

Original article

Khat chewing habit as a possible risk behaviour for HIV infection: A case-control study

Dawit Abebe, Asfaw Debella, Amare Dejene, Ambaye Degefa, Almaz Abebe, Kelbessa Urga, Lemma Ketema

Abstract

Background: The use/abuse of psychoactive drugs such as khat leaves (*Catha edulis*) are believed to alter one's moods or emotional state either through the sustained release or inhibition of neurotransmitters, thereby enhancing or dampening the response of the individual. Most people whose thinking are warped by continued drug use may not be able to see the harm resulting from their actions. Thus, there has been a strong linkage between drug use and casual or unsafe sexual practice despite the serious concern about HIV infection.

Objective: Khat chewing is known to be a widespread habit in Ethiopia. This study is, thus, aimed at investigating whether or not the use of this psychostimulant alone or in conjunction with other behaviors associated with its use constitutes a risk behavior that accelerates the spread of HIV infection.

Methods: A case-control study involving 850 human subjects, i.e. 425 HIV positives (cases) and 425 HIV negatives (controls) was conducted using rapid test algorithm and/or western blot method for determination of HIV status. Both groups were interviewed about their probable khat chewing habits, alcohol intake, multiple sexual practice, and the like, using a structured questionnaire. The data were analysed using SPSS/PC + statistical software.

Results: Risk behaviors for HIV infection such as khat chewing in conjunction with alcohol intake and casual sex were observed more in people with HIV than in the control group. Khat chewing was significantly associated with multiple sexual practice (OR = 4.03, 95% CI = 3.02, 5.39), which in turn was strongly linked with HIV cases (OR = 3.52, 95% CI = 2.64, 4.69). Thus, more than the non-chewers, khat chewers constituted significantly higher number of HIV cases (OR = 2.32, 95% CI = 1.75, 3.07).

Conclusion/Recommendations: Khat chewing is a risk behavior for the spread of HIV infection. Mainstreaming of khat control into national development planning initiatives is recommended. [Ethiop.J.Health Dev. 2005;19(3):174181]

Introduction

For over 1400 years, the chewing of fresh leaves of *Catha edulis* Forssk., variously referred to as khat, chat, Abyssinian tea, etc. as a stimulant/euphoriant has been practiced in the Middle East, Somalia, Ethiopia and extending down to as far as the Cape in South Africa (1). Up until a few decades ago, khat chewing was mainly restricted to older men or members of Muslim communities who used it in lieu of alcohol on religious grounds and, therefore, the habit did not pose serious public health or socio-economic problems (2). In recent years, however, its use has spread across many faiths, ethnic groups, age, sex, etc. (3). The ever spreading recourse being made to euphorians and/or stimulants like khat and other psychotropic substances may, thus, be attributed to many of the socio-economic and political upheavals, such as recurrent drought, famine, civil strife, and the spectre of the HIV/AIDS epidemic.

Recent trends indicate that by and large khat chewing has become a pastime activity resulting in the consumption of large quantities of the stimulant with serious consequences on the health and socio-economic conditions of communities (4, 5, 6, 7). For example, clinical pictures of behavioural disturbances induced by khat chewing have been reported by several workers (1, 8, 9, 10). The consumption of fresh khat leaves causes

the release of the active constituent, cathinone, which causes sympato-mimetic effects and induces symptoms such as euphoria and hyperactivity. Cathinone has analogous mechanisms of action with pharmacological properties that are reminiscent of those induced by amphetamine, i.e. anorexia as well as hypermotility (11). In fact, it is now being referred to as a "natural amphetamine" and its effects in animals correspond with those observed in khat using humans (6). The World Health Organization not only considers the wide-spread habit of khat chewing as pharmacologically equivalent to amphetamine abuse, but it has also included cathinone in its list of controlled drugs (12, 7, 6). Similarly, khat use in many European countries and Canada has been restricted or made illegal and is as such classified as a controlled substance. In the United States, the Drug Enforcement Agency (DEA) has asserted that the plant itself, *Catha edulis*, is a Schedule I substance on a par with opiates for the period it has cathinone in it, i.e. within the first 48 hours of harvest (13). Some advocates of khat, however, allege that khat leaf is rich in ascorbic acid and, therefore, the undesirable side effects of khat chewing are minimal. Of course, by modulating catecholaminergic activity or transmission of dopamine, ascorbic acid acts as an antidote to the effects of amphetamine (14, 15). However, this occurs assuming that there is adequate quantity of ascorbic acid in the leaf,

Ethiopian Health and Nutrition Research Institute, P.O. Box 1242, Tel. 756309 Addis Ababa, Ethiopia

and if it could ever be released from the leaf matrix by mastication and becomes bio-available. In light of WHO's recommendation, the problems associated with khat chewing for the moment should be considered in a manner similar to amphetamine abuse (12, 7, 6). Hence, it is the psychotropic and mind altering drug type whose use could possibly constitute a risk behaviour in the amplification of the HIV/AIDS epidemic in countries like Ethiopia, where the habit is widespread.

Furthermore, different varieties of khat are perceived to enhance sexual arousal among khat chewers. This was corroborated by pharmacological tests in male experimental animals that were administered with oral treatment of cathinone though there is still no evidence that the resulting increased sexual activity is accompanied by erectile and ejaculatory responses (16). The overwhelming evidence, however, suggests that the habit causes a high frequency of spermatorrhoea and decreased libido and, at a latter stage, impotence as observed in Somalia and Djibouti, where as high as 60% of the male chewers in those countries were reported to be impotent (7, 17, 4).

Whether khat chewing induces excessive sexual arousal, impotence or spermatorrhoea, the end result of the habit is believed to lead to strained relations between spouses or married couples and most likely to precipitate family fragmentation and/or multiple sexual practices. Khat chewing habit, may thus be postulated as one of those risky behaviors that could fuel the spread of HIV. In this regard, a link has been shown to exist between khat use and increased exposure to HIV/AIDS among prostitutes in Djibouti (18).

Insomnia is a common problem associated with the use of khat which prompts the chewer to use/abuse sedatives and to indulge in alcohol as a means of overcoming the side effect (18, 4, 10, 19). As such unplanned or unsafe sex and hence the risk of exposure to HIV under such heavy influence of a combination of drugs could not be an unlikely scenario.

Therefore, it can be surmised that khat chewing habit, like many other drugs of abuse could constitute risky behaviour contributing to the spread of HIV infection (20). Though khat chewing in Ethiopia is a common practice, there are,

however, no studies reflecting the possible existence or, for that matter, non-existence of a link between the chewing habit and the HIV epidemic.

Such studies could prove essential in the effectiveness of HIV prevention programs which critically depend on the extent to which they reduce the risk behaviour of those most likely to contract and spread the virus. The aim of the present study is therefore, to determine whether or not khat chewing alone or in combination with other behaviours associated with khat chewing constitute possible risk factor(s) in the spread of the HIV/AIDS epidemic in Ethiopia.

Methods

Study Sites: The study was conducted in 17 voluntary counselling and testing (VCT) centres found in the Southern Nations Nationalities and Peoples Region and the Oromia Regional State of Ethiopia between March 2003 and May 2004. The VCT centres where the study was conducted were: Adama Hospital (Adama Town), Atat Hospital (Atat wereda), Bushilo Catholic Health center (near Awassa Town), Dilla Hospital (Dilla Town), Hosana Hospital (Hosana Town), Kuyera Hospital (Kuyera Town), Weliso Catholic Hospital (Weliso Town), Yirgalem Hospital (Yirgalem Town); Bedele Health Centre (Bedele Town), Dukem Health Centre (Dukem Town), Mojo Health Centre (Mojo Town), Shashemene Clinic (Shashamane Town); Bethzatha Clinic (Adama town), branches of the Family Guidance Association of Ethiopia in Jimma, Adama, and Ziway towns and Marry Joyce in Awassa Town. The regions and the VCT centres were selected based on their high production, widespread use and trade in khat.

Study design: In order to examine whether khat chewing constitutes a statistically valid risk behaviour for exposure to HIV infection, an unmatched case-control study was conducted involving 850 human subjects, i.e. 425 HIV positives or cases, and 425 HIV negatives or controls as determined by a rapid test algorithm and/or western blot. Controls were required to assess why they were negative, while their counterparts are positive, i.e. what do they do that the cases don't or what is that they don't do, but the cases do.

Sample size calculation: Taking a 95% confidence interval (CI), 80% power and assuming exposure among controls to be 49.83% with an odds ratio (OR) of 1.49, the minimum sample size required was found to be 421 according to the statistical calculation programme in Epiinfo version 6.

Selection criteria of study subjects: The subjects selected were those that showed up voluntarily for HIV testing at the VCT centres and were tested either positive or negative for HIV. Their agreement to respond to questions relating

to their probable khat chewing habit and the associated behaviors was taken as an additional selection criterion.

Sampling technique: Each of the 17 VCT centres were provided with 50 copies of the questionnaire, 25 each for case and control subjects who showed up consecutively on their own free will and agreed to cooperate to respond to the issues set out in the questionnaire. Verbal consent of all the 850 subjects who presented themselves to the various VCT centres was thus obtained before administering the pre-tested structured questionnaire. The HIV status of the study subjects was taken as the dependent variable, while khat chewing habit was used as the key independent variable. Other major issues included in the questionnaire were multiple sexual activity and alcohol consumption.

The interviewers were trained HIV counsellors, mostly nurses and physicians working as permanent employees of the respective VCT centres. The counsellors were given orientation by the investigators of this study on how to fill out the questionnaire in consultation with those tested HIV positive (cases) and negative (controls) after blood test was undertaken in the selected centres. All cases and controls at or above the age of 16 years were included for the interview, while those below this age were excluded.

Ascorbic acid quantification in khat leaf: Ascorbic acid, a well known antidote against amphetamine and amphetamine-like substances, was reported to reach as much as 325mg/100g leaf of khat (21). In view of this a quantitative laboratory analysis of ascorbic acid was conducted in this study on the leaves of the six most popular local varieties of khat by adhering to standard phytochemical methods (22).

Data Analysis: Data were entered and analysed using SPSS/PC+ statistical software. The bivariate analysis was used to calculate the crude odds ratio (OR) and a 95% confidence interval (CI). For all statistical significance tests, the cut of value set was $p < 0.05$ as this was considered statistically reliable for analysis of such a study. Since crude OR does not take into account the effect of the confounding variable(s), a multivariate analysis was employed by fitting the logistic regression. Thus, HIV status was inserted as a dependent variable, while khat chewing was taken as a key independent variable along with other influencing factors, viz. age, sex, religion, address, educational status, marital status, alcohol consumption, and recourse to multiple sexual practice.

Results

The study population consisted of 850 individuals. More than 73% of the respondents were in the age group of 16-30 years and most (56.7%) were males. The unemployed and those with primary or less level of education made up 52% and 54.5% of the study subjects, respectively. The unmarried constituted the greater proportion of the respondents as did the Christians and urban residents.

The rate of khat chewing was found to be 41% among the controls and as high as 59% among the cases. An identical rate was observed with respect to alcohol consumption. Sixty three percent of the HIV cases resorted to multiple sexual practices, compared to only 37% of the controls. Females comprised of a significant proportion of the HIV cases compared to males ($p < 0.005$) [OR = 1.48, 95% CI = 1.12, 1.97]. Significantly higher HIV cases were observed among the age group at or above 31 years than those between 16-30 years, among those with primary or lesser levels of education more than those with secondary or higher levels, the married more than the singles, among khat chewers than in the non chewers, and among those who consumed alcohol, and resorted to multiple sexual practice ($p < 0.05$). Although the percentage of HIV cases was higher among the Christians more than the Muslim subjects in this study, the difference was not found to be statistically significant ($p > 0.05$) [Table 1].

In the present study population, HIV cases constituted 50%. In the stratified analysis for khat chewing, chewer controls indulging in alcohol were 37%, while HIV cases comprised 63%. HIV cases who chew and subsequently resorted to multiple sexual practice constituted 68%, while the rate was as low as 32% among the chewer controls. Chewers invariably constituted greater percentages of HIV cases than the non chewers ($p < 0.03$). It appears thus that khat chewing on its own right is a risk factor for higher rate of incidence of HIV cases though there is no significant difference between chewers or non chewers among the HIV cases of the age group at or above 31 years, rural infection along with other influencing factors, viz. age, sex, religion, educational and marital status, and multiple sexual practice. In light of this analysis, the risk of being HIV positive increases 1.97 times by khat chewing; by as much as 4.68 times through multiple sexual practice; by 2.05 times among the age group at or above 31 years; and by 2.71, 2.67, 2.09, and 1.62 times among the females, the less educated, among the married, and the Christians,

residents, married once and those who did not engage in multiple sexual practice ($p > 0.05$). Alcohol consumption and khat chewing are significantly associated, $p < 0.001$ [OR = 5.33, 95% CI = 3.96, 7.18]. There were significantly higher HIV cases among khat chewers who subsequently or concurrently indulged in drinking alcohol than in non chewers, but boozers, $p < 0.001$ (OR = 2.19, 95% CI = 1.39, 3.44).

The percentage of HIV cases was significantly higher among female chewers than non chewers, and among male chewers than in their non chewer counterparts ($p < 0.03$). Despite the higher percentage of HIV cases among chewers, the difference, however, was not significant between chewer or non chewer males who are: at or above 31 years, at primary or lesser levels of education, and those who do not engage in multiple sexual practices; among chewer or non chewer males and females who are: muslims, rural residents and married people ($p > 0.05$). Multiple sexual practice was higher among chewer males than in non chewer males, $p < 0.004$ [OR = 2.18, 95% CI = 1.28, 3.71]. A similar difference was also observed in female chewers compared to non chewers, $p < 0.009$ [Or = 2.40, 95% CI = 1.24, 4.62]. The rate of khat chewing and subsequent recourse to multiple sexual practice was much lower among the control group than in the HIV cases.

The outcome of the final regression model indicated that three variables, i.e., address, occupation and alcohol consumption were dropped. Khat chewing habit, however, emerged as a significant risk predictor for HIV

respectively. These differences are all statistically significant ($p < 0.021$). The result of the crude and adjusted OR is shown in Table 2.

The result of the quantitative determination of ascorbic acid during this study demonstrated the amount for the six local varieties of khat to be far less than 1mg/100g of leaf.

Table 1: Frequency of HIV case and control study subjects by socio-demographic characteristics in VCT centers 2003-2004.

Variable	Number of HIV		OR (95% CI)	P-value	
	Cases (%)	Controls (%)			
Exposure (Age in years)	Exposed (31 years or above)	142 (65)	77 (35)	2.30(1.67,3.17)	0.000
	Not Exposed (16-30 years)	270 (44)	338 (56)		
Exposure (Sex)	Exposed (Female)	204 (56)	163 (44)	1.48(1.12,1.97)	0.004
	Not Exposed (Male)	220 (46)	261 (54)		
Exposure	Exposed				

(Religion)	(Christian)	336 (52)	315 (48)	1.39(0.98,1.95)	0.051
	Not Exposed				
	(Islam)	80 (44)	104 (56)		
Exposure	Exposed				
(Address)	(Urban)	349 (52)	323 (48)	1.46(1.03,2.06)	0.028
	Not Exposed				
	(Rural)	75 (43)	101 (57)		
Exposure	Exposed				
(Occupation)	(Unemployed)	236 (53)	206 (47)	1.33(1.01,1.75)	0.039
	Not Exposed				
	(Employed)	189 (46)	219 (54)		
Exposure	Exposed				
(Educational status)	(Primary level or below)	282 (61)	180 (39)	2.69(2.02,3.59)	0.000
	Not Exposed				
	(Secondary level or above)	142 (37)	244 (63)		
Exposure	Exposed				
(Marital status)	(Married)	163 (60)	109 (40)	1.80(1.34,2.41)	0.000
	Not Exposed				
	(Single)	262 (45)	316 (55)		
Exposure	Exposed				
(Khat chewing)	(Yes)	285 (59)	200 (41)	2.32(1.75,3.07)	0.000
	Not Exposed				
	(Never)	138 (38)	225 (62)		
Exposure	Exposed				
(Alcohol consumption)	(Yes)	252 (59)	176 (41)	2.05(1.55,2.69)	0.000
	Not Exposed				
	(Never)	172 (41)	246 (59)		
Exposure	Exposed				
(Multiple sexual practice)	(Yes)	309 (63)	183 (37)	3.52(2.64,4.69)	0.000
	Not Exposed				
	(Never)	115 (32)	240 (68)		

Table 2: Final model of the logistic regression analysis of HIV cases and controls in VCT centers 2003-2004.

Variable	(HIV+)	(HIV-)	Cases (95% CI)	Controls (95% CI)	Crude OR (95% CI)	Adjusted OR
Exposure						
(Khat chewing)	Exposed					
	(Yes)		285 (59)	200 (41)	2.32(1.75,3.07)	1.965(1.598,2.332)
	Not exposed					
	(Never)		138 (38)	225 (62)		
Exposure	Exposed					
(Age in years)	(31+)		142 (65)	77 (35)	2.30(1.67,3.17)	2.052(1.660,2.445)
	Not exposed					
	(16-30)		270 (44)	338 (56)		
Exposure	Exposed					
(Sex)	(Female)		204 (56)	163 (44)	1.48(1.12,1.97)	2.717(2.349,3.086)
	Not exposed					
	(Male)		220 (46)	261 (54)		
Exposure	Exposed					
(Religion)	(Christian)		336 (52)	315 (48)	1.39(0.98,1.95)	1.628(1.222,3.086)

	Not exposed				
	(Islam)	80 (44)	104 (56)		
Exposure	Exposed				
(Educational status)	(Primary level or below)	282 (61)	180 (39)	2.69(2.02,3.59)	2.678(2.342,3.014)
	Not exposed				
	(Secondary level or above)	142 (37)	244 (63)		
Exposure	Exposed				
(Marital status)	(Married)	163 (60)	109 (40)	1.80(1.34,2.41)	2.092(1.716,2.468)
	Not exposed				
	(Single)	262 (45)	316 (55)		
Exposure	Exposed				
(Multiple sexual practice) (Yes)		309 (63)	183 (37)	3.52(2.64,4.69)	4.683(4.305,5.062)
	Not exposed				
	(Never)	115 (32)	240 (68)		

Discussion

This study showed that 59% of HIV cases were khat chewers compared to 41% in the control group.

Stratified analyses for khat chewing on the one hand, and khat chewing and the sexes on the other, indicated that the percentage of HIV cases was invariably higher among chewers than in non chewers, $p < 0.001$ [OR = 2.32, 95% CI = 1.75,3.07]. High rate of HIV cases in chewers was strongly associated with similarly high rates of multiple sexual activity, $p < 0.001$ [OR = 2.03, 95% CI = 1.36,3.02].

Lose of track of mind induced by khat chewing may have contributed for this higher rate of casual sex among the chewers more than the non chewers. Indeed, the effect of the drug is known to bring about mood swings that vacillate between hypomania and depression. During the hypomanic phase, chewers may not be capable of rational judgement and they also may not be able to predict the serious consequences of their actions. Thus, the chewers could walk into the most dangerous situations, feeling that they are invincible, that there is no danger - morally or physically. Oblivious of the possible dangers to their lives or well-being, they get motivated to venture forth to have unplanned and/or unsafe sex. Analogous situations were shown to exist through pharmacological tests in rats administered with cathinone, which like amphetamine delayed their response time in hot-plate tests (7).

The impairment of memory was also demonstrated in mice as early as the second day of repeated khat ingestion which caused failure to “remember” the consequences of performing an act which had earlier been accompanied by punishment (electric shock) (23). A parallel may be drawn regarding unrestrained behaviors such as engagement in multiple sexual practices among human chewers.

The observation in this study indicated the presence of a strong association between khat chewing and alcohol

consumption. The combined use of both drugs seemed to have a more amplifying effect on the incidence of rate of HIV infections than either drug has individually. For example, the rate of HIV cases was higher among chewer boozers than in non chewer boozers, $p < 0.001$ [OR = 2.19, 95% CI = 1.39, 3.44]. Alcohol inhibits the activity of all neurons of the brain, beginning with the higher cortical or “thinking” centres. Because of the anorexia they feel immediately after chewing, most khat users state that they refrain from drinking to inebriation. However, the small dose they take with the stimulant effect of khat initially depresses the inhibitory neurons, allowing the excitatory ones to take over (24). In doing so it removes the “brakes” from the brain, and it causes the loss of normal restraints on behavior. This may therefore account as one of the reasons for the observed high rate of multiple sexual practice with a consequent high rate of HIV infection among chewer subjects more than the non chewers.

People who use drugs and alcohol are also more likely to start having casual sex which is true even despite the concern about HIV infection. For both males and females, the use of these substances was strongly associated with having sexual intercourse. For example, a study undertaken in the United States demonstrated that males who use alcohol are 40% more likely to have casual sex than those who do not use alcohol, and the likelihood of having sex increases as much as three times by males who use marijuana more than those who do not (25).

For females, the importance of alcohol use is even greater as it increases their chance of having sex 80% more than those who refrain from this substance. Similarly, poly-drug use, for example, marijuana along with other illicit drug(s) was shown to increase the likelihood of having sex in as much as 5 times, more than the non users (26). The strong relationship between drug use and casual sex does not necessarily mean drugs cause sexual activity, but they represent behavior that is associated with the lives of the habitués.

To make matters worse, most chewers, according to one community-based study, have a common misconception about HIV transmission (Debella, pers comm). To them AIDS is a disease imported along with food aid and not transmitted by heterosexual promiscuous activity. Thus, there appears to be little reason for them to change their sexual behavior.

The rate of multiple sexual practice among chewer females was 76% compared to 57% among non chewer females and the difference is significant ($p < 0.008$). This may be a result of the physiological effects of khat and its active constituent. Amphetamine and amphetamine-like substances such as khat bring about negative physical and physiological effects by causing the sustained release of neurotransmitters, like norepinephrine and especially dopamine. Norepinephrine brings about increased sympathetic nervous system (SNS) activity, which not only alerts the system of the body to react instinctively to emergency situations but also thought to have a role in initiating sex drive. Increase in sexual arousal in women is believed to be likely because of increased SNS activity through increase in vaginal pulse amplitude and vaginal blood volume both of which may be enhanced by ephedrine administration or inhibited by clonidine, an antihypertensive drug that blocks sympathetic outflow (27). Nonetheless, this conjecture has yet to be experimentally established for khat chewing females even though it is known that ephedrine and norpseudoephedrine (an stereoisomer of ephedrine) in khat have similar pharmacological effects (28).

Against widely held assumptions, HIV cases were also found to be significantly higher among the married than in singles ($p < 0.001$). This difference, however, does not correlate with the response given by the married about their khat chewing habit or with their multiple sexual activity. Nonetheless, it may still be hypothesised that there is more casual sex being practiced within the married in the assumption that the wed-locked are less promiscuous and hence less likely to be carriers of the virus. The possible explanation would, thus, be that the married were most likely holding back the truth about their sexual life and the adultery they commit which is often considered as immoral and shameful.

The linkage of multiple sexual activity and khat chewing habit as demonstrated by the present case-control study differs from the previous studies that were based on cross-sectional surveys in which most of the respondents were said to loose the desire for sex after khat chewing (10, 6). It is common knowledge that cross-sectional study subjects are often very sceptical of questions, especially those that hinge around their sexual reflexes. This is even more so when the same question is posed to them along with their khat chewing habit as many of them doubt the legality of its use. Thus, any query on issues surrounding the subject

is bound to be considered as an attempt to outlaw khat or the response given as incriminating.

In both sexes khat chewing and multiple sexual practice were strongly associated. The situation is further exacerbated by similar strong linkage that exists between khat chewing habit and indulgence in alcohol. Thus, it goes without saying that chewers are not only the most likely to contract, but also inadvertently spread HIV. This is understandable in view of the fact that people who have more sexual partners are also known to be the least discreet in their sexual encounters. The effectiveness of our HIV prevention programmes, thus critically depend on the extent to which they identify and reduce such risk behaviors among those most likely to contract and spread HIV.

The result of the quantitative determination of ascorbic acid in this study demonstrated the amount for the six local varieties of khat to be far less than 1mg/100g of leaf, which sharply contrasts with previous reports (21). Such scanty quantity is hardly expected to have an antidote effect on the amphetamine-like effect resulting from khat chewing. On the contrary, it was stated that low systemic doses of the acid (50-200mg/kg) enhances the motor-activating effects of amphetamine and amphetamine-like substances (15). This may also be one factor responsible for the significant association between khat chewing, alcohol consumption and multiple sexual activity observed during the present study.

In the present study, khat chewing and its associated behaviors, i.e. alcohol consumption and committing multiple sexual practice were found to be linked more strongly with the increase in HIV cases than in the control group. It is, therefore, safe to state that khat chewing practice constitutes a risk factor for the spread of the HIV epidemic. It is, thus, a serious threat to the well-being of this and future generations of Ethiopia. But unfortunately, it has received very little or no attention so far. The researchers of this study however, believe that the present finding, as much as it calls for further and extended studies, is adequate to stimulate or galvanize the initiation and adoption of pragmatic actions to curb the chewing habit of khat and hence the risk of HIV infection.

Among other things such actions may include, mainstreaming of khat control into the national development planning, poverty alleviation schemes through the production of conventional cash crops that would replace the khat cultivation must be initiated and sustained through establishment of producer cooperatives, micro-credit facilities, as well as grants and extension services.

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