

BMJ Open Epidemiological characteristics of HIV infection among college students in Nanjing, China: a cross-sectional survey

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ABSTRACT

Objective This study aimed to investigate the epidemiological characteristics and HIV/AIDS-related knowledge, attitudes and practice (KAP) among HIV-positive college students.

Design A cross-sectional study.

Setting Five districts of Nanjing, China.

Participants A total of 156 college students with newly diagnosed HIV infection between September 2015 and July 2017.

Main outcome measures Social-demographic characteristics, mode of HIV acquisition, infection of sexually transmitted diseases, risky sexual behaviours and HIV/AIDS-related KAP were collected by a face-to-face questionnaire administered by trained interviewers.

Results About 98.7% (154/156) of HIV-positive college students in our study were men, and 96.1% (148/154) of them were infected by sexual intercourse with men. More than half (52.5%, 82/156) of participants were freshmen or sophomores. Nearly 30% (44/154) of male students did not realise the severe status of the HIV/AIDS epidemic among students who are men who have sex with men (MSM). More than four-fifths of male students did not know if their male regular (83.0%, 93/112) or casual (95.9%, 94/98) sexual partners were HIV-positive, while less than half of them had high-risk perceptions towards HIV infection from male regular and occasional sexual partners. Approximately one-half and four-fifths of male students had more than two regular (54.5%, 61/112) and occasional (79.6%, 78/98) partners during lifetime, respectively. However, only 62.5% (70/112) and 66.3% (65/98) of male students used condoms consistently during sexual intercourse with regular and casual partners, respectively. Geosocial networking apps have become the most dominant way for male students to seek sexual partners.

Conclusions This study reported a low level of HIV/AIDS-related knowledge, a high level of exposure to risky sexual behaviours and some valuable epidemiological characteristics among HIV-positive college students, which highlighted the importance of carrying out HIV/AIDS prevention education and risk warning education early and timely towards college students on campus.

INTRODUCTION

Approximately 37.9 million people were living with HIV/AIDS at the end of 2018 worldwide, and 1.7 million people became newly infected with HIV in 2018. Of 5000 individuals who

Strengths and limitations of this study

- The first study investigating the HIV/AIDS-related knowledge, attitudes and practice (KAP) among HIV-positive college students in China.
- Face-to-face questionnaires administered by trained interviewers in a separate private room to ensure privacy and confidentiality for the respondents and achieve satisfactory response rates.
- Possible overestimation of the HIV/AIDS-related knowledge levels due to the postdiagnostic measures of HIV/AIDS-related KAP.
- A cross-sectional study with small sample size and short time frame may not be generalisable to other regions or populations.

were newly infected cases with HIV each day in 2018, around 32% were young people aged 15–24 years old.¹ The UNICEF reported that the estimated number of adolescents (10–19 years) living with HIV/AIDS has increased by 480 000 from 2000 to 2018 globally, among whom 380 000 were male adolescents. About 740 000 adolescents could become infected with HIV between 2016 and 2030 due to the low level of knowledge regarding HIV/AIDS and high-risk sexual behaviours if current prevention progress is not optimised.²

In recent years, the number of people living with HIV/AIDS has been increased sharply among young people in China, especially in college students. According to the National Centre for AIDS/STD Control and Prevention, China Centers for Disease Control and Prevention (CDC), the number of newly diagnosed college students has seen an annual growth rate ranging from 30% to 50% over the past several years,³ and nearly 10 college students were infected with HIV each day.⁴ From 2013 to 2017, 12 037 new cases of HIV infection among young students were reported in China, and 97.7% of them were men.⁵ In 2017, the newly diagnosed students reached 3,077, which was tenfold greater

than 10 years ago.⁶ The proportion of men who have sex with men (MSM) among students was higher than that of adolescents outside school.⁷⁻⁹ Among 38 million university students in China,¹⁰ approximately 1.7 million are MSM aged 18–22 years.¹¹ Therefore, the prevalence of HIV infection among college students has become a worrisome issue and prevention efforts are needed urgently.

As an important educational centre, there are 53 institutions of higher education and nearly 780 000 college students in Nanjing city.¹² In recent years, students have captured considerable public health attention as an increasing number of them have been detected with HIV. Over 200 college students were diagnosed in Nanjing between 2002 and 2014.¹³ Our previous study reported that a total of 319 young students were diagnosed with HIV in Nanjing between 2011 and 2016 and the average growth rate was 33.9% during the 6 years.¹⁴ The proportion of HIV-infected MSM among young student cases (93.4%) was higher than that of adolescents outside school (77.8%).¹⁴ However, we have little knowledge of the epidemiological characteristics and HIV/AIDS-related knowledge, attitudes and practice (KAP) among HIV-positive college students in Nanjing, China. There is a critical need to study the detailed characteristics of this population.

Significance and objectives of the study

College students in China already face a number of challenges, and now HIV has been added to this list.⁴ Understanding the characteristics of HIV-infected college students could assist in identifying effective interventions to deal with the HIV epidemic on campus. In addition, evaluating HIV/AIDS-related KAP among HIV-positive college students rather than young students in general, could help retrospect the process of infection in college students and provide more useful information for HIV prevention on this population.¹⁵⁻¹⁸ Due to the critical gap between the increasing prevalence of HIV and the limited workforce in CDC in China, the data collected through routine surveillance systems were ineffective to provide sufficient information about the characteristics of HIV-infected college students. Therefore, in this study, we conducted a cross-sectional survey by a structured questionnaire, aiming to better understand the epidemiological characteristics and HIV/AIDS-related KAP among HIV-positive college students.

METHODS

Study area and period

This study was conducted from 1 September 2015, to 31 July 2017, in five counties (including Gulou, Xuanwu, Jiangning, Qinhuai and Qixia) of Nanjing, Jiangsu province, China. Of 53 institutions of higher education in Nanjing city, 45 are located in these five districts. Based on the unpublished data from Nanjing CDC, the number of HIV-infected students in these five districts accounted

for over 90% of the total number of HIV-positive students in Nanjing over the past few years.

Study participants

All newly diagnosed HIV-positive individuals were recruited consecutively if they met the following criteria: (1) HIV-positive cases screened by HIV-1/HIV-2 ELISA and confirmed by HIV-1 Western blot in Nanjing CDC between 1 September 2015 and 31 July 2017; (2) self-reported as undergraduates or postgraduates and was confirmed by the student cards/identification card/residence permit; (3) aged 18 years and above; (4) agreed to participate in this study with verbal or written informed consents. Eventually, 156 HIV-positive students were enrolled in the survey.

Study instrument

Data were collected using a structured interviewer-administered questionnaire. This questionnaire was developed based on the *Guidelines of intervention work for the prevention of HIV/AIDS among MSM and heterosexual in China* (issued by National Center for AIDS/STD Control and Prevention, China CDC) and took the characteristics of the young students into consideration. In our presurvey, this questionnaire showed high reliability and good internal consistency in measuring the HIV/AIDS-related KAP among college students (Cronbach's α is 0.762 and Kaiser-Meyer-Olkin is 0.843).

Three categories of indicators, including socio-demographic characteristics, information of infection and HIV/AIDS-related KAP, were collected. Socio-demographic indicators included gender, age, ethnicity, domicile, educational institution and year in college. Information on infection consisted of the mode of HIV acquisition and detection, and the self-reported infection of sexually transmitted diseases (STDs). HIV/AIDS-related knowledge was measured by eight items, which were specially developed for college students by the National Center for AIDS/STD Control and Prevention, China CDC.¹⁹ For each item, the correct answer ('yes') was scored 1, with the wrong answer ('no' or 'unknown') scored as 0. The total score of the HIV/AIDS-related knowledge was 8, with a higher score indicating a higher level of HIV/AIDS-related knowledge. Attitudes regarding HIV/AIDS prevention were measured by two questions, including whether the respondents knew the HIV-infection status of their sexual partners and whether or not they were worried about being infected with diseases from sexual partners. Sexual behaviour indicators included the types of sexual partners (eg, male and female regular sexual partner, male and female casual sexual partner), the way to seek sexual partners, the frequency of sexual behaviours and condom usage (online supplementary questionnaire).

Data collection

The interview was conducted at the first follow-up after the confirmation of HIV infection. Data were collected

through face-to-face questionnaire administered by trained staff who have long been engaged in HIV/AIDS prevention and control in each district CDC. All investigators were trained for questionnaire investigation and data collection to reduce information bias. The interview was conducted in a separate private room to protect the privacy of the respondents. Each interview took approximately 20–40 min.

Patient and public involvement

Patients were involved in the questionnaire investigation. The Nanjing CDC was involved in the study design. The questionnaire investigation was conducted by staff from district CDCs of Nanjing in a separate private room located in each district CDC.

Statistical analysis

Data analysis was performed using SPSS V.24.0 for windows. Quantitative data were calculated as means±SD, and qualitative data were presented by absolute number and percentage (n (%)).

RESULTS

Socio-demographic and infection characteristics

From 1 September 2015 to 31 July 2017, a total of 159 HIV-infected college students were confirmed in Nanjing. One male case declined to participate in the study, and another two patients (one man and one woman) did not belong to our survey area (five counties), resulting in 156 individuals enrolled in our study. The mean age of the 156 participants was 21.3±2.3 years (range 18–33). The majority of participants (98.7%, 154/156) were men, and only 1.3% (2/156) were women. Almost all (96.1%, 148/154) of male students were infected through sexual intercourse with men. The majority of participants were sophomore students (37.8%, 59/156), whereas freshmen, junior, senior and postgraduate students accounted for 14.7% (23/156), 17.3% (27/156), 19.9% (31/156) and 10.3% (16/156), respectively. Only 19.2% (30/156) of students were natives, while 22.4% (35/156) and 58.3% (91/156) were migrants from other cities in Jiangsu and other provinces, respectively. The proportion of active detection after high-risk behaviours accounted for 32.1% (50), while 67.9% (106) was discovered by passive detection. A total of 40 (25.6%) participants had self-reported STDs, including 17 (10.9%) syphilis, 17 (10.9%) condyloma acuminatum, 4 (2.6%) gonorrhoea and 2 (1.3%) genital herpes (table 1).

The level of knowledge regarding HIV/AIDS among HIV-infected male students

The overall mean score of knowledge regarding HIV/AIDS among male students was 6.7±0.1. The accuracy of responses for the eight items ranged from 67.5% to 96.8%, with four items below 80%. Fifty (32.5%) participants did not know that the new-type drugs (eg, methamphetamine, ecstasy, ketamine etc.) can increase HIV

Table 1 The social-demographic characteristics and information of infection of 156 HIV-positive students

Characteristics	Participants (n)	%
Gender		
Female	2	1.3
Male	154	98.7
Age (years)		
18–19	27	17.3
≥20	129	82.7
Ethnicity		
Han	152	97.4
Non-Han	4	2.6
Domicile		
Nanjing	30	19.2
Other cities in Jiangsu	35	22.5
Other provinces	91	58.3
Grade		
Freshman	23	14.7
Sophomore	59	37.8
Junior	27	17.3
Senior	31	19.9
Postgraduate	16	10.3
Mode of HIV acquisition		
Sexual intercourse with men	148	94.9
Male heterosexual behaviour	6	3.8
Female heterosexual behaviour	2	1.3
The way of diagnosis		
Active detection after high-risk behaviours	50	32.1
Medical	33	21.1
Blood donation	24	15.4
STDs detection	15	9.6
Health examination	12	7.7
Preoperation detection	10	6.4
Others	12	7.7
STDs		
Syphilis	17	10.9
Gonorrhoea	4	2.6
Condyloma acuminatum	17	10.8
Genital herpes	2	1.3
No	116	74.4

STDs, sexually transmitted diseases.

infection, and 44 (28.8%) individuals did not realise the severe status of HIV/AIDS epidemic among MSM in colleges in China (At present, the HIV/AIDS epidemic among young students in China is growing rapidly, and MSM are primarily afflicted, followed by heterosexual individuals). In addition, 24.0% (37) of individuals did

Table 2 Risk perceptions towards HIV infection among 154 HIV-positive male students

Risk perception	Male regular partners (112 respondents), N (%)	Male casual partners (98 respondents), N (%)	Female regular partners (13 respondents), N (%)	Female casual partners (9 respondents), N (%)
Knowing sexual partner had been infected during sexual intercourse with partners	19 (17.0)	4 (4.1)	0 (0.0)	2 (22.2)
Worrying about being infected with diseases by sexual partners	44 (39.3)	46 (46.9)	3 (23.1)	2 (22.2)

not know that HIV/AIDS is one of the serious and incurable diseases, and 22.1% (34) of subjects did not know that HIV/AIDS patients have equal rights for marriage, employment and education (online supplementary table S1).

Risk perceptions towards HIV infection among HIV-infected male students

Among the 154 HIV-positive male students, 112 (72.7%), 98 (63.6%), 13 (8.4%) and 9 (5.8%) respondents reported having sexual intercourse with male regular, male casual, female regular and female casual partners, respectively. The proportions of participants knowing that their sexual partner had been infected with HIV were extremely low (table 2). Among these respondents, only a low proportion of individuals reported that they were worried about being infected with diseases from partners (table 2). The predominant reason for not worrying about being infected with diseases was that they did not realise the potential risk (figure 1).

Sexual behaviors among HIV-infected male students

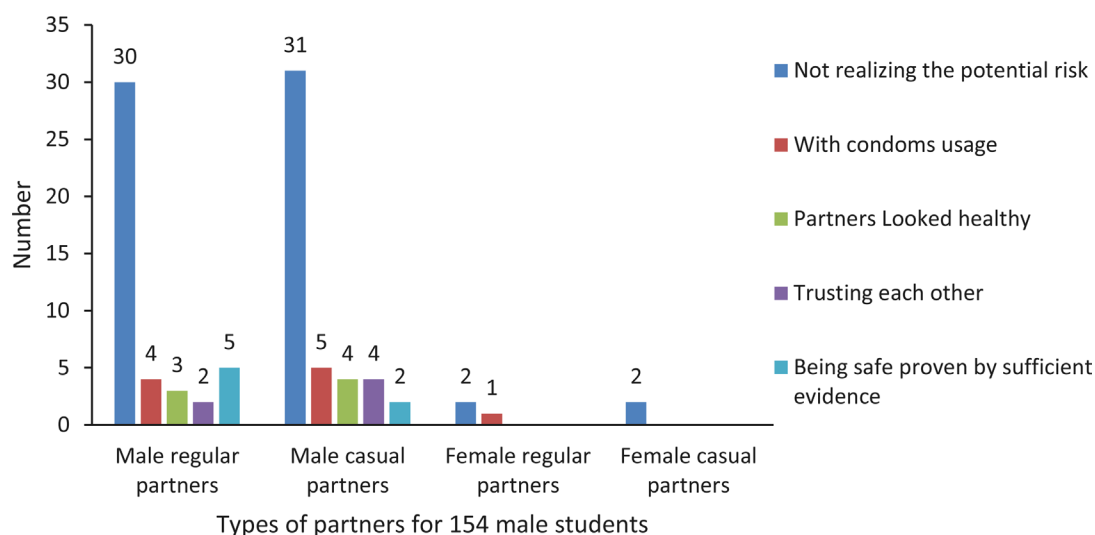
One hundred and forty-five male students reported on the experience of the initial sexual intercourse. The mean age for the initial experience of sexual intercourse was 19.1±2.0 years (range 12–33), and 37.7% (59/145) was before 18 years old. Four-fifths (80.7%) of the respondents reported that the partner of first sexual intercourse

was man, and 37.8% (55/145) did not use condoms during the initial sexual intercourse.

Of respondents who have had male regular and casual partners, 54.5% (61/112) and 79.6% (78/98) had more than two sexual partners during lifetime, respectively. The proportions of male students who had intercourse over two times per month with male regular and casual partners were 61.6% (59/112) and 30.6% (30/98), respectively. However, the proportions of using condoms consistently during sexual intercourse with partners were low. The predominant reason for not using condoms was not realising the necessity of using condoms in sexual intercourse (figure 2). Geosocial networking (GSN) apps have become the primary way for students to seek sexual partners (table 3).

DISCUSSIONS

The severity of the HIV/AIDS epidemic among college students has captured increasing attention of the Chinese government. Several interventions, including expanding the publicity of HIV/AIDS-related knowledge, sex and reproductive health education, making HIV testing more accessible on campuses, and offering adolescent peer education programmes on HIV/AIDS, have been taken to address the HIV epidemic on campus.^{3 20} However, the current interventions for preventing HIV/AIDS are

**Figure 1** The reasons for not worrying about being infected with diseases during sexual intercourse among 154 male students.

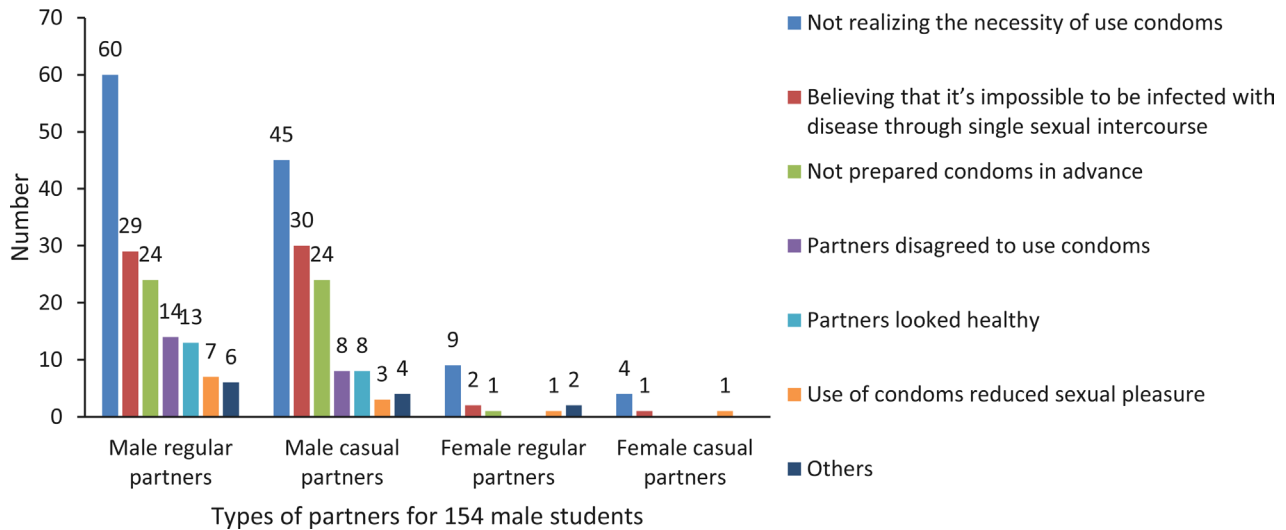


Figure 2 The reasons for not using condoms during sexual intercourse among 154 male students.

not provided in all universities and are implemented ineffectively.³ Sex education programmes are not well-implemented among a substantial proportion of nearly 2800 universities in China, and only a small number of colleges made HIV testing more accessible on campus. Thus, how to implement these strategies effectively has become critical for HIV/AIDS prevention and control among college students. In this study, for the first time, we described the epidemiological characteristics of HIV infection among HIV-positive college students and explored the potential factors that underlying the increasing HIV infection in students.

Previous studies reported that college students had a high level of HIV/AIDS-related knowledge as they were highly educated.^{21 22} However, in this study, we found that there was still some lack of knowledge about HIV/AIDS, since the accuracy rates of half of HIV/AIDS-related questions were below 80% among HIV-positive male students. Specifically, a considerable proportion of individuals did not know the serious status of HIV/AIDS epidemic among students who are MSM. If college students did not receive comprehensive sex education before sexually active, they would be highly vulnerable to HIV when they started having sexual intercourse. Because

Table 3 Characteristics of sexual behaviours among 154 HIV-positive male students

Characteristics	Male regular partners (112 respondents), N (%)	Male casual partners (98 respondents), N (%)	Female regular partners (13 respondents), N (%)	Female casual partners (9 respondents), N (%)
The numbers of sexual partners				
1	51 (45.5)	20 (20.4)	13 (100.0)	3 (33.3)
2–5	60 (53.6)	65 (66.3)	0 (0.0)	6 (66.6)
≥6	1 (0.9)	13 (13.3)	0 (0.0)	0 (0.0)
The way to seek sexual partners				
Geosocial networking apps	92 (82.1)	89 (90.8)	1 (7.7)	4 (44.4)
Students or friends	17 (15.2)	6 (6.1)	12 (92.3)	2 (22.2)
Others	3 (26.8)	3 (3.1)	0 (0.0)	3 (33.3)
Frequency of intercourse (times per month)				
1	43 (38.4)	68 (69.4)	9 (69.2)	7 (77.8)
2–5	52 (46.4)	28 (28.6)	4 (30.8)	2 (22.2)
≥6	7 (6.3)	2 (2.0)	0 (0.0)	0 (0.0)
Condom usage				
Consistently	70 (62.5)	65 (66.3)	4 (30.8)	4 (44.4)
Sometimes	31 (27.7)	19 (19.4)	6 (46.2)	3 (33.3)
Rarely	11 (9.8)	14 (14.3)	3 (23.1)	2 (22.2)



the competition for the college entrance examination is fierce in China, precollege education is mainly focused on scholarly studies with minimal sex education.²³ For many college freshmen, knowledge about HIV/AIDS, STIs and sexual health are extremely limited, and they do not know the serious status of the HIV/AIDS epidemic among young students either. Some students have had risky sexual behaviours before they received adequate awareness of disease prevention. Thus, comprehensive HIV/AIDS and sex education should be carried out early and timely to improve the level of HIV/AIDS-related knowledge among students. Not only educators in the schools but also parents in the families should take on the responsibility for fostering an open environment for education and awareness on HIV/AIDS for students. Meanwhile, peer-education also has the potential to improve awareness and enhance students' motivation for HIV protection.

After entering university, students have increased exposure to various sexual partners without parents' supervision, and tend to have sexual intercourse more frequently with multiple sexual partners as compared with before attending university.^{24 25} Some students with limited knowledge and awareness on sex education might be exposed to frequent unprotected sexual behaviours. Unfortunately, our findings revealed that a large number of male students did not know if their sexual partners were HIV-positive people and never realised that they could be infected with diseases through their sexual partners. The low level of risk perceptions towards HIV infection among male students might be a crucial factor for their risky sexual behaviour. Thus, there is a need to strengthen the warning education about risky sexual behaviours for college students. Furthermore, HIV infection presented in all grades of colleges in our study, indicating that the risk-warning education should be informed throughout the college stage. However, at present, some universities in China are unable to disseminate HIV/AIDS-related knowledge and implement sex education with an open and accepting attitude.²⁶ Thus, college administrators must create an open environment where sex education can be frequently accessed by students and awareness on HIV/AIDS can be sufficiently improved. Simultaneously, education sectors need to work together with public health professionals and student organisations to conduct education campaigns in a more engaging way.

The high-risk behaviours, for instance, bisexual intercourses, multiple sex partners, high frequency of intercourse and rare usage of condoms among college students in Nanjing were similar to those reported in non-infected students.^{27 28} We found that the rate of active HIV test was low, probably due to the ongoing impact of stigma and discrimination associated with HIV infection. Across 19 countries with available data, about 20% of people living with HIV avoided going to a clinic or hospital for HIV testing, treatment and prevention services, because they worried about stigma or discrimination related to their HIV status.²⁹ The small proportion of active detection

among students also indicated the lack of self-motivation for HIV testing and highlighted the importance of readily accessible means of testing on campus. Some community organisations have provided on-site HIV testing and anonymous HIV urine-testing services in universities,³⁰ which should be implemented nationwide.

A recent study reported that the use of GSN apps was associated with higher HIV incidence among MSM in China.³¹ In this study, we found that approximately 82.1% and 90.8% of male students used GSN Apps to seek the male regular and casual partners, suggesting that the GSN apps might also play an increasingly critical role in promoting the spread of HIV on campus, which was in line with other studies in USA and Europe.^{32–35} Yang *et al* reported that several GSN apps including Blued, Aloha and Zank were used widely for recognising sexual partners among Chinese MSM undergraduates.³⁶ Unfortunately, many GSN apps have not played a corresponding role in disseminating knowledge regarding HIV/AIDS. The other issue among college students was the coinfection of HIV and STDs. The survey showed that the prevalence of syphilis was posing a sharp increase among young Chinese MSM.^{37 38} On the one hand, multiple infection of STDs, especially syphilis and condyloma acuminata infection, may increase HIV-1 RNA levels, enhancing the transmissibility of HIV-1 among college students.³⁹ On the other hand, HIV-1 may affect the clinical presentation, treatment outcome and progression of STDs.⁴⁰ Therefore, both the measures of STDs prevention and treatment these HIV-positive individuals should be conducted on campus simultaneously.

Our study has some limitations. First, selection bias may exist as some HIV-positive college students concealed that they were attending colleges for the consideration of privacy. Thus, our data may not be fully representative of the epidemiological characteristics of HIV infection among college students in Nanjing. Second, participants may be unable to provide precise information on the experience of the first sexual intercourse they occurred many years ago, resulting in information bias. Participants tended to have underreported on some sensitive information, such as sexual behaviour. In addition, participants tended to improve their levels of HIV/AIDS-related knowledge after diagnosis of HIV infection, leading to the overestimated accuracy rates of HIV/AIDS-related knowledge questions. Third, we did not collect data on the availability and accessibility of treatment and information regarding issues of stigma and discrimination, which could be conducted in the future survey.

CONCLUSIONS

This study reported a low level of HIV/AIDS-related knowledge, a high level of exposure to risky sexual behaviours and some valuable epidemiological characteristics among HIV-positive male college students in Nanjing, China. A considerable proportion of HIV-positive male students did not know the serious status of the HIV/AIDS

epidemic among students who are MSM and had a low level of risk perceptions towards HIV infection. Comprehensive sex education should be carried out early and timely among Chinese students to improve the level of HIV/AIDS-related knowledge. Risk-warning education is needed throughout the college stage to enhance the awareness of HIV/AIDS prevention and to reduce risky sexual behaviours among college students. Furthermore, the GSN apps should be fully used in programmes for HIV prevention given GSN apps have become the main tool for college students to seek sexual partners.

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Contributors PW and XL were responsible for funding acquisition and project administration; WL and JC were major contributors in writing: original draft; ZZ was responsible for the resources; XL and YH contributed to the investigation; YG and QN helped in data curation and formal analysis; XL and THM contributed to the writing: review and editing. All authors read and approved the final version of the manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval This study was reviewed and approved by the Human Research Ethics Committee of the Zhongda hospital affiliated Southeast University, China (Approval ID: 2017ZDKYSB045). The objectives and the procedure of the study, and the potential risks and benefits of participating in the study were told to potential participants during the recruitment. Verbal or written consent procedures were obtained from participants and they had the right to discontinue the survey at any time.

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Data availability statement Data are available upon reasonable request. mpw1963@126.com.

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