RESEARCH ARTICLE

The psychological health and associated factors of men who have sex with men in China: A cross-sectional survey

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Abstract

Objectives

The psychological health of men who have sex with men (MSM) has received increased attention in recent years. We thus investigated the psychological status and associated factors among MSM in China.

Methods

A cross-sectional survey of 248 MSM was conducted from April to September 2015 using Symptom Checklist 90 (SCL-90) in Huludao and Zhengzhou, China. Statistical analyses utilized SPSS version 19.0 for Windows.

Results

All Cronbach’s α coefficients of the SCL-90 subscales exceeded 0.7, suggesting acceptable reliability. The coefficient range of the collective validity for all the subscales was >0.4. For the divisional validity, each item correlated better with the hypothetical subscale than with other subscales. Collective validity and divisional validity were both acceptable. The four most frequent types of psychological distress among MSM were depression, obsessive-compulsive behavior, interpersonal sensitivity, and anxiety. Results of the univariate analysis revealed that the following groups had significantly higher SCL-90 scores (P < 0.05): peasantry, married MSM, respondents who reported condomless anal intercourse and a greater number of male partners, and respondents who had not undergone psychosocial counseling and whose family or friends did not know about their sexual identity. In a multivariate logistic regression model, the following parameters were independently associated with higher SCL-90 scores: being married (AOR [adjusted odds ratio] = 3.19; 95% CI [confidence interval]: 1.96 to 5.93), condomless anal intercourse (AOR = 1.16; 95% CI: 1.02 to 1.31), number of male partners (AOR = 1.66 and 1.81; 95% CI: 1.08 to 2.34 and 1.32 to 2.69), family or friends not knowing about sexual identity (AOR = 2.13; 95% CI: 1.17 to 4.92), and lack of psychosocial counseling (AOR = 2.09; 95% CI: 1.06 to 4.09).
Conclusions
Our results indicate that psychological health problems among MSM in China are of concern. It is thus necessary to strengthen intervention efforts, with more emphasis on intervention programs to improve psychological health among Chinese MSM.

Introduction
Studies conducted in India and the Netherlands have revealed that men who have sex with men (MSM), in contrast with their heterosexual counterparts, have poorer mental health and experience more mental distress [1,2]. MSM in the United States report significantly higher rates of lifetime mood or anxiety disorder and have been identified as a higher risk group for depression compared with the general population [3,4]. A growing body of literature from China and France suggests that HIV risk among MSM increases when an individual reports a relatively greater number of psychological problems [5–8]. Psychological health issues may thus contribute to the propensity for MSM to engage in risky sexual behavior and may affect the degree to which they might benefit from HIV prevention programs [5–8]. Another study from the United States suggests that psychological problems among MSM are highly associated with drug use and risky sexual behavior [9]. Therefore, MSM with psychiatric symptoms might be at greater risk for HIV infection owing to a greater prevalence of sexual relations, multiple partners, and sexual abuse in the United States [10,11].

MSM have long since constituted a high-risk population for HIV infection and have recently become one of the target populations for preventing HIV transmission in China [12–14]. Several studies have reported depression, anxiety, sexual abuse, and other psychological syndromes among MSM in China [5,15–16], where homosexual relationships are not legal and homosexuality is stigmatized in the general public [17]. A study of MSM conducted in nine large Chinese cities found that 44–60% of the respondents felt that their life was substantially negatively affected by their sexual orientation [5]. Compared with heterosexual males, MSM are particularly vulnerable to psychiatric disorders [18]. A study of MSM conducted in four cities of northeast China suggested that Chinese MSM have significantly elevated prevalence and comorbidity of psychiatric disorders compared with heterosexual males [15]. A national survey revealed that 34.5% of Chinese homosexual males had attempted or committed suicide [19].

Another study revealed that higher levels of psychological distress are independently associated with older age, alcohol use, poor self-reported quality of life, and reduced condom use at last sexual encounter [20]. Discrimination, stigma, and socially related stress are often cited as potential contributing factors for the observed elevated psychological distress experienced by MSM [21,22]. Previous literature has also indicated that the prevalent stigma and discrimination against homosexuals and the resulting associations with depression can negatively influence quality of life and ability to make healthy decisions, including decisions regarding HIV preventive behaviors or initiation and adherence to HIV treatment [23–27]. MSM who reported a relative lack of social support and engaged in risky behaviors were more likely to have psychological problems [20,28]. Owing to the substantial mental health implications, more attention should be paid to the psychosocial health problems among the MSM population. However, very few studies have assessed the psychological health status of this population in China.
The Symptom Checklist 90 (SCL-90) has been one of the most reliable psychopathological testing tools for clinical populations worldwide and is becoming one of the most popular measures with which to assess psychiatric distress in diverse cultures worldwide. SCL-90 is a self-reporting tool that has proven reliable and valid for psychological evaluation [29,30], including its use in HIV/AIDS studies [31–33]. The Chinese version of the SCL-90 has also proven reliable and valid in studies of the general population in China [33,34].

The primary objective of this study was to assess the psychological health status and explore associated factors among MSM in China using SCL-90. We hypothesized that there might be high rates of mental health problems among MSM and that many factors likely contribute to the psychological problems of individuals in the MSM population. The findings help us understand the psychological status of MSM and the possible influencing factors that will inform the development of prevention strategies.

**Materials and methods**

**Respondents and procedures**

A cross-sectional study was conducted from April to September 2015 in two Chinese cities, Zhengzhou and Huludao. The initial sample size (N = 203) was calculated according to the formula $n = 100 \times (1 - p) / p$. It has been reported that 33.0–46.1% of MSM experience symptoms of depression or anxiety disorders in China [6,8,31]. To ensure an adequate sample size, the lowest prevalence rate (33%) was used as the $p$ value. The sample size was increased to 248 to take into account any lack of response from the initial 203 individuals. In total, 226 MSM completed the survey (response rate: 91.1%). Respondents were recruited from an internet advertisement, bars, and saunas. The respondents underwent a face-to-face explanation of the plan and intent of our study prior to taking the standardized questionnaire. The inclusion criteria were that respondents: (1) were 18 years of age or older, (2) had had sex with a man in the preceding 6 months, and (3) were without cognitive impairment. All questionnaires were self-administered in a private room. Only participants who gave written informed consent were enrolled in the study. The study protocol was approved by the bioethics advisory commission of China Medical University.

**Questionnaires**

The questionnaire was divided into three parts. The first part included socioeconomic characteristics such as age, vocation, marital status, education level, monthly income, sexual orientation, and family or friend awareness of sexual orientation. The second part concerned sexual-related behaviors and use of social services. Respondents were asked whether their first sex partner was male or female, the number of male partners in the preceding 6 months, whether they had engaged in unprotected anal intercourse (UAI), and whether they had sex with a female in the preceding 6 months. UAI was defined as having had at least one incident of condomless anal intercourse with any male partner in the preceding 6 months. Questions pertaining to use of social services included receiving HIV/syphilis testing, receiving AIDS information materials, receiving peer education, receiving AIDS counseling, and receiving psychosocial counseling. The third part was a Chinese version of SCL-90, which includes 90 items related to psychological health of an individual and contains nine subscales (somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, anger/hostility, phobic anxiety, paranoid ideation and psychoticism) and an additional scale that assesses disturbances in appetite and sleep. Respondents answered each question using a five-point scale (1 = ‘not at all’, 2 = ‘a little bit’, 3 = ‘moderately’, 4 = ‘quite a bit’, and 5 = ‘extremely’) as
relevant to symptoms experienced in the preceding 7 days. The responses to items relevant to each subscale were averaged to give a subscale score and, additionally, responses to all items were summed to give a total score. Any subscale score of >2.0 or a total score of >160 was considered a threshold for identifying individuals who require further evaluation [35,36]. Higher scores on the SCL-90 represent more serious psychological distress [35,36].

**Statistical analysis**

Cronbach’s $\alpha$ coefficient was used to assess the internal consistency of the SCL-90 items, and validity was assessed by collective validity and divisional validity. A t-test and one-way analysis of variance were used to identify factors related to psychological status. Logistic regression analyses were performed to identify factors associated with SCL-90 scores. Variables with a $P$-value < 0.10 for univariate results were considered eligible for the multivariate analysis. The significance level was fixed at $\alpha = 0.05$. All statistical analyses were carried out using SPSS$^\text{TM}$ version 19.0 for Windows$^\text{TM}$ (SPSS Inc., Chicago, IL, USA).

**Results**

**Evaluation of reliability and validity**

The degree of internal uniformity among the items of the SCL-90 questionnaire was expressed by Cronbach’s $\alpha$ coefficient. The overall Cronbach’s $\alpha$ coefficient was 0.844, which ranged from 0.810 (the depression dimension) to 0.959 (the phobic anxiety dimension). All Cronbach’s $\alpha$ coefficients of the subscales exceeded 0.7 and met the requirement for group comparison, suggesting acceptable reliability. The coefficient range of the collective validity for all the scales was >0.4. For the divisional validity, items have higher correlation with their hypothesized scales than with scales used to measure other concepts. Collective validity and divisional validity were good. Table 1 presents the results for collective validity and divisional validity of the SCL-90.

| Scale                  | Number | Coefficient range | Collective validity | Divisional validity | Success/total | Success rate (%) | Success/total | Success rate (%) |
|------------------------|--------|-------------------|---------------------|---------------------|---------------|------------------|---------------|------------------|
| Somatization           | 12     | 0.545–0.676       | 0.093–0.536         | 12/12               | 100           | 120/120          | 100           |
| Obsessive-compulsive   | 10     | 0.679–0.756       | 0.141–0.497         | 10/10               | 100           | 100/100          | 100           |
| Interpersonal sensitivity | 9     | 0.703–0.894       | 0.139–0.341         | 9/9                 | 100           | 90/90            | 100           |
| Depression             | 13     | 0.734–0.908       | 0.085–0.479         | 13/13               | 100           | 130/130          | 100           |
| Anxiety                | 10     | 0.704–0.897       | 0.154–0.517         | 10/10               | 100           | 100/100          | 100           |
| Anger/hostility        | 6      | 0.505–0.721       | 0.116–0.442         | 6/6                 | 100           | 60/60            | 100           |
| Phobic anxiety         | 7      | 0.654–0.802       | 0.128–0.494         | 7/7                 | 100           | 70/70            | 100           |
| Paranoid-ideation      | 6      | 0.564–0.655       | 0.186–0.444         | 6/6                 | 100           | 60/60            | 100           |
| Psychoticism           | 10     | 0.571–0.806       | 0.212–0.375         | 10/10               | 100           | 100/100          | 100           |
| Other                  | 7      | 0.487–0.788       | 0.227–0.425         | 7/7                 | 100           | 70/70            | 100           |

*a: Items per scale.

*b: Number of correlations between items and hypothesized scale corrected for overlap > 0.40/total number of collective validity tests.

*c: Number of correlations significantly higher/total number of divisional validity tests.

For collective validity, success means correlations between items and hypothesized scale corrected for overlap > 0.40, and for divisional validity success means items in a dimension were more highly correlated with their hypothesized dimension than with other dimensions.

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**Sociodemographic characteristics**

A total of 226 MSM completed the questionnaire. The age of respondents was 28.3 ± 8.6 years (range 18–68 years), and 94 (41.6%) self-identified as bisexual, 166 (73.5%) said they were single, and 60 (26.5%) were married. Education level was reported as follows: junior high school or lower (17.2%), senior high school (30.5%), and college or above (52.3%). Monthly income was categorized as: 1000–2000 Yuan (30.5%), 2001–3000 Yuan (42.5%), 3001–5000 Yuan (19.5%), and >5000 Yuan (7.5%). Respondent occupations were as follows: factory workers (18.2%), peasants (21.7%), administrators (21.2%), service personnel (32.7%), and students (6.2%). Among all respondents, 11.9% had disclosed their sexual orientation to family or friends.

**Sexual behaviors and social service utilization**

Among respondents, 75.2% reported that their first sex partner was male, 35.8% reported having only one male partner in the preceding 6 months, and 47.3% had engaged in condomless anal intercourse in the preceding 6 months. Additionally, 21.2% reported having had sex with a woman in the preceding 6 months. The proportions receiving HIV/syphilis testing and informational materials were 61.1% and 78.8%, respectively. A total of 62.8%, 72.6%, and 9.7% of the respondents received peer education, AIDS counseling, and psychosocial counseling, respectively.

**Assessment of psychosocial health**

Among our participants, the highest score was for depression (mean ± SD: 1.64 ± 0.70) and the lowest score was for somatization (mean ± SD: 1.39 ± 0.57). The total score for 46 of the participants was >160, suggesting psychological distress. The four domains having the highest scores were depression (46/226), obsessive-compulsive (44/226), interpersonal sensitivity (35/226), and anxiety (30/226). Compared with the Chinese norm [37], our MSM population had higher scores except for somatization and interpersonal sensitivity (P < 0.05; Table 2).

**SCL-90 scores stratified by sociodemographic characteristics**

The oldest group had a significantly higher mean score for the somatization subscale (1.68 ± 0.68, P < 0.05), and the youngest group had a significantly higher mean score for the

|                          | MSM(n = 226, mean±SD) | Chinese norms*(n = 7273, mean±SD) | t value |
|--------------------------|-----------------------|-----------------------------------|---------|
| Somatization             | 1.39±0.57             | 1.40±0.40                         | 0.364   |
| Obsessive-compulsive     | 1.62±0.65             | 1.49±0.54                         | 3.540*  |
| Interpersonal sensitivity | 1.50±0.60             | 1.45±0.52                         | 1.417   |
| Depression               | 1.64±0.70             | 1.42±0.49                         | 6.546*  |
| Anxiety                  | 1.48±0.66             | 1.31±0.42                         | 5.865*  |
| Anger/hostility          | 1.47±0.64             | 1.37±0.50                         | 2.933*  |
| Phobic anxiety           | 1.49±0.70             | 1.25±0.40                         | 6.670*  |
| Paranoid-ideation        | 1.52±0.70             | 1.35±0.49                         | 5.058*  |
| Psychoticism             | 1.47±0.64             | 1.22±0.37                         | 9.717*  |

SCL-90, Symptom Checklist 90; MSM, men who have sex with men.

*P < 0.05.

*The data of Chinese norms in the table originate from a previously published article[37]
phobic anxiety subscale (4.04 ± 0.96, P < 0.05). The peasantry had significantly higher scores for mean total score of SCL-90 (173.07 ± 63.52, P < 0.05), somatization (1.89 ± 0.71, P < 0.05), depression (2.02 ± 0.74, P < 0.05), paranoid-ideation (2.21 ± 0.50, P < 0.05), and psychoticism (2.08 ± 0.89, P < 0.05). The married MSM had significantly higher scores for mean total score of SCL-90 (171.92 ± 64.20, P < 0.05), obsessive-compulsive (2.02 ± 0.69, P < 0.05), interpersonal sensitivity (1.94 ± 0.71, P < 0.05), depression (2.38 ± 0.77, P < 0.05), anxiety (1.87 ± 0.89, P < 0.05), and psychoticism (1.98 ± 0.78, P < 0.05). The respondents with junior high school or lower education level had higher scores for mean phobic anxiety (2.26 ± 0.81, P < 0.05) and paranoid-ideation (1.82 ± 0.64, P < 0.05). Respondents who disclosed their sexual orientation to family or friends had lower scores for SCL-90 (120.06 ± 34.19, P < 0.05), depression (1.31 ± 0.55, P < 0.05), and anxiety (1.29 ± 0.38, P < 0.05). Table 3 presents the SCL-90 total scores stratified by sociodemographic characteristics.

### SCL-90 scores stratified by sexual behaviors and utilization of social services

No significant differences were found among different groups in terms of first sex partner (P > 0.05). Respondents with a greater number of male partners (≥4) had higher scores for

| Item                                           | Number | Percentage (%) | Total score (mean±SD) |
|-----------------------------------------------|--------|----------------|-----------------------|
| **Age**                                       |        |                |                       |
| ≤20                                           | 31     | 13.7           | 150.08±52.50          |
| 21–30                                         | 114    | 50.5           | 134.78±48.10          |
| 31–40                                         | 45     | 19.9           | 132.75±49.15          |
| ≥41                                           | 36     | 15.9           | 149.73±50.21          |
| **Vocation**                                  |        |                |                       |
| Worker                                        | 41     | 18.2           | 136.39±50.53*         |
| Peasantry                                     | 49     | 21.7           | 173.07±63.52          |
| Administrator                                 | 48     | 21.2           | 134.80±53.73          |
| Service Personnel                             | 74     | 32.7           | 136.97±58.03          |
| Student                                       | 14     | 6.2            | 130.15±58.44          |
| **Marital status**                            |        |                |                       |
| Single                                        | 166    | 73.5           | 134.78±48.95*         |
| Married                                       | 60     | 26.5           | 171.92±64.20          |
| **Education level**                           |        |                |                       |
| Junior high school or lower                   | 39     | 17.2           | 149.77±54.31          |
| Senior high school                            | 69     | 30.5           | 129.06±38.22          |
| College or above                              | 118    | 52.3           | 137.26±52.61          |
| **Monthly income (Yuan)**                     |        |                |                       |
| 1000–2000                                     | 69     | 30.5           | 137.91±49.47          |
| 2001–3000                                     | 96     | 42.5           | 144.04±56.55          |
| 3001–5000                                     | 44     | 19.5           | 124.34±47.08          |
| >5000                                         | 17     | 7.5            | 125.18±26.48          |
| **Family or friends know about sexual identity**|        |                |                       |
| Yes                                           | 27     | 11.9           | 120.06±34.19*         |
| No                                            | 199    | 88.1           | 142.75±57.67          |

SCL-90, Symptom Checklist 90.

*P < 0.05

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Factors associated with psychological levels among MSM as assessed with multivariate analysis

In the univariate analysis, SCL-90 total scores were significantly associated with the various vocations, marital status, number of male partners, condomless anal intercourse in the preceding 6 months, family or friends not knowing about sexual identity, and no receipt of psychosocial counseling (P < 0.05). To adjust significant background variables, logistic regression was...
used to identify factors associated with psychological levels for the total score of SCL-90 (<160 vs. ≥160). Significant factors included in the final model were as follows: married (AOR [adjusted odds ratio] = 3.19; 95% CI [confidence interval]: 1.96 to 5.93), condomless anal intercourse (AOR = 1.16; 95% CI: 1.02 to 1.31), number of male partners (AOR = 1.66 and 1.81; 95% CI: 1.08 to 2.34 and 1.32 to 2.69), family or friends not knowing about sexual identity (AOR = 2.13; 95% CI: 1.17 to 4.92), and no receipt of psychosocial counseling (AOR = 2.09; 95% CI: 1.06 to 4.09). Table 6 presents the results of the logistic regression analysis.

Table 5. SCL-90 total scores stratified by the utilization of social services.

| Item                                | Number | Percentage (%) | Total score (mean±SD) |
|-------------------------------------|--------|----------------|-----------------------|
| Receipt of HIV/syphilis testing     |        |                |                       |
| Yes                                 | 138    | 61.1           | 129.39±44.76          |
| No                                  | 88     | 38.9           | 141.72±54.61          |
| Receipt of AIDS information materials |        |                |                       |
| Yes                                 | 178    | 78.8           | 134.40±40.37          |
| No                                  | 48     | 21.2           | 137.60±53.89          |
| Receipt of peer education           |        |                |                       |
| Yes                                 | 142    | 62.8           | 133.86±47.31          |
| No                                  | 84     | 37.2           | 142.08±57.23          |
| Receipt of AIDS counseling          |        |                |                       |
| Yes                                 | 164    | 72.6           | 129.89±37.82          |
| No                                  | 62     | 27.4           | 139.57±55.36          |
| Receipt of psychological counseling |        |                |                       |
| Yes                                 | 22     | 9.7            | 110.57±31.69*         |
| No                                  | 204    | 90.3           | 139.61±52.15          |

SCL-90, Symptom Checklist 90.
*P < 0.05

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Discussion

In this study, the psychological health of Chinese MSM was assessed based on SCL-90. The SCL-90 has proven reliable and valid for our purpose. The four most frequent types of psychological distress were depression, obsessive-compulsive behavior, interpersonal sensitivity, and anxiety. Both the univariate analysis and the multivariate analysis showed that being married, condomless anal intercourse, the number of male partners, family or friends not knowing about sexual identity, and no receipt of psychosocial counseling were significantly associated with the SCL-90 score.

MSM are disproportionately affected by mental health problems, a finding that has been consistent across research studies and has received increasing attention [38–40]. In the western-based literature, homosexual and bisexual men are reported to have higher risk for mental health problems such as depression, anxiety, substance abuse, and suicidal ideation as compared with the general population [3,4,41]. A meta-analysis of studies of lesbians, gay men, and bisexuals found a 2-fold elevated risk of experiencing a psychiatric disorder lasting up to 1 year (OR [odds ratio] = 2.03, 95% CI = 1.68–2.46) or a lifetime (OR = 2.41, 95% CI = 1.91–3.02) [42]. A systematic review revealed that depression, anxiety, and alcohol and substance misuse were at least 1.5-times more common in lesbian, gay, and bisexual people [43]. A study conducted with MSM in India suggested that 29% of 150 MSM in Mumbai had experienced major depression and 24% experienced anxiety at some point in their life [1]. To date, little is
known regarding the mental and psychological characteristics of MSM in China. More than 20% of the MSM population in our investigation had a SCL-90 score of >160. Thus, our study indicates that the psychological status of MSM may be cause for concern in China. Therefore, MSM in China represent a diverse population with a broad range of psychological and health needs. Our findings provide information for future public health programs for the prevention and intervention of AIDS.

Social support has also been related to physical and mental health in the general populations worldwide and also for individuals with HIV [33,44,45]. It has been reported that effective social support can reduce substance abuse, promote other positive health behaviors, and improve mental well-being among MSM [46]. In our study, the respondents who had received psychological counseling generally had lower SCL-90 scores and good psychological health, consistent with other research. Counseling to reduce stress has been found to effectively enhance interventions and reduce HIV-related high-risk behaviors among MSM [46,47]. Bastardo and Kimberlin suggested that psychological support is a critical element of HIV care and can help enhance the quality life of patients in developing countries [48]. Psychosocial counseling can also help reduce fear of taking the HIV test and contributes to increased HIV testing among MSM [46]. Although the benefits of psychological counseling are obvious to researchers, only 9.7% of the respondents in our study had received this type of support. Enhancing psychological counseling for Chinese MSM is thus an urgent priority and might be an effective means of improving psychological health.

In our study, family or friends knowing about one’s MSM identity was also associated with a lower SCL-90 total score. A potential explanation for this protective effect is that those who disclosed their sexual orientation to relatives or friends are generally more accepting of their identity, i.e., they may be less likely to experience social pressures and stress related to their sexual orientation. In our study, only 11.9% of MSM had disclosed their sexual orientation to

Table 6. Factors associated with psychological levels among MSM in multivariable logistic regression model.

| Variables in the final model | psychological levels(< 160 vs. ≥ 160) |
|-----------------------------|-------------------------------------|
|                            | AOR       | 95% CI                |
| Marital status             |           |                       |
| single                     | 1         |                       |
| married                    | 3.19      | 1.96–5.93*            |
| Condomless anal intercourse|           |                       |
| No                         | 1         |                       |
| Yes                        | 1.16      | 1.02–1.31*            |
| Number of male partners    |           |                       |
| 1                          | 1         |                       |
| 2–3                        | 1.66      | 1.08–2.34*            |
| ≥4                         | 1.81      | 1.32–2.69*            |
| Family or friends know about sexual identity|           |                       |
| Yes                        | 1         |                       |
| No                         | 2.13      | 1.17–4.92*            |
| Receipt of psychosocial counseling|         |                       |
| Yes                        | 1         |                       |
| No                         | 2.09      | 1.06–4.09*            |

SCL-90, Symptom Checklist 90; MSM, men who have sex with men; AOR, adjusted odds ratio; CI, confidence interval.

* P < 0.05

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relatives or friends. More interventions could be beneficial to the psychological health of Chinese MSM who do not disclose their orientation.

Houston et al. suggested that a relatively larger number of depressive symptoms is associated with an increased propensity to engage in risky behaviors, e.g., a larger number of sexual partners and frequency of UAI [49]. A study conducted in India also suggested that a relatively larger number of depressive symptoms is associated with having had UAI and a larger number of male partners; for each additional sexual partner, there was an associated 4% increase in the number depressive symptoms [21]. In our study, larger numbers of male partners and condomless anal intercourse were significantly associated with higher SCL-90 scores. We found that those MSM who engaged in condomless anal intercourse had a 1.16-times greater risk of having psychological health problems than those who had not. SCL-90 scores increased with number of male partners, and respondents who had more than four male partners were approximately 2-times more likely to have psychological health problems than those who had one male partner. Our study thus suggests that psychological health is negatively impacted by risky sexual behaviors in accordance with other studies. Stall et al. suggested that psychosocial health problems are associated with exacerbated HIV risk behavior among MSM in the United States [10]. It also has been reported that MSM who have certain psychosocial health problems are more likely to report risky sexual behaviors [30]. Larger numbers of psychosocial health problems are also associated with greater prevalence for high-risk sexual behavior and HIV infection [51]. Studies have suggested that depression and anxiety undermine the intention of individuals to take up protective measures such as condoms, and increased HIV-related sexual risk behavior among MSM correlates with more psychological health problems [4,52]. Therefore, more mental health support services should be provided to the MSM population who practice risky sexual behaviors.

In our study, we found that the psychological status of married MSM was worse than that of unmarried MSM, especially in terms of the obsessive-compulsive behavior and depression, for which the measured values from our questionnaire were greater than the threshold of 2.0. Potential reasons could be that married MSM had experienced both social pressure and family pressure [53]. Because of potential fear of losing social status, feelings of guilt towards family, loneliness, and perceptions of immorality/abnormality, MSM are vulnerable to a variety of psychological difficulties such as serious depression, anxiety, and stress [15,53]. Rui Wang et al. suggested that unmarried MSM have better mental health compared with married MSM [54]. Therefore, more attention needs to be paid to the psychosocial health of married MSM.

Our study revealed that respondents with a junior high school or lower education level had higher SCL-90 total scores, and this was also true of the subscale scores for phobic anxiety and paranoid-ideation. Ning Liu et al. proposed that, in China, higher education level is usually associated with higher social class and economic status [55,56]. Results from studies conducted in Spain and China have shown that people with relatively lower education levels experience more stress and a poorer quality of life [56,57]. Another study concluded that, in China, higher education levels are generally associated with greater knowledge concerning how to deal with pressure [58]. We also found that, compared with other vocations, the MSM peasantry had the highest scores in all domains (P < 0.05), and the total SCL-90 scores were >160, which suggests that members of the MSM peasantry in China have a poor psychological status. In China, the peasantry live in very traditional rural communities, where homosexuality may be less understood/accepted than in urban areas; moreover, there are few entertainment opportunities in such communities [13]. Difficult living conditions and social ignorance may thus contribute to the relatively poor mental status of the MSM peasantry of China.

This study has important limitations. Owing to the social stigma of homosexuality in China and the consequent reclusive nature of the MSM population, potential respondents may have
decided not to participate in our study to protect their privacy; indeed, the sample size was relatively small, and the participants were recruited from only two cities in China. Therefore, our respondent group may not be representative of all Chinese MSM. Data were self-reported, and thus social desirability bias may exist. Otherwise, our study used cross-sectional data, which precluded conclusions regarding causality. Despite this limitation, our findings suggest that psychological health problems may be an important area for further research and future intervention among the Chinese MSM population.

Conclusion
Our results indicate that psychological health problems among MSM in China are of concern. It is thus necessary to strengthen intervention efforts, with more emphasis on intervention programs to improve psychological health among Chinese MSM.

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Conceptualization: Zhe Yi, Bo Qu.
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Formal analysis: Jie Liu, Yaxin Zhu.
Funding acquisition: Jie Liu, Bo Qu.
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Supervision: Zhe Yi, Bo Qu.
Visualization: Yaxin Zhu.
Writing – original draft: Jie Liu, Bo Qu.
Writing – review & editing: Zhe Yi.

References
1. Sivasubramanian M, Mimiga MJ, Mayer KH, Anand VR, Johnson CV, Safren SA. Suicidally, clinical depression, and anxiety disorders are highly prevalent in men who have sex with men in Mumbai, India: findings from a community recruited sample. Psychol Health Med. 2011; 16(4): 450–462. https://doi.org/10.1080/13548506.2011.554645 PMID: 21749242
2. Sandfort TG, Bakker F, Scheltevis FG, Vanwesenbeeck I. Sexual orientation and mental and physical health status: findings from a Dutch population survey. Am J Public Health 2006; 96(6): 1119–1125. https://doi.org/10.2105/AJPH.2004.058891 PMID: 16670235
3. Bostwick WB, Boyd CJ, Hughes TL, McCabe SE. Dimensions of sexual orientation and the prevalence of mood and anxiety disorders in the United States. Am J Public Health 2010; 100(3): 468–475. https://doi.org/10.2105/AJPH.2008.152942 PMID: 19696380
4. Alvy LM, McKirnan DJ, Mansergh G, Koblin B, Colfax GN, Flores SA, et al. Depression is associated with sexual risk among men who have sex with men, but is mediated by cognitive escape and selfefficacy. AIDS Behav. 2011; 15: 1171–1179. https://doi.org/10.1007/s10461-010-9678-2 PMID: 20217471
5. Chen G, Li Y, Zhang B, Yu Z, Li X, Wang L, et al. Psychological characteristics in high-risk MSM in China. BMC Public Health. 2012; 12: 58. https://doi.org/10.1186/1471-2458-12-58 PMID: 22264355
6. Jie W, Ciyong L, Xueqing D, Hui W, Lingyao H. A syndemic of psychosocial problems places the MSM (men who have sex with men) population at greater risk of HIV infection. PLoS One. 2012; 7: e32312. https://doi.org/10.1371/journal.pone.0032312 PMID: 22479319

7. Bouhnik AD, Préau M, Schultz MA, Peretti-Watel P, Obadia Y, Lert F, et al. Unsafe sex with casual partners and quality of life among HIV-infected gay men: evidence from a large representative sample of outpatients attending French hospitals (ANRS-EN12-VESPA). Acquir Immune Defic Syndr. 2006; 42: 597–603.

8. Li D, Li C, Wang Z, Lau JT. Prevalence and associated factors of unprotected anal intercourse with regular male sex partners among HIV negative men who have sex with men in China: a cross-sectional survey. PLoS One. 2015; 10(3): e0119977. https://doi.org/10.1371/journal.pone.0119977 PMID: 25816292

9. Wong CF, Schragger SM, Holloway IW, Meyer IH, Kipke MD. Minority stress experiences and psychological well-being: the impact of support from and connection to social networks within the Los Angeles House and Ball communities. Prev Sci. 2014; 15: 44–55. https://doi.org/10.1007/s11121-012-0348-4 PMID: 23412944

10. Stall R, Mills TC, Williamson J, Hart T, Greenwood G, Paul J, et al. Association of co-occurring psychosocial health problems and increased vulnerability to HIV/AIDS among urban men who have sex with men. Am J Public Health. 2003; 93(6):939–942. PMID: 12773359

11. Mustanski B, Garofalo R, Herrick A, Donenberg G. Psychosocial health problems increase risk for HIV among urban young men who have sex with men: preliminary evidence of a syndemic in need of attention. Ann Behav Med. 2007; 34(1):37–45. PMID: 17688395

12. Zhang H, Lu H, Pan SW, Xia D, Zhao Y, Xiao Y, et al. Correlates of unprotected anal intercourse: the influence of anal sex position among men who have sex with men in Beijing, China. Arch Sex Behav. 2015; 44(2): 375–387. https://doi.org/10.1007/s10508-014-0396-x PMID: 25548064

13. Chow EP, Lau JT, Zhuang X, Zhang X, Wang Y, Zhang L. HIV prevalence trends, risky behaviours, and governmental and community responses to the epidemic among men who have sex with men in China. Biomed Res Int. 2014; 2014: 607261. https://doi.org/10.1155/2014/607261 PMID: 24822214

14. Wang S, Song D, Huang W, He H, Wang M, Manning D, et al. Heterosexual Partnership and the Need for HIV Prevention and Testing for Men Who Have Sex With Men and Women in China: A Qualitative Study. AIDS Educ Prev. 2015; 27(2): 126–138. https://doi.org/10.1521/aeap.2015.27.2.126 PMID: 25916698

15. Yu L, Jiang C, Na J, Li N, Diao W, Gu Y, et al. Elevated 12-month and lifetime prevalence and comorbidity rates of mood, anxiety, and alcohol use disorders in Chinese men who have sex with men. PLoS One. 2013; 8(4): e50762. https://doi.org/10.1371/journal.pone.0050762 PMID: 23637731

16. Liao M, Kang D, Tao X, Boushey JH, Aliyu MH, Qian Y, et al. Alcohol use, stigmatizing/disapproving attitudes, and HIV-high risk sexual behaviors among men who have sex with men in China. Biomed Res Int. 2014; 2014:143738. https://doi.org/10.1155/2014/143738 PMID: 24795879

17. Sun YH, Sun L, Wu HY, Zhang ZK, Wang B, Yu C, et al. Loneliness, social support and family function of people living with HIV/AIDS in Anhui rural area, China. Int J STD AIDS. 2009; 20: 255–258 https://doi.org/10.1258/ijsa.2008.008348 PMID: 19304970

18. Chen H, Li Y, Wang L, Zhang B. Causes of suicidal behaviors in men who have sex with men in China: a national questionnaire survey. BMC Public Health. 2015; 15:91. https://doi.org/10.1186/s12889-015-1436-8 PMID: 25885430

19. Feng YJ, Wu ZY, Detels R. Evolution of Men Who Have Sex With Men Community and Experienced Stigma Among Men Who Have Sex With Men in Chengdu, China. J Acquir Immune Defic Syndr. 2010; 53: S98–103. https://doi.org/10.1097/QAI.0b013e3181c7d7f1 PMID: 20104118

20. Yi S, Tuot S, Chhoun P, Pal K, Choub SC, Mburu G. Mental health among men who have sex with men in Cambodia: Implications for integration of mental health services within HIV programmes. Int J Equity Health. 2016; 15(1):53.

21. Safren SA, Thomas BE, Mimiaga MJ, Chandrasekaran V, Menon S, Swaminathan S, et al. Depressive symptoms and human immunodeficiency virus risk behavior among men who have sex with men in Chennai, India. Psychol Health Med. 2009; 14: 705–715.

22. Diaz RM, Ayala G, Bein E. Sexual risk as an outcome of social oppression: Data from a probability sample of Latino gay men in three U.S. cities. Cultur Divers Ethnic Minor Psychol. 2004; 10: 255–267. https://doi.org/10.1037/1099-9809.10.3.255 PMID: 15311978

23. Fendrich M, Avci O, Johnson TP, Mackesy-Amiti ME. Depression, substance use and HIV risk in a probability sample of men who have sex with men. Addict Behav. 2013; 38(3):1715–1718. https://doi.org/10.1016/j.addbeh.2012.09.005 PMID: 23254224
24. Hou WL, Chen CE, Liu HY, Lai YY, Lee HC, Lee NY, et al. Mediating effects of social support on depression and quality of life among patients with HIV infection in Taiwan. AIDS Care. 2014; 26(8): 996–1003. https://doi.org/10.1080/09540121.2013.873764 PMID: 24423628

25. Sullivan PS, Carballo-Díéguez A, Coates T, Goodreau SM, McGowan I, Sanders EJ, et al. Successes and challenges of HIV prevention in men who have sex with men. Lancet. 2012; 380: 388–399. https://doi.org/10.1016/S0140-6736(12)60955-6 PMID: 22819659

26. Ruan Y, Qian HZ, Li D, Shi W, Li Q, Liang H, et al. Willingness to be circumcised for preventing HIV among Chinese men who have sex with men. AIDS Patient Care STDS. 2009; 23: 315–321. https://doi.org/10.1089/apc.2008.0199 PMID: 19335172

27. Li D, Jia Y, Ruan Y, Liu Y, Li Q, Liang H, et al. Correlates of incident infections for HIV, syphilis, and hepatitis B virus in a cohort of men who have sex with men in Beijing. AIDS Patient Care STDS. 2010; 24: 595–602. https://doi.org/10.1089/apc.2010.0083 PMID: 20731610

28. Yan H, Wong FY, Zheng T, Ning Z, Ding Y, Nehi EJ, et al. Social support and depressive symptoms among ‘money’ boys and general men who have sex with men in Shanghai, China. Sex Health. 2014; 11(3):285–287. https://doi.org/10.1071/SH14017 PMID: 24919661

29. Li L, Wan C, Ding R, Liu Y, Chen J, Wu Z, et al. Mental distress among Liberian medical staff working at the China Ebola Treatment Unit: a cross sectional study. Health Qual Life Outcomes. 2015; 13(1): 156.

30. Pappas P, Gouva M, Gourgoulis K, Hatzoglou C, Kotrotsiou E. Psychological profile of Greek doctors: differences among five specialties. Psychol Health Med. 2015:1–9.

31. Miller CT, Solomon SE, Bunn JY, Varni SE, Hodge JJ. Psychological symptoms are associated with both abstinence and risky sex among men with HIV. Arch Sex Behav. 2015; 44(2): 453–465. https://doi.org/10.1007/s10508-014-0464-2 PMID: 25614050

32. Jin YH, Potthoff A, Xu J, Yu WJ, Liu K, Weng NC, et al. Evaluation of mental status HIV-infected patients: implications for treatment. Curr HIV Res. 2012; 10(6): 546–551. PMID: 22716106

33. Chen S, Li L. Re-testing reliability, validity and norm applicability of SCL-90. Chin J Nerv Mental Dis. 2003; 29(5):323–327. [Article in Chinese]

34. Zhang L, Zhao J, Xiao H, Zheng H, Xiao Y, Chen M, et al. Mental health and burnout in primary and secondary school teachers in the remote mountain areas of Guangdong Province in the People's Republic of China. Neuropsychiatr Dis Treat. 2014; 10:123–130 https://doi.org/10.2147/NDT.S56020 PMID: 24465129

35. Jin C, Zhao G, Zhang F, Feng L, Wu N. The psychological status of HIV-positive people and their psychosocial experiences in eastern China. HIV Med. 2010; 11(4): 253–259. https://doi.org/10.1111/j.1468-1293.2009.00770.x PMID: 2002782

36. Zhuang SM, Chen F. Chinese adolescents and youth with methamphetamine dependence: prevalence and concurrent psychological problems. Nurs Res. 2016; 65(2):117–124. https://doi.org/10.1097/NNR.0000000000000141 PMID: 26938360

37. Tang QP, Cheng ZH, Yuan AH, Deng YL. The Use and Analysis of SCL-90 in China. Chinese Journal of Clinical Psychology. 1999; 7(1): 16–20. [Article in Chinese]

38. Safren SA, Blashill AJ, O’Cleirigh CM. Promoting the sexual health of MSM in the context of comorbid mental health problems. AIDS Behav. 2011; 15 Suppl 1:S30–S34.

39. Chae DH, Ayala G. Sexual orientation and sexual behavior among Latino and Asian Americans: Implications for unfair treatment and psychological distress. Journal of Sex Research. 2010; 47(5): 451–459. https://doi.org/10.1080/00224490903100579 PMID: 19626536

40. Hirschfield S, Wolitski RJ, Chiassona MA, Remien RC, Humberstone M, Wong T. Screening for depressive symptoms in an online sample of men who have sex with men. AIDS Care. 2008; 20 (8):904–910. https://doi.org/10.1080/09540120701796892 PMID: 18720088

41. Parker RD, Löhmus L, Valk A, Mangine C, Rüütel K. Outcomes associated with anxiety and depression among men who have sex with men in Estonia. J Affect Disord. 2015; 183: 205–209. https://doi.org/10.1016/j.jad.2015.05.014 PMID: 26025366

42. Meyer IH. Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: conceptual issues and research evidence. Psychol Bull. 2003; 129: 674–697. https://doi.org/10.1037/0033-2909.129.5.674 PMID: 1295639

43. King M, Semlyen J, Tai SS, Killaspy H, Osborn D, Popeyuk D et al. A systematic review of mental disorder, suicide, and deliberate self harm in lesbian, gay and bisexual people. BMC Psychiatry. 2008; 8:70. https://doi.org/10.1186/1471-244X-8-70 PMID: 18706118

44. Goldberg AE, Smith JZ. Stigma, social context, and mental health: lesbian and gay couples across the transition to adoptive parenthood. J Couns Psychol. 2011; 58: 139–150. https://doi.org/10.1037/a0021684 PMID: 21171740
45. Charles B, Jeyaseelan L, Pandian AK, Sam AE, Thenmozhi M, Jayaseelan V. Association between stigma, depression and quality of life of people living with HIV/AIDS (PLHA) in South India—a community based cross sectional study. BMC Public Health 2012; 12:463. https://doi.org/10.1186/1471-2458-12-463 PMID: 22720691

46. Herbst JH, Sherba RT, Crepaz N, Deluca JB, Zohrabian L, Stall RD, et al. A meta-analytic review of HIV behavioral interventions for reducing sexual risk behavior of men who have sex with men. J Acquir Immune Defic Syndr. 2005; 39: 228–241. PMID: 15905741

47. Darbes LA, Chakravarty D, Beougher SC, Neilands TB, Hoff CC. Partner-provided social support influences choice of risk reduction strategies in gay male couples. AIDS Behav. 2012; 16: 159–167. https://doi.org/10.1007/s10461-010-9868-8 PMID: 21221756

48. Bastardo YM, Kimberlin CL. Relationship between quality of life, social support and disease related factors in HIV-infected persons in Venezuela. AIDS Care. 2000; 5: 673–684.

49. Houston E, Sandfort T, Dolezal C, Carballo-Diéguez A. Depressive symptoms among MSM who engage in bareback sex: does mood matter? AIDS Behav. 2012; 16(8):2209–2215. https://doi.org/10.1007/s10461-012-0156-7 PMID: 22323005

50. Deuba K, Ekstrom AM, Shrestha R, Ionita G, Bhatta L, Karki DK. Psychosocial Health Problems Associated with Increased HIV Risk Behavior among Men Who Have Sex with Men in Nepal: A Cross-Sectional Survey. PLOS ONE. 2013; 8: e58099 https://doi.org/10.1371/journal.pone.0058099 PMID: 23516434

51. Mimiaga MJ, Biello KB, Sivasubramanian M, Mayer KH, Anand VR, Safren SA. Psychosocial risk factors for HIV sexual risk among Indian men who have sex with men. AIDS Care. 2013; 25(9): 1109–1113. https://doi.org/10.1080/09540121.2012.749340 PMID: 2339580

52. O’Cleirigh C, Skeer M, Mayer KH, Safren SA. Functional impairment and health care utilization among HIV-infected men who have sex with men: the relationship with depression and post-traumatic stress. J Behav Med. 2009; 32: 466–477. https://doi.org/10.1007/s10865-009-9217-4 PMID: 19526337

53. Steward WT, Miége P, Choi KH. Charting a moral life: the influence of stigma and filial duties on marital decisions among Chinese men who have sex with men. PLoS One. 2013; 8(8): e71778. https://doi.org/10.1371/journal.pone.0071778 PMID: 23951245

54. Wang R, Wu C, Zhao Y, Yan X, Ma X, Wu M et al. Health related quality of life measured by SF-36: a population-based study in Shanghai, China. BMC Public Health. 2008; 8:292. https://doi.org/10.1186/1471-2458-8-292 PMID: 18710578

55. Liu N, Zeng L, Li Z, Wang J. Health-related quality of life and long-term care needs among elderly individuals living alone: a cross-sectional study in rural areas of Shaanxi Province, China. BMC Public Health. 2013; 13: 313. https://doi.org/10.1186/1471-2458-13-313 PMID: 23566211

56. Zhu CY, Wang JJ, Fu XH, Zhou ZH, Zhao J, Wang CX. Correlates of quality of life in China rural-urban female migrate workers. Qual Life Res 2012; 21: 495–503. https://doi.org/10.1007/s11136-011-9950-3 PMID: 21695594

57. Lasheras C, Patterson AM, Casado C, Fernandez S. Effects of education on the quality of life, diet, and cardiovascular risk factors in an elderly Spanish community population. Experimental Aging Research 2001; 27: 257–270. https://doi.org/10.1080/036107301300208691 PMID: 11441647

58. Li J, Mao J, Du Y, Morris JL, Gong G, Xiong X. Health-Related Quality of Life Among Pregnant Women With and Without Depression in Hubei, China. Matern Child Health J. 2012; 16: 1355–1363. https://doi.org/10.1007/s10995-011-0900-z PMID: 22045020