Title: Association between cannabis use and sexual behavior among adolescents aged 12-15 years in 21 low- and middle-income countries

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Abstract

Aims

To investigate the relationship between cannabis use and two sexual behaviors (ever had sex, multiple partners) in a large representative sample of adolescents aged 12–15 years from 21 low- and-middle income countries.

Methods

Data from 84,867 adolescents aged 12–15 years participating in the Global School-based Student Health Survey were analyzed. Participants reported lifetime frequency of cannabis use (analyzed as 0, 1–2, 3–19 or ≥ 20 times), whether they had ever had sexual intercourse (yes/no) and, if yes, their lifetime number of sexual partners. We used multivariable logistic regression to analyze associations, adjusting for a range of relevant covariates.

Results

12.7% of the sample reported having had sexual intercourse, and of these adolescents, 53.1% had had multiple sexual partners. The prevalence of lifetime cannabis use of 1–2 times, 3–19 times, and ≥ 20 times were 1.1%, 1.2%, and 0.4%, respectively. Those who reported using cannabis 1–2 times, 3–9 times, and ≥ 20 times had 2.32 (95%CI = 1.47–3.65), 2.34 (95%CI = 1.34–4.07), and 5.45 (95%CI = 2.22–13.40) times higher odds of having had sexual intercourse than those who had never used cannabis. Among those who had ever had sexual intercourse, the respective odds ratios (95%CIs) for having multiple sexual partners were 1.56 (0.93–2.62), 1.70 (0.92–3.14), and 5.66 (2.97–10.82). There were no significant interactions by sex for these associations.

Conclusions

Adolescents from LMIC who use cannabis are more likely to have ever had sexual intercourse than those who do not. Among those who have had sexual intercourse, those who use cannabis are more likely to have had multiple sexual partners.

1. Introduction

Cannabis, a generic term used to describe several psychoactive preparations of the plant *Cannabis sativa*, is the world's most widely used recreational drug, excluding alcohol, consumed by approximately 2.5% of the world's population.(World Health Organization, 2019) With an increasing number of countries legalizing cannabis, it is important to have a full and comprehensive understanding of how cannabis use influences health and behavior.

Cannabis use in adolescence is a growing public health concern. Recent data from a study including 21 low- and middle-income countries (LMICs)(Carvalho et al., 2019) documented its use by a substantial proportion of adolescents in countries around the globe. In this study, the overall prevalence of past 30-day cannabis use in a sample of >86,000 12–15 year olds was 2.8%, ranging from 0.5% (Laos) to 37.6% (Samoa)(Carvalho et al., 2019). The overall prevalence of lifetime cannabis use was 3.9% (range 0.5%–44.9%)(Carvalho et al., 2019). Cannabis use is also prevalent in higher income countries: for example, in the USA, an estimated 0.7% of 13–14 year olds and 3.4% of 15–16 year olds use cannabis daily, and 22.2% of teenagers report using cannabis in the past month.(National Institute on Drug Abuse for Teens, 2019) The high global prevalence of cannabis use among adolescents is of concern given evidence linking cannabis use with a plethora of mental health problems, including schizophrenia, long-term psychotic disorders, and behavioral problems.(Chen, Yu, Lasopa, & Cottler, 2017; Hall & Weier, 2015; Shapiro & Buckley-Hunter, 2010).

Recently, there has been increasing interest in how cannabis use may influence sexual behaviors. For example, studies have shown that cannabis users are more likely to initiate sex at an earlier age in adolescence and young adulthood,(Ayhan et al., 2015; Cha, Masho, & Mezuk, 2016; El-Menshawi, Castro, Rodriguez de la Vega, Ruiz Peláez, & Barengo, 2019; Rosenbaum & Kandel, 1990) while cannabis use has been associated with risky health behaviors such as having multiple sex partners among adults.(Andrade, Carroll, & Petry, 2013) It has been hypothesized that cannabis use may increase risks for these behaviors via its adverse impact on neurodevelopment or decision-making capabilities,(Chen et al., 2017) while it is also possible that other factors such as personality traits, self-concept, social status, and attractiveness may also be implicated in this association. This is a major concern as early sexual initiation (i.e., having sexual intercourse before the age of 15) and having multiple sexual partners are associated with higher risk for sexually transmitted infections (STIs), HIV, and adolescent pregnancies.(Benotsch, Koester, Luckman, Martin, & Cejka, 2011; Cavazos-Rehg et al., 2011; Kingree, Braithwaite, & Woodring, 2000; Vasilenko, Kugler, & Rice, 2016)

The extant literature on cannabis use and sexual behavior among adolescents is, however, limited in focusing primarily on one aspect of sexual activity (timing of sexual debut) and data are only available from high-income settings (i.e., French Guiana, USA).(Ayhan et al., 2015; Cha et al., 2016; El-Menshawi et al., 2019; Rosenbaum & Kandel, 1990) Clearly, further research on the associations between adolescent cannabis use and other sexual behaviors is required to provide further insight into the risks associated with cannabis use, particularly in LMICs where differences in social and cultural factors mean attitudes towards and prevalence of cannabis use and sexual behavior vary considerably.(Bogt, Schmid, Gabhainn, Fotiou, & Vollebergh, 2006; Koski, Clark, & Nandi, 2017)

The present study therefore aimed to investigate the relationship between cannabis use and two sexual behaviors (ever had sex, multiple partners) in a large representative sample of adolescents aged 12–15 years from 21 LMICs.

2. Methods

2.1. The survey

Publicly available data from the global school-based student health survey (GSHS) were analyzed. Details on this survey can be found at http://www.who.int/chp/gshs and http://www.cdc.gov/gshs. Briefly, the GSHS was jointly developed by the WHO and the US Centers for Disease Control and Prevention (CDC), and other UN allies. The core aim of this survey was to assess and quantify risk and protective factors of major non-communicable diseases. The survey draws content from the CDC Youth Risk Behavior Survey (YRBS) for which test-retest reliability has been established.(Brener, Collins, Kann, Warren, & Williams, 1995) The survey used a standardized two-stage probability sampling design for the selection process within each participating country. For the first stage, schools were selected with probability proportional to size sampling. The second stage involved the random selection of classrooms which included students aged 13–15 years within each selected school. All students in the selected classrooms were eligible to participate in the survey regardless of age. The survey questions were translated into the local language in each country and pilot tested for comprehension. The questionnaires were distributed by survey administrators and the students completed the survey together during one regular class period. Students recorded their response on computer scannable sheets. All GSHS surveys were approved, in each country, by both a national government administration (most often the Ministry of Health or Education) and an institutional review board or ethics committee. Student privacy was protected through anonymous and voluntary participation, and informed consent was obtained as appropriate from the students, parents and/or school officials. Data were weighted for non-response and probability selection.

From all publicly available data, we selected all nationally representative datasets that included the variables used in the current analysis. If there were more than two datasets from the same country, we chose the most recent dataset. A total of 21 countries were included in the current study. The characteristics of each country or survey are provided in Table 1. For the included countries, the survey was conducted between 2010 and 2016, and consisted of 5 low-income, 9 lower middle-income, 7 upper middle-income countries based on the World Bank classification at the time of the survey.

2.2. Sexual behavior

Lifetime sexual intercourse was assessed by the question “Have you ever had sexual intercourse?” with ‘yes’ and ‘no’ answer options. Number of sexual partners was based on the question “During your life, with how many people have you had sexual intercourse?” We considered those with two or more sexual partners to have had multiple sexual partners. Data on multiple partners were not available from Bangladesh.

2.3. Cannabis use

Lifetime cannabis use was assessed with the question “During your life, how many times have you used marijuana?” Country-specific slang terms for marijuana were also included in the question. The answer options were ‘0 times’, ‘1–2 times’, ‘3–9 times’, 10–19 times', and ‘20 or more times’. We merged the categories of ‘3–9 times' and ‘10–19 times' as the number of those who replied ‘10–19 times' was small, and created a four-category variable: ‘0 times', ‘1–2 times', ‘3–19 times', ‘20 or more times'. This variable was also dichotomized as ‘never’ or ‘at least once’ and used in some analyses.

2.4. Control variables

The selection of the control variables was based on past literature(El-Menshawi et al., 2019) and included age, sex, food insecurity, alcohol consumption (drinking alcohol other than a few sips at least once in lifetime), lifetime amphetamine or methamphetamines use (at least once in lifetime), smoking (cigarette smoking at least once in lifetime), suicide attempts (at least once suicide attempt in past 12 months), and bullying victimization (bullied at least one day during the past 30 days). Food

insecurity was used as a proxy for socioeconomic status as there were no variables on socioeconomic status in the GSHS, and was assessed by the question "During the past 30 days, how often did you go hungry because there was not enough food in your home?" Answer options were categorized as 'never', 'rarely/sometimes', and 'most of the time/always'.(Ashdown-Franks et al., 2018)

2.5. Statistical analysis

Statistical analyses were performed with Stata 14.1 (Stata Corp LP, College station, Texas). The analysis was restricted to those aged 12–15 years as most students were within this age range and the exact age outside of this age range was not provided. We used multivariable logistic regression analysis to estimate the association between cannabis use (independent variable) and sexual intercourse or multiple sex partners (dependent variables). We also tested for interaction by sex in terms of the association between cannabis use and sexual intercourse or multiple sexual partners by including the product term "sex X cannabis use" in the model.

The analysis on multiple sexual partners was restricted to those who reported ever having had sexual intercourse. All regression analyses were adjusted for age, sex, food insecurity, alcohol use, amphetamines use, smoking, suicide attempts, bullying victimization, and country. Adjustment for country was done using fixed effects models as in previous GSHS studies.(Ashdown-Franks et al., 2018; Vancampfort, Stubbs, Firth, Van Damme, & Koyanagi, 2018) All variables were included in the regression analysis as categorical variables with the exception of age (continuous variable). Sampling weights and the clustered sampling design of the surveys were taken into account to obtain nationally representative estimates. Results from the logistic regression analyses are presented as odds ratios (ORs) with 95% confidence intervals (CIs). The level of statistical significance was set at $p < .05$.

3. Results

The final sample included 84,867 adolescents aged 12–15 years [mean (SD) age 13.7 (0.9) years; 48.6% females]. Overall, 12.7% had had sexual intercourse, and of these adolescents, 53.1% had had multiple sexual partners. The prevalence of lifetime cannabis use of 1–2 times, 3–19 times, and ≥ 20 times were 1.1%, 1.2%, and 0.4%, respectively. Adolescents who had ever had sexual intercourse were significantly more likely to have used cannabis, be older and male, while they were more likely to be hungry (Table 2). They were also significantly more likely to have consumed alcohol, used amphetamines, smoked, attempted suicide, and be victims of bullying.

The percentage of adolescents who ever had sexual intercourse was much higher among those who had consumed cannabis (Fig. 1). Specifically, in the overall sample, this percentage was only 11.2% among those who never consumed cannabis but increased to 64.5%, 71.8%, and 84.8% among those who had consumed cannabis 1–2 times, 3–19 times, and ≥ 20 times, respectively. Among those who had ever had sexual intercourse, the percentage of those who had had multiple partners increased linearly from 49.4% (never consumed cannabis) to 82.9% (consumed ≥20 times). Similar trends were found for boys and girls.

The associations between cannabis use and (i) sexual intercourse and (ii) multiple sexual partners estimated by multivariable logistic regression analysis are shown in Fig. 2. Increasing frequency of cannabis use was associated with higher odds of ever having had sexual intercourse. Specifically, compared with never having consumed cannabis, consumptions of 1–2 times, 3–9 times, and ≥ 20 times were associated with 2.32 (95%CI = 1.47–3.65), 2.34 (95%CI = 1.34–4.07), and 5.45 (95%CI = 2.22–13.40) times higher odds of having had sexual intercourse. Among those who had ever had sexual intercourse, having consumed cannabis at least once (vs. never) was associated with 2.18 (95%CI = 1.43–3.32) times higher odds of having had multiple sexual partners (data shown only in text). There was a dose-dependent increase in the ORs with increasing frequency of cannabis use, with the OR (95%CI) for having multiple sexual partners being 1.56 (0.93–2.62), 1.70 (0.92–3.14),

and 5.66 (2.97–10.82) for 1–2 times, 3–19 times, and ≥ 20 times, respectively. There were no significant interactions by sex for these associations.

4. Discussion

In a large, representative sample of adolescents aged 12–15 years from 21 LMICs, those who reported using cannabis were more likely to have ever had sexual intercourse. Among adolescents who had ever had sexual intercourse, those who used cannabis were more likely to have had multiple sexual partners. For each outcome, the odds increased with increasing frequency of lifetime cannabis use. For example, compared with those who never consumed cannabis, those who consumed it more ≥20 times were 5.45 (95%CI = 2.22–13.40) times more likely to have had sexual intercourse, while among those who had ever had sex, the corresponding figure for multiple sexual partners was 5.66 (95%CI = 2.97–10.82). These results were independent of a range of relevant covariates, including sociodemographic characteristics and other substance use. No significant interactions by sex were found.

These findings are in line with previous research documenting an association between cannabis use and increased risk of early sexual activity in adolescent samples in the USA and French Guiana.(Ayhan et al., 2015; Cha et al., 2016; El-Menshawi et al., 2019; Rosenbaum & Kandel, 1990) Moreover, they extend the evidence base by (i) replicating this association in a broad range of LMICs across the globe, (ii) providing evidence of a link between cannabis use and other sexual behavior (i.e. having multiple sexual partners), and (iii) showing a dose-dependent increase in odds of risky sexual behavior with increasing frequency of cannabis use.

Several mechanisms may explain the observed associations. First, cannabis use has been shown to have an adverse impact on decision-making capabilities(Chen et al., 2017) and neurodevelopment.(Casadio, Fernandes, Murray, & Di Forti, 2011) Indeed, brain imaging studies suggest lasting neurodevelopmental effects from cannabis use during adolescence, including altered white matter structural integrity(Arnone et al., 2008) and altered fMRI activity related to spatial working memory processes.(Schweinsburg et al., 2005; Schweinsburg et al., 2008) Moreover, literature suggests that cannabis use may influence cerebral blood flow; such neurovascular alterations may contribute to or underlie changes in brain activation, neuropsychological performance, and mood.(Jacobus et al., 2012) Changes in decision-making capabilities, neurodevelopment, and mood from cannabis use may make young adolescents more susceptible to engaging in risky behavior, including sexual intercourse and sexual intercourse with multiple partners, for example thorough increased impulsivity. Indeed, it has previously been suggested that cannabis use may set in motion a cascade of consequences that include increased risk of unconventional behaviors.(Kandel, Yamaguchi, & Chen, 1992) In support, previous studies have found that cannabis use is associated with increases in depression, suicidal ideation, suicidal attempt, violence, delinquency and illicit drug use, with these increases being most evident in those aged 14–15 years.(Fergusson, Horwood, & Swain-Campbell, 2002) Such increases in unconventional behaviors may also in turn promote early sexual activity. Another explanation may be that in many countries, cannabis use is illegal, bringing cannabis users into contact with drug dealers. It has previously been suggested that such contact provides regular cannabis users with unfavorable peer influences and role models that may encourage involvement in adverse behaviors,(Fergusson et al., 2002; Fergusson & Horwood, 2000) which could include sexual intercourse at a young age and intercourse with multiple partners.

5. Strengths and limitations

Clear strengths of the present study are the large, representative sample of young adolescents residing in LMICs and the statistical adjustment for a wide range of sociodemographic, behavioral, and psychological factors. However, findings from the present study must be interpreted in light of its limitations. First, the study was cross-sectional and therefore, causality or temporal associations cannot be established. However, there are plausible pathways between cannabis use and sexual

intercourse, discussed above, but not vice versa. Despite this, future research utilizing a longitudinal design is needed to shed light on the direction of causation. Second, the present study controlled for important covariates but residual confounding cannot be ruled out. Future work may wish to consider controlling for additional variables in models such as personality traits, self-concept, other measures of social status, and attractiveness. Third, we relied on self-reported data, which may have been affected by factors such as recall and social desirability bias. Moreover, cannabis use was assessed with one question only and there were no data on the circumstances of consumption. Next, the data on cannabis use and sexual intercourse were based on lifetime occurrence of these behaviors. Thus, it is unclear whether cannabis use occurred before or after sexual intercourse. Finally, the study was based on adolescents attending school. Thus, the study results may not be generalizable to adolescents who do not attend school.

6. Conclusions

In conclusion, the present study including 84,867 adolescents from 21 LMICs found that cannabis use was associated with increased odds of ever having had sexual intercourse, and having multiple sexual partners. In our study sample, 12.7% had had sexual intercourse, and of these adolescents, 53.1% had multiple sexual partners. This is concerning given the high risk these sexual behaviors carry in terms of adolescent pregnancy, and transmission of HIV and other STIs. On the basis of the present findings, cannabis use in early adolescence may serve as a marker for early sexual initiation and multiple sex partners. School-based programs that target multiple health risk behaviors may be effective in reducing risky sexual behaviors and substance abuse in adolescence.(Caracuel et al., 2017; Simonton, Young, & Johnson, 2018) Future studies of a longitudinal design are warranted to assess causality, and to assess whether addressing cannabis use can positively impact on risky sexual behavior in adolescents.

Table 1 Survey characteristics

Country-income	Country	Year	Response rate (%)	N[a]
Low	Benin	2016	78	717
	Cambodia	2013	85	1,812
	Mozambique	2015	80	668
	Nepal	2015	69	4,616
	Tanzania	2014	87	2,615
Lower middle	Bangladesh	2014	91	2,753
	Bolivia	2012	88	2,804
	East Timor	2015	79	1,631
	Ghana	2012	82	1,110
	Indonesia	2015	94	8,806
	Kiribati	2011	85	1,340
	Laos	2015	70	1,644
	Mongolia	2013	88	3,707
	Samoa	2011	79	2,200
Upper middle	Argentina	2012	71	21,528
	Fiji	2016	79	1,537
	Malaysia	2012	89	16,273
	Namibia	2013	89	1,936
	Peru	2010	85	2,359
	Thailand	2015	89	4,132
	Tuvalu	2013	90	679

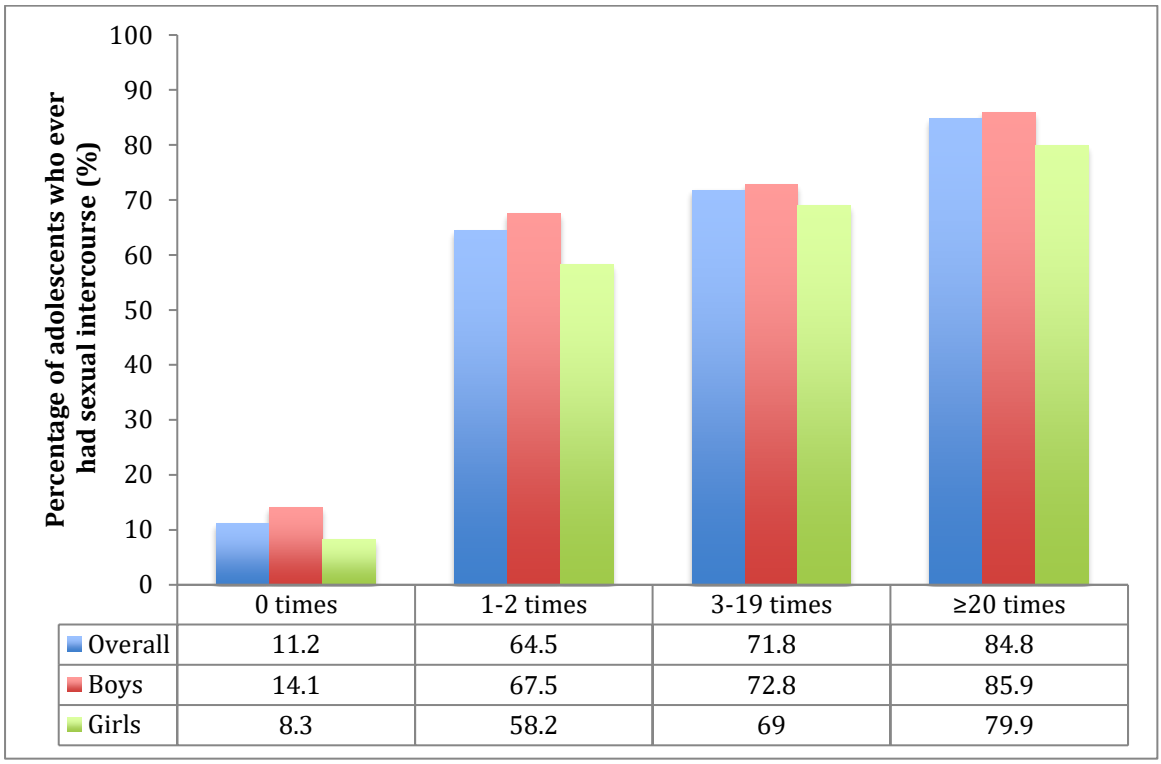
[a] Restricted to those aged 12-15 years.

Table 2 Sample characteristics (overall and by sexual intercourse)

			Sexual intercourse		
Characteristic	Category	Overall	No	Yes	P-value[a]
Cannabis use	0 times	97.4	99.5	90.5	<0.001
	1-2 times	1.1	0.3	3.5	
	3-19 times	1.2	0.2	4.1	
	≥20 times	0.4	0.05	1.8	
Age (years)	12	13.1	12.9	10.1	<0.001
	13	28.1	28.1	22.8	
	14	33.0	33.6	31.7	
	15	25.8	25.4	35.4	
Sex	Female	48.6	52.4	36.7	<0.001
	Male	51.4	47.6	63.3	
Hunger	Never	49.2	50.3	47.5	0.002
	Rarely/sometimes	44.2	44.3	44.8	
	Most of the time/always	6.6	5.5	7.7	
Alcohol use	No	84.2	88.2	60.9	<0.001
	Yes	15.9	11.8	39.1	
Amphetamines use	No	97.7	99.6	92.5	<0.001
	Yes	2.3	0.4	7.5	
Smoking	No	82.9	87.0	65.3	<0.001
	Yes	17.1	13.0	34.7	
Suicide attempt	No	91.1	93.9	81.0	<0.001
	Yes	8.9	6.1	19.0	
Bullying victimization	No	72.1	75.7	62.2	<0.001
	Yes	28.0	24.3	37.8	

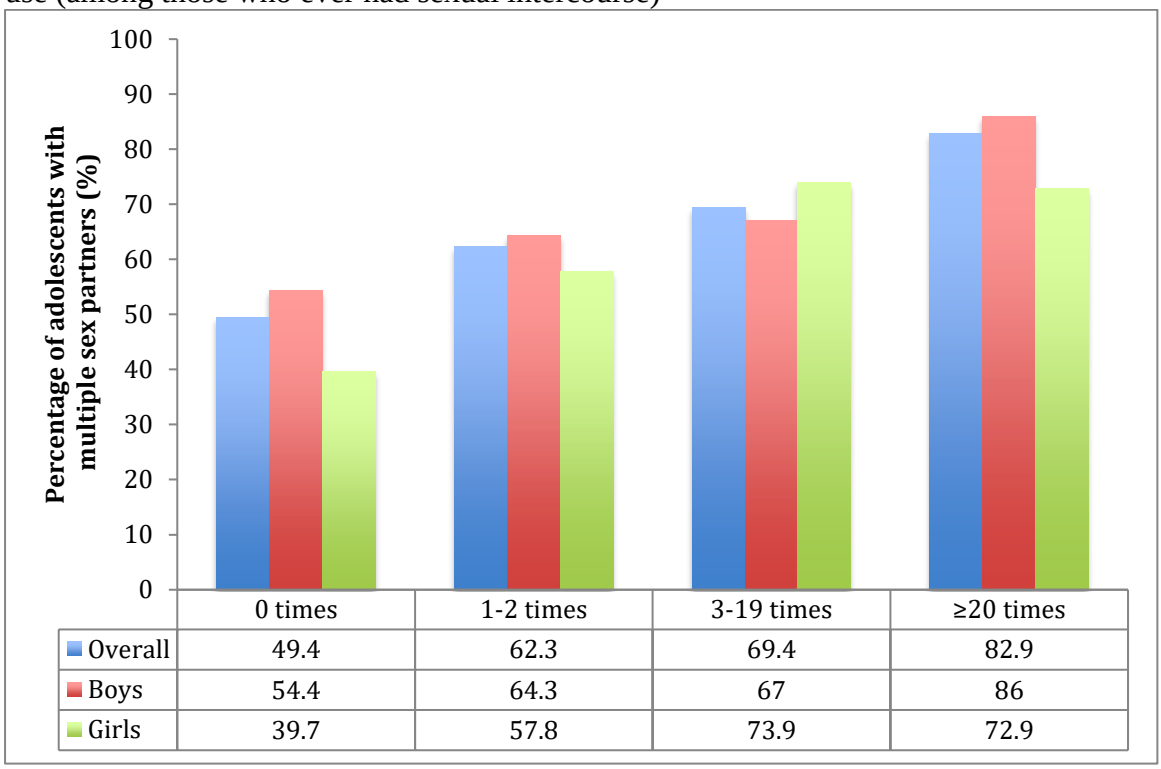
[a] P-value was calculated by Chi-squared tests.

(A) Percentage of adolescents who ever had sexual intercourse by frequency of lifetime cannabis use



	0 times	1-2 times	3-19 times	≥20 times
Overall	11.2	64.5	71.8	84.8
Boys	14.1	67.5	72.8	85.9
Girls	8.3	58.2	69	79.9

(B) Percentage of adolescents with multiple sex partners by frequency of lifetime cannabis use (among those who ever had sexual intercourse)[a]

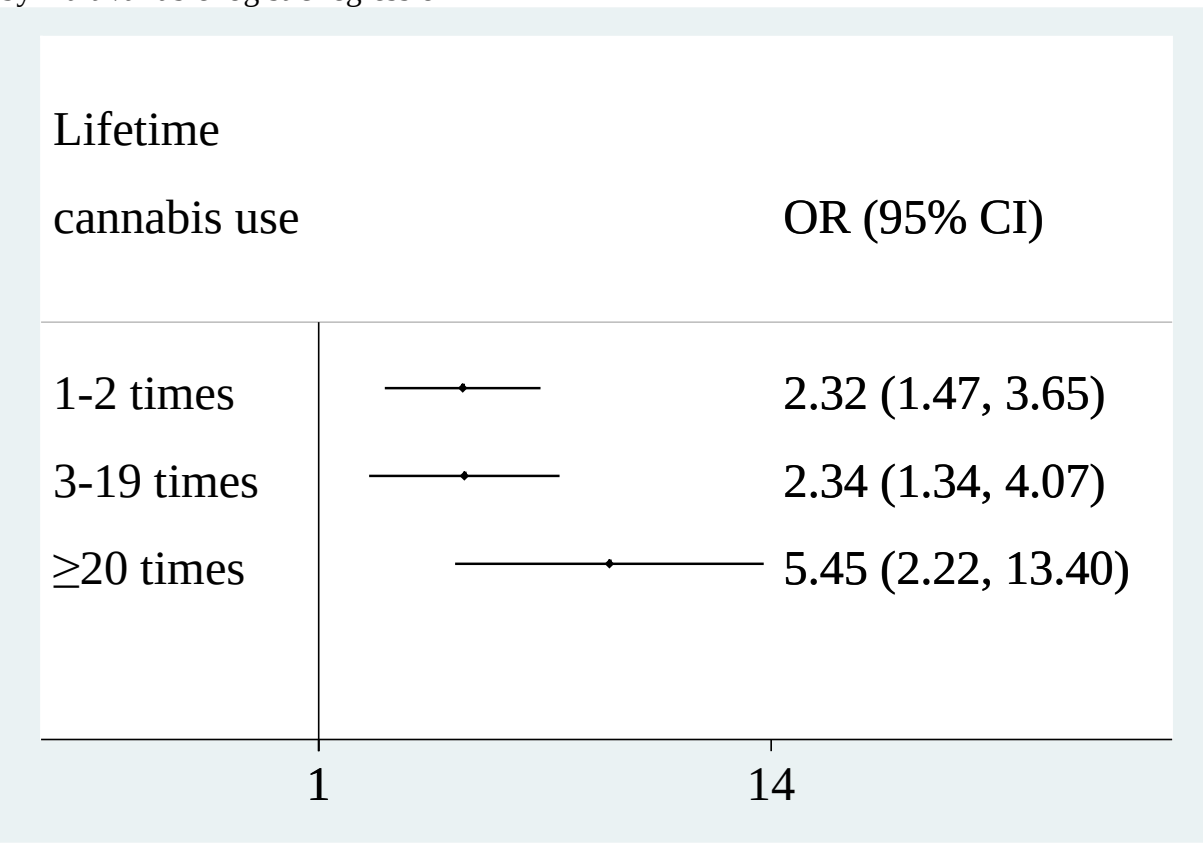


	0 times	1-2 times	3-19 times	≥20 times
Overall	49.4	62.3	69.4	82.9
Boys	54.4	64.3	67	86
Girls	39.7	57.8	73.9	72.9

Figure 1 (A) Percentage of adolescents who ever had sexual intercourse and (B) percentage of adolescents with multiple partners by frequency of lifetime cannabis use

[a] Restricted to those who ever had sexual intercourse. Bangladesh is not included due to lack of data.

(A) Association between lifetime frequency of cannabis use and sexual intercourse estimated by multivariable logistic regression



(B) Association between lifetime frequency of cannabis use and multiple sex partners[a]

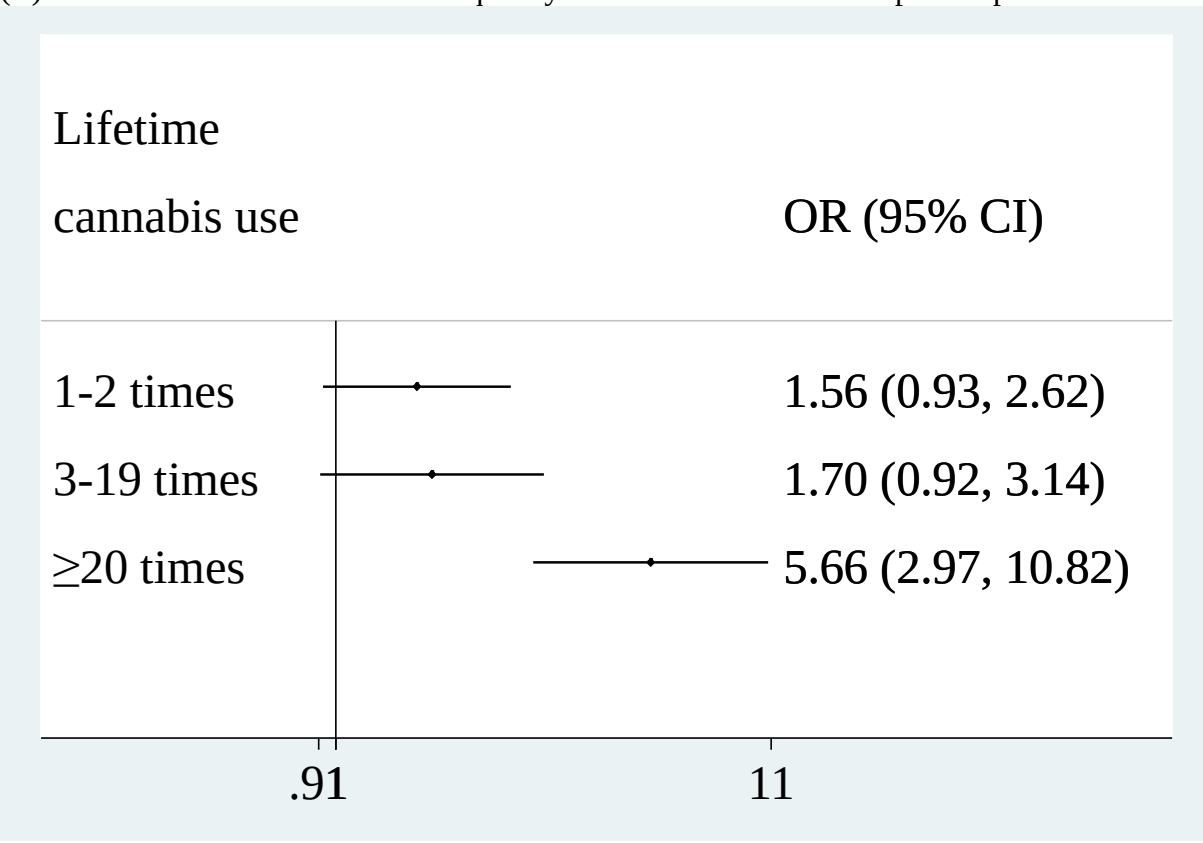


Figure 2 Association between frequency of lifetime cannabis use (exposure) and sexual intercourse or multiple sex partners (outcomes) estimated by multivariable logistic regression

Abbreviation; OR Odds ratio; CI Confidence interval

Reference category is '0 times'.

Models are adjusted for age, sex, food insecurity, alcohol use, amphetamine use, smoking, suicide attempts, bullying victimization, and country.

[a] Restricted to those who ever had sexual intercourse. Bangladesh is not included due to lack of data.

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