# Ways of Knowledge Access and Risky Sexual Behaviors Among Young Students: Evidence from a Cross-sectional Study

Yun Zhang, Jie Jin, Feng Cheng, Xingliang Zhang, Junfang Xu

Submitted to: JMIR Public Health and Surveillance
on: November 04, 2024

# *Table of Contents*

# Ways of Knowledge Access and Risky Sexual Behaviors Among Young Students: Evidence from a Cross-sectional Study

Yun Zhang[1]; Jie Jin[2]; Feng Cheng[3, 4]; Xingliang Zhang[5]; Junfang Xu[1]

[1]The Second Affiliated Hospital, Center for Health Policy Studies, School of Public Health, Zhejiang University School of Medicine Hangzhou CN
[2]Department of AIDS/STDs Control and Prevention, Hangzhou Center for Disease Control and Prevention Hangzhou CN
[3]Vanke School of Public Health, Tsinghua University Beijing CN
[4]Institute for Healthy China, Tsinghua University Beijing CN
[5]Department of AIDS/STDs Control and Prevention, Hangzhou Center for Disease Control and Prevention?Hangzhou Health Supervision Institution? Hangzhou CN

**Corresponding Author:**
Junfang Xu
The Second Affiliated Hospital, Center for Health Policy Studies, School of Public Health, Zhejiang University School of Medicine
Medical Comprehensive Building,10th FI.
Hangzhou
CN



## *Abstract*

**Background:** Human Immunodeficiency Virus (HIV) infection continues to pose a significant challenge for young students in China, with most infections resulting from risky sexual behaviors. Transmitting HIV-related knowledge through various knowledge accesses is found to be critical in preventing risky sexual behaviors. Different HIV-related information sources exhibit their unique characteristics, assigning different labels to the nature of information that affects young adults' perception of HIV and sexual behaviors.

**Objective:** This study aimed to examine the relationship between various knowledge accesses and risky behaviors, analyzing the mediating effects of HIV-related knowledge, which are expected to provide evidence for more effective HIV knowledge dissemination and the reduction of risky behaviors among youth.

**Methods:** A questionnaire on HIV-related knowledge and behavior of young students was used to conduct the online survey. Knowledge access included school education, mass communication, and interpersonal communication. HIV-related knowledge was categorized into general and prevention knowledge. Risky behavior was defined as having multiple sexual partners or engaging in unprotected sex. Binary logistic regression was used to analyze the relationship between knowledge accesses, HIV-related knowledge and risky behaviors. Multiple mediation models constructed by Process4.1 program were conducted to determine whether the levels of HIV-related knowledge mediated the relationship between knowledge access and risky behavior.

**Results:** A total of 20,602 young adult respondents participated in the survey, with 9,541 males (46.3%) and 11,061 females (53.7%), averaging 20.14±1.91 years. Mass communication reached 19,030 (92.37%) students; 17,949 (87.12%) participants acquired HIV-related knowledge from school education; 11,274 (54.72%) students accessed knowledge through interpersonal communication. Among the 2,423 students who had sex, 363 (14.98%) had multiple sexual partners and 830 (34.26%) engaged in unprotected sex. School education (OR=0.6, 95%Cl=0.46-0.78), mass communication (OR=0.64, 95%Cl=0.47-0.87) and HIV prevention knowledge (OR=0.79, 95%Cl=0.69-0.9) were negatively associated with multiple sexual partners, while interpersonal communication (OR=1.41, 95%Cl=1.13-1.75) was positively associated. School education (OR=0.75, 95%Cl=0.64-0.91) and HIV prevention knowledge (OR=0.81, 95%Cl=0.73-0.89) were negatively correlated with unprotected sexual behaviors, while interpersonal communication (OR=1.27, 95%Cl=1.09-1.46) and general HIV knowledge (OR=1.17, 95%Cl=1.08-1.28) were significantly positively correlated. The results of the multiple mediation models revealed that knowledge accesses had indirect effects on risky behaviors through prevention knowledge and general knowledge. School education had opposing indirect effects of -0.023 and 0.023 through prevention and general knowledge, leading to a non-significant overall indirect effect. Mass communication showed indirect effects of -0.044 and 0.012, while interpersonal communication demonstrated indirect effects of 0.007 and 0.005 through the same pathways.

**Conclusions:** Students who acquire HIV-related knowledge from school education and mass media are less likely to engage in risky behaviors, compared to those who acquire it through interpersonal communication. We should fully leverage the advantages of school education and mass communication, and an emphasis should be placed on prevention knowledge to promote changes in risky behavior. Knowledge access primarily influences risky behaviors by shaping cultural values and behavioral norms, rather than solely transmitting information. To effectively reduce risky behaviors through knowledge enhancement, non-mandatory, voluntary educational approaches are recommended.

(JMIR Preprints 04/11/2024:68339)
DOI: https://doi.org/10.2196/preprints.68339

## Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

# Original Manuscript

# Ways of Knowledge Access and Risky Sexual Behaviors Among Young Students: Evidence from a Cross-sectional Study

Yun Zhang[1], Jie Jin[2], Feng Cheng[3,4], Xingliang Zhang[2*], Junfang Xu[1*]

**Authors' affiliations**

[1] The Second Affiliated Hospital, Center for Health Policy Studies, School of Public Health, Zhejiang University School of Medicine

[2]Department of AIDS/STDs Control and Prevention, Hangzhou Center for Disease Control and Prevention（Hangzhou Health Supervision Institution）

[3]Vanke School of Public Health, Tsinghua University, Beijing, China

[4]Institute for Healthy China, Tsinghua University, Beijing, China

* Corresponding Author:

Junfang Xu, E-mail: xujf2019@zju.edu.cn; or Xingliang Zhang, Email: xingliangyufang@163.com

## Abstract

**Background:** Human Immunodeficiency Virus (HIV) infection continues to pose a significant challenge for young students in China, with most infections resulting from risky sexual behaviors. Transmitting HIV-related knowledge through various knowledge accesses is found to be critical in preventing risky sexual behaviors. Different HIV-related information sources exhibit their unique characteristics, assigning different labels to the nature of information that affects young adults' perception of HIV and sexual behaviors.

**Objective:** This study aimed to examine the relationship between various knowledge accesses and risky behaviors, analyzing the mediating effects of HIV-related knowledge, which are expected to provide evidence for more effective HIV knowledge dissemination and the reduction of risky behaviors among youth.

**Methods:** A questionnaire on HIV-related knowledge and behavior of young students was used to conduct the online survey. Knowledge access included school education, mass communication, and interpersonal communication. HIV-related knowledge was categorized into general and prevention knowledge. Risky behavior was defined as having multiple sexual partners or engaging in unprotected sex. Binary logistic regression was used to analyze the relationship between knowledge accesses, HIV-related knowledge and risky behaviors. Multiple mediation models constructed by Process4.1 program were conducted to determine whether the levels of HIV-related knowledge mediated the relationship between knowledge access and risky behavior.

**Results:** A total of 20,602 young adult respondents participated in the survey, with 9,541 males (46.3%) and 11,061 females (53.7%), averaging 20.14±1.91 years. Mass communication reached 19,030 (92.37%) students; 17,949 (87.12%) participants acquired HIV-related knowledge from school education; 11,274 (54.72%) students accessed knowledge through interpersonal communication. Among the 2,423 students who had sex, 363 (14.98%) had multiple sexual partners and 830 (34.26%) engaged in unprotected sex. School education (OR=0.6, 95%Cl=0.46-0.78), mass communication (OR=0.64, 95%Cl=0.47-0.87) and HIV prevention knowledge (OR=0.79, 95%Cl=0.69-0.9) were negatively associated with multiple sexual partners, while interpersonal communication (OR=1.41, 95%Cl=1.13-1.75) was positively associated. School education (OR=0.75, 95%Cl=0.64-0.91) and HIV prevention knowledge (OR=0.81, 95%Cl=0.73-0.89) were negatively correlated with unprotected sexual behaviors, while interpersonal communication (OR=1.27, 95%Cl=1.09-1.46) and general HIV knowledge (OR=1.17, 95%Cl=1.08-1.28) were significantly positively correlated. The results of the multiple mediation models revealed that knowledge accesses had indirect effects on risky behaviors through prevention knowledge and general knowledge. School education had opposing indirect effects of -0.023 and 0.023 through prevention and general knowledge, leading to a non-significant overall indirect effect. Mass communication showed indirect effects of -0.044 and 0.012, while interpersonal communication demonstrated indirect effects of 0.007 and 0.005 through the same pathways.

**Conclusions:** Students who acquire HIV-related knowledge from school education and mass media are less likely to engage in risky behaviors, compared to those who acquire it through interpersonal communication. We should fully leverage the advantages of school education and mass communication, and an emphasis should be placed on prevention knowledge to promote changes in risky behavior. Knowledge access primarily influences risky behaviors by shaping cultural values and behavioral norms, rather than solely transmitting information. To effectively reduce risky behaviors through knowledge enhancement, non-mandatory, voluntary educational approaches are recommended.


**Keywords:** Chinese young student; knowledge access; risky sexual behavior; HIV knowledge; health education; cross-sectional study

## Introduction

Human Immunodeficiency Virus (HIV) infection presents a significant public health challenge due to its high fatality rate and widespread transmission globally. Until 2023, a cumulative 39.9 million HIV positive cases including 1.3 million new infections were estimated according to the United Nation Programme on HIV/AIDS[1]. While China's concerted efforts have maintained overall HIV prevalence at a low level (approximately <0.1%), there is an alarming rise in infections among young students[2]. Worryingly, nearly 3,000 new cases of HIV infection are reported among young adults aged 15 to 24 every year, increasing at an annual rate of 30-50%[3,4]. Therefore, college students in China have become a high-risk group for HIV infection. Sexual transmission is the main mode of HIV spread among young students. Being sexually active and open to casual sex, without correct sexual behavior guidance, young students are prone to have risky behaviors (such as having multiple sexual partners and not using condoms), thereby increasing the risk of HIV infection. Given that, transforming risky behaviors is considered a preventive and control measure for restricting the spread of the HIV pandemic.

HIV-related information dissemination is found to be critical in behavioral intervention[5]. In order to reduce HIV infection among young students effectively, China conducted HIV health education for students in its six major projects aimed at curbing AIDS in 2019[6]. The public can acquire HIV-related information through various knowledge accesses, which can be commonly categorized into interpersonal communication, organizational communication, mass communication and other types in communication studies[7-9]. Information accesses exposure exerts an unstoppable and subtle influence on individuals' cognition and behaviors. Media Richness Theory proposed by Richard L. Daft and Robert H. Lengel suggests that differences in information accesses result in variations in the ability to transmit information. Different HIV-related information sources assign different labels to the nature of the information that affects young adults' understanding and perception of HIV, ultimately shaping their sexual behaviors. Therefore, the association between different knowledge accesses, knowledge levels and behaviors deserves attention, as it is essential for identifying effective methods to disseminate HIV-related knowledge and reduce risky behaviors.

However, research on sources of HIV information primarily focuses on correlation between information sources and HIV-related knowledge[10-12], which fails to fully capture the process transforming into sexual behavior. Students adopt safe sexual behavior and reject the risky behaviour based on their accumulation of knowledge, which is considered as the ultimate goal of HIV knowledge transmission. Only then can the risk of HIV infection among students be truly reduced[13]. Few studies have explored the relationship between communication channels and sexual behaviors, but they have often neglected to organize these channels[14,15]. Given the diversity of information sources, examining each one individually risks offering incomplete perspectives. Instead of focusing on each specific communication channel, such as distributing leaflets, watching TV, or chatting with classmates, it is essential to classify these different channels, which enables the identification of commonalities and differences among them, clarifying their respective strengths and limitations in the dissemination of information.

With the aim of seeking effective information accesses, providing evidence for disseminating knowledge and reducing risky behavior among young students, the study investigated the knowledge access, knowledge level and risky behaviors of students, focusing on whether knowledge accesses are associated with sexual behaviors, determining if the HIV-related knowledge mediates the relationship between knowledge accesses and risky behaviors.

# Methods

## Participants

Young students from colleges in Zhejiang province voluntarily participated the questionnaire survey on the basis of informed consent. We sampled students from five colleges, covering comprehensive education, science and technology, medicine, and vocational training, representing different types of higher education institutions in Zhejiang province.

## Data collection and variable measurement

A questionnaire on HIV/AIDS knowledge and behavior among young college students was used to conduct the online survey. The content of the questionnaire included demographic characteristics (age, gender, major etc.), knowledge accesses, HIV-related knowledge and sexual behaviors. Knowledge accesses in our study included school education, mass communication and interpersonal communication, which are always discussed in education communication[16]. As an educational organization, school can disseminate HIV-related knowledge by organizing classes and giving lectures, which plays an important role in the education of young students. Mass communication means the way to transmit information to the public via mass media, such as the Internet, radio, television, books, newspapers and so on. Interpersonal communication refers to direct interaction between two or more people obtaining information, as acquiring HIV-related knowledge from parents, classmates or friends.

As a commonly used scale [17,18], "Eight questions for Youth" was used to measure HIV-related knowledge, which refers to the eight items of HIV/AIDS core knowledge proposed by the Chinese Center for Disease Control and Prevention in 2016[19]. HIV-related knowledge was categorized into two types based on its content. The questions related to the harmfulness of HIV/AIDS and legal knowledge were summarized as the general HIV knowledge. The mode of HIV transmission, prevention measures, and coping strategies after risky behaviors were summarized as HIV prevention knowledge. Risky behavior in our study was defined as having multiple sexual partners or engaging in unprotected sexual behaviors. Having more than 2 sexual partners was considered as having multiple sexual partners. Not using a condom every time during sex was considered as unprotected sexual behavior, while consistent condom use was regarded as never engaging in unprotected sex.

## Statistical analysis

Data analysis was conducted using SPSS19.0. Chi-square test was used to analyze the differences in knowledge acquisition ways among people with different characteristics. Taking multiple sexual partners (no multiple sexual partners=0, had multiple sexual partners=1) and unprotected sexual behavior (no unprotected sexual behavior=0, had unprotected sexual behaviors=1) as dependent variables. Three forms of knowledge accesses including school education, mass communication and interpersonal communication, HIV-related knowledge containing general knowledge and prevention knowledge of HIV, were used as the core independent variables. After controlling the confounding factors such as gender, age, major and grade, the effects of knowledge access and HIV-related knowledge on sexual behaviors were analyzed using binary logistic regression.

Process4.1 (Model 4) program compiled by Hayes was used to construct multiple mediation models of "knowledge accesses-knowledge-risky behaviors" to explore how different knowledge accesses (school education, mass communication, and interpersonal communication) directly affect risky behaviors and how they indirectly affect risky behaviors through general knowledge and prevention knowledge. Multiple mediation (Model 4) analysis based on bootstrap, with 5000 repeated sampling

times. The confounding factors were controlled for analysis. The significance test was two-sided, and level of significance was set at $P<.05$.

## Results

## Sample characteristics

The study population comprised 20,602 students. There were 9541 males (46.3%) and 11061 females (53.7%). The average age was (20.14±1.91) years old. The number of freshmen, sophomores, juniors and seniors were 10339 (50.18%), 4679 (22.71%), 2532 (12.29%) and 974 (4.73%) respectively. 2078 (10.09%) were graduate students. In terms of major, 7835 (38.03%) were majoring in medicine, 6729 (32.66%) were enrolled in science and technology programs, 4947 (24.01%) were studying literature, arts, or management, and 1091 (5.3%) were in vocational education. A total of 2,423 students had sex. Among them, 363 (14.98%) had multiple sexual partners and 830 (34.26%) engaged in unprotected sexual behaviors.

## HIV-related knowledge and knowledge accesses

The average HIV-related knowledge score of 20,602 college students was 6.95±1.32. 8,485 students (41%) answered all questions correctly. 125 students (0.6%) scored 0. The average score of general knowledge was 3.26±0.88, and the average score of prevention knowledge was 3.69±0.69. (Table 1)

Table 1. Responses of HIV-related knowledge among young students

| | HIV-related knowledge | Correct count | Accuracy (%) |
|---|---|---|---|
| **General knowledge** | AIDS is a serious and incurable infectious disease. | 15623 | 75.8 |
| | The main transmission mode of AIDS among young students in China is male homosexual, followed by heterosexual behavior. | 15860 | 77 |
| | A person infected with HIV can be identified by their appearance. | 17918 | 87 |
| | The rights of people living with HIV, including marriage, employment, and education, are protected by national law. | 17669 | 85.8 |
| | Can daily life and learning contact infect HIV? | 18499 | 89.8 |
| **Prevention knowledge** | Consistent and correct condom use reduces the risk of acquiring and transmitting HIV. | 19671 | 95.5 |
| | The use of new psychoactive substances increases the risk of HIV infection. | 17985 | 87.3 |
| | Seeking HIV testing and counseling after engaging in risky behaviors is essential. | 19894 | 96.6 |

The audience for mass communication included 19,030 students (92.37%); 17,949 students (87.12%) received school education to acquire HIV-related knowledge; 11,274 (54.72%) obtained HIV-related knowledge via interpersonal communication, accounting for a relatively lower proportion. 9,645 students (46.8%) used all three forms of information channels to obtain knowledge, whereas only 2,596 students (12.6%) relied on a single source for obtaining knowledge (Figure 1).

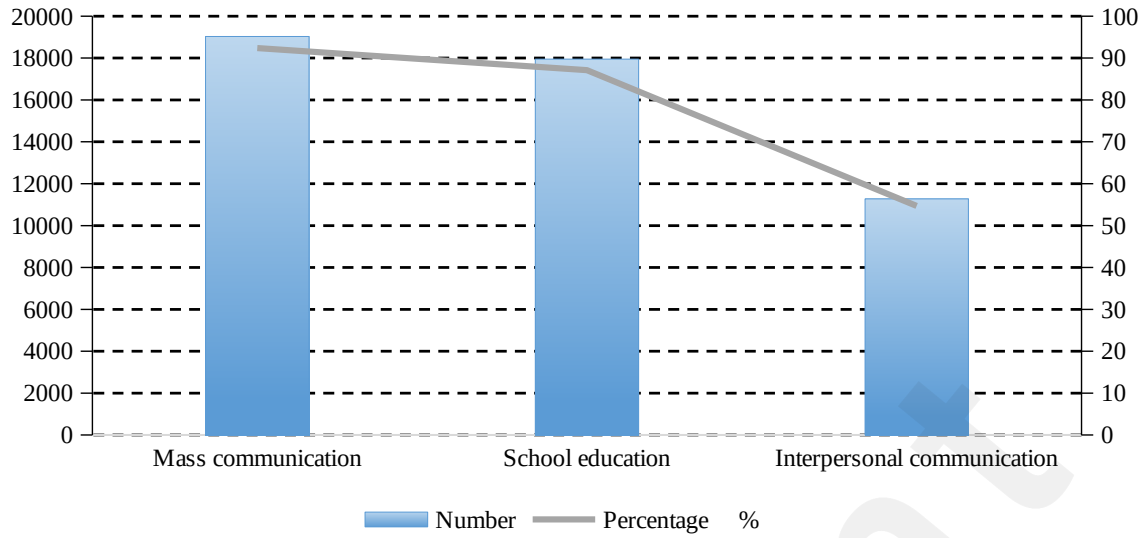


**Figure 1.** Knowledge accesses among young students

## Distribution characteristics of knowledge accesses of young students

Students with different genders, grades, ages, majors and sexual behaviors exhibited varying preferences for information sources. The majority of those relying on interpersonal communication were male. In terms of age, students under 20 primarily acquired knowledge through school education and interpersonal communication, and the audience of mass communication was mainly composed of students aged 20 and above. Medical students were the main audience for both school education and mass communication, whereas vocational students mostly preferred interpersonal communication. Students who never had sexual behavior mainly chose school education and mass communication. In terms of risky sexual behaviors, those with multiple sexual partners and those who engaged in unprotected sexual behaviors tended to obtain HIV-related knowledge through interpersonal communication (Table 2).

Table 2. Distribution characteristics of knowledge accesses in different populations

| Items | | Number | School Education [%] | Mass Communication [%] | Interpersonal Communication [%] |
|---|---|---|---|---|---|
| **Gender** | Male | 9541 | 8121 [85.12] | 8555 [89.67] | 5194 [54.44] |
| | Female | 11061 | 9828 [88.85] | 10475 [94.7] | 5980 [54.06] |
| | $\chi^2$ | | 63.72 | 184.36 | 4.19 |
| | *P* | | <.01 | <.01 | .04 |
| **Age** | ≤20 | 13835 | 12353 [89.29] | 12689 [91.72] | 7876 [56.93] |
| | >20 | 6767 | 5596 [82.7] | 6341 [93.7] | 3398 [50.21] |
| | $\chi^2$ | | 176.04 | 25.48 | 82.67 |
| | *P* | | <.01 | <.01 | <.01 |
| **Major** | Medicine | 7835 | 7098 [90.59] | 7301 [93.18] | 4521 [57.7] |
| | Science and technology | 6729 | 5650 [83.96] | 6193 [92.03] | 3541 [52.62] |
| | literature, arts, or management | 4947 | 4228 [85.47] | 4587 [92.72] | 2578 [52.11] |

| | | | | | |
|---|---|---|---|---|---|
| | Vocational education | 1091 | 973（89.18） | 949（86.98） | 634（58.11） |
| | $\chi^2$ | | 160.17 | 54.22 | 58.72 |
| | *P* | | <.01 | <.01 | <.01 |
| **Grade** | Freshman | 10339 | 9289（89.84） | 9421（91.12） | 5945（57.5） |
| | Sophomore | 4679 | 4152（88.74） | 4344（92.84） | 2625（56.1） |
| | Junior | 2532 | 2107（83.21） | 2395（94.59） | 1309（51.7） |
| | Senior | 974 | 807（82.85） | 907（93.12） | 499（51.23） |
| | Graduate student | 2078 | 1594（76.71） | 1963（94.47） | 896（43.12） |
| | $\chi^2$ | | 330.3 | 55.78 | 162.87 |
| | *P* | | <.01 | <.01 | <.01 |
| **Having sexual intercourse?** | Yes | 2423 | 1972（81.39） | 2213（91.33） | 1358（56.05） |
| | No | 18179 | 15977（87.89） | 16817（92.51） | 9916（54.55） |
| | $\chi^2$ | | 80.53 | 4.19 | 1.94 |
| | *P* | | <.01 | .04 | .16 |
| **Having multiple sexual partners?** | Yes | 363 | 281（77.41） | 313（86.23） | 219（60.33） |
| | No | 20239 | 17668（87.3） | 18717（92.48） | 11055（54.62） |
| | $\chi^2$ | | 31.07 | 19.79 | 4.69 |
| | *P* | | <.01 | <.01 | .03 |
| **Having unprotected sex?** | Yes | 830 | 673（81.08） | 747（90） | 478（57.59） |
| | No | 19772 | 17276（87.38） | 18283（92.47） | 10796（54.6） |
| | $\chi^2$ | | 28.11 | 6.89 | 2.87 |
| | *P* | | <.01 | <.01 | .09 |

## Association between knowledge accesses, HIV-related knowledge and multiple sexual partner behaviors

According to multivariate logistic regression analysis, compared with students who didn't acquire knowledge through school education and mass media, those who acquired knowledge through school education (OR=0.6, 95%Cl=0.46-0.78) and mass media (OR=0.64; 95%Cl=0.47-0.87) were less likely to have multiple sexual partners. Students who acquired knowledge through interpersonal communication (OR=1.41, 95%Cl=1.13-1.75) were more likely to have multiple sexual partners than those who didn't. A higher level of prevention knowledge (OR=0.79, 95% CI=0.69-0.9) was associated with a lower likelihood of having multiple sexual partners; the level of general knowledge had no significant effect on the behavior of having multiple sexual partners (Table 3).

Table 3. Association between knowledge accesses, HIV-related knowledge and multiple sexual partners behaviors

| Variables | B | SE | Wald | *P* | OR（95%Cl） |
|---|---|---|---|---|---|
| **Knowledge accesses** | | | | | |
| **School education** | -0.51 | 0.13 | 14.94 | <.01 | 0.6(0.46,0.78) |
| **Mass communication** | -0.45 | 0.16 | 8.05 | <.01 | 0.64(0.47,0.87) |
| **Interpersonal communication** | 0.34 | 0.11 | 9.33 | <.01 | 1.41(1.13,1.75) |
| **HIV-related knowledge** | | | | | |
| **General knowledge** | 0.11 | 0.06 | 2.69 | .1 | 1.11(0.98,1.26) |

| | | | | | |
|---|---|---|---|---|---|
| **Prevention knowledge** | -0.24 | 0.07 | 12.53 | <.01 | 0.79(0.69,0.9) |

## Association between knowledge accesses, HIV-related knowledge and unprotected sexual behaviors

The regression results showed that students who acquired knowledge through school education (OR=0.75, 95%Cl=0.64-0.91) were less likely to engage in unprotected sexual behaviors than those who didn't; students who obtained knowledge through interpersonal communication (OR=1.27, 95%Cl=1.09-1.46) were more likely to engage in unprotected sexual behaviors. There was no significant association between mass media exposure and unprotected sex behaviors. General HIV knowledge (OR=1.17, 95%Cl=1.08-1.28) was associated with an increased likelihood of engaging in unprotected sexual behaviors. Prevention knowledge (OR=0.81, 95%Cl=0.73-0.89) was negatively correlated with unprotected sexual behaviors (Table 4).

Table 4. Association of knowledge accesses, HIV-related knowledge and unprotected sexual behaviors

| Variables | B | SE | Wald | *P* | OR（95%Cl） |
|---|---|---|---|---|---|
| **Knowledge accesses** | | | | | |
| **School education** | -0.29 | 0.1 | 8.947 | <.01 | 0.75(0.62,0.91) |
| **Mass communication** | -0.19 | 0.12 | 2.442 | .12 | 0.83(0.65,1.05) |
| **Interpersonal communication** | 0.24 | 0.07 | 9.959 | <.01 | 1.27(1.09,1.46) |
| **HIV-related knowledge** | | | | | |
| **General knowledge** | 0.16 | 0.05 | 12.73 | <.01 | 1.17(1.08,1.28) |
| **Prevention knowledge** | -0.21 | 0.05 | 18.473 | <.01 | 0.81(0.73,0.89) |

## The mediating effect of HIV-related knowledge on the correlation between knowledge accesses and risky behaviors

The results of multiple mediation models showed that both general knowledge and prevention knowledge of HIV acted as joint mediators in the relationship between various knowledge accesses (school education, mass communication, and interpersonal communication) and risky behaviors.

The regression results indicated that school education was positively associated with prevention knowledge (B=0.11, *P*<.01) and general knowledge (B=0.15, *P*<.01). When simultaneously predicting risky behaviors with school education, prevention knowledge, and general knowledge, both school education (B=-0.24, *P*<.01) and prevention knowledge (B=-0.22, *P*<.01) were negatively associated with risky behaviors, while general knowledge was positively associated with risky behaviors (B=0.15, *P*<.01). The indirect effects of prevention knowledge and general knowledge were -0.023, 0.023 respectively, and neither bootstrap 95% confidence interval included zero. School education primarily influenced risky behaviors through direct effects, the total indirect effect was non-significant, suggesting that the opposing effects of the two mediating pathways may offset each other (Figure 2).

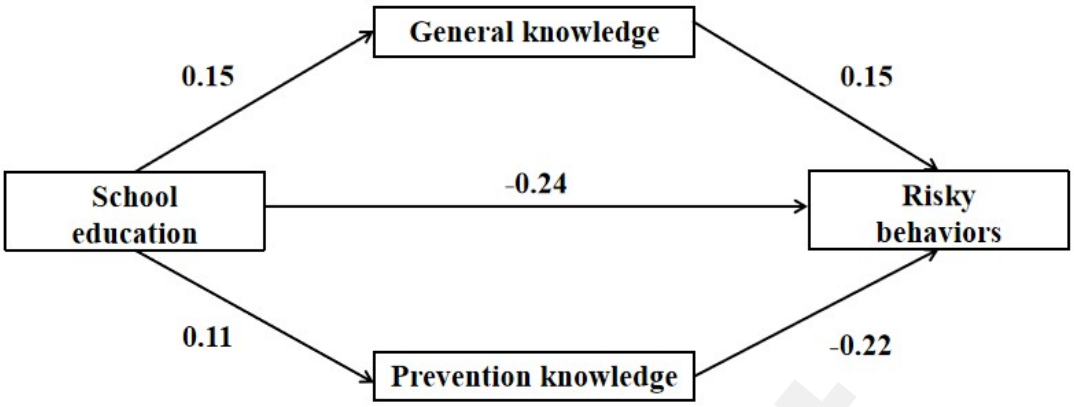


Figure 2 The mediating effect of general knowledge and prevention knowledge of HIV on the relationship between school education and risky behaviors

Mass communication was positively associated with prevention knowledge (B=0.2, *P*<.01) and general knowledge (B=0.08, *P*<.01). When predicting risky behaviors with mass communication, prevention knowledge, and general knowledge, both school education (B=-0.26, *P*<.01) and prevention knowledge (B=-0.21, *P*<.01) were negatively associated with risky behaviors, while general knowledge was positively associated (B=0.15, *P*<.01). Mass communication primarily influenced risky behaviors through direct effects, while also impacting risky behaviors by enhancing prevention knowledge and general knowledge. The indirect effects of prevention knowledge and general knowledge were -0.044, 0.012 respectively, and neither of the bootstrap 95% confidence intervals included zero (Figure 3).

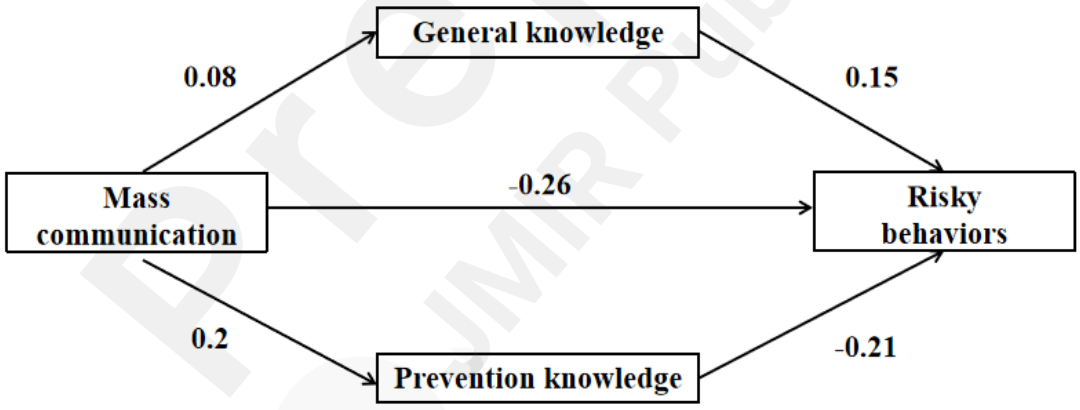


Figure 3 The mediating effect of general knowledge and prevention knowledge of HIV on the relationship between mass communication and risky behaviors

Interpersonal communication was negatively associated with prevention knowledge (B=-0.03, *P*<.01) and positively associated with general knowledge (B=0.03, *P*<.01). Interpersonal communication showed a direct positive association with risky behaviors (B= 0.21, *P*<.01), while both prevention knowledge (B =-0.22, *P*<.01) and general knowledge (B=0.14, *P*<.01) demonstrated significant effects on risky behaviors. Interpersonal communication directly had a positive impact on risky behaviors, and increased risky behaviors by improving general knowledge and reducing prevention knowledge. The indirect effects of prevention knowledge and general knowledge were 0.007 and 0.005 respectively, and both were statistically significant, as the bootstrap 95% confidence intervals did not include zero (Figure 4).

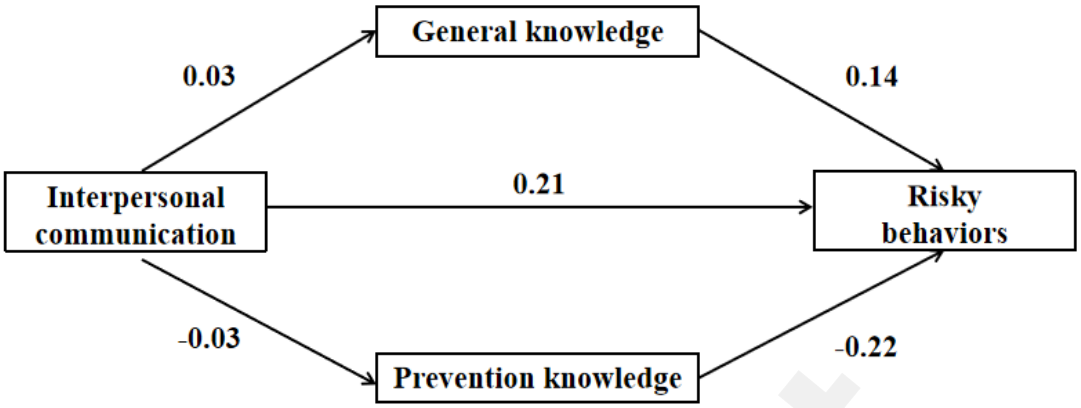


Figure 4 The mediating effect of general knowledge and prevention knowledge of HIV on the relationship between interpersonal communication and risky behaviors

## Discussion

A score of 6 or more is considered to be up to the standard for HIV health education knowledge[20]. In this survey, 89.8% of the students answered more than 6 questions correctly. There is still a long way to go to meet the the goal of over 95% of young students being aware of HIV, as outlined in the Implementation Plan for Curbing the Spread of HIV/AIDS (2019-2022). College students mainly obtain HIV-related information through mass media and school education, which aligns with previous studies conducted in China[21, 22]. This may be attributed to the rapid development of the Internet, allowing young adults can easily obtain various information about HIV/AIDS through search engines, social media and other platforms[23, 24]. School, being central to students' daily lives, offers a structured environment conducive to HIV educational campaigns, which has the advantage of centralized publicity. Therefore, the mass communication and school education are always favored by students. However, fewer students reported acquiring HIV-related knowledge through interpersonal communication, which may be affected by Chinese traditional culture. Sexual content is often regarded as an obscure and sensitive topic, whether parents or friends will deliberately avoid such topics.

Access to HIV-related knowledge through school education and mass media may have a positive association with a reduction in behaviors such as having multiple sexual partners and engaging in unprotected sex, as indicated by our regression analysis. As a vital form of organizational communication, school education holds a high level of authority and credibility, which is embodied in the strict censorship system of knowledge dissemination, so young students are inclined to trust the information they receive in school. In addition, organizational communication may be mandatory. For instance, schools can introduce compulsory HIV education courses or make it mandatory for students to attend relevant lectures, which can break through the personal "information cocoons" to some extent, where students might otherwise only seek only information aligned with their existing interests or biases. As a result, students are exposed to more comprehensive and accurate HIV-related knowledge than they might seek out on their own. The mass media, including newspapers, radio, television, and the Internet, also has unique advantages. Mass media is characterized by its speed of transmission and the breadth of its content, allowing it to rapidly achieve widespread information coverage. The ability of mass media to disseminate knowledge in engaging and entertaining formats helps overcome the discomfort associated with "face-to-face" discussions on sensitive topics like HIV, making it easier for students to accept and retain the information.

The association between school education and sexual behaviors such as having multiple sexual

partners and engaging in unprotected sex is stronger than that of mass media, which is consistent with the research of Chinese scholars[25]. Unlike online platforms, where information can be overwhelming and fragmented, school curricula are designed to be comprehensive and progressive, allowing students to build their understanding step by step. In addition, the accuracy of information from mass media is often difficult to guarantee. While the Internet has become the primary medium through which young students access information, its less regulated nature requires students to exercise caution. The sheer volume of content, along with the prevalence of unreliable or false information, underscores the importance of seeking official and authoritative channels to acquire accurate HIV knowledge.
Mass communication did not have a significant effect on unprotected sex, but did have a significant effect on the reduction of multiple sexual partners. When disseminating information, mass media always tailor content and format to align with the public's interests and concerns. Compared to topics like "correct condom use during sex", the issue of multiple sexual partners is much more provocative and sensitive, which can arouse the curiosity of college students. It is suggested that the mass media should not only consider the attractiveness of the content, but also shoulder the social responsibility of providing more comprehensive coverage of HIV/AIDS prevention.

By regression analysis, it was found that students who acquired knowledge through interpersonal communication were more likely to have multiple sexual partners and engage in unprotected sex. This may be due to the lack of clarity or comprehensiveness in the information disseminated through personal networks, which can even include incorrect knowledge, leading to misconceptions about HIV. In the mediation analysis, we found that interpersonal communication negatively predicted HIV prevention knowledge, which may be able to support this view. First, HIV-related knowledge acquired from family members or friends is relatively superficial[23], and it is transmitted may be based on personal understanding, hearsay or limited media information, making it difficult to guarantee the accuracy and comprehensiveness. Second, interpersonal communication tends to be unsystematic, and more emphasis is placed on general knowledge such as the harm of HIV/AIDS, which may lead to the omission of key prevention details. Third, Interpersonal communication often comes with personal filters, which can hinder the full absorption of knowledge. Affected by emotional factors, communicating with different people can result in the simplification or sharpening of the information. For instance, when receiving HIV knowledge from a close friend, the emotional bond may lead to a downplaying of risks, as he might use casual language or humor to address the topic, creating a false sense of security and diminish the perceived seriousness of harms of HIV. It is recommended that young students, especially the main audience group of interpersonal communication, consult HIV curricula in schools or official websites to avoid being misled by false information when discussing HIV with parents, relatives, or friends. When acting as communicators, young students must ensure the accuracy of the information, prioritize the transmission of prevention knowledge, and treat the topic with appropriate seriousness.

However, the study could not determine whether the acquisition of HIV-related knowledge through interpersonal communication occurs in succession with risky behaviors, so it could not clarify whether interpersonal communication promote the occurrence of risky sexual behaviors. Individuals who have already engaged in risky behaviors may seek understanding, support or information by communicating with friends or close partner, and similar views can be found[26]. This tendency to seek social support after engaging in risky behaviors may explain why acquiring knowledge through interpersonal communication is positively correlated with risky sexual behaviors.

According to the "KAP" model, knowledge is the foundation of behavior change, but a high level of HIV knowledge does not always lead to safe behaviors, reflecting the phenomenon of "separation". The study found that a higher level of general knowledge of HIV may related with more risky sexual

behaviors, while prevention knowledge plays a positive role in reducing such behaviors. The findings suggest that different types of knowledge have varying effects on risky behaviors. General knowledge provides a broad and foundational understanding of HIV, but may not effectively translate into safe sexual practices. In fact, a strong grasp of general knowledge may foster a sense of "overconfidence" or "risk underestimation", causing students to lower their vigilance during sexual behaviors. In addition, students may misunderstand the legal protection for HIV-positive individuals, regarding such policies as shelters for risky sexual behaviors. Consequently, general knowledge may be insufficient to reduce risky behaviors alone. Prevention knowledge is relatively more specific and practical, directly guiding individuals to adopt HIV prevention measures, such as correctly using condoms or knowing when and where to get tested after potential exposure. Unlike general knowledge, which may raise awareness but leave gaps in practical application, prevention knowledge equips students with concrete tools to lower their risk and facilitates the translation of knowledge into safe behaviors. Therefore, the focus should be on strengthening the dissemination of HIV prevention knowledge. However, it does not imply that we should reduce the publicity of HIV general knowledge, which serves as the foundation for building a comprehensive understanding of HIV. HIV health education should emphasize prevention knowledge while constantly reinforcing general knowledge[27], which enables college students to gain a more systematic and comprehensive grasp of HIV information. By combining a solid foundation of general knowledge with a stronger focus on prevention, young students will be better positioned to apply information in real-life situations, significantly lowering their likelihood of engaging in risky sexual behaviors.

Based on the results of the mediation analysis, it was found that school education, mass communication, and interpersonal communication all influence risky behaviors through both prevention knowledge and general knowledge. However, the overall mediation effects were relatively small, and the influence paths varied across these channels. It suggests that the impact of these knowledge accesses on behavior may not primarily operate through knowledge acquisition, but is instead driven more by their direct influence. Media systems serve not only as tools for knowledge transmission but also as sites for the production and reproduction of cultural capital, influencing individuals by shaping cultural values and behavioral norms. School education's influence on risky behaviors may arise less from knowledge acquisition and more from the structured and organized environment it provides, where students may feel external pressures or benefit from behavioral norms enforced by the school setting. Interpersonal communication easily foster an open atmosphere for young students, making students more likely to have fluke or curiosity, and ultimately leading to a higher likelihood of engaging in risky behaviors. The indirect effect of mass communication on reducing risky behaviors by improving the knowledge level of individuals is relatively strong, especially through the enhancement of prevention knowledge. It may be due to the voluntary nature of information seeking in mass communication that highlights the importance of knowledge acquisition initiatives. This personalized, needs-driven communication approach is more effective than passive teaching methods in influencing behavior by increasing the level of knowledge.

## Conclusion

Students who acquire HIV-related knowledge from school education and mass media are less likely to engage in risky behaviors, rather than through interpersonal communication. Therefore, we should give full play to the advantages of the authority of school education knowledge transmission and the timeliness of mass communication. Prevention knowledge should be emphasized to promote the transformation from knowledge to behavior. The primary influence of knowledge accesses lies in their ability to shape cultural values and behavioral norms, rather than solely transmitting information. To effectively reduce risky behaviors through knowledge enhancement, non-mandatory, voluntary educational approaches are recommended.

## Limitations

The study is subjective to some limitations. First, our study participants were collected from five universities in Zhejiang Province, the results could not represent all the college students in China considering the geographical and cultural differences. Second, with regard to the conceptualization of the three types of information contact, classification of knowledge and the selection of influencing variables, there is much room for further studies. Third, considering the sensitivity of sexual behaviors, the young students may provide social desirability responses, which may influence the results. Last but not least, as a cross-sectional design, our study could not explore the causality of HIV-related knowledge and risky sexual behaviors.

## Declarations

## Ethics approval and consent to participate

The study protocol and consent procedure were approved by Ethics Review Committee, School of Public Health, Zhejiang university(ZGL202306-9). The confidentiality of individuals was properly protected in the management of investigation and the processing of data.

## Consent for publication

All authors have agreed with the content and approved the submission of the manuscript.

## Availability of data and material

All of the main data have been included in the results. Additional materials with details may be obtained from the corresponding author.

## Competing interests

All authors declare that they have no competing interests.

## Funding

The research was supported by the Fundamental Research Funds for the Central Universities.

## Authors' contributions

All authors were responsible for the structure of this paper. YZ conducted the data analysis and drafted the paper. JX contributed to the study's conception and design, interpretation of the data, and critical revisions of the paper. XL and XZ contributed equally as co-Corresponding Authors. All authors all approved the final versions for submission.

## Acknowledgments

We are grateful to all study participants for their valuable participation.

## References:


1. UNAIDS, 2024 global AIDS report — The Urgency of Now: AIDS at a Crossroads.2024.https://www.unaids.org/sites/default/files/media_asset/2024-unaids-global-aids-update_en.pdf
2. Han MJ, Analysis on HIV/AIDS epidemic situation and prospect of prevention and control in China. Chin J AIDS STD, 2023; 29(03): p. 247-250.[doi:10.13419/j.cnki.aids.2023.03.01]
3. Li GQ, Jiang Y and Zhang LQ, HIV upsurge in China's students. Science, 2019; 364(6442): p. 711.[doi:10.1126/science.aay0799]
4. Wu ZY, New characteristics and challenges of HIV sexual transmission in China. Chinese Journal of Epidemiology, 2018; 39(06): p.707-709.
5. Fineberg, H V, Education to prevent AIDS: prospects and obstacles. Science, 1988; 239(4840): p. 592-6.[doi:10.1126/science.3340845]
6. China NHC, Implementation plan to curb the spread of AIDS (2019-2022) –China. 2020; 10(01): p. 47-50. https://hivpreventioncoalition.unaids.org/sites/default/files/attachments/implementation_plan_to_curb_the_spread_of_aids_2019-2022-_china.pdf
7. Palupi, R, B Purwanto and T Wuryanto, Role-Playing Method for Students' Interpersonal Communication Improvement. Khatulistiwa: Jurnal Pendidikan dan Sosial Humaniora, 2023; 3: p. 259-270. [doi:10.55606/khatulistiwa.v3i2.2085]
8. Yu D,Wang LL, Analysis on the communication channels and effects of major events in China in 2009- based on a survey of urban residents in Beijing, Shanghai, and Guangzhou. Modern Communication(Journal of Communication University of China), 2010; (09): p35-41.[doi:10.19997/j.cnki.xdcb.2010.09.008]
9. Wang D,Shi ZP, The Influence of Communication Channels Exposure on the Public's Infectious Disease Protection Behavior: Mediated by Health Beliefs. Journalism & Communication, 2023; 30(08): p63-79+127.
10. Tung, WC, et al., A Comparison of HIV Knowledge, Attitudes, and Sources of STI Information Between Female and Male College Students in Taiwan. Health Care Women Int, 2015; 36(8): p. 870-82. [doi:10.1080/07399332.2014.962136]
11. Abiona, T, et al., HIV/AIDS knowledge, perception of knowledge and sources of information among university students in USA, Turkey, South Africa and Nigeria. Health Education Journal, 2014; 73(6): p. 755-767. [doi:10.1177/0017896914550943]
12. Nwakasi, C, et al., HIV knowledge and information access among women cancer survivors in Nigeria. Journal of Cancer Policy, 2024; 39: p. 100456.[doi:10.1016/j.jcpo.2023.100456]
13. Niu WY, Health Communication. Chinese Journal of Health Education, 2004; (04): p43-46.
14. Nwagwu, W, Use of HIV/AIDS information sources and sexual behaviour of adolescents in a rural community in Southeastern Nigeria. Malaysian Journal of Library and Information Science, 2012; 17.
15. Tung, WC, et al., HIV knowledge and behavior among Chinese college students in China and the United States. West J Nurs Res, 2013;35(9): p. 1171-83. [doi: 10.1177/0193945913486201. ]
16. Purohit, N, Health Communication and Behavior Change. Healthcare System Management: Methods and Techniques. S. D. Gupta. Singapore, Springer Nature Singapore, 2022; p.295-312. [doi: 10.1007/978-981-19-3076-8_12 ]
17. Zhang, L, et al., HIV/AIDS-Related Knowledge and Attitudes Among Chinese College Students and Associated Factors: A Cross-Sectional Study. Front Public Health, 2021; 9: p. 804626. [doi: 10.3389/fpubh.2021.804626. ]

18. Lai X H,et al, Status of knowledge and behavior on AIDS among college students in Zhongshan. Chinese Journal of School Health, 2017; 38(10): p.1558-1559. [doi: 10.16835/j.cnki.1000-9817.2017.10.036]
19. China CDC, Notice on the issuance of the questionnaire on the core knowledge of AIDS publicity and education and the awareness rate of AIDS knowledge. 2016. https://ncaids.chinacdc.cn/zlk/cllb/xcy/xcdhbzy/202112/P020211221500983637737.pdf
20. Ma, Z, et al., HIV/AIDS-related knowledge and attitudes towards HIV rapid testing among Chinese college students: Findings from a cross-sectional survey. Prev Med Rep, 2023; 36: p. 102409. [doi:10.1016/j.pmedr.2023.102409]
21. Liu H, et al., Analysis on AIDS awareness and ways to acquire AIDS knowledge in middle school students in Zhangbei county. Modern Preventive Medicine, 2014; 41(01): p.37-40.
22. Zhang YP, Investigation and evaluation on AIDS knowledge attitude and practice of students in a university of Shenyang City Liaoning Province. Chinese Journal of Health Education, 2011; 27(08): p.596-599. [doi:10.16168/j.cnki.issn.1002-9982.2011.08.003]
23. Wang XX, Li YQ, Xiao DZ, Changes of HIV knowledge and attitude among students in Beijing from 2018 to 2022. Chin J Sch Health January, 2024; 45(01):p.51-54+59. [doi:10.16835/j.cnki.1000-9817.2024023]
24. Obeagu, EI, et al., Translation of HIV/AIDS knowledge into behavior change among secondary school adolescents in Uganda: A review. Medicine, 2023; 102(49): p. e36599. [doi:10.1097/MD.0000000000036599]
25. Hong X, et al., Investigation on health education demand and knowledge about AIDS in medical college students. Chin J Public Health, 2007; (09): p.1036-1037.
26. Duong, HT, et al., Preventing the COVID-19 outbreak in Vietnam: Social media campaign exposure and the role of interpersonal communication. Health Communication, 2023; 38(2): p. 394-401. [doi:10.1080/10410236.2021.1953729]
27. Wang JJ, Chen QF, Han MJ, Survey on AIDS knowledge awareness of male college students in 7 universities in China. Chin J AIDS STD, 2020; 26(05): p.493-495. [doi:10.13419/j.cnki.aids.2020.05.10]