Current Substances Use Among Students in Ethiopia: A Systematic Review and Meta-Analysis of 20-Years Evidence

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ABSTRACT

BACKGROUND: The use of psychoactive substances is one of the main public health issues worldwide. However, there is a lack of evidence on the magnitude of current substance use among students in Ethiopia. Therefore, this study aimed to provide comprehensive views of the current prevalence of substance use among students in Ethiopia.

METHODS: We searched PubMed/Medline, Health InterNetwork Access to Research Initiative (HINARI), Google Scholar, and gray literature sources between 2000 and 2019. The prevalence of current substances with a 95% confidence interval (CI) was estimated using the random-effects model. The results were presented using forest plots, and Cochrane *Q*-test and I^2 were used to measure the extents of between-study variations.

RESULTS: A total of 1543 study articles were identified from electronic databases, and 32 cross-sectional studies were included in the meta-analysis. The prevalence of current use of at least 1 substance was 37.63% (95% CI: 33.66, 41.69), alcohol 27.61% (95% CI: 22.10, 33.48), khat 17.20% (95% CI: 14.03, 20.62), and smoking 9.74% (95% CI: 7.17, 12.64). The prevalence of any substance use in high school students versus university/college students was 41.55% (95% CI: 38.83, 44.29) versus 36.24% (95% CI: 32.37, 40.20), alcohol 24.21% (95% CI: 14.05, 36.11) versus 25.27% (95% CI: 19.76, 31.20), khat 13.82% (95% CI: 8.61, 20.02) versus 17.30% (95% CI:13.75, 21.16), and cigarette 8.30% (95% CI: 1.89, 18.60) versus 9.80% (95% CI: 7.32, 12.58). Meta-regression analysis revealed publication year, sample size, female proportion, and age were not significantly associated with the current use of substances.

CONCLUSION: Overall, the current substance use of any substance, alcohol, chewing khat, and smoking cigarettes was relatively high. A significant proportion of high school students were already using substances at an early age. Policymakers should formulate and implement regulations to control the pervasive use of substances by young people around educational institutions at all levels.

PROTOCOL REGISTRATION: The protocol has been registered on 19 August 2019 on the International Prospective Register of Systematic Reviews (PROSPERO) with ID: CDR42019130560.

KEYWORDS: Current substance, alcohol, khat, smoking, student, Ethiopia

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Introduction

Psychoactive substances such as alcohol, khat, and tobacco are widely used.[1,2] According to the World Health Organization (WHO) Global Status Report of 2016, 2.3 billion people are current alcohol drinkers, and young people 15- to 19-years-olds account for 27% of current drinkers.[3] The use of psychoactive substances is the leading cause of morbidity[4,5] and is responsible for more than 250 million disability-adjusted life years in 2015.[6] Recent trends demonstrate the use of psychoactive substances has considerably increased mainly in developing countries, including sub-Saharan Africa,[5] and it became growing public health and social problem.[5] Accompanied with poverty, harmful use of substances resulted in disproportionately high morbidity and mortality in low-income countries,[7] and the growing use of substances is driven by rapid economic, social, and cultural changes.[8]

In Ethiopia, the use of substances like khat, alcohol, and cigarette are common among the general population,[9-11] and studies show growing trends in the use of these substances among high school and university students in Ethiopia.[12-20] This shows students in Ethiopia are at increased risk-taking behaviors resulting in economic, social, physical, and health complications[12-20] including social withdrawal, poor academic performance, and increased risk of concurrent lifetime use of substances in students.[21] Given the high burden and mounting problems of substance use and the subsequent detrimental health and social impacts among the young population,[22,23] Ethiopia designated the use of substances among youth as serious health and social problem.[24] While this can be the first response, understanding the patterns and types of substances used by high school and university/college students is key to

develop and prioritize policy actions that are aimed at mitigating and controlling the use of substances.

Since the 1980s, Epidemiological studies show the pattern and types of substance use in students vary from across the regions and by the level of education. For instance, some studies reported either a single or concurrent use of substances among students which predominantly focused on lifetime use.[25-27] The estimates indicating lifetime substance use tend to overestimate and do not capture the most recent behaviors related to substance use and any estimate derived from these studies inevitably faces the same drawbacks. This is observed in a meta-analysis we conducted to estimate the prevalence of lifetime substance use in high school and university/college students.[28] Another meta-analysis was on the prevalence of khat consumption but did not specify the outcome as current or lifetime.[29] The main limitation of studies that focus on a single substance is that most often the substance use is concurrent while some substances are considered the gateway for other substances[19] and given a concomitant use of substances, a prevalence of isolated single substance use may not reveal the actual burden. Therefore, there is a great need for accurate and reliable estimates that capture the current substance use behavior by type to control the use in vulnerable, young populations in different levels of school settings.

In contrast, estimates of the current use of substances among students in Ethiopia show a great disparity. For example, the prevalence current use of any or at least 1 substance ranges from 28.6% to 47.9%,[13,21,30-33] alcohol consumption 9.3% to 44.2%,[12,20] and smoking cigarettes 9.3% to 22.0%.[12-14,17,34,35] Khat chewing—a common practice in the Horn of Africa and Middle East Countries,[36] the prevalence in Ethiopian students ranged from 3.7% to 33.1%.[12-14,17,18,27,34,35,37,38] This shows there is no scarcity but comprehensive and accurate evidence on current substance use among students in Ethiopia, and this warrants a systematic review and meta-analysis. The results of this systematic review are imports for developing policies at the national and institutional level to mitigate and control the increasingly rampant use of substances in the young population in school settings. The findings of this systematic review and meta-analysis help to inform school administrators and decision-makers to develop strategies to address health and socio-economic challenges related to the rampant use of substances and avert its future trajectory among the young population. Therefore, the objectives of this review and meta-analysis were to provide comprehensive evidence over the last 2 decades, 2000 to 2019 on the current prevalence of; (1) any substance use (at least 1 substance), (2) alcohol consumption, (3) khat chewing, and (4) smoking cigarettes among secondary school and university/college students in Ethiopia.

Methods

Registration

The protocol of this systematic review and meta-analysis has been registered on the International Prospective Register of Systematic Reviews (PROSPERO) with ID: CDR42019130560.

Search strategy

A comprehensive search of electronic databases; PubMed/Medline and Health InterNetwork Access to Research Initiative (HINARI), and Google Scholar was performed. Additionally, we have done an extensive manual search for unpublished study studies in Addis Ababa University's electronic library.[39] We developed search terms subjectively and checking PubMed to identify controlled vocabulary (MeSH) terms related to our topics and identified keywords based on our knowledge of the field. The following search MeSH such as "substance related disorders," "alcohol drinking," "tobacco use," "Catha," and "students" and text words were used alone or in combination. For Google Scholar search, we used "substance," "psychoactive substance," "alcohol," "drinking alcohol," "alcohol drinking," "drinking," "khat chewing," "chewing Khat," khat, Smoking, "smoking cigarettes," "cigarette," "smoking," and "tobacco." Likewise, for the HINARI search, we used "substance," "alcohol," "khat," "chewing khat," smoking, "smoking cigarettes," and "student," "high school," "college," "university," and Ethiopia. The detail of the terms and results of the search of all sources is the supplementary (Supplement: search terms). PRISMA guideline for systematic review[40] was used to report the search results.

Inclusion and exclusion

In this systematic review and meta-analysis, we included cross-sectional studies conducted among regular high school, college, and university students in Ethiopia and published in English. Additionally, we included that reported the current prevalence of any substance, the current prevalence of alcohol consumption, the current prevalence of khat consumption, and the current prevalence of smoking cigarettes. Further, studies with a response rate ⩾80%, employed probability sampling procedures, reporting quality assurance methods, and a quality assessment score ⩾50% were included. Review articles, studies used non-probability sampling procedure, qualitative studies, abstract and studies with unclear outcomes, and studies that were conducted among non-regular students were excluded. Three researchers; HSR, ASB, and BG evaluated the studies for inclusion criteria. First HSR and ASB assessed the studies for inclusion criteria and BG involved when a disagreement arises in the decision to include or exclude the studies.

Quality assessment and data extraction

For a critical appraisal of the articles, we used the Joanna Briggs Institute Meta-Analysis for Statistics Assessment and Review Instrument, checklists.[41] The checklists consisted of 9 items assessing; (1) appropriateness of target population, (2) sampling procedures, (3) adequacy of sample size, (4) the description of subject and settings, (5) adequate coverage of identified sample, (6) the use of a valid method to identify the condition, (7) condition measured in a standard, reliable way for all

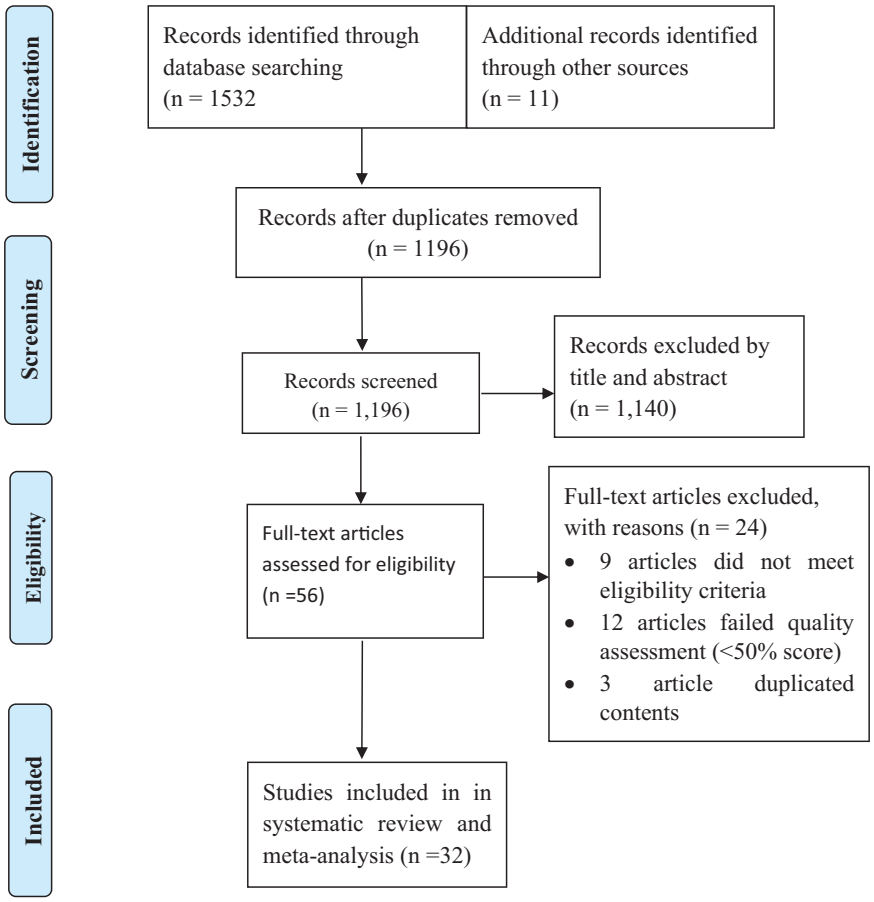

Figure 1. PRISMA flow chart diagram describing selected studies for systematic review and meta-analysis on the prevalence of current use of substances among students in Ethiopia.

participants, (8) appropriateness of statistical analysis, and (9) adequacy of the response. Two reviewers; HSR and ASB independently assessed the quality of articles using the checklists. Any disagreement which arose between the reviewers was solved by involving a third reviewer BG and HA. Data were extracted independently by 2 authors (HSR and ASB). We extracted information about the author(s), the study setting, study period, sample size, sampling technique, data collection method, response rate, mean age, and substances (any substance, khat, alcohol, and tobacco) on Microsoft Excel 2010.

Data analysis

Meta-analyses were conducted using the STATA version 14.0 statistical software package. All the estimates were combined using a random-effects model[42] to estimate the pooled prevalence of current substance use. Forest plots were used to present the results of pooled estimates with a 95% confidence interval (CI). The Cochran *Q*-test and I^2 statistic were used to test heterogeneity among studies. Group analyses were conducted by region, sample size, and level of educations. To conduct subgroup analysis, first, studies were grouped by regions in which school, college, or university was located, sample size categorized as less than 500, 500 to 1000, and 1000 or higher; the level of education: high school/preparatory school (PPS; referring to grade 9-12) or universities/college. Finally, meta-regression analyses were carried out to identify parameters (sample size, study year, and age of participants) associated with substance use.

Results

Search results

A total of 1543 studies were identified through electronic searches. Of these, 1532 studies were published, whereas 11 were master's thesis. After duplications were excluded, and 1196 records were screened by title and abstract. Other 1140 records were excluded by title and abstract, and the remaining 53 articles were screened further for quality eligibility, and from these, 21 articles were excluded since they were not eligible or failed quality criteria or contents were duplicated. Finally, 32 articles were included in the meta-analysis (Figure 1).

Characteristics of included studies

Overall 6 regions and 1 city administration were represented. Accordingly, 10 studies were conducted in educational institutions in Amhara Region,[20,30,33,37,43-48] 8 in Oromia Region,[13,15,17,18,38,49-51] 5 in Southern Nations, Nationalities and Peoples Region (SNNPR),[19,21,52-54] 2 in Addis Ababa,[12,55] 3 in Tigrai Region,[14,31,56] in Harari Region,[16] 1 in Somali Region,[57] and 1 study done in

both SNNPR and Oromia Regions.[58] Three studies included in the meta-analysis were unpublished, master's thesis.[20,31,50]

There was a wide sample size difference among the studies ranging from 193[56] to 3001.[44] The highest prevalence of current use of any substance was 47.9%,[32] 33.1% for khat consumption,[38] 44.2% for alcohol,[20] and 29.5% for smoking cigarettes.[56] All studies were conducted between 2002 and 2019 in high schools, preparatory schools, colleges, and Universities. Eight studies were conducted among high and preparatory schools,[15,16,32,47,49,54,55,58] 23 studies conducted among university students[12-14,17-21,30,31,33,37,38,44-46,48,50-53,56,57] 1 study was conducted among polytechnic college.[43] The mean age of the study participants ranges from 15.6 to 23 years (Table 1).

The quality of assessment

The quality of the studies was assessed based on the 9 quality areas. Accordingly, from the total studies, 27 (84.38%) studies adequately addressed the target population, and sampling was conducted appropriately. In more than half, 17 (53.13%) studies, the study subjects, and the setting were not described in detail, 9 (18.75%) studies, data analysis was conducted without sufficient coverage of the identified sample or not clearly described, 14 (43.75%) studies did not use a valid method to identify a current prevalence of substance use or unknown, and 28 (87.5%) studies data were not collected in a reliable way for all participants or not clearly described (Supplemental Table 2).

The prevalence of current use of any substance

A total of 11 studies; 10 published,[14,15,19,20,33,43,45,51,57,59] and 1 master's thesis[31] with a total of 6,638 participants were included in the meta-analysis. Concerning regional representation, 4 studies[20,33,43,45] were from Amhara Region, 2[19,59] from SNNPR, 2 studies[14,31] from Tigray Region, 2[15,51] from Oromia, and 1[57] from Somali Region. Nine studies[14,31,33,34,43,45,51,57,59] were conducted among university students and 2 studies[15,32] were conducted among high school and preparatory students. The prevalence of current use of any substance ranges from 28.6%[59] to 47.9%.[20] The pooled estimate of the current prevalence of any substance was 37.16% (95% CI: 33.39, 41.01). The analysis revealed the presence of substantial heterogeneity with ($I^2 = 90.55\%$, $P < .00$; Figure 2). However, there was no significant publication bias; Begg's test $P < 1.00$ and Egger's test $P < .560$.

The current prevalence of alcohol consumption

A total of 18 studies; 16 published,[12-17,20,21,33,43,45,48,51,52,54,55] 2 unpublished[20,31] studies with a total of 14 206 participants were included in the analysis. From a total, 6 studies[20,32,33,43,45,48] were from Amhara Region, 4 studies[13,15,17,51] were from Oromia Region, 2 studies[12,55] were from Addis Ababa, 2 studies[14,31] were from Tigray Region, 3 studies[52,54,59] were from SNNP, and 1 study[16] was from Harari Region. The prevalence of current alcohol use ranged from 8% among Haramaya University students[51] to 44.22% among Debre Birhan University students.[20] Four studies[15,16,20,55] were done among general secondary, and preparatory schools, and all of the studies were done between 2011 and 2018. The pooled prevalence of current alcohol use was 24.97% (95% CI: 20.07, 30.20). The analysis showed that there was high heterogeneity among studies ($I^2 = 97.96\%$, $P < .00$; Figure 3). The analysis showed no significant publication bias; Begg's test $P < .73$ and Egger's test $P < .33$.

The prevalence of current khat consumption

A total of 27 studies; 24 published studies,[12-15,17,18,20,21,30,33,37,38,43-49,51-54,57] and 3 unpublished studies[20,31,50] with a total of 19 679 participants were included in the analysis. From the total studies, 11 studies[20,30,33,37,43-48] were from Amhara Region, 8 studies[13,15,17,18,38,49-51] were from Oromia Region, 4[21,52-54] were from SNNP, and 2[14,31] were from Tigray, 1[12] was from Addis Ababa and 1 was from the Somali Region. The prevalence of current khat consumption ranges from 4% among Addis Ababa University students[12] to 33% in a study conducted among Jimma University students.[38] Five studies[15,20,47,49,54] were conducted in general secondary and preparatory school students, and 22 were conducted in university or college students. All studies were conducted between 2002 and 2018. The pooled prevalence of current khat consumption was 16.63% (95% CI: 13.57, 19.94). Significant heterogeneity was observed among studies ($I^2 = 97.25\%$, $P < .00$; Figure 4). However, there was no publication bias with Egger's test ($P < .240$), Begg's test $P < .044$.

The current prevalence of cigarette smoking

A total of 14 studies; 12 published,[13-15,20,21,30,33,43,45,48,51,58] 2 master's thesis[20,31] with a total of 10 213 participants were included in the analysis. From the total studies, 7 studies[20,30,32,33,43,45,48] were from Amhara Region, 2[14,31] were from Tigray Region, 3 studies[13,15,51] were from the Oromia Region, 1[21] was from SNNP and 1 study[58] was conducted in SNNP and Oromia Regions. Three studies were done in general secondary and preparatory schools,[15,20,58] 10 studies were conducted on university students,[13,14,20,21,30,31,33,45,48,51] and 1 study was done in polytechnic college.[43] Current cigarette smoking was between 3.1% in a study conducted in Debre Birhan University[48] and 17.2% in a study conducted among general secondary and preparatory schools in Hawassa and Jimma Towns. The studies were conducted between 2001[30] and 2018.[51] However, 13 of 14 studies were conducted between 2011 and 2018. The pooled prevalence of current cigarette smoking among students was 8.57% (95% CI: 6.32, 11.12). There was significant heterogeneity within studies

Table 1. Summary characteristics of studies included in the meta-analysis of the prevalence of current substance use among students in Ethiopia.

AUTHORS	STUDY AREA	STUDY POPULATION	MEAN AGE	SAMPLE SIZE	KHAT (%)	ALCOHOL (%)	SMOKING (%)	ANY PREVALENCE (%)	QA
Gebreselassie et al[14]	Tigray; Axum	University	22.3	756	27.9	32.8	9.3	44.8	8/9
Dida et al[15]	Oromia; Bale	Preparatory school	18.4	603	17.1	23.6	4.6	34.8	5/9
Tsegay and Esmael[45]	Amhara; Debre Markos	University	21.6	800	28.1	32.5	10.0	40.0	5/9
Aklog et al[43]	Amhara; Debre Markos	PT college	19.8	410	6.3	35.4	4.4	38.3	7/9
Kebede[30]	Amhara; Gonder, Bahir Dar	University	20.0	1103	17.5	–	8.1	–	9/9
Tesfaye et al[13]	Oromia; Harmaya	University	20.9	1022	23.6	20.0	10.8	–	8/9
Kassa et al[19]	SNNP; Hawassa	University	20.7	586	–	–	–	35.7	8/9
Kassa et al[52]	SNNP; Hawassa	University	20.7	586	16.3	29.5	–	–	8/9
Fufa et al[57]	Somale; Jijiga	University	21.2	600	28.3	-	–	40	6/9
Abrha[31]	Tigray; Mekelle	University	20.4	601	25.1	41.1	11.5	32.5	9/9
Mekonen et al[21]	SNNP, Wolaita Sodo	University	21.18	725	10.2	24.7	5.7	28.6	5/9
Adere et al[33]	Amhara; Woldia	University	20.74	655	10.4	29.7	6.4	31.5	8/9
Birhanu et al[32]	Amhara; Woreta	GSS and PPS	17.25	651	13.8	40.9	6.8	47.9	8/9
Teshome[50]	Oromia; Adamma	University	21.84	728	20.7	–	–	–	8/9
Gebrehanna et al[44]	Amhara; Bahr Dar	University	21.2	3001	7.7	–	–	–	8/9
Adane et al[37]	Amhara; Gondar	University	21.0	736	16.4	–	–	–	6/9

(Continued)

Table 1. (Continued)

AUTHORS	STUDY AREA	STUDY POPULATION	MEAN AGE	SAMPLE SIZE	KHAT (%)	ALCOHOL (%)	SMOKING (%)	ANY PREVALENCE (%)	QA
Abdeta et al[18]	Oromia; Jimma	University	21.9	619	23.9	–	–	–	8/9
Astatkie et al[53]	SNNP; Hawassa	University	21.4	1255	11.1	–	–	–	8/9
Deressa and Azazh[12]	Addis Ababa, AAU	University	20.4	622	3.7	9.3	–	–	5/9
Dachew et al[46]	Amhara; Gondar	University	21.3	836	13.6	-	–	–	5/9
Derese et al[17]	Oromia, Haramaya	University	21.0	725	20.3	17.5	–	–	5/9
Birhanu[20]	Amhara, Debre Berhan	University	21.2	346	22.3	44.2	14.7	–	5/9
Dires et al[49]	Oromia; Jimma	GSS	16.05	296	14.2	–	–	–	5/9
Lakew et al[47]	Amhara, Ataye	GSS and PPS	17.21	332	13.25	–	–	–	5/9
Reda et al[16]	Harari, Harar	GSS and PPS	16.4	1721		10.4	–	–	5/9
Meressa et al[38]	Oromia, Jimma	University	23.0	239	33.1	–	–	–	7/9
Teshome and Gedif[55]	Addis Ababa	GSS and PPS	16.93	2551	–	26.4	–	–	5/9
Dereje et al[58]	Oromia and SNNPR; Jimma and Hawassa	GSS and PPS	15.6	1673	–	–	17.2	–	6/9
Eticha and Kidane[56]	Tigray, Mekelle	University	21.2	193	–	–	29.5	–	5/9
Alebachew et al[51]	Oromia, Haramaya	University	23	251		8.0	–	–	4/9
Gebremariam et al[48]	Amhara	University	21.6	617	5.7	16.9	3.1	–	6/9
Duko et al[54]	SNNPR	GSS and PPS	16.8	564	6.9	15.1	–	–	6/9

Abbreviations: AAU, Addis Ababa University; GSS, General Secondary School; PPS, preparatory school; QA, quality assessment; SNNPR, Southern Nations, Nationalities and Peoples Region.

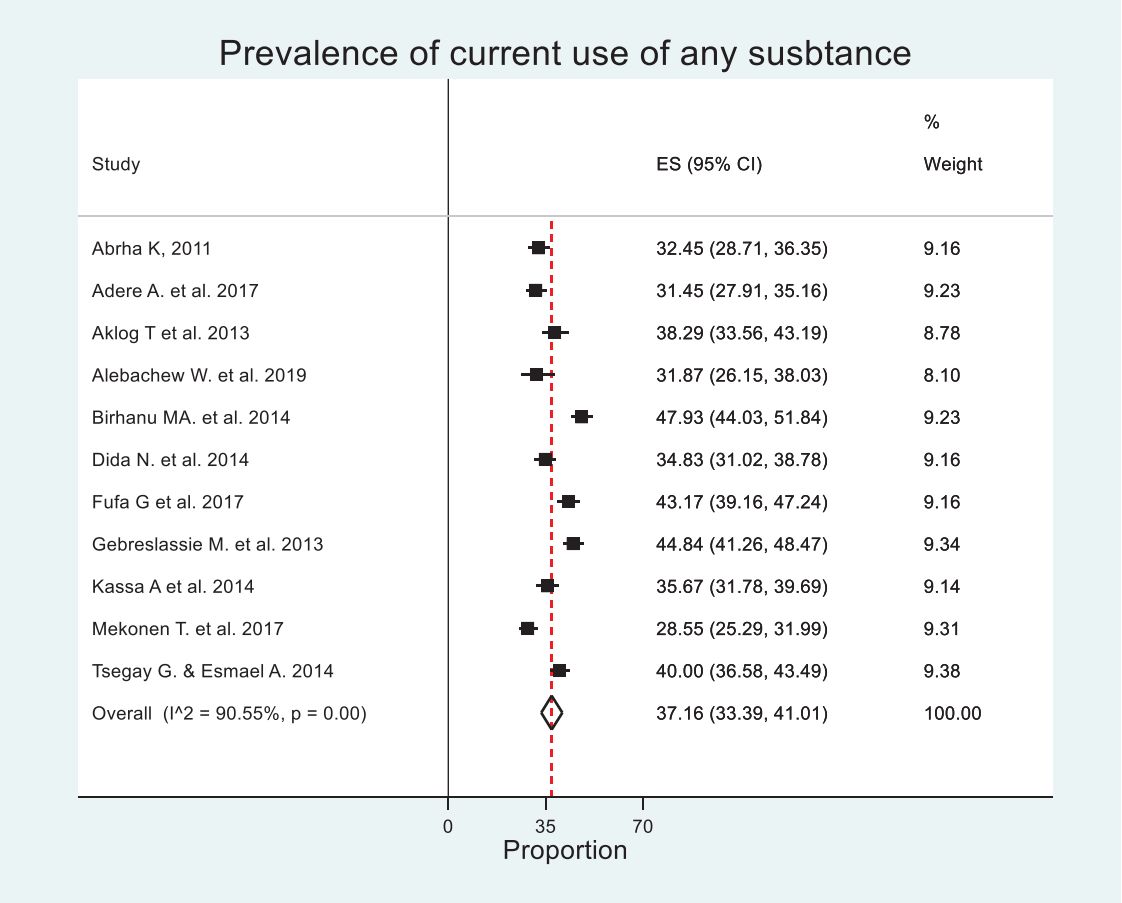

Figure 2. Forest plot of prevalence of current use of any substance among students in Ethiopia.

($I^2 = 94.68\%$, $P < .00$; Figure 5). However, there was no significant publication bias (Begg's test, $P < .192$ and egger's test, $P < .743$).

Subgroup analysis for any substance, alcohol, khat, and smoking cigarette

Figure 6A shows subgroup analyses of the prevalence of current use of any substance, alcohol, khat, and smoking cigarette by region to explore the sources of heterogeneity. Accordingly, the current prevalence of any substance use was highest in the other category (n = 1), 43.17 (95% CI: 39.16, 47.24) followed by the Amhara region (n = 4), 39.35% (95% CI: 33.64, 46.26). The current consumption of alcohol (n = 2), khat chewing (n = 2), and smoking cigarette (n = 3) was highest in Tigray region 36.43% (95% CI: 33.89, 39.01), 26.66% (95% CI: 24.34, 29.05), and 15.62% (95% CI: 7.73, 25.60), respectively. There was significant between-group heterogeneity for all substance use categories, $P < .000$.

Figure 6B shows a subgroup analysis of the prevalence of current use of the substance by sample size. The prevalence of current use of any substance was higher, 37.56% (95% CI: 33.22, 42.00) in studies with a sample size range from 500 to 1000 (n = 9). The current prevalence was highest in small sample size group (<500) for alcohol (n = 3) 27.42% (95% CI: 9.18, 50.86), khat (n = 6) 18.68% (95% CI: 10.89, 27.97), and cigarette smoking (n = 4) 14.89% (95% CI: 6.16, 26.50).

Figure 6C reveals a subgroup analysis of the current use of substances by the level of education. A higher prevalence of current use of any substance was observed among high school students (grade 9-12; n = 2), 41.55% (95% CI: 38.83, 44.29). However, higher prevalence was observed among university or college students; for alcohol (n = 13) 25.27% (95% CI: 19.76, 31.20), khat (n = 22) 17.30% (95% CI: 13.75, 21.16), and smoking cigarette (n = 12) 9.80% (95% CI: 7.32, 12.58).

Meta-regression

To explore the sources of between-study differences, we conducted meta-regression analysis, sample size, publication, the proportion of females (%), and mean age for the use of any substance, alcohol, khat, and smoking cigarettes. We found that the current use of any substance, khat, and smoking cigarettes showed a significant association with the respective sample size. Accordingly, the prevalence of current use of any substance and khat decrease by 5.91×10^{-5} ($P < .029$) and 5.81×10^{-5} ($P < .037$), respectively, for a unit increase in sample size. The prevalence of current smoking cigarettes increases by 8.32×10^{-5} for a unit increase in the sample size. However, study year and age the students were not associated with the

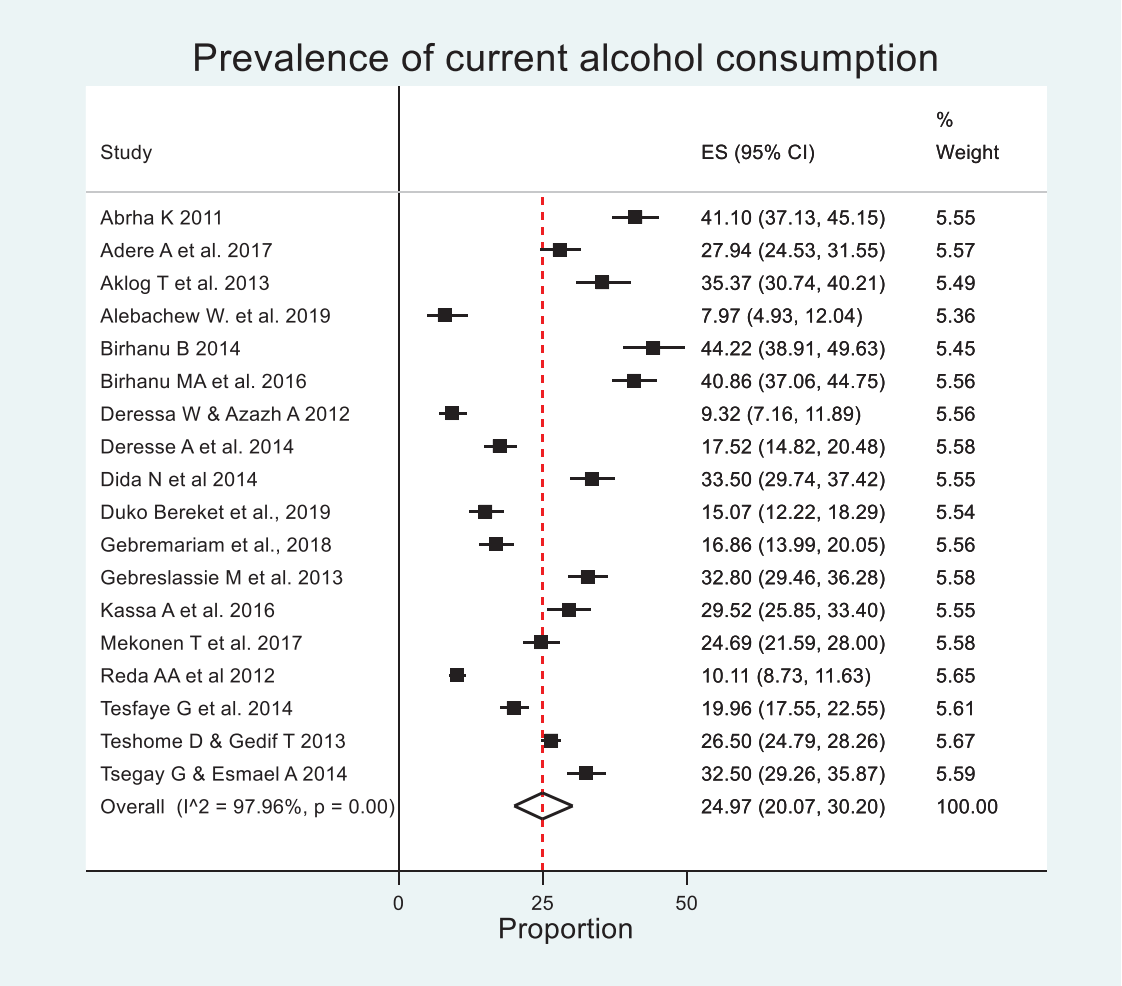

Figure 3. Forest plot of prevalence of current alcohol consumption among students in Ethiopia.

current use of any substance, alcohol, khat, and cigarette smoking (Supplemental Table S3).

Discussion

In this systematic review and meta-analysis, we have tried to provide an overview of estimates of current substance use among students in Ethiopia. We have also tried to derive the estimates that represent the secondary school and tertiary education students which are either considered separately or inadequately represented in the Ethiopian context. Therefore, this meta-analysis provides comprehensive views of the prevalence of current use of substances among students in secondary and higher educational institutions for policymakers and concerned bodies to guide future interventions.

The current prevalence of any substance (khat, alcohol, or cigarette smoking) in this meta-analysis was 37.16%, and a significant regional difference was observed. This shows young people are using substances and at increased risk of experiencing negative health and social impacts. Although there was no comparable meta-analysis report, this finding was slightly lower than the national prevalence of alcohol consumption 41%.[60] However, the prevalence was 8 times as high as when compared to a prevalence of a single substance, khat 5.3% at the national level,[11] and twice as high as the prevalence of cigarette smoking 19.8% among Iranian students, a result of a meta-analysis.[61] The observed difference could be attributed to a difference in the study population and study settings. For instance, the national prevalence of alcohol consumption was estimated from a population-based study conducted among the population with a wider age range, 15 to 64 years compared relatively younger population used in this meta-analysis. This implies that future studies need to focus on identifying a gateway substance for other substances to help delay exposure thereby preventing exposure to multiple substances.

This study showed 1 in 4 students were current alcohol consumers. This shows that a significant proportion of students was facing alcohol-related immediate complications such as gastrointestinal upsets, injuries, and long-term complications such as mental disorder-related dependency, withdrawal, and socio-economic instabilities. The finding was lower than the national alcohol consumption in 2016, which was 41%,[60] and a result of a meta-analysis of the prevalence of alcohol consumption among young people in eastern Africa, which 33%.[62] Since the national survey was conducted general population and

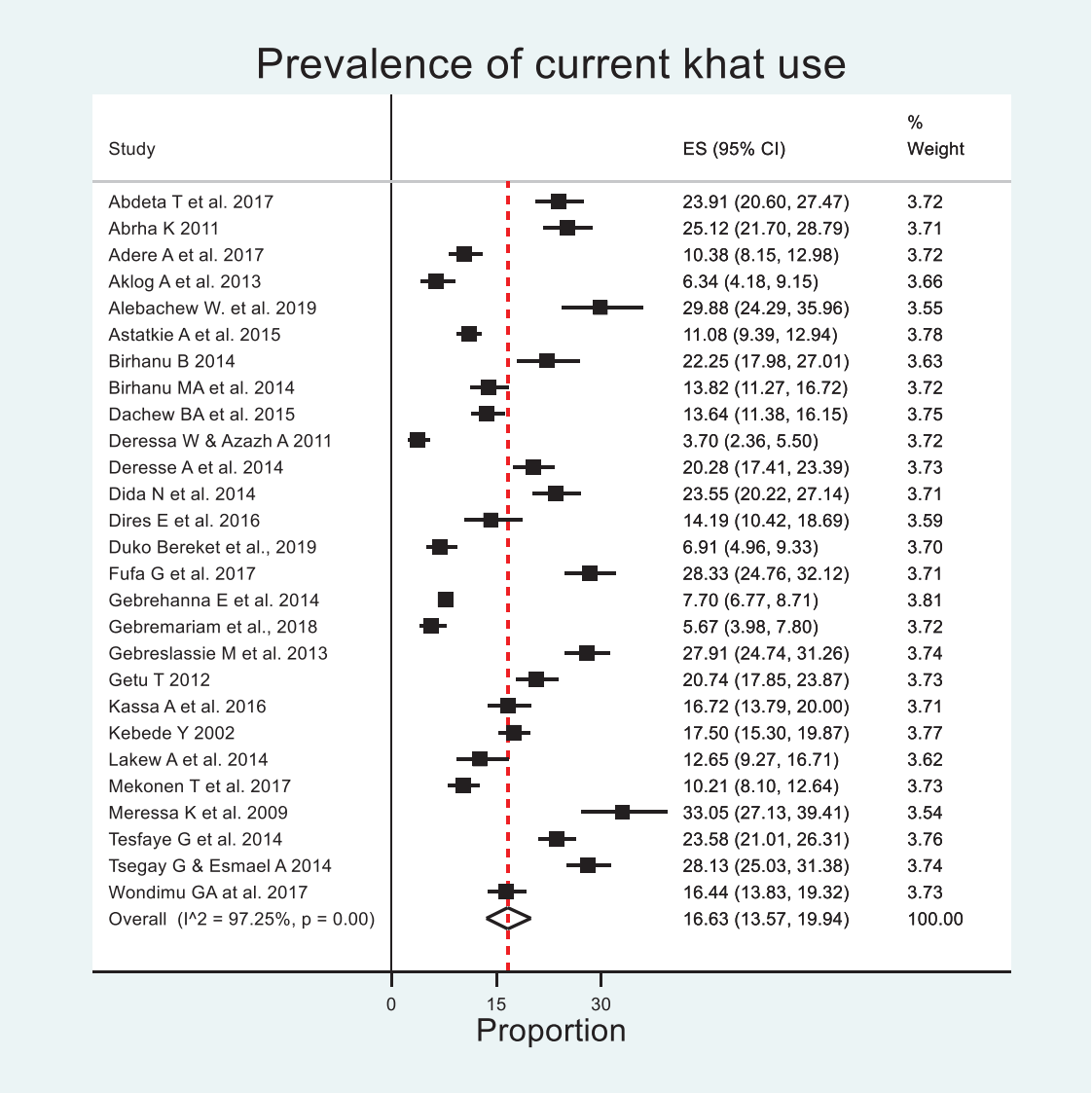

Figure 4. Forest plot of prevalence of current khat consumption among students in Ethiopia.

estimated the prevalence of lifetime alcohol consumption; whereas the results of the latter study represent the median prevalence of studies conducted only in secondary school students in East African countries, it is difficult to make plausible comparisons. Besides, inconsistent with previous studies,[11,29] we observed regional variation in the prevalence of alcohol consumption and it is partly driven by the use of other substances such as khat where alcohol is consumed to calm heightened mood after khat consumption.[63] Overall, given 1 in 4 high schools and university/college students were the current user of alcohol and this finding was relevant to design intervention strategies that aimed at preventing alcohol-related health and socio-economic problems.

The pooled prevalence of khat consumption was 16.63%. The result was consistent with the prevalence of alcohol consumption in Ethiopia, 15.8%,[60] and a result of a meta-analysis on the prevalence of khat chewing in the Middle East and Africa,14% to 30%.[64] However, the finding was lower when compared with a result of a meta-analysis of studies conducted on khat chewing among university students in Ethiopia, 23.2%.[29] The difference could be due to variation in the study population, settings, and definition of khat use. For example, unlike our study, the meta-analysis of a study conducted in the Middle East and Africa was based on primary studies done only among university students and failed to specify whether the prevalence was the estimate of a lifetime or current khat consumption. In general, the results of this study highlighted that a significant proportion of students were current khat chewer and at increased risks of poor academic performance,[65] sleeping disorders,[66,67] HIV and poor physical health,[68] risky sexual behavior,[69] and gastrointestinal disorders.[67,70,71] While production and distribution of khat is not regulated, it is one of the most commonly used substances due to its cheap price, and consumption is increasingly growing beyond producing region in Ethiopia which is not captured by this study. The public health importance of the current prevalence of khat consump-

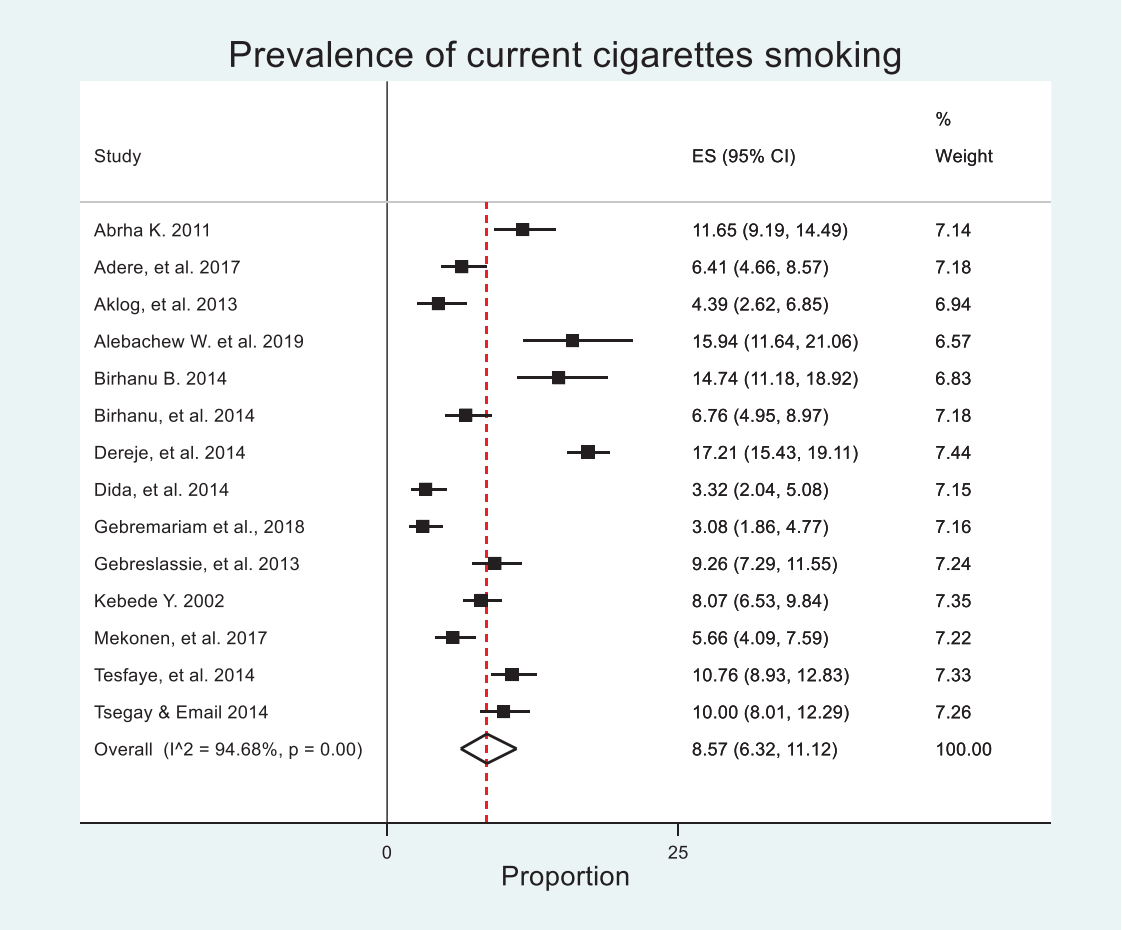

Figure 5. Forest plot of the current prevalence of smoking cigarettes among students in Ethiopia.

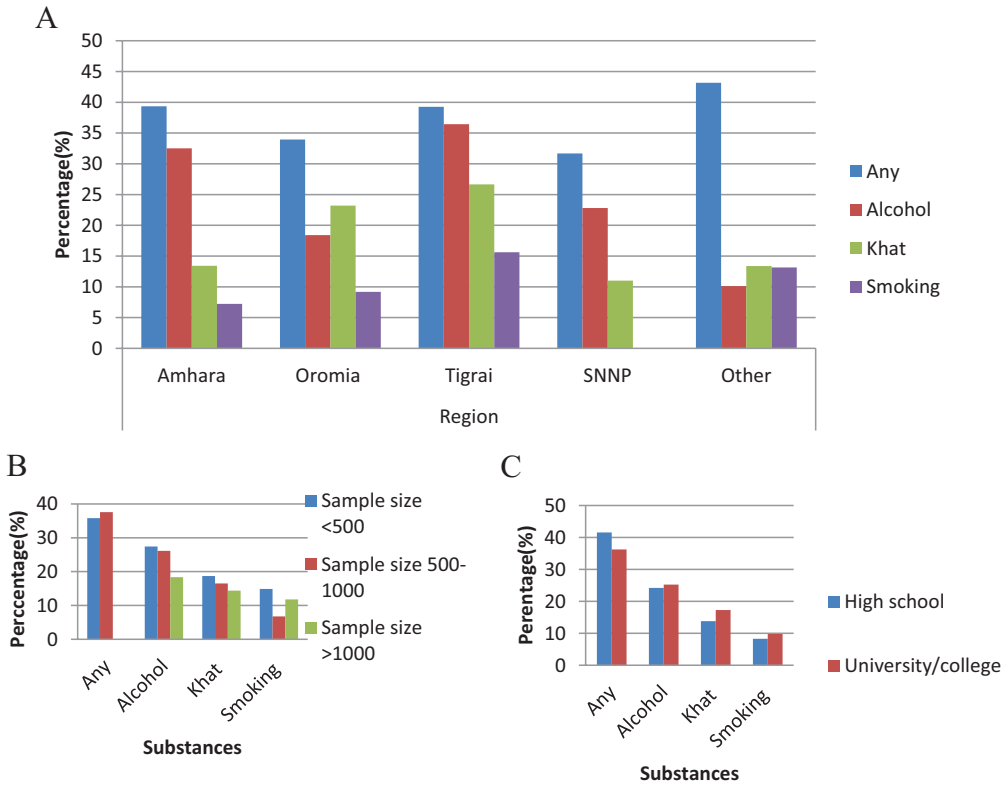

Figure 6. Prevalence of current any substance use by Regions (A), sample size (B), and level of education (C) among students in Ethiopia.

tion is that it can be an entry to the use of substances and therefore, can help predict future trends.

In this study, 1 in 10 students was a current smoker which more than twice as much as the prevalence of cigarette smoking (4.1%) among adults in Ethiopia[60,72] and lower than the prevalence of smoking of a meta-analysis conducted on Iranian university students, which was 19.8%.[61] The discrepancy could be due to a difference in the study population, settings, and how smoking cigarettes were measured. For example, the results on representing current estimate in adults in Ethiopia which was conducted among the adult population whereas this meta-analysis was based on primary studies conducted in schools or universities/colleges in Irani which may have resulted in variation in estimates. Evidence shows that cigarette smoking during early age causes significant health problems among young people, including an increase in the number and severity of respiratory illnesses, decreased physical fitness, and potential effects on lung growth and function.[73] Current cigarette smoking behavior also has a significant impact on future substance use behaviors. Evidence reveals that smoking behavior often lasting into and sometimes throughout adulthood and among adults who have ever smoked daily, 87% had tried their first cigarette by the time they were 18 years of age, and 95% had by age 21.[74] Therefore, this finding suggests the need for reaching out to current smokers and address influencing factors in young people in school settings.

In subgroup analyses, where we attempted to identify the sources of heterogeneity, there were significant between-study variations when the studies were grouped by the administrative regions in Ethiopia. The differences were observed for all categories of substances; current use of any substance, alcohol consumption, khat chewing, and smoking cigarettes. These findings were comparable to previous studies[11,29] that demonstrated regional variation in the epidemiology of substance use. This could be attributed to accessibility and socio-cultural influences. For example, the eastern part of Ethiopia is known for khat production and consumption that is deeply embedded in the culture whereas alcohol consumption is relatively relaxed in the North and Northwest.[22,75] Additionally, there is a tendency that the use of these substances co-occurs which might, in turn, contributed to the differences observed. This is supported by the results of several studies done in Ethiopia and Middle East countries revealing a high prevalence of cigarette smoking among chat chewers,[10,11,29,64,76] and alcohol is commonly consumed after khat chewing to lower heightened mood, commonly known as "*chabsi*," referring to breaking high mood due to cathinone, an active ingredient in the leaf. Another study[10] revealed that the majority of concurrent use of khat chewer and smokers reported having initiated khat before smoking. This calls for the need to address the challenges of substance use through societal interventions.

This systematic review and meta-analysis had several limitations in addition to the design-related limitations inherited in cross-sectional studies. First, we did not include illicit drugs which could have made this more comprehensive duet limited studies. Secondly, educational institutions were not adequately represented by types, especially private institutions. Thirdly, a few regions and universities were represented in this systematic review and meta-analysis. This might have resulted in under, or overestimation of substance use estimates as production, availability, and the use of the substances varies from region to region. Moreover, we did not assess determinant factors that are the key for prioritize intervention strategies.

Conclusion and Recommendation

The estimates of this meta-analysis highlighted the extent of prevalence of current use of any substance, khat, alcohol, and smoking cigarettes among students in Ethiopia over the last 2 decades. Overall, the current use of any substance was highest, followed by alcohol consumption, khat chewing, and smoking cigarettes. In this study, 4 in 10 high school students were the current user of at least 1 type of substance, nearly 1 in 4 were current alcohol users, and a significant number of students chew khat, and nearly 1 in 10 students smoke cigarettes. The current rate of use of specific substances was lightly slightly higher in university/college students. These imply that the problem of substance use is common among students in Ethiopia, and a significantly higher number of students had been exposed to the substances before joining university or college, and the number only increases as students are left unattended during tertiary education. We call for early interventions including awareness creation about the harms of substance and regulation of substance use in young people. We urge educational institutions and policymakers to institute strict control measures against the pervasive use of substances around schools, colleges, and universities at the national and local levels to prevent the social, economic, and health impacts of substances. Finally, a national survey should be conducted in educational institutions at regular intervals to investigate the magnitude, trends, gateway substance, and consequences of substance use among students to prevent its health and socio-economic impact.

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Author Contributions

HSR originally designed a systematic review and meta-analysis. HSR, BG, HA, and ASB equally contributed to study searching and selections, quality assessment, data extraction, and analysis. HSR, BG, HA, and ASB contributed to writing the manuscript and all authors read and approved the final manuscript.

Availability of Data and Material

All relevant data are within this paper. If further data are needed, it could be accessed from the first author upon request via e-mail: hamakiya@gmail.com or Shore.Roba@haramaya.edu.et.

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Supplemental Material

Supplemental material for this article is available online.

REFERENCES

1. Rehm J, Rehn N, Room R, et al. The global distribution of average volume of alcohol consumption and patterns of drinking. *Eur Addict Res*. 2003;9:147-156.
2. Tesfaye F, Byass P, Berhane Y, Bonita R, Wall S. Association of Smoking and Khat (Catha edulis Forsk) use with high blood pressure among adults in Addis Ababa, Ethiopia, 2006. *Public Health Research, Practice, and Policy*. 2008;5:1-11.
3. WHO. *Global Status Report on Alcohol and Health 2018*, In: Poznyak V, Rekve D, World Health Organization; 2018.
4. WHO. *WHO Report On THE Global Tobacco Epidemic*. WHO; 2011:7-74.
5. Odejide AO. Status of drug use/abuse in Africa: a review. *Int J Ment Health Addict*. 2006;4:87-102.
6. Peacock A, Leung J, Larney S, et al. Global statistics on alcohol, tobacco, and illicit drug use: 2017 status report. *Addiction*. 2018;113:1905-1926.
7. Anderson P. Global use of alcohol, drugs and tobacco. *Drug Alcohol Rev*. 2006;25:489-502.
8. John-Lengba J, Ezeh A, Guiella G, Kumi-Kyereme A, Neema S. Alcohol, drug use, and sexual risk behaviors among adolescents in four sub-Saharan African countries. In: Proceedings of the annual meeting program of the population association of America: 2004; Los Angeles, CA, 3 March–1 April 2004.
9. Kassay M, Sherief HT, Fissehaye G, Teklu T. Knowledge of drug use and associated factors as perceived by health professionals, farmers, the youth and law enforcement agencies in Ethiopia. *Ethiop J Health Dev*. 1999;13(2):141-149.
10. Nakajima M, Jebena MG, Taha M, et al. Correlates of khat use during pregnancy: a cross-sectional study. *Addict Behav*. 2017;73:178-184.
11. Haile D, Lakew Y. Khat Chewing practice and associated factors among adults in Ethiopia: further analysis using the 2011 demographic and health survey. *PLoS One*. 2015;10:e0130460.
12. Deressa W, Azazh A. Substance use and its predictors among undergraduate medical students of Addis Ababa University in Ethiopia. *BMC Public Health*. 2011;11:660.
13. Tesfaye G, Derese A, Hambisa MT. Substance use and associated factors among university students in Ethiopia: a cross-sectional study. *J Addict*. 2014;2014:969837.
14. Gebreslassie M, Feleke A, Melese T. Psychoactive substances use and associated factors among Axum University students, Axum Town, North Ethiopia. *BMC Public Health*. 2013;13:693.
15. Dida N, Kassa Y, Sirak T, Zerga E, Dessalegn T. Substance use and associated factors among preparatory school students in Bale Zone, Oromia Regional State, Southeast Ethiopia. *Harm Reduct J*. 2014;11:21.
16. Reda AA, Moges A, Wondmagegn BY, Biadgilign S. Alcohol drinking patterns among high school students in Ethiopia: a cross-sectional study. *BMC Public Health*. 2012;12:213.
17. Derese A, Seme A, Misganaw C. Assessment of substance use and risky sexual behaviour among Haramaya University students, Ethiopia. *Sci J Public Health*. 2014;2:102-110.
18. Abdeta T, Tolessa D, Adorjan K, Abera M. Prevalence, withdrawal symptoms and associated factors of khat chewing among students at Jimma University in Ethiopia. *BMC Psychiatry*. 2017;17:142.
19. Kassa A, Taddesse F, Yilma A. Prevalence and factors determining psychoactive substance (PAS) use among Hawassa University (HU) undergraduate students, Hawassa Ethiopia. *BMC Public Health*. 2014;14:1044.
20. Birhanu B. *The Relationship Between Stress, Coping Behaviour and Substance Abuse Among Debreberhan University*. Addis Ababa University; 2014.
21. Mekonen T, Fekadu W, Chane T, Bitew S. Problematic alcohol use among university students. *Front Psychiatry*. 2017;8:86.
22. Abebe W. The prevalence and consequences of substance use among high school and college students in Ethiopia. A review of literature. *Afr J Drug Alcohol Stud*. 2013;12:107-118.
23. Fekadu A, Atalay A, Charlotte H. Alcohol and drug abuse in Ethiopia: past, present and future. *Afr J Drug Alcohol Stud*. 2007;6:39-53.
24. Kevin EG, Ma A, Dawn MBF, Eric DW. Heavy drinking and poly drug use among college students. *Int J Drug Issues*. 2008;38:445-466.
25. Zein ZA. Polydrug abuse among Ethiopian university students with particular reference to khat (Catha edulis). *J Trop Med Hyg*. 1988;91:71-75.
26. Zein ZA, Admasu M, Tadesse M, et al. Patterns of cigarette-smoking among Ethiopian medical and paramedical students. *Ethiop Med J*. 1984;22:165-171.
27. Adugna F, Jira C, Molla T. Khat chewing among Agaro secondary school students, Agaro, southwestern Ethiopia. *Ethiop Med J*. 1994;32:161-166.
28. Roba HS, Beyene AS, Irenso AA, Gebremichael B. Prevalence of lifetime substances use among students in Ethiopia: a systematic review and meta-analysis. *Syst Rev*. 2019;8:326.
29. Gebrie A, Alebel A, Zegeye A, Tesfaye B. Prevalence and predictors of khat chewing among Ethiopian university students: a systematic review and meta-analysis. *PLoS One*. 2018;13:e0195718.
30. Kebede Y. Cigarette smoking and khat chewing among university instructors in Ethiopia. *East Afr Med J*. 2002;79:274-278.
31. Abrha K. *Psychoactive Substance Abuse and Intention to Stop Among Students of Mekelle University, Ethiopia*. Addis Ababa University; 2011.
32. Birhanu AM, Bisetegn TA, Woldeyohannes SM. High prevalence of substance use and associated factors among high school adolescents in Woreta Town, Northwest Ethiopia: multi-domain factor analysis. *BMC Public Health*. 2014;14:1186.
33. Adere A, Yimer NB, Kumsa H, Liben ML. Determinants of psychoactive substances use among Woldia University students in Northeastern Ethiopia. *BMC Res Notes*. 2017;10:441.
34. Kassa A, Deyno S. Prevalence and determinants of active and passive cigarette smoking among undergraduate students at Hawassa University, Hawassa, Ethiopia. *J Trop Dis*. 2014;2:145.
35. Haile YG, Alemu SM, Habtewold TD. Common mental disorder and its association with academic performance among Debre Berhan University students, Ethiopia. *Int J Ment Health Syst*. 2017;11:34.
36. Al-Juhaishi T, Al-Kindi S, Gehani A. Khat: a widely used drug of abuse in the Horn of Africa and the Arabian Peninsula: review of literature. *Qatar Med J*. 2012;2012:1-6.
37. Adane WG, Alemie GA, W/yhonnes SM, Gelaw YA. Prevalence and associated factors of khat use among university students in the University of Gondar, northwest Ethiopia. *J Subst Use*. 2017;22:176-181.
38. Meressa K, Mossie A, Gelaw Y. Effect of substance use on academic achievement of health officer and medical students of Jimma University, Southwest Ethiopia. *Ethiop J Health Sci*. 2009;19:155-163.
39. Addis Ababa University Institutional Repository. http://etd.aau.edu.et/handle/123456789/1557
40. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med*. 2009;151:264-269.
41. Munn Z, Moola S, Lisy KRD, Tufanaru C. Chapter 5: systematic reviews of prevalence and incidence. In: Aromataris E, Munn Z, eds. *JBI Manual for Evidence Synthesis*. JBI; 2020.
42. DerSimonian R, Laird N. Meta-analysis in clinical trials. *Control Clin Trials*. 1986;7:177-188.
43. Aklog T, Tiruneh G, Tsegay G. Assessment of substance abuse and associated factors among students of Debre Markos poly technique college in Debre Markos town, East Gojjam Zone, Amhara Regional State, Ethiopia, 2013. *Glob J Med Res*. 2013;13.
44. Gebrehanna E, Berhane Y, Worku A. *Khat Chewing Among Ethiopian University Students—A Growing Concern*. MC Public Health; 2014:14.
45. Tsegay G, Esmael A. Psychoactive substances use (khat, alcohol and tobacco) and associated factors among Debre Markos University Students, North-West Ethiopia, 2013. *J Defense Manag*. 2014;4:118.
46. Dachew B, Bifftu B, Tiruneh B. Khat use and its determinants among university students in northwest Ethiopia: a multivariable analysis. *Int J Med Sci Public Health*. 2015;4:319-323.
47. Lakew A, Tariku B, Deyessa N, Reta Y. Prevalence of *Catha edulis* (Khat) chewing and its associated factors among Ataye secondary school students in Northern Shoa, Ethiopia. *Adv Appl Sociol*. 2014;4:225-233.
48. Gebremariam TB, Mruts KB, Neway TK. Substance use and associated factors among Debre Berhan University students, central Ethiopia. *Subst Abuse Treat Prev Policy*. 2018;13:13.
49. Dires E, Soboka M, Kerebih H, Feyissa GT. Factors associated with khat chewing among high school students in Jimma Town Southwest Ethiopia. *J Psychiatry*. 2016;19:372.
50. Teshome G. *Magnitude and Factors Associated With Khat Chewing Among Students of Adama University, Oromia National Regional State*. Addis Ababa University; 2012.
51. Alebachew W, Semahegn A, Ali T, Mekonnen H. Prevalence, associated factors and consequences of substance use among health and medical science students of Haramaya University, eastern Ethiopia, 2018: a cross-sectional study. *BMC Psychiatry*. 2019;19:343.

52. Kassa A, Wakgari N, Taddesse F. Determinants of alcohol use and khat chewing among Hawassa University students, Ethiopia: a cross-sectional study. *Afr Health Sci*. 2016;16:822-830.
53. Astatkie A, Demissie M, Berhane Y, Worku A. Prevalence of and factors associated with regular khat chewing among university students in Ethiopia. *Subst Abuse Rehabil*. 2015;6:41-50.
54. Duko B, Melese Y, Ebrahim J. Determinants of cigarette smoking among adolescents in Ethiopia: a cross-sectional study. *Tob Induc Dis*. 2019;17:62.
55. Teshome D, Gedif T. Determinants of alcohol drinking and its association with sexual practices among high school students in Addis Ababa, Ethiopia: cross-sectional study. *Open J Prev Med*. 2013;3:420-427.
56. Eticha T, Kidane F. The prevalence of and factors associated with current smoking among College of Health Sciences students, Mekelle University in northern Ethiopia. *PLoS One*. 2014;9:e111033.
57. Fufa G, Shiferaw D, Kinati T, Desalegn M. The nexus between khat and other drug use among undergraduate students of Jigjiga University in Ethiopia; contributing factors and prevalence rates. *Public Health Res*. 2017;7:49-54.
58. Dereje N, Abazinab S, Girma A. Prevalence and predictors of cigarette smoking among adolescents of Ethiopia: school based cross sectional survey. *J Child Adolesc Behav*. 2014;3:182.
59. Mekonen T, Fekadu W, Mekonnen TC, Workie SB. Substance use as a strong predictor of poor academic achievement among university students. *Psychiatry J*. 2017;2017:7517450.
60. EHPI. *WHO: Ethiopian STEPS Report on Risk Facto for Chronic Non-communicable Diseases and Prevalence of Selected NCDs*. EPHI; 2016.
61. Haghdoost AA, Moosazadeh M. The prevalence of cigarette smoking among students of Iran's universities: a systematic review and meta-analysis. *J Res Med Sci*. 2013;18:717-725.
62. Francis JM, Grosskurth H, Changalucha J, Kapiga SH, Weiss HA. Systematic review and meta-analysis: prevalence of alcohol use among young people in eastern Africa. *Trop Med Int Health*. 2014;19:476-488.
63. Mihretu A, Teferra S, Fekadu A. Problematic khat use as a possible risk factor for harmful use of other psychoactive substances: a mixed method study in Ethiopia. *Subst Abuse Treat Prev Policy*. 2017;12:47.
64. Kassim S, Jawad M, Croucher R, Akl EA. The epidemiology of tobacco use among khat users: a systematic review. *Biomed Res Int*. 2015;2015:313692.
65. Kassa A, Loha E, Esaiyas A. Prevalence of khat chewing and its effect on academic performance in Sidama zone, southern Ethiopia. *Afr Health Sci*. 2017;17:175-185.
66. Robinson D, Gelaye B, Tadesse MG, Williams MA, Lemma S, Berhane Y. Daytime sleepiness, circadian preference, caffeine consumption and khat use among college students in Ethiopia. *J Sleep Disord Treat Care*. 2013;3:10.4172/2325-9639.1000130.
67. Teni FS, Surur AS, Hailemariam A, et al. Prevalence, reasons, and perceived effects of khat chewing among students of a college in Gondar town, northwestern Ethiopia: a cross-sectional study. *Ann Med Health Sci Res*. 2015;5:454-460.
68. Lifson AR, Workneh S, Shenie T, et al. Prevalence and factors associated with use of khat: a survey of patients entering HIV treatment programs in Ethiopia. *Addict Sci Clin Pract*. 2017;12:3.
69. Kebede D, Alem A, Mitike G, et al. Khat and alcohol use and risky sexual behaviour among in-school and out-of-school youth in Ethiopia. *BMC Public Health*. 2005;5:109.
70. Fasanmade A, Kwok E, Newman L. Oral squamous cell carcinoma associated with khat chewing. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod*. 2007;104:e53-e55.
71. Nigussie T, Gobena T, Mossie A. Association between khat chewing and gastrointestinal disorders: a cross sectional study. *Ethiop J Health Sci*. 2013;23(2):123-130.
72. Lakew Y, Haile D. Tobacco use and associated factors among adults in Ethiopia: further analysis of the 2011 Ethiopian demographic and health survey. *BMC Public Health*. 2015;15:487.
73. Centers for Disease Control and Prevention (CDC). *Preventing Tobacco Use Among Young People: A Report of the Surgeon General: Morbidity and Mortality Weekly Report*. Atlant, Georgia: Center of Disease COntrol and Prevention, USA; 1994;43.
74. Substance Abuse and Mental Health Services Administration. *National Survey on Drug Use and Health, 2014. Analysis by the American Lung Association Epidemiology and Statistics Unit Using SPSS Software*. 2014.
75. Tafere G. A review on traditional fermented beverages of Ethiopian. *J Nat Sci Res*. 2015;5:94-102.
76. Mahfouz MS, Alsanosy RM, Gaffar AM, Makeen A. Tobacco use among university students of Jazan region: gender differences and associated factors. *Biomed Res Int*. 2014;2014:279231.