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Depressive Symptoms Among Children and Adolescents in China: A Systematic Review and Meta-Analysis

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Background: Depressive symptoms are a pervasive mental health problem in Chinese adolescents. The aim of this article was to systematically assess the trend of depressive symptoms in China among adolescents (1988 to 2018).





Material/Methods: A systematic and comprehensive literature search was conducted in both English and Chinese databases, including PubMed, EMBASE, Cochrane CENTRAL, CNKI, and Wan Fang Database, to identify relevant studies published between 1988 and 2018. Batteries of analyses in this meta-analysis were undertaken using Stata version 12.0 statistical software.

Results: Sixty-two related reports involving 232 586 participants finally met our inclusion and exclusion criteria. The results suggest the prevalence of depressive symptoms has generally increased over time. The prevalence estimates before 2000 were 18.4% (95% CI, 14.5–22.3%), and were 26.3% (95% CI, 21.9–30.8%) after 2016. The pooled prevalence of depressive symptoms among children and adolescents was 22.2% (95% CI: 19.9–24.6%, $I^2=99.6%$, $p<0.001$). More subgroup analyses classified by screening instrument, gender, and region were carried out in this meta-analysis.

Conclusions: Results of our meta-analysis suggest that depressive symptoms have become more prevalent among Chinese adolescents. This trend emphasizes the need for effective prevention strategies and greater availability of screening tools for this vulnerable population.

MeSH Keywords: **Adolescent Psychology • China • Depression • Meta-Analysis**

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Background

Depression, a common and chronic disorder, is characterized by specific symptoms, with an estimated prevalence of around 4–5% in middle to late adolescence [1–3]. According to the World Health Organization, depression is projected to become the leading cause of global disease by 2030 [4,5]. Almost a quarter of all adults will experience depression beginning in adolescence [6]. Depression in adolescents can have devastating outcomes, including poor educational attainment, impaired social relationships, insomnia, smoking, substance misuse, and obesity [7–10]. More than half of suicide victims in adolescents had depressive disorder, making depression the most common cause of suicide [11]. As depression is a national public health problem, it is urgent to prevent its onset and recurrence in this vulnerable population by recognizing and treating this disorder [12,13].

Many studies have associated mental health with region, race, cultural setting, and socioeconomic status [14,15]. Owing to different cultures and beliefs, Canadian teenagers have lower prevalence of depressive symptoms than their counterparts in China [16]. During the past 2 decades, China has had sharp economic growth and entered into a dramatic transition of economy and society. Therefore, Chinese people must accordingly change their lifestyles and accelerate their pace of life to adapt to the transition. As a result, numerous risk factors appeared and increased in daily life, such as enormous emotional pressure and weakening of social support [17,18].

Although many studies have evaluated depressive symptoms among teenagers in China, the results widely varied across studies, ranging from 4.41% [19] to 55.7% [20]. This inconsistency is probably caused by differences in sample sizes and screening tools with diverse cutoffs [21]. For instance, the prevalence of depressive symptoms assessed using CES-D (Center for Epidemiological Studies Depression) as a screening instrument with different cutoffs varies from 5.6% [22] to 54.4% [23]. In consideration of these inconsistencies and in light of the many negative outcomes of depression, it is imperative to estimate the prevalence of depressive symptoms to design effective preventive strategies aimed at this vulnerable age group.

A recent systematic review and meta-analysis summarized the prevalence of depressive symptom in China, but included only middle school students [24]. While some studies reported that the prevalence estimates of depression start to grow in early adolescence, we also included children in this analysis. The association between the reported prevalence of depressive symptoms and the year of study publication was also explored in this meta-analysis, and we also analyzed the trend of depressive symptoms among children and adolescents in China in the last 30 years.

Material and Methods

Our study was conducted following the framework of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [25]. The quality assessment instrument for epidemiological studies was applied when assessing the quality of studies [26–28]. All analyses were based on previously published studies; therefore, ethics approval and patient consent were not required.

Search strategies

We conducted a comprehensive literature search to identify published research on the prevalence of depressive symptom among children and adolescents in China. The 5 major electronic databases – the CNKI database (China National Knowledge Infrastructure), the Wan Fang database, Cochrane CENTRAL, PubMed, and EMBASE – were searched to find all eligible articles. Medical subject headings [MeSH] and keywords combined with Boolean operators were used in the search strategy to look for relevant studies published between 1988 and 2018, and the following MeSH terms were used: “child*”, “teenager*”, “adolescent*”, “student*”, “depressive symptoms*”, “depression*”, “prevalence*”, “rate*”. The bibliographies and citations of relevant articles and review studies were also screened for other potential articles.

Inclusion and exclusion criteria

All the eligible studies in this meta-analysis were subjected to the following inclusion criteria: (1) cross-sectional study of depressive symptom about child and adolescence aged less than 18 years old; (2) depressive symptom as the major outcome of eligible articles was clearly identified by self-report scales that previous studies have demonstrated with validated psychometric properties; (3) prevalence statistics on depressive symptoms can be calculated in accordance with the relevant article; (4) the full-text article could be retrieved through different computerized databases; and (5) sample size greater than 200 individuals.

The following publications were excluded from this meta-analysis: (1) published reviews, conference abstracts, and opinion pieces or commentaries only presented with abstract; (2) studies with a sample population including undergraduates, patients, or groups who had a special vocation; (3) if there were multiple results emerging from the same cross-sectional dataset, only data from the paper with the largest sample size and the most stringent screening criteria was included; and (4) depressive symptoms were measured using the self-edited scales with no demonstrated psychometric properties. In the event of ambiguity, any differences at each stage were resolved by consensus and the involvement of another

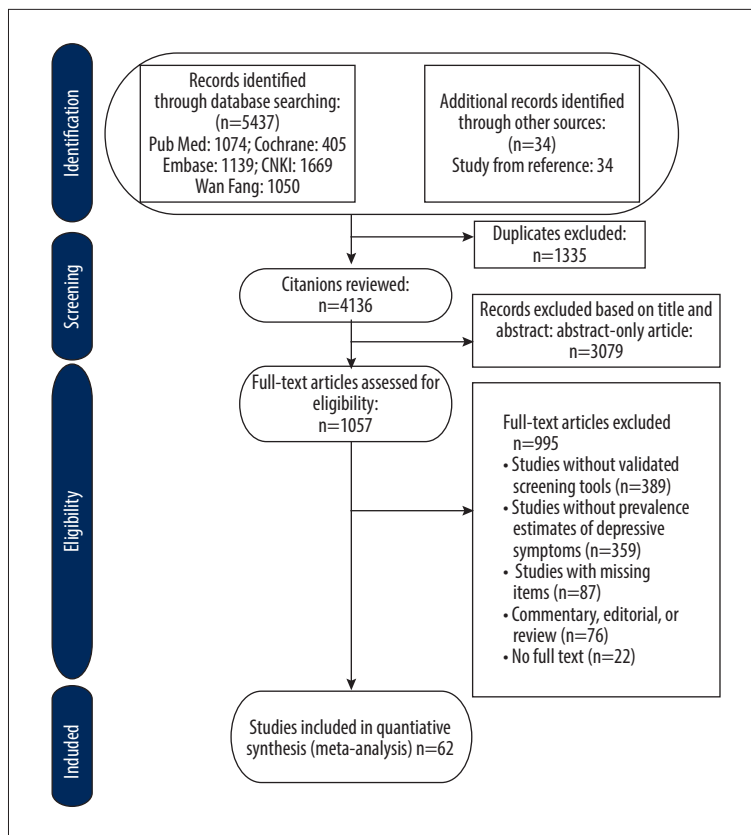


Figure 1. Literature review flowchart.

experienced expert (YX). Figure 1 demonstrates the selection process of this meta-analysis.

Data extraction

The same group of reviewers independently screened the title and abstracts. According to the inclusion and exclusion criteria, 2 reviewers assessed all the eligible studies that could be retrieved from the academic database. Data items were extracted by the first author (JYL) from relevant articles using a standardized data collection sheet developed by the previous review, which included the surname of the first author, publication year, demographic characteristic, sample size, the prevalence of depressive symptoms, and the number of cases of depression reported in the primary studies or other subgroup variables (e.g., scales, gender, and grades). Then, the results were double-checked by the second author (JL). To acquire missing information of relevant studies, the corresponding authors were contacted.

Quality assessment

The quality of each study was assessed by the quality assessment instrument for epidemiological studies [26–28]. The instrument was applied to evaluate all included studies with the following 8 items: (1) the target population was clearly

defined; (2) the sample was obtained through probability sampling methods; (3) having a representative sample; (4) non-responders were clearly described; (5) the response rate was great than 80% [29]; (6) having standardized data collection methods; (7) having good psychometrics measures to evaluate depressive symptoms; and (8) having confidence intervals for statistical estimates. Consistent with previous studies, articles were summed to give a total score out of 8, with each item assigned a score of 1 (“Yes”) or 0 (“No”). Discrepancies in scores of included studies were resolved through discussion to reach consensus.

Statistical analyses

Stata version 12.0 (Stata Corp, College Station, TX) was used for all statistical analyses. The pooled prevalence of depressive symptoms estimates was based on the random-effects model, which gave an overall estimate across studies weighted by sample size, with the assumption of statistical heterogeneity among studies [30,31]. The magnitude of heterogeneity across studies was estimated using the I^2 statistic, which shows the proportion of total variation of all included studies due to heterogeneity rather than change. The interpretation of I^2 values shows that 25%, 50%, and 75% indicate low, moderate, and high heterogeneity, respectively [32]. We calculated the pooled effect sizes, along with their respective 95%

confidence intervals (CI). Subgroup analysis was conducted to explore potential moderating factors for heterogeneity, stratified by region, gender, grade, year of publication, and scales combined with cutoffs. We performed meta-regressions to identify the association of prevalence of depressive symptom with year of publication. Publication bias was examined by adjusted-comparison funnel plot symmetry, and Egger's test was used to test the stability of the inverse funnel plot [33,34].

Results

Study characteristics

We initially identified 5437 articles through the search of 5 academic databases, of which 4136 were assessed after duplications were removed. Of these, 1057 remained after screening of titles and abstracts. On review of the full text, 62 papers that met the inclusion criteria were finally included in analysis. Of the 995 excluded articles, 359 did not provide prevalence estimates of depressive symptoms, 389 studies lacked validated screening tools, 87 studies lacked required items, 76 studies were commentary, editorial, or review, 62 studies reported the same population, and 22 articles did not include the full text. Figure 1 shows a flowchart of the selection process. Table 1 summarizes the characteristics of all included studies. In these 62 studies, 232 586 children and adolescents were involved and the sample size ranged from 300 to 47 863. The year of publication covered a time span of 27 years, which ranged from 1991 to 2018. Of these 62 included studies, 8 different self-report rating systems were used in our analysis.

Prevalence of depressive symptoms in children and adolescents

The prevalence of depressive symptoms of all the included studies were described in Table 1, ranging from 4.41% to 55.7% in individual studies. The overall pooled prevalence of depressive symptoms in children and adolescents was 22.2% (95% CI: 19.9–24.6%, $I^2=99.6%$, $p<0.001$), showing significant heterogeneity among studies.

Subgroup analyses and meta-regression

The results of meta-analyses stratified by date of publication and screening tool are summarized in Table 2. There were significant differences in the prevalence of depressive symptom by year of publication. The date of publication was divided into 5 sections. Five studies were published before 2000, the pooled prevalence of which was estimated as 18.4% (95% CI, 14.5–22.3%; $I^2=91.3%$). Eight studies were published between 2001 and 2005, the pooled prevalence of which was estimated as 25.4% (95% CI, 17.6–33.3%; $I^2=99.5%$). Nine studies were

published between 2006 and 2010, the pooled prevalence of which was estimated as 18.0% (95% CI, 13.9–22.3%; $I^2=98.4%$). Twenty-one studies were published between 2011 and 2015, the pooled prevalence of which was estimated as 20.1% (95% CI, 16.5–23.6%; $I^2=99.2%$). Nineteen studies were published after 2016, the pooled prevalence of which was estimated as 26.3% (95% CI, 21.9–30.8%; $I^2=99.8%$). Table 3 shows that the prevalence of depressive symptoms generally increased over time, while the meta-regression analysis showed that this trend was not associated with year of publication ($I^2=99.6%$, $p=0.30$). The pooled prevalence of depressive symptoms was lowest with SCL-90 (cutoff ≥ 2 , 10.3%; $p<0.001$) and highest with CESD-10 (cutoff ≥ 8 , 54.5%; $p<0.001$). Participants with a higher grade showed greater risk of depressive symptoms: primary school, 17.5% (95% CI, 14.0–21.1%); junior secondary school, 21.9% (95% CI, 18.7–25.1%); and senior secondary school, 24.2% (95% CI, 19.9–28.6%). Nevertheless, meta-regression analysis revealed that grade was not associated with the prevalence of depressive symptoms ($I^2=99.1%$, $p=0.07$). Females (22.3%; 95% CI, 19.5–25.0%) had a higher risk of depression than males (21.4%; 95% CI, 18.6–24.1%). Adolescents from rural areas (28.6%; 95% CI, 22.1–35.1%) had an obviously greater prevalence than these from urban areas (22.9%; 95% CI, 17.8–28.1%). Significant heterogeneity (I^2 greater than 85%) was observed within these variables.

Sensitivity analysis

Sensitivity analysis, conducted by omitting each study in succession in each group, showed that no individual study significantly influenced the primary results.

Publication bias

Significant asymmetry was visually observed in the funnel plot (Figure 2). Egger's test ($p<0.05$) showed there were substantial publication bias in this analysis.

Discussion

This systematic review and meta-analysis of 62 original studies involving 232 586 children and adolescents suggest that between 10.3% and 54.5% of adolescents screened positive for depression. The pooled prevalence in depressive symptom among children and adolescents in China was 22.2%, and these findings are reinforced by previous relevant meta-analyses [24].

Some studies have demonstrated that depression in adolescence is associated with higher risk of recurrent depressive episodes in adulthood [93] and increased comorbidity during adult life [94]. Since adolescent suffering from depression may commit suicide, making depression the second-to-third

Table 1. Characteristics of the 62 studies of depressive symptoms in the meta-analysis.

Author (s) (year)	Province	Grades	Scale	Cutoffs	ESS	Case	Prevalence (%)	Quality score
Liu et al. (1991) [35]	Shandong	J	SDS	≥50	537	135	25.14	4
lu et al. (1999) [36]	Shandong	J,S	CES-D	≥20	800	186	23.25	5
Zhou et al. (2000) [37]	Jiangsu	J	SCL-90	≥2	726	110	15.15	5
Yuan et al. (2000) [38]	Anhui	S	CES-D	≥20	3157	512	22.5	4
Mai et al. (2000) [39]	Guangdong	J,S	SCL-90	≥3	330	41	12.42	5
Zhang et al. (2001) [40]	Anhui	J,S	CES-D	≥20	12430	2834	22.8	5
Zhang et al. (2001) [41]	Multiple Cities	J,S	SCL-90	≥2	912	51	5.6	5
Cui et al. (2002) [42]	Anhui	J	SDS	≥41	331	104	31.42	4
Su et al. (2002) [43]	Anhui	S	Beck	≥5	1902	805	45.5	4
Tang et al. (2003) [44]	Hunan	P	DSRSC	≥15	565	97	17.17	4
Duan et al. (2004) [45]	Beijing	J,S	PHI	≥60	5910	1584	26.8	5
Sun et al. (2005) [46]	Tianjin	P,J	DSRSC	≥14	516	78	15.1	4
Feng et al. (2005) [47]	Sichuan & Chongqing	J,S	Beck	≥5	2634	1115	42.3	5
Shu et al. (2006) [48]	Guangdong	J	CDI	≥19	300	33	11	3
Xu et al. (2006) [49]	Jiangsu	J,S	CDI	≥20	7161	1060	14.8	5
Gu et al. (2007) [50]	Hebei	P	DSRSC	≥15	522	94	18.01	4
Zhang et al. (2007) [51]	Anhui	J	CES-D	≥16	4524	1201	26.5	5
Xu et al. (2008) [52]	Anhui & Guangdong	P	CDI	≥19	3224	341	10.6	5
Hong et al. (2009) [53]	Jiangsu	J	CDI	≥20	2444	384	15.7	5
Li et al. (2009) [54]	Guizhou	S	SDS	≥50	2352	336	14.3	5
Liu et al. (2009) [55]	Guangdong	P	CDI	≥19	667	112	16.5	4
Li et al. (2010) [56]	Henan	P,J	CES-D	≥16	755	261	34.57	4
Cao et al. (2011) [57]	Anhui	J,S	DSRSC	≥15	5003	1191	23.8	5
Liu et al. (2012) [58]	Beijing	J,S	CES-D	≥16	1175	354	30.1	4
Peng et al. (2012) [59]	Sichuan	S1	CES-D	≥31	5544	800	14.4	5
Jia et al. (2012) [60]	Yunnan	J,S	CES-D	≥20	7979	1802	22.6	5
Zhang et al. (2012) [61]	Shanxi	J,S	DSRSC	≥15	2363	545	23.1	5
Shan et al. (2013) [62]	Shanghai	J,S	CES-D	≥16	2761	767	27.8	5
Chang et al. (2013) [63]	Shanghai	P,J	CES-D	≥16	1250	494	39.5	3
Luo et al. (2013) [64]	Heilongjiang	P,J	DSRSC	≥15	1535	223	14.5	3
Hu et al. (2013) [65]	Gansu	P	CES-D	≥16	623	119	19.1	4
Liang et al. (2013) [66]	Guangdong	J,S	CDI	≥19	1087	205	18.86	4
Zhu et al. (2013) [67]	Hubei	P,J,S	CDI	≥19	1975	269	13.6	4

Table 1 continued. Characteristics of the 62 studies of depressive symptoms in the meta-analysis.

Author (s) (year)	Province	Grades	Scale	Cutoffs	ESS	Case	Prevalence (%)	Quality score
Chang et al. (2013) [19]	Jiangsu	P	DSRSC	≥15	749	33	4.41	3
Guo et al. (2014) [68]	Henan	J,S	CES-DC	≥29	1774	426	24	4
Zhang et al. (2014) [69]	Zhejiang	J,S	DSRSC	≥15	1939	334	17.23	4
Guo et al. (2014) [70]	Guangdong	J,S	CES-D	≥28	3186	205	6.4	5
Shen et al. (2015) [71]	Hubei	J,S	CDI	≥20	2283	281	12.6	4
Wu et al. (2015) [72]	Beijing	P	CDI	≥12	1472	457	31.04	3
Wu et al. (2015) [73]	Guangdong	J,S	CES-D	≥28	3042	307	10.1	4
Guo et al. (2015) [74]	Shanghai	P,J	CDI	≥19	950	135	14.21	4
Wang et al. (2015) [75]	Guangdong	S	SDS	≥53	1121	464	41.4	4
Wang et al. (2015) [76]	Henan	P,J,S	CDI	≥19	3002	430	14.3	5
Guo et al. (2016) [22]	Multiple Cities	J,S	CES-D	≥28	35893	2017	5.6	5
Tan et al. (2016) [23]	Guangdong	J	CESD-10	≥8	1661	905	54.4	4
Zhu et al. (2016) [77]	Hainan	P,J	CDI	≥19	4866	1573	32.3	4
Xie et al. (2016) [78]	Hubei	P,J,S	CDI	≥19	2888	412	14.3	4
Liu et al. (2016) [79]	Anhui	S	CES-D	≥20	2768	1339	48.4	4
Ding et al. (2017) [80]	Hubei	P,J,S	CES-D	≥16	6406	1041	16.3	4
Li et al. (2017) [81]	Guangdong	J	CES-D	≥16	1015	238	23.4	3
Jia et al. (2017) [20]	Shanghai	S	Beck	≥5	928	517	55.7	3
Zou et al. (2017) [82]	Shandong	J,S	CES-D	≥16	492	200	40.7	3
Wu et al. (2017) [83]	Zhejiang	J,S	CDI	≥20	2000	250	12.5	4
Zhang et al. (2017) [84]	Henan	J,S	CES-D	≥20	1343	269	20.03	4
Zhang et al. (2018) [85]	Hubei	P,J,S	CES-D	≥16	5793	739	16.2	5
Zhou et al. (2018) [86]	Multiple Cities	P,J	CES-D	≥17	2679	544	20.3	4
Zhang et al. (2018) [87]	Zhejiang	J,S	BDI-II	≥14	3264	949	29.08	4
Liu et al. (2018) [88]	Xinjiang	P,J	CDI	≥19	3610	1195	33.1	4
Peng et al. (2018) [89]	Chongqing	P,J	CDI	≥19	3351	841	25.1	4
Ji et al. (2018) [90]	Multiple Cities	P,J,S	CES-D	≥28	47863	5570	11.6	6
Qu et al. (2018) [91]	Xinjiang	J	SDS	≥53	1335	465	34.8	4
Lin et al. (2018) [92]	Xinjiang	P	CDI	≥19	919	103	11.2	4

ESS – effective sample size; P – primary school; J – junior high school; S – senior high school; SDS – Zung Self-Rating Depression Scale; CDI – Children’s Depression Inventory; CES-D – Center for Epidemiological Studies Depression; SCL-90 – The Symptom Checklist subscales for depression; DSRSC – Depression Self-Rating Scale for Children; BDI-II – Beck Depression Inventory-II; Beck – Beck Depression Inventory; PHI – Psychological Health Inventory.

Table 2. Subgroup analyses of the prevalence of depressive symptoms.

Subgroup	Categories	No. of studies	Total No. of participants	Number of cases	Prevalence (%)	95% CI	I ² (% with P-value)
Scales	Beck						
	≥5	3	5464	2437	46.7	39.4–53.9	96.4 (<0.001)
	BDI-II						
	≥14	1	3264	949	29.1	27.5–30.6	
	CDI						
	≥12	1	1472	457	31.0	28.7–33.4	
	≥19	7	23615	5308	18.7	13.5–23.8	99.0 (<0.001)
	≥20	5	17112	2316	13.2	11.3–15.1	92.3 (<0.001)
	CES-D						
	≥8	1	1661	905	54.5	52.1–56.9	
	≥16	11	27473	5958	26.3	21.5–31.1	98.9 (<0.001)
	≥20	6	28477	6942	25.5	18.7–32.3	99.4 (<0.001)
	≥29	5	91758	8525	11.4	7.7–15.2	99.7 (<0.001)
	≥32	1	5544	800	14.4	13.5–15.4	
	DSRSC						
	≥15	8	13192	2595	16.7	11.3–15.1	98.5 (<0.001)
	PHI						
	≥60	1	5910	1584	26.8	25.7–27.9	
	SCL-90						
	≥2	2	1638	161	10.3	0.9–19.7	97.4 (<0.001)
≥3	1	330	41	12.4	8.9–16.0		
SDS							
≥41	1	331	104	31.4	26.4–36.4		
≥50	2	2889	471	19.6	8.9–30.2	96.6 (<0.001)	
≥53	2	2456	929	38.1	31.6–44.5	91.0 (<0.001)	
Publication year	Before 2000	5	5550	984	18.4	14.5–22.3	91.3 (<0.001)
	2001–2005	8	25200	6668	25.4	17.6–33.3	99.5 (<0.001)
	2006–2010	9	21949	3822	18.0	13.9–22.0	98.4 (<0.001)
	2011–2015	21	50813	9841	20.1	16.5–23.6	99.2 (<0.001)
	After 2016	19	129074	19167	26.3	21.9–30.8	99.8 (<0.001)
Grades	P	19	41007	5753	17.5	14.0–21.1	98.9 (<0.001)
	J	31	63561	12857	21.9	18.7–25.1	99.1 (<0.001)
	S	23	45725	9682	24.2	19.9–28.6	99.3 (<0.001)

Table 2 continued. Subgroup analyses of the prevalence of depressive symptoms.

Subgroup	Categories	No. of studies	Total No. of participants	Number of cases	Prevalence (%)	95% CI	I ² (% with P-value)
Gender	Male	46	97085	16210	21.4	18.6–24.1	99.4 (<0.001)
	Female	46	97076	16021	22.3	19.5–25.0	99.3 (<0.001)
Region	Rural	13	23858	6097	22.9	17.8–28.1	98.9 (<0.001)
	Urban	13	22283	5151	28.6	22.1–35.1	99.3 (<0.001)

Table 3. The forest plot of depressive symptoms based on publication year.

Publication year	No. of studies	Participants	Cases	Prevalence of depressive	Heterogeneity (I ²)
Before 2000	5	5550	984	18.4 (14.5–22.3)	91.3
2000–2005	8	25200	6668	25.4 (17.6–33.3)	99.5
2006–2010	9	21949	3822	18.0 (13.9–22.0)	98.4
2011–2015	21	50813	9841	20.1 (16.5–23.6)	99.2
After 2016	19	129074	19167	26.3 (21.9–30.8)	99.8
Overall	62	232586	21315	22.2 (19.9–24.6)	99.6

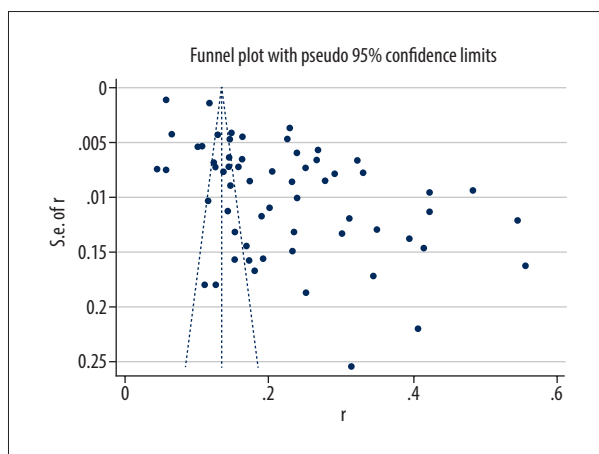


Figure 2. Funnel plot of depressive symptoms.

primary cause of death in this population [95], more effective interventions needed to be carried out early to prevent such tragedy. Adolescence is an extremely significant period for the building of personality and development of life skills. Once the process is interfered with depression during this period, a number of negative outcomes, such as dropping out of school, substance abuse, and unemployment, become more likely to occur throughout the lifespan [96,97]. Thus, this analysis highlights an urgent issue for children and adolescents.

In this analysis, the pooled prevalence estimate was higher than in 6 previous studies among teenagers in China [98–103]. When compared with other countries – 16.6% in Australia [104], 4.28% in Greece [105], 10.6% in Italy [106], and 17.3% in Korea [107] – this study also demonstrated a greater estimated prevalence of depressive symptoms. Previous research by Tang et al. [24] reported that the prevalence of depressive symptom was 24.3%, which is higher than the result in our analysis. This difference is likely mainly due to a larger sample size of participants covering a wider age range in the present study, which included primary school students, middle school students, and high school students. With regard to the cause of depression, which is a severe mental problem among youth, substantial research has been conducted to identify risk factors associated with depression, such as genetic risk (e.g., offspring of parents with depression) [108], family factors (e.g., family discord and poverty) [109], and stressful life events (e.g., academic pressure and interpersonal pressure) [110]. Although there are myriad risk factors facing youth, effective interventions aimed at depression, especially the early onset of depressive symptoms, are relatively scarce in China.

When stratified by year of publication and divided into 5 periods, the prevalence estimates of depressive symptoms were highest in the last period. Table 3 shows that the prevalence of depressive symptoms is positively associated with year of publication as a whole, but the difference was not significant

in meta-regression analysis. The foremost reason for this association is that the quantity of studies involved in this article varied among different periods; there were fewer studies in the 1990s and more in the 2010s, which to some extent reflects an increased awareness of depression among Chinese researchers. Meanwhile, the rapid development of the society and economy in China likely contributes to mental health problems in children and adolescents. Under these circumstances, some studies reported that depression is becoming the most common concern of Chinese teenagers [111].

The prevalence estimates were closely linked to grade in the present study, which is consistent with a previous review [24]. Some possible explanations for this phenomenon identified by previous studies are tremendous academic pressure of entrance examinations, neurobiological changes, and increased interpersonal problems [112].

In the current study, 8 self-report rating scales with different cutoffs were included. The result revealed that a significant difference in the summary prevalence estimates existed among different screening tools, which was a major source of heterogeneity. Nevertheless, the prevalence estimates of epidemiological studies usually varied with screening instruments, samples, and survey methods [113]. Although this heterogeneity was unavoidable, screening scales with strong psychometric properties and identified cutoffs should be taken into consideration during the initial design, thus making it possible to make direct comparison with other countries.

In terms of gender, there were slight differences in the summary prevalence estimates in this study: 22.3% for females and 21.4% for males. Some researches associated maturation of the hypothalamic-pituitary-adrenal (HPA) axis and endocrine systems with gender differences in depressive symptoms [13,114]. In addition, our results were not in line with previous meta-analyses based on nationally representative samples [115], which reported that the OR (odds ratio) value between prevalence of depression in females and males was 2. It revealed that gender differences in depressive symptoms generally appeared among adolescents at the age of 12 years old and continued during puberty. The wide age range in our study may have narrowed the gender difference.

We found that children from rural areas had a significantly higher prevalence of depressive symptoms than children from urban areas (26.2% versus 27.5%, respectively). This result was consistent with many previous reports [116,117], indicating that relative poverty, lack of social support, and low income status are linked to high prevalence in depressive symptoms among children.

Several strengths of the present meta-analysis should be noted. There were 62 primary studies involving a large pooled sample size in this study, which provided greater statistical power. In addition, we conducted a complete search on both Chinese databases and English databases, generating a comprehensive coverage. However, our findings also have important limitations. Economic and social development is highly uneven among provinces in China, and our study did not cover all the provinces, which to some extent limits generalizability of the results. Secondly, the majority of studies used school-based samples, and thus might be more prone to selection bias, although it is widely accepted that surveys conducted in schools are about as accurate as those conducted in the community setting [118]. Thirdly, although subgroup analyses aimed at publication years combined with other variables were performed to overcome the substantial heterogeneity, the problem remained in this meta-analysis of epidemiological studies [119].

Conclusions

The trend of prevalence of depressive symptoms among Chinese children and adolescents as a whole has increased in the last 3 decades. Our findings could be useful to policy makers and service commissioners to better understand depressive symptom, a notable problem facing children and adolescents. Given that depressive symptoms can begin at an early age, be recurrent, and are associated with more poor outcomes, we emphasized mental health services and effective interventions for children and adolescents.

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