Original research article

INTERNATIONAL JOURNAL OF STD & AIDS

International Journal of STD & AIDS
2021, Vol. 32(2) 144–151

DOI: 10.1177/0956462420943016
journals.sagepub.com/home/std
SAGE

Geographic and behavioral differences associated with sexually transmitted infection prevalence among Indian men who have sex with men in Chennai and Mumbai

Steven A Safren[1,2,*], Bella Devaleenal[3,*], Katie B Biello[2,3,4], Shruta Rawat[5], Beena E Thomas[3], Kristen S Regenauer[6], Vinoth Balu[3], C Andres Bedoya[7,8], Alpana Dange[5], Sunil Menon[9], Conall O'Cleirigh[2,7,8], Dicky Baruah[5], Vivek Anand[5], Luke E Hanna[3], Ramesh Karunaiananthan[3], Rakesh Thorat[5], Soumya Swaminathan[2,10], Matthew J Mimiaga[2,4] and Kenneth H Mayer[2,8]

Abstract

India has one of the largest numbers of men who have sex with men (MSM) globally; however, geographic data on sexually transmitted infection (STI) prevalence and associations with sexual behavior are limited. Six-hundred and eight MSM in Chennai and Mumbai underwent screening for a behavioral trial and were assessed for bacterial STIs (syphilis, chlamydia, gonorrhea), HIV, and past-month self-reported condomless anal sex (CAS). Mumbai (37.8%) had a greater prevalence of any STI than Chennai (27.6%) (prevalence ratio [PR] = 1.37, 95% CI: 1.09, 1.73). This pattern also emerged for gonorrhea and chlamydia separately but not syphilis. Conversely, Mumbai MSM reported lower rates of CAS (mean = 2.2) compared to Chennai MSM (mean = 14.0) (mean difference = −11.8, 95% CI: −14.6, −9.1). The interaction of city by CAS on any STI prevalence (PR = 2.09, 95% CI: 1.45, 3.01, $p < .0001$) revealed that in Chennai, higher rates of CAS were not associated with STI prevalence, but in Mumbai they were (PR = 2.49, 95% CI: 1.65, 3.76, $p < .0001$). The higher prevalence of bacterial STIs but lower frequency of CAS in Mumbai (versus Chennai), along with the significant interaction of CAS with city on STI rates, suggests that there are either differences in disease burden or differences by city with respect to self-reported assessment of CAS. Regardless, the high prevalence rates of untreated STIs and condomless sex among MSM suggest the need for additional prevention intervention efforts for MSM in urban India.

Keywords

Gay men, sexual behavior, chlamydia infection, gonorrhea, syphilis

Date received: 14 April 2020; accepted: 24 June 2020

[1]Department of Psychology, University of Miami, Coral Gables, FL, USA
[2]The Fenway Institute, Fenway Health, Boston, MA, USA
[3]Indian Council of Medical Research (ICMR) – National Institute for Research in Tuberculosis, Chennai, India
[4]Departments of Behavioral and Social Sciences and Epidemiology, Brown University School of Public Health, Providence, RI, USA
[5]The Humsafar Trust, Mumbai, India
[6]Department of Psychology, University of Maryland, College Park, MD, USA
[7]Department of Psychiatry, Massachusetts General Hospital, Boston, MA, USA
[8]Harvard Medical School, Boston, MA, USA
[9]Sahodaran, Chennai, India
[10]World Health Organization, Geneva, Switzerland

*Co-first authors.

Corresponding author:
Steven A Safren, Department of Psychology, University of Miami, 5665 Ponce de Leon Blvd, P.O. Box 248185, Coral Gables, FL 33124, USA.
Email: ssafren@miami.edu

Background

In India, men who have sex with men (MSM) are disproportionally affected by HIV and by sexually transmitted infections (STIs),[1] which cause morbidity and can potentiate HIV spread.[2,3] Accordingly, the HIV sentinel surveillance report issued by India's National AIDS Control Organization (NACO) found that, for 2017, MSM constituted the third largest core group of people living with HIV (PLHIV) in India (with 2.7% prevalence), compared to Hijra/Transgender people (3.1%) and persons who inject drugs (6.3%).[1] Studies from different Indian states have also found high rates of STIs – including genital warts (Delhi) and human papillomavirus (Maharashtra, Tamil Nadu),[4–6] syphilis (Delhi, Maharashtra, Telangana, Tamil Nadu),[7–9] herpes simplex virus-2 (Tamil Nadu),[9] chronic hepatitis B (Tamil Nadu),[9] gonorrhea (Delhi, Maharashtra, Telangana),[6,10] and chlamydia (Maharashtra, Telangana)[10] – among MSM in India. With the second largest population in the world,[11] India has one of the largest concentrations of MSM, and hence studies of prevalence, transmission risk, and associated variables are of high public health significance.

Self-reported HIV risk behavior, even when done via computerized assessment, can be limited by potential social desirability.[12,13] Although HIV and STIs are transmitted by similar risk behaviors (e.g. condomless anal sex [CAS]) among MSM,[14] there are other behaviors that transmit STIs that do not efficiently transmit HIV (e.g. oral sex),[15] and other STIs may be more easily transmitted than HIV, with bacterial STIs being generally more prevalent and having higher incidence rates than HIV.[16]

Given the overall size of India, both in terms of population and geography, as well as cultural differences across states, HIV and STI rates may differ widely across the country. If the background prevalence of STIs in the risk pool is different in different locations, the effects of behavioral interventions on STIs and HIV acquisition may differ, which could affect estimates of the efficacy of prevention interventions. India's NACO provides HIV prevalence estimates by state, for example, and the state of Maharashtra, which includes the city of Mumbai, has higher estimates (4.69%) of HIV among MSM than Tamil Nadu, which houses the city of Chennai (1.02%).[1] The purpose of the present study was twofold. First, we sought to examine whether the prevalence of HIV/STIs and self-reported transmission risk behaviors (CAS) differed among high-risk MSM in two major urban areas in India: Mumbai, and Chennai, with different HIV prevalence rates in MSM (4.7 and 1.0%, respectively, per NACO estimates). These two cities were chosen because they were participating in an efficacy trial for the target population, and are example cities in India representing two different regions, from different states.[17] Second, we sought to examine whether the association of CAS with bacterial STI prevalence differed among high-risk MSM in these two regions.

Methods

All procedures were reviewed and approved by the IRB at Partners HealthCare (Massachusetts General Hospital), Boston, Massachusetts, and the Ethics Committees at the National Institute for Research in Tuberculosis, Chennai, India, and the Humsafar Trust, Mumbai, India.

Participants

Participants were 608 MSM recruited for a psychosocial intervention trial focused on strengthening self-acceptance and reducing HIV risk among MSM in India.[17] MSM-identified peer recruiters with years of recruiting experience from HST in Mumbai (an NGO for MSM and TGS) and Sahodaran (a Chennai-based CBO for MSM and TGW) assisted in recruiting study participants. This was done primarily from the community through visits to the cruising sites which they frequented and some through virtual platforms. This included location-based apps/platforms used by communities for seeking partners and social media pages frequently visited by MSM communities. Data for the present analysis are from the baseline visit only. Inclusion criteria were (1) being MSM, (2) being 18 years old or older, and (3) having evidence for HIV acquisition risk defined by any of the following: (a) anal sex with four or more male partners (with or without condoms), (b) a diagnosis of an STI, (c) history of transactional sex activity, or (d) CAS with a man who was HIV unknown-status or serodiscordant. In India, there are various culturally recognized subgroups of MSM, and for this study, *Kothi* (feminine acting/appearing, predominately receptive partners in anal sex), *Double Decker* (both insertive and receptive in anal sex), or gay (identity was fluid, however, and sometimes changed between screening and baseline; some participants identified themselves as gay which aligns with Double Decker but they ultimately preferred to call themselves gay). Individuals also had to speak English or Tamil (in Chennai) or Hindi (in Mumbai) fluently.[18–20] In addition, those unable or unwilling to provide informed consent, and those with active untreated, unstable, major mental illness (i.e. untreated psychosis or mania) that would interfere with participation were excluded.

Assessments

All self-reported data were collected through the CommCare application[21] and entered directly into tablets connected to a secure server. All measures were interviewer-administered with the exception of sexual behaviors, which was self-administered through audio computer assisted self-interview (ACASI).

Covariates. Demographics included city of recruitment (Chennai, Mumbai), age, MSM subtype (Kothi, Double Decker, gay), education level (no formal, primary, middle, secondary, higher secondary, college, graduate), employment status (full-time, part-time, unemployed), and religion (Hindu, Christian, Muslim, Other/none). Participants also reported on participation in an HIV prevention intervention.

Sexual behavior. Participants completed a 7-item questionnaire that we developed based on our pilot work.[4] The items include number of male partners, number of times they had anal sex with male partners, and condom use with male partners. For the present analysis, we focus on behaviors that would place one at risk for an STI; as such, we calculated and report the number of CAS acts with a male partner in the past month.

HIV and STI testing

Participants underwent standard voluntary counseling and testing for HIV and STIs. Serological testing for HIV was performed using the Retroquic HIV Rapid card test (Qualpro Diagnostics, Goa, India). All the reactive samples were further tested using HIV Tri dot kit (J. Mitra & Co., New Delhi, India) for confirmation. Both the tests used have a reported sensitivity and specificity of 100%. Screening for syphilis was performed using the quantitative serologic test (rapid plasma reagin test) (Arkray Health care Private Ltd, Surat, India), and all reactive samples were retested using the *Treponema pallidum* hemagglutination assay/TPHA (Syphicheck-WB, Qualpro Diagnostics, Goa, India) having a sensitivity of 95.3% and specificity of 93.7% for confirmation of results. To test for chlamydia and gonorrhea, participants provided a small urine sample and a lab staff member/trained clinician took an oropharyngeal sample and a rectal swab in Abbott multi-collect tubes (Abbott Molecular, Illinois, USA). *Chlamydia trachomatis* and *Neisseria gonorrheae* (CT and NG) testing was performed using a nucleic acid amplification test (NAAT): the Abbott Real Time CT/NG Kit (Abbott Molecular, Illinois, USA). The samples were not pooled and the pharyngeal and rectal swabs and urine sample were tested separately. The assay was performed in accordance with the Abbott RealTime CT/NG testing protocol, on the Abbott *m*2000 system, consisting of the *m*2000*sp* instrument for sample preparation and the *m*2000*rt* instrument for amplification and detection. All participants with a diagnosed STI received treatment, and anyone who tested positive for HIV was referred to government HIV/AIDS program clinics where treatment was provided free of charge.

Data analysis

Means (for continuous variables) and proportions (for categorical variables) were calculated for all covariates. T-tests and Chi square tests examined differences in covariates by recruitment city. Proportions were calculated for each STI, for bacterial STIs and HIV overall and stratified by recruitment city. Differences in proportions were examined with Chi square tests. A series of regression models – specifying a Poisson regression with a log link and robust variance – were used to estimate prevalence ratios to examine relative differences in prevalence of STIs: (1) by city alone, (2) accounting for number of CAS acts, and (3) accounting for all covariates. Additional regression models assessed whether the associations between CAS and STIs were modified by recruitment city using interaction terms. To further describe significant interactions, regressions stratified by city were conducted. For ease of interpretation, CAS was standardized so that the prevalence ratio equals the relative difference in the prevalence associated with a one standard deviation increase in number of CAS acts with male partners. Because the self-report sexual behavior questions focused on CAS and not oral sex, we conducted sensitivity analyses excluding oropharyngeal STIs. All analyses were conducted in SPSS 25.

Results

Table 1 presents demographics and psychosocial data overall and by city. Statistically significant covariates were included in adjusted models. The mean age of participants was 26.2 years (SD = 6.3). Forty-five and a half percent identified as Kothi, 33.3% as Double Decker, and 21.2% as gay. Nine and three-tenths percent of participants reported having been tested for an STI in the prior four months, 3.3% reported being diagnosed with an STI, and 23.4% reported symptoms associated with an STI.

Table 2 presents the prevalence of STIs, HIV, and CAS overall and by city. Baseline STIs overall ranged from 9.5% for HIV to 15.5% for syphilis. Nearly one-third (32.7%) of participants had at least one bacterial STI diagnosed at their initial visit. Mean number of self-reported CAS acts in the past month was significantly lower in Mumbai compared to Chennai (mean difference = −11.8, 95% CI = −14.6 to −9.1, $p < .0001$). Conversely,

Table 1. Demographics and psychosocial factors, overall and by city.

	Mean (SD)			
	Total (n = 608)	Chennai (n = 304)	Mumbai (n = 304)	p-value
Age, in years	26.2 (6.3)	27.1 (6.8)	25.5 (5.6)	0.001
Number of male partners	11.9 (46.3)	18.4 (64.5)	5.5 (7.8)	0.001
Number of times CAS with male partners	8.1 (18.3)	14.0 (24.2)	2.2 (3.7)	<0.0001
	%			
MSM subpopulation identity				<0.0001
Kothi	44.5	71.3	17.8	
Double Decker	33.3	27.1	39.5	
Gay	21.2	0.7	41.8	
Other	1.0	1.0	1.0	
Religion				<0.0001
Hindu	72.7	78.6	66.4	
Christian	9.4	6.3	19.7	
Muslim	13.0	14.8	3.9	
Other/Agnostic/Atheist	4.8	0.3	9.9	
Education				<0.0001
Graduate or professional degree	14.1	19.7	8.6	
College degree	24.0	24.0	24.0	
Higher secondary	24.2	14.8	33.6	
Secondary	20.1	20.4	19.7	
Middle	12.5	15.5	9.5	
Primary	3.6	4.3	3.0	
No formal education	1.5	1.3	1.6	
Employment status				<0.0001
Full-time	48.4	36.8	59.9	
Part-time	16.1	25.0	7.2	
Unemployed	28.5	37.2	19.7	
Other	7.1	1.0	13.2	
Participation in any HIV prevention interventions, past year				<0.0001
Yes	51.3	8.3	94.4	
No	48.7	91.7	5.6	
HIV positive				0.053
Yes	9.5	7.2	11.8	
No	90.5	92.8	88.2	
STI test, past four months				0.789
Yes	9.3	9.6	9.0	
No	90.7	90.4	91.0	
STI diagnosis, past four months				0.069
Yes	3.3	2.0	4.6	
No	96.7	98.0	95.4	
STI symptoms, past four months				<0.0001
Yes	23.4	31.9	14.8	
No	76.6	68.1	85.2	
HIV test, ever				<0.0001
Yes	64.0	52.0	76.0	
No	36.0	48.0	24.0	

CAS: condomless anal sex, reported for the past month; MSM: men who have sex with men; STI: sexually transmitted infection.

however, prevalence of HIV, all bacterial STIs combined, gonorrhea, and chlamydia were significantly higher in Mumbai compared to Chennai; syphilis did not differ by city (p = .654). We also looked at prevalence by anatomical site. For chlamydia, there was a 2.0% (12 infections) prevalence for urethral, 12.1% (73 infections) prevalence for rectal, and 1.7% prevalence for oral (10 infections). For gonorrhea, there was a 1.0% (6 infections) prevalence for urethral, 7.1% (43 infections) prevalence for rectal, and 7.9% prevalence for oral (48 infections).

Table 3 presents the prevalence ratios for STIs by CAS and city. Notably, after controlling for number of

Table 2. Baseline STI positivity and sexual risk behaviors,[a] overall and by site.

	Mean (SD)				
	Overall N = 608	Mumbai n = 304	Chennai n = 304	Mean difference (95% CI)	p-value
Number of times CAS	8.1 (18.3)	2.2 (3.7)	14.0 (24.2)	−11.8 (−14.6 to −9.1)	<0.0001
	N (Prevalence %, 95% CI)			Prevalence ratio[b] (95% CI)	p-value
CHL	88 (14.7, 11.9–17.5)	54 (18.2, 13.8–22.6)	34 (11.3, 7.7–14.8)	1.62 (1.09–2.41)	.018
GON	73 (12.1, 9.5, 14.7)	48 (16.0, 11.9–20.1)	25 (8.3, 5.2–11.4)	1.93 (1.23–3.05)	.005
SYP	94 (15.5, 12.6, 18.3)	45 (14.8, 10.8–18.8)	49 (16.1, 12.0–20.3)	0.92 (0.63–1.33)	.654
Any BAC[c]	199 (32.7, 29.0, 36.5)	115 (37.8, 32.4–43.3)	84 (27.6, 22.6–32.7)	1.37 (1.09–1.73)	.008
HIV[d]	58 (9.5, 7.2–11.9)	36 (11.8, 8.2–15.5)	22 (7.2, 4.3–10.1)	1.64 (0.99–2.71)	.056

CAS: condomless anal sex; CHL: chlamydia; GON: gonorrhea; STI: sexually transmitted infection; SYP: syphilis.
[a]Self-reported sexual behavior in the past month.
[b]Estimated using Poisson regression, log link, robust variance.
[c]BAC = presence of one or more sexually transmitted bacterial infections
[d]Human Immunodeficiency Virus.

Table 3. Prevalence ratio of STIs by site and condomless anal sex (standardized) with male partners (CAS).

	Models A (no covariates/interaction)		Models B (+ covariates)		Models C (+ interaction)	
	Prevalence ratio[a] (95% CI)	p-value	Prevalence ratio[a] (95% CI)	p-value	Prevalence ratio[a] (95% CI)	p-value
CHL						
Mumbai Site	1.76 (1.16–2.67)	.008	1.33 (0.58–3.03)	.497	1.47 (0.66–3.29)	.344
Std_CAS, times	1.12 (0.98–1.28)	.096	1.09 (0.97–1.23)	.154	1.08 (0.95–1.22)	.230
Mumbai Site* Std_CAS					1.63 (0.92–2.89)	.097
GON						
Mumbai Site	2.18 (1.36–3.50)	.001	3.50 (1.55–7.89)	.003	3.26 (1.42–7.48)	.005
Std_CAS, times	1.16 (1.01–1.33)	.035	1.19 (1.03–1.38)	.019	1.20 (1.03–1.38)	.016
Mumbai Site* Std_CAS					0.73 (0.24–2.29)	.594
SYP						
Mumbai Site	0.91 (0.62–1.34)	.629	0.91 (0.41–2.02)	.821	1.09 (0.51–2.32)	.827
Std_CAS, times	0.98 (0.84–1.15)	.829	1.01 (0.87–1.17)	.952	0.98 (0.82–1.16)	.789
Mumbai Site* Std_CAS					2.26 (0.98–5.20)	.056
Any BAC[b]						
Mumbai Site	1.43 (1.12–1.83)	.004	1.32 (0.81–2.15)	.267	1.54 (0.98–2.44)	.064
Std_CAS, times	1.07 (0.97–1.18)	.210	1.07 (0.98–1.17)	.156	1.04 (0.95–1.15)	.372
Mumbai Site* Std_CAS					2.09 (1.45–3.01)	<.0001
HIV						
Mumbai Site	1.35 (0.78–2.34)	.290	1.65 (0.69–3.94)	.258	1.72 (0.65–4.53)	.276
Std_CAS, times	0.66 (0.37–1.17)	.156	0.66 (0.37–1.15)	.144	0.64 (0.34–1.20)	.168
Mumbai Site* Std_CAS					1.16 (0.29–4.72)	.834

CAS: condomless anal sex; CHL: chlamydia; GON: gonorrhea; STI: sexually transmitted infection; SYP: syphilis.
Covariates include age, sexual identity, religion, education, employment status, past behavioral intervention.
[a]Estimated using Poisson regression, log link, robust variance.
[b]BAC = presence of one or more sexually transmitted bacterial infection.

CAS acts, city differences remained for any bacterial STI, chlamydia, and gonorrhea, but CAS was only associated with prevalence of gonorrhea (PR = 1.16, 95% CI = 1.01–1.33, p = .035) and was borderline associated with prevalence of chlamydia (PR = 1.12, 95% CI = 0.98–1.28, p = .096).

In multivariable regressions adjusting for covariates (Models B in Table 3), prevalence of gonorrhea was associated with living in Mumbai (PR = 3.50, 95% CI = 1.55–7.89, p = .003) and increased number of CAS acts (PR = 1.19, 95% CI = 1.03–1.38, p = .019). Neither city nor CAS acts were associated with

prevalence of chlamydia, syphilis, any bacterial infection combined, or HIV (all p-values $> .10$).

We examined interactions of the effects of CAS acts and city on STI prevalence (Table 3, Models C). The effects of CAS acts on the prevalence of any bacterial STI were moderated by city, as evidenced by the significant interaction term ($p < 0.0001$). The interaction terms were borderline significant for chlamydia ($p = 0.097$) and syphilis ($p = 0.056$), and not significant for gonorrhea and HIV.

To further explore the interactions, we stratified analyses by city where significant or marginally significant (Table 4). Accordingly, in Mumbai greater CAS acts were significantly associated with being diagnosed with any bacterial STI (PR = 2.49, 95% CI = 1.65–3.76, $p < 0.0001$), chlamydia (PR = 2.09, 95% CI = 1.06–4.13, $p = 0.033$), and syphilis (PR = 2.43, 95% CI = 1.04–5.71, $p < 0.0001$), but in Chennai CAS acts were not associated with STI prevalence (all $p > 0.300$).

Across analyses, the sensitivity analyses excluding oropharyngeal STIs revealed the same pattern of results with respect to statistical significance.

Discussion

In this sample of MSM from two major Indian cities (Mumbai and Chennai), nearly one-third (Table 2) had at least one previously undiagnosed bacterial STI. This is higher than the rates found in other studies with Indian MSM (e.g. Aggarwal et al.[6] and Garg et al.[7]) and substantially higher than the national average.[22] Additionally (Table 1), substantial percentages of participants, particularly in Mumbai, reported having participated in an HIV prevention program. Accordingly, additional efforts to screen for, diagnose, and treat STIs in this population in these settings are urgently needed. Additionally, there may be room for improvement in the potency and effectiveness of existing HIV prevention programs (they may be limited to outreach messaging and condom distribution) that these men report they have participated in.

While Mumbai had higher STI prevalence compared to Chennai, levels of self-reported CAS acts in Mumbai were lower than Chennai (Table 2), and in Chennai, unlike Mumbai, CAS acts were not associated with STI prevalence (Tables 3 and 4). This pattern might reflect a higher disease burden in Mumbai, so that any new partner was more likely to transmit an STI than in Chennai. But, given the sensitivity which still exists around self-reporting of sexual acts, the higher reporting of CAS in Chennai cities could be attributed to the fact that participants in the Mumbai site were recruited directly by a local NGO (Humsafar Trust) and the assessments were done in the same site where MSM could be accessing other services. This could have resulted in the fears around privacy which could have led to more socially desirable responses. In Chennai, recruitment was done through a community-based organization, which referred participants to a research site (NIRT) in a different location, and assessments were done by investigators from the institution where the research was conducted. In this case, there was potentially more opportunity for anonymity.

The current study documented a high prevalence of asymptomatic bacterial STIs in a population of Indian MSM who were either living with HIV at rates greatly exceeding national averages or were at high risk for acquiring HIV (Table 2). National guidelines for STI management in MSM focus on presumptive treatment of symptomatic infection, which would not be sufficient for the MSM in this study, given that the majority of diagnosed infections were extragenital, similar to MSM cohorts in other parts of the world.[16,23,24] These findings suggest that the routine testing of extragenital sites for STIs using NAATs is indicated in order to decrease STI transmission and acquisition in this high risk population. The NACO program for testing and monitoring PLHIV and MSM at risk of HIV includes recommendations for syphilis testing twice a year, but does not address screening for gonorrhea and chlamydia. The high rates of asymptomatic genital and extragenital infection in this population suggest that this policy needs to be reconsidered, given the documented potential of STIs to facilitate

Table 4. Prevalence ratio of STIs by condomless anal sex (standardized) with male partners (CAS), stratified by site.

		Mumbai		Chennai	
		Prevalence ratio[a] (95% CI)	p-value	Prevalence ratio[a] (95% CI)	p-value
CHL	Std_CAS, times	2.09 (1.06–4.13)	0.033	1.03 (0.90–1.18)	.659
SYP	Std_CAS, times	2.43 (1.04–5.71)	.041	1.01 (0.87–1.18)	.890
ANY BAC[b]	Std_CAS, times	2.49 (1.65–3.76)	<0.0001	1.05 (0.95–1.16)	.348

CAS: condomless anal sex; CHL: chlamydia; STI: sexually transmitted infection; SYP: syphilis.

Covariates include age, sexual identity, religion, education, employment status, past behavioral intervention.

[a]Estimated using Poisson regression, log link, robust variance.

[b]BAC = presence of one or more sexually transmitted bacterial infections.

HIV transmission and acquisition. A reframing of HIV prevention programs to a broader concept of promoting sexual health may lead to increasing testing, diagnoses, treatment, and better control of the bacterial STIs and HIV epidemics among Indian MSM.

Lastly, over the past decade the use of antiretroviral pre-exposure prophylaxis (PrEP) has been shown to decrease HIV incidence among at-risk MSM.[25–28] Unfortunately, PrEP uptake has been limited in India to date, with no demonstration project yet underway for Indian MSM, despite their increased HIV risk.[29] Guidance from the WHO and US CDC recommend PrEP for MSM who report CAS and bacterial STIs, so a significant number of the participants in the current study would be appropriate PrEP candidates. Wider STI testing among Indian MSM could help address the Indian HIV epidemic by identifying appropriate candidates for this evidence-based HIV prevention intervention. In India, the HIV prevention program tends to focus extensively on HIV testing as an important tool for HIV control. Our study points to the need for propagating STI testing not only for syphilis but also for other bacterial STIs.

The present paper is limited by its cross-sectional presentation reporting the prevalence of baseline STIs. We do not know how long participants may have harbored these infections, so estimates of incidence need to await the follow-up assessments, which will present a broader picture of STIs over time across the two sites. Additionally, despite using ACASI the concerns of sexual history can still be a challenge with socially desirable responses.[12,13]

Despite these limitations, the results clearly show a high burden of STIs in this MSM study population. Interestingly, results varied across two urban areas – Mumbai and Chennai – where Mumbai had significantly higher numbers of bacterial STIs but lower levels of self-reported condomless sex acts than Chennai. Future investigation and replication would be needed to determine if there is increased disease burden in Mumbai or if there are differences by city with respect to the validity of self-report of sexual behavior. Nonetheless, the high prevalence of untreated STIs in both cities suggests that more prevention intervention efforts for MSM in urban India are needed.

Authors' contribution

Steven A Safren, Matthew Mimiaga, Beena Thomas, Kenneth Mayer, Sunil Menon, and Souymya Swaminathan developed the overall design of the parent grant, which included the data elements utilized here. Safren developed the idea for the specific data analysis project and wrote the first draft of the document, with the input and assistance of Bella Devaleenal, particularly on the introduction and discussion sections, and from Kristen Regenauer. Safren and Mimiaga led the development of the data tool for assessing sexual risk behavior, with input from the other collaborators. Kenneth Mayer, with the input of Bella Devaleenal, Rakesh Thorat, Luke Hanna, Ramesh Karunaianantham developed and led the implementation of the protocols and procedures for STI data collection. Katie Biello oversaw and led the data analyses, with input from Mimiaga, Conall O'Cleirigh, and the team. C Andres Bedoya, Conall O'Cleirigh, Alpana Dange, Shruta Rawat, Vinoth Balu, and Dicky Baruah assisted with the procedures and implementation of all data collection procedures. All authors reviewed and contributed to the manuscript.

Acknowledgements

We wish to thank all of the staff at the Humsafar Trust, The National Institute for Research in Tuberculosis, and Sahodaran for their help with the study. We also wish to thank the research participants who volunteered their time and completed the study procedures.

Data availability

The data are not currently in a repository. However, request for de-identified data can be made by contacting the first author (ORCID 0000-0002-0121-0806; ssafren@miami.edu). We anticipate that these data will be made available approximately two years after publication of the primary outcome paper for the trial; however, conditions of use/reuse will be in place with respect to prioritizing research ideas of the study investigator team for secondary data analysis projects, projects already planned with the data for secondary analysis, and relevant institutional data use agreements will need to be in place.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

The study was approved by the Partners (Massachusetts General Hospital), Boston Massachusetts, USA institutional review board (FWA00003136), the Ethics Committee of the Humsafar Trust (FWA00005331), Mumbai India, and the Ethics Committee of the National Institute for Research in Tuberculosis (FWA00025949) Chennai, India.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was funded by the National Institute of Mental Health of the National Institutes of Health (NIH) under Award Number R01MH100627. Additional support for investigator time at the NIRT site came from the India Council of Medical Research (ICMR), Government of India, and some consultative support came from NIH grant 1P30MH116867. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

ORCID iD

Steven A Safren https://orcid.org/0000-0002-0121-0806

References

1. National AIDS Control Organization (NACO) and ICMR-National Institute of Medical Statistics. HIV estimations 2017: Technical report. New Delhi: NACO, Ministry of Health and Family Welfare, Government of India, http://naco.gov.in/sites/default/files/HIV%20Estimations%202017%20Report_3.pdf (2018, accessed 1 June 2019).
2. Mayer KH and Venkatesh KK. Interactions of HIV, other sexually transmitted diseases, and genital tract inflammation facilitating local pathogen transmission and acquisition. *Am J Reprod Immunol* 2011; 65: 308–316.
3. Venkatesh KK, Van der Straten A, Cheng H, et al. The relative contribution of viral and bacterial sexually transmitted infections on HIV acquisition in southern African women in the methods for improving reproductive health in Africa study. *Int J STD AIDS* 2011; 22: 218–224.
4. Safren SA, Thomas BE, Mayer KH, et al. A pilot RCT of an intervention to reduce HIV sexual risk and increase self-acceptance among MSM in Chennai, India. *AIDS Behav* 2014; 18: 1904–1912.
5. Raghavendran A, Hernandez AL, Lensing S, et al. Genital human papillomavirus infection in Indian HIV-seropositive men who have sex with men. *Sex Transm Dis* 2017; 44: 173–180.
6. Aggarwal P, Bhattar S, Sahani SK, et al. Sexually transmitted infections and HIV in self reporting men who have sex with men: a two-year study from India. *J Infect Public Health* 2016; 9: 564–570.
7. Garg T, Chander R, Jain A, et al. Sexually transmitted diseases among men who have sex with men: a retrospective analysis from Suraksha clinic in a tertiary care hospital. *Indian J Sex Transm Dis AIDS* 2012; 33: 16–19.
8. UNAIDS. UNAIDS data 2017. Geneva: Joint United Nations Programme on HIV/AIDS (UNAIDS), http://www.unaids.org/sites/default/files/media_asset/20170720_Data_book_2017_en.pdf (2017, accessed 1 June 2019).
9. Solomon SS, Mehta SH, Srikrishnan AK, et al. High HIV prevalence and incidence among men who have sex with men (MSM) across 12 cities in India. *AIDS* 2015; 29: 723–731.
10. Gurung A, Prabhakar P, Narayanan P, et al. Prevalence of asymptomatic gonorrhea and chlamydia among men having sex with men (MSM) in India and associated risk factors. In: The 18th international AIDS conference, 2010.
11. United Nations, Department of Economic and Social Affairs, Population Division. World population prospects 2017 – Data booklet, 2017. New York: United Nations.
12. Kurth AE, Martin DP, Golden MR, et al. A comparison between audio computer-assisted self-interviews and clinician interviews for obtaining the sexual history. *J Sex Transm Dis* 2004; 31: 719.
13. Morrison-Beedy D, Carey MP and Tu X. Accuracy of audio computer-assisted self-interviewing (ACASI) and self-administered questionnaires for the assessment of sexual behavior. *AIDS Behav* 2006; 10: 541–552.
14. CDC. STDs and HIV – CDC fact sheet, https://www.cdc.gov/std/hiv/stdfact-std-hiv.htm (2017, accessed 13 May 2019).
15. CDC. HIV/AIDS: HIV risk and prevention: oral sex and HIV risk, https://www.cdc.gov/hiv/risk/oralsex.html (2016, accessed 13 May 2019)
16. World Health Organization (WHO). Sexually transmitted infections (STIs), https://www.who.int/news-room/fact-sheets/detail/sexually-transmitted-infections-(stis) (2019, accessed 13 May 2019).
17. Mimiaga MJ, Thomas B, Mayer KH, et al. A randomized clinical efficacy trial of a psychosocial intervention to strengthen self-acceptance and reduce HIV risk for MSM in India: study protocol. *BMC Public Health* 2018; 18: 890.
18. Humsafar Trust. Research findings of knowledge, attitude, behavior and practices among men having sex with men (MSM). Conducted at selected sites in Mumbai Metro. Mumbai: Humsafar Trust, Mumbai District AIDS Control Society, 2002.
19. Asthana S and Oostvogels R. The social construction of male 'homosexuality' in India: implications for HIV transmission and prevention. *Soc Sci Med* 2001; 52: 707–721.
20. Joseph S. Sexual orientation, partnership and identity of MSM in Kolkatta, India. In: The 15th international AIDS conference, 2004.
21. Chatfield A, Javetski G and Lesh N. CommCare evidence base. Dimagi web site, https://confluence.dimagi.com/display/commcarepublic/CommCare+Evidence+Base (2013, accessed 1 June 2019).
22. ICMR. National guidelines on prevention, management and control of reproductive tract infections including sexually transmitted infections, 2012. Dehli: ICMR.
23. Mayer KH. Sexually transmitted diseases in men who have sex with men. *Clin Infect Dis* 2011; 53: S79–S83.
24. Workowski KA and Bolan GA. Sexually transmitted diseases treatment guidelines, 2015. *MMWR Recomm Rep* 2015; 64: 1–137.
25. 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.
26. McCormack S, Dunn DT, Desai M, et al. Pre-exposure prophylaxis to prevent the acquisition of HIV-1 infection (PROUD): effectiveness results from the pilot phase of a pragmatic open-label randomised trial. *Lancet* 2016; 387: 53–60.
27. Smith DK, Grant RM, Weidle PJ, et al. Interim guidance: preexposure prophylaxis for the prevention of HIV infection in men who have sex with men. *MMWR* 2011; 60: 65–68.
28. World Health Organization (WHO). HIV: pre-exposure prophylaxis. WHO, http://www.who.int/hiv/topics/prep/en/ (2015, accessed 18 October 2019).
29. Patel V, Dange A, Golub S, et al. Early adopters of PrEP among MSM in India and determinants of emerging disparities [CROI Abstract 1016]. In: Abstract presented at: Conference on retroviruses and opportunistic infections, Boston, MA, March 2018.