Is male sex workers (MSW) more susceptible to HIV than sex buyers (SB)?

Cui Zhuang (✉ ZhuangCui417@126.com)
Tianjin Medical University  https://orcid.org/0000-0001-6495-766X

Xinying Zhang
Hongqiao District Center for Disease Control and Prevention, Tianjin

Honglu Zhang
Tianjin Medical University

Huijie Huang
Tianjin Medical University

Zeyang Yu
Tianjin Medical University

Tingting Yao
Tianjin Medical University

Tiantian Zhang
Tianjin Medical University

Desheng Song
Tianjin Medical University

Yang Chen
Tianjin Medical University

Chun Wang
Tianjin Medical University

Xiaomeng Wang
Tianjin Medical University

Yuanyuan Liu
Tianjin Medical University

Changping Li
Tianjin Medical University

Jie Yang
Tianjin Shenlan Community-Based Organization, Tianjin

Jun Ma
Tianjin Medical University

Research article
Abstract

Introduction: As both parties to commercial sex, MSW and SB are both at high risk of HIV infection. However, there are few studies on the comparison of HIV infection rates between these two groups of people.

Methods: The method of snowball sampling was used to recruit research participants by means of baths, bars, and the Internet. The recruited participants should cooperate with the investigators to complete the questionnaire (including general demographic characteristics, high risky behaviors, status of HIV and AIDS infection, awareness of AIDS knowledge) and blood antibody/antigen tests/oral mucosal exudate antibody tests. The difference analysis was performed using the \( c^2 \) test, and the correlates of HIV infection were analyzed using logistic regression.

Results: The final analysis included 435 MSWs and 729 SBs with HIV infection rates of 7.1% and 2.6%, respectively. Compared with SB, the HIV infection rate of MSW was 2.775 (1.340-5.746) times higher (after adjusting for age and marital status), 3.173 (1.512-6.659) times higher (after further adjusting the awareness rate of AIDS-related knowledge), 3.688 (1.711-7.950) times higher (after further adjusting the frequency of condom use in homosexual intercourse and commercial sex in the past six months).

Conclusions: MSW is more likely to infect HIV than SB. Therefore, effective preventive measures should be focused on MSW.

Introduction

Globally, men who have sex with men (MSM) have become the main infection and transmission of human immunodeficiency virus (HIV). According to global acquired immune deficiency syndrome (AIDS) statistics released by the Joint United Nations Programme on human immunodeficiency virus (HIV)/acquired immune deficiency syndrome (AIDS), key populations (including gay men and other men who have sex with men, sex workers, transgender people, people who inject drugs and prisoners and other incarcerated people) and their sexual partners accounted for more than half (54%) of global HIV infections in 2018\[1\]. Among them, sex workers have been listed as one of the key groups of AIDS infection, which means that more and more people have begun to pay attention to the role of sex workers in the spread of HIV.

Male sex workers (MSW, a subgroup of sex workers) refer to people who exchange or sell sex in exchange for money or goods. The study found that MSW population has the characteristics of younger, more mobile, more sexual partners and higher proportion of unmarried men than ordinary MSM\[2\]. Therefore, MSW has a higher chance of HIV infection, and the presence of MSW accelerates the spread of HIV among different populations and regions. It is reported that the top three countries/cities with HIV prevalence in MSW population during 2009-2012 are Cote d’Ivoire Abidjan (50%, n = 96), India (43.6%, n = 334) and Kenya Nairobi (40%, n = 507). Over the same period, the reported infection rate was high in sub-Saharan Africa and moderate in the Americas and the infection rate in several cities in China was 0.50%
(n = 205) ~ 12.80% (n = 47), which was at a low level[^3]. By the end of 2015, the reported HIV infection rates for MSW in cities across China ranged from 0.88% (n=113)[^4] to 11.50% (n = 330).[^5] So far, there is still a lack of persuasive data on the status of MSW infection in China.

When it comes to the harm of commercial sex, researchers tend to pay more attention to the MSW, but few studies mention the other party of commercial sex—sex buyers (SB). In fact, the harm of SB should not be ignored. A study in the United States compared the behavior and attitude perception between SB and MSW, but did not focus on their dangerous behavior and the prevalence of HIV[^6]. While a domestic study compared the general characteristics and the HIV infection rate of SB and ordinary MSM[^7], however, the MSW is ignored and the results of the study are limited due to the limited sample size and the time of investigation. At present, there is a lack of in-depth study on the comparison between the MSW and SB. In order to solve this problem, our research group has conducted a study aimed at comparing the difference of the HIV infection rate between the MSW and SB and providing a reference for the control of the spread of AIDS.

**Methods**

**Data Sources**

The data of this research came from the Tianjin Bathhouse-based Health Center Program from 2011-2017. This project was funded by the President's Emergency Plan for AIDS Relief (PEPFAR) in the United States, which was the only joint pilot project in China by the China Centers for Disease Control and Prevention (CDC) AIDS Prevention Center, the United States CDC and Tianjin CDC, implementing by the Tianjin Shenlan Community-Based Organization and aimed to establish a site dedicated to MSM for HIV counselling and testing services. And the inclusion criteria for participants were self-reported as MSM and had (or one year ago) had same-sex male sex.

All participants must signed the informed consent and finished fingerprint verification before testing, and then entered the consultation room for professional one-on-one consultation and testing. The questionnaire survey was completed by the consultant using jargon to talk to participants. After the questionnaire was completed, blood antibody / antigen tests were performed on the participants who agreed to take the blood, and oral mucosal exudate antibody tests were performed on the participants who did not agree with the blood collection and the results of the quick test needed to wait 20 minutes. During the waiting period, the consultant conducted a risk assessment of the participants through the previous questionnaire survey and gave them targeted safety education and behavior recommendations. Participants with negative test results will be given condoms and lubricants, meanwhile they will be encouraged to mobilize their peers to test. Participants with positive test results will also be given condoms and lubricants, what’s more, their ID cards will be retained and their real names will be verified, and Western blot (WB) tests will be performed to confirm the diagnosis. For participants who tested positive for WB, their information was reported to the CDC where they were registered, and they were referred for standard treatment.
In addition, since 2018, through baths, bars, the Internet (QQ, WeChat, MSM dating software) and other channels, the project team began to recruit young men who have sex with men (YMSM), who also accepted the above questionnaire survey, fingerprint entry and HIV testing. Due to the particularity of the MSM, snowball sampling was used in the study.

Quality control

All the investigators are from the Tianjin Shenlan Community-Based Organization. They are MSM themselves, so they can use jargon when communicating with the MSM who came to consult, and all questionnaires were completed during the communication process. In order to ensure the privacy of the consultant, the consultation and testing were conducted in a one-to-one manner in a private room, and the final test results are only known to the consultant himself. All above, the privacy of participants was fully protected. In addition, compared with ordinary people, investigators from Tianjin Shenlan Community-Based Organization are more professional and more likely to gain the trust of consultants. Therefore, the authenticity of the survey results is guaranteed.

Identification of study population

From October 1\textsuperscript{st}, 2011 to March 24\textsuperscript{th}, 2018, a total of 10566 MSM in the MSM bathhouse participated in the survey, and from January 1\textsuperscript{st}, 2018 to December 31\textsuperscript{st}, 2018, a total of 1075 YMSM were recruited. According to the question: "Have you ever had commercial sex with the same sex in the past six months", those who answered yes were screened out. Then MSW and SB were defined according to the occupation and the question "whether it is MSW". The occupation of MSW was defined as MSW, otherwise defined as SB. As for the question "whether it is MSW”, if the answer was yes, then defined as MSW, otherwise defined as SB.

Data analysis

The number of cases (composition ratio) was used for statistical description of categorical variables. Comparisons between groups of MSW and SB were performed using the c\textsuperscript{2} test. Both univariate and multivariate analyses of HIV infection were performed using logistic regression analysis to obtain odds ratio (OR) and adjusted OR respectively. P <0.05 was considered the difference to be statistically significant. The above statistical analysis was achieved by SAS9.4.

Results

General demographic characteristics

After screening, the final sample content was 1164 (1104 from MSM bathhouse and 60 from YMSM project). Among them, there were 435 (37.4%) MSWs and 729 (62.6%) SBs. The age range of MSW group was 18~49 years old, and the median age was 26 (24, 28.75), and SB group 17~70 years old, median 37
In the married group, the SB accounted for 91.8%, while the MSW was only 8.2%. In addition, MSW was less (109, 32.4%) and SB was more (227, 67.6%) in Tianjin native group (Table 1).

Table 1 General demographic characteristics of candidates
| Variable                        | MSW (n=435,%) | SB (n=729,%) | $c^2$     | P        |
|--------------------------------|---------------|--------------|-----------|----------|
| **Age group**                  |               |              |           |          |
| 17~                            | 116(70.3)     | 49(29.7)     | 135.360   | <0.0001  |
| 25~                            | 264(44.2)     | 333(55.8)    |           |          |
| $\geq$45                       | 8(5.4)        | 139(94.6)    |           |          |
| **Education**                  |               |              |           |          |
| Primary                        | 22(75.9)      | 7(24.1)      | 48.786    | <0.0001  |
| Secondary                      | 174(47.4)     | 193(52.6)    |           |          |
| University                     | 53(23.7)      | 171(76.3)    |           |          |
| **Marital status**             |               |              |           |          |
| Single                         | 368(55.3)     | 297(44.7)    | 162.149   | <0.0001  |
| Married                        | 20(8.2)       | 224(91.8)    |           |          |
| **Duration of residence in Tianjin(years)** | | | | |
| 1                              | 140(52.8)     | 125(47.2)    | 21.811    | <0.0001  |
| 1~2                            | 37(59.7)      | 25(40.3)     |           |          |
| $>2$                           | 178(37.8)     | 293(62.2)    |           |          |
| **Place of domicile**          |               |              |           |          |
| Tianjin                        | 109(32.4)     | 227(67.6)    | 22.863    | <0.0001  |
| Others                         | 279(48.7)     | 294(51.3)    |           |          |
| **Nationality**                |               |              |           |          |
| Han                            | 378(42.4)     | 513(57.6)    | 1.244     | 0.2648   |
| Others                         | 10(55.6)      | 8(44.4)      |           |          |

**High risky behaviors**
In the six months before the survey, 2 MSW and 8 SB reported never using condoms during homosexual anal intercourse and among the people who used condoms every time, MSW was 320 (43.5%) and SB 416 (56.5%); In the event of commercial sexual activity, 6 MSW and 20 SB reported never using condoms, and in the case of using condoms every time, MSW was 365 (37.9%) and SB 599 (62.1%); In the event of sexual intercourse with the opposite sex, 27 MSW and 186 SB reported never using condoms, among those used every time, MSW was 23 (31.1%) and SB 51 (68.9%). In addition, a total of 75 participants reported a history of drug use, including 51 MSW and 24 SB (Table 2).

**Status of HIV and STD infection**

A total of 50 cases of HIV infection were found in this study, including 31 (62.0%) MSW and 19 (38.0%) SB, and the difference of HIV infection among them was statistically significant (P = 0.0002). In addition, the study found a total of 69 participants who were diagnosed Sexually Transmitted Diseases (STD) positive in the year prior to the investigation, including 19(27.5%) MSW and 50(72.5%) SB, but the difference of STD positive rate between MSW and SB was not statistically significant (0.0817) by c² test (Table 2).

**Awareness rate of AIDS knowledge**

In the study, 405 (38.2%) MSW and 656 (61.8%) SB had a good grasp of AIDS knowledge, but there was no difference in the awareness rate between the two groups (P = 0.0700) (Table 2).

---

Table 2 High risky behaviors, infection status and AIDS knowledge of MSW and SB
| Variable                                                                 | MSW (n=435,%) | SB (n=729,%) | $\chi^2$ | P   |
|--------------------------------------------------------------------------|---------------|--------------|---------|-----|
| How often do you use condoms in anal sex with the same sex in the last six months? |               |              |         |     |
| Never                                                                   | 2(20.0)       | 8(80.0)      | 30.104  | <0.0001 |
| Sometimes                                                                | 110(27.4)     | 292(72.6)    |         |     |
| Every time                                                               | 320(43.5)     | 416(56.5)    |         |     |
| How often do you use condoms in the last six months when you have commercial sex with a same-sex person? |               |              |         |     |
| Never                                                                   | 6(23.1)       | 20(76.9)     | 2.379   | 0.3044 |
| Sometimes                                                                | 64(37.0)      | 109(63.0)    |         |     |
| Every time                                                               | 365(37.9)     | 599(62.1)    |         |     |
| How often do you use condoms when you have sex with the opposite sex in the last six months? |               |              |         |     |
| Never                                                                   | 27(12.7)      | 186(87.3)    | 29.606  | <0.0001 |
| Sometimes                                                                | 27(42.2)      | 37(57.8)     |         |     |
| Every time                                                               | 23(31.1)      | 51(68.9)     |         |     |
| drug taking                                                              |               |              |         |     |
| Yes                                                                      | 51(68.0)      | 24(32.0)     | 32.132  | <0.0001 |
| No                                                                       | 384(35.3)     | 705(64.7)    |         |     |
| HIV                                                                      |               |              |         |     |
| Positive                                                                 | 31(62.0)      | 19(38.0)     | 13.540  | 0.0002 |
| Negative                                                                 | 404(36.3)     | 710(63.7)    |         |     |
Univariate analysis on factors associated with HIV infection

Univariate logistic regression analysis showed that the prevalence of HIV positive was correlated with marriage status, frequency of condom use in homosexual intercourse and commercial sex in the past six months, awareness rate of AIDS knowledge and identity of the participants (Table 3).

Table 3 Univariate analysis on factors associated with HIV infection

|                               | Yes   | No    |    |    |
|-------------------------------|-------|-------|----|----|
| Have you ever been diagnosed  | 19(27.5) | 50(72.5) | 3.031 | 0.0817 |
| with STD in the last year?    |       |       |    |    |
|                               | 416(38.0) | 679(62.0) |       |       |
| AIDS knowledge score          |       |       |    |    |
| ≤ 5                           | 30(29.1) | 73(70.9) | 3.282 | 0.0700 |
| ≥ 6                           | 405(38.2) | 656(61.8) |       |       |
| Variable                        | HIV                  | OR(95%CI)         | P     |
|--------------------------------|----------------------|-------------------|-------|
|                                | Positive             | Negative          |       |
|                                | (n=60,%)             | (n=1114,%)        |       |
| Age group                      |                      |                   |       |
| 17~                            | 8(4.8)               | 157(95.2)         | -     | -     |
| 25~                            | 29(4.9)              | 568(95.1)         | 1.002(0.449-2.235) | 0.9961 |
| ≥45                            | 12(8.2)              | 135(91.8)         | 1.744(0.693-4.394) | 0.2377 |
| Education                      |                      |                   |       |
| Primary                        | 3(10.3)              | 26(89.7)          | -     | -     |
| Secondary                      | 15(4.1)              | 352(95.9)         | 0.369(0.100-1.358) | 0.1338 |
| University                     | 10(4.5)              | 214(95.5)         | 0.405(0.105-1.567) | 0.1904 |
| Marital status                 |                      |                   |       |
| Single                         | 43(6.5)              | 622(93.5)         | 2.741(1.152-6.524) | 0.0226 |
| Married                        | 6(2.5)               | 238(97.5)         | -     | -     |
| Duration of residence in Tianjin(years) |                           |                   |       |
| 1                              | 19(7.2)              | 246(92.8)         | -     | -     |
| 1~2                            | 3(4.8)               | 59(95.2)          | 0.658(0.189-2.299) | 0.5123 |
| >2                             | 23(4.9)              | 448(95.1)         | 0.665(0.355-1.245) | 0.2019 |
| Place of domicile              |                      |                   |       |
| Tianjin                        | 16(4.8)              | 320(95.2)         | -     | -     |
| Others                         | 33(5.8)              | 540(94.2)         | 1.222(0.662-2.256) | 0.5211 |
| Nationality                    |                      |                   |       |
| Han                            | 48(5.4)              | 843(94.6)         | -     | -     |
| Others                         | 1(5.6)               | 17(94.4)          | 1.034(0.135-2.329) | 0.9747 |
How often do you use condoms in anal sex with the same sex in the last six months?

|        | Never | Sometimes | Every time |
|--------|-------|-----------|------------|
| N      | 2(20.0) | 30(7.5)  | 18(2.4)  |
| %      | 8(80.0)  | 372(92.5) | 718(97.6) |
| OR     | 9.972(1.976-50.315) | 3.217(1.770-5.848) | - |
| p      | 0.0054 | 0.0001    | - |

How often do you use condoms in the last six months when you have commercial sex with a same-sex person?

|        | Never | Sometimes | Every time |
|--------|-------|-----------|------------|
| N      | 5(19.2) | 18(10.4)  | 27(2.8)  |
| %      | 21(80.8) | 155(89.6) | 937(97.2) |
| OR     | 8.263(2.898-23.557) | 4.030(2.168-7.493) | - |
| p      | <0.0001 | <0.0001   | - |

How often do you use condoms when you have sex with the opposite sex in the last six months?

|        | Never | Sometimes | Every time |
|--------|-------|-----------|------------|
| N      | 12(5.6) | 2(3.1)  | 3(4.1)  |
| %      | 201(94.4) | 62(96.9) | 71(95.9) |
| OR     | 1.413(0.387-5.152) | 0.763(0.124-4.718) | - |
| p      | 0.6005 | 0.7715    | - |

Drug taking

|        | Yes | No |
|--------|-----|----|
| N      | 4(5.3) | 46(4.2) |
| %      | 71(94.7) | 1043(95.8) |
| OR     | 1.278(0.447-3.649) | - |
| p      | 0.6471 | - |
Have you ever been diagnosed with STD in the last year?

|     | Yes | No  | ODDS RATIO | 95% CI       | P-VALUE |
|-----|-----|-----|------------|--------------|---------|
| Yes | 4(5.8) | 65(94.2) | 1.403(0.490-4.018) | 0.5278 |
| No  | 46(4.2) | 1049(95.8) | - | - |

Identity

|     | MSW | SB  | ODDS RATIO | 95% CI       | P-VALUE |
|-----|-----|-----|------------|--------------|---------|
| MSW | 31(7.1) | 404(92.9) | 2.867(1.599-5.142) | 0.0004 |
| SB  | 19(2.6) | 710(97.4) | - | - |

AIDS knowledge score

|     | ≤5 | ≥6  | ODDS RATIO | 95% CI       | P-VALUE |
|-----|----|-----|------------|--------------|---------|
| ≤5  | 12(11.7) | 91(88.3) | 3.550(1.792-7.032) | 0.0003 |
| ≥6  | 38(3.6) | 1023(96.4) | - | - |

Multivariate analysis on factors associated with HIV infection

After adjusting for age and marital status, the HIV infection rate of MSW was 2.775 (1.34-5.746) times higher than that of SB; after further adjusting the awareness rate of AIDS knowledge, the HIV infection rate of MSW was 3.173 (1.512-6.659) times higher than that of SB; and after further adjusting the frequency of condom use in same-sex sex and commercial sex in the past six months, the HIV infection rate of MSW was 3.688 (1.711-7.950) times higher than that of SB (Table 4).

Table 4 Multivariate analysis on factors associated with HIV infection
| Variable | OR       | 95%CI         | P    |
|----------|----------|---------------|------|
| **Mode 1*** |          |               |      |
| **Identity** |          |               |      |
| MSW      | 2.775    | (1.340-5.746) | 0.0060 |
| SB       | -        | -             | -    |
| **Age group** |          |               |      |
| 17~      | -        | -             | -    |
| 25~      | 1.434    | (0.636-3.236) | 0.3847 |
| ≥45      | 6.622    | (2.187-20.052)| 0.0008 |
| **Marital status** |          |               |      |
| Single   | 3.392    | (1.264-9.098) | 0.0153 |
| Married  | -        | -             | -    |
| **Model 2** |          |               |      |
| **Identity** |          |               |      |
| MSW      | 3.173    | (1.512-6.659) | 0.0023 |
| SB       | -        | -             | -    |
| **AIDS knowledge score** |          |               |      |
| ≤5       | 4.165    | (2.006-8.648) | 0.0001 |
| ≥6       | -        | -             | -    |
| **Model 3** |          |               |      |
| **Identity** |          |               |      |
| MSW      | 3.688    | (1.711-7.950) | 0.0009 |
| SB       | -        | -             | -    |
| **How often do you use condoms in anal sex with the same sex in the last six months?** |          |               |      |
| Never    | 2.942    | (0.302-28.687)| 0.3530 |
| Sometimes| 2.337    | (1.090-5.007) | 0.0291 |
| Every time | -        | -             | -    |
condoms in the last six months when you have commercial sex with a same-sex person?

|                |               |                |            |
|----------------|---------------|----------------|------------|
| Never          | 6.259         | (1.539-25.454) | 0.0104     |
| Sometimes      | 1.961         | (0.911-4.222)  | 0.0851     |
| Every time     | -             | -              | -          |

*Model 1 was adjusted for age and marital status

**Model 2 was further adjusted for AIDS knowledge score in addition to the variables in model 1

***Model 3 was further adjusted for condom use in anal sex and commercial sex with the same sex in the last six months in addition to the variables in model 2

**Discussion**

In recent years, more and more researchers have begun to pay attention to the status of HIV infection in MSM. As a subgroup of MSM, MSW has also begun to attract attention. According to the UNAIDS report, there were approximately 1.7 million new HIV infections worldwide in 2018\[1\]. Among infected people, gay men and other men who have sex with men accounted for an estimated 17% of new HIV infections globally, which was in a highly infected state. However, due to the hard-to-reach of MSW, it is difficult to carry out related research. As a result, there are fewer reports of HIV prevalence in MSW. In this study, a total of 50 HIV-infected individuals were identified, including 31 MSWs and 19SBs. The prevalence of MSW (7.1%) was significantly higher than that of SB (2.6%).

This study found that MSW (median age=26) was younger than SB (median age =37). This is similar to the findings of Amanja Verhaegh-Haasnoot's study, which found that MSW was younger than ordinary MSM\[8\]. Besides that, similar findings were found in research on female sex workers (FSW), which reported that the age of FSW was generally lower\[9\]. There may be several reasons. Psychologically, SB is more inclined to find "young and beautiful" sexual partners. In terms of physiological functions, older people are not suitable to become MSW. And MSW is mostly composed of people with lower economic income\[10\], while older people may have more stable jobs and incomes, so they do not need to make a living from it.

The heterosexual marriage rate of MSM in our study exceeded 25%, which was a high level in the countries currently reported\[11\]. This may be related to the cultural background of different countries. Compared to other countries, the Chinese people's concept of marriage is not so open. People generally prefer to accept monogamy, so "unmarried people" are not promoted in China. And due to the widespread stigmatization of MSM in the world\[12\], some MSM may use marriage as an umbrella for their
homosexual sexual orientation\textsuperscript{[13]}. Moreover, less than 10\% of MSW were reported in heterosexual marriage in this study, and the proportion of SB was more than 90\%. This is similar to the findings of Weiming Tang's study\textsuperscript{[14]}, which found that the marriage rate of MSW people was lower than that of ordinary MSM. The reason may be that the nature and content of MSW's work are contrary to the moral requirements in traditional Chinese culture, so that choosing to marry the opposite sex is not a responsible performance.

Besides, in homosexual and commercial sex, there were only a few people who reported never using condoms, and a high percentage of people use condoms each time, which is similar to the findings of Bea Vuylsteke's research\textsuperscript{[15]}. This may be related to the active publicity and education of relevant departments and the increase of awareness of disease prevention among MSM. Overall, the frequency of condom use in MSW was lower than that in SB, which is similar to the results of Stefan David Baral\textsuperscript{[3]}. On the one hand, it may be because MSW does not have the right to choose whether to use a condom or not as the party providing services when commercial sex occurs\textsuperscript{[16]}; On the other hand, it may be due to the higher demand and attention to money and the lower attention to safety in MSW after long-term sex work.

We found that singles, low frequency of condom use in same-sex and commercial sex, low awareness rate of AIDS knowledge, and MSW identity were risk factors for HIV infection. After adjusting age, marital status, AIDS knowledge awareness rate, and the frequency of condom use when homosexual and commercial sex occurred in the past six months with a stepwise approach, the risk of MSW infection is still higher than SB, and the results are always statistically significant. Therefore, MSW can be considered as a risk factor for HIV infection compared to SB identity. This is similar to Heide Castañeda's research, which found that MSW was more susceptible to HIV infection than ordinary MSM\textsuperscript{[17]}. The reasons may be as follows. First of all, compared with SB or other MSM population, MSW has more sexual partners and higher frequency of sexual intercourse\textsuperscript{[18]}, which means more source and chance of transmission and higher risk of infection. Second, the use of condoms is currently recognized as one of the effective ways to prevent the spread of diseases (e.g, AIDS, STD). However, MSW does not have the right to choose to use condoms when they have commercial sex. They are more inclined to meet the requirements of SB to obtain more economic income\textsuperscript{[19]}. Third, MSW faces more widespread discrimination and stigma, so they may have no access to services or be ashamed to seek services\textsuperscript{[20]}. Fourth, pre-exposure prophylaxis (PrEP)\textsuperscript{[21]} and post-exposure prophylaxis (PEP)\textsuperscript{[22]} are currently considered as effective preventive and remedial measure before and after high-risk behaviors occurrence. But because these two drugs are expensive (for example, in China PrEP costs 1980 yuan / month) and most MSW is a low-income group, they do not have the economic strength to buy such expensive drugs. Therefore, before and after the occurrence of high-risk behavior, they have no way to reduce the risk of possible infection, which ultimately leads to a high level of infection in MSW.

\textbf{Limitation}
1. Our study used snowball sampling with a degree of selection bias. However, due to the particularity of MSM, other methods of probability sampling are not applicable.

2. Due to the review of the situation in the last six months and one year in the questionnaire, it is inevitable that there will be some memory bias.

3. Unfortunately, due to limited survey conditions, we did not obtain samples of MSW and SB pairings.

Conclusions

In conclusion, MSW is more likely to infect HIV than SB, although they are both involved in commercial sex. Therefore, effective preventive measures should be focused on MSW.

List Of Abbreviations

MSW: male sex workers
HIV: human immunodeficiency virus
SB: sex buyers
AIDS: acquired immune deficiency syndrome
MSM: men who have sex with men
PEPFAR: President's Emergency Plan for AIDS Relief
CDC: Centers for Disease Control and Prevention
WB: Western blot
YMSM: young men who have sex with men
OR: odds ratio
STD: Sexually Transmitted Diseases
FSW: female sex workers
PrEP: pre-exposure prophylaxis
PEP: post-exposure prophylaxis

Declarations

Ethics approval and consent to participate
This study was reviewed and approved by the Institutional Review Board of the National Center for AIDS/STD Control and Prevention, China CDC [IRB approve number: X130205267] and sponsored by the President's Emergency Plan for AIDS Relief (PEPFAR). All participants signed an informed consent form before the survey started.

**Consent for publication**

Not applicable.

**Availability of data and materials**

The datasets analysed during the current study are not publicly available because it contains information that may damage the privacy of the research participants but are available from the corresponding author on reasonable request.

**Competing interests:**

The authors declare that they have no competing interests.

**Funding:**

This work was supported by Outcome Evaluation of the Tianjin Bathhouse-based Health Center Program, 2011-2017, PEPFAR (President’s Emergency Plan For Aids Relief, PEPFAR, USA), NU2GGH001153.

**Authors’ contributions:**

ZXY and YJ collected data. ZTT, YTT, SDS and CY organized the database. ZHL wrote the manuscript and analyzed data. HHJ and YZY reviewed the manuscript. WC and WXM contributed to discussion. LCP, CZ, LYY and MJ contributed to the research ideas of this study. And all authors have read and approved the final manuscript.

**Acknowledgements:**

All authors express special thanks to US Centers for Disease Control and Prevention (CDC), China CDC/National Center for STDs and HIV/AIDS (NCAIDS), Tianjin City CDC, and Tianjin Shenlan Community-Based Organization (CBO).

**Reference**

1. UNAIDS. [2019-UNAIDS-data_en](https://www.unaids.org/en/resources/documents/2019/2019-UNAIDS-data) 2019.

2. Underhill K, Morrow KM, Colleran C, Holcomb R, Calabrese SK, Operario D, et al. A Qualitative Study of Medical Mistrust, Perceived Discrimination, and Risk Behavior Disclosure to Clinicians by U.S. Male
Sex Workers and Other Men Who Have Sex with Men: Implications for Biomedical HIV Prevention. *J Urban Health* 2015; 92(4):667-686.

3. Baral SD, Friedman MR, Geibel S, Rebe K, Bozhinov B, Diouf D, et al. Male sex workers: practices, contexts, and vulnerabilities for HIV acquisition and transmission. *The Lancet* 2015; 385(9964):260-273.

4. Xiaowen S, Junying Y, Shouyuan Z, Li W. Survey on High Risk Behavior related with STD and HIV Infection among Sexual Workers in Wuxi City. *Modern Preventive Medicine* 2014; 41(16):2980-2983.

5. Hui Z, Maohe Y, Zhijun L, Yun C, Jie Y, Chuan G, et al. Analysis on the risk factors of HIV infection among MSWs in Tianjin. *Chinese Journal of AIDS & STD* 2018; 24(08):800-803.

6. Farley M, Golding JM, Matthews ES, Malamuth NM, Jarrett L. Comparing Sex Buyers With Men Who Do Not Buy Sex: New Data on Prostitution and Trafficking. *J Interpers Violence* 2017; 32(23):3601-3625.

7. Chen L, Mahapatra T, Fu G, Huang S, Zheng H, Tucker JD, et al. Male Clients of Male Sex Workers in China: An Ignored High-Risk Population. *J Acquir Immune Defic Syndr* 2016; 71:316-322.

8. Verhaegh-Haasnoot A, Dukers-Muijters NH, Hoebe CJ. High burden of STI and HIV in male sex workers working as internet escorts for men in an observational study: a hidden key population compared with female sex workers and other men who have sex with men. *BMC Infect Dis* 2015; 15:291.

9. Masvawure TB, Mantell JE, Tocco JU, Gichangi P, Restar A, Chabeda SV, et al. Intentional and Unintentional Condom Breakage and Slippage in the Sexual Interactions of Female and Male Sex Workers and Clients in Mombasa, Kenya. *AIDS Behav* 2018; 22(2):637-648.

10. Landers S, Closson EF, Oldenburg CE, Holcomb R, Spurlock S, Mimiaga MJ. HIV Prevention Needs Among Street-Based Male Sex Workers in Providence, Rhode Island. *American Journal of Public Health* 2014; 11; 104(11):100-102.

11. Narayanan P, Das A, Morineau G, Prabhakar P, Deshpande GR, Gangakhedkar R, et al. An exploration of elevated HIV and STI risk among male sex workers from India. *BMC Public Health* 2013; 11:1059.

12. Tsang EY, Qiao S, Wilkinson JS, Fung AL, Lipeleke F, Li X. Multilayered Stigma and Vulnerabilities for HIV Infection and Transmission: A Qualitative Study on Male Sex Workers in Zimbabwe. *Am J Mens Health* 2019; 13(1):1557988318823883.

13. Kong TS. Risk factors affecting condom use among male sex workers who serve men in China: a qualitative study. *Sex Transm Infect* 2008; 84(6):444-448.

14. Tang W, Mahapatra T, Liu F, Fu G, Yang B, Tucker JD, et al. Burden of HIV and Syphilis: A Comparative Evaluation between Male Sex Workers and Non-Sex-Worker Men Who Have Sex with Men in Urban China. *PLoS One* 2015; 10(5):e0126604.

15. Vuylsteke B, Semde G, Sika L, Crucitti T, Ettiegne Traore V, Buve A, et al. High prevalence of HIV and sexually transmitted infections among male sex workers in Abidjan, Cote d'Ivoire: need for services tailored to their needs. *Sex Transm Infect* 2012; 88(4):288-293.
16. Chang RC, Hail-Jares K, Zheng H, He N, Bouey JZH. *Mitigating circumstances: A model-based analysis of associations between risk environment and infrequent condom use among Chinese street-based sex workers*. *PLoS One* 2018; 13(5):e0195982.

17. Castaneda H. *Structural vulnerability and access to medical care among migrant street-based male sex workers in Germany*. *Soc Sci Med* 2013; 84:94-101.

18. Vuylsteke B, Semdé G, Auld A, Sabatier J, Kouakou J, Ettiègne-Traoré V, et al. *Retention and Risk Factors for Loss to Follow-Up of Female and Male Sex Workers on Antiretroviral Treatment in Ivory Coast: A Retrospective Cohort Analysis*. *J Acquir Immune Defic Syndr* 2015; 68:99-106.

19. Valente PK, Mantell JE, Masvawure TB, Tocco JU, Restar AJ, Gichangi P, et al. *"I Couldn't Afford to Resist": Condom Negotiations Between Male Sex Workers and Male Clients in Mombasa, Kenya*. *AIDS Behav* 2019.

20. Nyblade L, Reddy A, Mbote D, Kraemer J, Stockton M, Kemunto C, et al. *The relationship between health worker stigma and uptake of HIV counseling and testing and utilization of non-HIV health services: the experience of male and female sex workers in Kenya*. *AIDS Care* 2017; 29(11):1364-1372.

21. Cremin I, McKinnon L, Kimani J, Cherutich P, Gakii G, Muriuki F, et al. *PrEP for key populations in combination HIV prevention in Nairobi: a mathematical modelling study*. *The Lancet HIV* 2017; 4(5):e214-e222.

22. Pereira IO, Pascom A, Mosimann G, Barros Perini F, Coelho RA, Rick F, et al. *Post-exposure prophylaxis following consented sexual exposure: impact of national recommendations on user profile, drug regimens and estimates of averted HIV infections*. *HIV Med* 2019.