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Trends of Human Immunodeficiency Virus, Syphilis, and Hepatitis C Infections Among Men Who Have Sex With Men in Chongqing, China: A Serial Cross-sectional Survey From 2011 to 2018

Rongrong Lu, MPH,* Xiangjun Zhang, MS,† Chao Zhou, MPH,* Wei Zhang, BS,* Lin Ouyang, MPH,* Hui Xing, MS,‡ Yiming Shao, PhD,‡ Yuhua Ruan, PhD,‡ and Guohui Wu, MS*

Background: Human immunodeficiency virus (HIV) prevalence and incidence rates have expeditiously increased among Chongqing men who have sex with men (MSM) over the past decade. This study investigated the trends of HIV, syphilis, and hepatitis C virus (HCV) infections and behavioral attributes of Chongqing MSM.

Methods: Chongqing MSM who were 18 years or older were recruited annually from 2011 to 2018. Interviewer-administered paper-pencil interviews were used to collect demographics, behavioral information, and sexually transmitted diseases history. Blood samples were collected for the tests of HIV, syphilis, and HCV. A stepwise regression model was conducted to assess the associations of demographics, behaviors, and syphilis and HCV infections with HIV infection.

Results: A total of 4900 MSM participated in the study. The average HIV, syphilis, and HCV prevalence over 8 years were 15.4%, 4.0%, and 0.3%,

respectively. The HIV prevalence ranged from 13.5% to 16.4%. Syphilis and HCV were generally low and stable across years. An increased proportion of participants received HIV counseling, testing, and condoms. Multi-variable regression indicated that HIV-positive MSM were more likely to be older, married, and less educated, and they were more likely to perform unprotected anal intercourse with male partners in the past 6 months, have syphilis, and less likely to receive HIV counseling, testing, condoms, and peer education in the past year.

Conclusions: The HIV counseling, testing, and peer education programs showed a negative association with HIV-positive status among Chongqing MSM. The HIV prevalence is still high. More programs must be implemented to effectively curb the HIV epidemic.

From 2007, sexual transmission replaced injection drug transmission to become the most common transmission route of the human immunodeficiency virus (HIV) in China.^{1,2} New HIV infections, through sexual transmission, have been increasing steadily from nearly 40% in 2006 to 97% in 2017.¹ Transmission among men who have sex with men (MSM) is a significant route that increasingly contributes to new HIV infections in China. The proportion of new infections caused by transmission among MSM increased dramatically from 3.4% in 2007 to 25.5% in 2017.^{1,3} This is in addition to the already high prevalence of HIV among MSM in China, which has also been increasing for the past decade.⁴ Based on the results of a current large-scale systematic analysis study in China, the national HIV prevalence among MSM between 2001 and 2018 was 5.7% compared with a 0.037% rate in the general population in 2014.^{3,4}

Chongqing, the political and economic center in southwestern China, is 1 of 4 municipalities directly administrated by the Chinese central government. Its population exceeds 30 million residents, in which nearly two thirds of the population lived in urban areas in 2017.⁵ Chongqing's population has been historically comprised of migrants with a large transient population. Chongqing's first HIV case was recorded in 1988.⁶ Human immunodeficiency virus infection was mainly caused by injection drug use in its early years. Drug traffickers used the advanced transportation system of Chongqing to transport drugs to other regions in Mainland China. Since new infections through sexual transmission have exceeded injection drug use to become the major transmission route, reported HIV cases have shown a dramatic increase from 834 in 2007, to 2971 in 2011, and 7607 in 2017 in Chongqing.⁶ Additionally, the HIV epidemic among MSM raises serious concerns in Chongqing. Chongqing has the highest HIV prevalence among MSM in the nation with a rate of 13.8% and ranging from 10% to 23% between 2001 and 2018.^{4,7-10} The estimated HIV incidence rates among Chongqing MSM were 12.5% to 15.4% per 100 person-years compared with 5.6% of the national level.¹¹⁻¹³

Chongqing is famous for its openness, leisure time, and diversity. When young people in rural regions went to cities to look

From the *Chongqing Municipal Center for Disease Control and Prevention, Chongqing, China; †School of Community Health Sciences, University of Nevada, Reno, NV; and ‡State Key Laboratory of Infectious Disease Prevention and Control (SKLID), National Center for AIDS/STD Control and Prevention (NCAIDS), Chinese Center for Disease Control and Prevention (China CDC), Collaborative Innovation Center for Diagnosis and Treatment of Infectious Diseases, Beijing, China

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Ethics: This study was approved by the Institutional Review Board of Chongqing CDC. All records utilized in the analysis were anonymous and did not contain any personal identifiers.

Conflict of Interest: None declared.

Correspondence: Yuhua Ruan, PhD, Division of Virology and Immunology, National Center for AIDS/STD Control and Prevention (NCAIDS), China CDC, 155 Changbai Road, Changping District, Beijing, 102206, P.R. China. E-mail: ruanyuhua92@163.com; or Guohui Wu, MS, Chongqing Municipal Center for Disease Control and Prevention, Chongqing, China. E-mail: wgh68803652@163.com.

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for work opportunities, Chongqing was among the top destinations for migrants in China.¹⁴ Chongqing also attracted a large number of gay men. The estimated MSM population was 16,767 in Chongqing in 2011.¹⁵ Factors that may contribute to HIV infections among Chongqing MSM include no condom use,¹⁶ passive anal sex (only or mostly bottom),¹⁷ multiple and casual sex partners,⁹ online dating,¹⁸ coinfection with syphilis,^{9,19} alcohol consumption,²⁰ and drug use.⁹ Programs and efforts have been trying to promote HIV testing to prevent the spread of HIV in Chongqing, one of the HIV hotspots in China. However, HIV stigma acts as a barrier for MSM to take HIV testing.²¹ The results from a molecular epidemiologic study that monitors HIV-1 genotype distribution, indicated that the HIV epidemic spreads from injection drug users (IDU) to MSM and rapidly spreads in Chongqing MSM.²²

Additionally, syphilis infection among Chongqing MSM ranged from 8.5% to 11.9% between 2006 and 2009.^{10,19,23} Evidence indicated that syphilis infection was associated with HIV infection among MSM.^{19,24} A systematic review article has reported hepatitis C virus (HCV) infection among IDU in China was on average 61.4% between 1994 and 2006.²⁵ Using a large IDU sample from 15 cities in China in 2007, 1 study has reported HIV, syphilis, and HCV infection rates were 2.76%, 3.38%, and 32.35%, respectively.²⁶ However, HCV prevalence was much lower among MSM. A nationwide study has reported that HCV prevalence ranged from 1.5% to 0.7% from 2009 to 2013 among Chinese MSM.²⁷ We have included syphilis laboratory tests in our study because syphilis infection was a risk factor of HIV infection among MSM. We also included the HCV laboratory test in our study. Previous studies showed that HCV infection was prominently higher among IDU and that HCV prevalence could reflect the IDU magnitude of our MSM sample. Although evidence suggested that hepatitis B virus was associated with risk behaviors (such as having more sexual partners) among MSM,²⁸ the hepatitis B virus prevalence was comparable among MSM compared with the general population.^{29,30} Previous studies have also reported high sexually transmitted diseases (STDs) symptoms among MSM.²³ Our study did not include the diagnoses and tests for other STDs (such as gonorrhea and chlamydia), which require specimens' laboratory tests and clinical examination and diagnoses, which are not feasible in our study. We conducted this study to better understand the risk factors that are associated with HIV transmission and describe trends of the HIV epidemic among Chongqing MSM over time. This study uses a serial cross-sectional design in an 8-year period to assess HIV, syphilis, HCV infections, and behavioral characteristics among Chongqing MSM. The results of the study will be used to design interventions targeting risk factors to prevent HIV rapid transmission among Chongqing MSM.

MATERIALS AND METHODS

Study Design and Participants

Data were collected annually from 2011 to 2018 in Chongqing, China. We used multiple methods for recruitment to reach participants with different behavioral attributes. The first recruitment method was technology-based methods, including online and through social media. We posted recruitment information through local gay websites and QQ (a broadly used social media application in China) chat rooms. The second recruitment method was traditional outreach at gay communities and venues, such as bars, parks, and bathhouses. Trained peer recruiters distributed informational flyers about the study and recruited participants. The third method was through participants' referrals. Individuals who participated in the study were encouraged to refer their friends and peers to participate in the study.

The eligibility criteria included men who were 18 years or older, had sex with men within the past 6 months, currently living in Chongqing, and were willing to provide written informed consent. Individuals who met the criteria were provided written informed consent. After consent was obtained, an interviewer-administered paper-pencil survey was scheduled and administered. After the survey interview, HIV pre-test counseling was conducted, followed by a venous blood sample collection. Blood samples were sent to a qualified laboratory to conduct the tests of HIV, syphilis, and HCV. An HIV posttest counseling was provided when participants came back for the tests' results. Participants who were confirmed positive for HIV, syphilis, and HCV were referred to local hospitals for treatment and care. The study was approved by the institutional review board of the Chongqing Center for Disease Control and Prevention.

Data Collection

The training was provided to all research staff by Chongqing Center for Disease Control and Prevention about the study protocol, research ethics, HIV knowledge, confidentiality, communication skills, and skills related to conducting interviews and HIV counseling. We adopted the questionnaire from the Chinese national sentinel surveillance. One-on-one survey interviews were administered by trained research staff in a dedicated private room. We assigned each participant a unique identification number to link their questionnaires to the blood tests. All materials that contain individuals' information and data were restricted and password-protected. The structured questionnaire was anonymous and confidential and 30 minutes long. Questions included sociodemographics, sexual and drug use behaviors, receiving HIV prevention status, and STDs infection history. Participants received ¥ 30 gifts after they completed the study.

Laboratory Tests

We collected all participants' blood samples and conducted tests for HIV, syphilis, and HCV. We used an enzyme-linked immunosorbent assay (ELISA) (Beijing Wantai Biological Medicine Company, China) for HIV screening and a Western blot test, HIV Blot 2.2 WB (Genelabs Diagnostics, Singapore), for HIV confirmation. We used both a rapid plasma reagin test (Shanghai Rongsheng, China) and an ELISA test (Beijing Wantai Biological Production Company, China) to detect syphilis. Positive results on both the rapid plasma reagin and ELISA tests were considered a confirmed current syphilis infection. We used an ELISA (Beijing Wantai Biological Production Company, China) test for the screening of HCV. A positive HCV ELISA test was interpreted as current HCV infection or post-HCV infection that has resolved.

Data Analysis

We assessed demographic differences from 2011 to 2018 using χ^2 tests. The sample was stratified based on participants' age, marital status, ethnicity, years of education, local residence, and the type of Internet recruitment method each year. People usually have completed high school when they have had at least 12 years of education in China. Thus, we used 12 years of education as the cutoff point for high school completion. We also used χ^2 tests to assess potential differences of behavioral attributes, STDs history, and HIV, syphilis, and HCV infections in the years between 2011 and 2018. The variables with a *P* value less than 0.05 were selected for the multivariable regression model. A stepwise multivariable logistic regression model was conducted to determine variables to be kept in the final model. We calculated and reported odds ratios (OR), 95% confidence intervals (95% CI), and *P* values of all variables in relation to HIV infection in the multivariable logistic regression model. Then, we selected variables with a *P* value less than 0.05 for the final model. We calculated

and reported the adjusted OR (AOR), 95% CI, and *P* value of each variable in the final model. We used 2-sided tests. All analyses were performed in SPSS (version 17.0; SPSS Inc, Chicago, IL).

RESULTS

A total of 4990 MSM were recruited and screened for the study during the 8-year period. Ninety participants were excluded from the study because of the following reasons: 23 were younger than 18 years, 32 said that they did not have sex in the past 6 months, and 35 were not willing to participate in the study. A total of 4900 participants were included in the analyses. The survey had a response rate of 98.2%. From 2011 to 2018, the number of recruited participants ranged between 563 (in 2015) and 650 (in 2011). Participants' sociodemographic characteristics are presented in Table 1. The large majority of participants (97.8%) self-identified as being Han Chinese (one of the largest ethnic groups in the world). The proportions of participants who were 25 years or older increased from 54.2% in 2011 to 69.2% in 2015 ($P < 0.001$). Participants' marital statuses were consistent across the years. Only a small percentage of participants were married, which ranged from 8.4% to 11.5%. Same-sex marriage has not been legalized in China to date. Marital status only means when a participant is married to a female.

Participants who had more than 12 years of education accounted for 71.0% of the sample. Except for the year of 2011, participants who had more than 12 years of education showed a decrease from 80.0% in 2012 to 62.5% in 2018 ($P < 0.001$). On average, the majority of the participants (83.9%) resided in Chongqing. The proportions of local residence ranged from 80.3% to 88.3% ($P = 0.005$) across the study years. The proportions of participants recruited from the Internet showed a large variation from 10.9% to 92.7% across the study years ($P < 0.001$), and it was particularly high from 2014 to 2016 (64.3%–92.7%).

Participants' behavioral attributes, STDs history, HIV, syphilis, and HCV status from 2011 to 2018 are presented in Table 2. The majority of participants had anal intercourse with a male partner in the past 6 months with an average of 89.3% and ranging from 86.0% (2011) to 93.1% (2013). In addition, nearly half of the overall sample had unprotected anal intercourse with at least 1 male partner in the past 6 months (45.3%). The proportions of participants who had this risk behavior showed a steady decrease

over time from 58.5% in 2011 to 36.3% in 2018 ($P < 0.001$). The proportions of participants who had anal intercourse and unprotected anal intercourse with commercial male partners in the past 6 months were on average 1.3% and 0.4%, respectively. Generally, it showed a decrease across the years ($P < 0.001$). The proportions of participants who had sex (8.4%) and unprotected sex (5.4%) with female partners in the past 6 months showed varied but generally low rates (both $P < 0.001$). The proportions were relatively high among the years of 2011 (13.5% and 12.2%) and 2012 (10.8% and 7.3%).

An increased proportion of participants received HIV counseling, testing, and condoms in the past 12 months from 47.8% in 2011 to 78.0% in 2018 ($P < 0.001$). The proportions of participants who received peer education in the past 12 months increased from 36.5% in 2011 to 69.4% in 2015, and decreased to 22.0% in 2018 ($P < 0.001$). The percentage of syphilis (4.0%) and HCV (0.3%) infection was generally low and statistically different across years ($P < 0.001$ for syphilis and $P = 0.04$ for HCV). In 2011, both proportions showed the highest rates with 9.7% for syphilis and 1.1% for HCV. Drug use and STDs showed no significant differences over time. On average, 0.7% of the sample used drugs in the past and 4.9% of the sample had STDs in the past 12 months. The proportions of HIV positive were consistent over time that an average of 15.4% was HIV positive ($P = 0.60$). It ranged from 13.5% (2011) to 16.4% (2012).

Results from the multivariable logistic regression indicated that HIV-positive MSM were more likely to be older (AOR, 1.31; 95% CI, 1.09–1.56), married (AOR, 1.45; 95% CI, 1.08–1.93), and less educated (AOR, 1.50; 95% CI, 1.27–1.79) compared with HIV-negative MSM (Table 3). The HIV-positive MSM were more likely to perform unprotected anal intercourse with any male partners in the past 6 months (AOR, 2.87; 95% CI, 2.42–3.40), have syphilis (AOR, 3.48; 95% CI, 2.54–4.76); less likely to receive HIV counseling, testing, and condoms in the past 12 months (AOR, 0.55; 95% CI, 0.47–0.65); and less likely to receive peer education in the past 12 months (AOR, 0.66; 95% CI, 0.56–0.79).

DISCUSSION

The main finding of our study is that HIV prevalence among Chongqing MSM was high from 2011 to 2018 with an

TABLE 1. Sociodemographic Characteristics of Participants in Serial Cross-Sectional Studies From 2011 to 2018 in Chongqing, China

| | 2011, n (%) | 2012, n (%) | 2013, n (%) | 2014, n (%) | 2015, n (%) | 2016, n (%) | 2017, n (%) | 2018, n (%) | Total | χ^2 | <i>P</i> |
|-------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------|----------|
| Total | 650 | 641 | 626 | 583 | 563 | 633 | 626 | 578 | 4900 (100.0) | | |
| Age (years) | | | | | | | | | | 37.42 | <0.001 |
| <25 | 298 (45.8) | 289 (45.1) | 254 (40.6) | 234 (40.1) | 227 (40.3) | 247 (39.0) | 241 (38.5) | 178 (30.8) | 1968 (40.2) | | |
| ≥ 25 | 352 (54.2) | 352 (54.9) | 372 (59.4) | 349 (59.9) | 336 (59.7) | 386 (61.0) | 385 (61.5) | 400 (69.2) | 2932 (59.8) | | |
| Marital status | | | | | | | | | | 12.39 | 0.089 |
| Married | 64 (9.8) | 54 (8.4) | 49 (7.8) | 38 (6.5) | 57 (10.1) | 64 (10.1) | 72 (11.5) | 53 (9.2) | 451 (9.2) | | |
| Others | 586 (90.2) | 587 (91.6) | 577 (92.2) | 545 (93.5) | 506 (89.9) | 569 (89.9) | 554 (88.5) | 525 (90.8) | 4449 (90.8) | | |
| Ethnicity | | | | | | | | | | 22.57 | 0.002 |
| Han majority | 634 (97.5) | 617 (96.3) | 606 (96.8) | 569 (97.6) | 558 (99.1) | 624 (98.6) | 616 (98.4) | 571 (98.8) | 4793 (97.8) | | |
| Others | 16 (2.5) | 24 (3.7) | 20 (3.2) | 14 (2.4) | 5 (0.9) | 9 (1.4) | 10 (1.6) | 7 (1.2) | 107 (2.2) | | |
| Years of education | | | | | | | | | | 130.74 | <0.001 |
| ≤12 | 262 (40.3) | 128 (20.0) | 143 (22.8) | 143 (24.5) | 117 (20.8) | 202 (31.9) | 210 (33.5) | 217 (37.5) | 1422 (29.0) | | |
| >12 | 388 (59.7) | 513 (80.0) | 483 (77.2) | 440 (75.5) | 446 (79.2) | 431 (68.1) | 416 (66.5) | 361 (62.5) | 3478 (71.0) | | |
| Local residence | | | | | | | | | | 20.09 | 0.005 |
| Yes | 536 (82.5) | 545 (85.0) | 553 (88.3) | 484 (83.0) | 452 (80.3) | 511 (80.7) | 517 (82.6) | 483 (83.6) | 4081 (83.3) | | |
| No | 114 (17.5) | 96 (15.0) | 73 (11.7) | 99 (17.0) | 111 (19.7) | 122 (19.3) | 109 (17.4) | 95 (16.4) | 819 (16.7) | | |
| Recruited from Internet | | | | | | | | | | 1203.59 | <0.001 |
| Yes | 238 (36.6) | 193 (30.1) | 236 (37.7) | 375 (64.3) | 522 (92.7) | 478 (75.5) | 225 (35.9) | 63 (10.9) | 2330 (47.6) | | |
| No | 412 (63.4) | 448 (69.9) | 390 (62.3) | 208 (35.7) | 41 (7.3) | 155 (24.5) | 401 (64.1) | 515 (89.1) | 2570 (52.4) | | |

TABLE 2. Behavioral Characteristics and HIV and Syphilis and HCV Status of Participants in Serial Cross-Sectional Studies From 2011 to 2018 in Chongqing, China

| | 2011, n (%) | 2012, n (%) | 2013, n (%) | 2014, n (%) | 2015, n (%) | 2016, n (%) | 2017, n (%) | 2018, n (%) | Total | χ^2 | P |
|--|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------|----------|--------|
| Total | 650 | 641 | 626 | 583 | 563 | 633 | 626 | 578 | 4900 (100.0) | | |
| Had anal intercourses with any male partners in the P6M | | | | | | | | | | 1.61 | 0.024 |
| No | 91 (14.0) | 67 (10.5) | 43 (6.9) | 45 (7.7) | 43 (7.6) | 75 (11.8) | 85 (13.6) | 74 (12.8) | 523 (10.7) | | |
| Yes | 559 (86.0) | 574 (89.5) | 583 (93.1) | 538 (92.3) | 520 (92.4) | 558 (88.2) | 541 (86.4) | 504 (87.2) | 4377 (89.3) | 109.81 | <0.001 |
| Unprotected anal intercourses with any male partners in the P6M | | | | | | | | | | | |
| No | 270 (41.5) | 320 (49.9) | 346 (55.3) | 269 (46.1) | 288 (51.2) | 402 (63.5) | 419 (66.9) | 368 (63.7) | 2682 (54.7) | | |
| Yes | 380 (58.5) | 321 (50.1) | 280 (44.7) | 314 (53.9) | 275 (48.8) | 231 (36.5) | 207 (33.1) | 210 (36.3) | 2218 (45.3) | 13.05 | <0.001 |
| Had anal intercourses with any commercial male partners in the P6M | | | | | | | | | | | |
| No | 639 (98.3) | 626 (97.7) | 613 (97.9) | 577 (99.0) | 557 (98.9) | 624 (98.6) | 624 (99.7) | 576 (99.7) | 4836 (98.7) | | |
| Yes | 11 (1.7) | 15 (2.3) | 13 (2.1) | 6 (1.0) | 6 (1.1) | 9 (1.4) | 2 (0.3) | 2 (0.3) | 64 (1.3) | 10.79 | 0.001 |
| Unprotected anal intercourses with any commercial male partners in the P6M | | | | | | | | | | | |
| No | 645 (99.2) | 635 (99.1) | 622 (99.4) | 581 (99.7) | 561 (99.6) | 633 (100.0) | 626 (100.0) | 577 (99.8) | 4880 (99.6) | | |
| Yes | 5 (0.8) | 6 (0.9) | 4 (0.6) | 2 (0.3) | 2 (0.4) | 0 (0.0) | 0 (0.0) | 1 (0.2) | 20 (0.4) | 15.77 | <0.001 |
| Had sex with any female partners in the P6M | | | | | | | | | | | |
| No | 562 (86.5) | 563 (87.8) | 588 (93.9) | 551 (94.5) | 532 (94.5) | 586 (92.6) | 567 (90.6) | 538 (93.1) | 4487 (91.6) | | |
| Yes | 88 (13.5) | 78 (12.2) | 38 (6.1) | 32 (5.5) | 31 (5.5) | 47 (7.4) | 59 (9.4) | 40 (6.9) | 413 (8.4) | 19.72 | <0.001 |
| Unprotected sex with any female partners in the P6M | | | | | | | | | | | |
| No | 580 (89.2) | 594 (92.7) | 604 (96.5) | 562 (96.4) | 545 (96.8) | 602 (95.1) | 595 (95.0) | 551 (95.3) | 4633 (94.6) | | |
| Yes | 70 (10.8) | 47 (7.3) | 22 (3.5) | 21 (3.6) | 18 (3.2) | 31 (4.9) | 31 (5.0) | 27 (4.7) | 267 (5.4) | 1.05 | 0.305 |
| Use drug in the past | | | | | | | | | | | |
| No | 643 (98.9) | 636 (99.2) | 623 (99.5) | 579 (99.3) | 560 (99.5) | 630 (99.5) | 620 (99.0) | 576 (99.7) | 4867 (99.3) | | |
| Yes | 7 (1.1) | 5 (0.8) | 3 (0.5) | 4 (0.7) | 3 (0.5) | 3 (0.5) | 6 (1.0) | 2 (0.3) | 33 (0.7) | 237.46 | <0.001 |
| Received HIV counseling, testing and condom in the P12M | | | | | | | | | | | |
| No | 339 (52.2) | 265 (41.3) | 276 (44.1) | 171 (29.3) | 188 (33.4) | 154 (24.3) | 123 (19.6) | 127 (22.0) | 1643 (33.5) | | |
| Yes | 311 (47.8) | 376 (58.7) | 350 (55.9) | 412 (70.7) | 375 (66.6) | 479 (75.7) | 503 (80.4) | 451 (78.0) | 3257 (66.5) | 17.83 | <0.001 |
| Received peer education in the P12M | | | | | | | | | | | |
| No | 413 (63.5) | 434 (67.7) | 266 (42.5) | 287 (49.2) | 172 (30.6) | 465 (73.5) | 352 (56.2) | 451 (78.0) | 2840 (58.0) | | |
| Yes | 237 (36.5) | 207 (32.3) | 360 (57.5) | 296 (50.8) | 391 (69.4) | 168 (26.5) | 274 (43.8) | 127 (22.0) | 2060 (42.0) | | |

Continued next page

TABLE 2. (Continued)

| | 2011, n (%) | 2012, n (%) | 2013, n (%) | 2014, n (%) | 2015, n (%) | 2016, n (%) | 2017, n (%) | 2018, n (%) | Total | χ^2 | P |
|-------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------|----------|--------|
| Had STDs in the P12M | | | | | | | | | | 0.10 | 0.747 |
| No | 612 (94.2) | 619 (96.6) | 599 (95.7) | 547 (93.8) | 531 (94.3) | 594 (93.8) | 608 (97.1) | 549 (95.0) | 4659 (95.1) | | |
| Yes | 38 (5.8) | 22 (3.4) | 27 (4.3) | 36 (6.2) | 32 (5.7) | 39 (6.2) | 18 (2.9) | 29 (5.0) | 241 (4.9) | | |
| HIV(+) | | | | | | | | | | 0.28 | 0.600 |
| No | 562 (86.5) | 536 (83.6) | 526 (84.0) | 495 (84.9) | 476 (84.5) | 532 (84.0) | 527 (84.2) | 490 (84.8) | 4144 (84.6) | | |
| Yes | 88 (13.5) | 105 (16.4) | 100 (16.0) | 88 (15.1) | 87 (15.5) | 101 (16.0) | 99 (15.8) | 88 (15.2) | 756 (15.4) | | |
| Syphilis(+) | | | | | | | | | | 13.62 | <0.001 |
| No | 587 (90.3) | 622 (97.0) | 613 (97.9) | 562 (96.4) | 548 (97.3) | 607 (95.9) | 605 (96.6) | 558 (96.5) | 4702 (96.0) | | |
| Yes | 63 (9.7) | 19 (3.0) | 13 (2.1) | 21 (3.6) | 15 (2.7) | 26 (4.1) | 21 (3.4) | 20 (3.5) | 198 (4.0) | | |
| HCV(+) | | | | | | | | | | 4.22 | 0.04 |
| No | 643 (98.9) | 638 (99.5) | 626 (100.0) | 581 (99.7) | 562 (99.8) | 633 (100.0) | 624 (99.7) | 576 (99.7) | 4883 (99.7) | | |
| Yes | 7 (1.1) | 3 (0.5) | 0 (0.0) | 2 (0.3) | 1 (0.2) | 0 (0.0) | 2 (0.3) | 2 (0.3) | 17 (0.3) | | |

P6M, past 6 months; P12M, past 12 months.

average of 15.4%, which ranged from 13.5% to 16.4% over the course of the study. This confirmed that Chongqing MSM have the highest HIV prevalence of the nation. During this 8-year period, HIV prevalence did not show a decrease even though many preventive efforts have been carried out in Chongqing. Our reported HIV prevalence is consistent with previous studies.^{4,7-10} Multiple social and behavioral factors might contribute to the persistent high HIV prevalence among Chongqing MSM. The percentage of unprotected sexual behaviors is high. High mobility, gay culture, and stigma are the obstacles for preventive interventions to achieve maximum effects. Another possible reason would be that when cumulative HIV infections reach a high level, our preventive interventions and efforts are only able to slow down the speed of HIV transmission so that HIV prevalence does not increase. Furthermore, a study that tracked HIV-1 genotypes among Chinese MSM found that a new genotype cluster (CRF07_BC) entered Chinese MSM from IDUs in 2004 and spread rapidly among Chinese MSM. The new genotype of the virus with different transmission efficiency and dynamics raises new challenges for HIV prevention and requires further research, surveillance, and laboratory efforts.

Among Chongqing MSM, syphilis prevalence ranged from 2.1% and 9.7% with an average of 4.0% for the 8 years. Studies reported that syphilis prevalence among Chinese MSM is between 8.3% and 12.5% from 2008 to 2013 and decreasing. For Chongqing MSM, the syphilis prevalence was reported 11.7% in 2008¹⁹ and an average of 5.8% between the years from 2013 to 2017.⁹ Our sample showed a slightly lower syphilis infection rate compared with previous studies. In our study, the HCV infection rate was 0.3% on average compared with the rates ranging from 0.67% to 1.5% of previous studies among Chinese MSM.²⁷ Low HCV prevalence is evidence to support the low IDU rate of our sample because HCV prevalence is commonly high among IDU. Together with other evidence, our results testified the HIV epidemiology changes from predominantly injection drug use to predominantly sexual transmission.

As seen in previous studies among Chinese MSM, the infections of syphilis, HCV, and other STDs have decreased in recent years.²⁷ That could be due to scaling up testing and treatment through HIV prevention programs that have been conducted among MSM. Evidence has shown that syphilis and other STDs facilitate HIV acquisition and transmission. Therefore, STD services have been previously imbedded in HIV programs and efforts that aimed to prevent sexual transmission.³ These services included screening, laboratory tests, and treatment referrals that have been integrated with HIV prevention programs and prenatal

care. In addition, the Chinese Ministry of Health implemented a 10-year syphilis prevention plan in 2010 in response to the increasing incidence of syphilis. These efforts may have contributed to the decrease of syphilis among high-risk groups. The HCV testing programs have been implemented and also integrated with HIV prevention programs. Such programs raise awareness of HCV infection and prevents HCV transmission among high-risk groups.

Both rates of drug use⁹ and past year STDs infection reported in our study are much lower than the results from previous studies. The possible reasons include potential social disability bias, region specific character, and high mobility of the sample. Drug use is illegal in China. Thus, participants might have concerns reporting their drug use status. The information is subjected to be underreported due to social desirability bias. A large number of individuals who might be new to gay community were recruited and participated in the study. Therefore, the drug use rates among our sample are probably closer to rates among the general population. Compared with a drug use rate of 0.7% on average in our sample, a systematic review study reported illicit drug use among students was 2.10% from 2004 to 2013. Illicit drug use rates in Yunnan, one of the provinces that are most afflicted by drug trafficking and drug use in China, were reported between 0.73% and 0.94% from 2011 to 2015.

Our study indicated that being 25 years or older, married, and less educated MSM increased the likelihood of acquiring HIV. The results are consistent with previous studies.¹³ Previous studies also found that younger and higher educated MSM reported a higher HIV knowledge score. This is important as low HIV knowledge is a factor for HIV infection.¹⁹ It suggests that future HIV programs must target MSM who are 25 years or older and less educated to increase their HIV knowledge. Although, in general, there is a small proportion of MSM who have sex with or who are married to women. However, being married to a woman is a significant factor of HIV infection. It warns us the potential route of HIV transmission to the general population through unprotected sex with spouses. Future HIV prevention programs must convey information to married MSM about how to protect their spouses. Active unprotected sexual contacts with male partners and having syphilis are significantly associated with HIV infection. These results are consistent with previous studies. Our study suggests that in addition to promoting HIV knowledge, prevention efforts should encourage and facilitate safe sex practices, as well as syphilis testing and treatment.

Our results showed that receiving HIV counseling and testing, along with condom and peer education in the past year are

TABLE 3. Factors Associated With HIV Infection of Participants in Serial Cross-Sectional Studies From 2011 to 2018 in Chongqing, China

| Factors | Number | HIV Infection, n (%) | OR (95% CI) | P | AOR (95% CI) | P |
|--|--------|----------------------|------------------|--------|------------------|--------|
| Total | 4900 | 756 | — | — | — | — |
| Age, y | | | | | | |
| <25 | 1968 | 256 (13.0) | Reference | | Reference | |
| ≥25 | 2932 | 500 (17.1) | 1.38 (1.17–1.62) | <0.001 | 1.31 (1.09–1.56) | 0.003 |
| Marital status | | | | | | |
| Others | 4449 | 649 (14.6) | Reference | | Reference | |
| Married | 451 | 107 (23.7) | 1.82 (1.44–2.30) | <0.001 | 1.45 (1.08–1.93) | 0.012 |
| Ethnicity | | | | | | |
| Han majority | 4793 | 744 (15.5) | Reference | | — | — |
| Others | 107 | 12 (11.2) | 0.69 (0.38–1.26) | 0.225 | — | — |
| Years of education | | | | | | |
| >12 | 3478 | 441 (12.7) | Reference | | Reference | |
| ≤12 | 1422 | 315 (22.2) | 1.96 (1.67–2.30) | <0.001 | 1.50 (1.27–1.79) | <0.001 |
| Local residence | | | | | | |
| No | 819 | 129 (15.8) | Reference | | — | — |
| Yes | 4081 | 627 (15.4) | 0.97 (0.79–1.19) | 0.780 | — | — |
| Recruited from the Internet | | | | | | |
| No | 2570 | 409 (15.9) | Reference | | — | — |
| Yes | 2330 | 347 (14.9) | 0.92 (0.79–1.08) | 0.323 | — | — |
| Had anal intercourses with any male partners in the P6M | | | | | | |
| No | 523 | 74 (14.1) | Reference | | — | — |
| Yes | 4377 | 682 (15.6) | 1.12 (0.86–1.45) | 0.392 | — | — |
| Unprotected anal intercourses with any male partners in the P6M | | | | | | |
| No | 2682 | 235 (8.8) | Reference | | Reference | |
| Yes | 2218 | 521 (23.5) | 3.20 (2.71–3.77) | <0.001 | 2.87 (2.42–3.40) | <0.001 |
| Had anal intercourses with any commercial male partners in the P6M | | | | | | |
| No | 4836 | 745 (15.4) | Reference | | — | — |
| Yes | 64 | 11 (17.2) | 1.14 (0.59–2.19) | 0.695 | — | — |
| Unprotected anal intercourses with any commercial male partners in the P6M | | | | | | |
| No | 4880 | 750 (15.4) | Reference | | — | — |
| Yes | 20 | 6 (30.0) | 2.36 (0.90–6.16) | 0.079 | — | — |
| Had sex with any female partners in the P6M | | | | | | |
| No | 4487 | 672 (15.0) | Reference | | — | — |
| Yes | 413 | 84 (20.3) | 1.45 (1.13–1.87) | 0.004 | — | — |
| Unprotected sex with any female partners in the P6M | | | | | | |
| No | 4633 | 692 (14.9) | Reference | | — | — |
| Yes | 267 | 64 (24.0) | 1.80 (1.34–2.41) | <0.001 | — | — |
| Received HIV counseling, testing and condom in the P12M | | | | | | |
| No | 1643 | 355 (21.6) | Reference | | Reference | |
| Yes | 3257 | 401 (12.3) | 0.51 (0.44–0.60) | <0.001 | 0.55 (0.47–0.65) | <0.001 |

Continued next page

TABLE 3. (Continued)

| Factors | Number | HIV Infection, n (%) | OR (95% CI) | P | AOR (95% CI) | P |
|-------------------------------------|--------|----------------------|------------------|--------|------------------|--------|
| Received peer education in the P12M | | | | | | |
| No | 2840 | 510 (18.0) | Reference | | Reference | |
| Yes | 2060 | 246 (11.9) | 0.62 (0.53–0.73) | <0.001 | 0.66 (0.56–0.79) | <0.001 |
| Had STDs in the P12M | | | | | | |
| No | 4659 | 696 (14.9) | Reference | | | |
| Yes | 241 | 60 (24.9) | 1.89 (1.39–2.56) | <0.001 | — | — |
| Syphilis(+) | | | | | | |
| No | 4702 | 675 (14.4) | Reference | | Reference | |
| Yes | 198 | 81 (40.9) | 4.13 (3.08–5.55) | <0.001 | 3.48 (2.54–4.76) | <0.001 |

negatively associated with HIV infection. Having unprotected sex with male partners in the past 6 months is positively associated with HIV infection. At the same time, we found clear trends of both increased reception of HIV counseling, testing, condoms, and peer education and decreased current unprotected sex with male partners from 2011 to 2018 (Fig. 1). Although we cannot infer causal association due to the cross-sectional design of the study, the trends suggest the possible consequences of our HIV prevention programs and efforts in changing people's behaviors to help slow down the speed of HIV transmission. Although it showed a decrease over time, high-risk behaviors remain high among Chongqing MSM. Nearly 90% of individuals had active sexual contacts with male partners, and nearly half had unprotected anal intercourse. Our study suggests that HIV prevention programs should target at-risk groups to improve their HIV knowledge and practice of condom use. Also, the use of preexposure prophylaxis (PrEP) could improve the efficacy of protecting individuals from contracting HIV among at-risk groups. Preexposure prophylaxis is supported by evidence about its efficacy. Regarding the high HIV prevalence and high rates of risk behaviors among Chongqing MSM, PrEP would be considered as a method for HIV prevention. In particular, PrEP and condom use should be both disseminated and promoted as prevention strategies to prevent both HIV and STDs.

The study has limitations. First, social desirability could exist for self-reported questions especially regarding sensitive questions, such as sexual behaviors, STDs history, and drug use. The information is subjected to be underreported due to social desirability bias. Second, it is a cross-sectional design, although we conducted the study in an 8-year period, we did not follow participants over time. We cannot infer any causal factors that cause HIV infection, nor permit assessment of HIV, syphilis, and HCV incidence. Therefore, we cannot make a causal association between preventive programs and HIV or STDs acquisition. Although there are increases in program coverage and decreases in reported risk behaviors. The cross-sectional study design limits the study's ability to evaluate the impact of preventive programs on HIV and STDs transmission. Third, the study was conducted in Chongqing, which may be different from other places in China in terms of social and cultural background. The results of the study cannot be generalized to other places in China. Also, nonresponse bias might occur when individuals who voluntarily participated in the study are different from the ones who did not participate in the study. Fourth, the study utilized the anti-HCV test only to screen HCV infections. The number of HCV infected cases is likely to be overestimated when we included both current and resolved HCV infections. Despite these limitations, this is the first study that monitors the HIV epidemic among Chongqing MSM from 2011

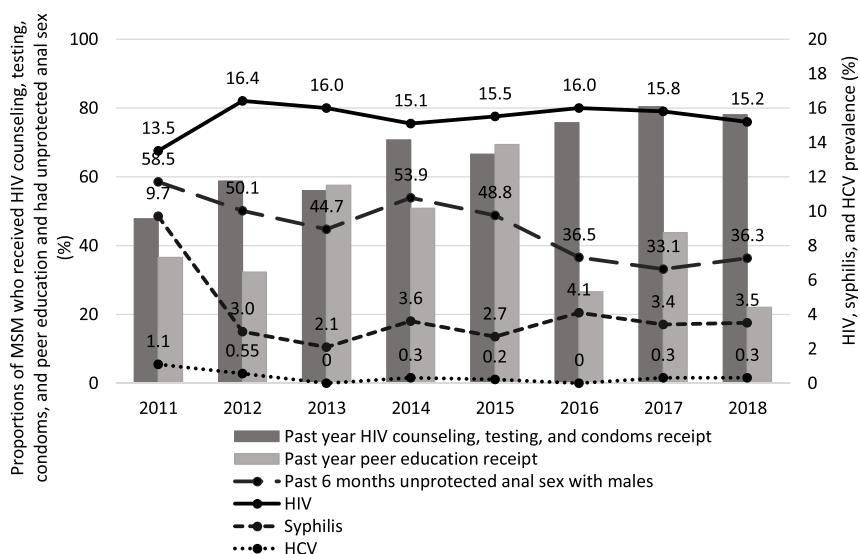


Figure 1. Yearly proportions of HIV, syphilis, and HCV infections and behaviors among Chongqing MSM (2011–2018).

to 2018 when sexual transmission became the major transmission route and HIV expanded rapidly in this group. It provides essential evidence to understand HIV, syphilis, HCV infections and behavioral characteristics among Chongqing MSM.

This 8-year serial cross-sectional study reports high HIV prevalence among Chongqing MSM. In contrast, both syphilis and HCV prevalence is relatively low. Based on the results of the study, intervention programs should be proposed to provide education about HIV knowledge, behavioral risks, and safe sex (both condom use and PrEP) targeting high-risk populations. More HIV counseling, testing, and peer education programs should be implemented among Chongqing MSM to effectively curb the HIV epidemic.

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For further references, please see “Supplemental References,” <http://links.lww.com/OLQ/A505>.