RESEARCH ARTICLE

Prevalence of substance use and associated factors among secondary school adolescents in Kilimanjaro region, northern Tanzania

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Abstract

Background

Substance use among school-going adolescents increases the risk of developing mental disorders, addiction, and substance use disorders. These may lead to poor academic performance and reduced productivity, which affects adolescent lives. The study aimed to determine the prevalence of substance use and associated factors among secondary school adolescents in the Kilimanjaro region, northern Tanzania.

Methodology

The study used secondary data from a cross-sectional survey of adolescents aged 10–19 years from public secondary schools in the Kilimanjaro Region, northern Tanzania. Substance use was measured using the Global School Health Survey (GSHS) questionnaire. Categorical variables were summarized using frequencies and percentages, while numerical variables used mean and standard deviation. Multivariable logistic regression models were used to obtain odds ratios (OR) and 95% confidence intervals (CI) to determine risk factors associated with lifetime and current (within the past 30 days preceding the survey) substance use.

Results

The lifetime and current prevalence of substance use among 3224 adolescents was 19.7% and 12.8%, respectively, while alcohol and cigarettes were commonly used. Female adolescents had lower odds of current substance use (OR = 0.63, 95%CI 0.50–0.80). Higher odds of current substance use were among adolescents who have ever had sex (OR = 4.31, 95% CI 3.25–5.71), ever engaged in a physical fight (OR = 2.19, 95%CI 1.73–2.78), ever been bullied (OR = 1.55, 95%CI 1.16–2.05), always seen alcohol advertisements (OR = 1.87, 95%CI 1.37–2.53), and adolescents whose parent/guardians rarely understood their

problems (OR = 1.38, 95% CI = 1.03–1.85). Adolescents whose classmates always showed social support had lower odds of current substance use (AOR = 0.71, 95%CI 0.53–0.97). Similar factors were associated with lifetime substance users.

Conclusion

The study reflects a high prevalence of substance use among adolescents in the Kilimanjaro region. Alcohol and cigarette are the most prevalent substances used. Regulatory measures are essential to limit alcohol advertisements that are media portrayed. Efforts are needed to reduce risk behaviors, such as physical violence and bullying, through peer support groups/ clubs in school environments.

Introduction

Substance use is the lifetime use of any substance, including khat (*Catha edulis*), cigarettes, illicit drug use, alcohol, and other substances [1, 2]. Substance use has increased in recent years and is a growing public health problem and a worldwide threat, significantly affecting young people aged 10–24 years [1–3]. The commonly used substances globally are alcohol, khat, cigarette, hashish, and other illicit drugs like cannabis, heroin, and cocaine [4, 5]. For instance, about 53% of people aged 15 years and above have ever used alcohol globally [6, 7]. A recent systematic review in sub-Saharan Africa estimated the prevalence of substance use among adolescents (10–19 years) to be 41.6%, with alcohol being the most prevalent (40.8%) compared to other substances [1, 2].

In Tanzania, the lifetime prevalence of substance use among school-going adolescents (11–17 years) was 7%, with alcohol at 4.5% and drugs (3.1%), specifically marijuana, amphetamines, or methamphetamines being the most used [8, 9]. In the Kilimanjaro region, cigarettes (15.5%), alcohol (9.2%), and marijuana (3%) were the most commonly used substances among school-going adolescents [10]. Studies on substance use and related risk behaviors among adolescents in Tanzania are scarce. Therefore, limited data is available to inform policy and interventions.

Adolescence marks a critical time of growth in the life course and profound changes in physical, cognitive, and social development [3]. Substance use at the early stages of adolescents increases the risk of developing addiction, mental disorders, and substance use disorders [1, 6]. For example, in developed countries, the estimated risk of developing drug dependence on cannabis uses alone among lifetime drug users who started using drugs during the adolescent period is 17% [11]. Substance use and mental disorders accounted for 183.9 million disability-adjusted life years (DALYs) in 2010, especially among adolescents and young to middle-aged adults aged 10–29 years [12–14]. In addition, substance use among school-going adolescents leads to poor academic performance, reduced productivity, high dropout rate, and indiscipline [4, 15], which have implications that can persist throughout the life course [16]. According to the Global initiative out-of-school children study in Tanzania, almost 2.3 million (57%) of secondary school-age children (14–17 years) are out of school; the reported dropout rate by 2014 among registered adolescents was 7.5% [17]. The factors are bad youth groups involved with substance use, specifically smoking bhang (marijuana) and truancy tendencies [17].

The Sustainable development Goals include strategies to reduce the burden of substance use among adolescents through strengthening the prevention and treatment of substance use [18]. Among other interventions, Tanzania's adolescent health and development strategy

2018–2022 aims to ensure the availability of preventive and treatment services that are affordable, accessible, and friendly to reduce the burden of disease among adolescents. Also, the strategy recommends substance use counseling among adolescents, which would require promoting community-based youth centers and strengthening community involvement in the Adolescent Health Strategy (ADHS) to improve key adolescent health care practices [19]. Nevertheless, most existing interventions focus on sexual and reproductive health (SRH) and HIV/AIDS and less on emerging adolescent issues such as substance use, accidents and injuries, mental health, and road safety [19].

In addition, studies on adolescent risk behaviors in different settings focused on one or a few substances, mainly involving young people aged 15–24 years and among out-of-school adolescents[6, 9, 16]. Therefore, information about the burden of substance use among the school-going adolescents (10–19 years) is relevant to complement the existing literature and inform targeted interventions and potential policy decisions. This study assessed the prevalence of substance use and associated factors among secondary school adolescents in the Kilimanjaro region, northern Tanzania.

Methods

Study design, area, and population

We carried out a secondary analysis of data from a school-based cross-sectional study conducted in public secondary schools in four districts of the Kilimanjaro region, namely Moshi municipality, Moshi, Hai, and Siha districts, by the Institute of public health in Kilimanjaro Christian Medical University College (KCMUCO). The main aim was to assess the risk behaviors of adolescents attending public secondary schools. The study included all consenting form-one students who attended public secondary schools in 2019 from the selected four districts of the Kilimanjaro region. Kilimanjaro is one of the regions in the Northern part of Tanzania, comprising seven districts and covering 13250 Km^2. Kilimanjaro has an estimated population of 1,640,087 people and an annual growth rate of 1.6%. The major economic activities in the region are agriculture and livestock keeping [20]. Kilimanjaro has many secondary schools compared to other regions, with 313 secondary schools (215 government, 98 private), making the region home to many adolescents who spend most of their time and days in school [21]. According to the country's profile, adolescent accounts for 23% of Tanzania's population, 13% and 10% for the 10–14 and 15–19 age groups, respectively [19].

Sampling, data collection methods, and tools

A multistage sampling technique was used to select 3227 adolescents. Four districts were purposefully selected in the first stage, ensuring rural-urban representativeness. The second stage was a random selection of public secondary schools from all available schools in each district. Only form-one students were included at the school level to build a cohort of repeated cross-sectional surveys in the following years. The purpose was to document trends of adolescent risk behaviors over four years period (i.e., form-one to four). Finally, a simple random sampling technique selected students proportional to the size of each school. Analysis was performed on 3224 adolescents after excluding three participants (0.1%) aged less than ten years and greater than 19 years of age.

The interviews were self-administered, using the Regional School Health Survey (RSHS) questionnaire adopted from the WHO/CDC Global Student Health Survey (GSHS) [22]. The RSHS questionnaire was standardized to assess risk behaviors among school-going students in Tanzania and administered in the Kiswahili language [8]. The tool has also been extensively used in other settings[15, 23, 24]. The risk behaviors in this survey included nutrition and

participation in physical activity, personal hygiene, and substance use, including smoking, alcohol, illicit drugs, marijuana, khat use, experiences of violence and abuse, and risky sexual behaviors. Trained medical students from KCMUCo collected data. Before data collection, the data collectors explained the study purpose to all form one students and responded to all the questions asked before administering the interviews. The selected participants were then given the questionnaires and instructed to wait for further instructions from the data collectors. The next step was reading one question after another to ensure each respondent understood the question before filling out the questionnaire. The process continued until the last question. The data collectors made the necessary efforts to ensure privacy and confidentiality during the data collection. This was done by clearly explaining to participants why this was important and ensuring spaces between participants when completing the questionnaires.

Study variables

The dependent variable in this study was substance use. Lifetime substance use refers to using any substance at least once throughout the adolescent's life [1, 2]. The substances considered in this study were alcohol, cigarette smoking, marijuana, khat, and recreational drugs (cocaine, heroin). Lifetime substance use was coded as "Yes" if an adolescent reported using any of the above substances and "No" if otherwise. Current substance use refers to using any of the following substances during the last 30 days preceding the interview: cigarette smoking, tobacco products, alcohol, recreational drug (cocaine and heroin), marijuana, khat, and amphetamines.

The independent variables included adolescent socio-demographic and behavioral characteristics. The demographic characteristics were adolescents age (10–14, 15–19 years), sex (male, female), schooling district (Moshi municipality council, Moshi district council, Siha, and Hai), and the number of days ever missed class (0 days, 1–3 days, ≥4 days). Social and behavioral variables were: parent/guardian use tobacco (neither, father or male guardian, mother or female guardian, both parents, don't know), ever had sex (no, yes), number of sexual partners (1 partner, ≥2 partners), source of alcohol (shop/ street vendor, gave someone else to buy, friends, family, stole, some other way), frequency seen alcohol advertisement (never, rarely, sometimes, most times, always), frequency parents/guardian understood your problems (never, rarely, sometimes, most times, always), number of close friends (no friends, 1–5 friends, >6 friends), social support from friends (never, rarely, sometimes, most times, always), ever been bullied (no, yes), ever engaged in a physical fight (no, yes), and ever rode in a car with a drunk driver (no, yes).

Data processing and analysis

Data were cleaned and analyzed using SPSS software version 20. Descriptive statistics for substance use characteristics were summarized using frequencies and proportions for categorical variables. Continuous variables were summarized using mean and standard deviation. The Chi-square test determined the association between participant characteristics with lifetime and current substance use. Binary and multivariable logistic regression analysis estimated odds ratios (OR) and 95% confidence intervals (CI) for determinants of a lifetime and current substance use. A p-value of <0.05 was considered statistically significant in crude and adjusted analyses.

Ethical consideration

The Kilimanjaro Christian Medical University College Research and Ethics Review Committee (KCMU-CRERC) approved the parent study. All people aged 18 years and above provided

oral informed consent. The headmasters from each secondary school assented to interview students aged <18 years because no invasive procedures required parental consent. Hence, the need for parental consent was waived by the ethics committee. Ethical approval for the current study was sought from the KCMU-CRERC and obtained approval ethical clearance certificate number PG04. The Institute Public Health director at KCMUCO provided permission to use the data. The study observed and protected the confidentiality and privacy of the subject's data. Instead of adolescent names or any personal identifiers, unique identification numbers identified study participants.

Results

Participant socio-demographic characteristics

The mean age of 3224 adolescents (10–19 years) in this study was 14.6 years and a standard deviation of 1.07 years. More than half (53.5%) were aged 10–14, and just over half (53.0%) were females. Most adolescents included in this study schooled in Moshi (41.6%) and Siha (21.2%) district councils and Moshi municipality (20.7%). Few respondents, 103 (3.2%), reported missing class at least for four days or more (Table 1).

Self-reported prevalence of substance use

The lifetime and current prevalence of substance use was 19.7% and 12.8%, respectively. Among those who reported having ever used substances, the most common substance reported was alcohol (14.8%) and cigarette smoking (7.6%), followed by khat (1.6%), recreational drugs, specifically cocaine and heroin (0.7%), and marijuana (0.7%). The common substances reported among adolescents currently using substances were alcohol (8.2%) and cigarette smoking (4.3%) (Table 2).

Adolescent social and behavioral characteristics

Among all the adolescents in this study, 13.5% had a father/male guardian in their family who was a smoker, compared to only 1.1% of mothers/female guardians. Among current alcohol

Table 1. Participant socio-demographic characteristics (N = 3224).

Variables	Frequency	Percentage
Age (years)		
Mean (SD)	14.6 (1.07)	
10–14	1726	53.5
15–19	1498	46.5
Sex		
Male	1515	47.0
Female	1709	53.0
Schooling council		
Moshi Municipality	667	20.7
Moshi district council	1342	41.6
Hai district council	533	16.5
Siha district council	682	21.2
Ever missed class		
Did not miss class	2609	80.9
1–3 days	512	15.9
≥ 4 days	103	3.2

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Table 2. Self-reported prevalence of substance use (N = 3224).

Variable	Frequency	Percentage
Ever use substances[†]		
Cigarette smoking	246	7.6
Alcohol	477	14.8
Recreational drugs [*]	23	0.7
Marijuana	23	0.7
Khat	51	1.6
Lifetime (overall) substance use		
No	2590	80.3
Yes	634	19.7
Current use of any substance [**][†]		
Cigarette smoking	139	4.3
Tobacco smoking	40	1.2
Alcohol	264	8.2
Recreational drugs [*]	8	0.2
Marijuana	9	0.3
Khat	24	0.7
Amphetamines	51	1.6
Current use of any substance (overall)		
No	2811	87.2
Yes	413	12.8

[*] Recreational drugs include both cocaine and heroin.

[**] Current substance use is within 30 days preceding the survey.

[†] Frequencies and percentages among those who answered "Yes".

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users, most of them reported the source of alcohol was stealing (32%) and family members (30.8%). In addition, adolescents reported having always seen alcohol advertisements (15.3%), and few reported ever riding in a car with a drunk driver (4.5%) (Table 3).

On the other hand, almost ten percent of adolescents reported having ever had sex (9.3%), of which 58.5% had two or more sexual partners. Nearly two-thirds (65.6%) reported having 1–5 close friends, and 47.6% said their parents always understood their problems. More than one-third (36.9%) reported always getting social support from their classmates. The self-reported prevalence of bullying was 13.6%. Furthermore, less than a quarter reported having ever engaged in a physical fight (22.9%) (Table 3).

Substance use by participant's social-demographic and behavioral characteristics

There were no significant differences in the proportions of a lifetime and current substance use by adolescent age groups. The proportion of lifetime substance use differed significantly by participant characteristics ($p < 0.05$). The proportion was higher among males (26.1%) compared to females (14.0%) and adolescents who missed class four days or more (29.1%) compared to those who did not (18.1%). In addition, the proportion of lifetime substance use was significantly higher among adolescents who: ever had sex (55.7), ever bullied (32.1%), ever engaged in a physical fight (32.8%), always seen alcohol advertisements (29.9%), and adolescents whose parents rarely understood their problems (25.0%) compared to their counterparts (Table 4).

Table 3. Participant's social and behavioral characteristics (N = 3224).

Variables	Frequency	Percentage
Parents use tobacco[*]		
Neither	2588	80.3
Father or male guardian	436	13.5
Mother or female guardian	36	1.1
Both parents	16	0.4
I do not know	144	4.5
Source of alcohol in the past 30 days (n = 264)[*]		
From shop/street vendor	13	5.2
Gave someone else to buy	10	4.0
Friends	52	20.8
Family	77	30.8
Stole	80	32.0
Some other way	18	7.2
Seen alcohol advertisements[*]		
Never	1690	52.4
Rarely	1034	32.0
Always	493	15.3
Ever had sex		
No	2924	90.7
Yes	300	9.3
Number of sexual partners(n = 300)[*]		
1 partner	118	41.5
≥ 2 partners	166	58.5
Number of close friends[*]		
No friends	288	8.9
1–5 friends	2115	65.6
>6 friends	812	25.2
Received Social support from classmates[*]		
Never	755	23.4
Rarely	1279	39.7
Always	1189	36.9
Parents/guardians understood your problems[*]		
Never	822	25.5
Rarely	864	26.8
Always	1536	47.6
Ever been bullied		
No	2785	86.4
Yes	439	13.6
Ever engaged in a physical fight		
No	2486	77.1
Yes	738	22.9
Ever ridden in a car with a drunk driver		
No	3079	95.5
Yes	145	4.5

[*]Frequencies and percentages do not add up due to missing values.

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Table 4. Substance use by participant characteristics (N = 3224).

Variable	Total (%)	Lifetime use	P-value	Current use [*]	P-value
		n (%)		n (%)	
Age					
10–14	1726 (53.5)	319 (18.5)	0.07	213 (12.3)	0.392
15–19	1498 (46.5)	315 (21.0)		200 (13.4)	
Sex					
Male	1515 (47.0)	395 (26.1)	<0.001	261 (17.2)	<0.001
Female	1709 (53.0)	239 (14.0)		152 (8.9)	
District					
Moshi MC	667 (20.7)	142 (21.3)	<0.001	93 (13.9)	0.001
Moshi DC	1342 (41.6)	310 (23.1)		201 (15.0)	
Hai	533 (16.5)	89 (16.9)		50 (9.4)	
Siha	682 (21.2)	93 (13.6)		69 (10.1)	
Days missed class					
Did not miss class	2609 (80.9)	473 (18.1)	<0.001	307 (11.8)	0.001
1–3 days	512 (15.9)	131 (25.6)		86 (16.8)	
≥ 4 days	103 (3.2)	30 (29.1)		20 (19.4)	
Ever had sex					
No	2924 (90.7)	467 (16.0)	<0.001	292 (10.0)	<0.001
Yes	300 (9.3)	167 (55.7)		121 (40.3)	
Ever been bullied					
No	2785 (86.4)	493 (17.7)	<0.001	311(11.2)	<0.001
Yes	439 (13.6)	141(32.1)		102(23.2)	
Seen alcohol advertisement[**]					
Never	1690 (52.4)	246 (14.6)	<0.001	152 (9.0)	<0.001
Rarely	1034 (32.0)	241 (23.3)		165 (16.0)	
Always	493 (15.3)	147 (29.9)		94 (19.1)	
Ever engaged in a physical fight					
No	2486 (77.1)	392 (15.8)	<0.001	239 (9.6)	<0.001
Yes	738 (22.9)	242 (32.8)		174 (23.6)	
Parents/guardians understood your problems[*]					
Never	822 (25.5)	246 (21.0%)	<0.001	152 (12.5)	<0.001
Rarely	864 (26.8)	241 (25.0%)		165 (17.6)	
Always	1536 (47.6)	147 (16.0%)		94 (10.8)	
Classmate social support[**]					
Never	755 (23.4)	174 (23.1)	<0.001	113 (15.0)	0.001
Rarely	1279 (39.7)	272 (21.3)		182 (14.2)	
Always	1189 (36.9)	188 (15.8)		118 (9.9)	

[*] Current use is within 30 days before the survey.

[**] Frequencies and percentages do not add up due to missing values.

Likewise, the proportion of current substance use was significantly higher among male adolescents (17.2%), those who missed class four days and more (19.4%), and those who ever had sex (40.3%) which was about four times higher than those who never had sex. Furthermore, the proportion of current substance use was significantly higher among those who had always seen alcohol advertisements (19.1%), ever engaged in a physical fight (23.6%), and whose classmate(s) never showed social support (15.0%) compared to their counterparts (Table 4).

Adjusted analysis for factors associated with substance use

Significantly lower odds of lifetime substance use were among female adolescents compared to males (AOR = 0.61, 95%CI 0.50–0.74), those from Siha district (AOR = 0.64 95%CI 0.47–0.87) compared to Moshi municipal council, and whose classmates always showed social support (AOR = 0.73, 95%CI 0.57–0.95). Higher odds of lifetime substance use were among adolescents who have ever had sex (AOR = 4.50, 95%CI 3.60–6.13), ever been bullied (AOR = 1.50, 95%CI 1.17–1.94), ever engaged in a physical fight (AOR = 2.03, 95%CI 1.65–2.50), and always seen alcohol advertisements (AOR = 2.09, 95%CI 1.61–2.70) (Table 5).

Table 5. Adjusted analysis for factors associated with substance use (N = 3224).

Variable	Lifetime substance use		Current substance use	
	AOR† (95%CI)	P-value	AOR† (95% CI)	P-value
Age				
10–14	1.00		1.00	
15–19	1.09 (0.70,1.32)	0.378	0.97 (0.77,1.22)	0.78
Sex				
Male	1.00		1.00	
Female	0.61 (0.50,0.74)	<0.001	0.63 (0.50,0.80)	<0.001
District				
Moshi MC	1.00		1.00	
Moshi DC	1.22 (0.96,1.57)	0.107	1.14 (0.86,1.52)	0.374
Hai	0.91 (0.66, 1.25)	0.57	0.77 (0.52,1.14)	0.193
Siha	0.64 (0.47, 0.87)	0.005	0.78 (0.55, 1.12)	0.180
Ever had sex				
No	1.00		1.00	
Yes	4.50 (3.60,6.13)	<0.001	4.31 (3.25,5.71)	<0.001
Days missed class				
Did not miss class	1.00		1.00	
1–3 days	1.40 (1.09, 1.78)	0.007	1.33 (1.00,1.76)	0.049
≥ 4 days	1.31 (0.80,2.14)	0.287	1.09 (0.62, 1.94)	0.75
Ever been bullied				
No	1.00		1.00	
Yes	1.50 (1.17,1.94)	0.002	1.55 (1.16, 2.05)	0.003
Seen alcohol advertisement				
Never	1.00		1.00	
Rarely	1.44 (1.16,1.79)	0.001	1.50 (1.16, 1.93)	0.002
Always	2.09 (1.61,2.7)	<0.001	1.87 (1.37, 2.53)	<0.001
Ever engaged in a physical fight				
No	1.00		1.00	
Yes	2.03 (1.65, 2.5)	<0.001	2.19 (1.73, 2.78)	<0.001
Parents/guardians understood your problems				
Never	1.00		1.00	
Rarely	1.16 (0.90, 1.49)	0.253	1.38 (1.03,1.85)	0.034
Always	0.81 (0.64,1.03)	0.860	0.90 (0.68, 1.21)	0.487
Classmate social support				
Never	1.00		1.00	
Rarely	0.89 (0.70, 1.13)	0.327	0.89 (0.68,1.18)	0.423
Always	0.73 (0.57, 0.95)	0.017	0.71 (0.53, 0.97)	0.029

† AOR: Adjusted Odds Ratio.

Furthermore, lower odds of current substance use were among female adolescents (AOR = 0.63, 95%CI 0.50–0.80) and whose classmates always showed social support (AOR = 0.71, 95%CI 0.53–0.97). The adolescents who ever had sex (AOR = 4.31, 95% CI 3.25–5.71), were bullied (AOR = 1.55, 95% CI 1.16–2.05), engaged in a physical fight (AOR = 2.19, 95% CI 1.73–2.78), always seen alcohol advertisements (AOR = 1.87, 95% CI 1.37–2.53), and whose parent/guardians rarely understood their problems (AOR = 1.38, 95% CI 1.03–1.85) had higher odds of current substance use (Table 5).

Discussion

The study aimed to determine the prevalence and factors associated with substance use among secondary-school adolescents in the Kilimanjaro region, Northern Tanzania. The lifetime and current prevalence of substance use was 19.7% and 12.8%, respectively. The most prevalent substances used were alcohol and cigarette smoking. Factors significantly associated with lifetime and current substance use included: sex (high among males), ever having sex, being bullied, ever in a physical fight, seeing alcohol advertisements, classmate's social support, and parents/guardians understanding adolescents' problems.

The lifetime prevalence (19.7%) of substance use among adolescents in this study is higher than 7% from the 2006 Tanzanian Global School-based Student Health Surveys (GSHS) [9]. Current substance use in this study is also higher than the 2017 GSHS, which reported specifically alcohol (4.5%), drugs (3.1%), tobacco (5.1%), and cigarette smoking (4.5%) [8]. A study in Dodoma reported a higher prevalence of substance use, specifically alcohol (19.8%), smoking cigarettes (7.4%), and marijuana (3.3%) among adolescents aged 15–17 years [25]. The current prevalence (12.8%) of substance use in this study is lower than the WHO Global Alcohol status report on current use (21.4%) among adolescents aged 15–19 years in African regions [7] and a study done among adolescents in Ethiopia (47.9%) [26]. The possible explanation for the difference may be reporting only one substance in other studies, sample size variations, and adolescent age. Compared to the national 2006 and 2015 GSHS studies, the findings show a higher prevalence, possibly because of the small geographical coverage in this study. These findings demonstrate a need to strengthen regulatory measures to reduce substance use, particularly alcohol and cigarette smoking.

We found no significant association between adolescent age and substance use. However, previous studies in Zambia [27] and Benin [28] in west Africa found high substance use practice among adolescents 15+ years. Likewise, analysis of GSHS data from six Asian low- and middle-income countries revealed a higher risk of substance use (alcohol and smoking) among older compared to younger adolescents [29]. However, there are limited studies about the association between adolescent age and substance use in SSA. Despite the observed differences with other studies, interventions should target reducing substance use practice among school-going adolescents because of their ingenuity in trying new things.

In this study, female adolescents had lower odds of using substances than males, similar to other studies in Morocco, Zimbabwe, and Ethiopia [26, 30, 31]. Alcohol use (among other substances) is also common among sexually active adolescent males in SSA [32]. Lower odds of substance use among females may be associated with societal and cultural gender role expectations to act and conduct themselves. Substance use among females is seen as a shameful, inappropriate practice and less sensation-seeking behavior than males [26, 30, 31].

Adolescents who reported ever having sex were significantly more likely to be lifetime and current substance users. Likewise, in Tanzania, young people aged 15–24 years using alcohol were more likely to engage in risky sexual behaviors [6]. A study in SSA associated sexual behaviors with alcohol use [32]. The finding is also consistent with studies in Iran and

Bangladesh that associated the experience of sexual activity with substance use [24, 33]. The observed association may be because substances such as alcohol, cigarette, and illicit drugs affect cognitive processes and decision-making, thus contributing to a compromised judgment [24, 33]. Also, sexual activity during these periods can make adolescents vulnerable to developing mental disorders like depression or anxiety, which, in turn, could lead them to use substances [24]. Health education interventions on the effects and consequences of substance use should be enhanced in secondary schools [8].

As reported elsewhere, adolescents who have ever been bullied had higher odds of a lifetime and current substance use [34]. A possible reason for this is that the victims of bullying are predisposed to use substances as a maladaptive coping strategy [34]. In addition, a study in Thailand found that engaging in a physical fight was associated with alcohol use and misuse, where adolescents used substances as a coping mechanism [35]. Likewise, we also found that adolescents who engaged in a physical fight had a higher likelihood of substance use, similar to a study done across eight sub-Saharan countries [36]. Therefore, adolescents need to be educated on the psychological effects that bullying and physical fights can cause, explaining how victimization can cause severe depression and anxiety that lead to substance use [37]. Student support groups or systems for the affected may help the victims cope with the bullying and physical abuse, reducing dependence on substance use.

Adolescents who reported always seeing alcohol advertisements were more likely to use substances. Likewise, advertising alcoholic beverages in the mass media promoted abusive alcohol consumption in Italy [38]. Adolescents exposed to alcohol advertising are more likely to start consuming alcohol earlier and drink large amounts [39]. A systematic review also demonstrated the relationship between alcohol advertisements and increased consumption among adolescents [40]. These findings indicate the need to limit alcohol advertisements in the media or ensure they portray their adverse effects. They also suggest prohibiting selling, buying, and posting substances on school premises, especially among school-going and out-of-school adolescents [41].

This study's findings also show that adolescents whose classmates always showed social support were less likely to use substances. These findings are consistent with the study done in Bangladesh, which reported that the likelihood of substance use increases with a lack of peer support as it exhibits greater anti-social behaviors that can manifest in substance use [24]. In Malaysia, adolescents with inadequate peer support had a higher likelihood of substance use [42]. On the contrary, a study done in Ghana found no association between peer support and substance use [34]. The possible reasons could be that the study only assessed two substances, i.e., cannabis and amphetamines, compared to over five substances this study examined.

In addition, adolescents whose parents rarely understood their problems were more likely to use substances. Previous studies demonstrated that parents' supervision of adolescents reduces substance use practice [27, 43]. Limited parental monitoring, involvement, and active substance use in the home at the family level may predispose adolescents to use substances [44]. Therefore, lack of social support may expose adolescents to substance use practices as a coping mechanism due to insecurity.

Study strengths and limitations

This study used a large sample size of 3224 adolescents from public secondary school schools in four districts of the Kilimanjaro region. Large sample size and wider geographical coverage enhance precision and study's representativeness, respectively. This study is one of the first in our setting to measure substance use's prevalence and associated factors. The study also estimated the burden of a lifetime and current substance use, specifically among adolescents aged 10–19 years, and associated factors, which is essential to inform necessary interventions.

The study had several limitations. Firstly, the study design is cross-sectional; hence cannot determine the temporal relationship between substance use and the associated factors. Secondly, the study collected data among adolescents attending public secondary schools. Thus, the results may not reflect students in private schools and out-of-school adolescents. Thirdly, the questionnaire used for data collection was adopted from the WHO/CDC Global Student Health Survey [22]. This tool does not capture all the factors associated with substance use. These factors include the place of upbringing, social sanctions, belief systems, self-control, cultural acceptance of substance use, and availability and accessibility of substances, particularly drugs and cigarettes/tobacco products[24, 26, 45]. The tool does not also capture the consequences of substance use among school-going adolescents. Lastly, there was also a possibility of recall and social-desirability bias where adolescents might have forgotten or answered what they thought was socially desirable. Such bias may either over or under-estimate the prevalence of substance use.

Conclusion and recommendations

The study reflects the high prevalence of substance use among adolescents in the Kilimanjaro region. Alcohol and cigarette are the most prevalent substances used. The factors significantly associated with substance use were sex (high among males), ever having sex, being bullied, ever in a physical fight, seeing alcohol advertisements, classmate's social support, and parents/guardians understanding adolescents' problems. The study recommends that students' leadership, with support from the teachers, create support groups or clubs that may help adolescents share alternative healthy ways of coping/dealing with stress, anxiety, and depression caused by bullying, which leads them to rely on substance use. The government should adopt regulatory measures to limit the number of alcohol advertisements the media portrays. Monitoring adolescents' prohibition of selling and buying any substance such as alcohol and tobacco products is crucial in or near the school premises.

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References

1. Ogundipe O, Amoo EO, Adeloye D. Substance use among adolescents in sub-Saharan Africa: A systematic review and meta-analysis. 2018;2016. https://doi.org/10.7196/SAJCH.2018.v12i2.1524

2. Jumbe S, Kamninga TM, Mwalwimba I, Kalu U. Determinants of adolescent substance use in Africa: a systematic review and meta- analysis protocol. 2021; 1–6.

3. WHO. Adolescents and young adults health key facts. In: World Health Organization [Internet]. 2021 [cited 1 Jun 2021]. Available: https://www.who.int/news-room/fact-sheets/detail/adolescents-health-risks-and-solutions

4. Gebremariam TB, Mruts KB, Neway TK. Substance use and associated factors among Debre Berhan University students, Central Ethiopia. Subst Abus Treat Prev Policy. 2018; 13: 1–8. https://doi.org/10.1186/s13011-018-0150-9 PMID: 29622021

5. Halladay J, Woock R, Munn C, Mackillop J, Amlung M, Ogrodnik M, et al. Patterns of substance use among adolescents: A systematic review. Drug Alcohol Depend. 2020; 216: 108222. https://doi.org/10.1016/j.drugalcdep.2020.108222 PMID: 32971420

6. Francis JM, Weiss HA, Mshana G, Baisley K. The Epidemiology of Alcohol Use and Alcohol Use Disorders among Young People in Northern Tanzania. 2015; 1–17. https://doi.org/10.1371/journal.pone.0140041 PMID: 26444441

7. WHO. Global status report on alcohol and health 2018. 2018.

8. MoHCDGEC. Tanzania Mainland Global School-based Student Health Survey Country Report. 2017.

9. Abio A, Sezirahiga J, Davis LE, Wilson ML. adolescents in a low-income sub Saharan setting. Inj Violence. 2020; 12: 21–27.

10. Mnyika KS, Masatu MC, Klepp K-I. Prevalence of and predictors of substance use among adolescents in rural villages of Moshi district, Tanzania. East Afr J Public Heal. 2011; 8: 1–5. Available: https://login.research4life.org/tacsgr1pubmed_ncbi_nlm_nih_gov/22066274/ PMID: 22066274

11. UNODC. Drug use and consequences, the world drug report. United Nations publication. 2020. Available: https://www.unodc.org/doc/wdr2016/WORLD_DRUG_REPORT_2016_web.pdf

12. Whiteford HA, Degenhardt L, Rehm J, Baxter AJ, Ferrari AJ, Erskine HE, et al. Global burden of disease attributable to mental and substance use disorders: Findings from the Global Burden of Disease Study 2010. Lancet. 2013; 382: 1575–1586. https://doi.org/10.1016/S0140-6736(13)61611-6 PMID: 23993280

13. Degenhardt L, Stockings E, Patton G, Hall WD, Lynskey M. Substance use in young people 1 The increasing global health priority of substance use in young people. The Lancet Psychiatry. 2016; 0366: 1–14. https://doi.org/10.1016/S2215-0366(15)00508-8

14. Idowu A, Aremu AO, Olumide A, Ogunlaja AO. Substance abuse among students in selected secondary schools of an urban community of Oyo-state, South West Nigeria: implication for policy action. 2018; 18: 776–785.

15. Riva K, Allen-taylor L, Schupmann WD, Mphele S, Moshashane N, Lowenthal ED. Prevalence and predictors of alcohol and drug use among secondary school students in Botswana: a cross-sectional study. 2018; 1–14.

16. Berhane Y, Canavan CR, Darling AM, Sudfeld CR, Vuai S, Adanu R, et al. The age of opportunity: prevalence of key risk factors among adolescents 10–19 years of age in nine communities in sub-Saharan Africa. Trop Med Int Heal. 2020; 25: 15–32. https://doi.org/10.1111/tmi.13339 PMID: 31698531

17. UNICEF-Tanzania. Global Initiative on Out of School Children: Tanzania Verification of the Out of School Children Study. 2018. p. 16.

18. UN. THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT. Arsenic Research and Global Sustainability—Proceedings of the 6th International Congress on Arsenic in the Environment, AS 2016. 2016. pp. 12–14. https://doi.org/10.1201/b20466-7

19. MoHCDGEC. National adolescent health and development strategy 2018–2022. Ministry of health Community Development Gender Elderly and Children. Reproductive and Child Health Section. Dar es Salaam. Tanzania; 2018.

20. Mgongo M, Chotta NAS, Hashim TH, Uriyo JG, Damian DJ, Stray-Pedersen B, et al. Underweight, stunting and wasting among children in Kilimanjaro region, Tanzania; a population-based cross-sectional study. Int J Environ Res Public Health. 2017; 14: 1–12. https://doi.org/10.3390/ijerph14050509 PMID: 28489043

21. PORALG. KILIMANJARO STARTEGIC PLAN 2011/12 to 2015/2016. 2011. pp. 7–41.

22. WHO. GSHS Questionnaire. In: World Health Organization [Internet]. 2021 [cited 5 Aug 2021]. Available: https://www.who.int/teams/noncommunicable-diseases/surveillance/systems-tools/global-school-based-student-health-survey/questionnaire

23. WHO. Global School Based Student Health Survey 2015. Global School Based Student Health Survey Nepal. 2015. Available: http://nhrc.gov.np/wp-content/uploads/2017/10/Ghsh-final-with-cover-and-anex.pdf

24. Ali M, Id K, Id MR, Jeamin SS. Psychosocial and socio-environmental factors associated with adolescents ' tobacco and other substance use in Bangladesh. 2020; 1–17. https://doi.org/10.1371/journal.pone.0242872 PMID: 33232381

25. Dwyer T, Kulasingam S, Mwimbe K, Dickson K, Rogers C. Risk - Taking Behaviors and Sexual Violence Among Secondary School Students in Tanzania. J Community Health. 2019; 44: 749–755. https://doi.org/10.1007/s10900-019-00673-2 PMID: 31069594

26. 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. 2014; 1–11.

27. Siziya S, Muula AS, Besa C, Babaniyi O, Songolo P, Kankiza N, et al. Cannabis use and its socio-demographic correlates among in-school adolescents in Zambia. Ital J Pediatr. 2013; 39: 1–5. https://doi.org/10.1186/1824-7288-39-13 PMID: 23415178

28. Bio-sya Asaad, Georgia Barikissou Damien Adolphe C. Kpatchavi ACA. Basic Clin Pharma Tox—2022—Bio-sya—Prevalence associated factors and level of dependence of substance use among.pdf. Basic Clin Pharmacol Toxicol (BCPT). 2022; 131: 205–213.

29. Ozeylem F, de la Torre-Luque A, Essau CA. Factors related to substance use among adolescents from six low-and middle-income countries. Addict Behav Reports. 2021; 14: 100370. https://doi.org/10.1016/j.abrep.2021.100370 PMID: 34938831

30. Zarrouq B, Bendaou B, Asri A El, Achour S, Rammouz I, Aalouane R, et al. Psychoactive substances use and associated factors among middle and high school students in the North Center of Morocco: a cross-sectional questionnaire survey. BMC Public Health. 2016; 1–9. https://doi.org/10.1186/s12889-016-3143-5 PMID: 27262322

31. Chivandire CT, January J. Correlates of cannabis use among high school students in Shamva District, Zimbabwe: A descriptive cross- sectional study. 2016; 28: 53–56.

32. Page RM, Hall CP. Psychosocial distress and alcohol use as factors in adolescent sexual behavior among sub-saharan african adolescents. J Sch Health. 2009; 79: 369–379. https://doi.org/10.1111/j.1746-1561.2009.00423.x PMID: 19630871

33. Baheiraei A, Hamzehgardeshi Z, Mohammadi MR, Mohammadi E. Alcohol and Drug Use Prevalence and Factors Associated With the Experience of Alcohol Use in Iranian Adolescents. 2013;15. https://doi.org/10.5812/ircmj.4022 PMID: 23984000

34. Asante KO. Cannabis and amphetamine use and its psychosocial correlates among school - going adolescents in Ghana. Child Adolesc Psychiatry Ment Health. 2019; 1–9. https://doi.org/10.1186/s13034-019-0293-0 PMID: 31485264

35. Pengpid S, Peltzer K. Alcohol use and misuse among school-going adolescents in Thailand: Results of a national survey in 2015. Int J Environ Res Public Health. 2019;16. https://doi.org/10.3390/ijerph16111898 PMID: 31146363

36. Gyan R, Seidu A, Adu C, Cadri A, Okoree D, Opoku B. SSM—Population Health Interpersonal violence among in-school adolescents in sub-Saharan Africa: Assessing the prevalence and predictors from the Global School-based health survey. SSM—Popul Heal. 2021; 16: 100929. https://doi.org/10.1016/j.ssmph.2021.100929

37. Wolke D, Lereya ST. Long-term effects of bullying. Arch Dis Child. 2015; 100: 879–885. https://doi.org/10.1136/archdischild-2014-306667 PMID: 25670406

38. Alonso-Fernández N, Jiménez-Trujillo I, Hernández-Barrera V, Palacios-Ceña D, Carrasco-Garrido P. Alcohol consumption among Spanish female adolescents: Related factors and national trends 2006–

2014. Int J Environ Res Public Health. 2019;16. https://doi.org/10.3390/ijerph16214294 PMID: 31694258

39. Jernigan D, Noel J, Landon J, Thornton N, Lobstein T. Alcohol marketing and youth alcohol consumption: a systematic review of longitudinal studies published since 2008. Addiction. 2017; 112: 7–20. https://doi.org/10.1111/add.13591 PMID: 27565582

40. Anderson P, De Bruijn A, Angus K, Gordon R, Hastings G. Special issue: The message and the media: Impact of alcohol advertising and media exposure on adolescent alcohol use: A systematic review of longitudinal studies. Alcohol Alcohol. 2009; 44: 229–243. https://doi.org/10.1093/alcalc/agn115

41. Aryal K. Report Global Based Student Global Health Survey Nepal, student Health survey. 2017.

42. Yusoff F, Sahril N, Rasidi NM, Zaki NAM, Muhamad N, Ahmad NA. Illicit drug use among school-going adolescents in Malaysia. Asia Pac J Public Health. 2014;26. https://doi.org/10.1177/1010539514542425 PMID: 25038195

43. Yazdi-Feyzabadi V, Mehrolhassani MH, Zolala F, Haghdoost AA, Oroomiei N. Determinants of risky sexual practice, drug abuse and alcohol consumption in adolescents in Iran: a systematic literature review. Reprod Health. 2019; 16: 115. https://doi.org/10.1186/s12978-019-0779-5 PMID: 31340817

44. Jones CM, Clayton HB, Deputy NP, Roehler DR, Ko JY. Prescription Opioid Misuse and Use of Alcohol and Other Substances Among High School Students—Youth Risk Behavior Survey, United States, 2019. 2020; 69: 38–46.

45. Ludick W, P'Olak K. Temperament and the risk of alcohol, tobacco, and cannabis use among university students in Botswana. African J Drug Alcohol Stud. 2016; 15: 22–35.