

# Association of depressive symptoms and suicidal ideation among university students in China

## A systematic review and meta-analysis

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### Abstract

The aim of this study was to investigate whether depressive symptoms are associated with suicidal ideation among university students in China.

Five Chinese and English electronic databases (EBSCO, PubMed, Chinese Web of Knowledge, Wanfang, and Weipu) were searched to identify relevant studies. Cross-sectional studies published from 2000 to 2016 reporting about the association between depressive symptoms and suicidal ideation among university students in China were used for meta-analysis to approximate the overall association between depression and suicidal ideation among university students in mainland China. StatsDirect 3 was used for meta-analysis of included literatures.

Of 513 initially identified references, 44 studies were selected, including 88,431 participants with depressive symptoms. The combined odd ratio of the relationship was 2.174 (95% confidence interval: 2.027–2.333;  $P < 0.0001$ ).

There exists a moderate association between depressive symptoms and suicidal ideation among university students in China, and depressive symptoms contribute to the development of suicidal ideation. In particular, university students from western regions of China, from nonmedical background, should be provided more psychological and clinical assistance.

**Abbreviations:** BDI = Beck Depression Inventory, NOS = Newcastle-Ottawa Scale, OR = odds ratio, SCL-90 = Self-reporting Inventory, SDS = Self-rating Depression Scale, WHO = World Health Organization.

**Keywords:** depression, meta-analysis, suicidal ideation, university students

### 1. Introduction

Almost each individual experiences, varying by degree, symptoms of depression least because of the various pressure exposed or biological etiology. Without early intervention, mild depressive symptoms can develop into a full-fledged depressive disorder and other mental disorders, which consequently is caused by a variety of biological or social factors.<sup>[1]</sup> The World Health Organization (WHO) predicts that depression will be the second leading cause of death and disability by 2020. Depression is one of the major symptoms for many major mental disorder.<sup>[2]</sup>

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Although the relationship between depression and suicidal ideation is still controversial, it is suspected that depression can lead to suicidal ideation and proactive attempts at suicide.<sup>[3]</sup> About 90% of people who kill themselves have depression symptom, and 47% to 74% of population risk of suicide is contributed by depression and its other psychiatric disorders.<sup>[4]</sup> Owing to psychological characteristics and lack of social experiences, in China, university students with depressive symptoms have particularly high risk for suicidal ideation. For example, Jing et al<sup>[5]</sup> pointed out that having previously suffered from depression is the primary risk factor for suicidal ideation among college students. He et al<sup>[6]</sup> found that university students' self-rating depression scores directly correlate with suicidal ideation.

A recent study found that depressive symptoms accurately predict suicidal ideation in 94.2% of cases,<sup>[7]</sup> suggesting a close link between depressive symptoms and suicidal ideation. Although procedures for recording deaths, cultural practices, and social values probably have profound effects on death reports and consequently lead to misclassification of suicide (e.g., as undermined death or death because of road accident), the estimated global burden of suicide is one million per year.<sup>[8]</sup> Suicide is identified as one of the priorities for mental-health work in China.<sup>[9]</sup> The translation from suicidal ideation into action is further upon the access to specific means for suicides. For example, in the United States, firearms, especially for male victims, are used in most suicides,<sup>[10]</sup> whereas in China, jumping from high sites, drowning, subway suicide (urban area), or pesticide indigestion (at rural area could be a high rate of 79% for female victims)<sup>[11]</sup> are often means for suicidal actions. The deleterious effects of suicide are immeasurable to individuals, friends, families, and society.

Owing to complex social and biological reason, the association between depression and suicidal ideation remains unclear. In this

study, we investigate the association between depression and suicidal ideation in college students in China. Many studies have also shown a strong correlation between depression and suicidal ideation,<sup>[12,13]</sup> whereas others have found a weak<sup>[6,14–16]</sup> to no correlative relationship.<sup>[17,18]</sup> In studies by Wang and Lu,<sup>[19]</sup> Yu et al,<sup>[20]</sup> and Kong,<sup>[21]</sup> a significant negative correlation was found between suicidal ideation and suicide attitude. Their research concluded that if a student with depression opposes suicide, he/she does not necessarily have suicidal ideation, and the possibility of suicide behavior reduced greatly. Understanding the association between depressive symptoms and suicidal ideation is essential for developing program that can effectively prevent the development of suicidal behavior, so we performed a meta-analysis of the current literature to elucidate the association between depression and suicidal ideation. In particular, we would like to estimate the association between depression and suicidal ideation, and to reveal the stratification for the association, especially across different regions and different background of students. Given those aims can be achieved, facilities and resource that can improve student psychological health be more distributed for regions that has high association. In addition, the clinicians and professionals can focus on the students who need the assistance.

## 2. Materials and methods

### 2.1. Data source, search strategy and eligibility criteria

A systemic literature search was performed by 2 authors, YHW and QYL, independently. Studies published between 2000 and June 2016 that reported the association between depressive symptoms and suicidal ideation among college students in China were searched in databases EBSCO, PubMed, Chinese Web of Knowledge, Wanfang (a Chinese database), and Weipu (a Chinese database). Studies written in either English or Chinese were considered. The following search terms were used to find relevant literature: ('depression' OR 'depression disorder' OR 'depressive symptoms' OR 'depressive tendencies') AND ('college students' OR 'university students') AND ('suicidal ideation' OR

'suicide attitude'). Studies were selected if they met the following eligibility criteria: the study was a cross-sectional study; the study was an epidemiological study performed among Chinese university students with an identified sample size; the aim of the study was to investigate the association between depressive symptoms and suicidal ideation.

Two independent reviewers, working in pairs, screened the titles and abstracts of all initially identified studies according to the selection criteria. In cases of disagreement, a decision was reached through consensus or consultation with the independent third author (ZTS). Full texts were retrieved from studies that satisfied all selection criteria. The Newcastle-Ottawa Scale (NOS) was used to assess the quality of the included publications. Literature with scores >4 points were included for the meta-analysis. This study was performed in accordance with relevant guidelines and regulations of the Zhejiang University of Finance & Economics and was approved by the Ethics Committee of the Zhejiang University of Finance & Economics.

### 2.2. Statistical analysis

Once the literature was selected as aforementioned, the meta-analysis was performed as proposed by Zheng Minghua.<sup>[22]</sup> The combined association and subgroups were computed using "StatsDirect 3" (England, UK). Cochran Q statistic and the  $I^2$  statistic were used to assess heterogeneity. If  $P$  value >0.1 for Q statistic and  $I^2 < 50\%$ , indicating homogeneity for studies, a fixed-effect model was used to estimate the parameter; if  $P < 0.1$  for Q statistic or  $I^2 \geq 50\%$ , indicating heterogeneity among studies, a random-effects model was used. Begg and Egger linear analysis was used to test publication bias, and  $P < 0.05$  indicates publication bias.

## 3. Results

### 3.1. Literature retrieval results

An initial comprehensive literature review identified 557 relevant articles, of which 44 met the inclusion criteria and were used for meta-analysis (Fig. 1). The sample size for the 44 selected studies

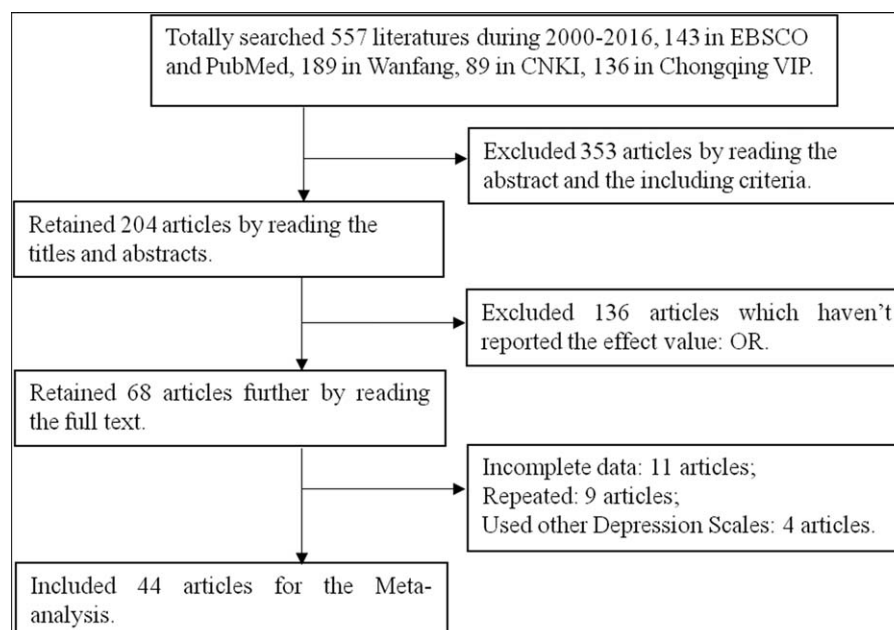


Figure 1. Literature search and screening flow chart.

**Table 1**  
Basic information of the literatures that included in this study.

No.	Article	Publication year	Paper level	Sample size	Survey region	Academy type	Depression Scale	Suicidal ideation defined time	Quality Evaluation	OR (univariate)	95% CI	OR (multivariate)	95% CI
1	Gao et al <sup>[23]</sup>	2003	Core	4882	Central	Complex	SCL-90	Nearly a week	7	8.732	6.785–11.237		
2	Xu <sup>[24]</sup>	2003	Thesis	415	East	Mixed	BDI	Nearly a week	5			1.183	1.126–1.243
3	Xu et al <sup>[25]</sup>	2004	Core	610	Central	Complex	SCL-90	Nearly a week	6	3.280	1.990–5.410	3.230	1.410–7.440
4	Yu et al <sup>[26]</sup>	2005	Core	479	Central	Complex	SCL-90	Nearly a week	7	7.331	4.339–12.385	3.703	1.860–7.373
5	Song et al <sup>[27]</sup>	2007	Core	718	East	Mixed	BDI	ever	5	1.880	1.550–2.280	1.690	1.360–2.100
6	Yang et al <sup>[28]</sup>	2007	Core	3568	East	Complex	SDS	Nearly a year	5			2.841	1.904–4.24
7	Fu and Li <sup>[29]</sup>	2007	Core	647	East	Complex	SDS	ever	6			4.518	2.996–6.814
8	Feng and Zhang <sup>[12]</sup>	2008	Core	1863	East	Complex	SDS	ever	7	292.924	101.546–844.981	13.742	3.113–60.663
9	Hu and Guo <sup>[30]</sup>	2008	Core	623	Mixing	Medicine	SCL-90	Nearly a year	6	2.080	1.224–3.532	2.276	1.309–3.957
10	Fan et al <sup>[31]</sup>	2008	Core	2160	Central	Medicine	SCL-90	Nearly a week	6	5.814	4.410–7.664	3.287	2.418–4.469
11	Shang et al <sup>[32]</sup>	2008	Core	2678	West	Complex	SDS	Nearly a year	7			3.175	2.449–4.117
12	Wu <sup>[17]</sup>	2008	Thesis	5716	Central	Medicine	BDI	ever	7			1.025	1.009–1.041
13	Li et al <sup>[33]</sup>	2008	Core	2055	East	Complex	BDI	Nearly a week	5			3.210	2.200–4.680
14	Qian et al <sup>[34]</sup>	2008	Core	2199	East	Medicine	BDI	Nearly a year	6			1.779	1.415–2.237
15	Wu and Zhao <sup>[7]</sup>	2009	Core	1195	East	Complex	SCL-90	Nearly a year	5	1.657	1.467–1.871		
16	Cao et al <sup>[14]</sup>	2009	Core	10344	Central	Medicine	BDI	ever	6			1.060	1.048–1.072
17	Liu <sup>[35]</sup>	2009	Core	1899	East	Complex	SCL-90	Nearly a year	6	0.384	0.186–0.731		
18	Shen et al <sup>[36]</sup>	2009	General	1154	Central	Medicine	SCL-90	Nearly a week	5	7.687	4.250–13.902	11.420	3.935–33.142
19	Wei <sup>[57]</sup>	2009	Thesis	2779	East	Complex	SDS	ever	7			1.555	1.373–1.720
20	Yan <sup>[38]</sup>	2009	Thesis	3505	East	Complex	BDI	Nearly a week	7			3.537	1.644–7.612
21	Li and Li <sup>[39]</sup>	2009	General	224	East	Complex	SCL-90	Nearly a year	6			1.747	1.425–2.142
22	Wang <sup>[40]</sup>	2009	Thesis	2545	Central	Medicine	BDI	ever	6			1.068	1.038–1.098
23	Yan et al <sup>[41]</sup>	2010	Core	2244	East	Complex	BDI	Nearly a week	5	4.340	2.060–9.150		
24	Han et al <sup>[42]</sup>	2010	General	384	East	Mixed	SDS	Nearly a year	5	8.421	3.559–19.416		
25	Gong <sup>[43]</sup>	2010	Thesis	10340	Central	Medicine	BDI	Nearly a week	6	2.750	2.445–3.093	1.609	1.414–1.832
26	Xin et al <sup>[59]</sup>	2010	Core	373	Central	Medicine	SDS	Nearly a year	6	3.289	2.165–4.997	1.704	1.034–2.808
27	Xin and He <sup>[44]</sup>	2010	Core	800	East	Medicine	SDS	Nearly a year	6			1.064	1.023–1.107
28	Chao <sup>[45]</sup>	2010	Core	1010	Central	Complex	SCL-90	Nearly a year	6			1.945	1.135–3.335
29	Zhu et al <sup>[46]</sup>	2011	Core	2374	East	Complex	BDI	Nearly a year	5			1.062	1.035–1.089
30	An et al <sup>[15]</sup>	2012	Core	4211	Central	Complex	SDS	Nearly a week	5			1.150	1.120–1.180
31	Wu et al <sup>[47]</sup>	2012	Core	1145	Central	Complex	SCL-90	Nearly a week	6			15.200	8.600–26.600
32	Wang <sup>[48]</sup>	2012	Core	3850	Central	Complex	SCL-90	Nearly a year	5			17.238	9.285–32.005
33	Heng et al <sup>[49]</sup>	2013	Core	1145	Central	Complex	SCL-90	Nearly a week	6	4.360	3.450–5.500		
34	Liu et al <sup>[50]</sup>	2013	Core	340	Central	Medicine	SDS	Nearly a year	5	10.762	4.069–33.074		
35	Yang et al <sup>[13]</sup>	2013	Core	1372	Central	Medicine	SDS	Nearly a week	6	12.946	6.489–25.829	7.159	3.416–15.001
36	Shi et al <sup>[51]</sup>	2013	Core	2730	West	Medicine	SDS	Nearly a week	7	197.161	89.011–542.268	3.022	1.947–4.629
37	Yang <sup>[52]</sup>	2013	Core	872	East	Medicine	SCL-90	Nearly a week	5	0.332	0.241–0.457	0.602	0.401–0.902
38	Yang et al <sup>[18]</sup>	2013	General	7743	East	Complex	SCL-90	Nearly a week	7			1.038	0.752–1.433
39	Guo and Zhao <sup>[53]</sup>	2013	General	1301	East	Normal	SDS	Nearly a year	7			3.233	1.859–5.621
40	Ma et al <sup>[54]</sup>	2013	Core	1636	West	Medicine	SCL-90	Nearly a year	6			1.139	1.073–1.210
41	Li et al <sup>[55]</sup>	2014	Core	2788	West	Mixed	SCL-90	Nearly a year	6			1.087	1.046–1.129
42	Wei <sup>[56]</sup>	2014	General	3040	Mixing	Complex	SCL-90	Nearly a year	5	6.110	3.790–9.860	5.740	3.990–8.270
43	Chu et al <sup>[57]</sup>	2015	Core	585	East	Complex	SDS	Nearly a year	6			1.070	1.026–1.117
44	Li et al <sup>[58]</sup>	2016	Core	5524	West	Complex	SCL-90	Nearly a week	7			6.247	4.424–8.820

BDI=Beck Depression Inventory, CI=confidence interval, OR=odds ratio, SCL-90=Self-reporting Inventory, SDS=Self-rating Depression Scale.

ranged from 224 to 10,344, totaling 88,431 no overlapping samples. The 44 studies covered 21 provinces, in the east (20), central (18), and west (4) regions of China, and 2 studies covered >1 province and city. The included samples were from comprehensive (24), medical (15), normal (1) universities, and colleges (4). Depressive symptoms in the study were measured with one of the scales: BDI (Beck Depression Inventory), SCL-90 (Self-reporting Inventory), or SDS (Self-rating Depression Scale). Measurements for suicidal ideation have a similar definition. Depression scales were BDI (11), SCL-90 (19), SDS (14). Suicidal ideation was classified as “ever” (7), “nearly a year” (19), and “nearly a week” (18) (Table 1).<sup>[7,12–15,17,18,23–59]</sup>

**3.2. Literature quality test**

The publications in association between depression and suicidal ideation for college students in China are largely written and published in Chinese and Chinese journals. For these 44 selected publications, none of them was found in other databases such as Scopus and Psychinfo. The selected 44 publications, which had NOS between 5 and 7 (5.932±0.759) (Table 1), were incorporated into the meta-analysis. Begg and Egger linear regression test was used to quantitatively determine whether there was publication bias (Table 3). No publication bias was found by Begg linear regression test. However, Egger test found

**Table 2**  
Literatures heterogeneity test results.

Classification	Study Number	Q	P	I <sup>2</sup>	Tau-Squared	Combined Model
Mixed	57	2385.957	<0.0001	97.7%	0.041	Random effect model
Single factor	20	636.790	<0.0001	97%	0.752	Random effect model
Multifactor	37	928.759	<0.0001	96.1%	0.016	Random effect model

**Table 3****Subgroup analysis for depressive symptoms and suicidal ideation relationship.**

Classification	Subgroups	Sample number	OR (95% CI)	Z	P	Sample size	Heterogeneity test			Publication bias test	
							I <sup>2</sup>	P	Tau-Squared	P (Begg)	P (Egger)
Mixed		44	2.174 (2.027–2.333)	21.639	<0.0001	88431	97.7%	<0.0001	0.0407	0.1357	<0.0001
Univariate		20	4.965 (3.325–7.414)	7.833	<0.0001	38423	97%	<0.0001	0.7519	0.1859	0.0558
Multivariate		37	1.569 (1.480–1.664)	15.081	<0.0001	95976	96.1%	<0.0001	0.0159	0.0421	<0.0001
Publication year	Before 2010	23	1.555 (1.449–1.668)	12.290	<0.0001	56805	95.4%	<0.0001	0.0133	0.6013	<0.0001
	After 2010	14	1.744 (1.545–1.969)	9.007	<0.0001	39171	96.9%	<0.0001	0.0314	0.0472	0.0027
Sample size	<500	4	1.709 (1.190–2.456)	2.899	0.0037	1491	88.1%	<0.0001	0.1011	0.7500	0.0809
	500–1000	7	1.398 (1.174–1.666)	3.753	0.0002	4855	88.6%	<0.0001	0.0317	0.5619	0.1218
	>1000	26	1.653 (1.542–1.772)	14.183	<0.0001	89630	96.6%	<0.0001	0.0159	0.0704	<0.0001
Academy type	Comprehensive	19	2.486 (2.154–2.868)	12.470	<0.0001	47890	97%	<0.0001	0.0620	0.4893	<0.0001
	Medical	14	1.232 (1.159–1.311)	6.637	<0.0001	42864	94.1%	<0.0001	0.0063	0.1010	0.0017
Survey region	East	16	1.648 (1.454–1.867)	7.841	<0.0001	33578	94.3%	<0.0001	0.0397	0.4503	0.0002
	Central	15	1.365 (1.266–1.471)	8.130	<0.0001	46109	96.3%	<0.0001	0.0096	0.0743	0.0001
	West	4	2.046 (1.489–2.815)	4.414	<0.0001	12626	98.1%	<0.0001	0.0943	0.0833	0.0145
Journal level	Core	26	1.698 (1.569–1.838)	13.147	<0.0001	57214	96.2%	<0.0001	0.0203	0.0704	<0.0001
	General	5	2.994 (1.517–5.905)	3.163	0.0016	13462	93.6%	<0.0001	0.5261	0.4833	0.3225
	Thesis	6	1.257 (1.137–1.389)	4.475	<0.0001	25300	96.2%	<0.0001	0.0118	0.2722	0.0054
Depression Scale	BDI	10	1.182 (1.123–1.243)	6.437	<0.0001	40211	94.3%	<0.0001	0.0039	0.0726	0.0006
	SCL-90	15	2.775 (2.131–3.614)	7.573	<0.0001	32858	96.8%	<0.0001	0.2137	0.2018	0.0010
	SDS	12	1.835 (1.596–2.111)	8.498	<0.0001	22907	95.5%	<0.0001	0.0344	0.6384	0.0004
Suicidal ideation	Nearly a week	9	1.196 (1.125–1.272)	5.727	<0.0001	44315	94.6%	<0.0001	0.0047	0.1194	0.0047
	Nearly a year	15	2.471 (2.017–3.027)	8.733	<0.0001	25040	96.1%	<0.0001	0.1072	0.8458	0.0008
	ever	13	1.762 (1.558–1.992)	9.049	<0.0001	26621	96.2%	<0.0001	0.0315	0.0305	<0.0001

BDI=Beck Depression Inventory, CI=confidence interval, OR=odds ratio, SCL-90=Self-reporting Inventory, SDS=Self-rating Depression Scale.

that, except for the *P* values of the single factor, studies with sample sizes <1000 may have publication bias but ignorable.

### 3.3. Heterogeneity test

The Cochran *Q* test was employed to examine the heterogeneity of the reported odds ratios (ORs) statistics in the 44 publications, and the *P* value of *Q* test was (*P* < 0.0001); *I*<sup>2</sup> > 50% indicates heterogeneity too. Therefore, a random-effects model to combine ORs was used throughout the meta-analysis, and the Tau-squared value was added as additional weights for the inverse variance estimator (Table 2).

### 3.4. Point and interval estimation results

The ORs were used to determine the association between depressive symptoms and suicidal ideation for this meta-analysis. When OR > 1, a range of 1.0 to 1.1 was considered no association, 1.2 to 1.4 a weak association, 1.5 to 2.9 a moderate association, 3.0 to 9.9 a strong association, and >10 a super association. All analyzed studies reported 95% confidence interval values. Among the included 44 studies, 20 studies reported university OR values, 37 reported multifactor-adjusted OR values, and 13 reported both univariate and multifactor-adjusted OR values. Meta-analysis showed that the combined OR values of the mixed (OR=2.174, 95% CI=2.027–2.333, N=44), single factor (OR=4.965, 95% CI=3.325–7.414, N=20), and multifactor (OR=1.569, 95% CI=1.480–1.664, N=37) were statistically significant. The inconsistent results may be because of the fact that single factor analysis did not consider the interference of other factors and introduced confounding bias that affected the reliability of the results.

Multifactor ORs were then used to conduct the subgroup analysis (Fig. 2). The studies were found to be highly heterogeneous (*I*<sup>2</sup>=97.7%, *P* < 0.0001; Table 3). To determine

the sources of the heterogeneity, subgroup analysis was conducted based on the reported multifactor ORs (Table 2).

In terms of the year of publication, the combined OR of literature published before 2010 (OR=1.555, 95% CI: 1.449–1.668, N=23) and after 2010 (OR=1.744, 95% CI: 1.545–1.969, N=14) both showed moderate strength association between depressive symptoms and suicidal ideation among college students. The combined OR value of the studies with a sample size <500 (OR=1.709, 95% CI: 1.190–2.456, N=4) and >1000 (OR=1.653, 95% CI: 1.542–1.772, N=26) both showed a medium association between depressive symptoms and suicidal ideation among students. Combined OR for studies with sample sizes between 500 and 1000 (OR=1.398, 95% CI: 1.174–1.666, N=7) showed a weak correlation between the two. However, when considering specific values, the association appears to be moderate.

Combined OR of comprehensive universities (OR=2.486, 95% CI: 2.154–2.868, N=19) and medical colleges (OR=1.232, 95% CI: 1.159–1.311, N=14) indicated a moderate and weak association between depressive symptoms and suicidal ideation among students, respectively.

Combined OR values of people in eastern (OR=1.648, 95% CI: 1.454–1.867, N=16) and central regions (OR=1.365, 95% CI: 1.266–1.471, N=15) displayed a relatively weak association between student depression and suicidal ideation, whereas the western region combined OR value (OR=2.046, 95% CI: 1.489–2.815, N=4) would suggest a moderate correlation between the two.

Combined OR for core (OR=1.698, 95% CI: 1.569–1.838, N=26) and general journals (OR=2.994, 95% CI: 1.519–5.905, N=5) indicated a moderately strong association between depressive symptoms and suicidal ideation among college students, whereas the combined OR for academic dissertations is 1.257 (95% CI: 1.137–1.389, N=6) that showed a weak correlation between the two. Further analysis of the origin of the

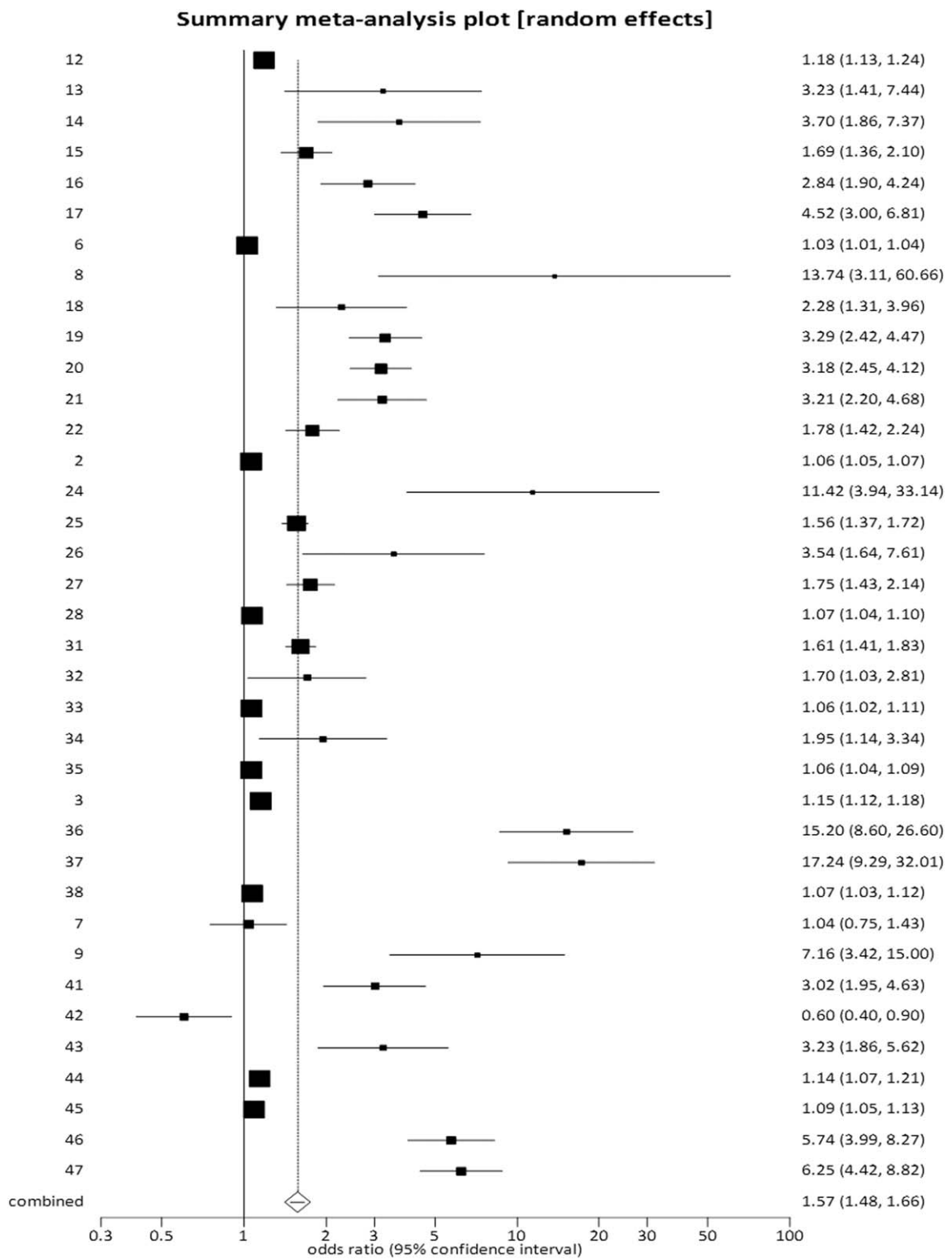


Figure 2. Forest plot for odds ratios estimated by multifactor logistic regression in the original studies.

dissertations revealed that they surveyed populations from eastern and central regions of them. Thus, differences in association intensity may reflect differences in region.

Combined OR values of the three depression scale including BDI (OR=1.182, 95% CI: 1.123–1.243, N=10), SCL-90 (OR=2.775, 95% CI: 2.131–3.614, N=15), SDS (OR=1.835, 95% CI: 1.596–2.111, N=12) showed three kinds of the degree of

association between depressive symptoms and suicidal ideation separately: very weak, relatively strong and moderate. In respect to the definition of suicidal ideation used by each study, the combined OR for the definition “nearly a week” (OR=1.196, 95% CI: 1.125–1.272, N=9) showed no association between depressive symptoms and suicidal ideation. The combined OR for “nearly a year” (OR=2.471, 95% CI: 2.017–3.027, N=15)

and “ever” (OR=1.762, 95% CI: 1.558–1.992, N=13) indicated moderate correlation between the two.

#### 4. Discussion

Liu and Hu<sup>[60]</sup> and Wu and Zhao<sup>[7]</sup> determined that suicidal ideation of college students is affected by multiple factors such as stress events, and that depressed mood is the determining factor for suicidal ideation. Meta-analysis results of the selected 44 studies showed there was an association between depressive symptoms and suicidal ideation. The higher estimate from univariate analysis may reflect the inflation of the estimate owing to confounding factors. We believe the result from combined ORs, which were adjusted by multifactor, should be reasonably stable: OR=1.569 (95% CI: 1.480–1.664,  $P < 0.0001$ ), showing a moderately strong association between depressive symptoms and suicidal ideation among college students. This view is consistent with the findings from multiple studies.

Our meta-analysis not only reported the overall association between depressive symptoms and suicidal ideation, but also revealed the target population, for whom prevention program such as psychological and clinical assistance should be made more accessible. First, students from comprehensive universities had a higher association between suicidal ideation and depression than medical students. We hypothesize that medical students are benefited from their curricular, which increase their knowledge of depressive symptoms and help-seeking skills. Second, students in eastern and central regions also displayed a weaker correlation than those from western regions. This may be because of regional difference resources in mental health education. Because western regions have less resource to provide adequate intervention and counseling for depressed college students, these students may have an increased risk of suicidal ideation. Psychological education program should be more targeted at nonmedical students, especially for those who were admitted in western regions of China. Third, a much stronger association between persistent suicidal ideation and depressive symptoms was found under the definition of suicidal ideation as “ever” or “nearly a year” than those as “nearly a week”. These results demonstrate the effectiveness of definitions that include “nearly a year” or “ever” to identify students with suicidal ideation and the potential importance of suicidal ideation frequency in early detection of suicidal behavior. However, for students identified with a suicidal ideation for “nearly a week,” long-term psychological evaluation follow-up is suggested because “nearly a week” may develop to “nearly a year.”

The analysis also found that studies using SDS or SCL-90 showed a stronger relationship than those using BDI in association with depressive symptoms. The differences in association among studies using different scales may be because of the differences in criteria used to define depression. Therefore, the differences may be indicative of differences in association based on the degree of depression. Therefore, we recommend using the SDS or SCL-90 to evaluate student mental health because they provide more sensitive detection of suicidal ideation.

Although the 44 included publications were selected strictly in accordance with the inclusion and excluding criteria, as our analysis was limited to publications in Chinese or English, it may have overlooked some, but marginal, relevant studies. Second, as the majority of the literatures did not report raw data, we only used the reported OR and 95% CI rather than calculating them from the original data, which may cause some deviations of the meta-analysis results. Furthermore, while selecting the literature,

it cannot be completely randomized for the selected 44 studies, as heterogeneity and publication bias were inevitable present.

Although it is overall association between depression and suicidal ideation, the underlying factors for depression, which can be either biological or environmental factors or even both, are unclear. As a vague statue, depression can be related to stress, state-dependent, and diathesis, trait-dependent. Key precipitating factors are stressful life style, which often will be experienced to especially the first year and the fourth year college student, and events, particularly sudden disruption of personal relationships. Furthermore, depression as a symptom may be relevant to many psychiatric disorders, such as major depressive disorder, schizophrenia, and bipolar disorder.<sup>[2]</sup> Although the prevalence of those major disorders should not be high and consequently takes a small proportion of college students having disorders, those individuals who are genetically vulnerable may need different psychiatric outreach compared to students whose depression is largely driven by environmental exposure. It is reported that suicide has strong familial aggregation for suicidal behavior; a higher rate of suicidal behavior in relatives of suicide victims or attempters compared to relatives of nonsuicidal controls was observed.<sup>[61–63]</sup> The familial history may lead to oppose relationship between depression and suicidal behavior, and the clinical intervention may need a different strategy. In practice, the listed factors leading to depression can be often more easily detected in China because dormitory system encourages college students living together, if not intensifying depression. So, other than professional assistance, specialized program can be initiated to help students who are in depression.

#### 5. Conclusions

Through meta-analysis of relevant literature, we have found that there is a moderate association between depressive symptoms and suicidal ideation among college students, demonstrating that depression is a contributing factor for suicidal ideation. This study provides evidence for the need for identification of depressive symptoms to identify and prevent suicidal ideation and behavior early. Given the association between depressive symptoms and suicidal ideation among college students in China, it will be helpful if future work can identify social and biological factors underlying this association.

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