

ORIGINAL ARTICLE

MAGNITUDE OF SUBSTANCE USE AMONG YOUNG PEOPLE IN ETHIOPIA:
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ABSTRACT

Introduction: Substance use is associated with higher odds of disabilities, mental illnesses, and loss of productivity, especially in young people. Despite a widespread use of substances by Ethiopian youth, little is known about pooled estimates and gender disparity in this target group. This meta-analysis was therefore conducted to estimate the magnitude of, and gender differences in, substance use among young people in Ethiopia.

Methods: For this review and meta-analysis. PUBMED, MEDLINE, Cochrane review, Google Scholar, CINAHL, and AJOL databases were searched. “Substance use”, “alcohol use”, “khat use”, “khat chewing”, “drug use”, “drug abuse” and other relevant search terms were used. The meta-analysis was conducted using STATA 14 software. Prevalence and odds ratios with 95% confidence intervals were used to determine the magnitude and gender differences in substance use. I^2 statistics were used to test heterogeneity of the included studies while, Egger’s test assessed publication bias. The meta-analysis was conducted using the random-effect model and findings were presented using forest plots.

Results: A total of 21 articles covering 24,925 participants were included in this review. The overall pooled lifetime and current prevalence of any substance use by Ethiopian youth was 31.5% (95%CI = 23.74, 39.24) and 23.9% (95%CI = 18.1, 29.73), respectively. Higher rates of lifetime alcohol consumption (33.95%), khat chewing (24.69%), and cigarette smoking (20.38%) were reported. The odds of a lifetime and current substance use was threefold (OR = 3.26 (95%CI = 2.46, 4.33 and OR = 2.98 (95% CI = 2.4, 3.69)) in young males compared to females, respectively.

Conclusions: Nearly one-third of young people in Ethiopia use different substances in their lifetime the magnitude of use being higher among young males than females. Designing and implementing school-and community-based interventions are important to intervene the growing problems of substance use disorders and improve young people’s awareness of the multifaceted impacts of substance use.

Keywords: Substance use; Alcohol consumption; Khat chewing; Cigarette smoking; systematic review; Meta-analysis; Youth; Ethiopia

INTRODUCTION

Substance use disorders are common and substantially contribute to years lived with disability, globally (1). Of particular importance amongst youths of developing countries including Ethiopia as well as few East African and the Gulf nations is that the preponderance of exceptional substance use such as khat, “*Catha edulis*” (2-6), which may worsen the situation in these regions.

Indeed, concurrent use of various substances is common (6), or perhaps one may act as a “gateway” for the other. Another concern is that substances are routinely used by institutional-based youth, mostly students (2-5, 7, 8), and associated with academic, psychosocial (e.g. depression and anxiety) (9) and developmental problems.

Factors at different levels including socio-demographic disadvantage, family history, peer influence, community norms, living patterns (2-6, 8, 10-12) and stress (7) may determine the pattern of substance use. Interestingly, religiosity, better social skills (4) and risk perception (12) are found to be protective factors of substance use among the youth in Ethiopia.

The lifetime prevalence of any psychoactive substance use among the youth in Ethiopia ranges from 2.7% to 65.4% (4, 13), and up to 45.7% in the past 12 months (2). Consequently, there is a concerted call for designing preventive strategies (2), which perhaps include family- and community-focused interventions in terms of maintaining healthy social norms (4) and adapting other policy measures. These strategies need to be focused and informed by evidence-based patterns of substance use across the nation.

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In cognizant, Sustainable Development Goal (SDG) (Target 3.5) prioritizes strengthening the prevention and treatment of substance use (14).

However, the rate of substance use among Ethiopian youth is inconsistent across types of substances (2), regions (11) and other pertinent characteristics. For example, some studies (12, 15) conducted in the country showed higher odds of substance use among young males than females while others showed the non-significant difference (16). However, the current state of knowledge on the magnitude of substance use among young people is inconclusive, with substantial levels of uncertainties.

This meta-analytic review, therefore, is intended to provide such informative estimations, with a series of subgroup analyses, across different characteristics in general, and gender in particular. This may inform the design and implementation of programs essential for the prevention and treatment of youth substance use problems. Moreover, the findings can be used by program implementers to monitor and evaluate the progress of programs pertinent to achieve SDG's target, at the national level.

MATERIALS AND METHOD

Study design: A systematic review and meta-analysis of published studies was conducted.

Search strategy: A comprehensive search of published articles using search terms for substance use, alcohol consumption, khat use, and cigarette smoking among Ethiopian youth was conducted using Boolean operators, "OR" or "AND." Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline (17) was followed to search relevant literature published on substance use in Ethiopia.

The databases included PubMed, MEDLINE, CINAHL, Google Scholar, African Journals Online (AJOL), and Cochrane review. Given the unprecedented surge of substances over the past two decades, all studies published from 1999 through to October 27, 2017 were included in the review. The search terms included: "substance use OR substance abuse OR psychoactive substance use OR social drug use OR alcohol drinking OR khat chewing OR *catha edulis* use OR cigarette smoking OR tobacco use AND Ethiopia." A search of the references list of included articles was also retrieved to identify additional studies for the meta-analysis.

Eligibility criteria

Studies that quantified the magnitude of substance use in young people were eligible for this review. Substances included alcohol consumption, khat chewing, and cigarette smoking. Youth was defined as being in the age range of 10-24 years. Studies which were published only in the English language were included. All included studies report findings both for male and female participants. Studies conducted on substance use but among people living with HIV, mental illness or another disease (s), as well as pregnant women and those visiting health facilities for clinical reasons were excluded, since they do not represent the general public for youth population who are apparently healthy young people of both sexes aged between 10-24 years of age. Moreover, studies that included people aged > 24 years and articles that fail to report the outcome of interest were excluded.

There were limited studies, which reported the magnitude of other substances such as marijuana/shisha/hashish/ganja, or cocaine and these types of substances were not included in this review.

Quality assessment

Both authors, independently, assessed and reviewed all eligible studies using the Joanna Briggs Institute (JBI) critical appraisal checklist (18). Both authors were also responsible in the assessment and decision to include or exclude articles based on the eligibility criteria of this study. Any disagreement was resolved through discussion. The overall mean quality score was used to categorize studies into low- and high-quality studies.

Data extraction

The data extraction format was adopted from the Joanna Briggs Institute (JBI) tool for prevalence studies (18). The tool contains information's on authors' name(s), year of publication, study area, study population, sample size, response rate, prevalence of substance use (both lifetime and current, the last 30 days and past 12-month) and gender differences in substance use including alcohol consumption, khat chewing, and cigarette smoking among male and female participants as well as overall sample.

Although some articles (2, 4, 6, 8, 9, 15, 19-30) present multiple estimates of lifetime and/or current use of different substance from a single study, we only included one estimate (i.e., the highest prevalence estimate) for a specific substance use in the pooled analysis because overlapping sample from the same study may bias the findings.

Data analysis

Data were extracted from all selected articles. Extracted data were entered into Microsoft Excel and then imported to STATA version 14 for further analysis. The prevalence of studies with corresponding standard error (SE) was used to present the overall prevalence of substance use and its 95% confidence interval (CI). Forest plot was used to show the combined estimate with the 95% CI. Lifetime and current prevalence of substance use were presented using forest plots. The random effects model was used in the meta-analysis because it takes account of heterogeneity while estimating the pooled effects from the studies included in the review (31).

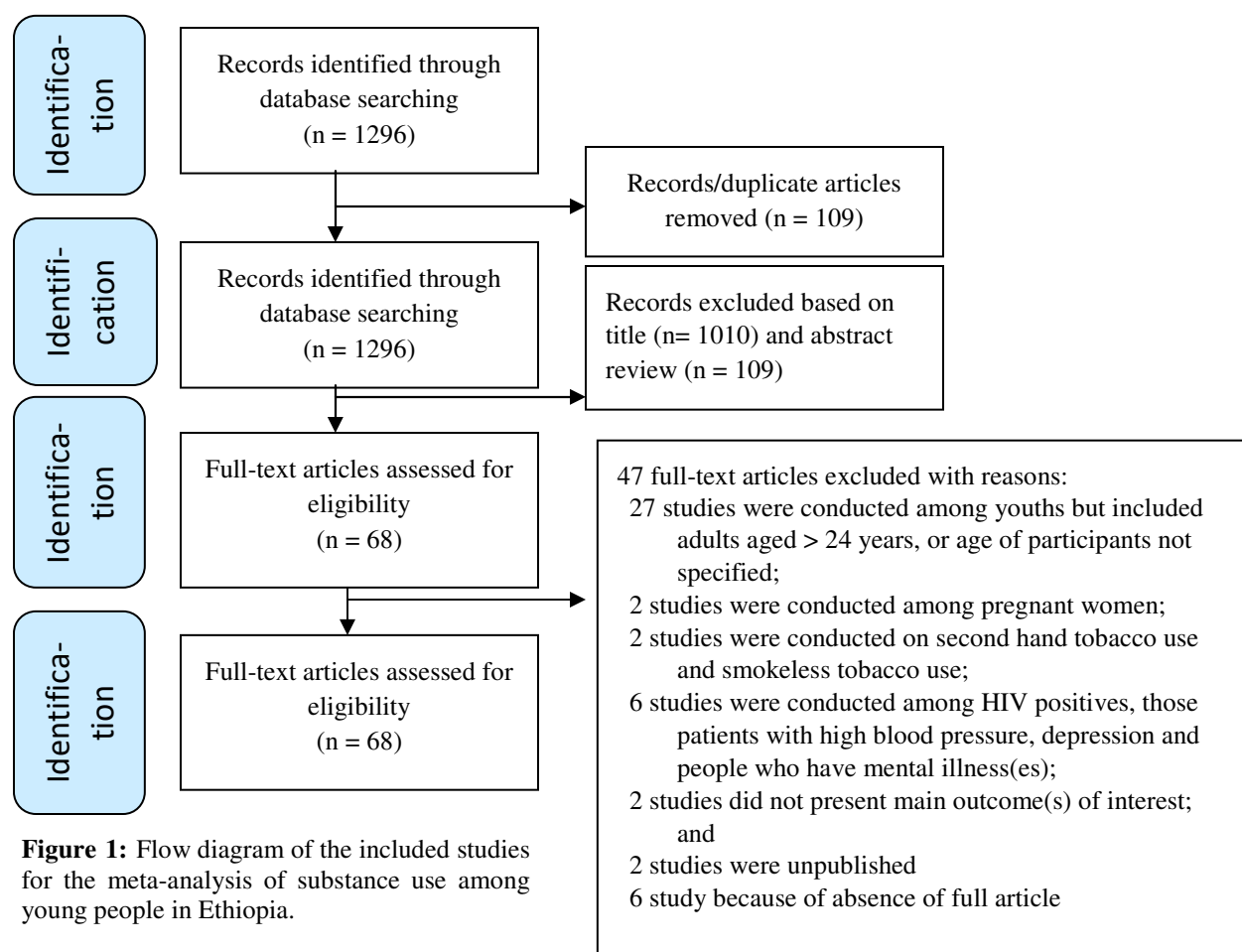
Subgroup analyses by type of substances (alcohol, khat, cigarette), region where the study was carried out, as well as by study type (institutional based vs community-based), publication year (using five-year interval from 1999 to 2017), and quality score of the study (low vs high score) were conducted. For studies presenting all different forms of substance use and failed to show the cumulative prevalence of substance use, the highest prevalence was taken to estimate the overall prevalence of substance use. Current prevalence was calculated as the use of substances in the last 12 months (6) and in the past 30 days before the actual data collection of included studies.

Heterogeneity and publication bias

Heterogeneity of included studies was assessed using visual inspection of forest plots, and its statistical significance was determined using the I^2 statistics (31). I^2 statistics of 25, 50 and 75 percent was used to declare low, moderate, and high heterogeneity, respectively (31). Publication bias, if any, of included studies, was assessed using the Egger's test, $p < 0.05$ represents possible publication bias (32, 33).

RESULTS

This review included data from all published studies on the magnitude of substance use among Ethiopian youth. A total of 1,296 records were identified through databases searching after removing 109 duplicates. Then 1,187 records were screened by titles and abstracts, from which 1,119 records were excluded. The remaining 68 articles were assessed for eligibility. Of these, 47 articles were excluded based on *a priori* exclusion criteria. A total of 21 articles were included in the final meta-analysis. The search strategy and study selection process is presented in Figure 1.



Characteristics of included studies

Five (23.8%) (4, 16, 29, 34, 35) of the included studies were conducted in Amhara region followed by Addis Ababa city ($n = 3$, 14.3%) (6, 12, 36), SNNPR (37-39) and Harari (5, 40, 41). The majority, 18 (85.7%) of studies were institution-based (4-7, 12, 15, 16, 25, 26, 29, 30, 34-36, 39-42), whereas only, 3 (14.3%) were community-based (9, 37, 38).

Of the institution-based studies, 8 (44.4%) were conducted in university/college settings (6, 7, 16, 25, 26, 29, 34, 35), whilst nine (50%) were conducted in high schools (4, 5, 15, 30, 36, 39-42). Sample size ranged from 161 (26) to 2997 (37, 38) with the overall sample of 24,925 participants included in the review. Mean study quality score was 7.19, and 17 (81%) studies had a higher score. Table 1 presents the summary characteristics of studies included in the meta-analysis.

Prevalence of substance use : There were differences in the patterns of both lifetime and current substance use across study parameters in Ethiopian youth. Figure 2 presents the pooled lifetime prevalence of any substance use among young people in Ethiopia.

Accordingly, the prevalence of substance use ranged from 6.5% (95% CI = 5.62, 7.4) (37) to 59% (95% CI = 55.22, 62.78) (4). The overall lifetime prevalence of substance use was 31.5% (95% CI = 23.74, 39.24).

Table 2 presents subgroup analyses of lifetime prevalence of substance use among young people in Ethiopia. A series of subgroup analyses were done by study characteristics and types of substances.

Accordingly, the lowest lifetime prevalence of substance use was recorded in SNNPR region, 10.5% (95% CI = 2.58, 18.45) whereas the highest was in Tigray region, 54% (95% CI = 46.02, 61.98), although only one study was included for this region.

Moreover, institution-based (universities and high schools) young people use substances [(33.3 (95% CI = 26.03, 40.51)] more often than the general public [(6.5% (95% CI = 5.62, 7.38)]. Further analyses showed that substance use was higher among university or college students (38.02% (95% CI = 26.94, 49.09)) than high school students (29.81% (95% CI = 20.1, 39.53)).

There was an increasing trend in young people's substance use in the last two decades.

Similar patterns of substance use were observed regardless of study quality score. The overall prevalence of current substance use was 23.9% (95% CI = 18.1, 29.73). The pooled prevalence of current substance use among the youth in Ethiopia is presented in Figure 3.

Prevalence of alcohol consumption: Two studies assessed alcohol consumption as outcome (36, 40). The lowest prevalence of lifetime alcohol use was 22.6% (95% CI = 20.24, 24.13) (40) and the highest was 45.7% (95% CI = 43.77, 47.63) (36). The pooled lifetime prevalence of alcohol consumption was 33.9% (95% CI = 10.92, 56.98) current alcohol consumption being 15.5% (95% CI = 0.61, 30.33).

Prevalence of khat chewing : Five studies assessed the magnitude of *khat* chewing. The prevalence in individual studies ranged from 6.5 (95% CI = 5.62, 7.38) (37) to 42.0% (95% CI = 37.16, 46.84) (35). The overall lifetime and current prevalence of *khat* chewing was 24.7% (95% CI = 13.04, 36.36) and 27.6% (95% CI = 16.69, 38.43), respectively.

Prevalence of cigarette smoking

Two studies (41, 42) were used to estimate the prevalence of cigarette smoking since these studies measured cigarette smoking as the outcome variable. The prevalence of cigarette smoking ranged from 12.2% (95% CI = 10.65, 13.75) (41) to 28.6% (95% CI = 26.44, 30.77) (42). The overall pooled lifetime prevalence of cigarette smoking was 20.38% (95% CI = 4.3, 36.45). The current prevalence of cigarette smoking was 16.2% (95% CI = 3.62, 28.71).

Gender differences in substance use: Table 3 presents gender differences in the prevalence of substance use among young people in Ethiopia. Inconsistencies were observed in the prevalence of substance use among male and female participants. Using 11 studies which presented the lifetime prevalence of substance use in both male and female youths, male participants more likely use substances (46.2% (95% CI = 33.31, 59.03)) than female participants (21.1% (95% CI = 11.38, 30.72)).

Further analyses by types of substances also showed a higher magnitude of alcohol consumption (60.81% vs. 33.91%), *khat* chewing (52.9% vs. 20.1%), and cigarette smoking (18.0% vs. 2.2%) among males than females.

Table 1a: Summary characteristics of studies included in the meta-analysis of the magnitude of substance use among young people in Ethiopia

Author(s)	Year	Region	Study area	Design	Study population	Age range	Mean age $\pm$ SD	Sample size	Response rate	Out come (s) measurement	Prevalence of substance use	
											Lifetime	Current
Alemet al.	1999	SNNPR	Butajira	Community based	Youths	15-24	Not Spec-ify	2997	100	Alcohol Consumption	-	2.6
Alem et al.	1999	SNNPR	Butajira	Community based	Youths	15-24	Not Spec-ify	2997	100	Khat Chewing	6.5	-
Rudatsikira et al.	2007	Addis Ababa City	Addis Ababa	Institution based	Adolescents	11 to 17	Median=15	1868	100	Tobacco Smoking	-	2.9
Baynesagne et al.	2009	Amhara	Bahirdar University	Institution based	University students	>=17	21 $\pm$ 2.27	293	91.8	Khat Chewing	33.8	31.2
Deressa and Azazh	2011	Addis Ababa City	Addis Ababa University	Institution based	University students High school students	>=15	Not Spec-ify	632	98.4	Substance Use	22.0	-
Reda et al.	2012	Harari	Harar town	Institution based	High school students	15 - 25	16.4 $\pm$ 1.60	1890	91.1	Cigarette Smoking	12.2	-
Reda et al.	2012	Harari	Harar town	Institution based	High school students	15-25	16.4 $\pm$ 1.60	1890	90.3	Khat Chewing Alcohol Consumption	24.2	-
Reda et al.	2012	Harari	Harar town	Institution based	High school students	15-25	16.4 $\pm$ 1.60	1890	91.1	Alcohol Consumption	22.2	-
Teshome and Gedif	2013	Addis Ababa City	Addis Ababa	Institution based	High school students	14-25	16.93 $\pm$ 1.35	2760	92.4	Alcohol Consumption	45.7	26.4
Birhanu et al.	2014	Amhara	woreta	Institution based	High school students	14-19	17.25 $\pm$ 1.24	684	92.5	Substance Use	59.0	40.9

Table 1b: Summary characteristics of studies included in the meta-analysis (continued from 1a)

Dereje et al.	2014	Nation based	Hawassa town and Jima town	Institution based	High school students	</>18	NS	1704	98.2	Cigarette Smoking	28.6	17.2
Eticha and Kidane	2014	Tigray	Mekele University	Institution based	University students	>=15	21.2 ±1.7	193	100	Cigarette Smoking	-	29.5
Mohammed	2014	Oromia	Ginnir town, Bale zone	Institution based	High school students	>=10	NS	220	100	Substance Use	-	10.9
Dachew et al.	2015	Amhara	Gondar University	Institution based	University students	</>19	NS	872	95.8	Khat Chew-ing	17.9	13.6
Kumesa et al.	2015	Oromia	Rift Valley University, Bishoftu Campus	Institution based	College students	>=15	22	356	97.7	Social Drug Abuse	44.8	39.1
Mossie et al.	2015	Tigray	Adigrat University	Institution based	University students	15-24	NS	161	93	Psychoactive Substance Use	54.0	-
Teni et al.	2015	Amhara	Gondar	Institution based	College students	>=16	NS	424	94.3	Khat Chew-ing	42.0	32.5
Adere et al.	2017	Amhara	Woldia University	Institution based	University students	>=18	20.74 ±1.36	730	89.7	Psychoactive Substance Use	36.9	31.5
Kassa et al.	2017	SNNPR	Sidama zone	Institution based	High school students	>=10	16.7± 2.3	1577	95.3	Khat Chew-ing	14.6	13
Kassaye et al.	2017	Nation based	Addis Ababa and Butajira	Institution based	High school students	>=10	NS	428	100	Drug Use	32.5	-
Wondemagegn et al.	2017	Oromia	Nekemte town, East Wollega zone	Community based	Adolescents and adults	>=15	NS	359	98	Khat Chew-ing	-	48.6

NS=Not Specified

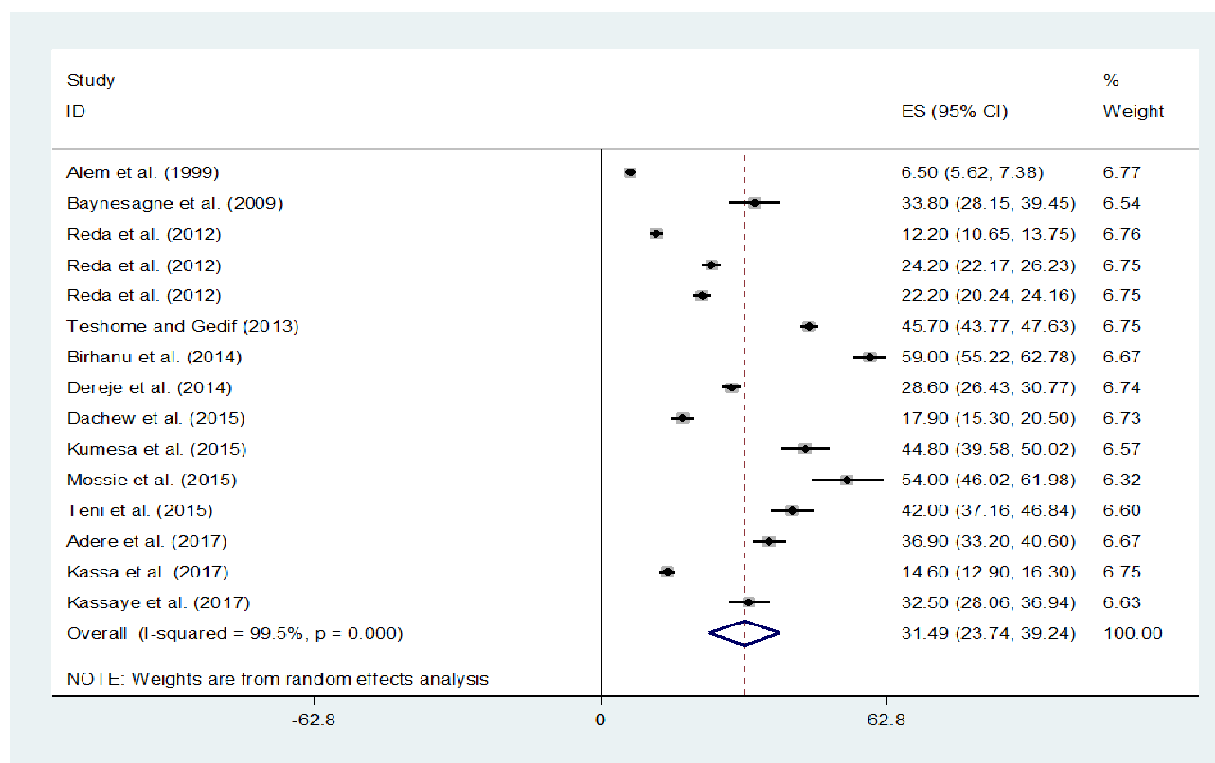


Figure 2: Pooled lifetime prevalence of any substance use among the youth in Ethiopia.

Table 2: Subgroup analyses of lifetime prevalence of Substance use among young peoples in Ethiopia.

Subgroup	Number of studies	Total sample size	Prevalence (95% CI)	Heterogeneity statistics		
				Tau-squared	p-value	I ²
Type of substance						
Alcohol consumption(36, 40)	2	4,650	33.95 (10.92, 56.98)	275.14	<0.001	99.6
Khat chewing(5, 16, 34, 35, 37)	5	16,010	24.69 (13.04, 36.36)	173.46	<0.001	99.2
Cigarette smoking (41, 42)	2	3,594	20.38 (4.31, 36.5)	133.56	<0.001	99.3
By region						
Tigray(26)	1	161	54.00 (46.02, 61.98)	-	-	-
Addis Ababa City(36)	1	2,760	45.70 (43.77, 47.63)	-	-	-
Oromia(25)	1	356	44.80 (39.58, 50.02)	-	-	-
Amhara(4, 16, 29, 34, 35)	5	3,003	37.90 (22.27, 53.53)	313.3	<0.001	98.8
Nationwide study*(30, 42)	2	2132	30.05 (26.36, 33.74)	4.43	<0.001	58.3
SNNPR(37, 39)	2	14,186	10.52 (2.58, 18.45)	32.3	<0.001	98.5
Harari(5, 40, 41)	3	5670	19.51 (11.74, 27.28)	46.23	<0.001	98.1
By study type						
Institutional-based study(4, 5, 16, 25, 26, 29, 30, 34-36, 39-42)	14	15,659	33.27 (26.03, 40.51)	187.01	<0.001	99.1
Community-based study(37)	1	12531	6.5 (5.62, 7.38)	-	-	-
By type of institution						
University/ college students(16, 25, 26, 29, 34, 35)	6	2,836	38.02 (26.94, 49.09)	184.55	<0.001	97.3
High school students	8	12,823	29.81 (20.1, 39.53)	195.01	<0.001	99.4
By publication year						
1999–2004(37)	1	12,531	6.5 (5.62, 7.38)	-	-	-
2005–2009(34)	1	293	33.8 (28.15, 39.45)	-	-	-
2010–2014(4, 5, 36, 40-42)	6	10,818	31.93 (19.94, 43.91)	222.99	<0.001	99.5
2015-2017(16, 25, 26, 29, 30, 35, 39)	7	4,548	34.39 (24.1, 44.68)	187.25	<0.001	98.4
By quality score						
High score(4, 5, 25, 26, 29, 35-37, 39-42)	12	26,597	32.37 (23.4, 41.34)	247.81	<0.001	99.6
Low score(16, 30, 34)	3	1,593	27.89 (16.48, 39.3)	96.68	<0.001	95.7
Overall	15	28,190	31.49 (23.74, 39.24)	230.55	<0.001	99.5

*studies including at least two regions were considered as nation-based studies

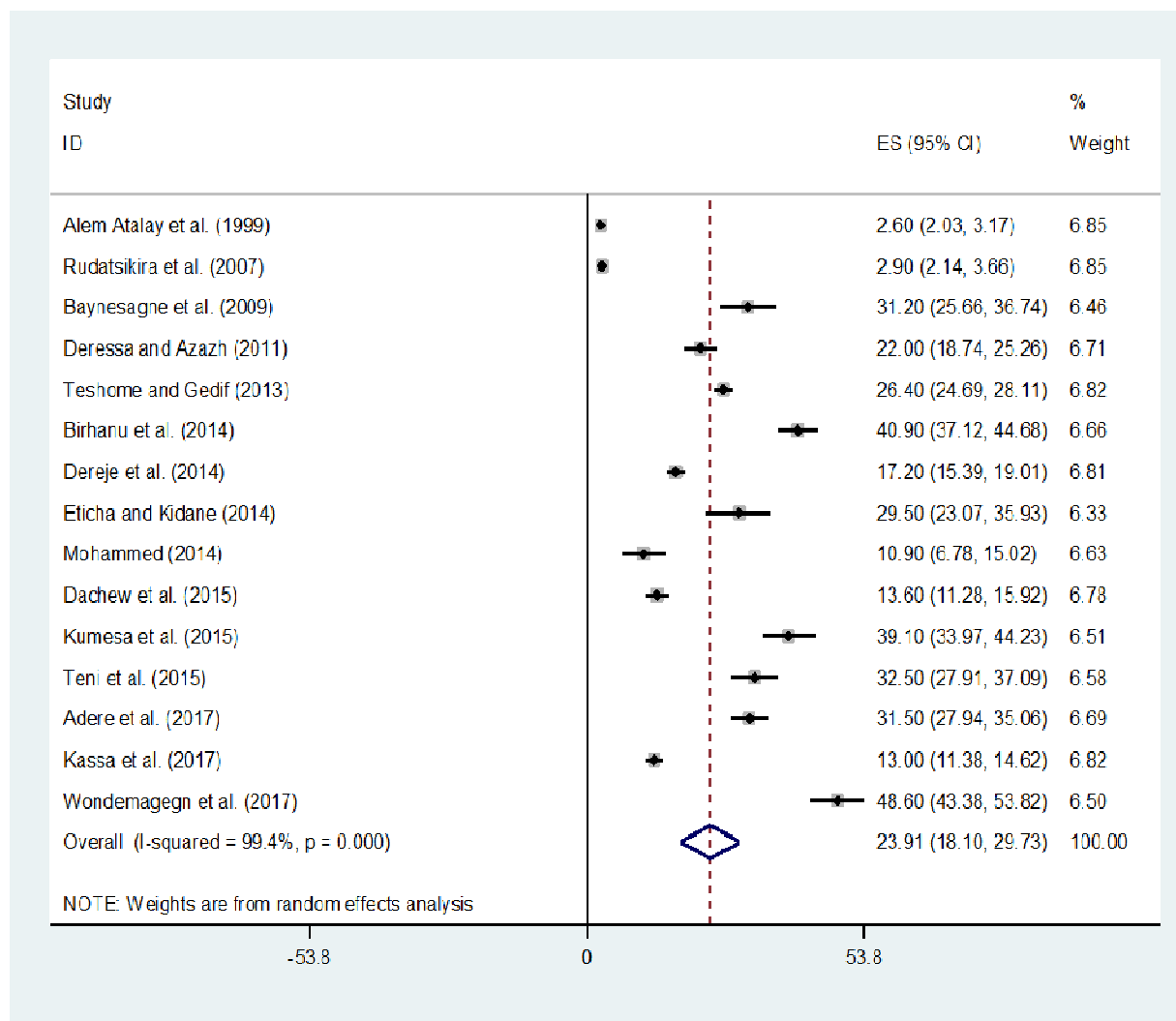


Figure 2. Pooled lifetime prevalence of any substance use among the youth in Ethiopia.

Further pooled analyses of the current prevalence of substance use also showed similar patterns across genders. A meta-analysis of 14 studies (5-7, 9, 12, 15, 16, 25, 29, 35, 36, 40-42) which examined the association of gender and lifetime substance use indicated that males were 3.3 times more likely to be substance users (alcohol, khat, or cigarette) as compared to females, OR=3.26 (95%CI=2.46, 4.33).

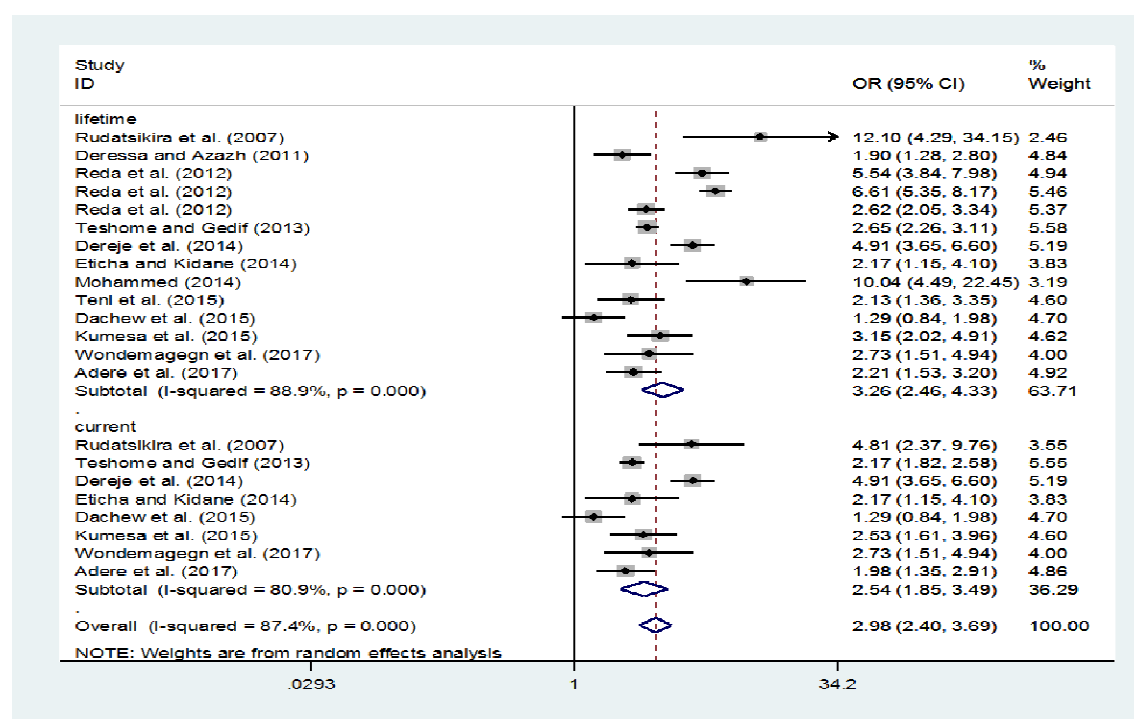
Similarly, males were found to be three times more likely to use substance currently than their female counterparts, OR=2.54 (95% CI = 1.85, 3.49).

Overall, males had three times greater risk of substance use disorders, OR = 2.98 (95% CI = 2.4, 3.69) (Figure 4).

There was significant heterogeneity across the included studies. Interestingly, Egger's test showed no publication bias, $p=0.06$.

Table 3: Gender difference in the prevalence of substance abuse among youths in Ethiopia.

			Male				Female	
	Num- ber of studies	Total sam- ple size	Prevalence (95% CI)	I ²	Num- ber of studies	Total sample size	Prevalence (95% CI)	I ²
Lifetime preva- lence								
Alcohol con- sumption	3	3,164	60.81 (53.71, 67.9)	94.3	3	3,645	33.91 (31.33, 36.49)	63.6
Khat chewing	3	1,220	52.95 (29.79, 76.11)	98.0	3	1,107	20.07 (7.49, 32.65)	95.0
Cigarette smoking	2	1,549	17.99 (12.9, 23.09)	86.0	1	2,053	2.24 (0.01, 6.36)	-
Overall substance abuse	11	7,507	46.17 (33.31, 59.03)	99.3	11	7,337	21.05 (11.38, 30.72)	99.6
Current preva- lence								
Alcohol consump- tion	2	1580	29.35 (21.12, 37.57)	91.0	3	1,753	20.25 (14.19, 26.29)	84.9
Khat chewing	2	830	33.69 (0.01, 70.93)	99.6	2	360	20.01 (3.07, 36.95)	93.8
Cigarette smoking	3	1676	22.99 (3.25, 42.74)	99.1	3	1,991	8.25 (1.37, 15.14)	97.6
Overall substance abuse	9	4,728	31.05 (18.86, 43.24)	99.2	9	4,305	16.78 (9.66, 23.91)	98.7

**Figure 4:** Forest plot showing ORs of lifetime and current substance use among the youth males (as compared to females) in Ethiopia.

DISCUSSION

This is the first-ever comprehensive summary of available evidence to estimate the pooled prevalence of substance use among Ethiopian youth. Overall lifetime and current prevalence of substance use among Ethiopian young people was higher than a study conducted in South Africa (19.8%) (43) and Western Kenya (69.8%) (44). Substance use disorders are sadly enormous among high school and university students, making their future at risk (44). Previous studies have shown that substance use is associated with psychiatric disorders (45), psycho-social problems (46-48), comorbidities, and disabilities, as well as loss of productivity (49, 50) and subsequent socio-economic impacts (49, 50). These effects are because of the multidimensional effect of substance use at individual, family and community levels (49).

This review found that a substantial proportion of university/college and high school students were using psychoactive substances. Previous studies have shown that the risk of substance dependence increases when people start substance use at an early age (51). There were also differences in the rates of substance use by study characteristics including types of substances and study regions. Specifically, khat, cigarette and alcohol were invariably used together. Perhaps these substances could be used concurrently, or one could serve a “gateway” for the other (6, 15, 19, 21, 23-29). The varying patterns in the prevalence of substance use across different regions of the country could be attributed to the availability of types of substances in different regions and the number of included studies in each region. Particularly, access to the substances within the context of the cultural norms in different sites across the country (availability, cost, regulations, social pressure, and urban/rural) could explain the variation of substance use across different regions of the country. Similarly, the difference in the number of studies and sample size included in each region, differences in study types, sampling preferences, period of study, stigma and response bias could also explain the difference. This calls the government and other concerned bodies to tailor targeted preventive interventions that likely reduce the rate of substance use.

There was a wide variation in the prevalence and risk of substance use between males and females. Indeed, the 2016 Ethiopian Demographic and Health Survey (EDHS) reported a higher magnitude of lifetime alcohol consumption (46% vs. 27%), khat chewing (27% vs. 12%), and cigarette smoking (4% vs. 1%) among men than women (52).

Peer influence and more exposures to substances in males, as well as more tolerant social attitude towards male substance use may be some of the cited reasons for the higher prevalence of substance use in males (44, 53). For example, 75.1% of Kenyan college students who admitted to using substances were introduced by their friends (44). Despite the lower prevalence of substance use among females, several studies reported that the use of alcohol by women is associated with higher rates of menstrual and other reproductive disorders possibly leading to infertility (54). This suggests that programs on prevention and early treatment of substance use among young peoples, irrespective of their gender, are essential.

School-and community-based interactive programs that specifically target alcohol use or tobacco smoking are effective methods for reducing substance use (55). These may involve programs that improve awareness levels of young people regarding the health, psychosocial and economic risks of substance use, especially at high school and university settings. Students who are involved in substance use need interactive educational programs by health professionals and psychologists who have experience in managing substance use. The use of peers as instructional leaders and the use of group discussion as part of the teaching method during the substance use education have shown positive attitudinal effects among substance users (56). Family-based interventions are also effective methods in reducing substance use among young people's (57). Starting treatment early for substance use and for more extended period has been found to show a better outcome (45). Emphasis should also be given to restoration of the health of individuals affected by substance use (58) perhaps through rehabilitation centers.

Although the current review strictly followed the PRISMA guideline, the cross-sectional nature of included studies might be subjected to recall bias. This study was also limited to the most commonly used substances in Ethiopia - alcohol, khat, and cigarette smoking - due to the limited number of published articles in the prevalence of use of other hard /illegal drugs. Hence, the use of substances like cocaine, cannabis, heroin, and other illegal drugs was not investigated in this review. However, emerging evidence reported 0.9% (2) to 3.33% prevalence of cannabis as well as 2% cocaine use (26) among university students in Ethiopia. Therefore, representative, population-based studies which assess the magnitude of the use of such illegal drugs among young people are needed.

Conclusion: One-third of Ethiopian youth use substances in their lifetime across the included regions. There is an increasing rate of current substance use in the young population. There was a gender disparity in substance use, males being more likely to use substances than females. However, the impact of a wide spectrum of substance use among the Ethiopian population is not well investigated. Further nationwide studies focusing on the health, social and economic impacts of substance use are needed. The country should also adopt policies that regulate substance use and establish rehabilitation centers to treat substance use-related complications among young people.

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REFERENCES

1. Vos T, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet*. 2017;390(10100):1211–59.
2. Kassa A, Tadesse F, Yilma A. Prevalence and factors determining psychoactive substance (PAS) use among Hawassa University (HU) undergraduate students, Hawassa Ethiopia. *BMC public health*. 2014;14(1):1044.
3. Gebrehanna E, Berhane Y, Worku A. Khat chewing among Ethiopian University Students—a growing concern. *BMC public health*. 2014;14(1):1198.
4. 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(1):1186.
5. Reda AA, Moges A, Biadgilign S, Wondmagegn BY. Prevalence and determinants of khat (*Catha edulis*) chewing among high school students in eastern Ethiopia: a cross-sectional study. *PLoS one*. 2012;7(3):e33946.
6. Deressa W, Azazh A. Substance use and its predictors among undergraduate medical students of Addis Ababa University in Ethiopia. *BMC public health*. 2011;11(1):660.
7. 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.
8. 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 reduction journal*. 2014;11(1):21.
9. Wondemagegn AT, Cheme MC, Kibret KT. Perceived psychological, economic, and social impact of khat chewing among adolescents and adults in Nekemte Town, East Welega Zone, West Ethiopia. *Bio Med research international*. 2017;2017.
10. Reda AA, Kotz D, Biadgilign S. Adult tobacco use practice and its correlates in eastern Ethiopia: A cross-sectional study. *Harm reduction journal*. 2013;10(1):28.
11. 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(1):487.
12. Rudatsikira E, Abdo A, Muula AS. Prevalence and determinants of adolescent tobacco smoking in Addis Ababa, Ethiopia. *BMC public health*. 2007;7(1):176.
13. Kebede D, Alem A. The epidemiology of alcohol dependence and problem drinking in Addis Ababa, Ethiopia. *Acta Psychiatrica Scandinavica*. 1999;100(S397):30–4.
14. UN. Sustainable Development Goals, 17 Goals to transform the world, Goal 3: Ensure healthy lives and promote well-being for all at all ages 2016 [Available from: <http://www.un.org/sustainabledevelopment/health/>].
15. Mohammed AY. Assessment of substance use and associated factors among high school and preparatory school students of Ginnir Town, Bale Zone, Southeast Ethiopia. *American Journal of Health Research*. 2014;2(6):414–9.

16. Vos T, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet*. 2017;390(10100):1211–59.
17. Kassa A, Tadesse F, Yilma A. Prevalence and factors determining psychoactive substance (PAS) use among Hawassa University (HU) undergraduate students, Hawassa Ethiopia. *BMC public health*. 2014;14(1):1044.
18. Gebrehanna E, Berhane Y, Worku A. Khat chewing among Ethiopian University Students—a growing concern. *BMC public health*. 2014;14(1):1198.
19. 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(1):1186.
20. Reda AA, Moges A, Biadgilign S, Wondmagegn BY. Prevalence and determinants of khat (*Catha edulis*) chewing among high school students in eastern Ethiopia: a cross-sectional study. *PLoS one*. 2012;7(3):e33946.
21. Deressa W, Azazh A. Substance use and its predictors among undergraduate medical students of Addis Ababa University in Ethiopia. *BMC public health*. 2011;11(1):660.
22. 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.
23. 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 reduction journal*. 2014;11(1):21.
24. Wondmagegn AT, Cheme MC, Kibret KT. Perceived psychological, economic, and social impact of khat chewing among adolescents and adults in Nekemte Town, East Welega Zone, West Ethiopia. *BioMed research international*. 2017;2017.
25. Reda AA, Kotz D, Biadgilign S. Adult tobacco use practice and its correlates in eastern Ethiopia: A cross-sectional study. *Harm reduction journal*. 2013;10(1):28.
26. 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(1):487.
27. Rudatsikira E, Abdo A, Muula AS. Prevalence and determinants of adolescent tobacco smoking in Addis Ababa, Ethiopia. *BMC public health*. 2007;7(1):176.
28. Kebede D, Alem A. The epidemiology of alcohol dependence and problem drinking in Addis Ababa, Ethiopia. *Acta Psychiatrica Scandinavica*. 1999;100(S397):30–4.
29. UN. Sustainable Development Goals, 17 Goals to transform the world, Goal 3: Ensure healthy lives and promote well-being for all at all ages 2016 [Available from: <http://www.un.org/sustainabledevelopment/health/>].
30. Mohammed AY. Assessment of substance use and associated factors among high school and preparatory school students of Ginnir Town, Bale Zone, Southeast Ethiopia. *American Journal of Health Research*. 2014;2(6):414–9.
31. Dachew BA, Biftu BB, Tiruneh BT. Khat use and its determinants among university students in north west Ethiopia: a multivariable analysis. *Int J Med Sci Public Health*. 2015;4(3):319–23.
32. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS medicine*. 2009;6(7):e1000097.
33. Munn Z, Moola S, Lisy K, Riitano D. The Joanna Briggs Institute Reviewers' Manual 2014. The Systematic Review of Prevalence and Incidence Data. Adelaide, SA: The Joanna Briggs Institute. 2014.
37. Eshetu E, Gedif T. Prevalence of khat, cigarette and alcohol use among students of technology and pharmacy, Addis Ababa University. *Ethiop Pharm J*. 2006;24(2):116–24.
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. *Ethiopian Journal of Health sciences*. 2009;19(3).
39. 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(1):693.
40. Kassa A, Loha E, Esaiyas A. Prevalence of khat chewing and its effect on academic performance in Sidama zone, Southern Ethiopia. *African Health Sciences*. 2017;17(1):175–85.
41. Reda AA, Moges A, Yazew B, Biadgilign S. Determinants of cigarette smoking among school adolescents in eastern Ethiopia: a cross-sectional study. *Harm reduction journal*. 2012;9(1):39.

42. Dereje N, Abazinab S, Girma A. Prevalence and predictors of cigarette smoking among adolescents of Ethiopia: school based cross sectional survey. 2014.
43. Madu SN, Matla M-QP. Illicit drug use, cigarette smoking and alcohol drinking behaviour among a sample of high school adolescents in the Pietersburg area of the Northern Province, South Africa. *Journal of Adolescence*. 2003;26(1):121-36.
44. Atwoli L, Mungla PA, Ndung'u MN, Kinoti KC, Ogot EM. Prevalence of substance use among college students in Eldoret, western Kenya. *BMC Psychiatry*. 2011;11(1):34.
45. Deas D, Brown ES. Adolescent substance abuse and psychiatric comorbidities. *Journal of Clinical Psychiatry*. 2006;67:18.
46. Caetano R, Nelson S, Cunradi C. Intimate partner violence, dependence symptoms and social consequences from drinking among white, black and Hispanic couples in the United States. *The American journal on addictions*. 2001;10 Suppl:60-9.
47. Grant BF, Stinson FS, Dawson DA, Chou SP, Dufour MC, Compton W, et al. Prevalence and co-occurrence of substance use disorders and independent mood and anxiety disorders: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Arch Gen Psychiatry*. 2004;61(8):807-16.
48. Gebiresilus AG, Gebresilus BG, Yizengaw SS, Sewasew DT, Mengesha TZ. Khat use prevalence, causes and its effect on mental health, Bahir-Dar, north west Ethiopia. *European Scientific Journal*, ESJ. 2014;10(23).
49. Hasin DS, Stinson FS, Ogburn E, Grant BF. Prevalence, correlates, disability, and comorbidity of DSM-IV alcohol abuse and dependence in the United States: Results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry*. 2007;64(7):830-42.
50. Harwood HJ, Fountain D, Livermore G. The economic costs of alcohol and drug abuse in the United States, 1992: US Department of Health and Human Services, National Institutes of Health, National Institute on Drug Abuse, Office of Science Policy and Communications; 1998.
51. Grant BF, Dawson DA. Age at onset of alcohol use and its association with DSM-IV alcohol abuse and dependence: results from the national longitudinal alcohol epidemiologic survey. *Journal of Substance Abuse*. 1997;9(Supplement C):103-10.
52. Central Statistical Agency - CSA/Ethiopia, ICF. Ethiopia Demographic and Health Survey 2016: HIV Report. Addis Ababa, Ethiopia: CSA and ICF; 2018.
53. The Recovery Village. A study of drug addiction between the genders United States of America: The Recovery Village; 2017 [Available from: <https://www.therecoveryvillage.com/drug-addiction/study-between-genders/>].
54. Brady KT, Randall CL. GENDER DIFFERENCES IN SUBSTANCE USE DISORDERS. *Psychiatric Clinics of North America*. 1999;22(2):241-52.
55. Tobler NS, Roona MR, Ochshorn P, Marshall DG, Streke AV, Stackpole KM. School-based adolescent drug prevention programs: 1998 meta-analysis. *Journal of primary Prevention*. 2000;20(4):275-336.
56. Bangert-Drowns RL. The effects of school-based substance abuse education—a meta-analysis. *Journal of drug education*. 1988;18(3):243-64.
57. Weinberg NZ, Rahdert E, Collier JD, Glantz MD. Adolescent Substance Abuse: A Review of the Past 10 Years. *Journal of the American Academy of Child & Adolescent Psychiatry*. 1998;37(3):252-61.
58. WHO. Substance abuse World Health Organization 2017 [Available from: http://www.who.int/topics/substance_abuse/en/].