Assessment of Chronic Khat Chewing with Blood Pressure and Predictors of Hypertension Among Adults in Gurage Zone, Southern Ethiopia: A Comparative Study

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Purpose: The leaves of the Khat plant contain amphetamine-like compounds which are implicated in the development of hypertension. The increase in blood pressure coincides with the plasma cathinone level. Other factors associated with hypertension are being overweight, obesity, cigarette smoking, alcohol use, physical inactivity, unhealthy diet, and stress. Thus, this study assessed the association of chronic khat chewing with hypertension and other factors associated with hypertension.

Patients and Methods: A community based comparative cross-sectional study was undertaken from October 5, 2018 to February 15, 2019 in Gurage zone, southern Ethiopia. A total of 1200 adults (600 chewers and 600 non-chewers) aged 18–65 years were selected using a convenience sampling method. The data was collected by an interviewer-administered questionnaire plus physical measurements and were carried out at a fixed time of the day in the morning (7:00 am–10:00 am). Linear regression and binary logistic regression analysis were performed to identify the determinant factors of blood pressure. The test of statistically significant association was declared by using 95% CI and p-value less than 0.05.

Results: A total of 1198 adults participated in the study giving a response rate of 99.8%. The mean age of Khat chewers were 34 (±11.27) and non-chewers were 34.73 (±11.48) years. The mean values of systolic blood pressure and diastolic blood pressure were higher in chewers than in non-chewers (p < 0.001). The prevalence of diastolic blood pressure > 80mmHg was significantly higher among Khat chewers than in non-chewers (17.4% versus 8.7%, p < 0.001). The duration of Khat chewing was significantly associated with systolic blood pressure (Beta coefficient = 0.83, p < 0.001) and diastolic blood pressure (Beta coefficient = 0.51, p < 0.001). The sex, age, BMI and alcohol were significantly associated with both systolic and diastolic blood pressure.

Conclusion: Chronic Khat chewing, male sex, BMI and alcohol were associated with increased systolic and diastolic blood pressure. To assess the cause and effect relationship between chronic Khat chewing and hypertension further studies with better defined cohorts and basic science studies need to be undertaken.

Keywords: chronic khat chewing, systolic blood pressure, diastolic blood pressure

Introduction

Khat was first identified by the botanist Forskal in 1762. There is a long history of Khat chewing in the Horn of Africa and the Arabian Peninsula. Khat chewing for social and psychological reasons has been practiced in Ethiopia for many centuries.
Chronic Khat chewing has also been associated with hypertension. Elevated systolic blood pressure among frequent chewers was fourteen times more compared to less frequent chewers (AOR:14.95, 95% CI:5.49–40.66). Among patients with acute coronary syndrome in Yemen, 72.2% were regular Khat chewers. People who chew Khat regularly have a significantly higher risk of death following stroke and heart failure. Chronic Khat chewing has also been associated with the increased incidence of acute coronary vasospasm and myocardial infarction.

The duration of Khat chewing and the number of hours spent per session of chewing Khat appears to directly associated with hypertension. Those who spent more than 6 hrs in Khat chewing session were almost 9 times more likely to have an elevated diastolic blood pressure compared with those who spent less than 6 hrs (AOR:8.99, 95% CI: 4.85–16.66).

A nationwide survey in Ethiopia showed that 18.7% of youths chewed Khat regularly. In a study conducted in Butajira town, Ethiopia, 50% of adults aged 15 years or older were found to be regular Khat chewers. Despite its adverse health impact, the prevalence of Khat chewing seems to be increasing.

Numerous studies have been undertaken to assess the acute effect of Khat consumption on blood pressure. Few studies have, however, assessed the association of chronic Khat chewing with hypertension. The current study was undertaken to assess the association of chronic Khat chewing with systolic and diastolic blood pressure among adults in the Gurage zone of southern Ethiopia. The study also assessed the association of sex, marital status, level of education, BMI, smoking, alcohol consumption and Khat chewing with the presence of hypertension in this region.

**Materials and Methods**

This study was undertaken in the Gurage zone which is one of the 14 zones of Southern Ethiopia. The administrative center of this zone is Wolkite. Based on the 2015 Central Statistical Agency of Ethiopia report, this zone had a total population of 3,567,377 with an area of 5893.40km². In addition, this zone comprises thirteen districts. Khat is cultivated in all parts of this zone and is widely chewed by both urban and rural communities.

A community based comparative cross-sectional study was conducted from October 5, 2018 to February 15, 2019 to assess the association of chronic chat chewing with blood pressure and predictors of hypertension among adults. All adults aged 18–65 years who met the inclusion...
criteria participated in the study. For Khat chewers the inclusion criteria were adults who chewed Khat for at least four years and in non-chewers there was no history of Khat chewing in their lifetime nor a family or personal history of hypertension. Those who had drunk coffee or alcohol or smoked a cigarette within 4 hrs before data collection plus pregnant women and those who had mental health issues and chronic diseases (renal disease and diabetes) were excluded from the study.

The sample size was calculated using the general formula for comparison of two means i.e. $n = \frac{(S_1^2 + S_2^2) (Z_{\alpha/2} + Z_{\beta})^2}{d^2}$ where, $n$: sample size, $Z_{\alpha/2}$: Z-value corresponding to 95% confidence interval, $Z_{\beta}$: Z-value corresponding to one-sided power of 95%, $S_1$: standard deviation among chewers, $S_2$: standard deviation among non-chewers and $d$: minimum detectable difference. The sample size was estimated by considering the mean (standard deviation) of diastolic blood pressure as 75.0 (11.6) mmHg among Khat chewers and 72.9 (11.7) mmHg among non-chewers reported in a previous study, 95% confidence interval (CI), 95% power, minimum detectable difference of 2.1 mmHg and design effect of 1.5. Substituting the above values to the formula gave a sample of 800. Multiplying it by design effect of 1.5 gave a total sample of 1200. This sample was equally divided into chewers and non-chewers so 600 Khat chewers and 600 non-chewers were included in the study.

Five districts from 13 districts in the Gurage zone were drawn randomly. The five districts selected by the lottery method were Cheha, Ezha, Meskane, Sodo, and Wolkite. The selected districts were then further divided into smaller geographic units within the administrative center (known as kebeles) and four kebeles were drawn from each district making a total of 20 kebeles selected randomly. The total sample size was allocated to the selected districts based on probability proportion. Accordingly, 62 participants from Wolkite, 242 participants from Cheha woreda, 294 participants from Ezha woreda, 318 participants from Meskane woreda and 284 participants from Sodo woreda were selected by convenience sampling methods. Both Khat chewers and non-chewers were selected using similar processes.

Eight health professionals were trained in the main areas of research and methods for data collection. The data were collected by these trained health professionals in collaboration with local health workers. The data were collected in the morning (7:00 am–10:00 am) at time usually free from Khat chewing. All Khat chewers included in the study had to avoid chewing Khat for 8 hrs prior to data collection. This 8 hr gap between chewing Khat and collecting data was aimed to eliminate the acute rise in blood pressure that occurs after chewing Khat. Socio-demographic and other related characteristics of the participants were collected as part of the interviewer-administered questionnaire. After collecting this information, blood pressure measurements were carried out. The blood pressure measurement was taken from the right arm supported at heart level after the participant had been sitting at rest for five minutes and was taken using a mercury BP apparatus. The mean values of three BP measurements were used for analysis. If there was 4mmHg or greater difference within 3 measurements the measurement was repeated once. The internal consistency of measurements across 8 health professionals was examined by Cronbach’s alpha that shown high internal consistency. In addition, the body weight and height of the participants were measured by using standard beam balance and erect height measuring scale. The instruments were calibrated before each measurement.

The level of BP was based on the new ACC/AHA high blood pressure guidelines. Accordingly, BP was categorized as normal (BP < 120/80mmHg), elevated (systolic blood pressure between 120–129 mmHg and diastolic blood pressure < 80mmHg), stage I (systolic blood pressure between 130–139 or diastolic blood pressure between 80–89mmHg) and stage 2 (systolic blood pressure at least 140mmHg or diastolic blood pressure at least 90 mmHg). The body mass index (BMI) of the participants was classified as underweight (BMI < 18.5kg/m²), normal (BMI between 18.5–24.9 kg/m²) and overweight (BMI ≥ 25kg/m²).

To ensure data quality, a pretest was undertaken on 5% of the sample size on people who did not participate in the study. Based on the pretest, necessary corrections such as adjusting the order of questions, adding necessary variables and removing unnecessary variables were performed. The completeness of data was checked daily. In addition, intensive training was given for all data collectors and double data entry was done to ensure quality.

The data were entered and analyzed using SPSS version 23. The results were described by using texts and tables. Descriptive statistics were used to summarize socio-demographic and other related characteristics of the participants. Bivariate and multiple linear regression and binary logistic regression analysis were performed to identify the determinant factors of blood pressure. The test of statistically significant association was declared by using 95% CI and p-value less than 0.05.
Results
Socio-Demographic Characteristics
1198 adults participated in the study giving a response rate of 99.8%. Of the total study participants, 647 (54.0%) were males with 328 Khat chewers and 319 non-chewers. From the total sample, 876 (73.1%) respondents had normal BMI values and 1024 (84.5%) respondents were urban residents. The mean (SD) age of Khat chewers and non-chewers were 34.0 (± 11.27) years and 34.73 (± 11.48) years, respectively. Intake of dietary salt was low among all study participants. Both groups were comparable and there were no significant differences between the two groups in terms of sex, marital status, residence, level of education, body mass index and mean age (p > 0.05) (Table 1).

Khat Chewing Status of the Chewers
Three hundred fifty-three (58.9%) of the chewers had a history of regular Khat chewing for 4–10 years. Three hundred fifty-four (59.1%) Khat chewers started due to peer pressure. The remaining, 217 (36.2%) and 28 (4.7%) chewers reported that they started to chew Khat to stay awake or due to family pressure. Most of the chewers, 342 (57.1%) chewed Khat daily and 360 (60.1%) chewers spent 2–3 hrs per each chewing session (Table 2).

Alcohol Intake and Smoking Status
Among the total study participants, 151 (12.6%) respondents had a history of cigarette smoking. The majority of the smokers, 90 (59.6%) smoked 3–5 cigarettes per day followed by 47 (31.1%) who smoked 6–10 cigarettes per day and the remaining, 14 (9.3%) smoked more than 10 cigarette per day. Most of the smokers, 139 (92.1%) were also Khat chewers and smoking was significantly associated with Khat chewing (p < 0.001). With regard to consuming alcohol, 537 (44.8%) participants were consumers of alcohol. Among the participants with an alcohol history, 142 (26.4%) consumed alcohol daily followed by 202 (37.6%) who consumed alcohol three times per week and the remaining, 193 (36.9%) consumed alcohol occasionally. Alcohol drinking was significantly associated with Khat chewing (p < 0.001) (Table 3).

Blood Pressure
The mean systolic blood pressure was significantly higher among Khat chewers compared with non-chewers (122.22 ±17.84mmHg versus 109.25 ± 15.08mmHg, mean difference = 12.96mmHg [95% CI 11.09, 14.83], p < 0.001). Similarly, the mean diastolic blood pressure was significantly higher among Khat chewers compared with non-chewers (75.71 ± 12.21 mmHg versus 68.08 ± 11.31 mmHg, mean difference = 7.64 mmHg [95% CI 6.30, 8.97], p < 0.001). The prevalence

| Variables | Non Chewer (n = 599) | Chewer (n = 599) | p-value |
|-----------|----------------------|-----------------|--------|
| Residence |                      |                 |        |
| Urban     | 505 (84.3%)          | 519 (86.6%)     | 0.251  |
| Rural     | 94 (15.7%)           | 80 (13.4%)      |        |
| Sex       |                      |                 |        |
| Male      | 319 (53.3%)          | 328 (54.8%)     | 0.602  |
| Female    | 280 (46.7%)          | 271 (45.2%)     |        |
| *Age (years) |                 |                 |        |
|           | 34.0 (11.27)         | 34.73 (11.48)   | 0.335  |
| Marital status |                  |                 |        |
| Married   | 289(48.2%)           | 311(51.9%)      | 0.101  |
| Single    | 290(48.4%)           | 258(43.1%)      |        |
| Widow/widower |               | 13(2.2%)       |        |
| Divorced  | 7(1.2%)              | 16(2.7%)        |        |
| Religion  |                      |                 | < 0.001|
| Orthodox  | 323(53.9%)           | 312(52.1%)      |        |
| Muslim    | 172(28.7%)           | 244(40.7%)      |        |
| Protestant| 73(12.2%)            | 29(4.8%)        |        |
| Others    | 31(5.2%)             | 14(2.4%)        |        |
| Ethnicity |                      |                 | < 0.001|
| Gurage    | 418(69.8%)           | 469(78.3%)      |        |
| Amhara    | 95(15.8%)            | 28(4.7%)        |        |
| Kebena    | 16(2.8%)             | 31(5.2%)        |        |
| Oromo     | 47(7.8%)             | 23(3.8%)        |        |
| Other     | 23(3.8%)             | 48(8.0%)        |        |
| Level of education |              |                 | 0.115  |
| Illiterate | 74(12.5%)          | 67(11.2%)       |        |
| Primary school | 134(22.4%) | 161(26.9%) |        |
| Secondary school | 164(27.4%) | 167(27.9%) |        |
| Diploma and above | 227(37.9%) | 204(33.6%) |        |
| Occupation |                    |                 | < 0.001|
| Merchant   | 130(21.7%)           | 127(21.2%)      |        |
| Government employed | 166(27.7%) | 146(24.4%) |        |
| Self employed | 108(18.0%) | 141(23.5%) |        |
| Unemployed | 42(7.0%)             | 57(9.5%)        |        |
| Daily labors | 25(4.2%)     | 79(13.2%)      |        |
| Others    | 128(21.4%)           | 53(10.7%)       |        |
| BMI (kg/m²) |                  |                 | 0.104  |
| < 18.5    | 77 (12.9%)           | 61(10.2%)       |        |
| 18.5–24.9 | 441(73.6%)           | 435(72.6%)      |        |
| ≥ 25      | 81(13.5%)            | 103(17.2%)      |        |

Note: *Data are expressed in mean (standard deviation). Abbreviation: BMI, Body Mass Index.
of diastolic blood pressure greater than 80mmHg was significantly higher among Khat chewers than in non-chewers (17.4% versus 8.7%, p < 0.001). Based on the new ACC/AHA high blood pressure guidelines, the prevalence of hypertension was 55.8% among Khat chewers and 22.7% among non-chewers (Table 4).

Association of Chronic Khat Chewing and other predictors with Blood Pressure

In simple linear regression analysis, sex, age, BMI, alcohol intake, duration of smoking cigarettes and Khat chewing duration were significantly associated with both systolic and diastolic blood pressure. These variables with significant association on bivariate analysis were further analyzed using multiple linear regression models to identify independent predictors of systolic and diastolic blood pressure.

After adjusting for these variables; sex, BMI, alcohol amount and Khat chewing duration remained significantly associated with systolic and diastolic hypertension. Females had a significantly lower risk of hypertension with a beta coefficient of 2.86 in comparison with males (Tables 5 and 6).

Binary logistic regression analysis showed that there was a significant association between chronic Khat chewing and hypertension. Participants with a history of 4–10 years of Khat chewing had 2.83 times higher risk of developing hypertension than non-chewers. Other variables such as age, BMI, history of alcohol intake and smoking history were also significantly associated with hypertension (Table 7).

Discussion

Khat is readily available in Ethiopia and it is a highly valued export commodity. The number of Khat chewers is increasing and its consumption has become popular in all parts of the Ethiopian population.25 As the consumption of Khat is continuing to increase in Ethiopia, more studies are needed to assess association and adverse effects of Khat consumption on blood pressure. This study aimed to investigate the association of chronic Khat chewing on systolic and diastolic blood pressure and predictors of hypertension.
This study demonstrated a significant association of blood pressure with chronic Khat chewing. The mean systolic and diastolic blood pressure of the chewers was significantly higher than non-chewers. In line with this result, another study showed that the mean diastolic blood pressure among Khat chewers was significantly higher than in non-chewers. Increased risk of hypertension in those who consumed large amounts of ethanol (≥ 210 gram per week) compared with those who did not consume alcohol over the 6 years of follow-up. High intake of alcohol stimulates the release of endothelin 1 and 2 as well as angiotensin II which are known to be potent vasoconstrictors. The association of prolonged and large amounts of alcohol intake with hypertension may also be explained by the large number of calories in alcohol that can result in unwanted weight gain which in itself is a risk factor for hypertension.

This study also demonstrated that there was significant association between BMI with systolic and diastolic blood pressures. This finding was is consistent with another study which reported that there was a significant positive correlation among BMI, systolic and diastolic hypertension. Furthermore, it showed that overweight/obese subjects were more likely to have hypertension than those with normal BMI.

### Table 5: Simple and Multiple Linear Regression Model Examining the Association Between Different Variables with Systolic Blood Pressure Among Adults in Gurage Zone, Southern Ethiopia, 2019 (n = 1198)

| Variables       | Simple Linear Regression | Multiple Linear Regression |
|-----------------|--------------------------|----------------------------|
|                 | Beta Coefficient | SE  | 95% CI for Beta Coefficient | p-value | Beta Coefficient | SE  | 95% CI for Beta Coefficient | p-value |
| Sex             | −3.72 | 1.02 | (−5.73, −1.71) | < 0.001 | −2.91 | 0.92 | (−4.71, −1.06) | 0.002 |
| Age             | 0.44  | 0.04 | (0.36, 0.53) | < 0.001 | 0.19  | 0.04 | (0.10, 0.28) | < 0.001 |
| BMI             | 0.55  | 0.15 | (0.25, 0.84) | < 0.001 | 4.03  | 0.88 | (2.30, 5.75) | < 0.001 |
| Alcohol amount  | 2.17  | 0.28 | (1.60, 2.73) | < 0.001 | 1.14  | 0.27 | (0.60, 1.68) | < 0.001 |
| Smoking duration| 0.49  | 0.11 | (0.27, 0.71) | < 0.001 | 0.00  | 0.11 | (−0.21, 0.21) | 0.999 |
| Chewing duration| 1.02  | 0.59 | (0.90, 1.13) | < 0.001 | 0.83  | 0.06 | (0.70, 0.96) | < 0.001 |

Note: Numerical data in bold indicates statistically significant (p < 0.05).
Abbreviations: BMI, body mass index; SE, standard error; CI, confidence interval.

### Table 6: Simple and Multiple Linear Regression Model Examining the Association Between Different Variables with Diastolic Blood Pressure Among Adults in Gurage Zone, Southern Ethiopia, 2019 (n = 1198)

| Variables       | Simple Linear Regression Model | Multiple Linear Regression Model |
|-----------------|--------------------------------|---------------------------------|
|                 | Beta Coefficient | SE  | 95% CI for Beta Coefficient | p-value | Beta Coefficient | SE  | 95% CI for Beta Coefficient | p-value |
| Sex             | −2.35  | 0.71 | (−3.76, −0.95) | < 0.001 | −1.96 | 0.67 | (−3.28, −0.64) | 0.004 |
| Age             | 0.20   | 0.03 | (0.14, 0.26) | < 0.001 | 0.05  | 0.03 | (−0.01, 0.11) | 0.105 |
| BMI             | 0.47   | 0.10 | (0.27, 0.68) | < 0.001 | 0.45  | 0.09 | (0.25, 0.64) | < 0.001 |
| Alcohol amount  | 1.24   | 0.20 | (0.84, 1.64) | < 0.001 | 0.69  | 0.20 | (0.29, 1.09) | < 0.001 |
| Smoking duration| 0.18   | 0.79 | (0.02, 0.33) | 0.026  | −0.09 | 0.07 | (−0.24, 0.06) | 0.251 |
| Chewing duration| 0.57   | 0.43 | (0.49, 0.65) | < 0.001 | 0.50  | 0.05 | (0.41, 0.60) | < 0.001 |

Notes: Numerical data in bold indicates statistically significant (p < 0.05).
Abbreviations: BMI, body mass index; SE, standard error; CI, confidence interval.
The current study demonstrated that there was no significant difference in BMI among chewers and non-chewers. This is not consistent with other studies that suggest that Khat chewing is associated with appetite suppression. Khat has behavioral, chemical and neurophysiological effects on appetite and metabolism that result in reduced body weight. The difference in our study may be due to the alcohol intake which was associated with chronic Khat chewing. The alcohol consumers could be replacing these calories from alcohol.

We found that the duration of Khat chewing and time spent at each chewing session were associated with elevated systolic blood pressure. A study conducted in northern Ethiopia revealed that those who spent more than 6 hrs in a Khat session were 7.25 times more likely to have elevated systolic blood pressure compared to those who spent less than 6 hrs. This is probably due to Khat or its active alkaloid cathinone impacting on both heart rate and contractility, thus increasing cardiac output, which is a major determinant of mean systolic blood pressure.

Increased systolic blood pressure was significantly associated with chronic Khat chewing in our study. This is in line with another study that showed chronic Khat chewing was significantly associated with elevated systolic blood pressure. However, another study showed a non-significant positive association between systolic blood pressure and Khat chewing. The difference in the findings may be due to differences in duration, amount and frequency of Khat chewing and differences in the study populations studied.

In the present study, the participants who chewed Khat for 4–10 years and greater than 15 years had 2.83 and 3.95 times more likely to develop hypertension as compared to non-chewer. This result indicated that blood pressure increases with increasing duration of khat chewing. The frequency of Khat chewing had also a significant positive association with blood

Table 7 Factors Associated with Hypertension Among Adults in Gurage Zone, Southern Ethiopia, 2019 (n =1198)

| Variables            | Hypertension |       | COR (95% CI) | AOR (95% CI) |
|----------------------|--------------|-------|--------------|--------------|
|                      | No, n (%)    | Yes, n (%) |              |              |
| **Sex**              |              |       |              |              |
| Male                 | 375(58)      | 272(42) | 1            |              |
| Female               | 353 (64.1)   | 198(35.9)| 0.77(0.61,0.97)| 0.79(0.61, 1.04) |
| **Age (years)**      |              |       |              |              |
| 15–24                | 130 (69.1)   | 58(30.9)| 1            |              |
| 25–34                | 344(67.5)    | 176(32.5)| 1.18(0.82, 1.69)| 1.01 (0.67,1.51) |
| ≥ 45                 | 116(47.54)   | 128(52.46)| 1.63 (1.10, 2.43)| 1.38 (0.86, 2.20) |
| **BMI**              |              |       |              |              |
| Under weight         | 101(73.20)   | 37(26.80)| 1            |              |
| Normal               | 545(62.20)   | 331(37.80)| 1.65 (1.11, 2.47)| 2.38 (1.49, 3.81) |
| Over weight          | 82(44.60)    | 102(55.4)| 3.39 (2.11, 5.46)| 4.91 (2.83, 8.54) |
| **Alcohol**          |              |       |              |              |
| No                   | 465(70.3)    | 196(29.6)| 1            |              |
| Yes                  | 263(49.0)    | 274(51.0)| 2.47 (1.95, 3.13)| 1.85 (1.24, 2.75) |
| **Smoking**          |              |       |              |              |
| No                   | 683(65.2)    | 364(34.8)| 1            |              |
| Yes                  | 45(29.8)     | 106 (70.2)| 4.42 (3.04, 6.40)| 2.65 (1.75, 4.02) |
| **Chewing duration**|              |       |              |              |
| Non chewer           | 463(77.0)    | 138(23.0)| 1            |              |
| 4–10 years           | 182(51.6)    | 171 (48.40)| 3.15 (2.37, 4.18)| 2.83 (2.04, 3.90) |
| ≥11 years            | 59 (45.0)    | 72 (55.0)| 4.09 (2.76, 6.06)| 3.95 (2.75, 5.67) |

Note: 1- reference group, numerical data in bold indicates statistically significant (p < 0.05).
Abbreviations: BMI, Body mass index; COR, crude odds ratio; AOR, adjusted odds ratio.
pressure. In line with our finding, a further study revealed that elevated systolic blood pressure among male chewers who chewed frequently was fourteen times greater than those who chewed less frequently.\textsuperscript{18}

The present study also demonstrated that there is a significant positive association between chronic Khat chewing and diastolic blood pressure. This finding supports earlier reports that have shown regular Khat chewing was associated with elevated diastolic blood pressure.\textsuperscript{8,11,12,18,36–39} Beyond the transient rise in blood pressure due to the acute effect of Khat, persistent vasoconstriction may develop secondary to the prolonged effect of cathinone. Hence, elevated diastolic blood pressure due to chronic Khat chewing may be explained by persistent and sustained peripheral vasoconstriction.\textsuperscript{8,9}

The duration, frequency and amount of Khat chewed had a direct association with blood pressure. This may be due to the continuous effect of cathine and cathinone on the heart and peripheral blood vessels. This is in line with a study that showed cathinone is detectable in blood up to 10 hrs after ingestion. Frequent chewing of Khat for long periods will expose chewers to the much longer effects of cathine and cathinone.\textsuperscript{9}

This study had some limitations. First, it is not known whether the association of chronic chewing with systolic and diastolic blood pressure is due to cathinone or other Khat constituents. Khat contains many different compounds and we did not identify the specific compounds in this study. Second, the study was based on self-reported Khat chewing duration which may be subjected to recall bias. Finally, we could not identify the level of physical activity, level of stress exposure, negative affect, lipid profile, asymptomatic cardiovascular or other systemic diseases that may affect the results of our study.

Conclusions
The current study has shown that long term Khat consumption is associated with increased systolic and diastolic blood pressure. A considerably higher proportion of Khat chewers than non-chewers developed hypertension. Other socio-demographic factors such as sex, BMI, and alcohol intake were significantly associated with hypertension. To assess the cause and effect relationship between chronic Khat chewing and hypertension further studies with better defined cohorts and more basic science studies need to be undertaken.

Abbreviations
BP, Blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index; SD, standard deviation; COR, crude odds ratio; AOR, Adjusted odds ratio; CI, confidence interval; SE, standard error.

Consent for Publication
Not applicable.

Ethics Approval and Informed Consent
The study was reviewed, ethically approved and written ethical clearance was obtained from the Institutional Review Board (IRB) of Wolkite University with ethical approval reference number IRB/56/8/2010. Then, the letter of permission to conduct the study was obtained from the district’s health office. The study participants were briefed about the study and written informed consent was obtained before the data collection. Confidentiality of the respondents’ information was kept throughout the study.

Data Sharing Statement
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Author Contributions
TGG and GGW conceived and designed the study, supervised the data collection. Then all authors contributed to data analysis, drafting and revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.
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Disclosure
The authors declare that they have no competing interests.

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