

## Review article

# Reported prevalence of depression or depressive symptoms among men who have sex with men in China, 2004–2018: A systematic review and meta-analysis



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## ABSTRACT

**Background:** Depression is a major mental disorder that imposes a considerable burden on health. Men who have sex with men (MSM) are at high risk for depression. Numerous studies have reported the prevalence of depression or depressive symptoms among MSM in China. However, the estimates have varied substantially between studies. This meta-analysis aimed to establish the pooled prevalence of depression or depressive symptoms among Chinese MSM to attract public attention.

**Method:** A systematic search of several electronic databases and a subsequent manual search was performed to identify relevant studies. A random effects model was adopted to calculate the pooled prevalence of depression or depressive symptoms. Heterogeneity between studies and publication bias was also assessed.

**Results:** A total of 54 articles with a sample size of 21,950 MSM were analysed. The pooled prevalence of depression or depressive symptoms among MSM was 40.0% (95% CI: 37.9%–45.0%). Substantial heterogeneity was observed across individual studies. The pooled summary estimate stratified by screening instruments and cutoff scores ranged from 19.0% to 60.2%. Subgroup analysis indicated that survey dates, sampling method, HIV infection status and occupation can partially contribute to the between-study heterogeneity.

**Limitations:** The findings should be interpreted with caution because of several limitations related to the heterogeneity across studies, sampling method and quality assessment.

**Conclusions:** Overall, the reported prevalence of depression or depressive symptoms among Chinese MSM was fairly high. The study suggested that more attention and effective intervention programmes are urgently provided to prevent and improve mental health issues among Chinese MSM.

## 1. Introduction

It has been established that men who have sex with men (MSM) experienced disproportionately high rates of depression. In an online sample of MSM in Australia ( $n = 2970$ ), for example, 28.3% were screened positive for current moderate-severe depression (Prestage et al., 2018). Likewise, in the USA, several studies have documented that the reported prevalence of depression among MSM was 28.4%–43.8% (Gonzales and Henning-Smith, 2017; Hanson et al., 2015; Reisner et al., 2009; Williams et al., 2015), higher than that among the general male population (Weinberger et al., 2018; Zhao et al., 2009). According to the meta-analysis performed by King and his colleagues, MSM were two to three times more likely to be depressed than their heterosexual counterparts (King et al., 2008).

Depression among MSM has major implications for public health. Empirical studies have indicated that depression among MSM was associated with increased risky sexual behavior, HIV infection and even suicide (Ahaneku et al., 2016; Batchelder et al., 2017; Miltz et al., 2017; Reisner et al., 2009; Safren et al., 2010; Shiu et al., 2014; Wu et al., 2015), which poses a great challenge for public health. Additionally, depression can be a great barrier to help seeking, engagement and retention in care, HIV testing, and initiation and adherence to anti-retroviral treatment (ART) for MSM living with HIV (Batchelder et al., 2017; de Moraes and Casseb, 2017; Lee et al., 2017; Tao et al., 2017a, b). Therefore, depression among MSM requires special attention, and effective psychological interventions are urgently needed and should be strengthened.

In China, there is an estimated 21.0 million MSM in the sexually

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active phase (Liu et al., 2015a). Although homosexuality has become increasingly visible in recent years, most Chinese people still disapprove of homosexuality (Hu, 2016; Xie and Peng, 2018). In a society deeply influenced by Confucianism and collectivism, MSM are considered to be engaging in immoral behavior, and therefore, they have been highly rejected, stigmatized and discriminated within this context (Hu, 2016; Liao et al., 2015; Xie and Peng, 2018), which makes them vulnerable to depression through a process termed minority stress (Meyer, 2003). Moreover, despite great efforts in HIV prevention and treatment, MSM continue to represent approximately one-third of new HIV infections in China (Wu, 2018). The dual pressure from homosexual-related stigma and HIV-related stigma may lead to an elevated risk of depression among MSM in China. Considering the large population base and adverse outcomes associated with depression, there is a need to screen for depression or depressive symptoms among Chinese MSM in practice and research.

In the past two decades, numerous studies have reported the prevalence of depression among Chinese MSM. However, the estimates have varied greatly, ranging from 26.8% to 55.8% (Li et al., 2016a; Su et al., 2018). Reliable estimates of depression prevalence are the first step in informing health-care policy and developing future research priorities. It would be helpful to synthesize individual studies evaluating depression to establish the extent of depression among MSM. Hence, we performed a meta-analysis aiming to determine the prevalence of depression or depressive symptoms among Chinese MSM to attract the attention of the public and policymakers to this subpopulation and develop appropriate interventions.

## 2. Methods

We performed this meta-analysis following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009).

### 2.1. Literature search and selection

Databases including PubMed, Web of Knowledge, Embase, Chinese National Knowledge Infrastructure, China Biology Medicine disc, Wangfang database and Chongqing VIP database for Chinese Technical Periodicals were systematically searched to identify relevant studies on April 1, 2019. There were no restrictions on publication year. The following search strategy was used: ((('man' OR 'male' OR 'men') AND (homosexual\* OR bisexual\* OR androphilia OR 'same-sex')) OR 'men who have sex with men' OR 'gay') AND (depress\*) AND (Chinese OR China). In addition, a manual search of the reference lists of the identified articles was performed to obtain additional relevant studies.

Studies were included if they met the following criteria: 1) the study was conducted among MSM in mainland China; 2) the study was published either in English or Chinese; 3) the study assessed depression or depressive symptoms using validated instruments; and 4) the study either provided the prevalence of depression or adequate information for calculating the prevalence estimates. Conversely, studies were excluded if they 1) were systematic reviews or qualitative interview studies; 2) were duplicate publications; and 3) failed to provide relevant data for the prevalence estimation of depression. Additionally, if multiple studies were published based on the same database, only studies with the most detailed information were selected.

Two authors independently completed the literature search and selection. Any disagreements with regard to the process were resolved by consensus.

### 2.2. Data extraction

Relevant data from the eligible studies were independently extracted and summarized by the same two authors mentioned above. Any inconsistencies in data extraction were discussed and resolved by

the third author if necessary. The following information was extracted from each eligible study: first author, publication year, survey dates, study location (city), area of China, sampling method, assessment method, average age of subjects, sample size, number of depressed MSM, screening instrument and criteria, and characteristics of subjects (e.g., status of HIV infection, sexual orientation, occupation).

Traditional quality assessment tools were not used to appraise individual articles included in the review as a result of the methodological concerns. For example, the representativeness of sample, an important dimension in traditional quality assessment tools, is limited because all participants in eligible studies were recruited using non-probability sampling. Therefore, consistent with the Meta-analysis of Observational Studies in Epidemiology guidelines, we adopted the risk-of-bias variables (i.e., sampling method and assessment methods), which were suggested in previous studies, to evaluate their effect on the meta-analytic results (Hottes et al., 2016; Salway et al., 2019; Stroup et al., 2000).

### 2.3. Statistical analysis

All statistical analyses were performed using the meta package in R 3.5.0 software. A random effects model was adopted to calculate the pooled prevalence estimates and 95% confidence intervals (CIs) due to expected heterogeneity. Between-study heterogeneity was evaluated using Cochran's chi-squared test (Cochran's Q) and I<sup>2</sup> values, where  $P < 0.1$  or  $I^2 \geq 50\%$  represented a moderate or high level of heterogeneity.

Subgroup analyses were conducted to explore the source of heterogeneity and determine the pooled prevalence of depression or depressive symptoms in MSM with different characteristics. Subgroups were defined according to pre-specified variables, such as instrument and criteria, survey dates (before 2010, 2010–2015, after 2015), area of China (northern city, southern city), sampling method (convenience sampling, snowball sampling, respondent-driven sampling), assessment methods (face-to-face interview, self-administered methods), HIV infection status (HIV positive, HIV negative), sexual orientation (homosexual, bisexual), occupation (money boy, non-money boy). A mixed-effects meta-regression was performed to investigate whether any covariates (e.g., average age and sample size) contributed to the heterogeneity. To further explore the source of heterogeneity, we performed additional subgroup analyses in studies using the same instrument and criteria where a minimum of 10 studies were available. Sensitivity analysis was conducted by repeatedly excluding one study at a time to test the stability of the pooled prevalence of depression. Publication bias was examined using funnel plots and Egger's tests. A  $P$  value  $< 0.05$  was considered statistically significant.

## 3. Results

### 3.1. Study selection and characteristics

A total of 525 records were retrieved through the initial search. After removal of duplicates and exclusion of the ineligible studies, 54 studies were finally included. The flow diagram of the search and screening process is shown in Fig. 1. All the studies were conducted during 2004–2018. The sample size of the included studies ranged from 50 to 1809, with a total number of 21,950. Of the 54 studies, 12 were conducted in northern China, 40 were conducted in southern China and 2 were conducted across the two areas. In terms of sampling methods, 22 studies used convenience sampling, 9 studies used snowball sampling, 11 studies used respondent-driven sampling, 8 studies used two sampling methods and 2 studies did not provide any information on the sampling method. With regard to assessment methods, 22 studies used self-administered methods, 29 studies used face-to-face interview methods, 1 study used a combination of these methods and 2 studies did not report the method used. Regarding screening instruments, most studies ( $n = 30$ ) assessed the prevalence of depression using the Center

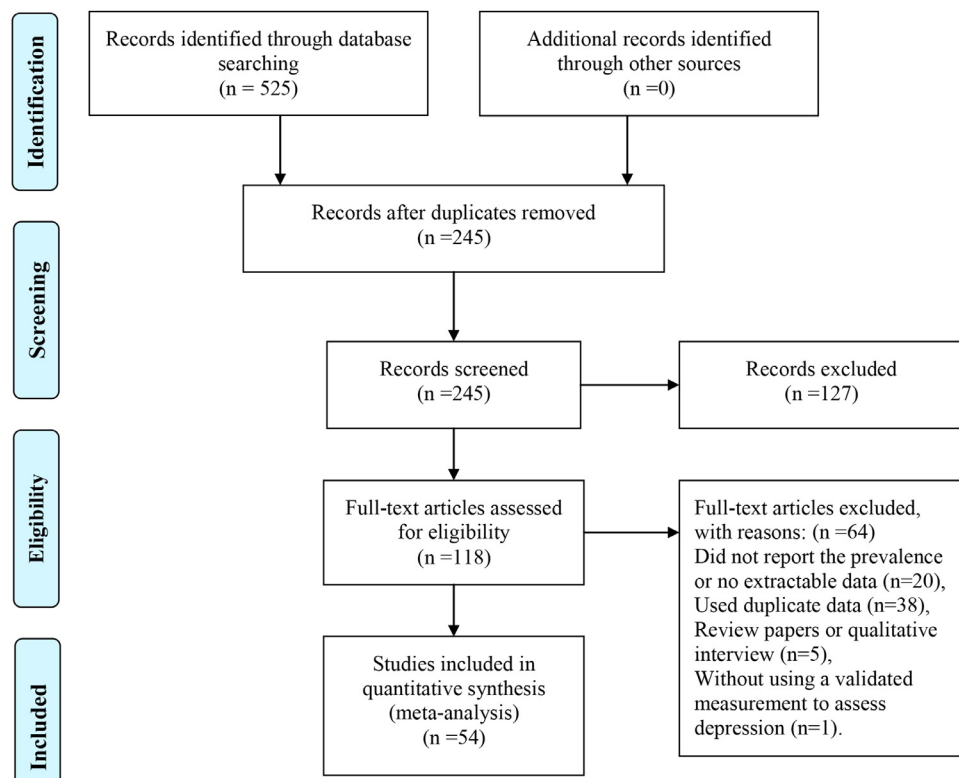


Fig. 1. Flowchart for the selection of studies.

for Epidemiologic Studies Depression Scale (CES-D), 16 studies used the Zung Self-Rating Depression Scale (SDS), 4 studies used 90-item Symptom Checklist (SCL-90), 2 studies used the Patient Health Questionnaire (PHQ-9), 1 study used the Hospital Anxiety and Depression Scale (HADS) and 1 study used the Depression Anxiety and Stress Scale (DASS). Additionally, 7 studies reported the prevalence of depression in bisexual MSM, 14 studies in homosexual MSM, 4 studies in money boys (MBs), 2 studies in non-money boys (non-MBs), 5 studies in HIV-negative MSM and 16 studies in HIV-positive MSM. The detailed characteristics of the eligible studies are presented in Table 1.

### 3.2. Prevalence of depression or depressive symptoms among MSM

The reported prevalence of depression or depressive symptoms among MSM by individual studies ranged from 19.0% to 68.1%, with a pooled meta-analysis prevalence of 40.0% (95% CI: 37.9%–45.0%) and significant between-study heterogeneity ( $P < 0.001$ ,  $I^2 = 93.9\%$ ) (Fig. 2).

To further determine the range of depression or depressive symptom prevalence characterized by screening instruments and cutoff scores, stratified meta-analyses were performed. The pooled summary estimates varied widely from 19.0% for the 20-item CES-D (cutoff value  $> 16$ ) to 60.2% for the PHQ-9 (cutoff value  $\geq 5$ ) (Table 2). When the meta-analysis was limited to when there were 10 or more studies in each stratification, only studies that used the 20-item CES-D with a cutoff value  $\geq 16$  were eligible. Significant differences were observed between pooled estimates yielded by stratification ( $P < 0.001$ ).

### 3.3. Subgroup analysis and meta-regression

The results of the subgroup analysis are shown in Table 3. The pooled estimates of depression decreased over time ( $P < 0.05$ ). For studies conducted before 2010, the pooled prevalence was 47.0% (95% CI: 38.3%–55.8%), and the estimate of depression was 39.6% (95% CI: 36.1%–43.2%) in studies conducted between 2010 and 2015, and

33.3% (95% CI: 27.8%–39.1%) in studies conducted after 2015. There were no significant between-group differences in pooled estimates when studies were grouped by area of China, sampling method and assessment methods. Additionally, the pooled prevalence of depression among MBs was 62.8% (95% CI: 55.0%–70.4%), which was significantly higher than that among non-MBs (44.6%, 95% CI: 40.3%–49.0%). The pooled prevalence of depression among HIV-positive MSM was 43.9% (95% CI: 38.5%–49.4%), which was significantly higher than that among HIV-negative MSM (34.8%, 95% CI: 28.9%–41.0%). The pooled prevalence of depression for homosexual and bisexual MSM was 43.5% (95% CI: 38.2%–48.9%) and 49.1% (95% CI: 41.9%–56.3%), respectively. However, this difference was not significant.

In the meta-regression analyses, the prevalence of depression did not significantly vary with the average age ( $\beta = -0.003$ ,  $P = 0.448$ ) or the sample size ( $\beta = -0.004$ ,  $P = 0.385$ ).

### 3.4. Heterogeneity within screening instruments

To further determine the source of heterogeneity, we performed additional meta-analyses within studies using the same instrument and criteria. According to the pre-specified requirements, only studies ( $n = 16$ ) using the 20-item CES-D (cutoff value  $\geq 16$ ) met the condition. The pooled estimate of depression or depressive symptoms by the 16 studies was 43.6% (95% CI: 38.9%–48.4%), with substantial heterogeneity ( $P < 0.001$ ,  $I^2 = 95.0\%$ ). Heterogeneity was partially accounted for by the sampling method, as studies using respondent-driven sampling (34.1%, 95% CI: 29.0%–39.5%) yielded lower prevalence estimates than studies using convenience sampling (45.7%, 95% CI: 39.9%–51.5%) and snowball sampling (41.3%, 95% CI: 25.9%–57.6%). When prevalence was stratified by survey dates, area of China and assessment methods, there was no significant difference in each subgroup.

Moreover, average age ( $\beta = -0.011$ ,  $P = 0.133$ ) and sample size ( $\beta = -0.008$ ,  $P = 0.060$ ) were not significantly associated with

**Table 1.**  
Selected characteristics of the 54 studies on the prevalence of depression or depressive symptoms among MSM in China.

Study	Survey dates	Location, City	Area	Sampling method	Method of data collection	Age, y	Sample size and characteristics of subjects	No. depressed	Instrument and cutoff score
(Yan et al., 2019)	2016.07–2016.08	Nanjing	Southern	convenience sampling	self-administered	Mean (SD): 33.9 (10.6) Range: 18–65	HIV-positive: 347 HIV-negative: 1809	HIV-positive: 134 HIV-negative: 682	CES-D $\geq$ 16 CES-D $\geq$ 16
(Hu et al., 2019)	2013.04–2014.10	Chongqing, Mianyang, Wulumuqi, etc.	Southern, Northwest	convenience sampling	self-administered				
(Zhang et al., 2018)	2016.07–2016.12	Ningbo	Southern	convenience sampling	face-to-face	Mean (SD): 31.1 (8.4)	516	150	CES-D $\geq$ 0.5
(Yun et al., 2018)	2012.03–2012.06	Shenyang	Northern	convenience sampling	face-to-face	Mean (SD): 31.3 (9.4)	HIV-negative: 134	HIV-negative: 30	Zung SDS $\geq$ 53
(Xiong et al., 2018)	2017.11–2018.01	Chengdu	Southern	RDS	self-administered	NR	103	37	Zung SDS $\geq$ 53
(Xie et al., 2018)	2015.03–2015.08	Shanghai	Southern	convenience sampling	face-to-face	Mean (SD): 29.3 (0.6)	Total: 738 Homosexual: 544 Bisexual: 179	Total: 286 Homosexual: 210 Bisexual: 73	CES-D $\geq$ 9
(Wang et al., 2018b)	2015.09–2017.06	Mianyang	Southern	snowball sampling	self-administered	Median (range): 21.0 (16–24)	355	118	Zung SDS $\geq$ 53
(Gao et al., 2018)	2016.06–2016.12	Kunming	Southern	convenience sampling	face-to-face	Mean (SD): 29.6 (9.0)	400	138	Zung SDS $\geq$ 53
(Yu et al., 2018)	2008.04–2009.01	Anshan, Benxi, Dandong, Shenyang	Northern	RDS	face-to-face	Mean (SD): 27.2 (0.3)	807	267	Zung SDS $\geq$ 53
(Su et al., 2018)	2014.11–2015.01	NR	NR	time-location/ convenience sampling	self-administered	Range: 18–25	Total: 507 Homosexual: 344	Total: 136 Homosexual: 95	CES-D $\geq$ 20
(Liu et al., 2018)	2015.04–2015.09	Huludao, Zhengzhou	Northern	convenience sampling	self-administered	Mean (SD): 28.3 (8.6)	226	46	SCL-90 $\geq$ 2
(Song et al., 2017)	2014.05–2014.12	Guilin	Southern	snowball sampling	face-to-face	Mean (SD): 32.5 (9.2)	400	113	Zung SDS $\geq$ 50
(Peng et al., 2017)	2016.03–2016.08	Shenzhen	Southern	RDS	face-to-face	Mean (SD): 29.2 (8.2)	Total: 596 Homosexual: 326 Bisexual: 239	Total: 307 Homosexual: 135 Bisexual: 149	Zung SDS $\geq$ 50
(Pan et al., 2017)	2014.11–2015.11	Shanghai	Southern	convenience/ snowball sampling	face-to-face	Median (range): 21.0 (18–72)	HIV-positive: 505	HIV-positive: 235	CES-D $\geq$ 9
(Meng, 2017)	NR	Nanning	Southern	convenience/ snowball sampling	face-to-face	Mean (SD): 23.1 (5.8)	435	185	Zung SDS $\geq$ 50
(Luo et al., 2017)	2015.05–2015.12	Chongqing	Southern	convenience sampling	face-to-face	Median (range): 28.0 (18–75)	HIV-positive: 400	HIV-positive: 99	Zung SDS $\geq$ 50
(Liu et al., 2017)	2013.03–2014.09	Changsha	Southern	convenience sampling	NR	Mean (SD): 29.0 (8.0)	Total: 321 HIV-positive: 321 Homosexual: 205 Bisexual: 99	Total: 132 HIV-positive: 132 Homosexual: 77 Bisexual: 48	PHQ-9 $\geq$ 5
(Li, 2017)	2013.12–2014.10	Wenzhou, Ningbo, Hangzhou	Southern	RDS	face-to-face	> 14	Total: 1303 HIV-positive: 190 HIV-negative: 1106	Total: 420 HIV-positive: 80 HIV-negative: 339	CES-D $\geq$ 16
(Tao et al., 2017b)	2013.03–2015.05	Beijing	Northern	NR	face-to-face	Median: 28.0	HIV-positive: 364	HIV-positive: 131	HADS $\geq$ 8
(Yu et al., 2016)	2014.01–2015.03	Guangzhou	Southern	RDS	self-administered	Median (range): 26.0 (18–38)	Homosexual: 420	Homosexual: 163	DASS > 6.03
(Wang et al., 2016)	2015.05–2015.07	Tianjin	Northern	convenience sampling	face-to-face	Mean (SD): 21.8 (2.5)	50	16	SCL-90 $\geq$ 2
(Pan et al., 2016)	2014.10–2015.08	Lianzhou	Southern	RDS, snowball sampling	self-administered	Mean (SD): 30.5 (11.5)	312	159	CES-D $\geq$ 16
(Jing, 2016)	2013.04–2014.10	Chongqing	Southern	convenience/ snowball sampling	self-administered	> 18	1230	359	CES-D $\geq$ 16
(Jiang et al., 2016)	2014.05–2014.09	Hangzhou, Wenzhou	Southern	convenience sampling	face-to-face	> 18	Total: 570 Homosexual: 349 Bisexual: 196	Total: 259 Homosexual: 167 Bisexual: 76	Zung SDS $\geq$ 0.5
(Chen, 2016)	2015.10–2016.01	Qingdao, Jinan	Northern	convenience/ snowball sampling	face-to-face	Mean (SD): 29.8 (6.5)	62	17	SCL-90 $\geq$ 2
(Li et al., 2016c)	2014.04–2014.06	Beijing	Northern	convenience sampling	self-administered	Mean (SD): 34.2 (9.3)	HIV-positive: 266	HIV-positive: 146	CES-D $\geq$ 16
(Li et al., 2016b)	2014.03–2014.05	Shanghai	Southern	snowball sampling	face-to-face	Mean (range): 30.5 (17–64)	547	169	CES-D $\geq$ 22

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Table 1. (continued)

Study	Survey dates	Location, City	Area	Sampling method	Method of data collection	Age, y	Sample size and characteristics of subjects	No. depressed	Instrument and cutoff score
(Li et al., 2016a)	2013.07–2013.10	Chengdu	Southern	convenience sampling	face-to-face	> 18	Total: 321 HIV-positive: 321 Homosexual: 273	Total: 179 HIV-positive: 179 Homosexual: 148	CES-D $\geq$ 16
(Zhou et al., 2015)	2014.01–2014.05	Ningbo	Southern	RDS	face-to-face	Mean (range): 28.8 (17–57)	Total: 126 Homosexual: 67	Total: 24 Homosexual: 12	CES-D > 16
(Liu et al., 2015b)	2013.05–2013.12	Beijing	Northern	convenience sampling	self-administered	Mean (SD): 35.0 (10.5)	HIV-positive: 76	HIV-positive: 33	CES-D $\geq$ 16
(Hu et al., 2015)	2013.01–2014.07	Chongqing, Mianyang, Suining, etc.	Southern	convenience sampling	self-administered	Mean (SD): 30.0 (9.0)	Total: 854 HIV-negative: 854 Homosexual: 603 Bisexual: 251	Total: 389 HIV-negative: 389 Homosexual: 259 Bisexual: 130	CES-D $\geq$ 16
(He et al., 2015)	2013.01–2013.07	Shanghai, Chengdu	Southern	snowball sampling	face-to-face	> 18	HIV-positive: 308	HIV-positive: 172	CES-D $\geq$ 16
(Dai, 2015)	2013.04–2014.10	Chongqing	Southern	convenience/ snowball sampling	self-administered	Median: 33.9	1125	513	CES-D $\geq$ 16
(Chen et al., 2015)	2012.12–2013.05	Guangzhou, Chongqing, Chengdu	Southern	snowball sampling	self-administered	Range: 18–63	Total: 541 HIV-positive: 541 Homosexual: 439 Bisexual: 88	Total: 242 HIV-positive: 242 Homosexual: 189 Bisexual: 47	CES-D $\geq$ 16
(Wu et al., 2015)	2013.03–2013.06	Hefei, Maanshan, Wuhu	Southern	convenience sampling	face-to-face	Mean (SD): 31.4 (9.2)	HIV-positive: 184	HIV-positive: 79	CES-D $\geq$ 22
(Li et al., 2015)	2012.05–2012.07	Beijing, Chengdu	Northern, Southern	convenience sampling	face-to-face	> 18	HIV-negative: 307	HIV-negative: 110	CES-D $\geq$ 10
(Yan, 2014)	2012.03–2013.04	Shanghai	Southern	convenience sampling	face-to-face	Mean (SD): 31.2 (9.8)	Total: 535 MB: 226 Non-MB: 309	Total: 255 MB: 120 Non-MB: 135	CES-D $\geq$ 9
(Sun et al., 2014)	2013.05–2013.12	Nanchang	Southern	convenience sampling	self-administered	Mean (SD): 28.3 (4.8)	HIV-positive: 65	HIV-positive: 41	Zung SDS $\geq$ 53
(Shi et al., 2014)	2012	Shanghai	Southern	convenience sampling	face-to-face	Mean (SD): 29.2 (8.0)	153	68	CES-D $\geq$ 16
(Liu et al., 2014)	2012.03–2012.09	Changsha	Southern	NR	self-administered	Mean (SD): 27.6 (5.5)	HIV-positive: 123	HIV-positive: 74	PHQ-9 $\geq$ 5
(Yan et al., 2014)	2008.07–2009.01	Shanghai	Southern	RDS	self-administered	Range: 18–71	Total: 404 MB: 200 Non-MB: 204 Homosexual: 252	Total: 234 MB: 140 Non-MB: 94 Homosexual: 145	CES-D $\geq$ 9
(Yu et al., 2013)	NR	Beijing	Northern	snowball sampling	face-to-face	Mean (SD): 31.4 (9.1)	105	48	CES-D $\geq$ 10
(Wang, 2013)	2010.08–2010.12	Shanghai	Southern	snowball sampling	face-to-face	Mean (SD): 36.3 (10.1)	HIV-positive: 200	HIV-positive: 48	CES-D $\geq$ 16
(Yun, 2012)	NR	Shenyang	Northern	convenience sampling	face-to-face	Mean (range): 29.0 (17–63)	HIV-positive: 70	HIV-positive: 24	Zung SDS $\geq$ 53
(Liu, 2012)	2010.07–2011.01	Foshan	Southern	RDS	face-to-face	Mean (SD): 31.9 (8.5)	249	86	Zung SDS $\geq$ 0.5
(Wu et al., 2012)	2010.03–2010.08	Guangzhou	Southern	convenience sampling	self-administered	Mean (range): 28.0 (18–68)	522	172	CES-D > 22
(Duan, 2011)	2006.12–2007.2	Mianyang, Yibin	Southern	RDS	self-administered	Mean (SD): 24.8 (6.5)	400	110	CES-D $\geq$ 19
(Wang et al., 2010)	2007.01–2007.02	Mianyang	Southern	RDS	self-administered	Mean (SD): 24.8 (6.5)	Total: 201 Homosexual: 152 Bisexual: 27	Total: 76 Homosexual: 57 Bisexual: 14	CES-D $\geq$ 16
(Huang et al., 2010)	2009	Shanghai	Southern	snowball sampling	NR	Mean (SD): 18.0 (1.0)	52	19	Zung SDS $\geq$ 53
(Feng et al., 2010)	2007.03–2007.06	Chengdu	Southern	snowball sampling	face-to-face, self- administered	Median (range): 24.0 (16–45)	513	275	CES-D $\geq$ 15
(Tao et al., 2009)	2007.10–2007.12	Jinan, Qingdao, Yantai, etc.	Northern	convenience sampling	face-to-face	Mean (SD): 23.1 (4.9)	MB: 116	MB: 79	Zung SDS $\geq$ 0.5
(Zhu et al., 2008)	2007.03–2007.05	Jinan	Northern	RDS	face-to-face	Mean (SD): 28.3 (7.4)	271	104	SCL-90 $\geq$ 2
(Wong et al., 2008)	2006.04–2006.06	Shanghai	Southern	RDS, convenience sampling	self-administered	Mean (SD): 25.2 (4.7)	Total: 239 MB: 239 Homosexual: 192	Total: 145 MB: 145 Homosexual: 121	CES-D $\geq$ 16

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Table 1. (continued)

Study	Survey dates	Location, City	Area	Sampling method	Method of data collection	Age, y	Sample size and characteristics of subjects	No. depressed	Instrument and cutoff score
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(Zheng et al., 2005) 2004.02 Hefei Southern convenience sampling self-administered > 16 Total: 167 Homosexual: 93 Total: 96 Homosexual: 44 Zung SDS  $\geq 41$

Abbreviations: MSM, men who have sex with men; RDS, respondent-driven sampling; SD, standard deviation; MB, money boy; Zung SDS, Zung Self-Rating Depression Scale; CES-D, Center for Epidemiologic Studies Depression Scale; SCL, Symptom Checklist; DASS, Depression Anxiety and Stress Scale; PHQ, Patient Health Questionnaire; HADS, Hospital Anxiety and Depression Scale; NR, none reported.

depression prevalence (Supplementary Tables 1 and 2).

### 3.5. Sensitivity analysis and publication bias

When each study was serially excluded from the overall meta-analysis, the combined prevalence did not change significantly, suggesting that the results were relatively stable and reliable (Supplementary Fig. 1). For publication bias, visual inspection of the funnel plot showed good symmetry (Fig. 3), and Egger's tests did not reveal evidence of publication bias.

## 4. Discussion

Currently, there is a dearth of nationwide data on the prevalence of depression among MSM in China. In the current systematic review and meta-analysis, we aggregated the reported prevalence of depression or depressive symptoms among Chinese MSM. Through rigorous screening, a total of 54 eligible studies involving 21,950 participants were eventually included in the analysis. Our findings showed that the pooled prevalence of depression or depressive symptoms among Chinese MSM was 40.0% (95% CI: 37.9%–45.0%), which was just in the range of 28.3%–46.3% reported in other countries (Ahaneke et al., 2016; Gonzales and Henning-Smith, 2017; Hanson et al., 2015; Prestage et al., 2018; Reisner et al., 2009; Sivasubramanian et al., 2011; Williams et al., 2015) but far higher than that reported in the general male population in China (0.54%–2.2%) (Baxter et al., 2016; Lee et al., 2009; Lu et al., 2008, 2018). The result was fairly striking and concerning given that depression is closely linked to an increased risk of sexual behavior, HIV infection and suicide, demonstrating a considerable health burden and urgent needs for mental health services among Chinese MSM.

There was a significant difference in pooled prevalence when stratified by screening instruments and cutoff scores, with the pooled estimates ranging from 19.1% to 60.2%. Hence, some caution is warranted when interpreting the results. In the present analysis, all of the included studies adopted a variety of validated screening questionnaires to assess depression or depressive symptoms, the sensitivity and specificity of which, as previously reported, differed greatly in diagnosing major depressive disorder (Rotenstein et al., 2016; Wang et al., 2018a). Evidence suggested that the sensitivity of the screening tools often takes precedence over specificity, which tends to result in an overestimation of the true prevalence estimates (Zhang et al., 2017). Therefore, the pooled prevalence of depression or depressive symptoms may be slightly exaggerated to some extent in this meta-analysis. Despite the limitations in screening instruments of depressive symptoms, they are essential for assessing depression in MSM in clinical practice and epidemiological surveys because they are time- and labor-saving and can be readily applied (Lim et al., 2018; Vilagut et al., 2016). However, the screening instruments are not recommended as a stand-alone diagnostic measure of depression and should be accompanied by a complete diagnostic interview (Lim et al., 2018). Additionally, according to the purpose of a given study, researchers differed in selecting a particular cutoff point and screening tool to identify depression (Vilagut et al., 2016). It has been noted that several cutoff scores within the same screening instrument were used in many eligible studies, which also contributed in part to the between-study heterogeneity.

Subgroup analyses revealed that the combined prevalence of depression or depressive symptoms among Chinese MSM has decreased over time, with the lowest pooled estimate of 33.3% in studies conducted after 2015 and the highest estimate of 47.0% in those before 2010. This may be attributed to an increased positive public perception of homosexuality in the social context of China. In 2001, homosexuality was deleted from the list of mental disorders in the third version of the Chinese Classification of Mental Disorders (CCMD-3) (Psychiatry, 2001), which indicated substantial progress and implied

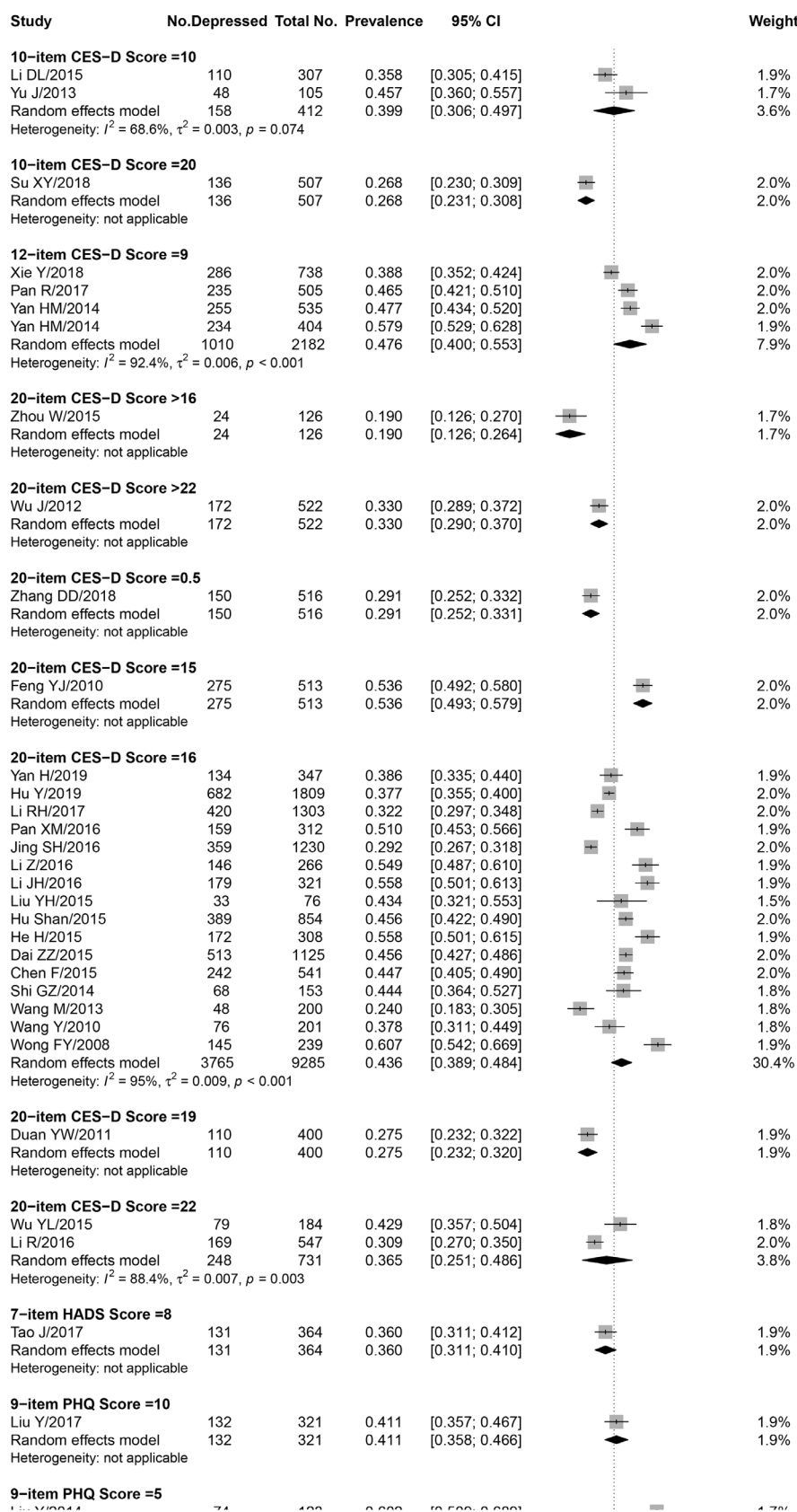


Fig. 2. Forest plot of the prevalence of depression or depressive symptoms.

that homosexuality was no longer viewed as a psychotic disorder in China. In recent years, with the opening and modernization of Chinese society, homosexuality has become increasingly visible in China

(Hu, 2016). It is suggested that modernizing factors, such as education, economic development, exposure to internet information and liberal inclinations, are associated with great social tolerance towards

**Table 2.**  
Meta-analyses of the prevalence of depression or depressive symptoms among MSM stratified by screening instrument and cutoff score.

Screening Instrument and Cutoff Score	No. of Studies	No. Depressed	Total No.	Combined prevalence,% (95% CI)	I <sup>2</sup> (%)	P value for heterogeneity
10-item Center for Epidemiologic Studies Depression Scale Score $\geq 10$	2	158	412	40.0 (30.6, 49.7)	68.60%	0.074
10-item Center for Epidemiologic Studies Depression Scale Score $\geq 20$	1	136	507	26.8 (23.1, 30.8)	–	–
12-item Center for Epidemiologic Studies Depression Scale Score $\geq 9$	4	1010	2182	47.6 (40.0, 55.3)	92.40%	<0.001
20-item Center for Epidemiologic Studies Depression Scale Score $> 16$	1	24	126	19.1 (12.6, 26.4)	–	–
20-item Center for Epidemiologic Studies Depression Scale Score $> 22$	1	172	522	33.0 (29.0, 37.1)	–	–
20-item Center for Epidemiologic Studies Depression Scale Score $\geq 0.5$	1	150	516	29.1 (25.2, 33.1)	–	–
20-item Center for Epidemiologic Studies Depression Scale Score $\geq 15$	1	275	513	53.6 (49.3, 57.9)	–	–
20-item Center for Epidemiologic Studies Depression Scale Score $\geq 16$	16	3765	9285	43.6 (38.9, 48.4)	95.00%	<0.001
20-item Center for Epidemiologic Studies Depression Scale Score $\geq 19$	1	110	400	27.5 (23.2, 32.0)	–	–
20-item Center for Epidemiologic Studies Depression Scale Score $\geq 22$	2	248	731	36.5 (25.1, 48.6)	88.40%	0.003
7-item Hospital Anxiety and Depression Scale Score $\geq 8$	1	131	364	36.0 (31.1, 41.0)	–	–
9-item Patient Health Questionnaire Score $\geq 10$	1	132	321	41.1 (35.8, 46.6)	–	–
9-item Patient Health Questionnaire Score $\geq 5$	1	74	123	60.2 (51.3, 68.7)	–	–
Depression Anxiety and Stress Scale Score $> 6.03$	1	163	420	38.8 (34.2, 43.5)	–	–
90-item Symptom Checklist Score $\geq 2$	4	183	609	29.3 (19.5, 40.0)	84.90%	<0.001
Zung Self-Rating Depression Scale Score $\geq 0.5$	3	424	935	49.0 (33.9, 64.1)	94.60%	<0.001
Zung Self-Rating Depression Scale Score $\geq 41$	1	96	167	57.5 (49.9, 64.9)	–	–
Zung Self-Rating Depression Scale Score $\geq 50$	4	704	1831	36.5 (24.4, 49.5)	96.90%	<0.001
Zung Self-Rating Depression Scale Score $\geq 53$	8	674	1986	35.3 (30.2, 40.6)	78.10%	<0.001

Abbreviations: MSM, men who have sex with men; CI, confidence interval.

homosexuality (Xie and Peng, 2018). In one study conducted among Chinese college students, most of them hold accepting attitudes towards homosexuality (Lin et al., 2016). The decreased stigma and discrimination against homosexuality can alleviate the pressure from family and society, reducing the occurrence of mental disorders among them. Even so, an overall negative perception of MSM currently remains in China (Hu, 2016; Xie and Peng, 2018). Great efforts are still needed to popularize knowledge of homosexuality and improve the public's perception of homosexuality to change the vulnerability of gay men in China.

Moreover, heterogeneity was also partially accounted for by sampling methods, with studies using respondent-driven sampling (RDS) yielding the lowest prevalence estimate among the 16 studies using 20-item CES-D (cutoff value  $\geq 16$ ). Previous studies have indicated that the use of different sampling methods could generate samples with distinct socioeconomic and risk profiles (Guo et al., 2011; Ibragimov et al., 2017; Kendall et al., 2008). Since MSM in China are still a hidden population, it is a great challenge to reach them. Non-probability sampling, such as convenience sampling, snowball sampling and RDS, has been widely used in research and routine work to recruit members of the MSM. Among them, RDS is recognized as approximating a random sampling method and proved to generate an unbiased population estimate (Badowski et al., 2017; Ludlam et al., 2015). Even so, it is recommended that multiple sampling methods are needed to obtain a representative sample in future studies.

Similar to our previous findings (Wang et al., 2018a), the pooled prevalence of depressive symptoms among HIV-positive MSM in this analysis was also 43.9%, higher than HIV-negative MSM. A substantial body of research has documented that HIV-related stigma experienced by individuals living with HIV is associated with a variety of poor mental health outcomes, particularly higher rates of depression (Kalomo, 2018; Li et al., 2016a; Onyebuchi-Iwudibia and Brown, 2014; Rueda et al., 2016; Tao et al., 2017c). Consequently, HIV-positive MSM suffer from dual sources of stigma from homosexuality and HIV infection, which make them more vulnerable to depression. It is thus essential to strengthen the incorporation of mental health interventions into HIV prevention programmes. In addition, we also identified a higher prevalence estimate of depressive symptoms in MB than in the overall population of MSM. In China, MB are referred to men who commercially sell sex to men, representing a unique subpopulation of MSM. Compared with the overall population of MSM, MB are considered to be at greater risk of HIV infection but are less concerned and socially supported (Chow et al., 2012; Yan et al., 2014). Therefore, they are more prone to depression. Additionally, consistent with a previous meta-analysis (Ross et al., 2018), the pooled prevalence of depressive symptoms was slightly higher in bisexual males than in homosexual males. However, there was no significant difference.

The study has several limitations. First, there was a high level of heterogeneity. Although we strived to determine the source of heterogeneity, a substantial amount of heterogeneity remained largely unexplained by the examined variables. Second, the recruitment of participants in all included studies was based on non-probability sampling. Therefore, the generalization of the meta-analytic pooling of the prevalence estimates will be limited to some extent. Finally, although risk-of-bias variables instead of traditional quality assessment tools were adopted to evaluate their effect on the result, the reliability of individual study results was not assessed and guaranteed. Therefore, it is warranted to be cautious when using our findings. Additionally, it is worth mentioning that gender-related issues have always been hotspots among MSM recently, which may also contribute to mental health problems (Sandfort et al., 2018). However, subgroup analyses stratified by gender was not performed in this study due to a lack of available data in each included studies, which warrant future attention and exploration.

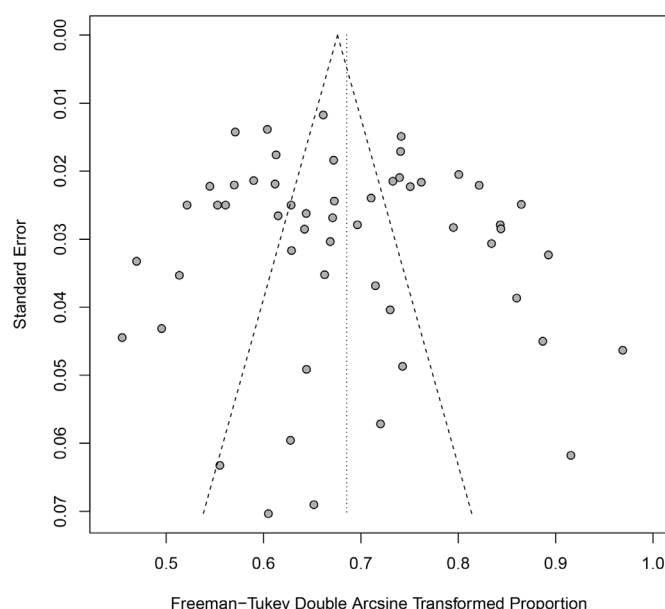
Despite these limitations, this systematic review provides insight into the prevalence of depression or depressive symptoms among



**Table 3.**  
Subgroup analyses for studies on the prevalence of depression or depressive symptoms among MSM in China.

Study or sample characteristics	No. of Studies	No. Depressed	Total No.	Combined prevalence,% (95% CI)	I <sup>2</sup> (%)	P value for heterogeneity	Test for subgroup differences Q (df)	P value
<b>Survey date</b>							<b>7.07</b>	<b>0.029*</b>
Before 2010	10	10	1405	3170	47.0 (38.3, 55.8)		<0.001	
2010–2015	27	27	5094	13,196	39.6 (36.1, 43.2)		<0.001	
After 2015	11	11	1348	3793	33.3 (27.8, 39.1)		<0.001	
<b>Location of investigation</b>							0.56	0.455
Southern city	40	40	7837	19,834	40.8 (37.6, 44.1)		<0.001	
Northern city	12	12	941	2547	37.7 (30.7, 41.5)		<0.001	
<b>Sampling method</b>							1.17	0.558
RDS	11	11	1828	4880	36.9 (31.0, 43.0)		<0.001	
Convenience sampling	24	24	3643	9147	40.9 (36.9, 44.8)		<0.001	
Snowball sampling	9	9	1204	3021	39.0 (31.3, 46.9)		<0.001	
<b>Assessment method</b>							2.30	0.129
Self-administered	22	22	4105	10,292	42.3 (37.9, 46.8)		<0.001	
Face-to-face interview	29	29	4098	10,772	37.9 (34.3, 41.5)		<0.001	
<b>HIV infection</b>							<b>4.67</b>	<b>0.031*</b>
HIV positive	16	16	1849	4281	43.9 (38.5, 49.4)		<0.001	
HIV negative	5	5	1550	4210	34.8 (28.9, 41.0)		<0.001	
<b>Sexual orientation</b>							1.50	0.220
Homosexual	14	14	1821	4175	43.5 (38.2, 48.9)		<0.001	
Bisexual	7	7	534	1078	49.1 (41.9, 56.3)		<0.001	
<b>Occupation</b>							<b>15.68</b>	<b>&lt;0.001*</b>
MB	4	4	484	781	62.8 (55.0, 70.4)		0.002	
Non-MB	2	2	229	513	44.6 (40.3, 49.0)		0.594	

Abbreviations: MSM, men who have sex with men; MB, money boy; RDS, respondent-driven sampling; CI, confidence interval.  
\* $p < 0.05$ .



**Fig. 3.** Funnel plots of the included studies with corresponding Egger's test results.

Chinese MSM. In conclusion, our findings highlight the fact that depression or depressive symptoms among MSM are common and a great burden to public health in China. We hope that the result will serve as a basis for policymakers and service providers to refine health service guidelines. More attention and effective intervention programmes are urgently needed to improve psychological health among Chinese MSM. Additionally, we appeal to the public to embrace homosexuality with a tolerant attitude and eliminate discrimination against them.

#### Author statement

HLF and TJF designed this study and contributed substantially to the design of the search strategy. TTW and XBW searched and selected the literatures. TTW, XBW and YMC participated in the data extraction and critically revised it. TTW and YMC performed the analysis and interpreted the data. HLF drafted the manuscript. TBV and TJF critically reviewed and proofread the manuscript. All authors read and approved the final manuscript.

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#### Conflict of interest

The authors have declared that no conflict of interest exists.

#### Supplementary information

*Supplementary Fig 1.* Sensitivity analysis of the prevalence of depression or depressive symptoms among MSM in China. mmc1.docx.

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#### Supplementary materials

Supplementary material associated with this article can be found, in

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