Correlates of khat use during pregnancy: A cross-sectional study

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ABSTRACT

Objectives: Khat is widely used in East African countries including Ethiopia. A growing body of evidence indicates that long-term khat use is associated with various health consequences. The aim of this study was to examine the magnitude and correlates of khat use in pregnant women.
Methods: This study used a cross-sectional, face-to-face interview design that included 642 pregnant women receiving antenatal care services at primary care centers in Ethiopia. A series of chi-square tests and regression models were conducted to examine whether khat use status (i.e., 123 current khat users, 41 former khat users, and 478 non-users) was associated with socio-demographic, mental distress, and substance use measures.
Results: As compared with non-users, current and former khat users had higher levels of depressive symptoms and distress. Khat users minimized potential health risks associated with khat use. Social and motivational factors related to khat use were different between current and former khat users.
Conclusions: Findings of this study suggest a substantial prevalence of khat use among pregnant women in Ethiopia and highlight the role of socio-demographic and cultural influences on khat use during pregnancy. Health care professionals in the region where khat is available are encouraged to ask their female patients about khat use and encourage them to refrain from use while they are pregnant. The positive link between khat and mental distress warrants further research focusing on biological, psychological, and social mechanisms of this relationship.

1. Introduction

Khat (*Catha edulis*) is a natural stimulant widely cultivated and available in East Africa and the Middle East (Belew, Kebede, Kassaye & Enquoselassie, 2000). Chewing fresh leaves of the khat tree is the most common mode of intake (Hoffman & al'Absi, 2010). Acute administration of khat enhances mood and alertness; however, these symptoms are typically followed by discomforts including depression, anxiety, and insomnia (Balint, Falkay, & Balint, 2009; Cox & Rampes, 2003; Nakajima et al., 2014). Cathinone, a chemical structured similar to that of amphetamine, is one of main constituents responsible for the psychopharmacological properties of khat (Kalix, 1990).

In Ethiopia, khat chewing is common. One epidemiological study (Alem, Kebede, & Kullgren, 1999) conducted among 10,468 adults in rural Ethiopia found that 56% of the participants reported khat chewing at some time in their lives. Fifty-percent of them currently chewed khat and 17.4% of them chewed on a daily basis (Alem et al., 1999). Another study (Belew, Kebede, Kassaye, & Enquoselassie, 2000) including 1200 adults found that 32% of the sample were current chewers. The rate of khat chewing in Jimma, where the present study was conducted, was 38.6% (Alemseged et al., 2012).

Despite the broad prevalence, long-term and excessive khat use has been suggested to be associated with major physical (Ali et al., 2011), psychological (Hassan, Gunaid, El-Khally, & Murray-Lyon, 2002), and psychiatric problems (Odenwald et al., 2005). While the underlying mechanism is not well understood (Odenwald et al., 2005), recent studies suggest that psychobiological factors such as stress play an important role in khat-related morbidity (al'Absi et al., 2013). Motivational, social, and cultural norms (Nakajima & al'Absi, 2013) also impact patterns of khat use.

Khat use is widely accepted among pregnant women (Khawaja, Al-Nsour, & Saad, 2008). A link between khat use during pregnancy and delivery complications has been reported (see Mwenda, Arimi, Kyama, & Langat, 2003 for a review). Human studies have found that khat use is associated with low birth weight (Abdul Ghani, Eriksson, Kristiansson, & Qirbi, 1987; Eriksson, Ghani, & Kristiansson, 1991). An-

other preliminary study found cathine (a constituent of khat) in khat-chewing mother's breast milk and her infant's urine (Kristiansson, Abdul Ghani, Eriksson, Garle, & Qirbi, 1987). Furthermore, daily khat use was associated with an increased risk of anemia among pregnant women (Kedir, Berhane, & Worku, 2013). Despite the fact that these negative pregnancy outcomes pose a significant threat to public health, available data systematically examining khat use in pregnant women are scarce. The purpose of this study was to examine patterns and correlates of khat use during pregnancy in Ethiopia. We report here data regarding socio-demographic information, khat use patterns, motives and attitudes toward khat use, and subjective distress. It was hypothesized that pregnant women who chew khat would report higher levels of subjective distress than those who do not chew khat. It was also anticipated that khat chewers would underestimate harmful effects associated with khat use relative to non-chewers.

2. Methods

2.1. Participants

This study was conducted in Jimma zone in southwest of Ethiopia. An estimated 2.7 million people live in Jimma zone area which covers 15,569 km^2 of the region (Central Statistical Authority, 2006). Three hospitals and 84 primary health centers exist in the zone where antenatal care services are available. Twelve public health facilities are also affiliated with Jimma University. Based on the number of pregnant women who attend antenatal care each year in Jimma zone (Jimma Zone Health Report 2012/13, unpublished data), a reasonable sample size of 660 was calculated using single population formula and probability proportional to size sampling techniques. Participant recruitment was completed in 11 primary care centers and one hospital in Jimma, Ethiopia between June and August of 2013. All pregnant women visiting the designated health care centers for antenatal care were approached and 642 completed this project. The study received approval from the ethical review board of Jimma University and the Institutional Review Board of the University of Minnesota.

2.2. Measures and procedure

Questionnaires regarding demographic information (e.g., age, education) and substance use (e.g., khat, tobacco, alcohol) were adapted from those used in previous studies (Nakajima et al., 2013) or developed by WHO (WHO, 1994). They were translated into local languages (Afan Oromo and Amharic) using the back-translation method. Several questionnaires were also collected to examine the relationships between psychosocial and behavioral variables and khat use. The Ethiopian version of the Edinburgh Postnatal Depression Scale (EPDS) was used to assess depressive symptoms in pregnant women (Hanlon et al., 2008). The Ethiopian version of the Self-Report Questionnaire (SRQ-20; Hanlon et al., 2008) was also used to assess psychological distress. The Ethiopian translated version of the Kessler Psychological Distress Scale (K10) has been shown to have acceptable psychometric properties among postnatal women in Ethiopia (Tesfaye, Hanlon, Wondimagegn, & Alem, 2010). In addition, the Ethiopian versions of the Patient Health Questionnaire-9 (PHQ-9; Gelaye et al., 2013) and the Household Food Insecurity Access Scale (HFIAS; Jebena et al., 2015) were administered.

This study used a face-to-face interview method. Participants were reached after their antenatal care. A team of qualified investigators asked pregnant women if they are interested in participating in the study. After obtaining consent, a trained interviewer asked questions regarding socio-demographic information, khat and other substance use patterns, depressive symptoms, psychological distress, and food insecurity. Each interview took approximately an hour to complete.

2.3. Data analysis

Analyses using two questions, "Have you ever chewed khat? (yes/no)" and if yes, "Do you currently chew khat? (yes/no)", found that 25% (n = 164) of pregnant women had chewed khat at least once in their life. Of those, 123 identified themselves as current khat chewers and 41 reported themselves as former khat chewers. The rest (n = 478) reported that they had not used khat before (i.e., non-chewers). A series of chi-square tests and one-way analysis of variance (ANOVA) were conducted to examine whether socio-demographic information, substance use pattern, and perception toward substance use were associated with khat use status (current chewers, former chewers, non-chewers). Variables that were statistically significant in these models were included in a multiple logistic regression model to test associations with khat use status after controlling for influences of other independent variables. The same approach was taken to examine which khat use pattern measures were related to khat use status (current and former chewers). For subjective distress and negative affect, one-way ANOVAs were conducted to test khat use group differences. Tukey's pairwise comparison tests were conducted as a follow-up of significant main effect of khat use groups. A multiple logistic regression model including significant socio-demographic correlates and all distress measures was conducted to test which distress measure(s) was predictive of khat use status after controlling for confounders. p-Values < 0.05 were considered statistically significant. SPSS version 20 (IBM Corp., Armonk, NY) was used for data analysis.

3. Results

3.1. Participant characteristics

The mean age of this sample was 25.8 (SEM: 0.3) and 91% of them reported being married (see Table 1). These variables did not differ across groups. Current khat use was associated with living in a rural area, being farmers, being Muslim, having a lower education level relative to former and non-chewers, having an older partner, and more children relative to non-chewers (see Table 1). Former chewers were more likely to report having family members or relatives with mental health problems.

3.2. Drug use, social settings, attitude toward khat use

Self-reported tobacco, alcohol, and other substance use was low in this sample (ever smoked < 1%; ever drank 6%; ever used other drugs 3%; see Table 1). Current khat chewers were more likely to use other illicit drugs than other two groups. Current chewers were more likely to have partners that chewed khat and have khat producers or sellers in their home. Perceived risk due to khat use showed a dose-dependent relationship (see Table 1). That is, current chewers tended to minimize potential harm associated with khat chewing, such as financial, social, physical, psychological, and reproductive problems more than formers chewers who, in turn, tended to underestimate the harm relative to non-chewers.

A multiple logistic regression including significant socio-demographic, social setting, and attitude variables as predictors (see Table 1) revealed that these variables significantly predicted khat use status (overall model: χ^2 = 370, p < 0.001). In this model, religion, education, having family members or relatives with mental health problems, number of children, have partners who chewed khat, financial issues, physical health and reproductive problems predicted khat use (p < 0.05). A final model including these significant predictors (overall model: χ^2 = 452, p < 0.001) indicated that, in general, the prediction of current khat use relative to nonusers resulted in larger calculated odds than the prediction of former use (see Table 2). The demographic variables predicted 4 to nearly 25 times an increase in current khat use relative to nonusers while the same range was just over

Table 1
Sample characteristics.

	N (N = 642)	Khat use groups (n (%))			Statistic	p-Value
		Current user (n = 123)	Former user (n = 41)	Non-user (n = 478)		
Demographics						
Age (yr)[a]	25.8 (0.3)	26.0 (0.4)	26.0 (0.8)	25.3 (0.2)	1.38	0.25
Residential area (urban)	377 (58.7)	53 (43.1)	27 (65.9)	297 (62.1)	15.6	< 0.001
Household size[a]	4.3 (0.1)	4.6 (0.1)	4.5 (0.3)	3.7 (0.1)	18.2	< 0.001
Occupation					26.1	0.001
Farmer	172 (26.8)	52 (42.3)	11 (26.8)	109 (22.8)		
Gov. employee	107 (16.7)	13 (10.6)	6 (14.6)	88 (18.4)		
Merchant	83 (12.9)	14 (11.4)	4 (9.8)	65 (13.6)		
Daily Labor	66 (10.3)	6 (4.9)	2 (4.9)	58 (12.1)		
Others	214 (33.3)	38 (30.9)	18 (43.9)	158 (33.1)		
Marital status (married)	584 (91.0)	114 (92.7)	40 (97.6)	430 (90.0)	3.20	0.20
Religion (Muslim)	447 (69.6)	118 (95.9)	33 (80.5)	296 (61.9)	56	< 0.001
Education					31.9	< 0.001
Illiterate	172 (26.8)	48 (39.0)	15 (36.6)	109 (22.8)		
Read and write	151 (23.5)	38 (30.9)	7 (17.1)	106 (22.2)		
Primary education	171 (26.6)	25 (20.3)	13 (31.7)	133 (27.8)		
Secondary education or more	148 (23.1)	12 (9.8)	6 (14.6)	130 (27.2)		
Partner's age (yr)[a]	33.5 (0.4)	35.2 (0.6)	32.9 (1.0)	32.3 (0.3)	8.82	< 0.001
Monthly income (Birr)[a]	1450 (71.9)	1427 (104.5)	1463 (181.0)	1607 (53.0)	1.35	0.26
Relative/family member(s) w/mental health problem	44 (6.9)	13 (10.6)	8 (19.5)	23 (4.8)	16.1	< 0.001
Antenatal care w/last pregnancy	322 (71.6)	63 (69.2)	15 (53.6)	244 (73.7)	5.45	0.07
Postnatal care after last delivery	195 (43.3)	30 (33.0)	11 (39.3)	154 (46.5)	5.54	0.06
Delivered at home	308 (68.4)	75 (82.4)	19 (67.9)	214 (64.7)	10.4	< 0.01
Youngest child's age (yr)[a]	3.2 (0.1)	3.1 (0.1)	3.5 (0.3)	3.0 (0.1)	1.29	0.28
Number of live birth[a]	1.7 (0.1)	2.1 (0.1)	1.8 (0.2)	1.3 (0.1)	12.9	< 0.001
Number of still birth[a]	0.1 (0.02)	0.1 (0.02)	0.1 (0.04)	0.1 (0.01)	0.74	0.48
Substance use						
Ever smoked tobacco	6 (0.9)	3 (2.4)	1 (2.4)	2 (0.4)	5.39	0.07
Currently smoke tobacco	3 (0.5)	2 (1.6)	1 (2.4)	0 (0)	9.22	0.01
Ever drink alcohol	39 (6.1)	6 (4.9)	5 (12.2)	28 (5.9)	3.04	0.22
Frequency of alcohol (1–3 days/week or less)	27 (93.1)	2 (100)	2 (100)	23 (92.0)	1.68	0.79
Other substance use	21 (3.3)	15 (12.2)	1 (2.4)	5 (1.0)	1.68	< 0.001
Partner chews	209 (35.1)	90 (78.3)	18 (45.0)	101 (22.9)	125	< 0.001
Partner smokes	31 (5.2)	9 (7.8)	4 (10.0)	18 (4.1)	4.60	0.10
Partner drinks alcohol	35 (5.9)	8 (7.0)	3 (7.5)	24 (5.4)	0.59	0.75
Producers or sellers in your home	426 (66.4)	111 (90.2)	32 (78.0)	283 (59.2)	44.9	< 0.001
Problems linked to khat						
Financial crisis	531 (82.7)	67 (54.5)	24 (58.5)	440 (92.1)	112	< 0.001
Social relationship	321 (50.0)	15 (12.2)	10 (24.4)	296 (61.9)	108	< 0.001
Physical health	349 (54.4)	22 (17.9)	15 (36.6)	312 (65.3)	94.1	< 0.001
Mental health	491 (76.5)	24 (19.5)	18 (43.9)	449 (93.9)	327	< 0.001
Reproductively	456 (71.0)	16 (13.0)	11 (26.8)	429 (89.7)	322	< 0.001
Sexual impotency	461 (71.8)	16 (13.0)	14 (34.1)	431 (90.2)	318	< 0.001
Exposure to harmful events	487 (75.9)	22 (17.9)	19 (46.3)	446 (93.3)	325	< 0.001

Entries indicates frequency and proportion (%) unless otherwise indicated entries which show mean and standard deviation.

[a] These variables were measured in continuous scales and tested by ANOVA. Variables without a superscript were tested by chi-square tests.

Table 2
Results of a multiple logistic regression testing associations of demographic and attitude variables with khat use status.

Variable	Current khat use (reference: nonusers)				Former khat use (reference: Nonusers)			
	B	SE	OR	p-Value	B	SE	OR	p-Value
Demographic variables								
Muslim	3.18	0.68	24.0	< 0.001	1.29	0.54	3.64	< 0.05
Illiterate	1.73	0.62	5.61	< 0.01	1.38	0.65	3.97	< 0.05
Primary education	1.27	0.64	3.55	< 0.05	1.39	0.63	4.03	< 0.05
Family mental health	1.85	0.71	6.33	< 0.05	2.45	0.67	11.6	< 0.001
Partner chews	2.52	0.40	12.4	< 0.001	1.00	0.43	2.72	< 0.05
Attitudes								
Financial harm	− 1.41	0.49	0.25	< 0.01	− 1.30	0.53	0.27	< 0.05
Physical health harm	− 1.28	0.42	0.28	< 0.01	− 0.65	0.44	0.52	0.14
Reproductive harm	− 3.85	0.45	0.02	< 0.001	− 3.21	0.52	0.04	< 0.001

B = Regression coefficient. SE = Standard error. OR = Odds ratio.

Table 3
Patterns and motives for khat use.

	N (n = 164)	Khat use groups (n (%))		Statistic	p-Value
		Current users (n = 123)	Former users (n = 41)		
Pattern of khat use					
Age of onset (yr)[a]	17.2 (0.2)	17.7 (0.2)	16.6 (0.4)	5.39	< 0.05
Duration of use (yr)[a]	6.90 (0.4)	7.7 (0.4)	6.1 (0.8)	3.11	0.08
Chewing before this pregnancy	136 (85.5)	119 (99.2)	17 (43.6)	73.5	< 0.001
Typical use before this pregnancy				n/a	n/a
Once a week	26 (21.1)	26 (21.1)	n/a		
2–4 days/week	49 (39.8)	49 (39.8)	n/a		
4–6 days/week	10 (8.1)	10 (8.1)	n/a		
Daily	16 (13.0)	16 (13.0)	n/a		
Occasional	22 (17.9)	22 (17.9)	n/a		
Hrs of chewing/day[a] before this pregnancy	2.6 (0.1)	2.6 (0.1)	n/a	n/a	n/a
Drink alcohol after chewing	4 (2.6)	1 (0.8)	3 (9.7)	7.47	< 0.01
Beverages/tobacco consumed while khat chewing					
Water	118 (78.1)	101 (82.1)	17 (60.7)	6.12	< 0.05
Soft drink	29 (19.2)	27 (22.0)	2 (7.1)	3.22	0.07
Tea/coffee	101 (66.9)	85 (69.1)	16 (57.1)	1.47	0.22
Energy drinks	0 (0)	0 (0)	0 (0)	n/a	n/a
Cigarettes	0 (0)	0 (0)	0 (0)	n/a	n/a
Shisha	0 (0)	0 (0)	0 (0)	n/a	n/a
Reasons for khat use					
Recreational	105 (64.0)	76 (61.8)	29 (70.7)	1.07	0.30
Medicinal	15 (9.1)	11 (8.9)	4 (9.8)	0.02	0.88
Habit	52 (31.7)	37 (30.1)	15 (36.6)	0.60	0.44
Socialization	100 (61.0)	73 (59.3)	27 (65.9)	0.55	0.46
Stress reduction	30 (18.3)	17 (13.8)	13 (31.7)	6.58	0.01

Entries indicate frequency and prevalence (%) except that items "age of onset" and "duration of use" are represented in means with standard error of the mean.

[a] These variables were measured in continuous scales and tested by ANOVA. Variables without a superscript were tested by chi-square tests.

double to 11 times an increase likelihood of being a former khat user (relative to nonuser). For example, being Muslim was associated with nearly 25 times the increased likelihood of being a current user (OR = 24.0, p < 0.001) but only tripled the risk of being a former user (OR = 3.64, p < 0.05; both relative to nonusers). In contrast, have family members with mental health problems was related to 11 times the elevated likelihood of being a former user (OR = 11.6, p < 0.001), which was higher than the likelihood of being a current user (OR = 6.33, p < 0.05; both relative to nonusers). Among attitudes related to khat use, current and former khat users were less likely to perceive that khat harms financial and reproductive health (see Table 2).

3.3. Patterns of khat use

Reported onset of khat chewing was younger in former chewers than in current chewers (see Table 3). The rate of khat chewing prior to the current pregnancy was higher in current than in former chewers. The majority of current chewers (60.9%) chewed up to 4 days a week and 13% of them chewed on a daily basis. On average, they spent 2.6 h a day chewing khat and had been chewing for approximately 8 years. Alcohol use after chewing was higher in former users than current users. The majority of pregnant women drank water and tea/coffee while khat chewing, although the rate of water drinking was higher in current users than in former users. None of them reported drinking energy drinks or smoking (cigarettes, shisha) while chewing. Regarding motives of khat use, recreational (64%), medicinal (9%), habitual (32%), and socializing (61%) were equally mentioned in current and former users. In contrast, the rate of khat use as stress management was higher in former than in current users (χ^2 = 6.58, p = 0.01; see Table 3). In a logistic regression model with five predictors (age of onset, chewing prior to this pregnancy, alcohol use after chewing, water use with chewing, and use for stress reduction; overall model: χ^2 = 36.0, p < 0.001) only one predictor was associated with current use. Khat use before the most recent pregnancy significantly increased the risk for current khat use (OR = 71.7, p < 0.001; relative to former

users) while none of the other predictors were significant.

3.4. Khat use and subjective distress

Measures of psychological distress varied as a function of khat use status (see Fig. 1). There was a significant group main effect in EPDS (F (2, 639) = 4.03, p < 0.05). Tukey's tests revealed higher depressive symptoms in current users relative to non-users (p = 0.02). There was a significant main effect of group in SRQ (F (2, 639) = 4.42, p < 0.05) indicating greater levels of mental distress in former chewers than in non-chewers (Tukey's test: p = 0.03). Also, a trend of group main effect in K10 (F (2, 639) = 2.90, p = 0.056) suggested a tendency of greater psychological distress in former chewers than in non-chewers (Tukey's test: p = 0.06). A significant group main effect in HFIAS (F (2, 639) = 4.37, p < 0.05) reflected greater food insecurity in former chewers than in current chewers (p < 0.01) and in non-chewers (p = 0.06). No group difference was found in PHQ (F < 1). A logistic regression was conducted to examine influences of negative affect (i.e., EPDS, SRQ) and food security status (i.e., HFIAS) on khat use status after controlling for background variables that were significant (i.e., religion, education, have family members or relatives with mental health problems, number of children, have partners who chewed khat, financial issues, physical health and reproductive problems). The overall model was significant (χ^2 = 473, p < 0.001) and results indicated that higher SRQ (OR = 1.16) and lower food insecurity (OR = 0.88) were related to current khat use (p < 0.05; relative to nonusers).

4. Discussion

To our best knowledge, this study was among the first to examine socio-demographic, motivational, and psychosocial correlates of khat use among pregnant women. Nearly 25% of pregnant women reported khat chewing at least once in their lifetime, and 19% reported that they currently chew khat (during pregnancy). The rate of khat use found in this study was lower than that reported in prior work (Kedir et al., 2013; Khawaja et al., 2008). Regional variations in khat use have been
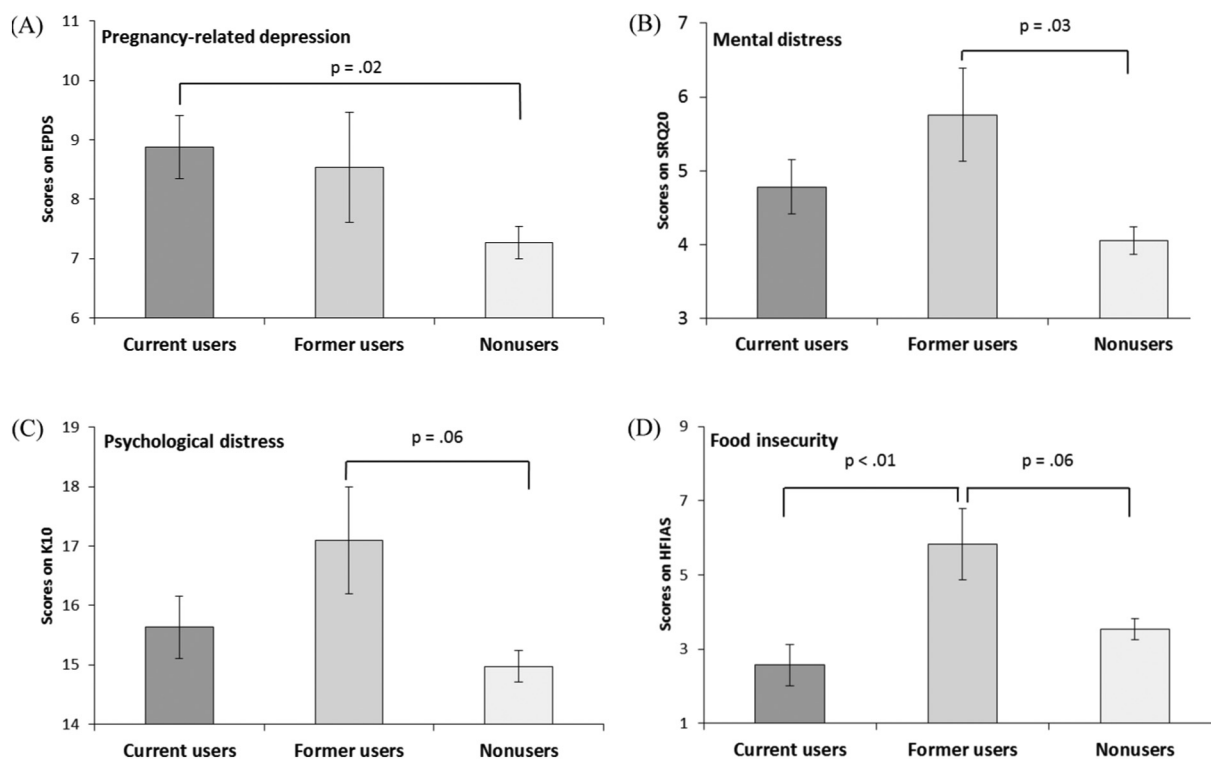
Fig. 1. Subjective distress and food insecurity measures as a function of khat use status. Note: Entries show mean and bars show standard error of the mean. All tests showed a significant main effect of khat use group by ANOVA. p-Values indicated in figures are results from the post-hoc comparisons using Tukey's pairwise tests. (A) The Edinburgh Postnatal Depression Scale (EPDS); (B) The Self-Report Questionnaire (SRQ-20); (C) The Kessler Psychological Distress Scale (K10); (D) The Household Food Insecurity Access Scale (HFIAS).

reported, which might contributed to differences across studies (Haile & Lakew, 2015). For instance, the rate of concurrent use of khat with cigarette and shisha smoking as well as alcohol drinking was very low in this study sample. This pattern was somewhat different from other countries such as Yemen where concurrent use of khat and tobacco is very common, particularly among men (Nakajima et al., 2013). Furthermore, the Ethiopian study by Kedir et al. (2013) was predominantly rural and based on a smaller population (N = 236,600 versus 2.7 million people in Jimma area). Urban and rural areas are known to have differences in both substance use patterns (Haile & Lakew, 2015) and access to health care (Kenea & Jisha, 2017). While the generalizability of the current results are limited to other pregnancy samples due to the focus of the study, our results highlight the importance of socio-cultural factors in khat consumption behavior.

Pregnant women in this study chewed about 3 h a day, and the majority of them chew at least 2 to 4 days a week. In addition, they had been chewing for approximately 8 years and almost all of them had chewed before the current pregnancy. These results reflect habitual khat use in this population. This is a matter of concern because chronic khat use is associated with deleterious impacts on fetal development, delivery outcomes, and postnatal maternal and infant health (see Mwenda et al., 2003 for a review). Our results and other relevant studies suggest the role of interrelated neurophysiological, psychosocial, and socio-cultural determinants as potential risk factors of this relationship.

In general, current and former khat chewers had higher levels of depressive symptoms and psychological distress than non-chewers. Also, greater frequency of khat chewing was linked with higher levels of mental distress. These findings are consistent with previous studies showing positive associations of chronic or excessive khat use with mood disorders and psychiatric conditions (Belew et al., 2000; Odenwald et al., 2005). Khat use and psychological distress may share common pathways in terms of negative impacts on pregnancy outcomes.

Acute administration of khat or cathinone stimulates the autonomic nervous system which results in the activation of cardiovascular systems and subsequent increases in blood pressure and heart rate (Brenneisen, Fisch, Koelbing, Geisshusler, & Kalix, 1990). It also stimulates the hypothalamic-pituitary-adrenocortical (HPA) axis to release cortisol that influences behavioral and metabolic functions (Nyongesa et al., 2013). These neurobiological changes are similar to what occurs when an individual is under stress (al'Absi, 2007). Long-term khat use has been associated with various complications in the cardiovascular system (al'Absi et al., 2013) and alterations in the central hormonal regulatory functions (al'Absi et al., 2013; Nyongesa et al., 2013). Similarly, chronic stress such as major life events and food insecurity is associated with prolonged activations of the autonomic and the HPA systems, leading to various negative health consequences (McEwen, 1998). Maternal khat use and mental distress could have direct and indirect negative implications for birth outcomes as HPA and cardiovascular systems play important roles in pregnancy outcomes including preterm labor leading to infant morbidity and mortality (Mastorakos & Ilias, 2003; Weinstock, 2005). While the impacts of khat use and psychological distress on delivery outcomes and infant growth have never been directly tested in humans, it is possible that the linkages between khat use, mental distress, and pregnancy outcomes are in part mediated by the central and peripheral sympathetic and adrenal physiological mechanisms (Hanlon et al., 2009). This is a critical question to be addressed because khat use (Alem et al., 1999; Belew et al., 2000), stressful life events and common mental disorders (Hadley et al., 2008), and poor perinatal outcomes and neonatal death (WHO, 2006) are all common in Ethiopia.

This study found environmental and social influences on khat use in women who were pregnant. Current chewers were more likely to live in rural areas, have spouses who chew khat, and have other family members who chew and produce khat for a living. Research suggests that khat producers are more likely to engage in habitual khat use because of its accessibility (Haile & Lakew, 2015). Khat users had lower levels of education and they underestimated potential harm associated

with khat use relative to non-users. Familial influence, social tradition, and education are important determinants of not using khat and tobacco among nonusers (Nakajima & al'Absi, 2013). These characteristics (rurality, spouse use of khat, khat production, education, attitudes toward use) are easily surveyed and could be incorporated into routine clinic intake procedures either via a simple questionnaire or a brief clinical interview. Due to the high rate of illiteracy, we do not advocate for one instrument or another but instead recommend simple, supportive questioning by the health care provider. This would allow for sensitive but targeted probing and patient education by health care providers. Additionally, public health campaigns could be targeted in rural areas known to produce khat and treatment programs specific for pregnant women could be developed in both urban and rural areas.

Former chewers were more likely to start khat chewing at younger age, have higher levels of mental distress and food insecurity, have close family members with mental problems, and chew khat as a means of stress reduction. These patterns suggest vulnerability to addiction-related problems. It has been suggested that chronic substance users take drugs to alleviate the impact of environmental demands such as chronic stress and psychiatric conditions (al'Absi, 2007). It is possible that former khat users faced more life challenges and hardships than current or non-users, leading them to chew khat to cope with them. However, it is not clear what led them to stop chewing khat or if in fact they had. Health concerns and economic reasons might contribute to this, as they were more aware of harmful impacts of khat use and had higher levels of food insecurity than current chewers. Future research should carefully examine pregnant women who recently quit khat chewing to understand better their social and individual characteristics. Such data could be useful to identify individuals particularly at risk as well as to elucidate determinants to reduce and prevent harm associated with khat use.

The results of this study are limited by the use of a cross-sectional design. Thus, it is not clear whether chronic khat use causes increased distress and negative affect during pregnancy, or if individuals who are predisposed to be vulnerable to stress are more likely to use khat during pregnancy to cope with demands. A face-to-face interview method might induce retrospective bias, self-selection bias, and social desirability responses. For example, reliance on self-report measures (e.g., a lack of urinalysis) limited our ability to verify claims of abstinence (former khat use). It is possible that some participants were not honest in reporting their khat use due to fear or stigma, which led to underestimation of khat use in this study. These could lead to biased results and suggests the need for urinalysis in the future. However, we note that this approach was necessary and effective relative to self-report because of relatively high rate of illiteracy of this sample. Inclusion of women who are not pregnant would improve the current findings. Among the strengths of the study is the use of validated questionnaires as well as carefully structured methodology to examine patterns and correlates of khat use among pregnant mothers.

In conclusion, prenatal exposure to drugs elevates risks for negative health consequences. This study found that khat use during pregnancy was associated with increased mental distress as well as social and familial factors. The results of this study call for a longitudinal approach to assess prospectively the extent to which khat use predicts delivery complications, and the role of biological and psychosocial factors in this linkage.

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Author's contributions

MN contributed to conception and design of the study, data analysis, and development of the manuscript. MJ contributed to conception and design of the study, study coordination and data collection, data management, and manuscript revision. MT contributed to conception and design of the study, study coordination, and data collection. MT contributed to conception and design of the study and revising the manuscript. EKG contributed to conception and design of the study, data collection, and manuscript revision. AL helped to revise and improve the manuscript. RF helped reviewing the literature and revising the manuscript. MA conceived of the study, participated in its design and helped with writing and revising the manuscript. All authors read and approved the final version of the manuscript.

Declaration of interests

The authors declare no conflict of interest in this study.

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