
Prevalence and associated factors of khat chewing among pregnant women: A Systematic Review and Meta-analysis

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Abstract

Background: Khat (*Catha edulis*) is a stimulant plant, broadly cultivated and consumed in the Horn of Africa and the Arabian Peninsula. It contains Cathinone, which is an amphetamines-like chemical and causes various adverse outcomes for pregnant women and babies when it is consumed during pregnancy. Decisive estimates of the prevalence of khat chewing and related risk factors which may increase this practice have not been determined.

Aim: To determine the pooled prevalence and associated factors of khat chewing among pregnant women in the Horn Africa and the Arabian Peninsula countries with a view to informing targeted interventions for the region.

Method: The study protocol was prepared and registered on PROSPERO, ID CRD42021190837. A database search including Gray literature and Google scholar was explored to identify 667 studies. Finally, 14 studies were considered relevant for meta-analysis, after removing 259 duplicates, 388 unrelated topics and 6 studies with full text examination. The Newcastle-Ottawa Scale quality assessment tool was used to assess the quality of the studies. The pooled prevalence was determined by using the random-effect model and the p- values of ≤ 0.05 were considered statistically significant to examine associations. Statistical heterogeneity amongst the studies was assessed by Cochrane chi-square and the I^2 statistical test.

Main Findings: From the meta-analysis of 14 studies with 15,343 study participants, the pooled prevalence of khat chewing among pregnant women was 21.42%, 95% CI (14.49 - 29.29); ($I^2 = 99.05\%$ ($p < 0.0001$)). The results of the meta-analysis demonstrated that pregnant women who had a khat chewing partner [OR 6.50 (95% CI 5.01, 8.43)]; low educational status [OR 2.53 (95% CI 2.24 - 2.85)], lived in rural area [OR 1.69 (95% CI 1.52 – 1.88)] or had a low level of income [OR 1.70 (95% CI 1.55 – 1.87)] were significantly more likely to chew khat during pregnancy.

Conclusion: The prevalence of khat chewing amongst pregnant women in the Horn of Africa and the Arabian Peninsula has never been measured before and was found to be high. Partners khat chewing status, maternal low educational and economic status were the main factors associated with the problem. Designing intervention strategies to specifically target these risk factors and

reduce the burden of the problem for women and their babies is urgently needed.

Keywords: Catha edulis; chat; khat; pregnancy; Ethiopia; Yemen; substance use; associated factor

Introduction

Khat (*Catha edulis*) is an evergreen plant widely cultivated and consumed in the eastern Africa and the Arabian Peninsula countries (1, 2). It was originated from Ethiopia, but later distributed to different countries such as in Somalia, Kenya, Malawi, Uganda, Zimbabwe, Afghanistan, Tanzania, the Congo, Zambia, Yemen and Madagascar(3). It also known as *qaat* and *jaad* in Somalia, *maria* in Tanzania and Kenya and *echat* in Ethiopia (4). It contains an amphetamines-like chemical called Cathinone (5). It is a central nervous system stimulant and gives the chewer a mild high to euphoria (1, 6). Traditionally, the majority of people chewing khat were adult men, khat was a social drug and people gathered together to consume for a social event (5). However, this trend has been changing, currently, people from different age groups including women consume this plant for recreational and other purposes (7).

Individual regional study findings indicate that the magnitude of khat chewing in the Horn of Africa and the Arabian Peninsula countries were distributed unevenly (2, 8). The higher prevalence was observed in Yemen, with 90% adult males and around 73% of women chew khat (8). Almost similar proportion, of 90% and 88%, khat chewing prevalence were reported in Djibouti and northwestern Kenya, respectively (8). In contrast, population-based survey conducted in southwest Ethiopia and Uganda identified a prevalence of 32%-38.6 %, in the general population (9, 10). A similar study conducted in the Jazan Region, Saudi Arabia, identified that the lifetime prevalence of khat chewing was 33.2% in the general population (3).

Moreover, the national population survey in Yemen stated that 40.7% of women chewed khat during their last pregnancy (11). Similarly, a community-based study conducted in rural parts of eastern Ethiopia identified a prevalence of 34.6 % among pregnant women (12). In comparison, the prevalence was found to be 19.5% in southwest Ethiopia in the same population group (13). The proportion of the problem was known to vary across the regions, with the lowest prevalence of 10% and the highest prevalence of 37% registered in the southern and eastern region of Ethiopia, respectively (14, 15).

Individual studies in a range of regions have identified that factors contributing to khat chewing during pregnancy include having a lower level of education and socioeconomic status, living in mountainous and rural areas, ethnicity and religious belief, number of children, having a partner who chews khat, physical and mental health problems (2, 11, 13, 16-18). Nakajima (2017) identified recreation and socialization as the main motivational factors of khat chewing during pregnancy. Alcohol drinking, cigarette smoking, and the use of other substances were also the most important predictors of khat chewing (13, 18-21).

Khat chewing during pregnancy has many adverse outcomes both for the mother and the fetus/baby (6, 22, 23). Khat chewing mothers are at high risk for blood transfusion, breech presentation, anemia, Premature Rupture of Membrane (PROM), Post Partum Hemorrhage (PPH), perineal tears, Intra Uterine Fetal Death (IUFD), depression, loss of appetite, anemia, sleep disturbance and memory impairment (2, 5, 13, 15, 24-27) (28).

Even though the problem is highly prevalent in the Horn African countries and the Arabian Peninsula, little has been reported about the overall prevalence and associated factors among pregnant women. The aim of this systematic review is to answer the following study questions; What is the pooled prevalence of khat chewing among pregnant mothers in the Horn Africa and the Arabian Peninsula and what are the main contributing factors associated with khat chewing during pregnancy? The results of this study will provide specific guidance and direction for policymakers and practitioners in the design of targeted interventions to address this challenge. Furthermore, it also provides input and direction for future research in the area.

Methods

Search and selection strategy

A systematic search technique was applied to the electronic databases MEDLINE, CINAHL, EMBASE, and PubMed without a year of publication and language restriction on June, 2021. The keyword identified for the main term khat included "Khat" OR "Cathas" OR "Catha edulis" OR "Mira!", and for pregnant mother "Pregnant Woman" OR "perinatal" OR "Expectant mother" OR "Expectant woman" OR "Prenatal" OR "pregnancy".

In addition, grey literature searches and manual google scholar searches were also applied. Finally, the search results were collected in Endnotex9 and then exported into Covidence(29). Two independent authors selected literature based on selection criteria using Covidence (29). The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) was used to describe the process of study selection (30). see Figure 1.

Inclusion/Exclusion criteria

Inclusion criteria

- ✓ **Population;** studies conducted on pregnant women/ during a pregnancy.
- ✓ **Intervention;** studies included khat chewing habits.
- ✓ **Outcome;** the outcome of the studies included was the proportion of khat chewing and associated factors: socio-demographic, emotional, mental, and physical health-related factors.
- ✓ **Study design;** all quantitative studies that contain the number/ proportion of khat chewing during pregnancy and/or associated factors were included in the study.
- ✓ **Study area;** studies conducted in in the East Africa and the Arabian Peninsula countries were included in the study.

Exclusion criteria

- ✓ Literature with undefined/ unrelated outcome measures, articles with missing or insufficient outcomes were excluded from the systematic review. Literature reviews, individual case reports and patient stories were also excluded.

Outcome measures

The two main outcomes of this study were 1) to the determine the pooled prevalence of khat chewing among pregnant women in the Horn Africa and the Arabian Peninsula countries and 2) to identify the associated factors of khat chewing during pregnancy.

Khat chewing during pregnancy, in this study was defined as the chewing of any amount of khat at least once during the current pregnancy or during a previous pregnancy if the women was not currently pregnant.

Quality assessment

The Newcastle-Ottawa Scale (NOS) quality assessment tool was used to assess the quality of the studies (31). The tool has 8 quality indicators which divided in 3 sections. Then, studies were classified as high (7-8), medium (4-6) and low (1-3) quality, based on their respective quality score (32). see supporting document 1. The investigators evaluated the quality of the papers independently and then met to discuss and agree on individual scoring differences. Finally, eight studies were scored a medium quality and six scored high-quality study. See table 1.

Data extraction procedure

A standardised data extraction tool was prepared in Microsoft Excel and general information of the study, participant eligibility criteria, study design, sample size, study results, and other important notes were extracted to it. The most common factors were isolated and summarised in the form of two by two tables for meta-analysis.

Data Analysis

The summary table was prepared to describe the findings in each study. The pooled prevalence of khat chewing in pregnant women was calculated using MedCalc software-version 20.0.13 and the pooled odd ratios for predictors was calculated using RevMan software version 5.3. The p-value ≤ 0.05 at 95% confidence interval was considered statistically significant. The random-effect model was used to determine the pooled prevalence. Clinical heterogeneity was controlled across the studies with proper selection criteria and statistical heterogeneity of the studies was assessed using the chi-square and the I^2 statistics test with p-value. I^2 values of 25%, 50%, and 75% were used to define as low, medium, and high heterogeneity, respectively (33). The Egger's test was used to assess the presence of publication bias.

Results

Search and selection results

The database and manual search strategy was applied and 679 citations with 259 duplicates were found, with the latter removed using Covidence(29). The titles and abstracts of the remaining 408 unique papers were screened, of these, 388 were considered irrelevant as they did not meet the inclusion criteria for the review. Full-texts of the remaining 20 citations were reviewed and six studies which did not contain our study outcome were excluded. Finally, 14 studies with 15343 study participants, were used for systematic analysis (meta-analysis). The search results and details of the selection process was described with a PRISMA diagram in Figure 1(30).

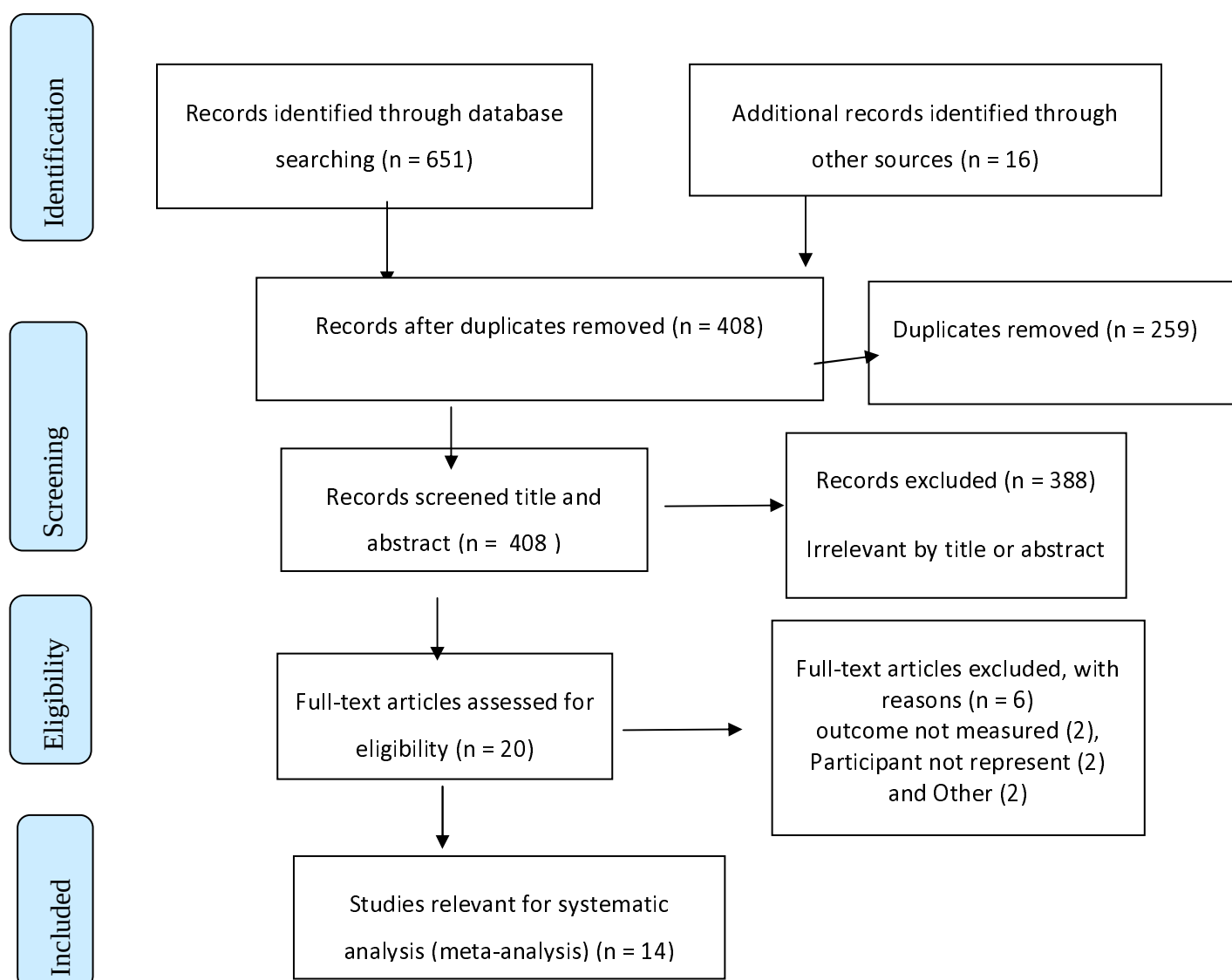


Figure 1: PRISMA flowchart describing the selection of studies for the systematic review and meta-analysis of prevalence and associated factors of khat chewing among pregnant women in Horn Africa and the Arabian Peninsula, 2021.

Among 14 studies considered relevant for systematic review meta-analysis, 12 studies were conducted in Ethiopia (six in Oromia region (13, 17, 18, 22, 23, 34), three in Southern region (14, 35, 36), two in Eastern part Ethiopia (15, 16) and one in Adis Ababa (37)) and two studies were conducted in Yemen (11, 27). See table 1.

Table 1: Summary characteristics of included studies for the systematic review and meta-analysis of prevalence and associated factors of khat chewing among pregnant women in Horn Africa and the Arabian Peninsula, 2021.

s. no	Author/Year	Study location	Study design/ setting	weight		Participants	Prevalence (95%CI)	Respo. rate	Quality
				Fixed	Random				
1	(Mekonnen et al. 2020)	Bale zone, Oromia region, Ethiopia	case-control / Institution	2.67	7.11	409	12.7% (9.84-16.37)	96.7%	MEDIUM 6
2	(Woldetsadik et al. 2019)	Bale Zone, Oromia region, Ethiopia	cross-sectional / community	4.84	7.17	743	10.4% (8.32-12.7)	99.3%	MEDIUM 6
3	(Tesfay et al. 2019)	Jimma town, Oromia region, Ethiopia	case-control / Institution	2.19	7.08	336	35.7% (30.7-40.95)	100%	MEDIUM 6
4	(Tesso et al. 2017)	Jimma zone, Oromia region, Ethiopia	cross sectional / Institution	1.91	7.05	293	24.9% (20.2-30.1)	98.9%	HIGH 7
5	(Nakajima et al. 2017)	Jimma zone, Oromia region, Ethiopia	Cress-sectional / Institution	4.19	7.16	642	19.15% (16.25-22.34)	97.3	HIGH 7
6	(Demelash et al. 2015)	Bale zone, Oromia region, Ethiopia	case-control / Institution	2.53	7.1	387	12.4% (9.43-15.97)	94 %	MEDIUM 6
7	(Mekuriaw et al. 2020)	Gedeo zone, Sothern NNPRS, Ethiopia	Cross-sectional / Institution	4.68	7.17	718	9.9% (7.86-12.24)	97.9	HIGH 7
8	(Alamneh et al. 2020)	Gurage Zone, Sothern NNPRS, Ethiopia	Cross-sectional / community	2.23	7.08	341	35.8% (30.8- 41.0)	96.9%	MEDIUM 6
9	(Mekuriaw et al. 2019)	Gedeo zone, Southern Ethiopia.	Cross-sectional / Institution	4.68	7.17	718	10% (7.86-12.24)	94.6%	HIGH 7
10	(Fetene et al. 2021)	(Jigjiga, Dire Dawa and Harar towns). Eastern Ethiopia	Cross-sectional / Institution	3.33	7.14	510	19.6% (16.33-23.23)	96.9%	HIGH 7

11	(Yadeta et al. 2020)	Harar town, Eastern Ethiopia	cross-sectional / Institution	11	7.22	1688	37.2% (34.9-39.53)	NA	MEDIUM 5
12	(Tesfaye et al. 2020)	Addis Ababa, Ethiopia	cross sectional / Institution	3.82	7.15	585	10.4% (8.14-13.1)	98.6%	HIGH 7
13	(Khawaja et al. 2008)	11435 households In Yemen	cross-sectional / Community	47.82	7.25	7343	40.5% (39.44-41.7)	NA	MEDIUM 6
14	(Muhammed 2015)	in Sana'a City Yemen.	Cross-sectional / Institution	4.11	7.16	630	35.9% (32.2-39.7)	NA	MEDIUM 4
	Total (fixed effects)			100.00	100.00	15343	29.92% (29.20 - 30.66)		
	Total (random effects)			100.00	100.00	15343	21.42% (14.49 - 29.29)		

Meta-analysis result

The prevalence of khat chewing among pregnant women

In this study, a total of 15343 study participants were included from 14 studies. This study confirmed the pooled prevalence of khat chewing during pregnancy, using random-effect model, was 21.42% with a 95% CI (14.49 - 29.29). See table 1. The result detected statistically significant heterogeneity among the studies ($I^2 = 99.05\%$ ($p < 0.0001$)). The Egger's test indicates that publication bias was not statistically significant ($p = 0.0034$) See figure 2.

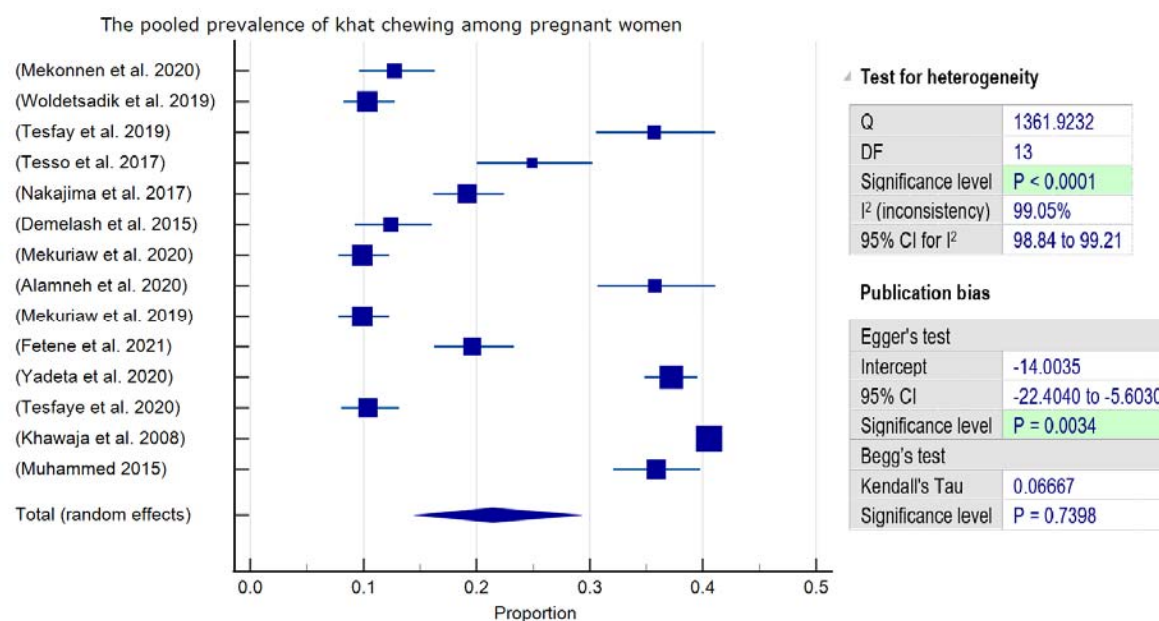


Figure 2. Forest plot of the pooled prevalence of khat chewing among pregnant women in Horn Africa and the Arabian Peninsula, 2021.

Sub-group analysis

The sub-group analysis was done to determine pooled prevalence of khat chewing in Ethiopia. Among 12 studies with 7270 participants the prevalence was found to be 18.91%, with the 95% CI (12.75 to 25.96). The analysis demonstrated significant heterogeneity between the studies ($I^2 = 98.12\%$; $p < 0.0001$). The result of Egger's test did not demonstrate a statistically significant publication bias ($p = 0.356$). see Figure 3.

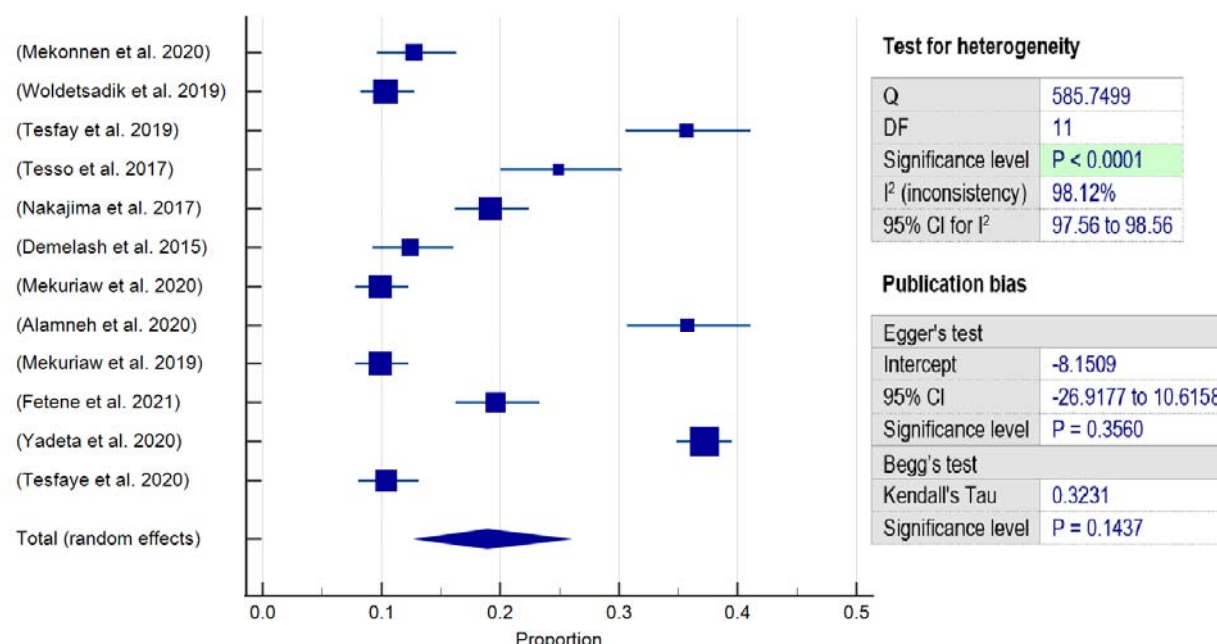


Figure 3. Forest plot of the sub-group analysis on pooled prevalence of khat chewing among pregnant women in Ethiopia, 2021.

Among sub group-analysis in Ethiopian regions, the highest prevalence of 28.09%, with the 95% CI (12.81 - 46.59), was registered in the Eastern part of Ethiopia and the lowest prevalence of 17.13%, 95% CI (5.99 - 32.44), was observed in southern region of Ethiopia. The pooled prevalence of khat chewing in Oromia region of Ethiopia was 18.51%, 95% CI (12.05 - 25.99). see table 2. The overall prevalence of khat chewing among pregnant mothers in Yemen found to be 38.58% with the 95% CI (34.11 - 43.14). see table 2.

Table 2. Table of the sub-group analysis on pooled prevalence of khat chewing among pregnant women in Ethiopian regions and Yemen, 2021

Region	Number of studies	Participant	Prevalence (95% CI)	Heterogeneity
Oromia, Ethiopia	6 (13, 17, 18, 22, 23, 34)	2810	18.51% (12.05 - 25.99)	P < 0.0001, I ² 95.69%
Southern Ethiopia	3 (14, 35, 36)	1777	17.13% (5.99 - 32.44)	P < 0.0001, I ² 98.24%
Eastern Ethiopia	2 (15, 16)	2198	28.09% (12.81 - 46.59)	P < 0.0001, I ² 98.35%

Overall Yemen	2 (11, 27)	7973	38.58% (34.11 - 43.14)	P = 0.0207, I ² 81.32%
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Factors associated with khat chewing during pregnancy

This meta-analysis identified significant factors contributing to khat chewing during pregnancy. In summary these included maternal educational status, place of residence, level of income, partner khat chewing status, and maternal Antenatal Care (ANC) follow-up. Whereas, lifetime prevalence of maternal use of alcohol did not demonstrate a statistically significant association. Figure 3:A-E

Partner khat chewing status found to be the major predictor. Those mothers who had a partner who chewed khat were more than 6.5 times more likely to chew khat than their counterparts [OR 6.50 (95% CI 5.01, 8.43); I² =55%; p<0.08]. Heterogeneity among the studies was medium and not statistically significant (figure 3A).

Pregnant mothers who did not have formal education were two and a half times more likely to chew khat during pregnancy than mothers who attained at least primary school (95% CI 2.24 - 2.85) see Figure 3B. High level of statistical heterogeneity was observed between studies (I² =89%; p<0.00001).

Maternal place of living was also found to be a significant determinant of khat chewing, mothers living in rural regions were 1.7 times more likely to chew khat during pregnancy than mothers who lived in urban areas (95% CI 1.52 – 1.88) (I² =6%; p<0.36) figure 3D. Similarly, those pregnant mothers who had an income status of low were 1.7 times more likely to chew khat than high-income mothers (95% CI 1.55 – 1.87). See Figure 3E.

Mothers who did not have ANC follow-up either in current or during last pregnancy were more than one and a half times more likely to chew khat than their counterparts (OR = 1.53; 95% CI 1.39–1.68;) (see Figure 3F). Maternal ever alcohol use did not show a statistically significant association in pooled odd ratio.

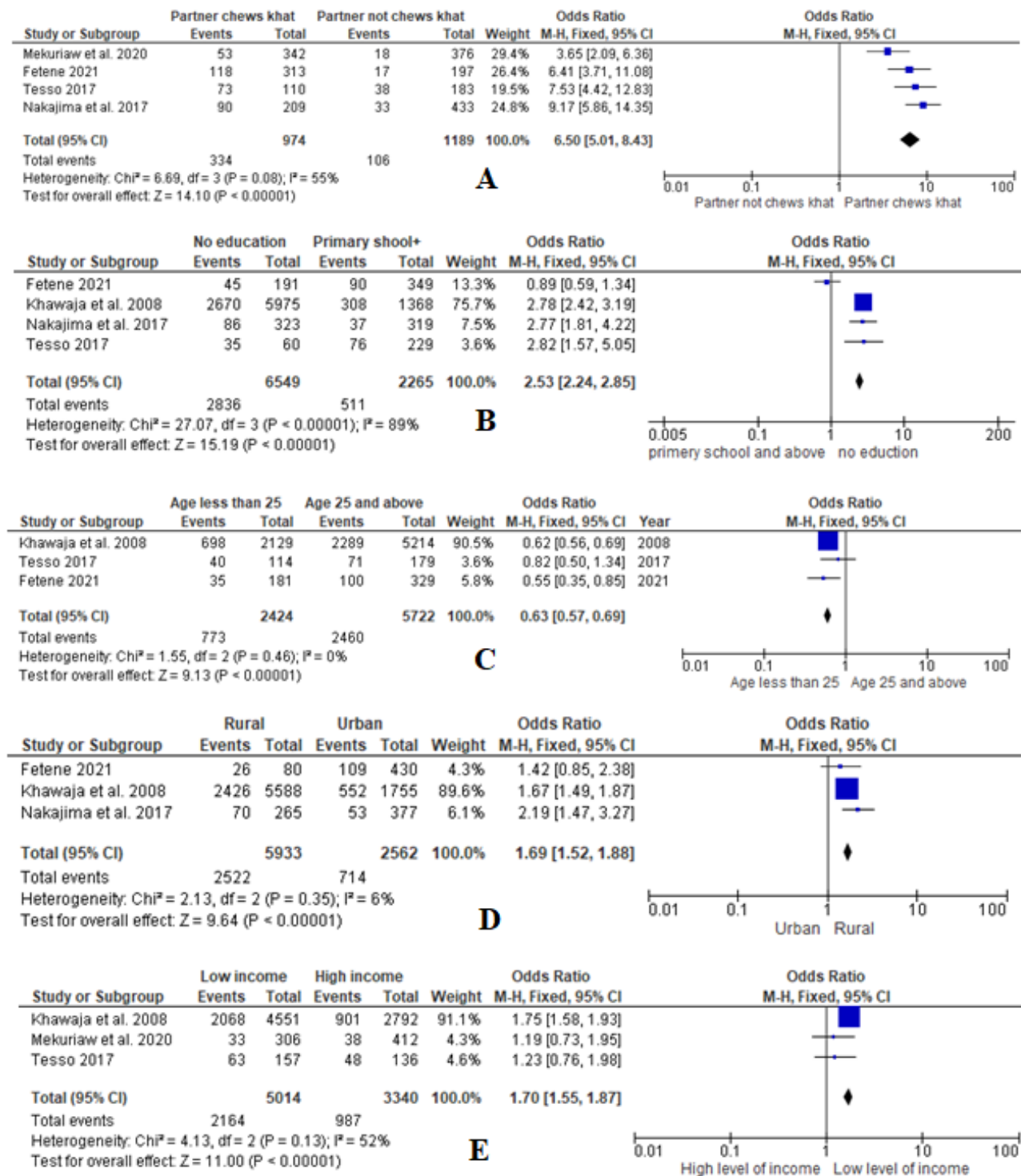


Figure 4: Forest plot of factor association of khat chewing with (A) Partner khat chwing status B) maternal education C) Age D) Place of living E) Level of income) among pregnant women, 2021.

Discussion

The aim of this study was to determine for the first time, the pooled prevalence and associated factors of khat chewing among pregnant women in Horn Africa and the Arabian Peninsula countries with a view to informing targeted interventions for policy and practice. It is recognised that substance use during pregnancy can result in multiple physical, emotional, social, and psychological problems (2, 38, 39). However, it is also recognised that women chew the substance khat during pregnancy for various reasons including relief from stress, enjoyment with their partners, to feel happy, to socialise and for habitual and medicinal reasons (13, 14).

The pooled prevalence of khat chewing amongst pregnant women in the Horn of Africa and the Arabian Peninsula was found to be 21.42%, with 95% CI (14.49 - 29.29). The prevalence of khat chewing was known to be variable across the countries, regions and population groups (21, 40). Similarly, our sub-group analysis showed, the pooled prevalence of khat chewing in Yemen was highest at, 38.58% with the 95% CI (34.11 - 43.14), and this was found to be approximately twice the prevalence in Ethiopia at, 18.91% with the 95% CI (12.75 to 25.96). Among Ethiopian regions: the highest prevalence was observed in the Eastern part at 28.09% with the 95% CI (12.81 - 46.59), and almost a similar proportion of 18.51% with the 95% CI (12.05 - 25.99) and 17.13% with the 95% CI (5.99 - 32.44), was observed in Oromia region and Southern region, respectively. These variations across the countries and regions may be as a result of the difference in population characteristics including religion, geographic area and the distribution of associated factors among the groups (7, 40). For example, the higher prevalence observed in Yemen and in Eastern parts of Ethiopia was may be due to cultural and social reasons as within these regions it is known that the majority of people were of the same religion (21, 40). Different studies have identified that religion is a significant correlate of khat chewing (11, 13).

If we compare our results with studies exploring other socially acceptable drugs in the broader region we see that, our findings are similar to the prevalence of alcohol use among pregnant women in Nigeria, South Africa, Australia, New Zealand and the UK (41-43). The overall prevalence of alcohol drinking among women in Ethiopia was 35.3 %, with less than 1% in the Somalia region and 71 % in the Tigray region (EDHS 2016). Clearly the need to address the use

of socially accepted substance use during pregnancy is important for policy and planning in the region.

This systematic review and meta-analysis confirmed age, educational status, place of residence, income, partner khat use, and ANC follow up history were statistically significant predictors of khat use during pregnancy. The systematic review and meta-analysis performed among university students and a cross-sectional study conducted based on Ethiopian Demographic and Health Survey (EDHS) 2016, also found similar variables as predictors of khat use within those populations (21, 40, 44). However, alcohol use, which had been frequently cited as a correlate of khat use, did not show statically significant association in our study (35, 40, 45). This difference may be due to the variation in the study population and setting or for other reasons and further research on this topic among women who are pregnant is warranted.

Pregnant women who had khat chewing partners were over six times more likely to chew khat than those women whose partners did not chew. This result is also supported by the cross-sectional study which assessed the most common reason of khat chewing during pregnancy and the systematic review and meta-analysis conducted among university students (14, 45).

Disadvantaged women in terms of educational status, place of residence and income level were more likely to chew khat than their counter group. The EDHS 2016 results and the World Health Organisation stated that illiteracy and low educational status are one of the main predictors of substance use during pregnancy (44, 46). This may be due to the fact that mothers who have low educational status and live in rural area may have poor knowledge about the teratogenic effects of substance use during pregnancy (16). Moreover, various studies conducted in Yemen and Ethiopia reported that the majority of women who chew khat were farmers and live in remote areas, where accessibility for media and health information was very poor (11, 13, 40). Furthermore, khat chewing is socially acceptable practice and its deeply rooted with the culture and religion of rural communities (2, 7).

Conclusion

This study confirmed that the prevalence of khat chewing amongst pregnant mothers was high, nearly one third of pregnant mothers' chew khat in the study areas.

This meta-analysis identified significant factors contributing to khat chewing during pregnancy. This included maternal educational status, place of residence, level of income, partner khat chewing status, and maternal Antenatal Care (ANC) follow-up. Whereas, maternal ever drink alcohol did not show a statistically significant association.

Despite the fact that khat chewing is known to have harmful effects both for the mother and the baby, little effort has been made so far to measure or address the magnitude of the problem. This may be due to the fact that the problem commonly occurs in rural, remote and disadvantaged societies. Therefore, conducting further community based research that can encompass all contributing factors is important. More importantly, designing evidence based and specifically targeted intervention strategies is needed to decrease the prevalence and impact of khat chewing during pregnancy on both mothers and their babies.

Limitation of the study

The main limitation of this study was the absence of sufficient research in the area. This study was planned to include all studies available in east African and Arabian Peninsula countries. However, the studies that were found during the search strategy were only limited to Ethiopia and Yemen. Moreover, some studies did not investigate all associated factors of khat chewing among pregnant mothers.

Key points

The prevalence of khat chewing amongst pregnant mothers was high in Ethiopia and Yemen.

The prevalence known to be variable across the regions and population groups.

Pregnant women who had khat chewing partner and disadvantaged women in terms of educational and economic status were more likely to chew khat than the opposite group.

Studies conducted in the area are a few, conducting advanced research in the future is recommended.

The need to address the use of socially accepted substance use during pregnancy is important for policy and planning in the region.

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Not applicable

Competing interests

The authors declare that they have no competing interests.

Funding

The authors received no specific funding for this work.

Authors' contributions

MB developed the study protocol, search strategy and data extraction with the supervision of CC. Both authors (MB and CC) involved in study selection, quality appraisal and data analyses. MB prepared the final manuscript. CC participated in revision, discussion and consensus and approved the final manuscript.

Acknowledgements

Not applicable

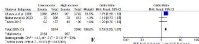
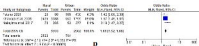
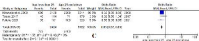
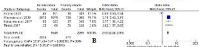
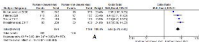
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(Alamneh et al. 2020)

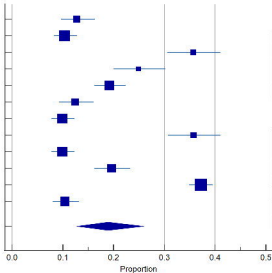
(Mekuriaw et al. 2019)

(Fetene et al. 2021)

(Yadeta et al. 2020)

(Tesfaye et al. 2020)

Total (random effects)



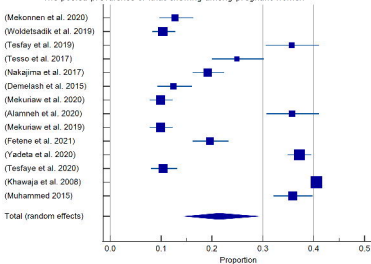
Test for heterogeneity

Q	585.7499
DF	11
Significance level	$P < 0.0001$
I^2 (inconsistency)	98.12%
95% CI for I^2	97.56 to 98.56

Publication bias

Egger's test	
Intercept	-8.1509
95% CI	-26.9177 to 10.6158
Significance level	$P = 0.3560$
Begg's test	
Kendall's Tau	0.3231
Significance level	$P = 0.1437$

The pooled prevalence of khat chewing among pregnant women



Test for heterogeneity

Q	1361.9232
DF	13
Significance level	$P < 0.0001$
I^2 (inconsistency)	99.05%
95% CI for I^2	98.84 to 99.21

Publication bias

Egger's test	
Intercept	-14.0035
95% CI	-22.4040 to -5.6030
Significance level	$P = 0.0034$
Begg's test	
Kendall's Tau	0.06667
Significance level	$P = 0.7398$