, exposure to tertiary education was associated with a significant decrease in khat chewing (Fig. 1). This could be attributed to better access to oral health information among the respondents with tertiary education.

Mean DMFT scores for current chewers were significantly higher than those for non chewers ( $p < 0.05$ ), while there were no significant differences in the mean DMFT scores for former khat chewers and non chewers. These results may be attributed to the new trends emerging in urban communities where khat consumption is habitually accompanied by use of cariogenic foods and/or drinks such as sweets, chewing gum and soft drinks. Assessment of periodontal health indices however, revealed no significant differences in the periodontal status of khat chewers and non chewers, but the group of khat chewers reported an approximate threefold increase in dental staining due to the tannin content of khat.

Some authors have described development of mucosal lesions such as stomatitis and glossitis as sequels of chronic khat use. Malnutrition, which is characteristic to khat addiction, exaggerates the incidence of stomatitis and glossitis<sup>24</sup>. The

short average durations of khat use (Fig. 2) in this study population may explain low occurrences of mucosal lesions in this study. Given that most users are unaware of the adverse oral and systemic effects of khat chewing, the 63.80% of respondents who reported seeking treatment from professional oral health providers represent unexploited opportunities for patient education.

The results from this study indicate that the traditional modes of khat use are changing, although further research is necessary so as to fully describe the oral and dental effects of khat in Kenya. However, this study does show conclusively that the short term habitual use of khat can lead to a variety of oral and dental problems.

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