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HIV Prevalence and Related Risk Behaviors in Men Who Have Sex with Men, Yemen 2011

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Abstract Men who have sex with men (MSM) are at growing risk of HIV infection in many parts of the world; however, the epidemic has not been well explored among this population in most Arab countries. To estimate the prevalence of HIV and related risk behaviors among MSM in Yemen, we recruited 261 adult MSM from the port cities of Aden and Al-Hudaydah through venue- and facility-based sampling. Behavioral data were collected with a face-to-face questionnaire, and HIV status was determined by serological testing. HIV prevalence was 5.9 % (95 % CI 4.8–7.3). One-fourth (25.8 %, 95 % CI 20.7–31.5) had tested for HIV in the last year and received results; 27.8 % (95 % CI 22.5–33.7) had comprehensive knowledge about HIV; 20.0 % (95 % CI 15.8–25.0) reported condom use at last anal sex; and 31.4 % (95 % CI 25.9–37.3) reported that they or their sexual partner had a sexually transmitted disease symptom. Injecting drugs in the last year was reported by 0.8 % (95 % CI 0.1–9.2). Multiple risk behaviors, low HIV knowledge, few preventive behaviors, and HIV prevalence greater than 5 % denote a concentrated and potentially expanding HIV epidemic among MSM in Yemen. No time should be lost in intervening to prevent further expansion of the epidemic to levels already seen among MSM outside the Middle East.

Keywords Men who have sex with men · HIV · Risky behaviors · Yemen · Bio-behavioral survey

Introduction

The HIV epidemic in most countries outside of sub-Saharan Africa is concentrated in groups engaging in high-risk

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activities. These groups, often referred to as "most-at-risk populations" or, more recently as "key populations", are primarily female sex workers (FSW), persons who inject drugs (PWID), and men who have sex with men (MSM). Depending on locale, they may also include populations characterized by mobility, circumstances, or professions as proxies for sexual risk, such as long-distance truck drivers, seafarers, prisoners, or uniformed personnel. Of such groups, MSM are often the hardest to reach due to low visibility, high stigma, and illegality of male–male sex. Such is the case in many nations in the Middle East and North Africa (MENA) region [1, 2]. An estimated 5–10 % of HIV cases worldwide result from sexual transmission between men; the MENA region is not likely to be an exception to this disproportionate burden of infection, but data are lacking from many MENA countries. [3, 4].

The Republic of Yemen is an Islamic country in the MENA region with a very conservative society. Yemen is classified among countries with the lowest level of HIV prevalence, estimated to be 0.1–0.2 % of the general population. By December 2011, a total of 3,502 HIV cases had been identified and reported (there were 266 new cases in 2011), but the estimated number of people actually living with HIV in Yemen is 22,000 (95 % CI 19,000–25,000) [5]. While overall prevalence of HIV infection is low, the country might be experiencing or poised to experience epidemics concentrated in one or more key populations. There may be no intrinsic meaning to a threshold prevalence of 5 % in a key population, but it is conventionally used to differentiate between a low-level and a concentrated epidemic, and exceeding it lends urgency to any response in the affected population.

In Yemen, the cultural context, a few local studies and case surveillance data point to potentially high vulnerability to HIV among MSM [3, 6, 7]. Yemeni culture is strongly influenced by Islamic values (99 % Muslim). While all extramarital sexual behavior is illegal and stigmatized, the current legal sanction for male homosexuality may be relatively less severe than that for sex work or adultery. However, MSM are still at a structural disadvantage in obtaining specific HIV prevention messages and other health services related to male–male sex [8].

The main information available on risk behavior among Yemenis comes from two situation analysis studies: one in Sanaa city among FSW in 2001 [9] and the other a household study of 15–49-year-old inhabitants of the governorates of Al-Hudaydah, Taiz, Aden, and Hadhramut in 2003 [6]. The four-governorate study found that 6.7 % of general-population males ever had a genital discharge in the preceding 12 months. Questions about extramarital and male–male sex were deemed too sensitive, so participants were asked about their social networks instead. Among general-population respondents, 19.2 % of males had been told personally by another male that they had extramarital sex in the preceding 12 months. In addition, 8.8 % of males in the general population had firsthand knowledge of MSM [6]. In 2009, there were 318 new cases of HIV reported in Yemen, a 30 % increase from 2008 [9].

By report, heterosexual transmission accounted for 62 % of the cases, yet only 7 % were attributed to male–male sex, likely because of high stigma. The increase in detected cases is due in part to scale-up of HIV counseling and testing services as part of the recent "Prevention and Control of HIV/AIDS" campaign. Nonetheless, the high ratio of AIDS to HIV cases indicates that a large proportion of persons living with HIV in the country is not yet diagnosed. For each HIV case detected in Yemen, it is estimated that there might be 15 others undetected [7]. In brief, a lack of direct information on male–male sexual behavior, severe under diagnosis, and likely underreporting of male–male sexual behavior leave great doubt as to the true prevalence of HIV among MSM in Yemen.

To fill a large gap in the understanding of HIV in Yemen, the present study was designed to provide credible estimates of HIV prevalence and related risk behaviors among MSM in two major port cities, Aden and Al-Hudaydah. We report here on the results of this first-of-its-kind study in Yemen.

Methods

Setting and Study Sites

From September to December 2011, adult men who reported engaging in sex with other men in the past 6 months were recruited for a cross-sectional HIV serological and behavioral survey in Aden and Al-Hudaydah. Aden is the main seaport for Yemen, with 800,000 inhabitants who have an above-average economic status with higher-than-median income and access to health facilities. The city is relatively cosmopolitan, but society still follows Islamic rules. Al-Hudaydah is also a port, with 400,000 inhabitants, a lower economic level than Aden, and more stigma and discrimination associated with HIV and high-risk populations. Selection of these two cities was based on information made available previously regarding the presence of MSM, as well as a prerequisite for this study that MSM-friendly services be available for collaboration and referrals, such as voluntary counseling and testing (VCT) programs catering to MSM and HIV treatment services with staff sensitized to the needs and concerns of MSM, especially privacy. In Aden, two nongovernmental organizations (NGO) were used as recruitment sites: the Women's Association for Sustainable Development (WASD) and the Social Services Association (SSA). WASD was established in 1998 and started HIV

prevention projects in 2004, such as peer support groups and raising HIV awareness among youth and key populations, including MSM. It also operates a VCT center. SSA has been working since 2005 with marginalized populations, including FSW, MSM, and street children and youth, on HIV education and prevention promotion. It, too, runs a VCT center. The single recruitment and project site in Al-Hudaydah was the Abu-al-Musa NGO, established in 1999. Its main area of work is social welfare—not only helping marginalized populations, including MSM, find basic needs and medical services but also providing health education and raising HIV awareness. Abu-al-Musa provides VCT services not on-site but through local referral.

Study Subjects, Sampling Methods, and Recruitment

The sampling design and recruitment methods were a pragmatic combination of intercepting MSM at mapped venues and at the three collaborating facilities. Eligible participants were men aged at least 18 years who acknowledged engaging in male–male sex in the 6 months before the interview; were self-identified as gay, bisexual, or heterosexual; and were living in Aden or Al-Hudaydah. At each recruitment facility, a trained peer recruiter consecutively approached men seeking services in order to identify MSM, first by appearance and then, after building trust, by asking directly. The recruiter introduced the study and verified once again that the eligibility criteria had been met. In addition to the facilities, MSM were recruited at venues identified during a community mapping exercise in 2010 [10]. The list of venues (71 in Aden and 48 in Al-Hudaydah) was compiled by interviewing key firsthand informants (i.e., MSM NGO clients) and secondhand informants (health officers, NGO staff, taxi drivers, store owners, and sellers) about MSM gatherings and venues. Because of political disturbances in Yemen at the time, we were not able to fully enumerate the number of MSM present at each venue to create a proportional sample frame. The initial attempt to update and validate the entire list of venues was discontinued, so the list includes only the districts where the NGOs operated. An outreach team from each NGO visited the venues at times when a high number of MSM attendees was expected. A peer recruiter approached men consecutively to identify eligible MSM, introduce the study, and verify eligibility criteria. If they expressed interest and agreement, MSM were offered transport to the NGO on the same day or were scheduled for an appointment in the following days.

At the NGO sites, a trained interviewer explained to potential participants in easily understandable language the importance of the survey and how its findings would be beneficial to the community. All interviews were conducted after obtaining the verbal informed consent of participants. Interviews and pre- and post-test counseling were done in private rooms on-site. For their time, participants were given 10 US$ for the interview plus an additional 5 US$ for providing blood for HIV testing. The study protocol and procedures were reviewed and approved by the Research Review Board of Kerman University of Medical Sciences in Iran and the Ministry of Public Health in Yemen.

Measures

Data were collected by trained interviewers using a structured questionnaire to gather information on sociodemographic characteristics and HIV-related variables. Key areas covered were basic sociodemographics (age, nationality, education, marital status, income, migration status, employment, sex work); history of incarceration; sexual risk behaviors by partner type (number, insertive or receptive role, age of initial anal sexual intercourse, oral sex, condom use, reasons for nonuse, ways of finding partners, sexual contact with women); substance use (including injection drug use, sex while using, sex with PWID, exchanging sex for drugs); knowledge and history of sexually transmitted diseases (STD); knowledge of and attitudes about HIV/AIDS. The questionnaire was piloted to measure its comprehensibility among 15 MSM in the two recruitment sites. The final questionnaire was drafted in English then translated into Arabic. Interviewers were trained, and detailed code books and field activity guidelines were created to ensure consistency.

HIV Testing

Following an interview, those who consented were tested anonymously by two sequential rapid HIV tests. Men with a reactive result in the first rapid test (Determine HIV-1/2, Abbott Laboratories, Tokyo, Japan) were asked to provide another blood sample for a second rapid test (Determine HIV-1/2, Abbott Laboratories, Tokyo, Japan) and a dried blood spot (DBS) for quality control. Every fifth initially HIV-negative MSM was also asked to provide a DBS for quality assurance. DBS for all men who tested positive on the first rapid test and for 20 % of all negative men were transported to Pasteur Institute in Iran for validation and quality assurance. These DBS samples were retested by 2 sequential fourth-generation ELISA (Genescreen, Biorad). A participant was considered HIV positive if the results of both tests were positive. In Aden, HIV results were given to participants through available VCT services at the NGO site. In Al-Hudaydah, participants were referred to the local VCT center to receive their HIV results. In the study, we found the sensitivity of the 2 rapid HIV tests to be 100 % (95 % confidence interval [CI], 71.5-100.0) and the specificity to be 96.2 % (95 % CI 80.4–99.9).

Statistical Analysis

Data were entered in EpiData v.3.1 software, with programmed completeness and consistency checks. For analysis, the NGO site was considered as the primary sampling unit, and we calculated the point estimates and 95 % CI using the Taylor-linearized variance estimator by STATA v.12, Survey Analysis Package.

Results

A total of 261 MSM were recruited, including 111 from facilities and 150 from outreach to MSM-oriented venues. Most (253 MSM, or 96.9 %) agreed to HIV testing, and 15 were HIV positive (5.9 %, 95 % CI 4.8–7.3). Reasons for declining to test were not collected. MSM recruited at the facilities had somewhat but not significantly higher HIV prevalence compared with MSM recruited at venues (7.5 % vs. 4.7 %, $P = 0.350$).

Demographic Characteristics

On average, MSM in the two cities were aged 23.8 years (95 % CI 17.8–29.8); 63.6 % were younger than 25 years (Table 1). Nearly all (98.8 %) were Yemeni nationals. Half (50.2 %) had no education beyond primary school. Only 8.2 % of MSM were married at the time; far more men were in a steady relationship with another man (39.3 %). Mobility was moderate; 23.8 % reported living away from the city continuously for at least 1 month in the past 12 months. Few of the MSM had permanent or temporary jobs (7.7 % and 23.0 %, respectively), with many dependent upon support from family (37.9 %), spouse or partner (3.4 %), or government (0.4 %). Selling sex as the main source of income was reported by 22.6 % of participants. History of ever being in prison was reported by 5.0 %.

Table 1 Demographic characteristics and incarceration history of study participants in a bio-behavioral survey of men who have sex with men (MSM) in Yemen, 2011. ($n = 261$)

Variable	Mean or percent (95 % CI)
Age in years (mean)	23.8 (17.8–29.8)
Age younger than 25 years (%)	63.6 (57.5–69.2)
Yemeni nationality (%)	98.8 (60.2–100.0)
Education:	
Never been to school (%)	4.2 (0.3–42.8)
Primary (%)	46.0 (27.0–66.2)
High school (%)	37.5 (22.8–55.0)
Above high school (%)	12.3 (3.6–34.3)
Current marital/relationship status:	
Married (%)	8.2 (2.4–24.3)
In a steady relationship with a man (%)	39.3 (7.5–83.7)
In a steady relationship with a woman (%)	3.5 (0.1–50.2)
Single, widower, or divorced (%)	49.0 (17.5–81.4)
Away from the city continuously for 1 month or more in last year (%)	23.8 (20.5–27.6)
Main source of income or support:	
Permanent employment (%)	7.7 (2.4–21.8)
Temporary or part-time employment (%)	23.0 (7.1–53.7)
Family support (%)	37.9 (12.4–72.5)
Spouse or partner support (%)	3.4 (0.5–18.9)
Social welfare (%)	0.4 (0.0–17.5)
Selling sex (%)	22.6 (0.4–95.1)
Other (%)	5.0 (1.5–14.9)
Monthly income in US$ (mean)	124.3 (58.1–190.6)
History of being in prison (%)	5.0 (1.5–14.9)

Sexual Partners and Practices

Overall, 88.0 % of participants reported that they had anal sex as the insertive partner with a man, and 78.1 % reported anal sex as the receptive partner (Table 2). On average, men were aged 14.9 years in their first sexual act, either insertive or receptive, with a male partner. The average number of male sexual partners during the last 6 months was 3.8 (95 % CI 1.0–6.7) when the respondent was insertive and 5.7 (95 % CI 0.7–10.6) when receptive. In a period of 6 months, MSM had an average of 2.9 commercial partners to whom they sold sex and 3.0 partners from whom they bought sex. Condoms were used in the last anal sex contact in only 20.0 % of participants. While 63.3 % of participants had oral sex in the last 6 months, only 4.8 % said they used a condom in the last oral sex with a male partner. The most common way MSM met their partners was through friends (54.6 %), although a substantial number found partners via the Internet (20.8 %). Regarding female partners, 40.9 % of MSM surveyed ever had sexual contact with a woman. Among these men, the average number of female sexual partners was 4.3 over the 6 months before the interview, with 2.0 being commercial partners, 1.5 being casual, and 0.8 being a regular or main partner.

Condom Use by Partner Type

Condom use by partner type and reasons for not using a condom at the last episode are presented in Table 3. A notably high percent of MSM had never used condoms with any partner, ranging from 63.9 % for those with commercial partners to 76.4 % for those with casual partners. As a consequence, consistent condom use was low, ranging from 6.0 % with female partners to 10.1 % with casual partners. With male partners, participants reported

Table 2 Number and types of sexual partners among men who have sex with men (MSM), in a bio-behavioral survey, Yemen, 2011. ($n = 261$)

Variable	Mean or percent (95 % CI)
Ever had insertive anal sex with a man (%)	88.0 (58.2–97.5)
Ever had receptive anal sex with a man (%)	78.1 (63.9–87.8)
Age at first anal sex with a man (mean)	14.9 (13.0–16.9)
Number of male partners in last 6 months as:	
Insertive (mean)	3.8 (1.0–6.7)
Receptive (mean)	5.7 (0.7–10.6)
Number of male partners in last 6 months as:	
Commercial, selling (mean)	2.9 (0.0–6.1)
Commercial, buying (mean)	3.0 (0.0–12.3)
Casual (mean)	1.8 (0.6–2.9)
Regular or main (mean)	1.5 (1.0–2.1)
Used condom at last anal sex (%)	20.0 (15.8–25.0)
Age at first oral sex with a man (mean)	16.4 (15.9–16.9)
Had oral sex with a man in last 6 months (%)	63.3 (57.2–69.0)
Number of male oral-sex partners in last 6 months (mean)	6.3 (1.2–11.3)
Used condom at last oral sex (%)	4.8 (1.8–12.0)
Places where male partners were found in last 12 months:	
Bars, clubs, other commercial establishments (%)	3.5 (0.3–27.0)
Public places (e.g., parks) (%)	21.2 (2.1–76.9)
Internet (%)	20.8 (5.8–52.6)
Through friends (%)	54.6 (10.0–92.9)
Ever had vaginal sex (%)	40.9 (20.5–65.0)
Had vaginal sex in last 6 months (of those ever having) (%)	61.3 (34.0–83.0)
Number of female partners in last 6 months (mean)	4.3 (2.5–6.0)
Number of female partners in the last 6 months as:	
Commercial (buying was assumed) (mean)	2.0 (1.1–2.8)
Casual (mean)	1.5 (0.5–2.6)
Regular or main (mean)	0.8 (0.6–1.1)

not using a condom because they dislike them or do not think of them, and a high proportion of men (30.7 %) said they had confidence in their regular partner. With female partners, the most common reasons for nonuse of condoms were thinking it was unnecessary and having a partner who objected.

Substance Use

Use of most drugs was relatively rare (Table 4). The proportion of MSM who reported injected drug use in their lifetime was 1.5 % (95 % CI 0.3–8.4), and in the last 12 months it was 0.8 % (95 % CI 0.1–9.2). A few MSM (2.3 %) had sex partners they knew had injected drugs in the last 12 months; 3.1 % (95 % CI 0.3–27.1) of MSM reported exchanging sex for drugs. Alcohol use (a social and religious taboo in Yemen) before or during sex was reported by 20.8 % of MSM. Sex while using other drugs was reported by moderate to low numbers and principally involved marijuana or hashish (9.2 %), hallucinogens (4.6 %), and cocaine or crack (3.8 %).

STD Knowledge and History

As presented in Table 5, most (89.6 %) MSM had heard of STD and 52.6 % could describe some STD symptoms in men. STD symptoms in the last 12 months were reported by 26.9 % (95 % CI 21.8–32.6) of participants, most of whom (67.1 %, 95 % CI 55.7–77.3) did not seek treatment. STD symptoms in male partners were reported by 9.7 % (95 % CI, 6.6–13.9) of respondents. Overall, 31.4 % (95 % CI 25.9–37.3) of study subjects reported STD symptoms either in themselves or in their male sexual partners in the last 12 months.

HIV Knowledge, Attitudes, and Testing

Knowledge of and attitudes about HIV and AIDS among the participating MSM are presented by item in Table 6. Nearly all MSM (98.8 %) in the two cities had heard of AIDS. However, only 27.8 % (95 % CI 22.5–33.7) of participants had comprehensive knowledge of HIV—i.e., they could correctly identify all preventive measures and reject common misconceptions. A minority (46.3 %) knew that mosquitoes are not a vector for HIV, and a slight majority (52.5 %) knew that a healthy-looking person could be infected. Responses indicated that many MSM harbor stigmatizing attitudes: 40.9 % were unwilling to shake hands with someone who has AIDS, and 45.9 % were unwilling to share a meal. Close social networks and national TV were the main sources of HIV knowledge. Regarding HIV testing history, 36.2 % (95 % CI 30.0–42.2) of participants had ever tested for HIV, while 25.8 % (95 % CI 20.7–31.5) had tested for HIV in the last 12 months and received their results.

Discussion

Our study provides data that HIV prevalence has surpassed the conventional threshold of 5 % and is concentrated among MSM in Yemen. As an arbitrary line to cross, in one sense, this fact prevents Yemen from being classified as having a low-level epidemic and elevates the urgency for a response. Further, the response needs to be specifically tailored to MSM, with messages on the risks and preventive behaviors associated with male–male sex as

Table 3 Condom use with different types of partners and reasons for not using condoms (reported as percentage and 95 % confidence interval) among men who have sex with men (MSM), in a bio-behavioral survey, Yemen, 2011. ($n = 261$)

Variable	Commercial partners ($n = 191$)	Casual partners ($n = 85$)	Regular partners ($n = 172$)	Female partners ($n = 65$)
Use a condom in last 6 months:				
Every time	10.0 (3.4–25.9)	10.1 (1.5–46.0)	7.6 (1.1–37.6)	6.0 (0.2–61.9)
Most of the time	11.7 (2.9–36.7)	6.7 (1.6–24.5)	8.1 (2.8–21.3)	9.0 (1.8–34.0)
Sometimes	14.4 (13.8–15.1)	6.7 (2.6–16.3)	14.0 (5.2–32.4)	11.9 (0.5–77.4)
Never	63.9 (42.8–80.7)	76.4 (58.1–88.3)	70.3 (59.1–79.6)	73.1 (34.9–93.2)
Condom used in last anal sex	20.0 (13.6–28.4)	16.9 (9.8–27.4)	18.6 (12.8–26.2)	16.4 (9.8–26.1)
Reasons for not using a condom:				
Not available	11.8 (8.8–15.7)	5.4 (0.5–41.3)	5.1 (1.1–20.2)	3.6 (1.8–7.1)
Too expensive	2.8 (0.2–27.4)	1.4 (0.0–68.0)	0.7 (0.0–54.2)	0.0
Shy	2.1 (0.0–49.9)	2.7 (0.6–11.5)	3.6 (0.1–66.3)	5.4 (1.2–20.3)
Partner objected	11.1 (7.6–16.0)	12.2 (2.8–40.4)	8.8 (4.0–18.1)	30.4 (14.4–53.0)
Do not like them	30.6 (13.2–56.0)	35.1 (24.8–47.1)	30.7 (10.8–61.6)	1.8 (0.0–46.3)
Did not think it was necessary	2.8 (0.1–57.9)	1.4 (0.0–68.0)	2.9 (0.3–22.3)	32.1 (11.9–62.4)
Did not think of it	38.2 (11.9–73.8)	43.2 (10.0–83.9)	32.8 (13.8–60.0)	17.9 (12.1–25.6)
Have confidence in partner	11.1 (6.1–19.3)	8.1 (3.9–16.1)	30.7 (7.8–69.7)	0.0
Had an HIV test with partner	1.4 (0.4–5.3)	0.0	0.7 (0.0–25.4)	0.0

Table 4 Substance use and related behaviors among men who have sex with men (MSM), in a bio-behavioral survey, Yemen, 2011. ($n = 261$)

Variable	Percent (95 % CI)
Ever injected drugs	1.5 (0.3–8.4)
Injected drugs in last 12 months	0.8 (0.1–9.2)
Sex with male partner known to inject drugs, in last 12 months	2.3 (0.5–9.4)
Ever exchanged sex for drugs	3.1 (0.3–27.1)
Alcohol or drug use immediately before or during sex, in last 12 months:	
Alcohol	20.8 (4.2–60.9)
Cocaine or crack	3.8 (0.1–56.1)
Ecstasy	0.0
Marijuana or hashish	9.2 (1.7–38.1)
Amyl nitrate ("poppers"), diazepam, or voltarin injection	3.1 (0.1–45.4)
Hallucinogen (e.g., LSD)	4.6 (3.0–6.9)

Table 5 Knowledge and history of sexually transmitted diseases (STD) among men who have sex with men (MSM), in a bio-behavioral survey, Yemen, 2011. ($n = 261$)

Variable	Percent (95 % CI)
Had heard of diseases that can be transmitted through sex	89.6 (85.6–93.1)
Can describe a symptom of STD in men	52.6 (46.1–59.1)
Had one or more of the following STD symptoms in last 12 months:	26.9 (21.8–32.6)
Urethral discharge	7.6 (5.1–11.6)
Burning pain on urination	20.3 (15.8–25.7)
Genital ulcers/sores	1.5 (0.5–4.0)
Swellings in groin area	0.3 (0.1–2.7)
Ulcers/sores on the anus	5.7 (3.4–9.4)
Did not seek professional help for above symptoms	67.1 (55.7–77.3)
Saw or heard of STD symptom in partner, in last 12 months	9.7 (6.6–13.9)
Self or partner had one or more STD symptoms, in last 12 months	31.4 (25.9–37.3)

Table 6 Knowledge of and attitudes about HIV/AIDS among men who have sex with men (MSM) and testing history, in a bio-behavioral survey, Yemen, 2011 ($n = 261$)

Variable	Percent (95 % CI)
Ever heard of a disease called AIDS	98.8 (79.2–99.9)
Comprehensive knowledge and rejection of misconceptions (see statements below)	27.8 (22.5–33.7)
Correct knowledge about HIV:	
People can protect themselves from the HIV virus by using a condom correctly every time they have sex	76.1 (51.1–90.6)
A person can get the HIV virus from mosquito bites	46.3 (25.0–68.9)
People can protect themselves from the HIV virus by abstaining from sexual intercourse	77.6 (40.2–94.7)
A person can get the HIV virus by sharing a meal with someone who is infected	70.8 (25.5–94.5)
Having sex with only one faithful, uninfected partner can reduce the risk of HIV transmission	62.0 (30.2–86.1)
A person can get the HIV virus from injections with a needle that has already been used by someone else	92.6 (86.9–96.0)
A healthy-looking person can be infected with HIV, the virus that causes AIDS	52.5 (29.6–74.4)
A person can get the HIV virus by kissing someone who is infected	56.6 (30.7–79.3)
Considers self at risk for HIV infection	62.1 (42.2–78.6)
Positive attitudes about persons with HIV:	
Willing to shake hands with a person who has AIDS	59.1 (27.5–84.6)
Willing to share a meal with a person who has AIDS	54.1 (29.1–77.1)
Sources from which information on AIDS is received:	
National radio	7.5 (0.4–61.0)
National TV	39.6 (7.8–83.6)
Newspapers or magazines	12.2 (9.6–15.2)
Posters or billboards	7.1 (3.4–14.1)
Family, friends, peers	40.4 (18.0–67.7)
Nongovernmental or community–service organizations	32.5 (2.2–91.0)
Health workers	3.9 (0.2–47.3)
Religious leaders	1.2 (0.0–22.1)
Educational institutions	9.4 (4.9–17.2)
Public awareness campaigns	22.4 (4.0–66.3)
Ever tested for HIV	36.2 (30.0–42.2)
Tested for HIV in last 12 months and received results	25.8 (20.7–31.5)

well as creation of MSM-friendly clinics for HIV and STD care. Several indicators of risk are cause for concern in this population: consistent condom use was quite low; less than one-fourth of the study population had tested for HIV during the year preceding the interview and was informed about his HIV status; less than one-third of the study's MSM had comprehensive knowledge of HIV prevention and rejected common misconceptions; more than one-third of MSM or their sexual partners had STD symptoms during the past 12 months and only a few sought appropriate treatment.

Yemen is now among the few countries in the MENA region that has crossed the 5 % threshold for HIV among MSM. The observed HIV prevalence of 5.9 % is comparable with MSM in Egypt (5.7–5.9 %) [11], higher than in Lebanon (3.7 %) [12], and lower than in Pakistan (11.4 %) [13]. Risk indicators in Yemen also seem high compared with other MSM studies in MENA [2]. MSM in Yemen appear to have high partner turnover, with an average of six male partners in the previous 6 months. This might be due to the young age of MSM in our sample (most were younger than 25 years) and the high proportion who were buying or selling sex. The measure of consistent condom use—about 10 % regardless of partner type—is lower than the 25 % typically found in the eastern Mediterranean region [2]. A very high number of participants in the study had not used a condom during the past 6 months, offering reasons similar to those in the regional review of MSM studies by Mumtaz et al. (e.g., disliking condoms) [2].

Our data highlight multiple challenges for the prevention response in Yemen, especially in how to change attitudes among MSM and their female sexual partners about using condoms. It's likely that increasing even basic HIV knowledge will be difficult because of already low levels of knowledge and common misconceptions about HIV among this population of MSM. The general population also has poor knowledge about routes of transmission and misconceptions about HIV (24–55 %) [14]. Indicators also point to possible structural factors, such as poverty and unemployment, that may affect risk and prevention (e.g., selling sex was the main source of income for one-fourth of the recruited MSM). As noted for heterosexual risk behaviors, such forces may drive teenaged males to engage in sex with other males [14].

We acknowledge limitations in our study. A primary issue is the representativeness of the sample. Although we attempted to diversify the sample and guide its composition through formative mapping, it must fundamentally be considered a convenience sample. We undertook to produce the most rigorous sample possible by mapping the universe of venues where MSM could be found and by not relying solely on facilities. Political unrest in the country did not allow a randomized sampling of venues or enumeration of attendance at them. We do note a somewhat higher HIV prevalence among MSM recruited at facilities rather than at venues, indicating that there might be some upward bias due to inclusion of those at higher risk and seeking services. Although we did not conduct a

community-based random sampling survey, considering the political disturbances that started in Yemen in 2011, we used the most feasible sampling method available to us. We were also unable to assess participation bias, as we did not collect data on the number of MSM present at venues, the number who were eligible, the number who refused the eligibility assessment when approached, the number who declined if eligible, or reasons for refusal. Given the high stigma around HIV and related risk behaviors, particularly sexual contact between men in Yemen, findings may be prone to under-reporting and socially desirability biases. Some sort of validation study (to measure the amount of under-reporting) [15] and further adjust the estimates for such biases with proper bias-analysis techniques [16] are recommended. We also acknowledge that our sample size is not sufficient to explore the correlates or drivers of HIV infection among MSM in Yemen. Despite these concerns, we believe we obtained a reasonably diverse sample of MSM in two locations in the country.

Our snapshot of HIV prevalence and relevant risk behaviors provides a rare assessment of MSM in the Middle East region. We confirmed that HIV is concentrated among MSM in Yemen and that the potential is high for further spread. We outline the formidable challenges facing a scaled-up response for the nation, with low HIV knowledge, weak norms for the use of condoms, limited HIV testing, and poor sexual health-seeking behaviors. If these factors are not addressed, we predict a continuing rise in HIV among MSM in Yemen's cities as well as in other areas of the Middle East region that have a similar context.

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