Prevalence of lifetime substances use among students in Ethiopia: a systematic review and meta-analysis

Hirbo Shore Roba 1*, Addisu Shunu Beyene 1,2, Asnake Ararsa Irenso 1,3 and Berhe Gebremichael 1

Abstract

Background: The use of substances is a growing concern in Ethiopia, and their impacts on younger generation have been a concern of different professionals. Even though students are at high-risk of substance abuse, there is lack of comprehensive evidence for policy decision on substance use among students. Therefore, the aim of this systematic review and meta-analysis was to estimate the prevalence of common substances among students in Ethiopia.

Method: A comprehensive literature searches were done from biomedical databases: PubMed/Medline, African Journal Online, HINARI, Science Direct, and Google Scholar for article published until December 31, 2017, and Addis Ababa University's electronic library search of unpublished thesis and dissertations. Two authors autonomously selected studies, extracted data, and evaluated quality of studies. The prevalence of lifetime substances use was estimated using the random effects model. Q and I² statistics were computed to measure the extents of heterogeneity.

Results: A total 676 study articles were identified from electronic databases, and 28 of them were included in meta-analysis. The analysis revealed that the lifetime prevalence of any substance use was 52.5% (95% CI 42.4–62.4%), khat 24.7% (95% CI 21.8–27.7%), alcohol 46.2% (95% CI 40.3–52.2%), and smoking cigarette 14.7% (95% CI 11.3–18.5%). Significant heterogeneity was observed but there was no significant publication bias. The lifetime prevalence of khat, alcohol, and cigarette smoking among high school vs university students was 22.5% (95% CI 15.2–30.7%) vs 25.1% (95% CI 21.9–28.5%), 41.4% (95% CI 22.1–62.1%) vs 47.8% (95% CI 39.9–55.7%), and 21.5% (95% CI 12.6–32.1%) vs 12.9% (95% CI 10.1–16.0%), respectively.

Conclusion: This meta-analysis highlighted the extent of lifetime prevalence of any substance, khat, alcohol, and cigarettes smoking among students in Ethiopia. Significant percent of high school students have exposed to substances. Policy makers should devise and implement strictly binding regulation to curb widespread of substances around educational institution premises at national level. Priority should be given to intervention strategies that help delay first use of substance to prevent problems later in life. Besides, the problem warrants regular national-level educational institutions based studies focusing on the magnitude, trajectory, and consequences of substance use among students.

Keywords: Substances, Prevalence, High school, University, Meta-analysis, Ethiopia

* Correspondence: hamakiya@gmail.com
1School of Public Health, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia
Full list of author information is available at the end of the article
Background
Psychoactive substances act on the central nervous system and change the activities of the brain. These substances have wide range of effects, including short-term changes in perceptions, mood, consciousness, and behaviors [1]. Substances such as alcohol, khat, and tobacco are widely used [2, 3], and they are leading causes of human sufferings and become important public health and socioeconomic issue globally [4–6]. Current trends showed that the use of psychoactive substances have considerably increased predominantly in developing countries [6].

In 2012, 5.9% of all global deaths and 5.1% of disability-adjusted life year were attributable to alcohol consumption [7]. Roerecke et al. reported that alcohol per capita consumption in 15 years and above in sub-Saharan Africa is higher than the global consumption rate [8]. Similarly, a quarter of the world population smoke cigarettes, and it was leading risk factor for premature death and disability in 2015. Smoking accounts for 11.5% of death and is among five leading risk factors of disability-adjusted lost life years (DALY) in 109 countries and territories in 2015 [9, 10]. Studies also showed that chronic khat consumption not only causes severe neurological, psychiatric, cardiovascular, dental, gastrointestinal, and reproductive dysfunction [11–16], but it also has adverse socioeconomic effects affecting other aspects of life [17].

Evidence showed that poor socioeconomic condition increases the risk of harmful drug use, and people living in low-income countries disproportionately affected by higher burden of substance-related disability and premature death [18]. It is also worthy to note that rapid economic, social, and cultural changes increased use of various substances in sub-Saharan Africa countries [19].

Like other sub-Saharan countries, Ethiopia is also facing a growing problem of substance use. The use of substances has long been a serious concern for various professionals in Ethiopia due to their adverse impacts on younger generation [20, 21]. Therefore, Ethiopia recognizes substance use by young people as a serious health and social problem, and students being a high-risk abusers of substance [22]. Studies revealed that khat, alcohol, and cigarette are commonly abused substances in general population [23–25], and they are also widely used substances by high school and university students in Ethiopia [26–34].

The use of substance is associated with various health risks. For instance, a study showed that the use of substance is associated with HIV infection and risky sexual behaviors [35]. Additionally, studies revealed that the use of substances poses high risk-taking behaviors among students, which results in economic, social, physical, and health complications [26–34]. Other study showed that substance use among students is associated with social phobia, poor academic performance, and the use of multiple substances in lifetime [36]. Furthermore, it has been documented that substance abuse is associated with suicidal attempt [37].

In Ethiopian, the study of the prevalence cigarette smoking dates back to 1984 [38], and that of poly-substances use, including khat among university students, was reported in 1988 [39]. Whereas prevalence of khat use among high school students was first reported in 1994 [40]. The available studies showed wide range of variations in magnitude of substances used by students in Ethiopia. For instance, the overall prevalence of lifetime use of any substances range from 28.4 to 82.7% [27, 34, 36, 41–43], whereas lifetime prevalence of alcohol was 22.4–50.2% [27]. Furthermore, several studies showed that lifetime prevalence of smoking range from 9.3 to 22.0% [26–28, 31, 44, 45]. The studies also revealed great disparities in lifetime prevalence of khat across various universities, 27.7–41.0% [27, 28, 31, 32, 40, 44–47].

Two meta-analyses done on prevalence of substance use among students have been documented recently [48, 49]. Both studies report prevalence substance among university students focusing khat, alcohol, and smoking cigarettes. However, the evidence showed that a vast majority of students initiated using substance before joining university [27, 28, 32, 36, 41, 46, 50, 51]. Additionally, the estimated of one meta-analysis [48] did not specify whether prevalence represents lifetime, recent, or current use of substance. Therefore, in order to forward recommendation for comprehensive intervention, it is crucial to have prevalence estimates of substance that represents both high school and university students.

A report of Ministry of Education of Ethiopia showed that 3,767,322 students were enrolled in secondary (grade 9–12) school, colleges, TVET, and universities in the 2015/2016 academic year. Of these, 2,421,163 of them were enrolled in secondary education, and 830,287 of them enrolled in higher education [52]. With ever increasing number of students being enrolled in secondary to higher education, it is essential to address the issue of substance use in order to produce productive human power that is free from substance abuse. Therefore, the aim of this review and meta-analysis was to provide comprehensive views of prevalence of different substances practiced by students enrolled in secondary schools and higher educational institutions in Ethiopia for concerned decision makers and to inform administrators to dealing with ever increasing challenges of substances.

Methods
Registration
This systematic review has been registered on the International Prospective Register of Systematic Reviews (PROSPERO CRD42018082635).

Search strategy
A comprehensive literature search was done from biomedical databases: PubMed/Medline, HINARI, African
Inclusion and exclusion

All studies done among secondary school, college, and university students in Ethiopia reporting combined lifetime prevalence of substances, or lifetime prevalence of khat, cigarette smoking, and alcohol consumption reporting in English language were included. The main outcomes of this review and meta-analysis were overall lifetime prevalence of any substance, lifetime prevalence of khat chewing, lifetime prevalence of alcohol consumption, and lifetime prevalence of smoking cigarette. Additionally, studies with cross-sectional design, having response rate ≥ 80%, used probability sampling techniques; reporting quality assurance methods and quality assessment score ≥ 50% were included. Review articles, studies employed non-probability sampling techniques, qualitative studies, studies available only as abstract with unclear outcomes, and studies conducted in non-regular (extension and summer) students were excluded.

Quality assessment and data extraction

The Joanna Briggs Institute Meta-Analysis for Statistics Assessment and Review Instrument (JBI_MASTARI) was used for critical appraisal [55]. The manual contains appraisal checklists. Two reviewers independently assessed articles prior to inclusion in the final review using the checklists. Any disagreement which arose between the reviewers was solved by involving a third reviewer. Data were extracted independently by both authors. For each eligible article or abstract, information about author(s), the study setting, study period, sample size, sampling technique, method of data collection, response rate, age mean/range, substances (khat, alcohol, and tobacco) use measures (lifetime or ever use prevalence), and results were extracted on Microsoft excel 2010.

Data analysis

The analysis of the evidence was based on all studies included in this review in accordance with a PRISMA guidelines. The extracted data were exported to STATA Version 13.0 statistical software package. During the meta-analysis, all selected studies were combined using random effects model [56] to estimate the pooled prevalence of substance use. The Cochran Q test and I² statistics were used to test heterogeneity in pooled prevalence estimates. The subgroup data analyses were done using region of study setup, sample size, level of educations, proportion of female students, study year, year of publication, and age of participants. Meta-regression analyses were carried out to identify parameters (sample size, year of publication, female proportion, and age of participants) associated with substance use.

Results

Search results

The review identified a total of 676 studies based on literature searches. Of these, 665 articles were from published sources and the remaining 11 were unpublished master’s thesis. From the total, 103 duplicated records were excluded and 521 records were excluded after screened by title and abstract. A total of 52 articles were screened for eligibility and quality. From these, 24 articles were excluded with reasons; 9 articles did not meet eligibility criteria, 14 articles failed quality assessment (< 50% score), and 1 article duplicated contents. Finally, 28 articles were included in the final analysis (Fig. 1).

Characteristics of studies

The majority of the regions in Ethiopia were represented. Ten studies included in the review were from Amhara Regional State [34, 41, 43, 46, 51, 57–61], five were from Oromia regional state [27, 31, 32, 62, 63], four were from Southern Nations, Nationalities, and People’s Region (SNNPR) [33, 36, 64, 65], two were from Addis Ababa [26, 50], two were from Tigray [28, 42], three from Harari [30, 66, 67], one from Somale Region [68], and one study done in both SNNPR and Oromia [69]. Three articles included in meta-analysis were master’s thesis [42, 60, 63]. Six studies (21.4%) were conducted between 2000 and 2010, and 20 (71.4%) studies employed stratified sampling technique. The sample size of studies included ranges from the minimum of 193, a study conducted among Mekelle University students [70] to a maximum of 3001, a study conducted among Bahir Dar University students [58]. The studies were published between 2002 and 2017 in different high schools, preparatory schools, colleges, and universities. From the studies included in the review, 9 studies conducted in high and preparatory schools [29, 30, 34, 50, 61, 62, 66, 67, 69], 21 studies conducted on university students [26–28, 31–33, 36, 41–43, 46, 47, 51, 58–60, 63–65, 68, 70], and one study conducted among polytechnic college in Debre Markos town [57] (Table 1). The proportion of females ranges from 12.5 to 56.85%. All included studies passed quality assessment based on the Joanna Briggs Institute Meta-Analysis for Statistics Assessment and Review Instrument for cross-sectional studies (JBI_MASTARI) (Additional file 2: Table S2).
Lifetime prevalence of any substance

A total of 11 studies reported lifetime prevalence of any substance use (khat, alcohol, or cigarette smoking) [27, 28, 33, 34, 36, 41–43, 51, 57, 68] with a total of 7,909 participants included in meta-analysis. The prevalence ranging from 28.4% in study conducted among Bahir Dar and Gonder University students [41] to 82.7% in study conducted in Mekelle University students [42]. The overall pooled lifetime prevalence of any substance use the use of at least one substance was 52.5% (95% CI 42.4, 62.4%). The analysis revealed substantial heterogeneity across studies with $I^2 = 98.8\%$, $p < 0.00$ (Fig. 2). However, both Begg’s test $p < 0.1195$ and Egger’s test $p < 0.1075$ showed non-significant publication bias.

Subgroup analyses were done to explore sources of heterogeneity by aggregating studies by region, sample size, female proportion, publication year, and participants’ mean age. Subgroup analysis showed that the highest prevalence was observed in Tigray ($n = 2$), 63.3% (95% CI 60.7–65.9%), and the lowest was observed in Southern Nations, Nationalities, and People’s Region ($n = 2$), 42.2% (95% CI 39.5–44.9%). Subgroup analysis by sample size revealed that the prevalence was higher in studies with participants $\leq 1000$ ($n = 9$), 54.1% (95% CI 43.7–64.4%). The prevalence was highest in studies with female proportion 40–50% ($n = 3$), 57.7% (95% CI 44.9–70.0%) and studies conducted and published between 2011 and 2014 ($n = 7$), 60.4% (95% CI 50.7–69.7%). The prevalence was higher ($n = 2$), 64.0% (95% CI 61.1–66.9%) among studies with participants’ average age younger than 20 years. Inter-group heterogeneity was observed in regions, participants’ average age, and year
| Author/year            | Region/City          | Study year | Study setting | Sampling technique | Mean Age (year) | Sample size | Gender M, F (%) | Response rate (%) | Khat (%) | Alcohol (%) | Tobacco (%) | Any substance (%) |
|------------------------|----------------------|------------|---------------|--------------------|----------------|-------------|----------------|-------------------|----------|-------------|-------------|-------------------|
| Gebreslassie et al. 2013 [28] | Tigrai; Axum         | 2012       | University   | Stratified SRS     | 22.3           | 756         | M = 60.3 F = 39.7 | 98.7              | 28.7     | 34.5        | 95          | 459               |
| Tsegay and Esmael 2014 [55]  | Amhara, Debre Markos | 2013       | University   | SRS                | 21.6           | 800         | M = 58.5 F = 41.5 | 94.6              | 30.8     | 35.0        | 113         | 484               |
| Aklog T et al. 2013 [53]   | Amhara; Debre Markos | 2013       | College      | SRS                | 198            | 410         | M = 54.9 F = 45.1 | 97                | 13.4     | 60.0        | 78          | 617               |
| Kebede Y 2002 [41]        | Amhara; Gonder, B/ Dar | 2001      | University   | Stratified systematic | 200           | 1103        | M = 84.5 F = 15.5 | 87.7              | 26.7     | -           | 13.1        | 284               |
| Tesfaye G et al. 2014 [27] | Oromia; Hararaya     | 2013       | University   | Stratified SRS     | 209            | 1022        | M = 76.0 F = 24.0 | 98.3              | 41.0     | 50.2        | 220         | 624               |
| Kassa A et al. 2014 [33]  | SNPP; Hawassa        | 2011       | University   | Stratified SRS     | 207            | 586         | M = 81.7 F = 18.3 | 99.3              | -        | -           | -           | 536               |
| Kassa A et al. 2016 [61]  | SNPP; Hawassa        | 2011       | University   | Stratified SRS     | 207            | 586         | M = 81.7 F = 18.3 | 94.5              | 24.1     | 48.7        | -            | -                 |
| Fufa G et al. 2017 [66]   | Somaile; Jijiga      | 2016       | University   | Stratified SRS     | 21.2           | 600         | M = 86.0 F = 14.0 | 92.6              | 33.3     | -           | -           | 524               |
| Abra K 2011 [42]          | Tigrai; Mekelle       | 2011       | University   | Stratified SRS     | 204            | 601         | M = 68.2 F = 31.8 | 90.8              | 35.1     | 69.7        | 175         | 827               |
| Mekonen T et al. 2017 [69] | SNPP; Wolaita Sodo   | 2015       | University   | Clustered SRS      | 21.2           | 725         | M = 68.5 F = 33.5 | 97.1              | -        | -           | -           | 331               |
| Adere A et al. 2017 [43]  | Amhara; Wolda        | 2015       | University   | Stratified SRS     | 207            | 655         | M = 69.3 F = 30.7 | 89.7              | 13.0     | 33.1        | 79          | 369               |
| Birhanu MA et al. 2014 [34] | Amhara; Woreta     | 2012       | GSS & PPS    | Stratified SRS     | 173            | 651         | M = 55.0 F = 45.0 | 95.2              | 34.9     | 59.0        | 22.9        | 654               |
| Teshome G, 2012 [60]      | Oromia; Addama       | 2012       | University   | Stratified SRS     | 21.8           | 728         | M = 87.5 F = 12.5 | 95.3              | 27.7     | -           | -           | -                 |
| Gebrehanna E et al. 2014 [54] | Amhara; Bah Dar   | 2012       | University   | Stratified SRS     | 21.2           | 3001        | M = 77.6 F = 22.4 | 84.4              | 24       | -           | -           | -                 |
| Wondimnu GA et al. 2017 [46] | Amhara; Gonder      | 2011       | University   | Stratified SRS     | 21.0           | 736         | M = 76.5 F = 23.5 | 92.0              | 27.7     | -           | -           | -                 |
| Abdeta T et al. 2017 [32] | Oromia; Jimma       | 2016       | University   | Stratified SRS     | 21.9           | 619         | M = 75.0 F = 25.0 | 95.1              | 26.3     | -           | -           | -                 |
| Astatkie A et al. 2015 [62] | SNPP; Hawassa   | 2014       | University   | Stratified SRS     | 21.4           | 1255        | M = 73.9 F = 26.1 | 97.3              | 22.8     | 599        | 148         | -                 |
| Deressa & Azazh, 2011 [26] | Addis Ababa, AAU    | 2009       | University   | All               | 204            | 622         | M = 68.5 F = 31.5 | 98.4              | 14.1     | 31.0        | 87          | -                 |
| Dachew BA et al. 2015 [56] | Amhara; Gonder      | 2014       | University   | Stratified SRS     | 21.3           | 836         | M = 64.4 F = 35.6 | 95.8              | 17.9     | -           | -           | -                 |
| Deresse A et al. 2014 [31] | Oromia; Hararaya    | 2011       | University   | Stratified SS      | 21.0           | 725         | M = 60.4 F = 39.6 | 95.0              | 30.3     | 41.7        | -           | -                 |
| Birhanu B, 2014 [57]      | Amhara, D/Berhan     | 2014       | University   | Stratified SRS     | 21.2           | 346         | F = 60.1 F = 39.9 | 95.0              | 25.4     | 62.7        | 196         | -                 |
| Dires E, et al. 2016 [59] | Oromia; Jimma       | 2015       | GSS          | Stratified SRS     | 1605           | 296         | M = 43.2 F = 56.8 | 100               | 15.9     | -           | -           | -                 |
| Lakew A, et al. 2014 [58] | Amhara, Ataye       | 2014       | GSS and PPS  | Stratified SRS     | 1721           | 332         | M = 53.6 F = 46.4 | 88.0              | 15.4     | -           | -           | -                 |
| Reda A et al. 2012 [64]   | Harari, Harar       | 2010       | GSS and PPS  | Cluster sampling   | 164            | 1721        | M = 50.1 F = 49.9 | 91.1              | 24.2     | -           | -           | -                 |
Table 1 Characteristics of studies included in meta-analysis of prevalence of lifetime substance use among students in Ethiopia (Continued)

| Author year | Region/city | Study year | Study setting | Sampling technique | Mean Age (year) | Sample size | Gender M, F (%) | Response rate (%) | Khat (%) | Alcohol (%) | Tobacco (%) | Any substance (%) |
|-------------|-------------|------------|---------------|--------------------|-----------------|-------------|----------------|-------------------|-----------|-------------|-------------|-------------------|
| Reda A et al. 2012 [30] | Harari, Harar | 2010 | GSS and PPS | Cluster sampling | 164 1721 | M = 50.1 F = 49.9 | 91.1 | - | 22.2 | - | - |
| Reda A et al. 2012 [65] | Harari, Harar | 2010 | GSS and PPS | Cluster sampling | 164 1721 | M = 50.1 F = 49.9 | 91.1 | - | - | 12.4 | - |
| Teshome and Gedif. 2013 [63] | Addis Ababa | 2010 | GSS and PPS | Cluster sampling | 1693 2551 | M = 45.2 F = 54.8 | 92.4 | - | 45.7 | - | - |
| Dereje N et al. 2014 [67] | Oromia and SNNP | 2014 | GSS and PPS | Stratified SRS | 15.6 1673 | M = 47.7 F = 52.3 | 98.2 | - | - | 28.6 | - |

AAU Addis Ababa University, SNNP Southern Nations, Nationalities and People’s Region, GSS General Secondary School, PPS Preparatory School, B/Dar Bahir Dar, D/Berhan Debre Berhan, SS systematic sampling, SRS sampling random sampling, M male, F female
of publication (Table 2). However, in meta-regression analysis, year of publication, study year, sample size, proportions of female, and mean age were not associated with lifetime use of at least one substance (Table 3).

Prevalence of khat use
Twenty-two articles: 19 published articles [26–28, 31, 32, 34, 41, 43, 46, 51, 57–59, 64–66, 68] and three masters theses [42, 60, 63], with a total of 17,773 participants, 4,621 lifetime khat users, were included in the analysis. The prevalence of lifetime khat use widely varied across studies. The lowest lifetime prevalence was 13% reported in study conducted in Woldia University students [43], while the highest lifetime prevalence was 41% reported in study conducted in Haramaya University students, Eastern Ethiopia [27]. Meta-analysis of all 22 studies yielded the overall pooled prevalence of lifetime khat use, 24.7% (95% CI 21.8–27.7%). Substantial heterogeneity was observed between studies; $I^2 = 95.4\%$, $p < 0.00$ (Fig. 3). However, the analysis showed that there was no significant publication bias with Egger’s test $p < 0.1057$.

Subgroup analyses were done by region, sample size, proportion of female students, level of education, and year of publication to explore for sources of heterogeneity. Accordingly, the highest lifetime prevalence of khat use was observed in study from Somale region ($n = 1$), 33.3% (95% CI 29.6–37.3%), followed by Tigray region ($n = 2$), 31.5% (95% CI 29.0–34.0%), and the lowest prevalence was observed in Addis Ababa ($n = 1$), 14.1% (95% CI 11.5–17.1%). The highest prevalence was also observed in studies with more than 1,000 study participants, 27.6% (95% CI 22.3–33.2%), and it was lowest in studies with study participants less than 500, 17.3% (95% CI 12.5–22.7%). Similarly, the prevalence was highest in studies with female proportion 20–30%, 28.2% (95% CI 22.2–34.6%), and the lowest, 23.1% (95% CI 17.9–28.8%) was observed in studies with female proportion 40–50%. Subgroup analysis by level of education showed that the prevalence was higher, 25.1% (95% CI 21.9–28.5%) in studies conducted in university or college students. Subgroup analysis by age showed that prevalence was higher in studies with average age of participants 20 years or older ($n = 17$), 25.9% (95% CI 22.6–29.3%). Prevalence was also highest ($n = 1$), 26.7% (95% CI 24.1–29.4%) in a study published before 2010. The highest prevalence ($n = 14$), 26.3% (95% CI 22.6–30.3%) was also observed in studies conducted between 2011 and 2014 (Table 4).

There was significance between group heterogeneity in regions and sample size (Additional file 3: Table S3). Meta-regression analysis showed that study year, year of publication, sample size, female proportion, and mean age were not significantly associated with lifetime prevalence of khat use (Table 3).

Prevalence of alcohol consumption
A total of 14 studies: 12 published [26–28, 30, 31, 34, 43, 50, 51, 57, 64, 65] and two master’s theses [42, 60]
with the total of 12,701 participants, of which 5,598 lifetime alcohol users were included in the analysis. Lifetime prevalence of alcohol use range from 22.0% reported in study conducted among high school students in Harar [30] to 70.0% reported among Mekelle University students [42]. The studies were conducted in 2011 to 2017. The overall pooled prevalence of lifetime alcohol use was 46.4% (95% CI 38.7–54.2%). There was substantial heterogeneity with $I^2 = 98.7\%$ and $p < 0.00$ (Fig. 4), although there was no significant publication bias with Begg’s test, $p < 0.6614$, and Egger’s test, $p < 0.5485$.

Subgroup analysis showed that the highest prevalence ($n = 2$), 56.4% (95% CI 54.2–58.7%) was observed in SNNPR and the lowest was observed in Harar ($n = 1$), 21.6% (95% CI 19.7–23.6%). The prevalence was highest in studies with sample size less than 500 ($n = 2$), 61.2% (95% CI 57.7–64.7%), female proportion 20–30% ($n = 2$), 55.6% (95% CI 53.5–57.6%) and lowest ($n = 6$), 42.2% (95% CI 30.5–54.3%) in studies with female proportion 40–50%. The prevalence was higher in studies conducted in university/college students ($n = 11$), 47.8% (95% CI 39.9–55.7%). The prevalence was also higher in studies with average age of participants 20 years or older ($n = 10$), 46.6% (95% CI 38.3–55.0%). Subgroup analysis showed that the prevalence was higher ($n = 4$), 50.1% (95% CI 37.9–62.4%) in studies published from 2015 to 2017. Highest prevalence was observed in the studies conducted between 2011 and 2014 ($n = 10$), 52.1% (95% CI 44.6–59.6%) (Table 4). There was significant heterogeneity between regions, sample size groups, and study years (Additional file 3: Table S3). Meta-regression analysis revealed that publication year, sample size, female proportion, and mean age were not significantly associated with lifetime alcohol use (Table 4).

### Lifetime prevalence of cigarettes smoking

A total of 13 studies: eleven published studies [26–28, 34, 41, 43, 51, 57, 65, 67, 69] and two unpublished studies [42, 60] with a total of 11,615 participants, of which

| Subgroup                        | Number of studies (n) | Prevalence (95% CI) | Between group heterogeneity statistics |
|---------------------------------|-----------------------|---------------------|---------------------------------------|
|                                 |                       |                     | Cochrane Q | $p$ value | $I^2$ (%) |
| **Region**                     |                       |                     |           |           |           |
| Tigrai                          | 2                     | 63.3 (60.7, 65.9)   | 3.2       | 0.075     | 99.0      |
| Oromia                          | 1                     | 62.4 (59.4, 65.4)   |           |           |           |
| Somale                          | 1                     | 56.7 (52.6, 60.7)   | 149.5     | 0.000     | 99.0      |
| Amhara                          | 5                     | 48.0 (33.7, 62.4)   |           |           |           |
| SNNP                            | 2                     | 42.2 (39.5, 44.9)   |           |           |           |
| **Sample size**                 |                       |                     |           |           |           |
| < 1000                          | 9                     | 54.1 (43.7, 64.4)   |           |           |           |
| 1000+                           | 2                     | 44.4 (42.3, 46.6)   |           |           |           |
| **Female proportion**           |                       |                     |           |           |           |
| 10–20                           | 3                     | 46.0 (27.2, 65.4)   |           |           |           |
| 20–30                           | 3                     | 49.2 (34.8, 63.8)   | 2.1       | 0.556     | 98.8      |
| 30–40                           | 2                     | 56.7 (54.0, 59.4)   |           |           |           |
| 40–50                           | 3                     | 57.7 (44.9, 70.0)   |           |           |           |
| **Mean age**                    |                       |                     |           |           |           |
| < 20                            | 2                     | 64.0 (61.1, 66.9)   | 5.6       | 0.018     | 98.8      |
| 20+                             | 9                     | 50 (38.7, 61.3)     |           |           |           |
| **Publication year**            |                       |                     |           |           |           |
| 2000–2010                       | 1                     | 28.4 (25.7, 31.1)   |           |           |           |
| 2011–2014                       | 7                     | 60.4 (50.7, 69.7)   | 42.5      | 0.000     | 98.8      |
| 2015–2017                       | 3                     | 42.1 (28.5, 56.3)   |           |           |           |
| **Study year**                  |                       |                     |           |           |           |
| 2000–2010                       | 1                     | 28.4 (25.7, 31.1)   |           |           |           |
| 2011–2014                       | 7                     | 60.4 (50.7, 69.7)   | 2.2       | 0.137     | 98.8      |
| 2015–2017                       | 3                     | 42.1 (28.5, 56.3)   |           |           |           |
1,898 lifetime smokers were included in the analysis. The highest prevalence, 28.6%, was reported in adolescents in high and preparatory school in Hawassa and Jimma [69], whereas the lowest prevalence, 7.8%, was reported in studies conducted among Debre Markos Polytechnic College students [57]. The pooled lifetime prevalence of smoking cigarettes among students in Ethiopia was 14.7% (95% CI 11.3–18.5). The analysis showed considerable heterogeneity among studies with $I^2 = 96.7\%$ and $p < 0.000$ (Fig. 5). However, the analysis revealed that there was no significant publication bias with Egger's test $p < 0.269$.

Subgroup analysis showed that highest prevalence was observed in studies conducted in Oromia Region ($n = 1$), 22.0% (95% CI 15.5–24.7%). But, lifetime prevalence based on six studies was from Amhara Region ($n = 6$) 13.3% (95% CI 9.1–18.1%). Subgroup analysis showed that prevalence was highest ($n = 5$), 18.2% (95% CI 12.6–24.5%) in studies with sample size larger than 1000. The highest prevalence was ($n = 1$), 28.6% (95% CI 26.5–30.9%) observed in studies with female proportion 50% or higher followed by the 17.9% (95% CI 16.4–19.5%), the estimate based on studies ($n = 2$) with female proportion 20–30%, and the lowest was ($n = 5$), 12.9% (95% CI 8.8–17.3%) in studies with female proportion 40–50%. Analysis showed that the prevalence was higher in studies conducted among secondary schools ($n = 3$), 21.5% (95% CI 12.6–32.1%) and studies with average age of study participants younger than 20 years ($n = 4$), 17.7% (95% CI 9.8–27.3%). Prevalence was highest ($n = 10$), 15.7% (95% CI 11.4–20.5%) in studies published between 2011 and 2014. When studies grouped by study years, the prevalence was highest ($n = 9$), 16.6% (95% CI 12.1–21.7%) (Table 4). Heterogeneity between groups was observed in regional, female proportion, and study year subgroup analysis, $p < 0.00$ (Additional file 3: Table S3). However, meta-regression analyses revealed that only average age was significantly associated with lifetime prevalence of tobacco smoking, $p < 0.043$ with slope, $-1.017$, and intercept = 0.497 (Table 3).

### Table 3

Meta-regression analysis of study level covariates of lifetime prevalence of any substance, khat, alcohol, and cigarettes smoking among students in Ethiopia

| Substance/study characteristics | Coefficient ($\beta$) | Intercept | Standard error | $p$ value |
|-------------------------------|----------------------|-----------|----------------|-----------|
| **Lifetime use of any substance** |                       |           |                |           |
| Year of publication           | 0.0060609            | -11.68013 | 0.0124317      | 0.638     |
| Study year                    | 13.89607             | -0.0082915| 9.605409       | 0.182     |
| Sample size                   | -0.0003494           | 0.7741379 | 0.0002403      | 0.180     |
| Female proportion             | 0.0037158            | 0.4131199 | 0.0045819      | 0.438     |
| Mean age                      | -0.0387067           | 1.317451  | 0.0389781      | 0.347     |
| **Lifetime khat use**         |                       |           |                |           |
| Study year                    | -0.0020241           | 4.325688  | 0.0052509      | 0.704     |
| Year of publication           | -0.0021067           | 4.495044  | 0.0051577      | 0.687     |
| Sample size                   | 0.0000108            | 0.2432449 | 0.0000275      | 0.698     |
| Female proportion             | -0.100255            | 0.2853794 | 0.11533259     | 0.526     |
| Mean age                      | 0.0084523            | 0.081158  | 0.0094737      | 0.383     |
| **Lifetime alcohol use**      |                       |           |                |           |
| Year of publication           | 0.0042828            | -8.160433 | 0.0242541      | 0.863     |
| Study year                    | 0.0255544            | -50.95082 | 0.022354       | 0.275     |
| Sample size                   | 0.0000688            | 0.527942  | 0.0000622      | 0.319     |
| Female proportion             | -0.0003517           | 0.5924492 | 0.0042616      | 0.425     |
| Mean age                      | -0.005842            | 0.3477194 | 0.0223419      | 0.798     |
| **Lifetime tobacco smoking**  |                       |           |                |           |
| Year of publication           | 0.0018767            | -3.622797 | 0.0055397      | 0.741     |
| Study year                    | 0.0035468            | -6.980033 | 0.0053445      | 0.521     |
| Sample size                   | 0.0000605            | 0.097251  | 0.0430878      | 0.171     |
| Female proportion             | 0.0014625            | 0.1013142 | 0.0017218      | 0.414     |
| Mean age                      | -0.0173243*          | 0.4966166 | 0.0075743      | 0.043     |

*Significant association; $p < 0.043$
Discussion

This meta-analysis tried to estimate the pooled lifetime prevalence of most commonly used substances, khat, alcohol, and smoking cigarettes, and the overall prevalence of any substance in students in Ethiopia.

In this meta-analysis, the pooled estimates showed that more than one in two (52%) students involved in the use of at least one substance in their lifetime. The finding was consistent with the results of meta-analysis done on the lifetime prevalence of alcohol consumption among young people in eastern Africa which was 50% [71]. This indicates the use of substance is far more common among students in Ethiopian. It is not surprising to observe high prevalence of substance use when educational institutions surrounded by substance sellers, who even provide their customers with private rooms [72]. Additionally, this could be due to the facts that these substances (khat, alcohol, and smoking) are not controlled, and educational institutions do not have binding law that prevents the use of these substances in Ethiopia. Furthermore, studies [73, 74] showed ever increasing partying which is becoming the integral part of culture among students, might explain high lifetime prevalence of substances.

There was significant regional variation with the highest prevalence observed in Tigrai region, although all regions were not represented, including Oromia, the largest region. The differences could be explained by difference in social values attached to different substances [20]. Alcohol drink in Northern and khat use in south-west and Eastern part of Ethiopia are widely accepted. Additionally, the observed difference may be explained by the effect of school environment on healthy behavior, which influenced further by compositional and contextual factors [75, 76]. Similarly, there was significant variation of prevalence when studies grouped by year of publication with the highest prevalence observed in conducted 2010–2014, 60%. The use of substances affects wider range of aspects of life. The literature showed that students involved in substance use are at higher risk of developing violent behaviors, risky sexual behaviors, and withdrawal symptoms [20, 32, 77].

The pooled prevalence showed that 24.7% (95% CI 21.8–27.7%) of students had used khat at least once in
their lifetime. This finding was slightly higher than national prevalence of lifetime khat consumption, 19% [78]. The observed difference could be due to difference in study population and study settings. This study showed that khat consumption is spreading at an alarming rate in recent days among students that can be attributed to misconception that khat consumption improves academic performance which in fact disagree with available literatures [36, 79]. Even, the results of meta-analysis of various studies revealed that acute or sub-chronic exposure to khat impair short-term memory [80]. The ever increasing khat consumption complemented by absence of laws that regulate the production, distribution, and use in school environment in Ethiopia, and inevitably, there will be challenges ahead in formulating rules and regulation since khat becomes one of the leading commodities for export in recent days [39], and farmers are increasingly abandoning other crops for cultivating khat [81].

Segregation of the study by region and sample size revealed substantial heterogeneity. The pooled estimate based on two studies showed that lifetime prevalence of khat use was highest in Somale Region (n = 1), 33.3% [82].

| Subgroup | Khat | Alcohol | Cigarette smoking |
|----------|------|---------|-------------------|
|          | n    | % (95% CI) | n    | % (95% CI) | n    | % (95% CI) |
| By region |      |          |      |          |      |          |
| Somale   | 1    | 33.3 (29.6, 37.3) |      | - | - | - |
| Tigrai   | 2    | 31.5 (29.0, 34.0) | 2    | 50.2 (47.5, 52.9) | 2    | 12.8 (11.1, 14.6) |
| Oromia   | 5    | 28.1 (21.0, 35.8) | 2    | 46.6 (44.3, 49.0) | 1    | 22.0 (19.5, 24.7) |
| Harari   | 1    | 24.8 (22.8, 26.9) | 1    | 21.6 (19.7, 23.6) | 1    | 14.0 (12.4, 15.7) |
| Amhara   | 10   | 22.6 (18.6, 26.8) | 5    | 49.8 (36.8, 62.8) | 6    | 13.3 (9.1, 18.1) |
| SNNP     | 2    | 22.0 (20.1, 23.9) | 2    | 56.4 (51.1, 58.6) | 1    | 14.8 (12.9, 16.9) |
| Addis Ababa | 1    | 14.1 (11.5, 17.1) | 2    | 42.5 (40.8, 44.2) | 1    | 8.7 (6.6, 11.2) |
| Other    | -    | - | - | - | - | 1 | 17.6 (11.2, 24.1) |
| Sample size |      |          |      |          |      |          |
| < 500    | 4    | 17.3 (12.5, 22.7) | 2    | 61.2 (57.7, 64.7) | 2    | 12.7 (10.4, 15.1) |
| 500–1000 | 13   | 25.8 (21.7, 30.1) | 8    | 44.0 (34.7, 53.6) | 6    | 12.5 (8.5, 17.2) |
| > 1000   | 5    | 27.6 (22.3, 33.2) | 4    | 43.8 (28.0, 60.3) | 5    | 18.2 (12.6, 24.5) |
| Female proportion (%) |      |          |      |          |      |          |
| 10–20    | 3    | 24.9 (20.8, 29.3) | 1    | 48.6 (44.5, 52.8) | 1    | 13.1 (11.2, 15.3) |
| 20–30    | 5    | 28.2 (22.2, 34.6) | 2    | 55.6 (53.5, 57.6) | 2    | 17.9 (16.4, 19.5) |
| 30–40    | 7    | 23.6 (16.9, 31.0) | 5    | 47.6 (32.6, 62.9) | 4    | 12.9 (7.8, 19.2) |
| 40–50    | 7    | 23.1 (17.9, 28.8) | 6    | 42.2 (30.5, 54.3) | 5    | 12.7 (8.8, 17.3) |
| > 50     | -    | - | - | - | 1 | 28.6 (26.5, 30.9) |
| Education level |      |          |      |          |      |          |
| Secondary school | 4    | 22.5 (15.2, 30.7) | 3    | 41.4 (22.1, 62.1) | 3    | 21.5 (12.6, 32.1) |
| University/college | 18   | 25.1 (21.9, 28.5) | 11   | 47.8 (39.9, 55.7) | 10   | 12.9 (10.1, 16.0) |
| Mean age (year) |      |          |      |          |      |          |
| < 20     | 5    | 20.5 (13.8, 28.2) | 4    | 46.0 (28.6, 63.9) | 4    | 17.7 (9.8, 27.3) |
| 20+      | 17   | 25.9 (22.6, 29.3) | 10   | 46.6 (38.3, 55.0) | 9    | 14.7 (11.3, 18.5) |
| Year of publication |      |          |      |          |      |          |
| 2000–2010 | 1    | 26.7 (24.1, 29.4) | -    | - | - | 1 | 13.1 (11.2, 15.3) |
| 2011–2014 | 13   | 26.2 (22.3, 30.4) | 10   | 44.9 (35.7, 54.3) | 10   | 15.7 (11.4, 20.5) |
| 2015–2017 | 8    | 21.9 (17.6, 26.5) | 4    | 50.1 (37.9, 62.4) | 2    | 12.3 (10.8, 13.8) |
| Study year |      |          |      |          |      |          |
| 2000–2010 | 3    | 21.7 (15.4, 28.7) | 3    | 32.4 (17.5, 49.3) | 3    | 12.0 (9.2, 15.0) |
| 2011–2014 | 14   | 26.3 (22.6, 30.3) | 10   | 52.1 (44.6, 59.6) | 9    | 16.6 (12.1, 21.7) |
| 2015–2017 | 5    | 21.9 (15.5, 29.0) | 1    | 33.1 (29.5, 36.9) | 1    | 7.9 (6.0, 10.3) |
Fig. 4 Forest plot of lifetime prevalence of alcohol consumption among students in Ethiopia

Fig. 5 Forest plot of lifetime prevalence of cigarettes smoking among students in Ethiopia
(95% CI 29.6, 37.3) and followed by Tigray Region which is non-khat growing region in the country. The widespread use explained by the fact that the region is predominantly inhabited by Muslim and khat consumption is widely accepted [82]. For the case of the Tigray Region, the higher prevalence would be explained by the fact that khat consumption is spreading to most major cities from traditional khat growing regions [81]. The prevalence was also highest in studies with sample size greater than 1000 (n = 5), 27.76% (95% CI 22.59, 32.92). This indicates that the estimate was influenced by larger sample size studies.

The pooled estimate of lifetime prevalence of alcohol consumption in this meta-analysis was 46.4% (95% CI 38.7–54.2). This finding was slightly lower than national prevalence, 49% [78], and 82% in university students in eastern African countries [71]. The observed difference could be explained by difference in study population and settings. Additionally, the difference could also be attributed to social influence, peer pressure [83], and cultural differences. Most importantly, aggressive commercial promotions of various alcohol brands targeting younger people through major private and government owned media outlets are partly responsible for high consumption of alcohol among students [84, 85]. Subgroup analysis by region showed that prevalence of alcohol consumption was significantly different across regions. The variation could be attributed to difference in the social value of alcohol, settings, and study methods [20]. The prevalence significantly varied with sample size that the highest was observed in small sample size studies. However, the overall estimate was not significantly affected by sample size. Similarly, the highest prevalence was observed in studies female proportion 20–30% of sample size. This could be due to difference in risk of substance use between male and female. This could be due to the fact that being male is associated with higher risk of substances use [26, 27, 29, 30, 51, 57, 64, 86].

The pooled lifetime prevalence of cigarette smoking in this meta-analysis was 14.7%. The finding was higher than the results of EDHS analysis; 4.1% all forms of tobacco use and 8.1% prevalence in men [87]. However, the prevalence was lower than the result of meta-analysis of studies conducted in Iranian university male students, which was 19.8% [88]. The difference could be explained variation in definition of cigarettes smoking. The latter study did not specify the prevalence as current or lifetime. Additionally, the variation could be attributed to difference in population. This meta-analysis included studies conducted in secondary schools and universities whereas the EDHS conducted among adults, and meta-analysis result from Iran was based on studies done among male university students. Furthermore, cultural and socioeconomic differences might have played role. The observed between group difference in regions in Ethiopia in this meta-analysis was similar with study conducted among adults [87]. Meta-regression analysis in current study showed that age was associated with tobacco smoking, which was consistent with prevalence studies done in Ethiopia [87, 89]. However, the review by Wicki, et al. [90] argued that the results on relation of alcohol consumption and the age of the students were inconsistent.

Overall, the results of this meta-analysis showed significant number of students exposed to various substances before joining university. Early exposure to substances at younger age has adverse health and behavioral effects during adulthood [91]. For instance, studies showed that early exposure is associated with risky behaviors and sexually transmitted diseases, early pregnancy, low educational attainment, alcohol abuse and dependency, and anti-social behavior [92–94]. Furthermore, a recent longitudinal study in Finland among substance use discordant twin demonstrated that early exposure to substance disrupts transition into adulthood [95].

The strength of this meta-analysis was the representativeness of the estimates since we strictly followed the PRISMA guideline. The other strength was various substances that are commonly used by students in Ethiopian were comprehensively presented to facilitate accessibility of the evidences for concerned decision makers. Moreover, data extractions were carried out by using comprehensive tools, and two authors independently extracted data to reduce potential risks.

However, some subgroup estimates for prevalence of any substance, khat, alcohol, and tobacco smoking based on a single study do not necessarily reflect the actual context. This limits the generalizability of the finding based on a single study estimate. Even though universities and secondary schools were represented in this study, there were limited studies representing third generation or newly established universities. Inadequate or absence of studies representing public and private colleges also limits the generalizability of the finding to all education settings. Additionally, the current meta-analysis focused on lifetime prevalence of substance use and the results do not show the current substance use status, though large majority of ever substance users are current users. Lastly, we did not pool the estimate for the risk factors because of differences in risk factors across studies. Therefore, future studies should focus on substance use risk factors.

Conclusion

The pooled estimates of this meta-analysis highlighted the extent of lifetime prevalence of any substance, khat, alcohol, and cigarette smoking among students in Ethiopia. The uses of these substances are common in educational
institutions and vary with study characteristics such as region, proportion of female students, mean age, and publication year. Therefore, policy makers should devise and implement strictly binding regulation to curb widespread use of substances around educational institution premises at national level. Priority should be given to intervention strategies that help delay first use of substance to prevent problems later in life. Besides, the issue warrants regular national-level educational institutions based studies focusing on the magnitude, trajectory, and consequences of substance use among students.

Supplementary information
Supplementary information accompanies this paper at https://doi.org/10.1186/s13643-019-1217-z.

Additional file 1: Table S1. Prisma 2009 Checklist.
Additional file 2: Table S2. Mythological quality assessment results of studies included in the meta-analysis using the Joanna Briggs Institute Meta-Analysis for Statistics Assessment and Review Instrument (JB-MAStARI).
Additional file 3: Table S3. Subgroup analysis of lifetime prevalence alcohol, khat and cigarette smoking among students in Ethiopia.

Abbreviations
AAU: Addis Ababa University; AJOL: African Journal Online; CI: Confidence interval; DALY: Disability-adjusted life year; EDHS: Ethiopian Demographic and Health Survey; SNNNPR: Southern Nations Nationalities and People’s Region; HIV: Human immuno-deficiency virus; TVET: Technical and vocational education training

Author’s contribution
HSR originally designed the systematic review and meta-analysis. HSR, ASB, AAI, and BG equally contributed in study searching and selections, quality assessment, data extraction, and analysis. HSR and ASB contributed to report writing. All authors read and approved the final manuscript.

Ethics approval and consent to participate
Not applicable

Competing interests
The authors declare that they have no competing interests.

Author details
1School of Public Health, College of Health and Medical Sciences, Haramaya University, Harar, Ethiopia. 2Research Center for Generational Health and Ageing, School of Medicine and Public Health, Faculty of Health and Medicine, University of Newcastle, Newcastle, Australia. 3Deakin University, School of Exercise and Nutrition Sciences, Burwood, Australia.

Received: 22 November 2018 Accepted: 4 November 2019
Published online: 14 December 2019

References
1. WHO. Neuroscience of psychoactive substance use and dependence summary. Geneva: World health Organization; 2004.
2. Rehm J, Rehm N, Room R, Monteiro M, Gmel G, Jernigan D, Fricke U. The global distribution of average volume of alcohol consumption and patterns of drinking. Eur Addict Res. 2003;9:147–56.
3. Tesfaye F, Byas 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 Res Pract Police. 2008;5(3):1–11.
4. WHO. Report On THE Global Tobacco Epidemic; 2011. p. 7–74.
5. WHO. Global status report on alcohol and health; 2011. p. XI–5.
6. Odeide AO. Status of drug use/abuse in Africa: a review. Int J Ment Health Addict. 2006;4(2):87–102.
7. WHO. Global status report on alcohol and health 2014. 2014.
8. Roerecke M, Obot IS, Patra J, Rehm J. Volume of alcohol consumption, patterns of drinking and burden of disease in sub-Saharan Africa. 2002. Afr J Drug Alcohol Stud. 2008;7(1):1–15.
9. Galidou E, Forouzanfar MH, Murray CJL, Zhang A, Zipkin B, Sayed ME, Zaid Z, Chuanhua Y, Reitsma MB, Fullman N, et al. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990–2015: a systematic analysis from the Global Burden of Disease Study 2015. Lancet. 2017;389(10082):1885–906.
10. Forouzanfar MH, Afshim A, Alexander LT, et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016;388:1659–724.
11. Hassan NA, Gunaid AA, Abdo-Rabbo AA, Abdel-Kader ZY, Al-Mansoob MA, Awad AY, IM ML. The effect of Qat chewing on blood pressure and heart rate in healthy volunteers. Trop Doct. 2000;30(2):107–8.
12. AL-Hebshi NN, Skag N. Effect of khat chewing on 14 selected periodontal bacteria in sub- and supragingival plaque of a young male population. Oral Microbiol Immunol. 2005;20(3):141–6.
13. Kennedy JS, Teague J, Rokaw K, Cooney E. A medical evaluation of the use of qat in North Yemen. Soc Sci Med. 1983;17(12):783–93.
14. Abdul Ghanii N, Eriksson M, Kristansson S, Qebri A. The influence of khat- chewing on birth-weight in full-term infants. Soc Sci Med. 1987;24(7):625–7.
15. Al-Motarreb A, Baker K, Broadley KJ. Khat: pharmacological and medical aspects and its social use in Yemen. Phytother Res. 2002;16:403–13.
16. Balint EE, Falkay G, Balint GA. Khat – a controversial plant. Wien Klin Wochenschr. 2009;121:604–14.
17. Hussein MA. Age-ly: Health and socio-economic hazards associated with khat consumption. J Family Community Med. 2008;15(3):13–11.
18. Anderson P. Global use of alcohol, drugs and tobacco. Drug and Alcohol Review. 2006;25:489–502.
19. J. John-Lengba, A. Ezeh GG, A. Kumi-Kyereme, S. Neema: 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, 2004.
20. 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(2):107–18.
21. A. Fekadu, A. Atalay, H. Charlotte: Alcohol and drug abuse in Ethiopia: past, present and future. Afr J Drug Alcohol Studies 2007;6(1):39–53.
22. Kevin EG, Amella MA, Dawn MBF, Eric DW. Heavy drinking and poly drug use among college students. Int J Drug Issues. 2008;8(3):445–66.
23. Kassay M, Shenef HT, Fissehay 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 (EJHD). 2017;32(2):101-6.
24. Nakajima M, Jebena MG, Taha M, Tesfaye M, Gudina E, Lemieux A, Hoffman R, AF Absi M. Correlates of khat use during pregnancy: a cross-sectional study. Addict Behav. 2017;73:179–84.
25. Hallé D, Lakew Y, 2001: Khat chewing practice and associated factors among Axum University students, Axum Town, North Ethiopia. BMC public health. 2013;13:693.
26. Deseresa W, Azazh A. Substance use and its predictors among undergraduate medical students of Addis Ababa University in Ethiopia. BMC public health. 2011;11:660.
27. Tesfaye G, Derese A, Hambisa MT. Substance use and associated factors among university students in Ethiopia: a cross-sectional study. J Addict. 2014;2014.
28. Gebreselasie M, Feleke A, Melesse T. Psychoactive substances use and associated factors among Azum University students, Azum Town, North Ethiopia. BMC public health. 2013;13:693.
29. Oda N, Kasa Y, Strak T, Zerga E, Dassalegn T. Substance use and associated factors among preparatory school students in Bale Zone, Oromia Regional State, Southeast Ethiopia. Harm reduction J. 2014;11:21.
30. Reda AA, Moges A, Wondmagegn BY, Baidiglin S. Alcohol drinking patterns among high school students in Ethiopia: a cross-sectional study. BMC public health. 2012;12;213.
31. Dereje A, Seme A, Misganaw C. Assessment of substance use and risky sexual behaviour among Haramaya University students. Ethiopia. Sci J Public Health. 2014;2(2):102–10.

32. Abdela T, Taleesa D, Adorjan K, Aberra M. Prevalence, withdrawal symptoms and associated factors of khat chewing among students at Jimma University in Ethiopia. BMC Psychiatry. 2017;17.

33. 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.

34. Birhanu AM, Bitetegn TA, Woldeyohannes SM. High prevalence of substance use and associated factors among high school adolescents in Woreta Town, Northwest Ethiopia: multivariate factor analysis. BMC public health. 2014;14:1186.

35. Berhanu D, Diener-West M, Ruff A, Davis WW, Celentano DD, Go VF. Associations between khat use and HIV risk and status among voluntary counseling and testing center clients in Addis Ababa, Ethiopia. J Addict Med. 2017;11:730–7.

36. Mekonnen T, Tekadu W, Mekonnen TC, Worke SB. Substance Use as a Strong Predictor of Poor Academic Achievement among University Students. Psych J. 2017;2017:75470.

37. Bagge CL, Sher KJ. Adolescent alcohol involvement and suicide attempts: toward the development of a conceptual framework. Clin Psychol Rev. 2008;28(8):1283–96.

38. Zein ZA, Admasu M, Tadesse G, Kassa A, Taddesse F. Determinants of alcohol use and khat chewing among students at Ataye Secondary School Students in Northern Sha, Ethiopia. Adv Appl Sociol. 2014;4:225–33.

39. Dires E, Soboka M, Kerebel H, Feyaessa GT. Factors associated with khat chewing among high school students in Jimma Town Southwest Ethiopia. J Psychiatry. 2016;19(4):372.

40. Tesfome G. Magnitude and factors associated with khat chewing among students of Addama University. Oromia National Regional State Addis Ababa: Addis Ababa University; 2012.

41. Kebede Y. Cigarette smoking and khat chewing among university instructors in Ethiopia. East Afr Med J. 2002;79(5):274–8.

42. Kidan A. Psychoactive substance abuse and intention to stop among students of Mekelle University. Addis Ababa: Addis Ababa University; 2011.

43. 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(1):441.

44. Kassa A, Deymo S. Prevalence and determinants of active and passive cigarette smoking among undergraduate students at Hawassa University, Hawassa, Ethiopia. J Trop Dis. 2014;4(4):145.

45. Lakew A, Tariku B, Deyessa N, Reta Y. Prevalence of Catha edulis (Khat) chewing and its associated factors among regular khat chewing among university students in Ethiopia. Substance Abuse and Rehabilitation. 2015;6:41–50.

46. Berhanu AA, Moges A, Biadgilign S. Determinants of cigarette smoking among adolescents in Eastern Ethiopia: a cross-sectional study. Harm reduc j. 20129(1):39.

47. 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(2):49–54.

48. 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.

49. 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(10):e111033.

50. Francis JM, Grosskurth H, Changalucha J, Kapiga SH, Weiss HS. Systematic review and meta-analysis: prevalence of alcohol use among young people in eastern Africa. Tropical Medicine and International Health. 2014;19(4):475–88.

51. Gebreselassie AG, Gebresilus BG, Yizengaw SS, Sevasew DT. Khat use prevalence, causes and its effect on mental health, bahir-dar, north west Ethiopia. Eur Sci J. 2014;10(23):234–53.

52. Buettner CK, Khurana A, Slesnick N. Drinking at college parties: examining the influence of student host-status and party-locaton. Addict Behav. 2013;38(12):1365–8.

53. Pedersen ER, Labrie J. Party before the party: examining prepartying behavior among college students. J Am Coll Health. 2007;56(3):237–45.

54. Bonell C, Parry W, Wells H, Jamal F, Fletcher A, Harden A, Thomas J, Campbell R, Petticrew M, Murphy S, et al. The effects of the school environment on student health: a systematic review of multi-levelstudies. Health &Place. 2013;21:180–91.

55. West P. School effects research provides new and stronger evidence in support of the health-promoting school idea. Health Educ. 2006;106:421–4.

56. Berhan Y, Hailu D, Alano A. Polysubstance use and its linkage with risky sexual behavior in university students: significance for policy makers and parents. Ethiop Med J. 2013;51(1):113–23.

57. FMOH. EPHI. WHO. Ethiopian STEPS report on risk factors for chronic non-communicable diseases and prevalence of selected NCDs: Addis Ababa: EPHE; 2016.

58. Ayana AM, Mekonnen Z, Khat (Catha edulis Forsk) chewing, sociodemographic description and its effect on academic performance. Jimma University students 2002. Ethiop Med J. 2004(42(2):125–36.

59. Berihu BA, Asfaha GG, Woldeierufael AL, Debede YG, Zelelew YB, Beene HA. Toxic effects of khat (Catha edulis) on memory: systematic review and meta-analysis. J Neurosci Rural Pract. 2017;8(1):30–7.

60. Cochrane L. O’Reagan D. Legal harvest and illegal trade: trends, challenges and options in khat production in Ethiopia. Int J Drug Policy. 2016;30:27–34.

61. Lemessa D. Khat (Catha edulis): botany, distribution, cultivation, usage and economics in Ethiopia. UN-Emergencies Unit for Ethiopia: Addis Ababa, 2001.
83. Smith LA, Foxcroft DR. The effect of alcohol advertising, marketing and portrayal on drinking behaviour in young people: systematic review of prospective cohort studies. BMC public health. 2009;9:51.
84. Negussie H, Berhane Y. Assessment of alcohol advertising practices in Ethiopia. Ethiop J Health Dev. 2012;26(3):216–25.
85. Alula WA. The need of laws to reduce the impact of alcohol merchandising on youth under 18 years old in Ethiopia. Universal J Manage. 2017;5(9):437–46.
86. Cotto JH, Davis E, Dowling GJ, Elcano JC, Staton AB, Weiss SR. Gender effects on drug use, abuse, and dependence: a special analysis of results from the National Survey on Drug Use and Health. Gender medicine. 2010;7(5):402–13.
87. 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.
88. 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(8):717–25.
89. Lodebo TM, Hajito KW, Gebrehiwot TT, Achicha TB. Prevalence of cigarette smoking and its associated factors among parents at Misrak Bedawacho District, Southern Ethiopia. J Addiction Prevention. 2017;5(1):9.
90. Wicki M, Kunsteche E, Gmel G. Drinking at European universities? A review of students’ alcohol use. Addict Behav. 2010;35:913–24.
91. Hingson RW, Heeren T, Winter MR. Age at drinking onset and alcohol dependence: age at onset, duration, and severity. Archives Pediatrics & Adolescent Medicine. 2006;160:739–46.
92. Stueve A, O’Donnell LN. Early alcohol initiation and subsequent sexual and alcohol risk behaviors among urban youths. Am J Public Health. 2005;95:887–93.
93. McGue M, Iacono WG. The association of early adolescent problem behavior with adult psychopathology. Am J Psychiatry. 2005;162:1118–24.
94. King KM, Meehan BT, Trim RS, Chassin L. Marker or mediator? The effects of adolescent substance use on young adult educational attainment. Addict. 2006;101:1730–40.
95. Rose RJ, Winter T, Viken RJ, Kaprio J. Adolescent alcohol abuse and adverse adult outcomes: evaluating confounds with drinking-discordant twins. Alcohol Clin Exp Res. 2014;38(8):2314–21.

Publisher’s Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.
Learn more biomedcentral.com/submissions