

## Electrocardiogram Alteration and its Association with Khat Chewing: A study in Jimma Town, Ethiopia

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### Abstract

**Background:** The electrocardiogram has become the most commonly performed cardiovascular test and an essential diagnostic tool in clinical cardiology. Increasing evidences suggest that long-term khat chewing may have powerful implications on the cardiovascular system. However; very few studies have focused on the association between khat chewing and ECG alteration.

**Objective:** To asses Electrocardiogram alteration and its association with khat chewing in Jimma town, Southwest Ethiopia.

**Method:** In this study, a cross-sectional, house-to-house survey on the representative sample of 342 persons, age  $\geq 18$  years, was conducted in Jimma town, southwestern Ethiopia, from March to April 2016. Sociodemographic characteristics, khat chewing history and ECG record (by standard 12-lead) data were collected. Kebeles, household, one member of a family in each household was chosen by the lottery method. Collected data was checked for its completeness and coded then entered to Epi-data 3.1 version and then exported to SPSS version 20 window for analysis. Descriptive statistics, binary and multivariate logistic regression analyses were applied to compute the variables.

**Results:** There was a significant statistical association between age, khat chewing and ECG alteration. The most prevalent altered ECG finding was high heart rate 28(47.46%), followed by myocardial infarction 12(20.34%).

**Conclusion:** This work and previous studies demonstrated that age, chronic khat chewing and increase in systolic blood pressure have effect on ECG alteration.

**Recommendation:** Health promotion interventions should aim to prevent cardiovascular system diseases. Policy makers should design strategies to control the production, usage and distribution of khat.

**Keywords:** ECG alteration; khat chewing

### Introduction

#### Theoretical background and statement of the problem

Electrocardiography (ECG) is a transthoracic interpretation of the electrical activity of the heart over a period of time, as detected by electrodes attached to the surface of the skin and recorded by a device external to the body is commonly used, noninvasive procedure the record which is called an electrocardiogram [1].

The electrocardiogram introduced into clinical practice more than 100 years ago by William Einthoven, comprises a linear recording of cardiac electrical activity as it occurs over time [2]. Physiological factors that affect ECG wave forms include sex, age, ethnicity, height, weight, torso morphology, body mass index, and pregnancy [3].

Khat or *Catha edulis* is an indigenous plant in Yemen, Ethiopia and East Africa, which has sympathomimetic and euphoriant effects [4]. The phenylpropylamine-type alkaloid cathinone is the major component responsible for the effects of khat on the heart and blood vessels. Cathinone is structurally and functionally similar to amphetamine [5].

The cardiovascular changes, induced by chewing khat, show evidence of a significant rise in arterial systolic and diastolic blood pressure and pulse rate with a peak effect of three hours after starting chewing khat. These changes run parallel with the changes in plasma Cathinone levels during and after khat chewing [4]. Regular chewing of Khat is associated with elevated mean diastolic blood pressure, which is consistent with the peripheral vasoconstrictor effect of Cathinone [6]. As we have seen from the above review a lot of researches proved

that consumption of khat results in increased heart rate. Therefore, the main objective of this study is to assess the association between ECG alteration and khat use. While the specific objectives of the studies are as follows

- To describe the association between ECG alteration and sociodemographic variables.
- To determine the association between ECG alteration and khat chewing.
- To describe the association between ECG alteration and blood pressure.

### Literature Review

#### ECG and sociodemographic characteristics

There is substantial evidence that males and females differ regarding their cardiac electrophysiology. This is assumed to be due to the intrinsic

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Received January 20, 2017; Accepted February 06, 2017; Published February 16, 2017

Citation: Almaz A, Andualem M, Amare D, Samuel T (2017) Electrocardiogram Alteration and its Association with Khat Chewing: A study in Jimma Town, Ethiopia. Anat Physiol S6: 008 doi:10.4172/2161-0940.S6-008

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differences of the cardiac cells like differential properties of ion channels or due to different sex hormones. Testosterone, in males alters QT interval by affecting electrolytes and ion channels. Similarly, estrogen can enhance refractory period by affecting potassium channels [7]. This response to estrogen involves cGMP-dependent phosphorylation of the potassium channel or a closely associated regulatory molecule, and further evidence suggests involvement of the Ca NO/cGMP signaling system in coronary smooth muscle [8].

### Ecg and khat

The growing use of Khat has motivated an interest in further knowledge of its active ingredients and their biological effects. There are three main alkaloids present in khat leaves S-(-)-cathinone (s-aminopropiophenone), norepseudoephedrine (cathine) and norephedrine [9].

The main component of khat is cathinone, which is structurally and functionally similar to amphetamine and cocaine. Several studies have demonstrated that khat chewing has unfavorable cardiovascular effects [5]. Cathinone may enhance the production of vasoconstrictor agents like angiotensin-II or may inhibit the production and action of nitric oxide, which is a potent vasodilator. Amphetamine produces its effects by activating neurotransmission mediated by the Catecholamine, noradrenaline and dopamine; in particular by releasing these neurotransmitters from their physiological storage sites. Cathinone is also capable of releasing dopamine, noradrenaline and serotonin from synaptic terminals [10-12]. The key observation demonstrating this is the finding that - Cathinone and + amphetamine have the same mechanism of action in that both substances induce the release of dopamine from CNS terminals and thus increase the activity of dopaminergic pathways [10,13].

Khat chewing induces small and transient rises in blood pressure and heart rate. Cathinone (0.5 mg base/kg of body weight) has similar effects coinciding with the presence of cathinone in blood plasma [14].

The Amphetamine-type stimulants are the second most widely used drugs globally. QT interval prolongation after the use of amphetamine-type stimulants has been reported, and few studies have reported the effects of concurrent use of amphetamines and methadone on QTc change [10].

## Methods and Material

### Study design

Community based cross-sectional study was employed.

The study population was all sampled people of Jimma town 18 years and above.

### Sample size determination and sampling techniques

Sample size was determined using single population proportion formula taking an estimated 17% of ECG alteration from the study done in Addis Ababa [13] with the assumption of 95% CI.

$n$ =the desired sample size

$z$ =the standard normal deviate, set at 1.96 which corresponds to 95% confidence level,

$p$ =17% the proportion of ECG alteration. This gives as maximum sample size

$d$ =Permitted error (5%, for the confidence level is 95%)

Therefore  $n=1.96 \times 1.96 \times (0.17 \times 0.83)/(0.05 \times 0.05)=217$

$N=217 \times 1.5=326$

Systematic multistage sampling methods was used. By adding non-response rate of 5% and design effect of 1.5 Therefore, the total sample size of the study was 342

Then after, sample was proportionally allocated in each sub group using the formula

$n_j=n/N \times N_j$

where,  $n$ =HH sample size=342

$N$ =total HH=15444

$N_j$ =total number of HH in each Kebeles

### Data collection material

- Interviewer –administered questionnaire was used.
- Digital Electrocardiography
- BP-cuff
- Stethoscope

### Recording of ECG

Standard 12-lead electrocardiogram recorded with a paper speed of 25mm per second and [15].

Machine: Electrocardiography, MODEL NO. YSIPL-155

**Calibration:** The 1 mV=10 mm standardization pulse at the beginning of an ECG allows clinicians to visually confirm a proper calibration setting [16].

### Blood pressure (BP)

After 5-10 minutes of rest in a sitting position, BP was measured for all patients for bilateral arm using sphygmomanometer with the appropriate cuff size. At 5 minute apart three measurements were taken and average measurement taken for analysis.

### Data analysis procedure

After checking the collected data for completeness, it was entered in to Epi-data version 3.1 and exported to SPSS version 20 for windows. Descriptive statistics, binary and multivariate logistic regression were employed to see associations of dependent and independent variables. Then p-value less than 0.05 were set to determine significantly associated variables.

## Results

Out of the total of 342 participants in the study, 326 underwent all the study components, giving a response rate of 95.3%. While 16 (4.7%) of sampled individuals were excluded due to the incompleteness of their data.

Figure 1,2 Shows among the study subject ECG alteration were accounted 59(18.1%).

As per Table 1,2 below shows from those ECG altered study subjects 11(23.74%) had ST Segment deviation, 28(47.45%) had T-wave abnormality, 7(11.86%) had Prolongation of QT interval, 3(5.09%) had prolonged QRS interval, 3(5.09%) had R wave amplitude increased and 4(6.77%) had Short PR interval.

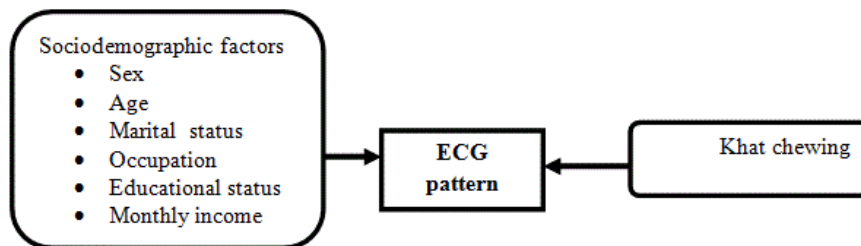


Figure 1: Conceptual framework showing potential risk factors of ECG alteration in Jimma town 2016.

Variable	category	Frequency	Percent
duration khat chewing	<6 month	7	6.54
	6 month-1 year	6	5.61
	1 year-2 years	4	3.73
	>2 years	90	84.11
frequency of khat chewing	everyday	30	28.04
	3-2 days per week	30	28.04
	once per week	20	18.69
	occasionally	27	25.24
amount of khat chew per day	<20 birr	91	85.05
	20-30 birr	15	14.01
	>40 birr	1	0.94

Table 1: Frequency of Life style characteristics.

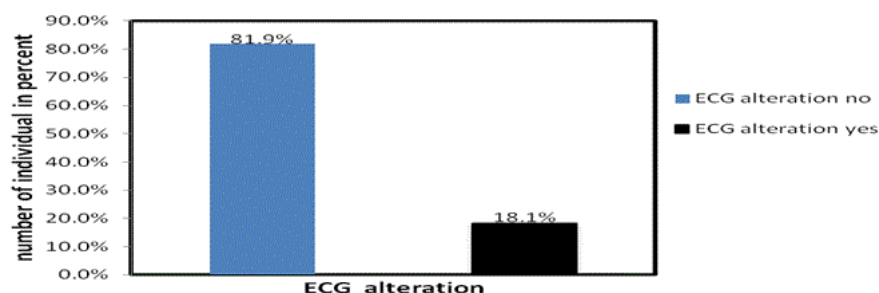


Figure 2: Altered ECG waves alteration among study subject.

Variables	Frequency	Percent (%)
ST segment deviation	14	23.74
T-wave abnormality	28	47.45
Prolongation of QT interval	7	11.86
Short PR interval	3	5.09
R wave amplitude increased	3	5.09
Prolonged QRS interval	4	6.77
Total	59	100

Table 2: Altered ECG waves alteration among study subject.

As indicated on figure 3 ECG alteration finding in electrical axis abnormality, heart rate abnormality, arrhythmia, MI and Atrial or ventricular hypertrophy which accounts for 7(11.86%), 28(47.46%), 3(5.09%), 12(20.34%) and 9(15.25%) respectively.

### Binary logistic regression analysis for sociodemographic characteristic and ECG alteration of the study subject

As can be seen from table 3 below in binary logistic regression analysis sociodemographic characteristic age significantly associated with the ECG alteration.

### Blood pressure and ECG alteration

As can be seen from table 4 below in binary logistic regression analysis chronic khat chewing, SBP and DBP were significantly associated with the ECG alteration on bivariate analyses.

### Multivariable logistic regression models independent variable ECG alteration of the study subject

It was observed that age group 25-34 was nearly 5 times more likely to have ECG alteration than age group 18-24 years (AOR=4.669

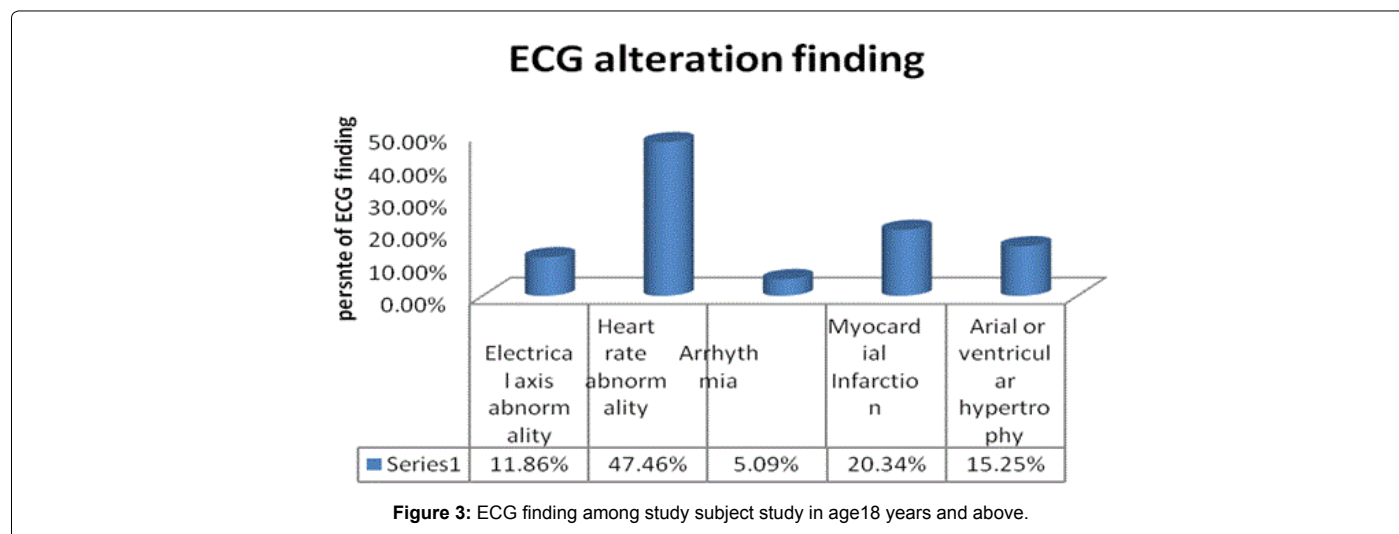


Figure 3: ECG finding among study subject study in age 18 years and above.

Variable		ECG alteration			COR(95% CI)	P -value
		Total(n=326) n (%)	Yes (n=59) n (%)	No (n=267) n (%)		
Age	18-24	125(38.3)	11(20.4)	111(41.6)	1r	
	25-34	82(25.2)	19(35.2)	61(22.8)	0.341(0.14-0.82)	0.030*
	35-49	60(18.4)	11(20.1)	49(18.0)	1.067(0.48-2.38)	0.874
	>=50	59(18.1)	13(24.1)	46(16.9)	0.794(0.33-1.95)	0.615
Sex	Male	201(61.7)	39(66.1)	162(60.7)	1.07(0.59-1.96)	0.829
	Female	125(38.3)	20(33.9)	105(39.3)	1r	
Religion	Orthodox	126(38.7)	17(31.5)	109(41.0)	0.47(0.46-4.76)	0.521
	Muslim	147(45.1)	26(48.1)	121(44.5)	0.65(0.64-6.45)	0.709
	Protestant	38(11.7)	9(16.7)	29(10.7)	0.93(0.86-10.09)	0.953
	Catholic	11(3.4)	1(1.9)	10(3.7)	0.30(0.02-6.38)	0.440
Ethnicity	Other	4(1.2)	1(1.9)	3(1.1)	1r	
	Oromo	207(63.5)	38(70.4)	169(62.1)	1r	
	Amhara	73(22.4)	14(25.9)	59(21.7)	0.95(0.48-1.87)	0.887
	Tigre	10(3.1)	2(3.7)	10(3.7)	1.65(0.47-5.79)	0.435
	keffa	26(8.0)		26(9.6)	1.35(0.38-4.81)	0.644
	others	10(3.1)		8(2.9)	<0.01(0.00-0.00)	0.998
	Marital status	Single	120(36.8)	13(24.1)	107(39.3)	1r
	Married	184(56.4)	38(70.4)	146(53.7)	1.88(0.99-3.59)	0.55
	Divorced	11(3.4)	1(1.9)	10(3.7)	0.70(0.08-5.86)	0.74
	Widowed	11(3.4)	2(3.7)	9(3.3)	2.63(0.63-11.1)	0.18
occupation	Employed	125(38.3)	23(42.6)	102(37.5)	1r	
	House wife	64(19.6)	8(14.8)	56(20.6)	0.60(0.253-1.427)	0.411
	Dailey laborer	56(17.2)	8(14.8)	48(17.6)	0.95(0.41-2.07)	0.248
	Merchant	37(11.3)	9(16.7)	28(10.3)	1.56(0.67-3.65)	0.831
Income	Others	44(13.5)	6(11.1)	38(14.0)	0.66(0.25-1.75)	0.307
	<1000	174(53.4)	29(49.2)	145(54.3)	1r	
	1000-2000	110(33.7)	23(39.0)	87(32.6)	1.00(0.40-2.47)	1.00
>2000	42(12.9)	7(11.9)	35(13.1)	1.32(0.52-3.35)	0.55	

Table 3: Binary logistic regression analysis for the association between sociodemographic characteristic and ECG alteration among study subject.

[95% CI: 1.757, 12.411]). Similarly, study participants who chewed khat were nearly 2 times more likely to have ECG alteration than those individuals who were not chewing khat (AOR=2.150 [95% CI: 1.015, 4.557]). Regarding systolic blood pressure (mean ± SD) a unit increase in the systolic blood pressure increases ECG alteration by 1.04.

## Discussion

Previous studies show that habitual khat chewing adverse effects on the physical, physiological, economical and psychosocial wellbeing of the productive section of the society [9]. There are only very few

communities based studies done in Ethiopia to determine ECG alteration and its association with khat chewing, sociodemographic characteristic and BP.

This study revealed that the prevalence of ECG alteration in Jimma town was 18.1% (n=59) out of a total of 326 subject. This figure is relatively similar with past research finding [13]. According to the present study, there is significant association (p<0.046) between chronic khat chewing and ECG alteration. This study supports the finding of past study [6] Table 5.

Variables		ECG altered			COR(95% CI)	P -value
		Total(n=326) N (%)	Yes (n=59) N (%)	No (n=267) N (%)		
SBP	<90	26(8.0)	7(11.9)	19(7.1)	1 <sup>r</sup>	
	90-139	273(83.7)	43(72.9)	230(86.1)	2.471(0.71-8.62)	0.156
	≥ 140	27(8.3)	9(16.9)	18(6.7)	0.36(0.15-0.86)	<b>0.22*</b>
DBP	<60	46(14.1)	10(14.8)	36(13.5)	1 <sup>r</sup>	
	60-90	275(84.4)	47(79.7)	228(85.4)	0.84(0.08-8.57)	0.885
	>90	5(1.5)	2(3.4)	3(1.1)	0.78(0.09-7.17)	0.828
chronic khat use	No	219(67.2)	32(54.2)	187(70.0)	1 <sup>r</sup>	
	Yes	107(32.8)	27(45.8)	80(30.0)	0.46(0.25-0.83)	<b>0.010</b>

\*- candidate variables at p<0.25 for Multivariate analyses, 1<sup>r</sup>=reference

**Table 4:** Binary logistic regression analysis of blood pressure and ECG alteration among study subject in Jimma town Southwest Ethiopia, From March to April 2016.

Model	B	P	AOR	95% C.I Lower	Upper
Sex					
Female	-0.306	0.432	0.736	0.343	1.582
Male			1 <sup>r</sup>		
Age					
18-24			1 <sup>r</sup>		
25-34	1.541	0.002	4.669	1.757	12.411
35-49	0.623	0.27	1.865	0.616	5.64
≥ 50	0.446	0.453	1.562	0.488	5.001
SBP(mmHg)	0.04	0.047	1.04	1.001	1.082
DBP(mmHg)	-0.031	0.317	0.969	0.911	1.031
Life time Khat Use					
Yes	0.766	0.046	2.15	1.015	4.557
No			1 <sup>r</sup>		

Bold=significant independent variables (at p<0.05), 1<sup>r</sup>=reference.

**Table 5:** Multivariate logistic regression analysis for the association of different variable with ECG alteration among study subject.

In present study the age range from 25-35 years have been significantly associated with ECG alteration (p<0.002). as per past finding khat chewing was more frequent in the age group between 16 and 45 years and less common above the age of 55 [15]. Similar study is done outside Ethiopia which explains that both amplitudes and intervals of ECG waveforms change as person become older [3].

According to past researchers' finding, chewing of khat has been associated with a transient rise in blood pressure and heart rate in experimental studies. Regular chewing of khat is associated with elevated mean diastolic blood pressure, which is consistent with the peripheral vasoconstrictor effect of Cathinone [16].

## Conclusion and Recommendation

### Conclusion

This work and previous studies demonstrated that age, chronic khat chewing and increase in systolic blood pressure have effect on ECG alteration.

### Recommendation to health professionals

Health promotion interventions should aim to prevent cardiovascular system diseases by regular screening program in general population.

### Recommendation to policy makers

Should design strategies to control the production, usage and distribution khat.

## Limitation and for further researches suggestions

For this study because of the constraints of time, only cross sectional study design was employed which may be able to establish continues relationship among variables. So further researchers should apply longitudinal method to identify more relationship among variables for the long of time.

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This article was originally published in a special issue, entitled: "**Muscle Research**", Edited by Sawant SP