

RESEARCH

Open Access



# HIV knowledge, sexual attitudes, and PrEP-Eligible behaviors among college students in Southwest China: a cross-sectional study

Shiyu Qin<sup>1†</sup>, Jiao Qin<sup>1†</sup>, Qiuqian Su<sup>1†</sup>, Ting Huang<sup>1</sup>, Junyu Zhan<sup>2</sup>, Xi Yang<sup>2</sup>, Yuanhong Yang<sup>2</sup>, Jinfeng He<sup>1</sup>, Zhifeng Lin<sup>1,2</sup>, Xinju Huang<sup>1</sup>, Li Ye<sup>1,2</sup>, Hao Liang<sup>1,2</sup>, Hongyang Tang<sup>2\*</sup>, Ping Cen<sup>1,2\*</sup> and Bingyu Liang<sup>1,3\*</sup>

## Abstract

**Background** There is an increasing number of human immunodeficiency virus (HIV) reported cases among students in Southwest China. However, the data on HIV/sex-related knowledge, attitude toward sex, sexual behaviors, and correlates of pre-exposure prophylaxis (PrEP)-eligible behaviors among college students in this area is still limited. This study aimed to assess the prevalence of HIV/sex-related knowledge, sexual attitudes, sexual behaviors, and factors associated with PrEP-eligible behaviors among college students.

**Method** An online survey from 2020 to 2021 based on a multistage stratified and cluster sampling method was conducted among college students in Southwest China, and a well-designed questionnaire collected data. Propensity score matching (PSM), logistic, and log-binomial regression were used to identify the determinants of PrEP-eligible behaviors.

**Result** A total of 108,987 students participated in the survey, and 92,946 provided valid responses. 91.6% (85,145/92,946) had good HIV-related knowledge, while only 26.0% (24,137/92,946) reported awareness of sex-related knowledge. Furthermore, more than half of the participants (64.5%) held negative stances towards engaging in “one-night stand”, and 58.9% (617/1,047) reported PrEP-eligible behaviors. Log-binomial regression analysis indicated that unaware of HIV-related knowledge ( $aPR = 1.66$ , 95%  $CI: 1.22-2.26$ ,  $P = 0.001$ ), not discussing about sex with their parent(s) ( $aPR = 1.16$ , 95%  $CI: 1.01-1.33$ ,  $P = 0.021$ ), not receiving sex-related education in school ( $aPR = 1.24$ , 95%  $CI: 1.07-1.45$ ,  $P = 0.005$ ), not participating in HIV/AIDS prevention activities in the past year ( $aPR = 1.32$ , 95%  $CI: 1.09-1.60$ ,  $P = 0.004$ ), experiencing forced sex ( $aPR = 2.08$ , 95%  $CI: 1.19-3.63$ ,  $P = 0.010$ ), and having the drug abuse ( $aPR = 22.21$ , 95%  $CI: 5.59-88.31$ ,  $P < 0.001$ ) were significantly associated with increased odds of PrEP-eligible behaviors.

<sup>†</sup>Shiyu Qin, Jiao Qin and Qiuqian Su contributed equally to this work.

\*Correspondence:

Hongyang Tang

tanghy503@163.com

Ping Cen

cenping877@163.com

Bingyu Liang

liangbingyu@xmu.edu.cn

Full list of author information is available at the end of the article



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

**Conclusion** College students in Southwest China exhibited suboptimal HIV/sex-related knowledge, received limited sex education, reported conservative attitudes towards casual sex, and significant PrEP-eligible behaviors. These findings suggest that sexually experienced college students who were unaware of HIV-related knowledge, lacked sex education, experienced forced sex, and reported drug abuse were the key individuals for evaluating eligibility for PrEP initiation, and interventions aimed at increasing awareness of HIV/sex-related knowledge, promoting participation in sex education, addressing issues related to forced sex and tackling drug abuse could contribute to reducing the incidence of PrEP-eligible behaviors among college students.

**Keywords** HIV/sex-related knowledge, Sexual attitudes, Sex education, Sexual behaviors, PrEP-eligible behaviors, College students

## Introduction

Acquired immunodeficiency syndrome (AIDS) continues to pose a huge challenge for youth populations worldwide. According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), there was an average of 3,200 new Human Immunodeficiency Virus (HIV) infections each day among adults aged 15 and older, with approximately 30% of these infections occurring in individuals aged 15–24 in 2022 [1]. Worryingly, the number of new HIV infections among college students in China has been growing sharply in recent years, increasing at an annual rate of 30–50% [2]. Furthermore, the proportion of students among reported HIV cases has increased from 8.5% in 2010 to 21.7% in 2019, with 98.2% of these cases resulting from sexual transmission [3]. Therefore, college students in China have become a high-risk group for HIV infection.

US Public Health Service published the “Prevention of HIV Infection in the United States: 2021 Update Clinical Providers’ Supplement”, which proposed that PrEP should be considered for sexually active individuals engaging in unprotected sex, those with sexual partners who are HIV-positive, and individuals who have been diagnosed with Sexually transmitted infections (STIs) [4]. In China, the Chinese Center for Disease Control and Prevention (CCDC) issued “Chinese AIDS diagnosis and treatment guidelines” in 2021, which recommended that individuals engaging in unprotected sexual activities, men who have sex with men (MSM), sex workers, individuals with multiple sexual partners and needle sharers should initiate PrEP [5]. In 2023, the eligibility criteria for PrEP use in China as proposed are as follows: (1) Individuals who are sexually active, HIV-negative, or medically eligible to take PrEP medications; (2) Individuals who have engaged in unprotected sex, shared needles or reported recent STIs; (3) Individuals whose sexual partners are HIV-positive; and (4) Individuals who have frequently utilized Post-exposure Prophylaxis (PEP) to prevent HIV infection through sexual or intravenous transmission [6]. Therefore, PrEP-eligible behaviors were defined as activities that qualify individuals for the initiation of PrEP, such as unprotected sex, sharing needles, and sex with HIV-positive partners.

With increasing liberal sexual attitude [7] and inadequate sex education [8], college students are more likely to report PrEP-eligible behaviors in sex, exposing them to disproportionately high risk of unplanned pregnancies and STIs, including HIV, Hepatitis C Virus (HCV) and syphilis. Indeed, previous studies have revealed that 17.5% of sexually active female students experienced unplanned pregnancies, 31.7–54.2% of sexually active college students had multiple sexual partners in their lives and 79.5% reported unprotected sex, which were significantly associated with an increased risk of STIs [9, 10]. PrEP-eligible behaviors among college students have become an obstacle on the way to combating the spread of HIV, as well as causing a considerable burden on their mental and physical health [11]. Previous studies indicate that their awareness of HIV/sex-related knowledge remains suboptimal [12–14]. The rate of correct response to HIV-related knowledge was 87.4% among freshmen in Jiangsu Province and 67.3% among male college students in Guangxi [12, 13], while the rate of correct response to sex-related knowledge was even as low as 0.5% across China [14]. Lack of HIV/sex-related knowledge also contributes to increased rates of HIV infection and other reproductive health problems [15, 16], such as STIs and unplanned pregnancies, which can be mitigated by increased sex education and decreased Risky sexual behavior (RSB) [17]. Hence, it is urgent to examine the awareness of HIV/sex-related knowledge and the prevalence of PrEP-eligible behaviors, as well as its correlates among college students.

Previous studies have determined numerous factors associated with PrEP-eligible behaviors among college students. For example, sociodemographic factors such as sex, age, education, and marital status have been reported to be associated with it [18–20]. Students with liberal sexual attitudes and low sex-related knowledge are found to be more likely to report PrEP-eligible behaviors in sex [7, 21]. In addition, family and school factors also play a key role in safe sex for college students. Students who refrained from discussing sex issues with their parents in the past year showed a higher likelihood of reporting PrEP-eligible behaviors in sexual activities, while those who felt they were under parental supervision were less

likely to report PrEP-eligible behaviors in sex [22]. Students who received counseling from teachers equipped with comprehensive sexuality education were intended to use contraceptive protection and postpone their sexual debut [23]. Other behaviors such as smoking, alcohol and drug use, and finding sexual partners online also promote PrEP-eligible behaviors among college students [24–26]. However, previous studies have not comprehensively analyzed the impact of HIV/sex-related knowledge, sexual attitudes, sexual behavior, school sex education, and family sex education on PrEP-eligible behaviors among college students. Understanding the prevalence of reporting PrEP-eligible behaviors in sexual intercourse and its correlates among university students will provide crucial information for the development of effective HIV prevention strategies and measures.

The HIV epidemic in Guangxi is the third highest province in China, and the HIV reported cases among college students are also increasing year by year [12]. To curb the spread of HIV, 10 departments, including the National Health Commission made the target of over 95% awareness of AIDS prevention and treatment among young students [27]. Alarmingly, sex education is not yet fully available in Chinese families and schools [28], and students receive incompletely correct HIV/sex-related knowledge online [29]. In the era of information technology, students have more channels to obtain sexual health knowledge, and their sexual concepts have also changed accordingly. However, the latest research on the prevalence of HIV/sex-related knowledge, sexual attitudes and behaviors, and factors associated with PrEP-eligible behaviors among college students are suboptimally elucidated. Previous studies mostly are based on a small sample scale, which limited the generalizability of the findings. Therefore, this study based on a large-scale sample aiming to assess the HIV/sex-related knowledge, sexual attitudes and behaviors, and factors associated with PrEP-eligible behaviors among college students.

## Methods

### Study design and procedure

From October 1, 2021, to December 20, 2021, a cross-sectional survey was conducted by the Nanning Centre for Disease Control among students from 16 colleges in Nanning City. Based on the National HIV Sentinel Surveillance Questionnaire issued by the National Center for HIV Control and Prevention [30], we designed an anonymous online questionnaire Wenjuanxing (<https://www.wjx.cn/>) by combining expert guidance and literature review. A unique link or QR code for the questionnaire was sent to uniformly trained class teachers, who then sent it to students for survey. Before the formal survey, we determined the sample size for a pre-survey based on the total sample size, using the principle that the number

of pre-survey respondents would be 10–20% of the total sample size. After the pre-survey, the Cronbach's alpha and the Measure Sampling Adequacy (Kaiser-Meyer-Olkin, KMO) of the questionnaire were respectively 0.751 and 0.820, the HIV-related knowledge scale were respectively 0.770 and 0.867, the sex-related knowledge scale were respectively 0.741 and 0.790, and sexual attitude scale are respectively 0.758 and 0.786. The online questionnaire was used to collect respondents' sociodemographic characteristics, HIV/sex-related knowledge, sexual attitudes, sex education, sexual behavioral characteristics, use of drugs, and HIV/AIDS education/prevention services.

The inclusion criteria for participants were (1) students who were studying in the colleges located in Nanning (2) aged 18–25 years old, and (3) consent to participate in this survey. The exclusion criteria were (1) foreign students; (2) students with serious mental health; and (3) college students with postgraduate degree.

The prevalence of sexual behaviors among Chinese college students ranged from 10.40 to 11.9% [8, 31]. It is assumed that the prevalence of sexual behaviors among college students in Guangxi was 11.0% and the sample size in this study was calculated as follows.

$$n = \left( \frac{Z_{1-\alpha/2}}{\delta} \right)^2 \times P \times (1 - P)$$

The  $\alpha$  was set to 0.05,  $Z_{1-\alpha/2}$  represents the standard normal distribution bound at an alpha of 0.05 and  $\delta$  represents the permissible error taken as 0.011. A sample size of  $n=3,198$  was calculated by using the Power Analysis and Sample Size Software version 21.0.3, taking into account a 15% drop-out rate, a minimum of 3,763 participants were required.

This study used a multistage stratified and cluster sampling method. Firstly, 16 colleges were randomly selected from the 35 colleges in Nanning, Guangxi, based on a random number table (simple random sampling). Secondly, four college departments were randomly selected from each selected college. Third, students in each department were divided into six strata by grade: grades 1 to 5 and graduate students. Subsequently, five classes were selected from selected departments at each level of grades one to three and two classes at each level of grades four to five.

### Ethical consideration

This study was reviewed and approved by the Medical Ethics Committee of Guangxi Medical University (no. 2019-SB-088). The data collected was stored in the online platform we managed and it wasn't compromised.

## Measure

### **Sociodemographic and behavioral characteristics**

Sociodemographic characteristics included sex (male or female), age (18–20 or  $\geq 20$ ), registered residence (Guangxi or outside of Guangxi), Ethnic minority (yes or no), degree in study progress (undergraduate or junior college), sexual orientation (heterosexual or non-heterosexual), social relationship (single or not) and sexual experience (yes or no). Other behavioral characteristics included having drug abuse, receiving HIV/AIDS knowledge education, HIV/AIDS prevention activities, or HIV testing in the past year.

### **HIV/sex-related knowledge, sexual attitudes of individuals, and sex education**

HIV/sex-related knowledge consisted of 15 questions, of which the first eight were HIV-related knowledge and the last seven were sex-related knowledge with “yes”, “no” and “I don’t know” response options for each question. HIV-related knowledge questions answered six or more correctly were considered aware of HIV-related knowledge according to the National Center for HIV Control and Prevention. There was no gold standard cut-off method to access sex-related knowledge levels, so the highest quartile of the distribution of sex-related knowledge correct responses as aware of sex-related knowledge (i.e., correct responses of 5 and above). The HIV/sex-related knowledge questions are shown in Table S1. Sexual attitudes of individuals were measured by the following questions: attitudes toward premarital sex, premarital cohabitation, and “one-night stands,” with response options of “Opposed,” “Neutral,” or “Acceptable.” Sex education included school sex education and family sex education. School education items included “Have you ever received sex education in school?”, “Stage of participating sexual courses in school”, and “Satisfaction of school sex courses”. Family sex education included “Have you ever got solution about sex questions from your parent(s)?”, “The frequency of discussion sex with your parents” and “The evaluation of your family’s attitudes about sex”.

### **Sexual behaviors**

The following information was collected from participants in this section: sex-related behaviors (whether they had sex in the past year, age at first sex, sexual partner at first sex (steady sexual partner or other), whether they experienced forced sex, condom use at first sex, unintended pregnancy at first sex). The steady sexual partner in this study refers to a boy/girl friend, husband/wife.

### **PrEP-eligible behaviors**

In this region, the main route of transmission of HIV among college students is sexual behaviors [32], and the non-use of condoms during sex could increase the risk

of HIV transmission [33]. Additionally, according to the Experts’ consensus issued by China, individuals with consistent condoms use during casual, commercial, and anal sex are not eligible for PrEP, which shows that condom use as a criterion for defining PrEP-eligible behavior is reasonable [6]. Therefore, we exclusively consider the use of condoms during casual, commercial, or anal intercourse as the criteria for defining PrEP-eligible behaviors. PrEP-eligible behaviors in this study were defined as behaviors that would qualify participants to initiate PrEP, considering known behavioral predictors of HIV acquisition. Participants had to meet two following criteria: (1) Reporting engaging in sexual behavior(s) in the recent one year; (2) Acknowledge involvement in any of the following sexual activities—casual, commercial, or anal sexual intercourse(s)—without consistent condom use during these activities.

### **Data analysis**

Data were processed with the Excel program. The response of participants to each variable was analyzed using descriptive statistics (SPSS.26) with frequency and percentage (95% CI). GraphPad Prism 9.5 software was used to graph the prevalence of casual, commercial, or anal sex behavior and the proportion of PrEP-eligible behaviors in these sexual activities. We employed PSM to mitigate differences in sociodemographic characteristics between the PrEP-eligible behaviors group and PrEP-ineligible behaviors group and enhance the efficiency of the study. PSM by MatchIt package in R version 4.3.3 was performed on socio-demographic characteristic, including gender, age, registered residence, Ethnic minority, degree in progress, sexual orientation, and social relationship. Secondly, 8 independent variables of sexual attitudes, awareness of HIV/sex-related knowledge, sex education, sexual behaviors, and other behaviors (including drug abuse, HIV/AIDS knowledge education, HIV/AIDS prevention services or HIV testing) screened by stepwise logistic regression, AIC=900.83, and PrEP-eligible behaviors as dependent variable both were included in log-binomial regression to identify the determinants of PrEP-eligible behaviors by R version 4.3.3. The PSM ratio was set to 1:1 and the caliper to 0.20. Finally, we got 850 respondents included in the model. The data used for analysis are shown in Figure S1.

## Results

### **Sociodemographic and behavioral characteristics**

A total of 108,987 students participated in the survey, and 92,946 valid questionnaires were obtained, giving a validity rate of 85.3%. Table 1 showed the socio-demographic and behavioral characteristics of the participants. Among the 92,946 participants, the median age (interquartile range) of the participants was 19 (19–20) years, 61.3%

**Table 1** Sociodemographic and behavioral characteristics of college students in Guangxi, 2021 (N=92,946)

Variables	N	Percentage(95%CI)
<b>Sex</b>		
Male	36,007	38.7(38.4, 39.0)
Female	56,939	61.3(61.0, 61.6)
<b>Age</b>		
18-20	52,109	56.0(53.5, 58.5)
≥20	40,837	43.9(43.6, 44.2)
Median (interquartile range)	19 (19–20)	
<b>Registered residence</b>		
Guangxi	84,499	87.8(87.6, 88.0)
Outside of Guangxi	11,727	12.2(12.0, 12.4)
<b>Ethnic minority</b>		
Yes	33,728	36.3(35.8, 36.7)
No	59,218	63.7(63.4, 64.0)
<b>Degree in progress</b>		
Undergraduate	48,017	51.7(51.3, 52.0)
Junior college	44,929	48.3(48.0, 48.7)
<b>Sex orientation</b>		
Heterosexual	83,781	90.1(89.9, 90.3)
Non-heterosexual	9,165	9.9(9.6, 10.2)
<b>Single</b>		
Yes	67,200	72.3(72.0, 72.6)
No	25,746	27.7(27.4, 28.0)
<b>Sexual experience</b>		
Yes	11,652	12.5(12.3, 12.7)
No	81,294	87.5(87.3, 87.7)
<b>Drug abuse</b>		
Yes	445	0.5(0.4, 0.5)
No	92,501	99.5(99.5, 99.6)
<b>Have you ever received HIV/AIDS education</b>		
Yes	78,237	84.2(83.9, 84.4)
No	14,709	15.8(15.6, 16.0)
<b>Have you ever participated in HIV/AIDS prevention activities</b>		
Yes	69,478	74.8(74.5, 75.0)
No	23,468	25.2(24.9, 25.5)
<b>Self-reported tested for HIV testing in the past year</b>		
Yes	8,115	8.7(8.5, 8.9)
No	84,831	91.3(91.1, 91.4)

were female, and 72.3% were identified as single. 51.7% of the individuals were undergraduate and 90.1% self-identified as heterosexual orientation. Moreover, 12.5% of the respondents reported having sexual experience and only 0.5% reported drug abuse. Notably, a substantial portion of participants reported involvement in HIV/AIDS education (84.2%) and AIDS/HIV prevention activities (74.8%), while a minority, 8.7%, indicated having received HIV testing in the past year.

#### HIV/sex-related knowledge, attitudes toward and sex education

Table 2 described the response of HIV/sex-related knowledge among participants. An overwhelming 91.6% of respondents demonstrated awareness of HIV-related

knowledge, while, only 13% were aware of sex-related knowledge. The HIV-related knowledge questions, “Consistent and correct use of condoms can reduce the risk of HIV infection”, and “After engaging in high-risk behaviors, such as needle sharing, drug use, or unsafe sex, people should actively seek HIV testing and counseling”, had a correct response rate above 95.0%. The sex-related knowledge questions with the highest correct response rate, “Having sex before menstruation (14 days) is likely to get pregnant”, and “Genital herpes is a sexually transmitted disease”, had a percentage of correct responses of more than 60.0%. Figure S2 presented the awareness of HIV/sex-related knowledge on sex, age, and degree in progress. More than 90.0% of participants exhibited being aware of HIV-related knowledge on sex, age, and

**Table 2** Responses of HIV/sex-related knowledge among college students in Guangxi, 2021 (N= 92,946)

Variables	Response	N	Percentage(95%CI)
<b>HIV-related knowledge questions</b>			
AIDS is a serious and incurable infectious disease.	Correct	81,855	88.1(87.9, 88.3)
	Incorrect	11,091	11.9(11.7, 12.1)
The main HIV transmission route among students in China is homosexual, followed by heterosexual, right?	Correct	77,401	83.3(83.0, 83.5)
	Incorrect	15,545	16.7(16.5, 17.0)
A person infected with HIV can be identified by appearance.	Correct	83,210	89.5(89.3, 89.7)
	Incorrect	9,736	10.5(10.3, 10.7)
Daily contacts can transmit HIV.	Correct	84,142	90.5(90.3, 90.7)
	Incorrect	8,854	9.5(9.3, 9.7)
Consistent and correct use of condoms can reduce the risk of HIV infection.	Correct	88,663	95.4(95.3, 95.5)
	Incorrect	4,283	4.6(4.5, 4.7)
The use of new drugs (Such as Methamphetamine, Ecstasy, Ketamine, etc.) increases the risk of HIV infection.	Correct	85,618	92.1(91.9, 92.3)
	Incorrect	77,328	7.9(7.7, 8.1)
After engaging in high-risk behaviors, such as needle sharing, drug use, or unsafe sex, people should actively seek HIV testing and counseling.	Correct	90,201	97.0(96.9, 97.2)
	Incorrect	2,745	3.0(2.8, 3.1)
Mosquito can bites transmit HIV	Correct	68,574	73.8(73.5, 74.1)
	Incorrect	24,372	26.2(25.9, 26.5)
Awareness of HIV-related knowledge	Yes	85,145	91.6(91.4, 91.8)
	No	7,801	8.4(8.2, 8.6)
<b>Sex-related knowledge questions</b>			
Having sex before menstruation (14 days) is likely to get pregnant.	Correct	59,964	64.5(64.2, 64.8)
	Incorrect	32,982	35.5(35.2, 35.8)
Sperm can survive in a woman's uterus or vagina for about 7 days.	Correct	20,238	21.8(21.5, 22.0)
	Incorrect	72,708	78.2(78.0, 78.5)
Ejaculation outside the body can effectively prevent pregnancy.	Correct	50,083	53.9(53.5, 54.2)
	Incorrect	42,863	46.1(45.8, 46.5)
Having sex in a safe period can effectively avoid pregnancy.	Correct	43,133	46.4(46.1, 46.8)
	Incorrect	49,813	53.6(53.2, 53.9)
Genital herpes is a sexually transmitted disease.	Correct	64,702	69.6(69.3, 69.9)
	Incorrect	28,244	30.4(30.1, 30.7)
After pregnancy, female menstruation will continue for two or three months.	Correct	51,296	55.2(54.9, 55.5)
	Incorrect	41,650	44.8(44.5, 45.1)
Painless abortion is safer than ordinary abortion.	Correct	26,388	28.4(28.1, 28.7)
	Incorrect	66,558	71.6(71.3, 71.9)
Awareness of sex-related knowledge	Yes	24,137	26.0(25.7, 26.3)
	No	68,809	74.0(73.7, 74.3)

degree in progress, while approximately 25.0% exhibited being aware of sex-related knowledge on sex, age, and degree in progress. There were statistical differences of awareness of HIV/sex-related knowledge on sex, age, and degree in progress.

Table 3 described the sexual attitudes and sex education among participants. In terms of sexual attitudes, approximately a quarter of participants exhibited opposition to premarital sexual activities (25.4%) and premarital cohabitation (24.0%). However, more than half of the participants held a negative stance towards engaging in “one-night stand” (64.5%). For sexual education, 54.4% of the respondents reported never engaging in conversations about sex with their parent(s), 40.6% seeking resolutions for sexual issues from the parent(s), and 48.4% perceiving

their family's sexual perceptions as conservative. In addition, 78.4% had received sex education in school, yet only 54.7% were satisfied with it. 67.6% began attending sex education courses at middle school.

### Sexual behaviors

Figure 1 displayed the sexual behaviors at the first intercourse among sexually experienced college students. Among the 11,652 participants who reported having sexual experience, 70.3% engaged in sexual intercourse in the past year. 92.6% initiated sex with steady sexual partners, 84.1% reported not ever experiencing forced sex, and 71.8% initiated their inaugural sexual encounter between the ages of 18 and 20. Furthermore, approximately three-quarters (76.3%) reported using a condom

**Table 3** Sex attitudes and sex education among college students in Guangxi, 2021 (N=92,946)

Variables	N	Percentage(95%CI)
<b>Attitude on premarital sex</b>		
Oppose	23,592	25.4(25.1, 25.7)
Neutral	37,835	40.7(40.4, 41.0)
Acceptable	31,519	33.9(33.6, 34.2)
<b>Attitude on cohabiting before getting married</b>		
Oppose	22,296	24.0(23.7, 24.3)
Neutral	37,296	40.1(39.8, 40.5)
Acceptable	33,354	35.9(35.6, 36.2)
<b>Attitude on engaging in "one-night stand"</b>		
Oppose	59,941	64.5(64.2, 64.8)
Neutral	26,771	28.8(28.5, 29.1)
Acceptable	6,234	6.7(6.6, 6.8)
<b>Solution about sex questions from parent(s)</b>		
Yes	37,698	40.6(40.2, 40.9)
No	10,959	11.8(11.6, 12.0)
I don't know	44,289	47.7(47.3, 48.0)
<b>Frequency of discussion about sex with parent(s)</b>		
Never	52,448	56.4(56.1, 56.8)
Occasionally	38,228	41.2(40.8, 41.4)
Frequently	2,270	2.4(2.3, 2.5)
<b>Evaluation of your family's attitudes about sex</b>		
Conservative	44,997	48.4(48.1, 48.7)
Moderate	32,140	34.6(34.3, 34.9)
Enlightened	15,809	17.0(16.8, 17.2)
<b>Have ever received sex education in school</b>		
Yes	72,866	78.4(78.1, 78.7)
No	10,461	11.3(11.1, 11.5)
I don't know	9,619	10.3(10.1, 10.5)
<b>Stage of participating in sexual courses</b>		
Primary school	17,924	19.3(19.0, 19.5)
Middle school	62,845	67.6(67.3, 67.9)
College	12,177	13.1(12.9, 13.3)
<b>Satisfaction of sex courses in school</b>		
Satisfied	50,836	54.7(54.4, 55.0)
Moderate	37,673	40.5(40.2, 40.9)
Dissatisfied	4,437	4.8(4.6, 4.9)

at the first sexual intercourse, with only 9.6% having unplanned pregnancies at first sexual intercourse.

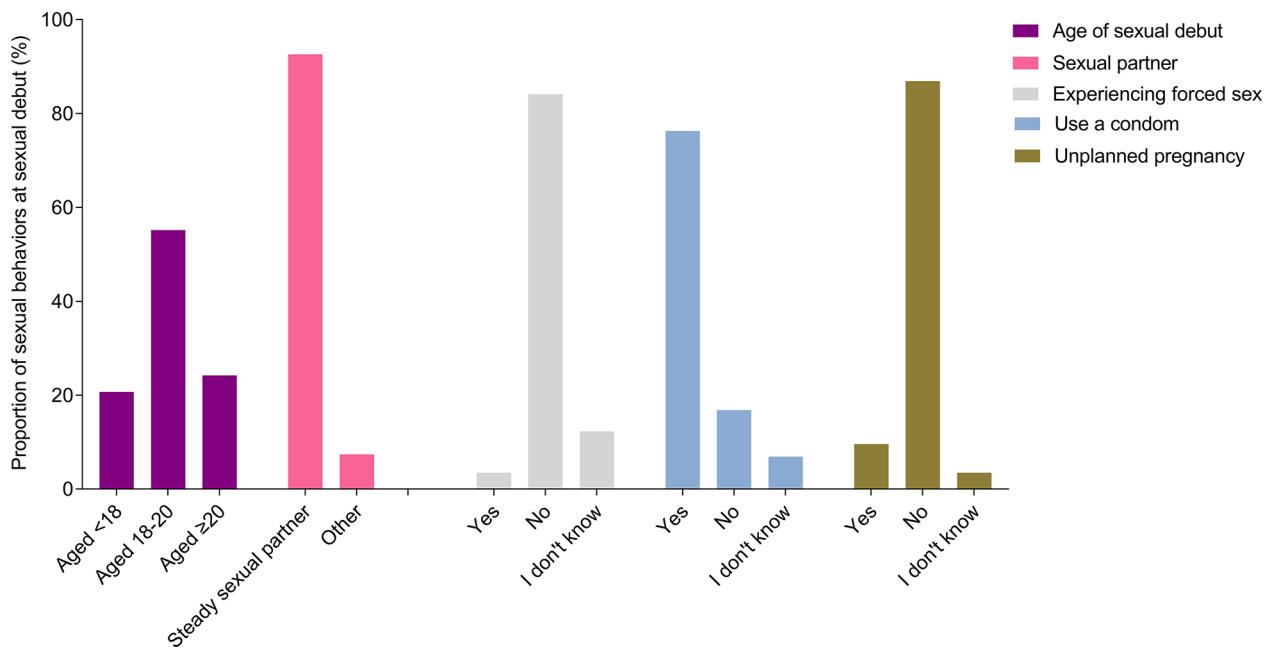
#### Casual, commercial, and anal sexual behaviors, and PrEP-eligible behaviors

Figure 2 elucidated the prevalence of casual, commercial, and anal sexual behaviors, and PrEP-eligible behaviors in the past year. 12.8% (1,047/8,192) of sexually experienced respondents in the past year had engaged in casual, commercial, or anal sexual behavior, of which 10.4% (851/8,192) reported engaging in casual sexual behaviors, 4.8% (400/8,192) in commercial sexual activities, and 8.8% (408/4,587) in anal sexual behaviors. Overall, 58.9% (617/1,047) reported PrEP-eligible behaviors. It is pertinent to highlight that 57.3% (487/851) reported

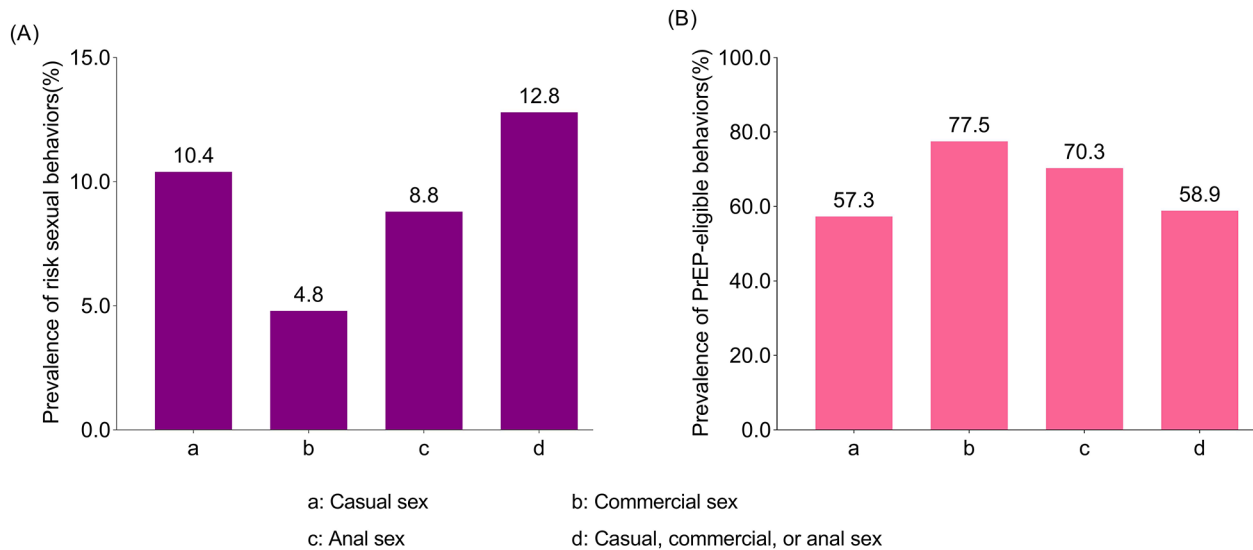
PrEP-eligible behaviors in casual sex, 77.5% (310/400) in commercial sex, and 70.3% (287/408) in anal sex.

#### Correlates of PrEP-eligible behaviors

A total of 8 variables screened by stepwise logistic regression were included in logistic and log-binomial regression. As Table 4 presented, log-binomial regression indicated that unaware of HIV/AIDS knowledge ( $aPR=1.66$ , 95% CI:1.22–2.26,  $P=0.001$ ), not discussing about sex with their parent(s) ( $aPR=1.16$ , 95% CI:1.01–1.33,  $P=0.021$ ), not ever receiving sex-related education in school ( $aPR=1.24$ , 95% CI: 1.07–1.45,  $P=0.005$ ), not participating in HIV/AIDS prevention activities in the past year ( $aPR=1.32$ , 95%CI:1.09–1.60,  $P=0.004$ ), experiencing forced sex ( $aPR=2.08$ , 95% CI: 1.19–3.63,  $P=0.010$ ), and having the drug abuse ( $aPR=22.21$ , 95%



**Fig. 1** Age, sexual partners and sexual behaviors at sex debut among sexually experienced college students in Guangxi, 2021 (N= 11,652)



**Fig. 2** (A) The prevalence of casual, commercial, and anal sex in the past year among participants; (B) The prevalence of PrEP-eligible behaviors in casual, commercial and anal sex in the past year

CI:5.59–88.31,  $P < 0.001$ ) were significantly associated with increased odds of PrEP-eligible behaviors. The results of logistic regression were consistent with log-binomial regression's, as showed in Table S2.

**Discussion**

This study employed a substantial sample size, representing 10% of college students in Guangxi Province, providing a comprehensive examination of HIV/sex-related knowledge, sex education, attitudes towards sex, and

sexual behavior among college students. Importantly, the findings of the study indicated that PrEP-eligible behaviors were associated with several factors, including poor knowledge of HIV, lack of sex education, non-participation in HIV/AIDS prevention activities, experiencing forced sex, and involvement in drug abuse. These insights underscore the importance of targeted interventions and educational initiatives to address these risk factors and decrease PrEP-eligible behaviors among college students in the region.



**Table 4** Logistic and log-binomial regression after PSM of factors associated with PrEP-eligible behaviors among college students in Guangxi, 2021 (N = 850)

Variables	Total (%)	PrEP-eligible behaviors (%)	aOR(95%CI)	aPR(95%CI)	p
<b>N</b>	850(100.0)	425(50.0)			
<b>Attitude on premarital sex</b>					
Oppose	184(21.6)	157(85.3)	<b>2.87(1.64, 4.91)</b>	<b>1.82(1.32, 2.56)</b>	<b>&lt;0.001</b>
Neutral	106(12.5)	53(50.0)	1.03(0.63, 1.69)	1.01(0.87, 1.17)	0.606
Acceptable	560(65.9)	215(38.4)			
<b>Aware of HIV-related knowledge</b>					
Yes	687(80.8)	290(42.2)			
No	163(19.2)	135(82.8)	<b>2.60(1.55, 4.35)</b>	<b>1.66(1.22, 2.26)</b>	<b>0.001</b>
<b>Solution about sex questions from parent(s)</b>					
Yes	417(49.1)	249(59.7)	<b>1.96(1.29, 2.97)</b>	1.11(0.97, 1.27)	0.128
No	433(50.9)	176(40.6)			
<b>Discussion about sex with parent(s)</b>					
Yes	306(36.0)	116(37.9)			
No	544(64.0)	309(56.8)	<b>2.07(1.34, 3.13)</b>	<b>1.16(1.01, 1.33)</b>	<b>0.021</b>
<b>Have ever received sex education in school</b>					
Yes	649(76.4)	315(48.5)			
No	201(23.6)	110(54.7)	<b>1.84(1.27, 2.67)</b>	<b>1.24(1.07, 1.45)</b>	<b>0.005</b>
<b>Experiencing forced sex at first sexual intercourse</b>					
Yes	31(3.6)	23(74.2)	<b>5.06(2.08, 12.31)</b>	<b>2.08(1.19, 3.63)</b>	<b>0.010</b>
No	746(87.8)	367(49.2)			
I don't know	73(8.6)	35(47.9)	0.95(0.83, 1.09)	0.99(0.97, 1.02)	0.130
<b>Drug abuse</b>					
Yes	129(15.2)	127(98.4)	<b>41.32(9.91, 172.40)</b>	<b>22.21(5.59, 88.31)</b>	<b>&lt;0.001</b>
No	721(84.8)	298(41.3)			
<b>Have ever participated in HIV/AIDS prevention activities in the past year</b>					
Yes	666(78.4)	303(45.5)			
No	184(21.6)	122(66.3)	<b>1.87(1.25, 2.81)</b>	<b>1.32(1.09, 1.60)</b>	<b>0.004</b>

This study showed that the rate of awareness of HIV-related knowledge was 91.6%, exceeding rates observed in other cities of China, such as Shenzhen City, Kunming City, and Beijing City by 85.6% [34]. This rate also surpassed the awareness levels found in Chongqing City of China (62.62%) [8], Lagos City of Nigeria (86.3%) [35], and among Afro-Descendant Youths in Ecuador (88.8%) [36]. Nonetheless, it is noted that these rates did not meet the standards established by the China National Health Commission [27]. These discrepancies may be associated with the local economic level, cultural proficiency, and coverage of HIV prevention education in different regions. In recent years, the Guangxi government had issued strategies to strengthen sexual health and AIDS prevention education among college students [37]. In addition, colleges in Guangxi actively offered courses on health counseling and peer education for new college students [38]. These may be the reasons why college students in this study had a high rate of awareness of HIV-related knowledge. Disturbingly, the overall correct response of sexual health knowledge was merely 26.0%, some studies showed that 66% of mean scores of sexual health knowledge scored by college students in the USA [36], 60%

in the UK [39], and 65% in Turkey [40]. It is difficult to compare with other studies given the different definitions and methods to access the awareness of sexual health knowledge, while the study revealed shortcomings in the structure and comprehensiveness of HIV/sex-related knowledge among college students as a whole. Additionally, this deficiency in HIV/sex-related knowledge in the study may be positively associated with a deficiency of parents' instruction for kids in sex and school-based sex education. As shown in this study, we found that parents' involvement in sex education for their children was relatively poor, aligning with previous studies [41–44], and the reason for this may be that parents were reluctant to discuss sexual topics with their children due to shame and embarrassments for sex [45]. Furthermore, parents tended to limit their sex education efforts to abstinence rather than offering reasoned guidance and scientific solutions [46], which underscores a troubling dilemma in family-based sex education. It is a mixed blessing that the majority of students reported ever receiving sex education in school, surpassing 55.6% in other regions of China [28], which may be attributed to the robust efforts undertaken by the Chinese government to promote the

healthy development of adolescents in recent years [2]. Yet only half of the students responded affirmatively to the effectiveness of the sex education in this study and there is a pressing need for further improving students' participation in school-based sex education. Enhancing parent-adolescent communications and enriching the educational approaches in school both are conducive to bridging knowledge gaps on HIV/sex-related knowledge and promoting healthier behavior [28, 47, 48].

Additionally, among the participants who engaged in casual, commercial, and anal sex in the past year, 58.9% of them reported PrEP-eligible behaviors, higher than 37.6% in eastern China [49], but lower than 73.2% in Zhejiang Province, China [50], 61.4% in Nigerian [51]. It's concerning that while college students had a higher rate of awareness about HIV-related knowledge, they also reported a high the prevalence of PrEP-eligible behaviors. This finding was inline with previous study [52]. A reasonable explanation for discrepancy is that participants who were aware of HIV-related knowledge may not change their high risk behaviors, as sexual attitude was also a crucial factor associated with this behaviors. Jiang T found that Chinese college students who exhibited enlightened attitudes towards casual sex were more likely to engaged in high-risk sex behaviors [53]. In this study, approximately 35% of participants exhibited enlightened attitudes towards casual sex, making them more likely to engage in PrEP-eligible behaviors despite being aware of HIV-related knowledge. Notably, increasing the self-perceived susceptibility to the risk of HIV infection and enhancing condom self-efficacy are both effective interventions for decreasing PrEP-eligible behaviors [51].

In the study, we observed that the absence of sexual education, either at home or at school, increases the likelihood of college students reporting PrEP-eligible behaviors during sexual activities, aligning with prior research findings [28, 54, 55]. Classroom education and parental guidance served as crucial ways for Chinese students to acquire sexual health knowledge [8], while parents were reluctant to discuss sexual topics with their children due to embarrassment or stigma of sex [45]. Moreover, inadequately trained teachers were unable to meet the needs of young students regarding sex education [29]. It was noteworthy that the absence of sex education tended to lead students to decrease condom use during sexual activities, thereby which undoubtedly increased PrEP-eligible behaviors [54]. This finding indicated that these college students lacking sex education should be evaluated for taking PrEP, and those who meet the medically-eligible conditions should take PrEP timely to reduce the possibility of HIV infection. Rasberry CN and Kirby DB found that strengthening sex education in school could increase condom use during sex, consequently diminishing PrEP-eligible behaviors [48, 56], which indicated that schools

could adopt educational approaches that students were most receptive to, such as specialized sex education classes, Internet-based sex education, peer education, and AIDS public welfare activities, to mitigate PrEP-eligible behaviors [8].

Consistent with previous studies [49, 57], individuals lacking awareness of HIV/AIDS-related knowledge were more predisposed to engage in PrEP-eligible behaviors. Those who had limited knowledge of HIV and perceived themselves as less susceptible to HIV infection due to their knowledge gap were more inclined to have sex without consistent condom use [58–61]. However, it's worth noting that there was a contrasting finding among nursing students at the University of Palermo [62]. The effectiveness of HIV-related education in reducing high-risk sexual behavior among students is evident from various studies [63]. This includes educational initiatives delivered by parents and the reinforcement of school-based programs [48, 64, 65].

Forced sex plays a significant role in determining PrEP-eligible behaviors. It's important to note that females often face obstacles to condom use due to males' dominance, coercion, and manipulation in heterosexual relationships [66, 67]. There is compelling evidence indicating that females are disproportionately vulnerable to experiencing coerced sexual encounters [66, 68–70], placing them at an elevated risk of contracting HIV due to inconsistent condom use. Therefore, this finding indicated that college students who experience forced sex should be considered as the focus individuals of eligibility for PrEP initiation. Furthermore, a viable strategy to address this issue involves providing females with relevant knowledge and enhancing their communication skills in condom use. This empowerment enables them to use condoms as a protective measure during sexual intercourse, effectively advancing STIs prevention [71].

This study indicates that drug abuse increases the odds of engagement in PrEP-eligible behaviors, consistent with previous studies [72–74], the reason for this may be that it profoundly compromises the individuals' judgment and makes them use condoms inconsistently during sexual intercourse [75, 76]. Noticeably, adolescents who are in the rebellious phase may engage in sexual experimentation by taking drug abuse due to sexual curiosities during this period [75–77]. Furthermore, university students might actively take drugs to gain an increased sexual desire and pleasure [78], which undoubtedly increases the risk of PrEP-eligible behaviors. Therefore, these drug users should be included in the intervention targets of PrEP services to provide them with opportunities to use PrEP. Additionally, there is an urgent need to enhance college students' awareness of the negative consequences associated with drug abuse through educational

initiatives and strict implementation of legal measures is essential to reduce students' exposure to drugs.

### Strengths and limitations

This study is the first to systematically assess the prevalence of correct SRH knowledge, sexual attitudes, sexual behavior, and correlates of PrEP-eligible behaviors among college students in Southwest China. Secondly, the large sample size used in this study makes the result representative and generalizable.

However, some limitations should be considered. Firstly, participants are prone to responding to certain sensitive questions with a degree of reservations or lack of seriousness considering the sensitive nature of the topics under this investigation. We adopt the way of anonymous questionnaires online to mitigate the non-response rate associated with sensitive questions. Participants were more inclined to respond according to their true thoughts in the absence of others. Additionally, we implemented restrictive settings in the questionnaire, ensuring that it could only be submitted once all questions had been answered. Secondly, the characteristics originated from an online survey were self-reported and subjected to information bias. We collected these behaviors in recent years to mitigate recall bias. Thirdly, We did not collect all the PrEP-eligible behaviors, such as frequently using Post-exposure Prophylaxis (PEP), having a sexual partner with HIV, and reporting recent infection with STIs. This might potentially underestimate the rate of PrEP-eligible behavior. However, The prevalence of recently reported sexual partners with HIV-positive, PEP use, and STIs among college students in this region was very low [32, 34, 79], so we could neglect this underestimation. Besides, the large sample size, representing 10% of the college students in this city, rendered this underestimation negligible. Fourth, log-binomial regression performs poorly in evaluating the association between rare events and variables and is only applicable to data with a high incidence of outcomes. The residuals of this model failed to meet the normality assumption, and we employed Robust Standard Errors to compute adjusted coefficient estimates and significance test results to enhance the robustness of parameter estimation testing. Fifth, Our samples are drawn from the region in China with relatively underdeveloped economic and educational levels, findings of which are limited to providing more references for other regions. Lastly, Given the cross-sectional nature of the survey, this study does not allow inference on causality.

### Conclusion

College students in Southwest China exhibited suboptimal HIV/sex-related knowledge, received limited sex education, reported conservative attitudes about casual

sex, and high prevalence of PrEP-eligible behaviors. Our findings indicated that sexually experienced college students who had unawareness of HIV-related knowledge, lacked sex education, experienced forced sex, and reported drug abuse should be the key individuals for evaluating eligibility for PrEP initiation, and interventions aimed at increasing awareness of HIV/AIDS, enriching sex education styles, addressing issues related to forced sex, and tackling drug abuse could contribute to reducing the incidence of PrEP-eligible behaviors among college students.

### Abbreviations

PSM	Propensity score matching
AIDS	Acquired immune deficiency syndrome
HIV	Human immunodeficiency virus
HCV	Hepatitis C Virus
RSB	Risky sexual behaviors
MSM	Men who have sex with men
STIs	Sexually transmitted infections
PEP	Post-exposure Prophylaxis
PrEP-eligible behaviors	Pre-exposure prophylaxis-eligible behaviors

### Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12879-024-09657-7>.

**Figure S1.** Flow chart of data exclusion and analysis

**Figure S2.** Awareness of HIV/sex-related knowledge on gender, age, and degree in progress.

Supplementary Material 3

Supplementary Material 4

### Acknowledgements

We thank all researchers involved in this study and the staff of the Nanning Center for Disease Control and Prevention.

### Author contributions

Li Ye, Hao Liang, Bingyu Liang, Hongyang Tang and Ping Cen conceived and designed the study. Shiyu Qin, Jiao Qin and Qiuqian Su analyzed the data and wrote the manuscript. Junyu Zhan, Xi Yang, Yuanhong Yang, Ting Huang, Jinfeng He, Zhifeng Lin, Xinju Huang assisted in data collection. Li Ye, Hao Liang, Bingyu Liang, Hongyang Tang and Ping Cen directed the data analysis. All authors read and approved the final manuscript.

### Funding

This work was supported by the Guangxi Scientific and Technological Key Project (2022AC23005 and 2022JJA141110), Guangxi Natural Science Foundation (2023GXNSFAA026287), Thousands of Young and Middle age Key Teachers Training Program in Guangxi Colleges and Universities (To Bingyu Liang), Nanning Scientific Research and Technological Development Project (20223051), National Natural Science Foundation of China (No. 82060610 and 82103899).

### Data availability

The datasets generated and/or analyzed during the current study are not publicly available because of ethical and legal reasons but are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

This study has been reviewed and approved by the Ethics Committee of Guangxi Medical University (no.2019-SB-088). The study methods used in this study were by the relevant guidelines and regulations. All respondents were aware of the content and purpose of this study and agreed to provide informed consent online before this survey.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

### Author details

<sup>1</sup>Guangxi Key Laboratory of AIDS Prevention and Treatment, School of Public Health, Guangxi Medical University, Nanning 530021, Guangxi, China

<sup>2</sup>Nanning Center for Disease Control and Prevention, Nanning 530023, Guangxi, China

<sup>3</sup>Collaborative Innovation Centre of Regenerative Medicine and Medical Bioresource Development and Application Co-constructed by the Province and Ministry, Life Science Institute, Guangxi Medical University, Nanning 530021, Guangxi, China

Received: 7 January 2024 / Accepted: 24 July 2024

Published online: 14 August 2024

## References

- UNAIDS. Core epidemiology slides [Internet]. 2022 [cited 2024 May 17]. [https://www.unaids.org/en/resources/documents/2023/core-epidemiology-slides?\\_gl=1\\*1vmf90e\\*\\_ga\\*OTgzNDcyNDC2LjE2OTMyOTEwMjU.\\*\\_ga\\_T7FBEZEXNC\\*MTY5MzI5MTAyNS4xLjEuMTY5MzI5MzQ5Ny42MC4wLjA](https://www.unaids.org/en/resources/documents/2023/core-epidemiology-slides?_gl=1*1vmf90e*_ga*OTgzNDcyNDC2LjE2OTMyOTEwMjU.*_ga_T7FBEZEXNC*MTY5MzI5MTAyNS4xLjEuMTY5MzI5MzQ5Ny42MC4wLjA)
- Li G, Jiang Y, Zhang L. HIV upsurge in China's students. *Science*. 2019;364(6442):711–711.
- Zhao H, Liu H, Wang L, Yang X, Wang S, Han M, et al. Epidemiological characteristics of newly-reported HIV cases among youth aged 15–24 years - China, 2010–2019. *China CDC Wkly*. 2020;2(48):913–6.
- US Public Health Service: PREEXPOSURE PROPHYLAXIS FOR THE PREVENTION OF HIV INFECTION IN THE UNITED STATES – 2021 UPDATE, A CLINICAL PRACTICE GUIDELINE [Internet]. 2021. <https://www.cdc.gov/hiv/pdf/risk/prep/cdc-hiv-prep-guidelines-2021.pdf>
- Acquired Immunodeficiency Syndrome and Hepatitis C Professional Group, Society of Infectious Diseases, Chinese Medical Association, Chinese Center For Disease Control And Prevention. Chinese Guidelines for diagnosis and treatment of human Immunodeficiency virus Infection/Acquired Immunodeficiency syndrome(2021 edition). *Med J Peking Union Med Coll Hosp*. 2022;13(2):203–26.
- Zhang L, Wang H. Experts consensus of on PrEP of HIV infection in China-2023. *Chin J AIDS STD*. 2023;29(9):954–61.
- Yang XH, Yuan S, Zhang R, Yu JF, Nzala SH, Wang PG, et al. Risky sexual behaviors and Associated Factors among College students in Lusaka, Zambia. *Arch Sex Behav*. 2019;48(7):2117–23.
- Qing L, Wang Y, Yang T, Chen X, Zhang M, Bu Q, et al. Study on HIV/AIDS knowledge, sexual attitudes, sexual behaviors, and preventive services among young students in Chongqing, China. *Front Public Health*. 2022;10:982727.
- Cao Y, Xiao H, Yan H, Li J, Li S. Prevalence and sex-related risk factors of premarital pregnancy and reproductive tract infections among female undergraduates in Wuhan, China. *Asia Pac J Public Health*. 2015;27(2 Suppl):S30–40.
- Kassie BA, Yenus H, Berhe R, Kassahun EA. Prevalence of sexually transmitted infections and associated factors among the University of Gondar students, Northwest Ethiopia: a cross-sectional study. *Reprod Health*. 2019;16(1):163.
- Jin Z, Cao W, Wang K, Meng X, Shen J, Guo Y, et al. Mental health and risky sexual behaviors among Chinese college students: a large cross-sectional study. *J Affect Disord*. 2021;287:293–300.
- Lai J, Pan P, Lin Y, Ye L, Xie L, Xie Y, et al. A Survey on HIV/AIDS-Related knowledge, attitudes, risk behaviors, and characteristics of men who have sex with men among University students in Guangxi, China. *Biomed Res Int*. 2020;2020:7857231.
- Tu F, Yang R, Li R, Du G, Liu Y, Li W, et al. Structural Equation Model Analysis of HIV/AIDS knowledge, attitude, and Sex Education among freshmen in Jiangsu, China. *Front Public Health*. 2022;10:892422.
- Lyu J, Shen X, Hesketh T. Sexual knowledge, attitudes and behaviours among undergraduate students in China-implications for Sex Education. *Int J Environ Res Public Health*. 2020;17(18):6716.
- Zhang L, Yu H, Luo H, Rong W, Meng X, Du X, et al. HIV/AIDS-Related knowledge and attitudes among Chinese College Students and Associated factors: a cross-sectional study. *Front Public Health*. 2021;9:804626.
- Carstairs C, Philpott B, Wilmshurst S. Sex education and the need for change. *CMAJ*. 2018;190(50):E1482–3.
- Tseng YH, Cheng CP, Kuo SH, Hou WL, Chan TF, Chou FH. Safe sexual behaviors intention among female youth: the construction on extended theory of planned behavior. *J Adv Nurs*. 2020;76(3):814–23.
- Sun X, Liu X, Shi Y, Wang Y, Wang P, Chang C. Determinants of risky sexual behavior and condom use among college students in China. *AIDS Care*. 2013;25(6):775–83.
- Yip PSF, Zhang H, Lam TH, Lam KF, Lee AM, Chan J, et al. Sex knowledge, attitudes, and high-risk sexual behaviors among unmarried youth in Hong Kong. *BMC Public Health*. 2013;13:691.
- Alamrew Z, Bedimo M, Azage M. Risky Sexual Practices and Associated Factors for HIV/AIDS Infection among Private College Students in Bahir Dar City, Northwest Ethiopia. Siziya S, Rosano A, Mawson AR, editors. *ISRN Public Health*. 2013;2013:763051.
- Ren Z, Zhou Y, Liu Y. Factors associated with unsafe sexual behavior among sexually active Chinese University students, Hebei Province, 2019. *BMC Public Health*. 2021;21(1):1904.
- Fekadu Wakasa B, Oljira L, Demena M, Demissie Regassa L, Binu Daga W. Risky sexual behavior and associated factors among sexually experienced secondary school students in Guduru, Ethiopia. *Prev Med Rep*. 2021;23:101398.
- Ramírez-Villalobos D, Monterubio-Flores EA, Gonzalez-Vazquez TT, Molina-Rodríguez JF, Ruelas-González MG, Alcalde-Rabanal JE. Delaying sexual onset: outcome of a comprehensive sexuality education initiative for adolescents in public schools. *BMC Public Health*. 2021;21(1):1439.
- Rubens M, Batra A, Sebekos E, Tanaka H, Gabbidon K, Darrow W. Exploring the determinants of risky sexual behavior among ethnically diverse University students: the student behavioral health survey-web. *J Racial Ethn Health Disparities*. 2019;6(5):953–61.
- Tekletsadik EA, Ayisa AA, Mekonen EG, Workneh BS, Ali MS. Determinants of risky sexual behaviour among undergraduate students at the University of Gondar, Northwest Ethiopia. *Epidemiol Infect*. 2021;150:e2.
- Xu J, Luo Y, Dong H, Zhao G. The effects of Internet exposure on sexual risk behavior among sexually experienced male College students in China: cross-sectional study. *JMIR Public Health Surveill*. 2022;8(5):e31847.
- National Health Commission of the People's Republic of China. The implementation plan for the containment and control of HIV/AIDS (2019–2022) [Internet]. 2019 [cited 2024 May 17]. [https://www.gov.cn/xinwen/2019-10/13/content\\_5439036.htm](https://www.gov.cn/xinwen/2019-10/13/content_5439036.htm)
- Li C, Cheng Z, Wu T, Liang X, Gaoshan J, Li L, et al. The relationships of school-based sexuality education, sexual knowledge and sexual behaviors-a study of 18,000 Chinese college students. *Reprod Health*. 2017;14(1):103.
- Burki T. Sex education in China leaves young vulnerable to infection. *Lancet Infect Dis*. 2016;16(11):26.
- Chinese Center For Disease Control And Prevention. The National AIDS Sentinel Surveillance Questionnaire [Internet]. [http://www.jycdc.com/userfiles/files/%E5%85%A8%E5%9B%BD%E8%89%BE%E6%BB%8B%E7%97%85%E5%93%A8%E7%82%B9%E7%9B%91%E6%B5%8B%E5%AE%9E%E6%96%BD%E6%96%B9%E6%A1%88\(2017%E7%89%88\).pdf](http://www.jycdc.com/userfiles/files/%E5%85%A8%E5%9B%BD%E8%89%BE%E6%BB%8B%E7%97%85%E5%93%A8%E7%82%B9%E7%9B%91%E6%B5%8B%E5%AE%9E%E6%96%BD%E6%96%B9%E6%A1%88(2017%E7%89%88).pdf)
- Liang H, Hu Z. Predictors and consequences of early sexual debut among 43,251 University students in China. *Arch Sex Behav*. 2021;50(7):2789–92.
- Wang N, Lan G, Zhu Q, Chen H, Huang J, Meng Q, et al. HIV Epidemiology, Care, and treatment outcomes among Student and Nonstudent youths Living with HIV in Southwest China between 1996 and 2019: historical cohort study. *JMIR Public Health Surveill*. 2023;9:e38881.
- Setse RW, Siberry GK, Gravitt PE, Moss WJ, Agwu AL, Wheeling JT, et al. Correlates of sexual activity and sexually transmitted infections among human immunodeficiency virus-infected youth in the LEGACY cohort, United States, 2006. *Pediatr Infect Dis J*. 2011;30(11):967–73.

34. Liu T, Wang X, Li A, Ye J, Shan D, Zhang G, et al. Service acceptance of HIV non-occupational post-exposure prophylaxis (nPEP) among college students: a cross-sectional study in China. *BMC Public Health*. 2021;21(1):1220.
35. Kanma-Okafor OJ, Onwuasoanya EE, Sekoni AO, Ayankogbe OO, Izuka OM, Ejekam C. HIV/AIDS-Related knowledge, attitudes and Uptake of HIV Testing services: a comparative study of male and Female Secondary School students in Lagos, Nigeria. *West Afr J Med*. 2019;36(3):222–31.
36. Hernandez I, Sharma V, Reina-Ortiz M, Rosas C, Ochoa T, Izurieta R, et al. HIV/AIDS-related knowledge and behavior among School-attending afro-descendant youths in Ecuador. *Int J MCH AIDS*. 2020;9(3):397–407.
37. Guangxi Health Commission. Implementation Plan for curbing the spread of AIDS (2019–2022) [Internet]. 2020 [cited 2024 May 18]. [https://wsjkw.gxzf.gov.cn/xxgk\\_49493/fdzdgn/gkwj/zcjd/t5704132.shtml](https://wsjkw.gxzf.gov.cn/xxgk_49493/fdzdgn/gkwj/zcjd/t5704132.shtml)
38. Department of Education of Guangxi Autonomous region. Circular of the Department of Education of the Autonomous region on AIDS Prevention Education in Schools in 2023 [Internet]. 2023 [cited 2024 May 18]. [http://jyt.gxzf.gov.cn/zfxgk/fdzdgn/tzgg\\_58179/t17304417.shtml](http://jyt.gxzf.gov.cn/zfxgk/fdzdgn/tzgg_58179/t17304417.shtml)
39. Fayers T, Crowley T, Jenkins JM, Cahill DJ. Medical student awareness of sexual health is poor. *Int J STD AIDS*. 2003;14(6):386–9.
40. Uğurlu M, Karahan N. Sexual health knowledge and influencing factors among health science students at a state university in Turkey. *Eur J Contracept Reprod Health Care*. 2022;27(1):75–82.
41. Kusheta S, Bancha B, Habitu Y, Helamo D, Yohannes S. Adolescent-parent communication on sexual and reproductive health issues and its factors among secondary and preparatory school students in Hadiya Zone, Southern Ethiopia: institution based cross sectional study. *BMC Pediatr*. 2019;19(1):9.
42. Mcharo RD, Mayaud P, Msuya SE. Where and how do young people like to get their sexual and reproductive health (SRH) information? Experiences from students in higher learning institutions in Mbeya, Tanzania: a cross-sectional study. *BMC Public Health*. 2021;21(1):1683.
43. Maina BW, Ushie BA, Kabiru CW. Parent-child sexual and reproductive health communication among very young adolescents in Korogocho informal settlement in Nairobi, Kenya. *Reprod Health*. 2020;17(1):79.
44. Vongsavanh V, Lan VTH, Sycharun V. Sexual and reproductive health communication between parents and high school adolescents in Vientiane Prefecture, Lao PDR. *Glob Health Action*. 2020;13(sup2):1785145.
45. Dagnachew Adam N, Demissie GD, Gelagay AA. Parent-adolescent communication on sexual and Reproductive Health issues and Associated Factors among Preparatory and secondary School students of Dabat Town, Northwest Ethiopia. *J Environ Public Health*. 2020;2020:4708091.
46. Mataraarachchi D, Buddhika Mahesh PK, Pathirana TEA, Ariyadasa G, Wijemanne C, Gunatilake I, et al. Mother's perceptions and concerns over sharing sexual and reproductive health information with their adolescent daughters—A qualitative study among mothers of adolescent girls aged 14–19 years in the developing world, Sri Lanka. *BMC Womens Health*. 2023;23(1):223.
47. Swanemyr J, Amin A, Robles OJ, Greene ME. Creating an enabling environment for adolescent sexual and reproductive health: a framework and promising approaches. *J Adolesc Health*. 2015;56(1 Suppl):S7–14.
48. Raspberry CN, Young E, Szucs LE, Murray C, Sheremenko G, Parker JT, et al. Increases in Student Knowledge and Protective Behaviors Following Enhanced Supports for Sexual Health Education in a large, Urban School District. *J Adolesc Health*. 2022;70(4):588–97.
49. Chen W, Zhou X, Ma Q, He L, Chen W, Guo Z, et al. Correlates of condom use among male university students from eastern China who engage in casual sex. *PLoS ONE*. 2023;18(5):e0283970.
50. Yang Z, Chen W, Ma Q, Zhou X, Chen W, Wang H, et al. Factors Associated with Commercial Sex Behavior among Male College Students who engaged in Temporary Heterosexual Behavior in Zhejiang Province, China. *Biomed Res Int*. 2022;2022:4319194.
51. Ajayi AI, Ismail KO, Akpan W. Factors associated with consistent condom use: a cross-sectional survey of two Nigerian universities. *BMC Public Health*. 2019;19(1):1207.
52. Yang Z, Huang Z, Dong Z, Zhang S, Han J, Jin M. Prevalence of high-risky behaviors in transmission of HIV among high school and college student MSM in China: a meta-analysis. *BMC Public Health*. 2015;15:1272.
53. Jiang TT, Chen L, Zhou X, Wang H, Chen WJ, Chen WY, et al. [Evaluation on the confidence of refusing unprotected sex behavior and related factors among college students in Zhejiang province]. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2019;40(12):1601–5.
54. Salimi M, Fatehizadeh M. Investigation of effectiveness of Setual Education based on behavioral-cognitive method on Sexual Intimacy, Knowledge and Self-expression of Married Woman in Mobarakeh. *J Mod Psychol Researches*. 2013;7(28):105–22.
55. Oliveira-Campos M, Giatti L, Malta D, Barreto SM. Contextual factors associated with sexual behavior among Brazilian adolescents. *Ann Epidemiol*. 2013;23(10):629–35.
56. Kirby DB, Laris BA, Roller LA. Sex and HIV education programs: their impact on sexual behaviors of young people throughout the world. *J Adolesc Health*. 2007;40(3):206–17.
57. Elshiekh HF, Hoving C, de Vries H. Psychosocial determinants of consistent condom use among university students in Sudan: findings from a study using the Integrated Change Model. *BMC Public Health*. 2023;23(1):578.
58. Fauk NK, Kustanti CY, Liana DS, Indriyawati N, Crutzen R, Mwanri L. Perceptions of determinants of Condom Use behaviors among male clients of female sex workers in Indonesia: a qualitative Inquiry. *Am J Mens Health*. 2018;12(4):666–75.
59. Tarkang EE, Pencille LB. Psychosocial predictors of consistent condom use among migrant road construction workers in the Southwest Region of Cameroon using the Health Belief Model. *Pan Afr Med J*. 2018;29:215.
60. Katikiro E, Njau B. Motivating factors and psychosocial barriers to Condom Use among out-of-School youths in Dar Es Salaam, Tanzania: A Cross Sectional Survey using the Health Belief Model. *ISRN AIDS*. 2012;2012:170739.
61. Regan R, Morisky DE. Perceptions about HIV and condoms and consistent condom use among male clients of commercial sex workers in the Philippines. *Health Educ Behav*. 2013;40(2):216–22.
62. Santangelo OE, Provenzano S, Grigis D, Terranova A, D'Anna G, Armetta F, et al. Why nursing students have sex without condom? A study in the university of Palermo. *Clin Ter*. 2020;171(2):e130–6.
63. Raifman J, Beyrer C, Arrington-Sanders R. HIV Education and sexual risk behaviors among Young men who have sex with men. *LGBT Health*. 2018;5(2):131–8.
64. Pierce JD, Ylitalo KR, Lanning BA, Limbers CC. Sex Education and HIV Testing among Young men who have sex with men: findings from the 2006–2010 and 2011–2015 National Survey of Family Growth. *J Acquir Immune Defic Syndr*. 2018;79(2):179–85.
65. Widman L, Choukas-Bradley S, Noar SM, Nesi J, Garrett K. Parent-adolescent sexual communication and adolescent Safer Sex Behavior: a Meta-analysis. *JAMA Pediatr*. 2016;170(1):52–61.
66. Teitelman AM, Tennille J, Bohinski JM, Jemmott LS, Jemmott JB. Unwanted unprotected sex: condom coercion by male partners and self-silencing of condom negotiation among adolescent girls. *ANS Adv Nurs Sci*. 2011;34(3):243–59.
67. Zhao YL, Kim H, Peltzer J. Relationships among Substance Use, multiple sexual partners, and Condomless Sex. *J Sch Nurs*. 2017;33(2):154–66.
68. Alleyne B, Coleman-Cowger VH, Crown L, Gibbons MA, Vines LN. The effects of dating violence, substance use and risky sexual behavior among a diverse sample of Illinois youth. *J Adolesc*. 2011;34(1):11–8.
69. Fontenot HB, Fantasia HC, Lee-St John TJ, Sutherland MA. The effects of intimate partner violence duration on individual and partner-related sexual risk factors among women. *J Midwifery Womens Health*. 2014;59(1):67–73.
70. Silverman JG, McCauley HL, Decker MR, Miller E, Reed E, Raj A. Coercive forms of sexual risk and associated violence perpetrated by male partners of female adolescents. *Perspect Sex Reprod Health*. 2011;43(1):60–5.
71. Jemmott JB, Jemmott LS, Braverman PK, Fong GT. HIV/STD risk reduction interventions for African American and latino adolescent girls at an adolescent medicine clinic: a randomized controlled trial. *Arch Pediatr Adolesc Med*. 2005;159(5):440–9.
72. Liao MZ, Wang M, Li JH, Zhu XY, Wang L, Huang PX, et al. [Relationship between new-type drug use and high risk sex behavior in men who have sex with men]. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2020;41(11):1882–7.
73. Lu TS, Holmes A, Noone C, Flaherty GT. Sun, sea and sex: a review of the sex tourism literature. *Trop Dis Travel Med Vaccines*. 2020;6(1):24.
74. Clark DA, Arterberry BJ, Walton MA, Cunningham RM, Goldstick JE, Zimmerman MA, et al. Examining same-day associations between Cannabis Use motives and Condom Use in Urban emerging adults: a brief report. *J Stud Alcohol Drugs*. 2021;82(4):516–21.
75. Govender D, Naidoo S, Taylor M. My partner was not fond of using condoms and I was not on contraception: understanding adolescent mothers' perspectives of sexual risk behaviour in KwaZulu-Natal, South Africa. *BMC Public Health*. 2020;20(1):366.
76. Patton R, Keaney F, Brady M. Drugs, alcohol and sexual health: opportunities to influence risk behaviour. *BMC Res Notes*. 2008;1:27.

77. Gyesaw NYK, Ankomah A. Experiences of pregnancy and motherhood among teenage mothers in a suburb of Accra, Ghana: a qualitative study. *Int J Womens Health*. 2013;5:773–80.
78. Malandain L, Mosser S, Mouchabac S, Blanc JV, Alexandre C, Thibaut F. Chemical sex (chemsex) in a population of French university students. *Dialogues Clin Neurosci*. 2021;23(1):39–43.
79. Zhang J, Ma B, Han X, Ding S, Li Y. Global, regional, and national burdens of HIV and other sexually transmitted infections in adolescents and young adults aged 10–24 years from 1990 to 2019: a trend analysis based on the global burden of Disease Study 2019. *Lancet Child Adolesc Health*. 2022;6(11):763–76.

#### **Publisher's Note**

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