Original research

Association between rectal douching and HIV acquisition: the mediating role of condom use and rectal bleeding in a national online sample of Chinese men who have sex with men

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ABSTRACT

Objectives Previous studies have demonstrated that rectal douching (RD) is associated with HIV acquisition among men who have sex with men (MSM). However, the precise mechanism underlying the association between RD and HIV remains unclear.

Methods We recruited participants over WeChat from October 2017 to October 2018. Respondents received mailed HIV self-testing kits, uploaded images of HIV self-test results and completed an online electronic questionnaire simultaneously. The questionnaire assessed sociodemographic characteristics, RD practices and sexual risk behaviours. HIV status was measured as the result of the HIV self-testing. The Baron and Kenny statistical method was used to assess the association between RD and HIV, controlling for condomless anal intercourse (CAI) and rectal bleeding.

Results Of 1365 participants, 39.93% (545/1365) reported RD in the past 6 months, 60.07% had multiple male sexual partners and 43.08% had CAI in the past 6 months. The prevalence of HIV, based on self-testing, was 3.37% (46/1365). Multivariable logistic analysis showed RD was significantly associated with both sexual role (adjusted OR (aOR) 14.0; 95% CI 9.8 to 20.2), having multiple male sexual partners (aOR 1.8; 95% CI 1.4 to 2.2), CAI (aOR 1.3; 95% CI 1.0 to 1.6), rectal bleeding (aOR 2.0; 95% CI 1.6 to 2.6) and HIV infection (aOR 1.9; 95% CI 1.0 to 3.4). Baron and Kenny analysis found both CAI (aOR 2.2; 95% CI 1.2 to 4.1) and rectal bleeding (aOR 1.9; 95% CI 1.0 to 3.4) play a mediating role in the association between RD and HIV.

Conclusions Our study results confirmed the relationship between RD and HIV, and found CAI and rectal bleeding mediated HIV infection in Chinese MSM who douch. Strategies should be encouraged to strengthen health education and reduce high-risk sexual behaviour in order to reduce the risk of HIV in MSM who use enemas. Rectal microbicides may represent an efficient means of providing HIV prophylaxis among MSM.

BACKGROUND

The epidemic of HIV infection remains disproportionately high globally among men who have sex with men (MSM).1 2 China also faces a significant challenge imposed by the HIV epidemic among certain populations, particularly MSM. National surveillance data have indicated that the prevalence of HIV among MSM increased from 0.9% in 2003 to 8% in 2015.3 4 Given the disproportionately high burden of HIV infection among MSM, it is essential to understand the sexual behaviours and preferences of this key population in order to develop a novel and effective strategy to prevent HIV infection.

Rectal douching (RD) is the act of using tools to insert liquid into the rectum for the purpose of cleansing. Recent research has raised concerns over the association between RD and HIV infection. A large-scale cross-sectional study, involving 112 countries and 1725 respondents, demonstrated that 66% of participants reported experiencing RD during their lifetime.5 Several previous studies have reported that RD is associated with an increased prevalence of HIV in MSM.6–9 There are various explanations for the association between RD behaviour and HIV infection. Traditionally, it was assumed that RD might result in damage being incurred by the effect of friction on the single-cell epithelium of the rectum, thereby facilitating the entry of pathogens and increasing the acquisition of HIV and other STIs.10 11 Some academics assume that RD is correlated with STIs, including clamidia and gonorrhoea,12 hepatitis B virus (HBV) and hepatitis C virus (HCV).13 14 and therefore increases the risk of HIV infection by an indirect manner. Previous studies have also investigated the association between RD and certain high-risk sexual behaviours. For example, Noor’s study demonstrated that MSM who douch were more likely to engage in unprotected anal intercourse (AI), and more likely to be associated with HIV, compared with those who did not.15 Furthermore, MSM who practised RD also reported a history of group sex and multiple sexual partners13 16; collectively, these behaviours increase the possibility of HIV infection. However, very little is known with regard to the potential role of high-risk sexual behaviour in the pathway associated RD with the acquisition of HIV.

The complex nature of this relationship suggested that a more accurate and complex model was needed in order to examine the associations...
between RD, high-risk sexual behaviour and HIV infection. As expected, a mediation model was previously used to assess the mediating role of high-risk sexual behaviours in the association between recreational drug use (RDU) and HIV/STIs. Furthermore, previous studies of RD by MSM were mainly conducted in western countries, adopted small sample sizes and were only carried out at a small number of sites, thus limiting the generalisability of the results. Therefore, we conducted a national, behavioural and epidemiological online survey of Chinese MSM in an attempt to propose a conceptual model to assess the mediating role of high-risk sexual behaviours and the association of RD and HIV. We also aimed to acquire a significant body of data relating to the prevalence of RD and its association with HIV infection and high-risk sexual behavioural associations between RD, high-risk sexual behaviour and HIV infection. As expected, a mediation model was previously used to assess the mediating role of high-risk sexual behaviours in the association between recreational drug use (RDU) and HIV/STIs. Furthermore, previous studies of RD by MSM were mainly conducted in western countries, adopted small sample sizes and were only carried out at a small number of sites, thus limiting the generalisability of the results. Therefore, we conducted a national, behavioural and epidemiological online survey of Chinese MSM in an attempt to propose a conceptual model to assess the mediating role of high-risk sexual behaviours and the association of RD and HIV. We also aimed to acquire a significant body of data relating to the prevalence of RD and its association with HIV infection and high-risk sexual behaviour.

**METHODS**

**Study design**

Between October 2017 and October 2018, we invited five operators of WeChat public platforms (software product of Tencent, Shenzhen, China), which were actively followed and used by their MSM fans, to help the project release HIVST recruitment advertisements. Individuals were able to click the link of a recruitment advertisement to attend the HIVST project inclusion criteria screening. MSM participants were eligible and are included in the project if they met all the following criteria: (1) born biologically male; (2) aged ≥18 years; (3) having no HIV-positive test history previously; (4) self-reporting had oral or anal sex with other males at least once in their lifetime; (5) agreed to the study contents of this project and provided online informed consent. Then the eligible MSM participants were required to provide their address, phone number and nickname for getting HIV self-testing kits through express mail. After receiving the self-testing kit, the MSM respondents could complete HIV self-testing following the detailed steps of instructions in the express mail. Then, respondents were required to upload their image of self-testing results, and meanwhile, complete an online electronic questionnaire and add the personal WeChat account that dedicated to this project to get help for the interpretation of the HIVST results and receiving questionnaire compensation fees. The researcher staff would review the results uploaded by respondents within 24 hours and give each respondent 15 RMB (US$2.4) through WeChat for the compensation of attending with the questionnaire survey.

**Measures**

Participants needed to complete a self-administrated electronic survey and reported their (1) demographic data, including age, monthly income, occupation, education and sexual orientation; (2) HIV sexual risk behaviours in the past 6 months, including whether reported practice of RD, the primary venue for seeking male sexual partners, predominant sexual role during AI in the past 6 months, the number of male sexual partners, the use of condoms and rectal bleeding; (3) recreational drug use in the past 6 months, including using cannabis, amphetamine, methamphetamine, methadone, cocaine, ketamine and ecstasy; and (4) HIV test history, including lifetime HIV test history before attending this HIVST survey and average HIV test interval.

We acquired the HIV status of each participant by self-testing. A finger-prick-based HIVST kit (Wondfo, Beijing, China), approved by the Food and Drug Administration of China, was used in our study. Blood samples were obtained using disposable blood needles and collected by an EDTA-treated capillary. Then, the specimen of blood was dropped on the specimen reaction zone. Finally, Alera Determine Chase solution was added onto the reaction zone. Respondents were then instructed to read the HIV testing results in approximately 15 min. To ensure the accuracy of HIV self-testing results, the instructions of HIVST kits detail each step of self-testing process in the form of pictures and text. Besides, a two-dimensional code is provided in the instruction, which allows participants to watch the operation video of HIVST by scanning the two-dimensional code. Moreover, we also provide a personal WeChat account and phone number dedicated to this project, and participants can contact us if they encountered any difficulties during the testing process. For individuals with a reactive HIV test result, we would provide advice for further HIV testing in order to confirm the diagnosis. If a positive diagnosis was confirmed, then we also referred the patient for treatment and care.

**Statistical analysis**

Chi-square statistics were used to compare the differences in demographics, HIV risk behaviours, and HIV test variables between MSM who reported RD and those who did not. Multiple logistic regressions were also used to estimate the associations between RD and condomless anal intercourse (CAI), RDU, multiple male sexual partners, rectal bleeding, HIV infection and other variables.

We also used the mediation model, using the methods described by Baron and Kenny. We performed a series of regression models to estimate the mediating role of CAI and rectal bleeding on the association between RD and HIV. In the mediation model, CAI (M1) and rectal bleeding (M2) served as mediators, RD served as an independent variable (X) and HIV served as a dependent variable (Y). First, we regressed CAI on RD, and then regressed HIV on RD and CAI, respectively. Finally, we regressed HIV on both RD and CAI. Similarly, we further estimated the mediating effect of rectal bleeding on the association between RD and HIV. Demographic variables, including age, monthly income and occupation, which showed statistical significance in the bivariate analyses, based on whether an enema was used, were controlled as covariates for each multiple logistic regression model.

All statistical analysis was carried out using SPSS V22.0. The regression coefficient of each equation was estimated by adjusted OR (aOR) and 95% CIs. A two-tailed alpha of 0.05 was considered to be statistically significant.

**RESULTS**

**Demographic data**

In total, 1701 MSM from 30 provinces in mainland China applied for self-testing kits during 2017–2018. Of those who applied, 1501 (88.24%) conducted self-testing and completed the survey. After the exclusion of MSM who did not answer questions related to RD practices in the past 6 months, or those that failed to upload their HIV self-testing results, 1365 (80.24%) eligible participants were included in the final analysis (figure 1). The sociodemographic information of these MSM participants is shown in **table 1**. The analysis showed that 51.36% of respondents were 25 years or older, had a monthly income of US$300–900 or higher (66.30%), and had attended high school or college (95.97%). In addition, the majority of the participants identified their sexual orientation as homosexual (70.92%).

**RD, high-risk sex and HIV test results**

Of the 1365 respondents, 545 (39.93%) reported that they had used rectal douches over the past 6 months. Furthermore, 60.07%
of respondents reported that they had multiple male sexual partners, and 43.08% had reported CAI in the past 6 months; 46 MSM participants reported positive HIV test results. The prevalence of HIV, based on self-testing results, was 3.37% (46/1365). After adjustment for demographic variables, multivariable analysis showed that those who used rectal douches were significantly associated with taking anal sex as bottom role (vs top role) (aOR 14.0; 95% CI 9.8 to 20.2) or versatile role (vs top role) (aOR 9.2; 95% CI 6.4 to 13.3), seeking male sexual partners from the Internet (aOR 1.4; 95% CI 1.0 to 1.9), multiple male sexual partners (aOR 1.8; 95% CI 1.4 to 2.2), CAI (aOR 1.3; 95% CI 1.0 to 1.6), RDU (aOR 3.3; 95% CI 2.6 to 4.1), rectal bleeding (aOR 2.0; 95% CI 1.6 to 2.6), recent testing for HIV (aOR 1.8; 95% CI 1.3 to 2.4) in the past 6 months, and a higher HIV prevalence (aOR 1.9; 95% CI 1.0 to 3.4), compared with those who did not use RD (table 2) (each p < 0.05).

Association between RD and CAI, rectal bleeding and HIV
RD was significantly associated with HIV infection (aOR 1.9; 95% CI 1.0 to 3.4). Mediation analysis, in which CAI was considered as a potential mediator for the association between RD and HIV infection, showed that CAI was independently associated with both RD (aOR 1.3 95% CI 1.0 to 1.6) and HIV infection (aOR 2.3; 95% CI 1.3 to 4.3). When CAI and RD were both included in this model, the association between CAI and HIV infection (aOR 2.2; 95% CI 1.2 to 4.1) remained significant; however, non-significant associations were identified between RD and HIV infection (aOR 1.8; 95% CI 1.0 to 3.2). Thus, CAI serves as a significant mediator in the association between RD and HIV infection (table 3).

Analysis of the potential mediating role of rectal bleeding in the association between RD and HIV infection is also presented in table 3. A significant association was identified between rectal bleeding and HIV (aOR 1.9; 95% CI 1.0 to 3.4) in mediation analysis. We also identified that rectal bleeding also served as another mediator in the association between RD and HIV infection.

**DISCUSSION**

To our best knowledge, this is the first national-level study to assess the RD behaviour and its correlation with HIV in MSM population, and this study also demonstrates the role of some high-risk sexual behaviours in the mediating of association.

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**Table 1** Social and behavioural characteristics and HIV prevalence among Chinese MSM (n=1365)

| Variables                     | Total   | Rectal douching in the past 6 months | Without rectal douching in the past 6 months |
|-------------------------------|---------|-------------------------------------|---------------------------------------------|
|                               | (n=545) | (=820)                              |                                             |
| Age (years)                   |         |                                     |                                             |
| ≥25                           | 701     | 305 (56.0)                          | 399 (48.7)                                 |
| <25                           | 664     | 240 (44.0)                          | 421 (51.3)                                 |
| Monthly income (US$)          |         |                                     |                                             |
| <300                          | 460     | 153 (28.1)                          | 307 (37.4)                                 |
| 300–900                       | 568     | 246 (45.1)                          | 322 (39.3)                                 |
| >900                          | 337     | 146 (26.8)                          | 191 (23.3)                                 |
| Occupation                    |         |                                     |                                             |
| Full-time employment          | 783     | 341 (62.6)                          | 442 (53.9)                                 |
| Unemployed/retired/students/others | 582    | 204 (37.4)                          | 378 (46.1)                                 |
| Education                     |         |                                     |                                             |
| Junior school or below        | 55      | 25 (4.6)                            | 30 (3.7)                                   |
| High school                   | 386     | 160 (29.4)                          | 226 (27.6)                                 |
| College or above              | 924     | 360 (66.0)                          | 564 (68.7)                                 |
| Sexual orientation            |         |                                     |                                             |
| Homosexual                    | 968     | 431 (79.1)                          | 537 (65.5)                                 |
| Other                         | 397     | 114 (20.9)                          | 283 (34.5)                                 |
| Predominant sexual role during AI in the past 6 months |         |                                     |                                             |
| Top                           | 420     | 54 (10.4)                           | 366 (43.1)                                 |
| Versatile                     | 360     | 196 (37.8)                          | 164 (23.8)                                 |
| Bottom                        | 427     | 268 (51.7)                          | 159 (23.1)                                 |
| Primary venue for seeking male sexual partners |         |                                     |                                             |
| Internet apps                 | 1165    | 478 (87.7)                          | 687 (83.8)                                 |
| Non-internet apps             | 200     | 67 (12.3)                           | 133 (16.2)                                 |
| No of male sexual partners in the past 6 months |         |                                     |                                             |
| ≥2                            | 820     | 371 (68.1)                          | 449 (54.8)                                 |
| 0–1                           | 545     | 174 (31.9)                          | 371 (45.2)                                 |
| CAI in the past 6 months      |         |                                     |                                             |
| Yes                           | 588     | 253 (46.4)                          | 335 (40.9)                                 |
| No                            | 777     | 292 (53.6)                          | 485 (59.1)                                 |
| Rectal bleeding in the past 6 months |         |                                     |                                             |
| Yes                           | 466     | 236 (43.3)                          | 230 (28.0)                                 |
| No                            | 899     | 309 (56.7)                          | 590 (72.0)                                 |
| Recreational drug use in the past 6 months |         |                                     |                                             |
| Yes                           | 464     | 273 (50.1)                          | 191 (23.3)                                 |
| No                            | 901     | 272 (49.9)                          | 629 (76.7)                                 |
| Lifetime HIV testing history before |         |                                     |                                             |
| Yes                           | 1011    | 439 (80.6)                          | 572 (69.8)                                 |
| No                            | 354     | 106 (19.4)                          | 248 (30.2)                                 |
| Average HIV test interval‡    |         |                                     |                                             |
| ≤6 months                     | 484     | 237 (54.0)                          | 247 (43.2)                                 |
| 6–12 months                   | 229     | 97 (22.1)                           | 132 (23.1)                                 |
| ≥12 months or interval is not fixed | 298   | 105 (23.9)                          | 193 (33.7)                                 |
| HIV status                    |         |                                     |                                             |
| HIV self-testing positive     | 46      | 26 (4.8)                            | 20 (2.4)                                   |
| HIV self-testing negative     | 1319    | 519 (95.2)                          | 800 (97.6)                                 |

Recreational drug use: psychoactive drug to alter one’s mental state in a way that modifies emotions, perceptions and feelings for recreational purposes, including rush poppers, methamphetamine, amphetamine, tramadol, cocaine, ketamine and ecstasy.

*Unadjusted p values calculated by the χ² test.
†There were 158 participants who had no anal intercourse in the past 6 months.
‡There were 354 participants who had not tested for HIV previously.
AI, anal intercourse; CAI, condomless anal intercourse; MSM, men who have sex with men.
between RD and HIV. Our mediation models found that CAI and rectal bleeding behaviours make a significant contribution to HIV risk in MSM who reported RD. The practice of RD was also associated with CAI, RDU, rectal bleeding and multiple male sexual partners. These findings provided further understanding of how RD is associated with HIV infection and provides valuable information for the prevention of HIV with regards to the use of enemas by MSM.

Table 2: Multivariate association between rectal douching and behavioural characteristics and HIV prevalence among Chinese MSM (n=1365)

| Variable | Rectal douching in the past 6 months | Adjusted model | P value* |
|----------|-------------------------------------|----------------|----------|
|          |                                     | aOR (95% CI)   |          |
| Predominant sexual role during AI in the past 6 months† | Top | 12.9 (54/420) | Ref | |
|          | Versatile | 54.4 (196/360) | 9.2 (6.4 to 13.3) | <0.001 | |
|          | Bottom | 62.8 (268/427) | 14.0 (9.8 to 20.2) | <0.001 | |
| Main venue for seeking male sexual partners | Internet app | 41.0 (478/1165) | 1.4 (1.0 to 1.9) | 0.046 | |
|          | Non-internet app | 33.5 (67/200) | Ref | |
| No of male sexual partners in the past 6 months‡ | a2 | 45.2 (371/820) | 1.8 (1.4 to 2.2) | <0.001 | |
|          | ≥1 | 31.9 (174/545) | Ref | |
| CAI in the past 6 months | Yes | 43.0 (253/588) | 1.3 (1.0 to 1.6) | 0.0038 | |
|          | No | 37.6 (292/777) | Ref | |
| Rectal bleeding in the past 6 months | Yes | 50.6 (236/466) | 2.0 (1.6 to 2.6) | <0.001 | |
|          | No | 34.1 (309/905) | Ref | |
| Recreational drug use in the past 6 months | Yes | 58.8 (273/464) | 3.2 (2.6 to 4.1) | <0.001 | |
|          | No | 30.2 (272/901) | Ref | |
| Lifetime HIV testing history | Yes | 43.4 (439/1011) | 1.7 (1.3 to 2.2) | <0.001 | |
|          | No | 29.9 (106/354) | Ref | |
| Average HIV test interval | ≤6 months | 49.0 (237/484) | 1.8 (1.3 to 2.4) | <0.001 | |
|          | 6–12 months | 42.4 (97/229) | 1.3 (0.9 to 1.9) | 0.105 | |
|          | ≥12 months or interval is not fixed | 35.2 (105/298) | Ref | |
| HIV status | Self-testing positive | 56.5 (26/46) | 1.9 (1.0 to 3.4) | 0.038 | |
|          | Self-testing negative | 39.3 (519/1319) | Ref | |

Table 3: Mediating effect of CAI and rectal bleeding on rectal douching and HIV infection in Chinese MSM

| Outcome: HIV infection (Y) | X−M | M−Y | X−Y | (X, M)−Y |
|----------------------------|-----|-----|-----|----------|
| aOR (95% CI) | P value | aOR (95% CI) | P value | aOR (95% CI) | P value | aOR (95% CI) | P value |
| Rectal douching in the past 6 months (X) | 1.3 (1.0 to 1.6) | 0.038 | N/A | 1.9 (1.0 to 3.4) | 0.038 | 1.8 (1.0 to 3.2) | 0.061 |
| CAI in the past 6 months (MI) | N/A | 2.3 (1.3 to 4.3) | 0.007 | N/A | 1.9 (1.0 to 3.4) | 0.038 | 1.7 (0.9 to 3.1) | 0.089 |
| Rectal bleeding in the past 6 months (M) | 2.0 (1.6 to 2.6) | <0.001 | N/A | 1.9 (1.0 to 3.4) | 0.038 | 1.9 (1.0 to 3.4) | 0.044 |

The Baron and Kenny approach was used to analyse the mediating effect of CAI and rectal bleeding. Multivariate logistic regression models were controlled for age, monthly income and occupation.

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on the HIV testing and HIV pre-exposure prophylaxis (PrEP) among MSM. The novel approach of crowdsourcing that can improve community awareness of RD is needed (eg, a crowdsourcing video and image contest, etc). In addition, public health departments, community-based organisations and HIV testing agencies should also adopt significant roles in the improvement of awareness with regards to enema use, and provide strategies during HIV testing and consultation.

We found that MSM who reported RD was positively associated with a number of high-risk sexual behaviours, including CAI, multiple male sexual partners, RDU and rectal bleeding; these findings were consistent with the existing literature. Specifically, more recreational drugs were reported in those who practised RD than those who did not. This may be partly explained by the fact that RDU bypassed safer sex practices; for example, those who used enemas were also associated with unprotected sex during AI. In addition, the use of certain substances (eg, opioids) is associated with the possibility of intestinal dysfunction and constipation, thus potentially creating a demand for RD. Our data provide further evidence for the link between RD and high-risk sexual behaviour. The co-occurrence of these risk behaviours, including RD, is more likely to contribute to the acquisition of HIV among MSM, which indicates a need for interventional strategies to reduce HIV infection in this high-risk sexual environment. Antiretroviral therapy for PrEP has been widely applied in MSM population. Rectal microbicides represent another feasible option for HIV prophylaxis, if proven to be efficacious. Some academics have demonstrated high levels of interest in rectal microbicides in the MSM population. A gel and douching-based rectal microbicides, which meet the RD need of MSM population, could also provide them an important option for both hygiene and HIV prophylaxis in the future. Future research should also examine the acceptance and potential barriers of rectal microbicides in Chinese MSM.

There are some limitations to this study that need to be considered. First, recall bias, and social desirability bias, may represent an issue as all variables in this study were measured via self-reporting. Second, a cross-sectional study cannot clarify the causal inference and mechanism between RD and HIV infection, and more longitudinal studies are further needed to determine the relationship between RD and HIV among MSM. Third, this study and most previous peer studies did not evaluate the effect of the timing of anal douching (before or after anal sex) and the anal douching devices (commercial RD devices or non-commercial RD devices) on HIV among MSM; further research is required to address this issue. Fourth, compared with the number of HIV-negative MSM (n=1319), the number of HIV-positive MSM (n=46) was much smaller; which limited the statistical power for some data analysis results of our study, so further related HIVST should be conducted to MSM population with larger sample size or having higher HIV-prevalence level. Finally, the data described in this manuscript were mainly derived from HIV self-testing users; those who underwent HIV testing in the community or medical facilities were not included; this factor may reduce the generalisability of our data.

In summary, the practice of RD is highly prevalent among Chinese MSM. CAI and rectal bleeding both serve as mediators for the association between RD and HIV acquisition. MSM who reported the use of RD were also more likely to report multiple sexual partners, RDU and a high prevalence of HIV. The public health departments, community-based organisations and HIV testing agencies should now develop strategies to educate the MSM population about the risk of RD and provide health materials to increase awareness. Interventions to reduce high-risk sexual behaviour should be encouraged in the MSM population who practise RD. Rectal microbicides may represent a considerable asset for HIV prophylaxis and therefore mitigate the HIV epidemic in China.

**Epidemiology**

**Key messages**

- Rectal douching (RD) is associated with HIV among men who have sex with men, although the precise mechanism underlying the association between RD and HIV remains unclear.
- Condomless anal intercourse and rectal bleeding mediate the association between RD and HIV.
- Men who practise RD should be informed of the increased risk of this behaviour and use appropriate interventions to reduce high-risk sexual behaviours.

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**Contributors** TL, XM, Y-JJ and XC conceived and designed the experiments. TL, XM, EP, YG, ZC and WZ carried out the study and experiments. TL, XM and WD analysed and interpreted the results of study. TL, Y-JJ and XC wrote and revised the manuscript. All authors reviewed the manuscript.

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**Ethics approval** The study was approved by the ethics committee of the First Affiliated Hospital of China Medical University (2018-174-2). All procedures were in accordance with all relevant guidelines and regulations. Informed consent was obtained from each participant prior to the survey being provided.

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**Data availability statement** Data are available on reasonable request. The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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**REFERENCES**

1. Beyrer C, Baral SD, van Griensven F, et al. Global epidemiology of HIV infection in men who have sex with men. Lancet 2012;380:367–77.
2. Joint United Nations Programme on HIV/AIDS. UNAIDS data 2018, 2018. Available: https://www.unaids.org/sites/default/files/media_asset/unaids-data-2018_en.pdf
3. Qin Q, Tang W, Ge L, et al. Changing trend of HIV syphilis and hepatitis C among men who have sex with men in China. Sci Rep 2016;6:31081.
4. Tang S, Tang W, Meyers K, et al. HIV epidemiology and responses among men who have sex with men and transgender individuals in China: a scoping review. BMC Infect Dis 2016;16:588.
5. Javanbakht M, Stahlman S, Pickert J, et al. Prevalence and type of rectal douches used for anal intercourse: results from an international survey. BMC Infect Dis 2014;14:95.
6. achterberg R, van der Hel M, van den Boom W, et al. Is rectal douching and sharing douching equipment associated with anorectal chlamydia and gonorrhoea? A cross-sectional study among men who have sex with men. Sex Transm Infect 2017;93:431–7.
7. Noor SW, Rosser BRS. Enema use among men who have sex with men: a behavioral epidemiologic study with implications for HIV/STI prevention. Arch Sex Behav 2014;43:755–69.
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8 Carballo-Díaz A, Bauermeister JA, Ventuneac A, et al. The use of rectal douches among HIV-uninfected and infected men who have unprotected receptive anal intercourse: implications for rectal microbicides. *AIDS Behav* 2008;12:860–6.

9 Messiah A, Bucquet D, Mettetel JF, et al. Factors correlated with homosexually acquired human immunodeficiency virus infection in the era of “safer sex”. Was the prevention message clear and well understood? Alain Bruegat Physician Group. *Sex Transm Infect* 1993;20:51–8.

10 Fuchs EJ, Lee LA, Torbenson MS, et al. Hyperosmolar sexual lubricant causes epithelial damage in the distal colon: potential implication for HIV transmission. *J Infect Dis* 2007;195:703–10.

11 Baggsalez RF, White RG, Boily MC, et al. HIV transmission risk through anal intercourse: systematic review, meta-analysis and implications for HIV prevention. *Int J Epidemiol* 2010;39:1048–63.

12 Hassan A, Blumenthal JS, Dube MP, et al. Effect of rectal douching/enema on rectal gonorrhoea and chlamydia among a cohort of men who have sex with men on HIV pre-exposure prophylaxis. *Sex Transm Infect* 2018;94:508–14.

13 Kozioł DE, Saah AJ, Osada N, et al. A comparison of risk factors for human immunodeficiency virus and hepatitis B virus infections in homosexual men. *Ann Epidemiol* 1993;3:434–41.

14 Apers I, Vanden Bergh W, De Wit S, et al. Risk factors for HCV acquisition among HIV-positive MSM in Belgium. *J Acquir Immune Defic Syndr* 2015;68:585–93.

15 Hambrick HR, Park SH, Goedel WC, et al. Rectal douching among men who have sex with men in Paris: implications for HIVSTI risk behaviors and rectal microbiode development. *AIDS Behav* 2018;22:379–87.

16 Galea JT, Kinsler JJ, McLean S, et al. Rectal douching prevalence and practices among Peruvian men who have sex with men and transwomen: implications for rectal microbicides. *AIDS Behav* 2016;20:2555–64.

17 Xu JJ, Zhang C, Hu Q-H, JJ X, QH H, et al. Recreational drug use and risks of HIV and sexually transmitted infections among Chinese men who have sex with men: mediation through multiple sexual partnerships. *BMC Infect Dis* 2014;14:642.

18 Alere. Alere determine HIV-1/2 quick reference card-global (English). Available: https://www.alere.com/zh/zh/product-details/determine-hiv-1-2.html

19 Baron RM, Kenny DA. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol* 1986;51:1173–82.

20 Rice CE, Maihofer C, Fields KS, et al. Beyond anal sex: sexual practices of men who have sex with men and associations with HIV and other sexually transmitted infections. *J Sex Med* 2016;13:374–82.

21 Li P, Yuan T, Fitzpatrick T, et al. Association between rectal douching and HIV and other sexually transmitted infections among men who have sex with men: a systematic review and meta-analysis. *Sex Transm Infect* 2019;95:28–36.

22 Levaux FJ, Bakshi RP, Fuchs EJ, et al. Isoosmolar enemas demonstrate preferential gastrointestinal distribution, safety, and acceptability compared with hyperosmolar and hypoosmolar enemas as a potential delivery vehicle for rectal microbicides. *AIDS Res Hum Retroviruses* 2013;29:1487–95.

23 Tang W, Wei C, Cao B, et al. Crowdsourcing to expand HIV testing among men who have sex with men in China: a closed cohort stepped wedge cluster randomized controlled trial. *PLoS Med* 2018;15:e1002645.

24 Santos G-M, Coffin PO, Das M, et al. Dose–response associations between number and frequency of substance use and high-risk sexual behaviors among HIV-negative substance-using men who have sex with men (SUMSM) in San Francisco. *J Acquir Immune Defic Syndr* 2013;63:540–4.

25 Panchal SJ, Müller-Schwefe P, Wurzelmann JI. Opioid-induced bowel dysfunction: prevalence, pathophysiology and burden. *Int J Clin Pract* 2007;61:1181–7.

26 Camilleri M. Opioid-Induced constipation: challenges and therapeutic opportunities. *Am J Gastroenterol* 2011;106:835–42.

27 Molina J-M, Charreau I, Spire B, et al. Efficacy, safety, and effect on sexual behaviour of on-demand pre-exposure prophylaxis for HIV in men who have sex with men: an observational cohort study. *Lancet HIV* 2017;4:e402–10.

28 Tingler RC, Conrochie D, Bauermeister JA. Rectal douching and microbicide acceptability among young men who have sex with men. *AIDS Behav* 2020;24:1414–21.