



# HIV/AIDS-related knowledge and attitudes towards HIV rapid testing among Chinese college students: Findings from a cross-sectional survey

Ze Ma<sup>a</sup>, Li Guo<sup>b</sup>, Meng Zhou<sup>a</sup>, Hui Zuo<sup>a,c,\*</sup>

<sup>a</sup> School of Public Health, Suzhou Medical College of Soochow University, Suzhou, China

<sup>b</sup> Soochow University Hospital, Soochow University, Suzhou, China

<sup>c</sup> MOE Key Laboratory of Geriatric Diseases and Immunology, Suzhou Medical College of Soochow University, Suzhou, China

## ARTICLE INFO

### Keywords:

HIV/AIDS  
HIV rapid testing  
Knowledge  
Survey  
College students  
China

## ABSTRACT

Data of the awareness level of college students in China about Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) knowledge are limited. Also, the attitudes towards HIV rapid testing remain unknown among this population. Therefore, this study aimed to evaluate the awareness of HIV/AIDS knowledge and attitudes towards HIV rapid testing among Chinese college students. An online cross-sectional survey was performed in 2020. A total of 1,474 participants were finally included. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to examine associated factors for the cognitive levels and attitudes by multivariable logistic regression. Spearman rank correlation was used to examine the relationship between HIV/AIDS-related knowledge and attitudes. About 91% of participants had a high cognitive level on HIV/AIDS-related knowledge and 84.7% held a positive attitude towards the HIV rapid testing. Postgraduates (OR = 1.75, 95% CI: 1.16–2.66) and females (OR = 1.69, 95% CI: 1.13–2.52) were more knowledgeable. Females' attitudes towards the HIV rapid testing were more positive (OR = 1.91, 95% CI: 1.40–2.62). Moreover, the knowledge was positively correlated with attitudes towards the rapid testing (Spearman  $r = 0.14$ ,  $p < 0.001$ ). In conclusion, the Chinese college students had a high cognitive level on HIV/AIDS knowledge and positive attitudes towards HIV rapid testing. A high cognitive level of knowledge paralleled with positive attitudes. Special strategies such as tailored education via HIV/AIDS curriculum and awareness campaigns are needed for undergraduates and male students to minimize the gaps regarding HIV/AIDS-related knowledge and attitudes.

## 1. Introduction

Human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) continues to be a major global public health challenge. According to the statistics on global disease burden in 2019, about 36.8 million people were living with HIV, and 0.86 million HIV deaths worldwide (Jahagirdar et al., 2021).

China had a total of 148,598 new HIV cases and 31,522 HIV deaths in 2019 (Wu et al., 2021). Notably, the prevalence rate among young college students has been rising rapidly. According to the data from the National AIDS/ Sexually Transmitted Disease (STD) Prevention and Control Center, the China Center for Disease Control and Prevention, the number of newly diagnosed students has seen an annual growth rate of 35% in 2011 and 50% in 2014 (Cai et al., 2020; Li et al., 2019). HIV/AIDS incidence increased rapidly between 2008 and 2015, with stable incidence reported between 2015 and 2017 (Dong et al., 2020). From

2013 to 2017, 12,037 new cases of HIV among young students were reported in China (Han et al., 2018). Correspondingly, the Chinese government has made great efforts in HIV prevention among college students (Zheng et al., 2020).

Nevertheless, college students in China were still not well equipped with HIV/AIDS-related knowledge. A national survey in China reported that the overall cognitive level of HIV/AIDS-related knowledge among young people was as low as 58.9% (Ruan et al., 2021). Only 71% of the college students in Qinghai Province knew that the use of condoms could reduce the risk of being HIV-positive (Liu et al., 2020). The awareness rate of HIV/AIDS-related knowledge among students from a university in Henan Province was 80.8% (Zhang et al., 2021).

The use of HIV rapid testing kits is a newly important public health service strategy for HIV/AIDS prevention. A study suggested that introducing and promoting HIV rapid testing could increase HIV testing frequency among gay and bisexual men (Keen et al., 2019). Among four

\* Corresponding author at: School of Public Health, Suzhou Medical College of Soochow University, 199 Ren'ai Rd., Suzhou 215123, China.  
E-mail address: [zuohui@suda.edu.cn](mailto:zuohui@suda.edu.cn) (H. Zuo).

methods of HIV testing available for Australian, the most favorite one was family HIV rapid testing (Yang et al., 2014).

Despite these findings, limited data are available on the HIV/AIDS-related knowledge among Chinese college students, and no study has reported the attitudes towards the use of HIV rapid testing kits in Chinese colleges. Therefore, the purpose of this study was to evaluate the awareness level of HIV/AIDS-related knowledge among college students and investigate their attitudes towards HIV rapid testing on campus in China, which may provide valuable insights for HIV/AIDS prevention strategies and educational campaigns.

## 2. Methods

### 2.1. Study design and participants

An online cross-sectional survey was conducted at a university in Eastern China in November 2020. All data were collected via the WJX (a Chinese online survey platform, <https://www.wjx.cn>). We used cluster random sampling approach to recruit a sample with diverse majors and from different grades. Individuals are eligible if they meet the following criteria: 1) undergraduate and postgraduate students in the university; 2) aged 18 years or older; 3) willing to provide informed consent. A total of 1,477 college students accepted the invitation by their grade counselors. Three participants with an answering time of <30 s were excluded to ensure the reliability of the data, leaving 1,474 participants for the final analyses. The effective response rate was 99.8%. The survey was conducted according to the Declaration of Helsinki, which is an internationally recognized ethical guideline for medical research involving human subjects. All participants provided online informed consent.

### 2.2. Measures

The anonymous questionnaire was mainly adapted from the “Chinese AIDS Sentinel Testing Implementation Plan” published by the Chinese Center for Disease Control and Prevention, and integrated questions about the attitudes towards HIV antibody rapid test kits after an extensive literature review and consulting with professionals in the HIV/AIDS field. The questionnaire was composed of 22 questions including sociodemographic information (5 questions), HIV/AIDS-related knowledge (13 questions), and the attitudes towards HIV rapid testing (4 questions). Sociodemographic indicators included gender, age, hometown, educational level, and sexual orientation. For the single-choice questions of HIV/AIDS-related knowledge, the correct answer was scored 1 point, and the wrong answers were scored 0 points (Kene et al., 2021). For the multiple-choice questions, 1 score was assigned only if they provided all the right answers. The HIV knowledge rate of the population was measured by 13 questions. Accordingly, assessments were based on the analysis of the summation of these scores, which had a possible range of 0–13, whereby scores greater than or equal to 10 indicated a high cognitive level of HIV, else were considered as having a low cognitive level of HIV. For each question of the attitudes towards HIV rapid testing kits, the answers (‘no’, ‘to pay no attention to it’, ‘it doesn’t matter’, and ‘I don’t want to learn’) were scored as 0, and the rest of the choices scored as 1. Those who scored 3 or more were considered as having a positive attitude towards the HIV rapid testing kits.

### 2.3. Statistical analysis

Sociodemographic characteristics of the participants are presented as frequencies and percentages. Multivariable logistic regression was conducted to evaluate possible factors (gender, age, hometown, educational level, and sexual orientation) associated with HIV/AIDS-related knowledge and attitudes towards the HIV rapid testing. The corresponding results were presented as odds ratio (OR) and 95% confidence interval (CI). Spearman rank correlation was used to examine the

relationship between HIV/AIDS-related knowledge and attitudes towards HIV rapid testing kits. All analyses were performed using Statistics Analysis System (version 9.4). All tests were two-tailed, and a P value < 0.05 was considered statistically significant.

## 3. Results

### 3.1. Characteristics of the study participants

In this study, about half of the participants were female (51.9%), master and doctoral students (53.8%), and came from the urban area (53.8%). The majority, i.e. 93.8% of the participants were aged 18–25 years. Eighty-six percent of the participants were reported as heterosexual (Table 1).

### 3.2. HIV/AIDS-related knowledge

Overall, 91% of the participants were at a high cognitive level on HIV/AIDS-related knowledge. Of the 13 HIV/AIDS-related knowledge questions, the correct rate of  $\geq 7$  questions was more than 90%. The three questions with the most correct answers were that sharing syringes with people living with HIV may get AIDS (99.7%), blood transfusion with HIV will get AIDS (99.4%), and we should actively seek HIV testing and counseling after a high-risk behavior including sharing needles and equipment among drug users/unsafe sexual behaviors (98.4%). Approximately three-quarters of the participants answered correctly that HIV can not be transmitted through mosquito bites (74.1%), STD can increase the risk of acquiring HIV (74.2%), and only 67.9% of the participants responded yes to the question “whether the main mode of AIDS transmission among young students in our country is male-male sexual behaviors, followed by heterosexual behaviors”. Moreover, only 55.6% of the participants could give a completely correct answer about the institutions which provide authoritative HIV/AIDS testing services (Table 2).

### 3.3. Attitudes towards HIV rapid testing

Overall, 84.7% of the participants held a positive attitude towards the HIV rapid testing. Specifically, 86.0% expressed their willingness to watch videos provided on campus regarding the free use of HIV antibody rapid test kits. If suspecting being HIV-positive, 86.2% of the students preferred to seek formal testing through authorized institutions, whereas 12.8% of them would like to test with HIV test strips by their own, the remaining 1.0% showed a disinterest in pursuing any testing method. When asked about their ability to correctly use the HIV antibody rapid test kits, only 8.0% of the participants responded affirmatively, whereas 77.7% of the students expressed a desire to learn the use

**Table 1**  
Sociodemographic characteristics of the study participants in Eastern China, November 2020 (n = 1,474).

Characteristics	Number of participants	Percentage (%)
Gender		
Male	709	48.1
Female	765	51.9
Hometown		
Urban	743	50.4
Rural	731	49.6
Educational level		
Undergraduate	681	46.2
Postgraduate	793	53.8
Heterosexual		
Yes	1,268	86.0
No	206	14.0
Age (years)		
$\leq 25$	1,383	93.8
$> 25$	91	6.2

**Table 2**  
Cognitive levels on the HIV/AIDS-related knowledge among the college students in Eastern China, November 2020 (n = 1,474).

1. Can a person with HIV be distinguished by his appearance?	1,422	96.4
2. At present, the prevalence of AIDS among young students in our country is increasing rapidly. The main mode of transmission is male-male sexual behaviors, followed by heterosexual behaviors, right?	1,001	67.9
3. Can AIDS be transmitted by mosquito bites?	1,093	74.1
4. Will a person who has a meal with those living with HIV/AIDS get AIDS?	1,366	92.6
5. Can I get AIDS by transfusing blood with HIV?	1,466	99.4
6. Is it possible to get AIDS by sharing syringes with people living with HIV/AIDS?	1,470	99.7
7. Is it possible for a child born to a woman living with HIV to get AIDS?	1,437	97.5
8. Can the consistent use of condoms reduce HIV/AIDS transmission?	1,397	94.7
9. Will the use of new drugs (such as methamphetamine, ecstasy, K powder, etc.) increase the risk of acquiring HIV?	1,221	82.8
10. Should a person actively seek HIV testing and counseling after a high-risk behavior (sharing needles and equipment among drug users/unsafe sexual behaviors, for instance)?	1,451	98.4
11. Does suffering from sexually transmitted diseases increase the risk of acquiring HIV?	1,094	74.2
12. Can the hepatitis C virus be transmitted through blood?	1,267	85.9
13. Which institutions provide HIV testing services? (Multiple choice question)	820	55.6
Overall	1,341	90.9

of the kits. A notable proportion (14.3%) of the participants demonstrated neither the intention to use the kits nor the willingness to learn. Furthermore, 55.3% of the participants were unaware that the HIV antibody rapid test kits were available for free with an ID card on campus via condom machines (Table 3).

3.4. Associated factors

As shown in Table 4, gender and educational level were significantly associated with the cognitive level of HIV/AIDS-related knowledge. Compared with males and undergraduate students, female (OR = 1.69, 95% CI: 1.13–2.52; P = 0.011) and postgraduate students (OR = 1.75, 95% CI: 1.16–2.66; P = 0.008) were more likely to have a higher cognitive level. Moreover, females had 0.91 times of higher odds (95% CI 1.40–2.62; P < 0.001) of holding positive attitudes towards HIV rapid testing kits compared to males.

**Table 3**  
Attitudes towards HIV antibody rapid test kits among the participants in Eastern China, November 2020 (n = 1,474).

	Participants (%)
Would you like to watch and learn the information on HIV antibody rapid test kits which is promoted on campus?	
Yes	1,267 (86.0)
No	63 (4.3)
Nothing to do with me.	144 (9.7)
Which test would you like to choose if you suspect that you have been being HIV-positive?	
To test with HIV test strips by myself	188 (12.8)
To get a standardized test by authorized institutions	1,271 (86.2)
To pay no attention to it	15 (1.0)
Can you use the HIV antibody rapid test kit correctly?	
Yes	118 (8.0)
No, but I would like to learn it.	1,146 (77.7)
No, and I don't want to learn it.	210 (14.3)
Do you know that the HIV antibody rapid test kits are available for free with an ID card, via a condom machine on campus?	
Yes	659 (44.7)
No	815 (55.3)

**Table 4**  
Multiple logistic regression analysis on factors associated with the cognitive levels on HIV/AIDS-related knowledge and attitudes towards HIV rapid testing kits among 1,474 college students in Eastern China, November 2020.

	High cognitive levels on HIV/AIDS-related knowledge		Positive attitudes towards HIV rapid testing kits	
	OR (95% CI)	P	OR (95% CI)	P
Gender				
Male	1		1	
Female	1.69 (1.13, 2.52)	0.011	1.91 (1.40, 2.62)	<0.001
Educational level				
Undergraduate student	1		1	
Postgraduate student	1.75 (1.16, 2.66)	0.008	0.84 (0.60, 1.15)	0.274
Age (years)				
≤25	1		1	
>25	0.87 (0.38, 2.00)	0.740	0.70 (0.40, 1.21)	0.199
Heterosexual				
Yes	1		1	
No	0.73 (0.45, 1.19)	0.210	0.95 (0.62, 1.45)	0.809
Hometown				
Urban	1		1	
Rural	0.96 (0.66, 1.38)	0.821	1.13 (0.84, 1.51)	0.414

3.5. Correlation analysis

We further observed that cognitive level of HIV/AIDS-related knowledge was positively correlated with the attitudes towards the HIV rapid testing kits (Spearman r = 0.14, P < 0.001).

4. Discussion

4.1. HIV/AIDS-related knowledge and associated factors

Overall, 90.9% of the participants had a high cognitive level of HIV/AIDS-related knowledge, which was encouraging. The proportion was higher than the findings from Hunan Province, China (76.8%) (Xu et al., 2019) and report from a Southeast city in the US (77.2%) (Okumu et al., 2017).

In addition to efforts of health education, the high cognitive level in our study may also be due to the high quality of the participated students from a high level university. Nevertheless, the accuracy understanding of several questions was low. For example, only 74% of the participants knew mosquito bites could not spread HIV. Similar findings were reported elsewhere (Blignaut et al., 2015; Wong et al., 2008). At the same time, the average awareness rate on the question of the institutions that could provide HIV testing was 55.6%, which was lower than that in Nigerian university students (78%) (Iliyasu et al., 2020). This difference in correct response rates could be attributed to cultural and HIV/AIDS-related educational difference between Chinese and Nigerian students. It is important for students to know where to access HIV testing services, which reminds us to make more efforts on this issue. Previous studies had revealed that school health education could increase the awareness rate of HIV/AIDS prevention and control from 48.6% to 79.3% (Liu et al., 2020). Therefore, precise health education about HIV/AIDS-related knowledge is necessary for Chinese students.

The cognitive level of HIV/AIDS-related knowledge was higher among the female students than males in our study, which was consistent with previous reports (Evans et al., 2018; Muinonen et al., 2002). This was probably because women's encyclopedic brains and the precocity of their bodies make them learn sexual knowledge earlier (de Vries & Forger, 2015). Consistent with a previous study (Gökengin et al.,

2003), the cognitive level of HIV/AIDS-related knowledge in our study increased with the level of education. Education can effectively increase students' awareness of HIV/AIDS-related knowledge (Zheng et al., 2020). As the level of education increased, students had more social experiences, and more opportunities to be exposed to HIV/AIDS-related knowledge.

#### 4.2. Attitudes towards HIV rapid testing kits and associated factors

In the present study, 86% of the participants showed a positive attitude to HIV rapid testing kits. And also, 92% of the participants reported being unable to use the HIV antibody rapid test kits correctly, which was not comparable to those in Singapore (85%) (Lee et al., 2007). Previous studies suggested that HIV testing was an important and acceptable way to existing HIV testing methods and early diagnosis of AIDS could greatly extend the lives of patients (Huang et al., 2008; May et al., 2011). Notably, more than half of the participants in our study did not know that they could get the HIV antibody rapid testing kits for free with an ID card via a condom machine on campus. College students have not fully realized the significance of HIV rapid testing kits. Another possible explanation was that the students have not realized that the only way to diagnose AIDS was through an HIV antibody screening test and HIV antibody confirmatory test, which is reported in "diagnosis for HIV/AIDS" of Health Industry Standard of the People's Republic of China. We observed that students with a high cognitive level of HIV/AIDS-related knowledge also had a positive attitude towards HIV rapid testing kits. A close relationship has been previously reported between increased HIV self-testing and reduced HIV incidence (Izizag et al., 2018; Rosenberg et al., 2013), and HIV/AIDS-related knowledge was closely related to HIV testing behaviors (Asaolu et al., 2016). Therefore, we should commit to improving their knowledge about HIV/AIDS and HIV self-testing, which may finally improve the awareness rate of HIV self-testing, reacceptance, and detection rate.

Moreover, female students had a more positive attitude towards HIV rapid testing kits than males in our study. A study reported that young females had higher odds of HIV testing compared to males in Nigeria (Ajayi et al., 2020), which meant that females knew more about HIV testing methods including HIV rapid testing kits. The more they learned about HIV rapid testing kits, the more positive their attitude would become. Therefore, an extra attention to the promotion of HIV rapid testing kits needs to be paid to male students to enhance their acknowledgment and acceptance of HIV rapid testing.

#### 4.3. Implications and future study directions

It is crucial for policy makers and healthcare providers to develop and implement educational programs that specifically target college students, aiming to improve their understanding of HIV/AIDS knowledge, as well as the importance of early testing. Moreover, our findings observed that a large proportion of the college students were unaware that HIV rapid testing kits were available for free through condom machines on campus. To address this issue, it is necessary to enhance accessibility to the kits on college campuses. By providing clear information and promoting their accessibility, universities and health authorities will be able to encourage more college students to utilize these kits for early detection and prevention of HIV/AIDS.

Interventions including HIV/AIDS curriculum and awareness campaigns are needed on Chinese college students and the long-term effects of the interventions should be assessed. Moreover, given the observed gender disparity in attitudes, further research could develop targeted intervention measures specifically on male and undergraduate students to enhance their knowledge and improve their attitudes related to HIV/AIDS.

#### 4.4. Strengths and limitations

The main strengths of our study include the relatively large sample size and high response rate (99.8%). However, the present study has also several limitations. First, our study may not be representative of all Chinese college students and selection bias may have existed. Second, the reliance on self-reported data introduced the potential of self-report bias. Third, some detailed information such as the number and type of sexual partners, the situation of oral sex, anal sex, condom use, unprotected sex, or other sexual behaviors was not included in the questionnaire, which limited a further analysis.

#### 5. Conclusion

The present study indicated that the overall cognition level of HIV/AIDS-related knowledge among the Chinese college students was at a relatively high level. Nevertheless, the students know little about some specific issues including the main mode of HIV transmission, institutions which provide HIV testing services, and whether STD can increase the risk of acquiring HIV, which highlights the necessity of culturally tailored HIV/AIDS education strategies via HIV/AIDS curriculum and awareness campaigns. Since a high cognitive level of knowledge paralleled with positive attitudes, targeted prevention policies should be developed and empowered for undergraduates and male students to minimize the gaps regarding HIV/AIDS-related knowledge and attitudes.

#### CRedit authorship contribution statement

**Ze Ma:** Writing – original draft, Software, Data curation, Formal analysis. **Li Guo:** Conceptualization, Methodology, Investigation, Project administration. **Meng Zhou:** Writing – review & editing. **Hui Zuo:** Conceptualization, Methodology, Supervision, Writing – review & editing.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Data availability

Data will be made available on request.

#### References

- Ajayi, A.I., Awopegba, O.E., Adeagbo, O.A., Ushie, B.A., Oladimeji, O., 2020. Low coverage of HIV testing among adolescents and young adults in Nigeria: Implication for achieving the UNAIDS first 95. *PLoS One* 15 (5), e0233368.
- Asaolu, I.O., Gunn, J.K., Center, K.E., Koss, M.P., Iwelunmor, J.I., Ehiri, J.E., Thorne, C., 2016. Predictors of HIV Testing among Youth in Sub-Saharan Africa: A Cross-Sectional Study. *PLoS One* 11 (10), e0164052.
- Blignaut, R.J., Jacobs, J., Vergnani, T., 2015. Trends in HIV risk behaviour of incoming first-year students at a South African university: 2007–2012. *SAHARA J.* 12, 39–50. <https://doi.org/10.1080/17290376.2015.1086275>.
- Cai, C., Tang, H.L., Chen, F.F., Li, D.M., Lyu, P., 2020. Characteristics and trends of newly reported HIV infection in young students in China, 2010–2019. *Zhonghua Liu Xing Bing Xue Za Zhi* 41 (9), 1455–1459. <https://doi.org/10.3760/cma.j.cn112338-20200417-00592>.
- de Vries, G.J., Forger, N.G., 2015. Sex differences in the brain: a whole body perspective. *Biol. Sex Differ.* 6 (1), 15. <https://doi.org/10.1186/s13293-015-0032-z>.
- Dong, Y., Wang, L., Burgner, D.P., Miller, J.E., Song, Y., Ren, X., Li, Z., Xing, Y., Ma, J., Sawyer, S.M., Patton, G.C., 2020. Infectious diseases in children and adolescents in China: analysis of national surveillance data from 2008 to 2017. *BMJ* 369, m1043. <https://doi.org/10.1136/bmj.m1043>.
- Evans, D., Musakwa, N., Nattety, C., Bor, J., Lonnermark, E., Larshans, C., Andreasson, S., Nyasulu, P., Long, L., 2018. Knowledge, risk perception and access to healthcare services for HIV and tuberculosis among university students in Johannesburg, South Africa. *South African J. Child Health* 12 (spe), s19–s31. <https://doi.org/10.7196/sajch.2018.v12i2.1525>.



- Gökengin, D., Yamazhan, T., Ozkaya, D., Aytuğ, S., Ertem, E., Arda, B., Serter, D., 2003. Sexual knowledge, attitudes, and risk behaviors of students in Turkey. *J. Sch. Health* 73 (7), 258–263. <https://doi.org/10.1111/j.1746-1561.2003.tb06575.x>
- Han, J., Mao, Y.R., Tang, H.L., Li, J., Wu, Z.Y., 2018. Initial follow-up and CD4(+) T cell count test of newly reported students HIV cases in China, 2013–2017. *Zhonghua Yu Fang Yi Xue Za Zhi* 52 (12), 1254–1258. <https://doi.org/10.3760/cma.j.issn.0253-9624.2018.12.012>
- Huang, H., Ye, X., Cai, Y., Shen, L., Xu, G., Shi, R., Jin, X., 2008. Study on peer-led school-based HIV/AIDS prevention among youths in a medium-sized city in China. *Int. J. STD AIDS* 19 (5), 342–346. <https://doi.org/10.1258/ijsa.2007.007208>
- Ilyasu, Z., Kassim, R.B., Ilyasu, B.Z., Amole, T.G., Nass, N.S., Marryshow, S.E., Aliyu, M. H., 2020. Acceptability and correlates of HIV self-testing among university students in northern Nigeria. *Int. J. STD AIDS* 31 (9), 820–831. <https://doi.org/10.1177/0956462420920136>
- Izazag, B.B., Situakibanza, H., Mbutwi, T., Ingwe, R., Kiazayawoko, F., Nkodila, A., Mandina, M., Longokolo, M., Amaela, E., Mbula, M., 2018. Factors associated with acceptability of HIV self-testing (HIVST) among university students in a Peri-Urban area of the Democratic Republic of Congo (DRC). *Pan Afr. Med. J.* 31, 248. <https://doi.org/10.11604/pamj.2018.31.248.13855>
- Jahagirdar, D., Walters, M.K., Novotney, A., Brewer, E.D., Frank, T.D., Carter, A., Biehl, M.H., Abbastabar, H., Abhilash, E.S., Abu-Gharbieh, E., Abu-Raddad, L.J., Adekanmbi, V., Adeyinka, D.A., Adnani, Q.E.S., Afzal, S., Aghababaei, S., Ahinkorah, B.O., Ahmad, S., Ahmadi, K., Ahmadi, S., Ahmadpour, E., Ahmed, M.B., Ahmed Rashid, T., Ahmed Salih, Y., Akliu, A., Akram, T., Akunna, C.J., Al Hamad, H., Alahdab, F., Alanezi, F.M., Aleksandrova, E.A., Alene, K.A., Ali, L., Alipour, V., Almustanyir, S., Alvis-Guzman, N., Ameyaw, E.K., Amu, H., Andrei, C.L., Andrei, T., Anvari, D., Arabloo, J., Aremu, O., Arulappan, J., Atnafu, D.D., Ayala Quintanilla, B.P., Ayza, M.A., Azari, S., B. D.B., Banach, M., Bärnighausen, T.W., Barra, F., Barrow, A., Basu, S., Bazargan-Hejazi, S., Belay, H.G., Berheto, T.M., Bezabhe, W.M., Bezabih, Y.M., Bhagavathula, A.S., Bhardwaj, N., Bhardwaj, P., Bhattacharyya, K., Bibi, S., Bijani, A., Bisignano, C., Bolarinwa, O.A., Bolor, A., Boltsev, A.A., Briko, N.I., Buonsenso, D., Burkart, K., Butt, Z.A., Cao, C., Charan, J., Chatterjee, S., Chattu, S.K., Chattu, V.K., Choudhari, S.G., Chu, D.-T., Couto, R.A.S., Cowden, R.G., Dachew, B.A., Dadras, O., Dagnone, A.B., Dahlawi, S.M.A., Dai, X., Dandona, L., Dandona, R., das Neves, J., Degenhardt, L., Demeke, F.M., Desta, A.A., Deuba, K., Dhamnetiya, D., Dhungana, G.P., Dianatinasab, M., Diaz, D., Djalalinia, S., Doan, L.P., Dorostkar, F., Edinur, H.A., Effiong, A., Eftekhazadeh, S., El Sayed Zaki, M., Elayedath, R., Elhadi, M., El-Jaafari, S.I., El-Khatib, Z., Elsharkawy, A., Endalamaw, A., Endries, A.Y., Eskandarieh, S., Ezeonwumelu, I.J., Ezzikouri, S., Farahmand, M., Faraon, E.J.A., Fasanmi, A.O., Ferrero, S., Ferro Desideri, L., Filip, I., Fischer, F., Polayan, M.O., Foroutan, M., Fukumoto, T., Gad, M. M., Gadhana, A.A., Gaidhane, A.M., Garg, T., Gayesa, R.T., Gebreyohannes, E.A., Gesesew, H.A., Getachew Obsa, A., Ghadiri, K., Ghasghaee, A., Gilani, S.A., Ginindza, T.G., Glavan, L.-R., Glushkova, E.V., Golechha, M., Gughani, H.C., Gupta, B., Gupta, S., Gupta, V.B., Gupta, V.K., Hamidi, S., Handanagic, S., Haque, S., Harapan, H., Hargono, A., Hasaballah, A.I., Hashi, A., Hassan, S., Hassanipour, S., Hayat, K., Heredia-Pi, I., Hezam, K., Holla, R., Hoogar, P., Hoque, M.E., Hosseini, M., Hosseinzadeh, M., Hsairi, M., Hussain, R., Ibitoye, S.E., Idrisov, B., Ikuta, K.S., Ilesanmi, O.S., Ilic, I.M., Ilic, M.D., Irvani, S.S.N., Islam, M.M., Ismail, N.E., Itumalla, R., Iyamu, I.O., Jabbarinejad, R., Jain, V., Jayawardena, R., Jha, R.P., Joseph, N., Kabir, A., Kabir, Z., Kalhor, R., Kaliyadan, F., Kamath, A., Kanchan, T., Kandel, H., Kassahun, G., Katoto, P.D., Kayode, G.A., Kebede, E.M., Kebede, H.K., Khajuria, H., Khalid, N., Khan, E.A., Khan, G., Khatab, K., Kim, M.S., Kim, Y.J., Kisa, A., Kisa, S., Kochhar, S., Korshunov, V.A., Koul, P.A., Koulmane Laxminarayana, S.L., Koyanagi, A.I., Krishan, K., Kuate Defo, B., Kumar, G.A., Kumar, M., Kumar, N., Kwarteng, A., Lal, D.K., Landires, I., Lasrado, S., Lassi, Z.S., Lazarus, J.V., Lee, J.-H., Lee, Y.Y., LeGrand, K.E., Lin, C., Liu, X., Maddison, E.R., Magdy Abd El Razek, H., Mahasha, P.W., Majeed, A., Makki, A., Malik, A.A., Manamo, W.A., Mansourina, M.A., Martins-Melo, F.R., Masoumi, S.Z., Memish, Z.A., Menezes, R.G., Mengesha, E.W., Merie, H.E., Mersha, A.G., Mestrovic, T., Meylakhs, P., Mheidly, N., Miller, T.R., Mirica, A., Moazen, B., Mohammad, Y., Mohammadi, M., Mohammed, A., Mohammed, S., Mohammed, S., Moitra, M., Mokdad, A.H., Molokhia, M., Moni, M.A., Moradi, G., Moradi, Y., Mpundu-Kaambwa, C., Mubarik, S., Munro, S.B., Mwanri, L., Nachega, J.B., Nagarajan, A.J., Narayana, A.I., Naveed, M., Nayak, B.P., Nduaguba, S.O., Neupane Kandel, S., Nguifack-Tsague, G., Nguyen, T.H., Nixon, M.R., Nnaji, C.A., Noubiap, J.J., Nuñez-Samudio, V., Nyirenda, T.E., Oghenetega, O.B., Olagunju, A.T., Olakunde, B.O., Owopetu, O.F., P a, M., Padubidri, J.R., Pakhale, S., Parekh, T., Pashazadeh Kan, F., Pawar, S., Pepito, V.C.F., Peprah, E.K., Pinheiro, M., Pokhrel, K.N., Polibin, R.V., Pollok, R.C.G., Postma, M.J., Quazi Syed, Z., Radfar, A., Radhakrishnan, R.A., Rahim, F., Rahimi-Movaghar, V., Rahimzadeh, S., Rahman, M., Rahmani, A.M., Ram, P., Ranabhat, C.L., Ranasinghe, P., Rao, C.R., Rao, S.J., Rathii, P., Rawaf, D.L., Rawaf, S., Regassa, L.D., Rehman, I.u., Renzaho, A.M.N., Rezaei, N., Rezaehosseini, O., Rezaei, M.S., Rezapour, A., Ripon, R.K., Rodrigues, V., Roshchin, D. O., Rwegerera, G.M., Saeed, U., Saeedi Moghaddam, S., Sagar, R., Saif-Ur-Rahman, K.M., Salem, M.R., Samaei, M., Samy, A.M., Santric-Milicevic, M.M., Saroshe, S., Sathian, B., Satpathy, M., Sawhney, M., Schutte, A.E., Seylani, A., Shaikh, M.A., Shaka, M.F., Shamshad, H., Shamsizadeh, M., Shannawaz, M., Shetty, A., Shin, J.I., Shivakumar, K.M., Singh, J.A., Skryabin, V.Y., Skryabina, A.A., Somayaji, R., Soshnikov, S., Spurlock, E.E., Stein, D.J., Sufiyan, M.B., Tadbiri, H., Tadesse, B.T., Tadesse, E.G., Tamiru, A.T., Tarkang, E.E., Taveira, N., Tekalegn, Y., Tesfay, F.H., Tessema, G.A., Thapar, R., Tovani-Palone, M.R., Traini, E., Tran, B.X., Tsai, A.C., Tusa, B.S., Ullah, S., Umeokonkwo, C.D., Unnikrishnan, B., Valadan Tahbaz, S., Villafañe, J.H., Vladimirov, S.K., Vo, B., Vongpradith, A., Vu, G.T., Waheed, Y., Wamai, R.G., Wang, G., Wang, Y., Ward, P., Westerman, R., Winkler, A. S., Yadav, L., Yahyazadeh Jabbari, S.H., Yazie, T.S., Yi, S., Yigit, V., Yirdaw, B.W., Yonemoto, N., Yu, C., Yunusa, I., Zastrozhin, M.S., Zastrozhina, A., Zhang, Z.-J., Zumla, A., Salomon, J.A., Eaton, J.W., Naghavi, M., Dwyer-Lindgren, L., Wang, H., Lim, S.S., Hay, S.I., Murray, C.J.L., Kyu, H.H., 2021. Global, regional, and national sex-specific burden and control of the HIV epidemic, 1990–2019, for 204 countries and territories: the Global Burden of Diseases Study 2019. *The Lancet HIV* 8 (10), e633–e651.
- Keen, P., Jamil, M., Callander, D., Conway, D.P., McNulty, A., Davies, S.C., Couldwell, D. L., Smith, D.E., Holt, M., Vaccher, S.J., Gray, J., Cunningham, P., Prestage, G., Guy, R., 2019. NSW Rapid HIV Testing Evaluation Framework, 2019. Rapid HIV testing increases testing frequency among gay and bisexual men: a controlled before-after study. *Sex Health* 16 (2), 172–179. <https://doi.org/10.1071/SH18161>
- Kene, C., Deribe, L., Adugna, H., Tekalegn, Y., Seyoum, K., Geta, G., 2021. HIV/AIDS Related Knowledge of University Students in Southeast Ethiopia: A Cross-Sectional Survey. *HIV AIDS (Auckl)* 13, 681–690. <https://doi.org/10.2147/HIV.S300859>
- Lee, V.J., Tan, S.C., Earnest, A., Seong, P.S., Tan, H.H., Leo, Y.S., 2007. User acceptability and feasibility of self-testing with HIV rapid tests. *J. Acquir. Immune Defic. Syndr.* 45 (4), 449–453. <https://doi.org/10.1097/QAI.0b013e318095a3f3>
- Li, G., Jiang, Y., Zhang, L., 2019. HIV upsurge in China's students. *Science* 364 (6442), 711. <https://doi.org/10.1126/science.aay0799>
- Liu, Y., Lu, L., Wang, Y.Y., Wilkinson, M.R., Ren, Y.M., Wang, C.C., Zhang, F.B., Gao, J., Liu, S., 2020. Effects of health education on HIV/AIDS related knowledge among first year university students in China. *Afr. Health Sci.* 20 (4), 1582–1590. <https://doi.org/10.4314/ahs.v20i4.10>
- May, M., Gompels, M., Delpech, V., Porter, K., Post, F., Johnson, M., Dunn, D., Palfreeman, A., Gilson, R., Gazzard, B., Hill, T., Walsh, J., Fisher, M., Orkin, C., Ainsworth, J., Bansil, A., Phillips, A., Leen, C., Nelson, M., Anderson, J., Sabin, C., 2011. Impact of late diagnosis and treatment on life expectancy in people with HIV-1: UK Collaborative HIV Cohort (UK CHIC) Study. *BMJ* 343 (oct11 2), d6016.
- Muunonen, U., Suominen, T., Valimäki, M., Lohrmann, C., Peate, I., 2002. Early adolescents' HIV-related knowledge, attitudes and behaviour in Finland. *Int. J. Nurs. Pract.* 8 (2), 81–88. <https://doi.org/10.1046/j.1440-172x.2002.00337.x>
- Okumu, E., Jolly, D.H., Alston, L., Eley, N.T., Laws, M., MacQueen, K.M., 2017. Relationship between Human Immunodeficiency Virus (HIV) Knowledge, HIV-Related Stigma, and HIV Testing among Young Black Adults in a Southeastern City. *Front. Public Health* 5, 47. <https://doi.org/10.3389/fpubh.2017.00047>
- Rosenberg, N.E., Westreich, D., Barnighausen, T., Miller, W.C., Behets, F., Maman, S., Newell, M.L., Pettifor, A., 2013. Assessing the effect of HIV counselling and testing on HIV acquisition among South African youth. *AIDS* 27 (17), 2765–2773. <https://doi.org/10.1097/01.aids.0000432454.68357.6a>
- Ruan, L., Zhao, R., Ong, J.J., Fu, X., Xiong, Y., Chen, Y., He, D., Chen, Y., Zhuang, X., Zhang, L., 2021. A national survey of HIV knowledge, sexual practices and attitude towards homosexuality for HIV elimination among young people in China. *Sex. Health* 18 (1), 64–76. <https://doi.org/10.1071/SH20122>
- Wong, L.P., Chin, C.K., Low, W.Y., Jaafar, N., 2008. HIV/AIDS-Related Knowledge Among Malaysian Young Adults: Findings From a Nationwide Survey. *J. Int. AIDS Soc.* 10 (6), 148. <https://doi.org/10.1186/1758-2652-10-6-148>
- Wu, Z., McGoogan, J.M., Detels, R., 2021. The Enigma of the Human Immunodeficiency Virus (HIV) Epidemic in China. *Clin. Infect. Dis.* 72 (5), 876–881. <https://doi.org/10.1093/cid/ciaa835>
- Xu, H., Xie, J., Xiao, Z., Xiao, H., Li, X., Goldsamt, L., Williams, A.B., Wang, H., 2019. Sexual attitudes, sexual behaviors, and use of HIV prevention services among male undergraduate students in Hunan, China: a cross-sectional survey. *BMC Public Health* 19 (1), 250. <https://doi.org/10.1186/s12889-019-6570-2>
- Yang, M., Prestage, G., Maycock, B., Brown, G., de Wit, J., McKechnie, M., Guy, R., Keen, P., Fairley, C.K., Zablotska, I.B., 2014. The acceptability of different HIV testing approaches: cross-sectional study among GMSM in Australia. *Sex. Transm. Infect.* 90 (8), 592–595. <https://doi.org/10.1136/sextrans-2013-051495>
- Zhang, L., Yu, H., Luo, H., Rong, W., Meng, X., Du, X., Tan, X., 2021. HIV/AIDS-Related Knowledge and Attitudes Among Chinese College Students and Associated Factors: A Cross-Sectional Study. *Front. Public Health* 9, 804626. <https://doi.org/10.3389/fpubh.2021.804626>
- Zheng, Y., Zhang, X., Sun, X., Shi, Y., Chang, C., 2020. Evaluation of the college-based HIV/AIDS education policy in Beijing, China: a mixed method approach. *Environ. Health Prev. Med.* 25 (1), 50. <https://doi.org/10.1186/s12199-020-00890-5>