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Depression, Loneliness, and Sexual Risk-Taking Among HIV-Negative/Unknown Men Who Have Sex with Men in China

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Abstract Research conducted among men who have sex with men (MSM) in high-income countries has demonstrated that negative mental health is one of the significant drivers of HIV infection, and few studies have examined the status of mental health among MSM in China. We sought to describe depression and loneliness and identify their correlates among Chinese MSM. A cross-sectional study was conducted among HIV-negative or unknown status MSM in 2014. Time–location sampling and online convenience sampling methods were employed. Depression was measured via a short version of CES-D (CES-D 10). Loneliness was measured from a single item in CES-D 10. Multivariable logistic regressions were conducted to identify independent correlates of depression and loneliness. A total of 507 individuals participated in the study. Of them, 26.8 and 35.5% reported moderate-to-severe symptoms of depression and feeling lonely, respectively. Depressed participants were more likely to have a sense of hopelessness for the future (AOR 3.20, 95% CI 1.90, 5.20) and report higher levels of internalized homophobia (AOR 2.32, 95% CI 1.47, 3.67). Participants who reported feeling lonely were more likely to have had condomless receptive anal intercourse in the past 6 months (AOR 1.67, 95% CI 1.08, 2.58) and feel hopeless for the future (AOR 2.40, 95% CI 1.60, 3.70). MSM in China have significant rates of depression and loneliness. HIV prevention efforts should address the mental health needs of Chinese MSM such as providing safe environments for social support and role models.

Keywords MSM · HIV · Depression · Loneliness · Mental health · Sexual orientation

Introduction

Men who have sex with men (MSM) are one of the most affected groups by the HIV/AIDS epidemic across the world (Neme, Goldenberg, Stekler, Sullivan, & Stephenson, 2015). Globally, the MSM population represents 78% of all men who have been newly diagnosed with HIV (Centers for Disease Control and Prevention, 2015). In the U.S., MSM comprise more than half of all newly infected people with HIV annually and continue to be the largest group of individuals infected with HIV (Hall et al., 2008). In China, the prevalence of HIV among MSM has also increased substantially in recent years, and 29.4% of new HIV infections in 2011 were through male-to-male contact (Wu et al., 2015). While numerous behavioral interventions focused on reducing sexual risk of MSM in China have been adopted in the past two decades, effective, long-term, and sustainable behavioral change will be hard to obtain without considering psychosocial and mental health factors.

Psychosocial and mental health issues such as depression contribute significantly to HIV risk in the MSM population. For example, gender role-related stress, homophobia, gay-related stigma and discrimination, poor social support, and high rates of drug and alcohol use lead to riskier sexual behavior and an increased prevalence of HIV among this population (Safren, Reisner, Herrick, Mimiaga, & Stall, 2010). Moreover, MSM suffer from a range of mental health issues, most notably depression.

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Clinical depression is characterized by low mood, loss of interest or pleasure in most activities, feelings of worthlessness or inappropriate guilt, changes in appetite, difficulty sleeping, loss of energy, difficulty concentrating, appearing restless or slowed down, and thoughts of suicide (Ophir, Asterhan, & Schwarz, 2017). The prevalence of moderate-to-high depressive symptoms in MSM varies in different countries, ranging from 11% in India (Tomori et al., 2016), to 24.6% in the U.S. (Dyer, Regan, Pacek, Acheampong, & Khan, 2015), to 44.5% in Peru (Ferro et al., 2015), and to 46.3% in Tanzania (Ahaneku et al., 2016). In China, the prevalence of depression among MSM is 46.1% (Yan et al., 2014), and among the general population is 3% (Chen et al., 2007). Furthermore, depression has been shown to affect sexual functioning and increase the risk of condomless sex and substance use among MSM (Ahaneku et al., 2016; Watkins et al., 2016). Finally, depression can be a barrier to accessing HIV prevention services and care (Du Bois & McKirnan, 2012; Wei et al., 2016).

Loneliness is also common among MSM, many of whom do not disclose their sexual orientation to family and friends for fear of rejection. Loneliness is an unpleasant, subjective experience that results from the lack of quantity or quality of social relationships (Peplau & Perlman, 1982). Loneliness may stem from minority stress (Kuyper & Fokkema, 2010), perceived and enacted stigma, lack of social support (Hubach et al., 2015), and loss of friends and intimate partners due to HIV/AIDS (Dispenza, Dew, Tatum, & Wolf, 2015). Moreover, loneliness has been shown to be a barrier to receiving HIV testing and counseling among MSM (Neme et al., 2015). Similar to depression, feeling lonely is associated with higher rates of condomless sex and increased risk for HIV infection (Kott, 2011); in fact, condomless sex was reported to be a coping mechanism for lonely and isolated MSM to decrease their feelings of loneliness (Martin & Knox, 1997; Shernoff, 2006). When not directly using sexual behavior as a coping strategy, some lonely MSM may engage in activities that indirectly lead to unsafe sexual behaviors; for example, lonely MSM may turn to substances to escape feelings of loneliness, leading to lowered sexual inhibitions, resulting in increased risky sexual behavior (Kurtz, 2005).

Not only do psychosocial and mental health factors disproportionately affect MSM, they interact to lead to elevated HIV-risk behavior among MSM. In fact, the more psychosocial and mental health issues an individual endorses, the greater his risk for both participating in risky sexual behaviors (unprotected anal intercourse, multiple sex partners) and becoming infected with HIV. These co-occurring psychosocial health problems may actually be driving the HIV epidemic among MSM (Mustanski, Garofalo, Herrick, & Donenberg, 2007; Stall et al., 2003). Moreover, a few theoretical models have been developed to explain the connection between negative affective states and HIV-risk behaviors, such as the AIDS Risk Reduction Model (ARRM) (Catania, Kegeles, & Coates, 1990), the Information–Motivation–Behavioral Skill Model of HIV prevention behavior (Fisher, Fisher, & Shuper, 2009), the Integrative Model of Behavioral Prediction (Fishbein, 2009), and the Loneliness and Sexual Risk Model (LSRM) (Torress & Gore-Felton, 2007). As an example, the LSRM has shown that loneliness is associated with increased risky sexual behavior and that this relationship is mediated by the influence of substance use and compulsive behavior (Torress & Gore-Felton, 2007). Additionally, a modified version of the LSRM suggests that internalized homophobia mediates the relationship between loneliness and sexual behavior among MSM (DeLonga et al., 2011).

While the impact of depression and loneliness on sexual risk-taking among MSM has been well documented in the mental health and HIV prevention literature in the past decade from developed countries, their association with risky sexual behaviors is poorly understood among MSM in Asian countries such as China. One study in China examining social support and depressive symptoms found the prevalence of depression among general MSM of various serostatuses was 46.1% (Yan et al., 2014). Another study discovered the prevalence of depression among a group of HIV-positive MSM to be 36.0%, and that the level of depressive symptoms had an impact on whether participants initiated antiretroviral therapy (Tao et al., 2017). However, there are still no studies addressing the relationship between depression, loneliness and risky sexual behavior among MSM in China. Moreover, many of the existing studies were conducted among MSM who are HIV-positive, so it is unclear whether these findings apply to HIV-negative MSM. Exploring the connection between depression, loneliness, and risky sexual behavior among HIV-negative and unknown status, MSM in China may shed additional light on how to best reduce HIV transmission in this vulnerable population.

In this study, we sought to describe the prevalence of depression and loneliness among a diverse sample of HIV-negative/unknown MSM in China, and examined their associations with demographic factors, psychosocial conditions, and HIV-related risk behaviors.

Method

Participants

We conducted a cross-sectional survey study of MSM in Jiangsu Province, China, between November and January 2014. This survey was the baseline data collection for a longitudinal cohort study designed to assess the effects of an intervention to increase HIV testing uptake among MSM in the province. To be eligible for the study, participants had to meet the following criteria: (1) be biologically male; (2) be at least 18 years of age; (3) be living in Jiangsu Province; (4) have had oral or anal sex with another male in the past year; and (5) self-report being HIV-negative or having unknown HIV status. In addition, since this was part of a cohort study, we asked eligible participants to provide their contact information during the informed consent process. We emplo-

yed two sampling methods to recruit participants: time–location sampling (TLS) and online convenience sampling.

Time–Location Sampling (TLS)

TLS is used to sample MSM populations through the creation of a sampling frame that comprises a universe of venues, days, and time periods where and when the population can be found to congregate. It has been described in detail elsewhere (Zhao et al., 2015). Briefly, during the formative phase, we constructed an up-to-date universe or sampling frame of venues frequented by MSM, including bars, dance clubs, bathhouses, and cruising areas, as well as the days and time periods of attendance in the Chinese city of Nanjing. From the roster of all possible venue-day-time (VDT) periods, a random sample of VDT periods was drawn. At the randomly selected VDT, all potentially eligible subjects were counted. Men entering/exiting the venue or crossing a predetermined line were intercepted, assessed for eligibility, and invited to participate.

During the assessment, recruiters briefly described the study to the men and asked whether they were willing to participate. Men who had not previously participated were referred to an interviewer who screened for eligibility. Eligibility screening occurred in a private area of the venue or in a designated interviewing space near the venue. In addition to the above eligibility criteria, participants recruited through TLS also had to be consecutively approached by the staff at the randomly selected VDT (i.e., they could not approach staff on their own or at a later time). Once participants were determined eligible, staff discussed informed consent using a tablet computer and addressed questions. To consent to the study, participants had to click the "Agree" button on the electronic informed consent form. Staff then oriented participants to the tablet computer-assisted interview. Once participants were familiar with the operation of the tablet computer, they completed a self-administered survey.

Participants were recruited during 23 randomly selected VDT periods from November 2013 to December 2013. Staff enumerated 777 men from ten venues, consecutively approached 478, screened 342 (71.5% eligibility determination), found 290 to be eligible (84.8% eligibility), and 261 (90.0% participation) consented to the study and completed the survey.

Online Convenience Sampling

We posted our study advertisement on the most popular provincial gay-oriented website to invite online participation in our study. By clicking on the advertisement, interested MSM were taken to an Internet-based survey webpage. The eligibility screening and informed consent procedures implemented for the online survey component were the same as the aforementioned TLS component. To prevent duplicate participation, a feature within the survey software program was enabled which would not allow potential participants to access the survey more than once from the same IP address. Furthermore, our staff double-checked the contact information provided by participants before giving out incentives for completing the survey. From mid-November 2013 to mid-January 2014, 985 potential participants clicked on our online survey advertisement or link. Of these, 941 entered the eligibility screening page and 823 answered all eligibility questions (87.5% eligibility determination), 592 met the eligibility criteria (71.9% eligibility), and 271 (45.8% participation) consented to the study and completed the survey.

Participants who completed the survey received an incentive in the form of a 50RMB ($\approx$ 8USD) pre-paid cell phone card. The study was approved by the University of California—San Francisco's Committee on Human Research and Jiangsu Provincial Center for Disease Control and Prevention's Institutional Review Board.

Measures

Outcome Variables

Depression (CES-D10) The Chinese version of 10-item CES-D Depression scale was used to screen depressive symptomatology within the past week. It has been validated among a clinically depressed population as well as a non-clinical, general population in China (Kohout, Berkman, Evans, & Cornoni-Huntley, 1993; Yu, Lin, & Hsu, 2013). Scores of the CES-D 10 range from 0 to 30, with higher scores indicating more depressive symptoms (Cronbach's $\alpha = 0.81$). Those who had scores above 20 were classified as having moderate-to-severe depressive symptoms.

Loneliness Loneliness was measured from a single item ("I felt lonely") in the CES-D 10 (Kohout et al., 1993). Participants who reported feeling lonely "sometimes" or "most or all of the time" were categorized as experiencing loneliness. Although the utility of a single-item loneliness measure may be called into question, due to the stigma associated with being identified as lonely, it has been widely used in previous studies in China and other countries (Luo & Waite, 2014; Savikko, Routasalo, Tilvis, Strandberg, & Pitkala, 2005; Zhong, Xu, Jin, Zou, & Liu, 2016) and has been proven to have good face and predictive validity (Tilvis, Pitkala, Jolkkonen, & Strandberg, 2000). In addition, this single-question measure was the original standard against which multi-item instruments were validated. It has been shown to be highly correlated with the two most widely used loneliness assessment tools: the UCLA Loneliness Scale (Russell, 1996) and the de Jong Gierveld Loneliness Scale (de Jong Gierveld & van Tiburg, 1999). Single-item surveys have also been used in other studies to measure mood status and general health and are considered to have the advantage of simplicity while preserving validity (DeSalvo, Bloser, Reynolds, He, & Muntner, 2006; Luria, 1975).

Independent Variables

Sociodemographics Participants were asked about their age, educational level, legal marital status, whether or not they were cohabiting with a man or woman, employment status, monthly gross income, and sexual orientation.

Sexual Behaviors and HIV Testing Participants reported the number of male partners they engaged in anal intercourse within the past 6 months, and whether or not they consistently used condoms when engaging in insertive and/or receptive anal intercourse. Participants were also asked whether they were tested for HIV in the past 12 months.

Internalized Homophobia Five out of the seven items from the Reactions to Homosexuality scale were used to measure internalized homonegativity ("I feel comfortable in gay bars," "I feel comfortable discussing homosexuality in a public situation," "I feel comfortable being a homosexual man," "Homosexuality is morally acceptable to me,""Even if I could change my sexual orientation, I wouldn't") (Berg, Ross, Weatherburn, & Schmidt, 2013). The face validity of the five items was confirmed by a panel including Chinese professionals and members from the MSM community; scores of the five-item scale ranged from 0 to 4, with higher cores indicating fewer experiences of homophobia. (Cronbach's $\alpha = 0.65$).

Future Expectations Five items from the Chinese version of the Beck Hopelessness Scale were used to measure participants' negative expectancies for the future (e.g., "It is very unlikely that I will get any real satisfaction in the future,""the future seems uncertain to me") (Beck & Weissman, 1974; Shek, 1993). The individual item scores ranged from 0 to 5 (Cronbach $\alpha = 0.73$), and the total "hopelessness score" was the sum of the scores on the individual items, with higher scores indicating more hopelessness.

Analysis

Potential duplication between TLS and online participants was examined by comparing the contact information provided by participants; seven duplicated records were excluded from analysis. The analytical sample included 507 MSM participants who completed the CES-D 10. We conducted all analyses in STATA/SE 11 (College Station, TX) with level of significance determined at a .05 p value.

Descriptive analyses were conducted to describe characteristics of the sample, including sociodemographics, HIV-related sexual or health behavior, and psychosocial conditions. The internal consistency of the scales was assessed using Cronbach's alpha coefficients. Bivariate analyses, using χ^2 tests, of depression and loneliness began with the full set of demographic, sexual behavior, HIV testing, hopelessness, and internalized homophobia variables. Variables that were associated with depression and loneliness at $p \leq .10$ in bivariate analysis were entered into multivariable logistic regression models.

Results

We enrolled a total of 507 participants. Of these participants, 30% were between the ages of 18–25, 41.6% had college degree or above, 19.8% of the participants were married, 20.3% were cohabitating with another man, and 67.9% were self-identified as gay. 78.5% reported having prior HIV testing at the time of interview. The percentage of condomless insertive anal intercourse (CIAI) and condomless receptive anal intercourse (CRAI) was 38.7 and 31.2%, respectively (Table 1). Of the participants, 26.8% experienced moderate-to-severe symptoms of depression (hereafter "depressed") and 35.5% experienced loneliness in the past week. Meanwhile, 41.2% of the participants felt hopeless and 46.2% had high levels of internalized homophobia (Table 1).

Table 2 presents the bivariate correlates of moderate-to-severe depression and loneliness among the study participants. Compared to those who were not depressed (i.e., non-to-mild), participants who had experienced moderate-to-several depression were significantly more likely to be 18–25 years old ($p = .002$), and be cohabiting with men ($p = .003$). They were marginally less likely to have been HIV tested in the past 12 months ($p = .058$), and more likely to feel hopeless ($p < .001$) and have higher levels of internalized homophobia ($p = .001$). Meanwhile, compared to those who had not experienced loneliness, participants who experienced loneliness were significantly more likely to be aged between 26 and 35 years old ($p = .026$) and have no main male partner ($p = .04$). They were significantly less likely to have been HIV tested in the past 12 months ($p = .036$), more likely to have CRAI ($p = .022$) and feel hopeless about the future ($p < .001$).

Table 3 presents the multivariable correlates of moderate-to-severe depression and loneliness of the study participants. Participants who were cohabiting with men were 3.37 times more likely to be depressed (AOR 3.37, 95% CI 1.31, 8.64) compared to those were cohabiting with women. Participants who felt hopelessness about the future (AOR 3.20, 95% CI 1.90, 5.20) and reported higher level of internalized homophobia (AOR 2.32, 95% CI 1.47, 3.67) were more likely to be depressed. Meanwhile, participants who were aged 26–35 years old had greater odds of experiencing loneliness compared to those aged between 18 and 25 years old (AOR 1.55, 95% CI 0.95, 2.52). Participants who had CRAI had greater odds of experiencing loneliness compared to those did not have CRAI in the past 6 months (AOR 1.67, 95% CI 1.08, 2.58). Finally, participants who had a sense of hopelessness were 2.4 times more likely to experience loneliness compared to those who felt hopeful for the future (AOR 2.40, 95% CI 1.60, 3.70).

Table 1 Prevalence of negative mental health issues and sample characteristics among HIV-negative/unknown men who have sex with men, Jiangsu, China, 2013

Characteristics		*N*	%
Depression	No	371	73.2
	Yes	136	26.8
Loneliness	No	327	64.5
	Yes	180	35.5
Age (in years)	18–25	151	30.0
	26–35	186	36.9
	36+	167	33.1
Education	Middle school or less	74	14.6
	High school or technical	222	43.8
	College or above	211	41.6
Marital status	Single	292	57.7
	Married	100	19.8
	Other	114	22.5
Cohabitating partners	With women	93	18.3
	With men	103	20.3
	Other	311	61.3
Employment	Fulltime	418	82.4
	Other	89	17.6
Income (RMB)	≤2999	173	34.1
	3000–4999	195	38.5
	≥5000	139	27.4
Sexual orientation	Gay	344	67.9
	Bisexual/straight/unsure	163	32.1
Out to anyone	No	230	45.4
	Yes	277	54.6
Age of first anal intercourse	≤18	72	16
	19–25	260	57.6
	≥26	119	26.4
Condom use in first anal intercourse	No	163	36.1
	Yes	288	63.9
Have a main male partner	No	276	54.4
	Yes	231	45.6
Number of male anal sex partners	≤1	217	42.8
	2–5	217	42.8
	≥6	73	14.4
CIAI	No	277	61.3
	Yes	175	38.7
CRAI	No	311	68.8
	Yes	141	31.2
HIV testing	No	109	21.5
	Yes	398	78.5
Hopelessness	Hopeful	298	58.8
	Hopeless	209	41.2
Internalized homophobia	Low	254	53.8
	High	218	46.2

CIAI condomless insertive anal intercourse, *CRAI* condomless receptive anal intercourse

Table 2 Bivariate correlates of moderate-to-severe depressive symptoms and loneliness among HIV-negative/unknown men who have sex with men, Jiangsu, China, 2013

Characteristics		Depression				Loneliness			
		Yes	*N*	%	*p*	Yes	*N*	%	*p*
Age (in years)	18–25	47	151	31.13	.002	54	151	35.76	.026
	26–35	59	186	31.72		78	186	41.94	
	36+	28	167	16.77		47	167	28.14	
Education	Middle school or less	16	74	21.62	.476	23	74	31.08	.660
	High school or technical	64	222	28.83		82	222	36.94	
	College or above	56	211	26.54		75	211	35.55	
Marital status	Single	86	292	29.45	.079	107	292	36.64	.566
	Married	18	100	18.00		31	100	31.00	
	Other	32	114	28.07		42	114	36.84	
Cohabitating partners	With women	12	93	12.90	.003	28	93	30.11	.131
	With men	34	103	33.01		31	103	30.10	
	Other	90	311	28.94		121	311	38.91	
Employment	Fulltime	115	418	27.51	.449	155	418	37.08	.107
	Other	21	89	23.60		25	89	28.09	
Income (RMB)	≤2999	43	173	24.86	.704	60	173	34.68	.858
	3000–4999	56	195	28.72		68	195	34.87	
	≥5000	37	139	26.62		52	139	37.41	
Sexual orientation	Gay	95	344	27.62	.559	122	344	35.47	.979
	Bisexual/straight/unsure	41	163	25.15		58	163	35.58	
Out to anyone	No	67	230	29.13	.286	82	230	35.65	.949
	Yes	69	277	24.91		98	277	35.38	
Age of first anal intercourse	≤18	20	72	27.78	.199	24	72	33.33	.268
	19–25	80	260	30.77		102	260	39.23	
	≥26	26	119	21.85		37	119	31.09	
Condom use in first anal intercourse	No	49	163	30.06	.450	61	163	37.42	.670
	Yes	77	288	26.74		102	288	35.42	
Have a main male partner	No	81	276	29.35	.161	109	276	39.49	.040
	Yes	55	231	23.81		71	231	30.74	
Number of male anal sex partners	≤1	60	217	27.65	.758	80	217	36.87	.427
	2—5	59	217	27.19		79	217	36.41	
	≥6	17	73	23.29		21	73	28.77	
CIAI	No	81	277	29.24	.415	95	277	34.30	.460
	Yes	45	175	25.71		66	175	37.71	
CRAI	No	81	311	26.05	.197	100	311	32.15	.022
	Yes	45	141	31.91		61	141	43.26	
HIV testing	No	37	109	33.94	.058	48	109	44.04	.036
	Yes	99	398	24.87		132	398	33.17	
Hopelessness	Hopeful	29	209	13.88	.000	50	209	23.92	.000
	Hopeless	107	298	35.91		130	298	43.62	
Internalized homophobia	Low	52	254	20.47	.001	86	254	33.86	.455
	High	74	218	33.94		81	218	37.16	

CIAI condomless insertive anal intercourse, *CRAI* condomless receptive anal intercourse

Table 3 Multivariable correlates of moderate-to-severe depressive symptoms and loneliness among HIV-negative/unknown men who have sex with men, Jiangsu, China, 2013

Characteristics		Depression			Loneliness		
		AOR	95% CI	*p*	AOR	95% CI	*p*
Age (in years)	18–25	1		.191	1		.043
	26–35	1.41	(0.84, 2.73)		1.55	(0.95, 2.52)	
	36+	0.67	(0.34, 1.31)		0.86	(0.50, 1.45)	
Marital status	Single	1		.964	–	–	–
	Married	0.98	(0.46, 2.12)		–	–	
	Other	1.07	(0.59, 1.94)		–	–	
Cohabitating partners	With women	1		.042	–	–	–
	With men	3.37	(1.31, 8.64)		–	–	
	Other	2.28	(1.01, 5.0)		–	–	
Have a main male partner	No	1		.580	1		.054
	Yes	0.87	(0.54, 1.41)		0.66	(0.44, 1.00)	
CRAI	No	–	–		1		.021
	Yes	–	–		1.67	(1.08, 2.58)	
HIV testing	No	1		.315	1		.445
	Yes	0.77	(0.45, 1.29)		0.83	(0.51, 1.34)	
Hopelessness	Hopeful	1		.000	1		.000
	Hopeless	3.20	(1.90, 5.20)		2.40	(1.60, 3.70)	
Internalized homophobia	Low	1		.000	–	–	–
	High	2.32	(1.47, 3.67)		–	–	

–, not included in the final model; CRAI, condomless receptive anal intercourse

Discussion

In this study, we found that about one-fourth of the HIV-negative or unknown status MSM participants in China suffered from moderate-to-severe depression and one-third suffered from loneliness. The prevalence of moderate-to-severe depression in our sample, 26.8%, was lower than the rates reported in previous studies of Chinese MSM of various serostatuses, which was 46.1% (Yan et al., 2014), and Chinese MSM who were HIV-positive, which was 36.0% (Tao et al., 2017). The rate was within the range reported by other developing countries, with 11–46.3% experiencing depressive symptoms among general MSM (Ahaneku et al., 2016; Tomori et al., 2016). The results of our study also revealed a high prevalence of other negative psychological states such as hopelessness and internalized homophobia, which were significantly correlated with depression and loneliness among our sample of MSM participants. In general, MSM are disproportionately impacted by mental health issues, such as depression and suicidality (Dyer et al., 2015; Li et al., 2016). These mental health issues may be consequences of stigma and discrimination and may result in adverse behavioral and health outcomes, including HIV infection and poorer health outcomes due to lack of adherence in testing and treatment (Dyer et al., 2015).

A global online survey reported that internalized homophobia was negatively associated with having ever tested for HIV among Chinese MSM (Pyun et al., 2014). As one of the social barriers of HIV care and treatment, internalized homophobia, i.e., negative feelings about one's own sexual orientation resulting from the internalization of anti-gay stigma and prejudice (Herek, 2004), may cause negative self-worth, increased self-judgment, and the belief that something is wrong with oneself; this may further contribute to minority stress and feelings of depression and ultimately affect health-seeking behaviors such as HIV testing. Therefore, campaigns that focus on destigmatizing homosexuality and promoting acceptance of one's sexuality may be helpful in reducing internalized homophobia and improving HIV prevention efforts among MSM.

Previous studies reported that the MSM population in China was vulnerable to poor social support and increased depression and loneliness, which are associated with higher rates of suicidal ideation (Li et al., 2016; Yan et al., 2014). Depression and loneliness may arise due to genetic predisposition, personality development (lack of self-esteem and self-worth) and early or later life experiences. Lonely and depressed people are more likely to experience cognitive distortions, such as seeing neutral stimuli as negative and threatening, which then perpetuate the cycle of psychological distress (Blatt, Luyten, & Corveleyn, 2005). Moreover, many MSM in China do not disclose their same-sex behaviors to others, including health care workers, for fear of being rejected and discriminated against (Choi, Lui, Guo, Han,

& Mandel, 2006; Wei et al., 2014). This might discourage them from accessing HIV prevention and other services provided by the Chinese government. Furthermore, decreased communication between MSM and their family and friends about their lifestyle and constantly concealing their sexual orientation may further exacerbate their already existing depressive symptoms and loneliness. To alleviate their psychological distress, they may be prone to pursue high-risk sexual behaviors (Martin & Knox, 1997; Shernoff, 2006). Therefore, development of a nuanced HIV prevention program considering psychological, social, and personality issues should be adopted among MSM in China.

An interesting finding in this study is that participants who are cohabiting with other men have greater odds of being depressed. A possible explanation may be that those MSM who are cohabitating with men are doing so out of necessity because they have been rejected by their family and peers. The rejection from family and peers may contribute to higher levels of isolation, shame, loneliness, and depression, which may then lead to increased risky sexual behavior. Another possibility is that MSM who cohabitate with other men may not feel they can do so openly, but rather feel the need to conceal their living arrangements. The additional stress of hiding their home situation may contribute to increased feelings of stress and depression. To corroborate these hypotheses, a previous study among Chinese MSM showed that cohabiting with a male partner was associated with having increased rates of condomless anal sex (Zhang et al., 2015). This finding supports the idea that MSM who cohabitate with men have higher rates of loneliness and depression, which then increases their risk of having condomless receptive anal intercourse.

People feel lonely when they perceive their interpersonal relationships to be deficient, situationally or chronically. A variety of coping strategies, from constructive to highly destructive, have been adopted by people who feel lonely (Woodward & Kalyanmasih, 1990). Loneliness was shown to be associated with instability of self-esteem, avoidance behaviors, and lower social support among MSM (Martin & Knox, 1997). Loneliness may contribute to difficulties with safer sex negotiation and condom use (Vanable, Carey, Blair, & Littlewood, 2006). A recent study showed that a one-unit increase in the UCLA loneliness score was met with a 10% decrease in the odds of condom usage among a sample of HIV-positive MSM (Hubach et al., 2015). In our study, lonely participants were significantly more likely to have condomless receptive anal intercourse, which is consistent with data from previous studies (Hubach et al., 2015; Martin & Knox, 1997). Lonely MSM may engage in condomless sexual behaviors to nurture committed relationships or seek casual sexual encounters to ward off feelings of loneliness and foster a sense of connection with sex partners (de Voux et al., 2016; Pope, Wierzalis, Barrett, & Rankins, 2007). Therefore, when examining barriers to condom use, psychological factors such as loneliness and depression should be strong considerations in addition to the usual access barriers (e.g., obtaining condoms) and usage barriers (e.g., decreased sexual sensation) (Mimiaga et al., 2013). A better understanding of the social context of the MSM community will benefit HIV prevention programs.

Mental health of MSM is influenced by a collection of environmental, social, and individual factors, especially the contexts they are living in. While previous studies have shown that HIV behavioral interventions are effective in reducing the odds of having unprotected anal sex, deeply rooted social problems and inequities, such as poverty, homelessness, racism, stigma and homophobia, and the resulting mental health problems, may affect HIV risk and can impact the effective delivery of prevention programs. Thus, maximizing the effectiveness of these interventions through continued assessment of mental health issues is critical for a sustainable impact on the HIV epidemic (Herbst et al., 2007). Current HIV programming for MSM in China is heavily focused on promoting condom use and HIV testing, and there are no evidence-based interventions addressing the social and mental health contexts of HIV-related sexual behavior in this population. Measures to prevent HIV in China may have limited efficacy if mental and behavioral health are not considered together. Although the attitude of the general public toward MSM populations has improved dramatically in the past decade, MSM- and HIV-related stigma and discrimination are still highly prevalent in the community. Being attuned to psychological barriers to HIV prevention behaviors that stem from depression and loneliness will be crucial to more effectively combat the HIV epidemic in China. To have more impact, HIV prevention programs should not be limited to screening for mental health and psychosocial issues, but also provide a supportive community for MSM via peer-led education and health communication. A comprehensive intervention program addressing the sexual health and overall wellbeing of MSM at both the individual and the community level should be developed and scaled up nationally. Such interventions should focus on the interaction of psychological and behavioral mechanisms for HIV risk and integrate with treatment of mental health problems found among Chinese MSM. Meanwhile, improving competency of screening and identify early mental disorders of patients among health professionals in HIV organizations will strengthen the current health system in coping with HIV epidemic across China and the world.

This study had several limitations. First, participants were recruited from MSM venues and a gay-oriented website in one Chinese Province. Thus, our findings may not be generalizable to MSM who do not frequent these venues, do not visit the website, or live in other parts of China. Second, data were collected via self-report, which is subject to social desirability bias. This bias was decreased by having participants self-administer our survey. In addition, participants were asked to recall information from the past 6 months, which allows for the potential of recall bias. Finally, loneliness was measured from a single item on the CES-D 10, so may be conflated with our measure for depression. Although the single question has face validity, future studies may consider other fully validated short scales measuring

loneliness, such as the short version of the UCLA Loneliness Scale, which contains three items measuring three aspects of loneliness (Hughes, Waite, Hawkley, & Cacioppo, 2004).

In summary, our study suggests that MSM in China have significant rates of depression and loneliness. Loneliness may lead to higher rates of sexual behavior that place MSM at risk for becoming infected with HIV. Further exploration of the pathway through which loneliness leads to increased risky sexual behavior is warranted among Chinese MSM. Prevention programs should integrate mental health and behavioral assessments and interventions with HIV and STI screening in order to be maximally effective. Providing a supportive community to address psychosocial and mental health factors may be the critical step in more efficiently reducing HIV transmission among MSM in China.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest.

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