



Prevalence of depressive symptoms in children and adolescents in China: A meta-analysis of observational studies

Wen-Wang Rao^{a,1}, Dan-Dan Xu^{a,b,1}, Xiao-Lan Cao^{c,1}, Si-Ying Wen^{c,1}, Weng-Ian Che^d, Chee H. Ng^e, Gabor S. Ungvari^{f,g}, Fan He^{h,*}, Yu-Tao Xiang^{a,*}

^a Unit of Psychiatry, Faculty of Health Sciences, Institute of Translational Medicine, University of Macau, Avenida da Universidade, 3/F, Building E12, Taipa, Macao SAR, China

^b Department of Biology, Faculty of Sciences, Harbin University, Harbin, China

^c Shenzhen Key Laboratory for Psychological Healthcare & Shenzhen Institute of Mental Health, Shenzhen Kangning Hospital & Shenzhen Mental Health Center, Shenzhen, China

^d Department of Public Health Science, Karolinska Institutet, Stockholm, Sweden

^e Department of Psychiatry, University of Melbourne, Melbourne, Victoria, Australia

^f University of Notre Dame Australia, Fremantle, Australia

^g Division of Psychiatry, Medical School, University of Western Australia, Perth, Australia

^h The National Clinical Research Center for Mental Disorders & Beijing Key Laboratory of Mental Disorders Beijing Anding Hospital & The Advanced Innovation Center for Human Brain Protection, School of Mental Health, Beijing Anding Hospital, Capital Medical University, Beijing, China

ARTICLE INFO

Keywords:

Children and adolescents
Depressive symptoms
Meta-analysis
Prevalence

ABSTRACT

Depressive symptoms are common in children and adolescents. The prevalence of depressive symptoms in children and adolescents in China vary significantly across studies. A meta-analysis of the prevalence of depressive symptoms in children and adolescents in China was conducted. Literature search was performed in both English (PubMed, PsycINFO and EMBASE) and Chinese (China National Knowledge Internet, WANFANG Data and SinoMed) databases. Random-effects model was used to synthesize the prevalence of depressive symptoms. Eighteen studies covering 29,626 participants were identified and analyzed. All these studies used the same measurement to identify depressive symptoms. The reported point prevalence of depressive symptoms ranged between 4% and 41% in the studies; the pooled prevalence of depressive symptoms was 19.85% (95% confidence interval: 14.75%–24.96%). In the subgroup analyses the prevalence of depressive symptoms was significantly associated with the region where the study was conducted: 17.8% in eastern, 23.7% in central, 22.7% in western, and 14.5% in northeast regions of China ($P < 0.001$). Considering the adverse impact of depressive symptoms on health outcomes, regular screening and effective interventions should be implemented in this population.

1. Introduction

Depression is common in children and adolescents and is the third leading cause of disability in adolescents globally (World Health Organization, 2018). Depression in children and adolescence is not only associated with immense personal and family suffering, but also other adverse outcomes, such as poor school performance, insomnia, huge treatment and economic burden and suicide (Foley et al., 2006; Lynch and Clarke, 2006; Buysse et al., 2008; Fröjd et al., 2008).

In order to develop effective preventive and treatment strategies, it is crucial to understand the epidemiological patterns of depression in

children and adolescents. Depression refers to a clinical diagnosis comprising a variety of depressive subtypes diagnosed based on a number of symptoms; in contrast, depressive symptoms refer to a number of symptoms usually seen in depressive illness and listed in standard diagnostic schedules and rating scales. Surveying depressive symptoms in an epidemiological study is far easier because it is less time-consuming, inexpensive and does not require highly trained interviewers. For this reason, most epidemiological studies on children and adolescent measure depressive symptoms only. Many prevalence studies of depressive symptoms in children and adolescents have been conducted, but the findings have been inconsistent (Rushton et al.,

* Corresponding authors.

E-mail addresses: hf981207@163.com (F. He), ytxiang@umac.mo (Y.-T. Xiang).

¹ These authors contributed equally to the work.

2002; Saluja et al., 2004; Klasen et al., 2015). For instance, a Japanese study found the prevalence of depressive symptoms in adolescents was 14.9% (Denda et al., 2006), while in a Swedish study of adolescents the prevalence was 8.8% (Ivarsson and Gillberg, 1997). The inconsistent findings across studies may be partly due to different age of study populations (e.g., primary school (Yong et al., 2011) vs. middle school (Tu et al., 2015)), sampling method (e.g., stratified and random (Zhang et al., 2016) vs. cluster sampling (Xu et al., 2015)), cut-off values of measures (e.g., ≥ 15 (Chang et al., 2013) vs. ≥ 16 of the Depression Self-Rating Scale for Children (DSRSC) (Dong et al., 2013)) and socioeconomic and ethnic factors (e.g., Han (Cao et al., 2012) vs. Uyghur (Liu et al., 2016) samples; urban (Shen et al., 2006) vs. rural samples (Lai et al., 2012)).

A number of general scales on depressive symptoms have been developed such as the Montgomery–Asberg Scale (Montgomery and Asberg, 1979) and the 16-item Quick Inventory of Depressive Symptomatology–Self-Report (Rush et al., 2003). However, most scales are not designed specifically for children and adolescents. The DSRSC is a widely used self-report instrument on depressive symptoms occurring in the past week designed specifically for children and adolescents (Birlerson, 1981). The Chinese version of DSRSC has been validated in Chinese children and adolescents with satisfactory psychometric properties. The test-retest reliability of the DSRSC was 0.53, split-half validity was 0.72, Cronbach's alpha was 0.73 and the correlation coefficients between each item and the total scores ranged between 0.29 and 0.60. The DSRSC cut-off value for depression was ≥ 15 , with specificity of 0.82 and sensitivity of 0.86 (Su et al., 2003; Yin et al., 2012).

The epidemiology of depressive symptoms is significantly influenced by sociocultural and economic contexts (Kleinman, 2004; Compton et al., 2006), therefore it needs to be examined in different countries and territories separately. In China, epidemiological surveys of depressive symptoms in children and adolescents using the DSRSC yielded inconsistent results. For example, a survey of 5,003 adolescents in four junior high schools in Bengbu city (Weng et al., 2012) found a rate of 11.2%, while the corresponding figure was 14.87% in three middle schools in Zhongshan City (Zhang, 2012). In a meta-analysis the prevalence of depressive symptoms was 15.4% in Chinese children and adolescents (Li et al., 2016), but this study had several methodological limitations. First, only Chinese databases were searched, thus studies published in English language journals may have been missed. Second, only studies published between 2000 and 2014 were covered, and third, depressive symptoms measured with different scales were pooled despite these scales having different structures and psychometric properties.

Thus, the rationale of conducting this meta-analysis was to search the Chinese and English databases and include only studies that used the DSRSC when examining the pooled prevalence of depressive symptoms in children and adolescents in China.

2. Methods

The study protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO; registration number CRD42017080200).

2.1. Data sources and search strategies

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2009), a systematic literature search was conducted covering electronic English (PubMed, PsycINFO and EMBASE) and Chinese (China National Knowledge Internet, WANFANG Data and SinoMed) databases from their commencement dates to May 25, 2017 using the following search terms: (“adolescents” OR “students” OR “children” OR “teen” OR “teenagers”) AND (“depression” OR “depressive disorders” OR “depressive symptoms”) AND (“prevalence” OR “epidemiology” OR “survey” OR “rate”

OR “percentage”) AND (“China” OR “Chinese”).

2.2. Study eligibility

According to the PICOS acronym, the following inclusion criteria were used: Participants (P): children or adolescents < 18 years in population- or community-based studies; and students in high school or below; Intervention (I): not applicable; Comparison (C): not applicable; Outcomes (O): prevalence of depressive symptoms or relevant information that could generate prevalence of depressive symptoms, with data measured only with the DSRSC; Study design (S): cross-sectional or cohort studies (only baseline data were used) conducted in China. Exclusion criteria were: (1) Case reports and reviews; (2) Studies conducted in special populations (e.g., children of left-behind by their parents outpatients, inpatients, children with physical problems (e.g. obesity) or psychiatric disorders). Titles and abstracts of the relevant publications were first screened, followed by reading the full texts independently by five researchers (WWR, DDX, SYW, XLC and WIC). If more than one publication based on the same dataset were published, only the study with the complete data was included in the analysis. Any disagreement between researchers was resolved by a discussion with a senior researcher (YTX).

2.3. Data extraction

Five researchers (WWR, DDX, SYW, XLC and WIC) independently conducted the data extraction and any uncertainty was settled by a discussion with a senior researcher (YTX). Basic demographic information, sample size, sampling methods, study site, year of survey and relevant data on prevalence of depressive symptoms were extracted using a standardized data record form (Table 1).

2.4. Quality assessment

Study quality was independently assessed two researchers (WWR, DDX) using an eight-domain questionnaire that was developed for evaluating quality of epidemiological studies (Boyle, 1998; Pringsheim et al., 2014) and used widely in systematic reviews or meta-analyses (Cooper et al., 2007; Ibrahim et al., 2013). The eight domains are: (1) the target population was clearly defined; (2) probability sampling or entire population surveyed; (3) the response rate was $\geq 80\%$; (4) non-responders were clearly described; (5) the sample was representative of the target population; (6) the data collection methods were standardized; (7) validated criteria were used to measure depressive symptoms; (8) the prevalence estimates were given with confidence intervals and detailed by subgroups. Any discrepancies in the process of quality assessment were resolved by a discussion with a senior researcher (YTX).

2.5. Statistical analysis

The data analyses were conducted using R, Version 3.3.0 and RStudio, Version 0.99.903. The pooled point prevalence of depressive symptoms with its 95% confidence intervals (CIs) was calculated using the random effects model. Heterogeneity across studies was measured using I^2 -statistic and Cochran's Q test; I^2 statistic of $> 50\%$ or Cochran's Q ($P < 0.05$) (Rotenstein et al., 2016) indicated significant heterogeneity. Since more than ten studies were included in the meta-analysis, publication bias was assessed by a funnel plot and Egger's and Begg's rank tests. Subgroup and meta-regression analyses were performed to examine potential sources of heterogeneity across studies that could be associated with different sampling methods (i.e., cluster vs. others), cut-off values (i.e., ≥ 15 vs. others or not report), and geographic area (i.e., eastern vs. northeast vs. central vs. and western regions of China divided according to the official Chinese economic zone division). In addition, meta-regression analyses were performed to moderate continuous variables (i.e., ratios of male and female genders), sample size,

Table 1
Characteristics of the studies included in the meta-analysis.

No.	References	Publication language	Survey year	Sampling method	Sample size	Response rate (%)	Age (Mean ± SD)	Age range	Male (N, %)	City/Province	Area	Number with depression symptoms	DSRSC cut-off value	Quality score
1	(Sun and Zhou, 2005)	CH	NR	RC	516	95.7	11.5 ± 0.29	8–15	273 (52.9)	Tianjin	E	78	8–12: F ≥ 15, M ≥ 16 13–16: F ≥ 16, M ≥ 14 ≥ 15	5
2	(Shen et al., 2006)	CH	2004	C	302	100.0	NR	8–13	149 (49.3)	Hangzhou/Zhejiang	E	42	≥ 15	5
3	(Su et al., 2006)	CH	NR	C	565	95.9	10 ± 2	7–13	290 (51.3)	Changsha/Hunan	C	54	≥ 15	5
4	(Wang and Su, 2006)	CH	2001	C	209	94.1	8.73 ± 0.92	8–10	107 (51.2)	Changsha/Hunan	C	85	≥ 15	4
5	(Gu et al., 2007)	CH	2004	C	522	100.0	8.92 ± 1.13	8–10	270 (51.7)	Handan/Hebei	E	94	≥ 15	5
6	(Tang et al., 2007)	CH	NR	C	370	92.0	10.65 ± 1.18	NR	181 (48.9)	Hangzhou/Zhejiang	E	62	NR	5
7	(Yong et al., 2011)	CH	NR	SRC	1417	93.0	10 ± 1	8–13	729 (51.5)	Chongqing	W	328	≥ 15	6
8	(Zhu et al., 2011)	CH	2010	C	1140	91.9	13.5 ± 1.3	11–17	524 (46.0)	Zhanjiang/ Guangdong	E	69	≥ 15	5
9	(Cao et al., 2012)	CH	2010	SCR	5268	98.7	13.21 ± 0.99	11–16	2769 (52.6)	Bengbu/Anhui	C	1283	≥ 15	6
10	(Lai et al., 2012)	CH	2010	RSC	2060	93.0	16.57 ± 3.57	NR	955 (46.4)	Beijing	E	398	13–16: F > 16, M > 14 ≥ 15	5
11	(Chang et al., 2013)	CH	NR	SC	749	97.9	10.93 ± 1.25	NR	380 (50.7)	Zhenjiang/Jiangsu	E	33	≥ 15	5
12	(Dong et al., 2013)	EN	2009	MR	3155	98.6	15.88 ± 1.74	12–18	1594 (50.5)	Linyi and Liaocheng/ Shandong	E	266	≥ 16	4
13	(Luo et al., 2013)	CH	NR	SC	1535	90.3	NR	NR	776 (50.6)	Daqing/ Heilongjiang	NE	223	≥ 15	5
14	(Tu et al., 2015)	CH	2013	CR	3397	97.1	13.73 ± 1.01	NR	1776 (52.3)	Shaoxing/Zhejiang	E	1282	UR ≥ 15; RU ≥ 14	5
15	(Xu et al., 2015)	CH	NR	C	704	100.0	10.99 ± 1.18	8–15	404 (57.4)	Lingwu/Ningxia	W	178	≥ 15	6
16	(Liu et al., 2016)	CH	2014	RC	2157	95.9	14.82 ± 1.69	NR	1146 (53.1)	Urumchi/Xinjiang	W	441	≥ 15	5
17	(Xing et al., 2016)	CH	2013	SCR	3197	96.9	13.73 ± 1.03	11–17	1667 (52.1)	Shaoxing/Zhejiang	E	1216	≥ 15	6
18	(Zhang et al., 2016)	CH	NR	SRC	2363	96.9	15.54 ± 1.76	12–18	1113 (47.1)	Changzhi/Shanxi	C	545	≥ 15	5

CH = Chinese; EN = English; C = Cluster sampling; M = Multistage sampling; R = Random sampling; S = Stratified sampling; NR = Not Reported; SD = Standard deviation; E = Eastern region; W = Western region; NE = Northeastern region; UR = Urban; RU = Rural; F = Female; M = Male; Regions (Western vs. Eastern vs. Central vs. Northeastern) based on the National Bureau of Statistics of China

* This study was conducted in middle school students, which fulfilled the inclusion criterion “students in high school or below”, although some participants were older than 18 years.

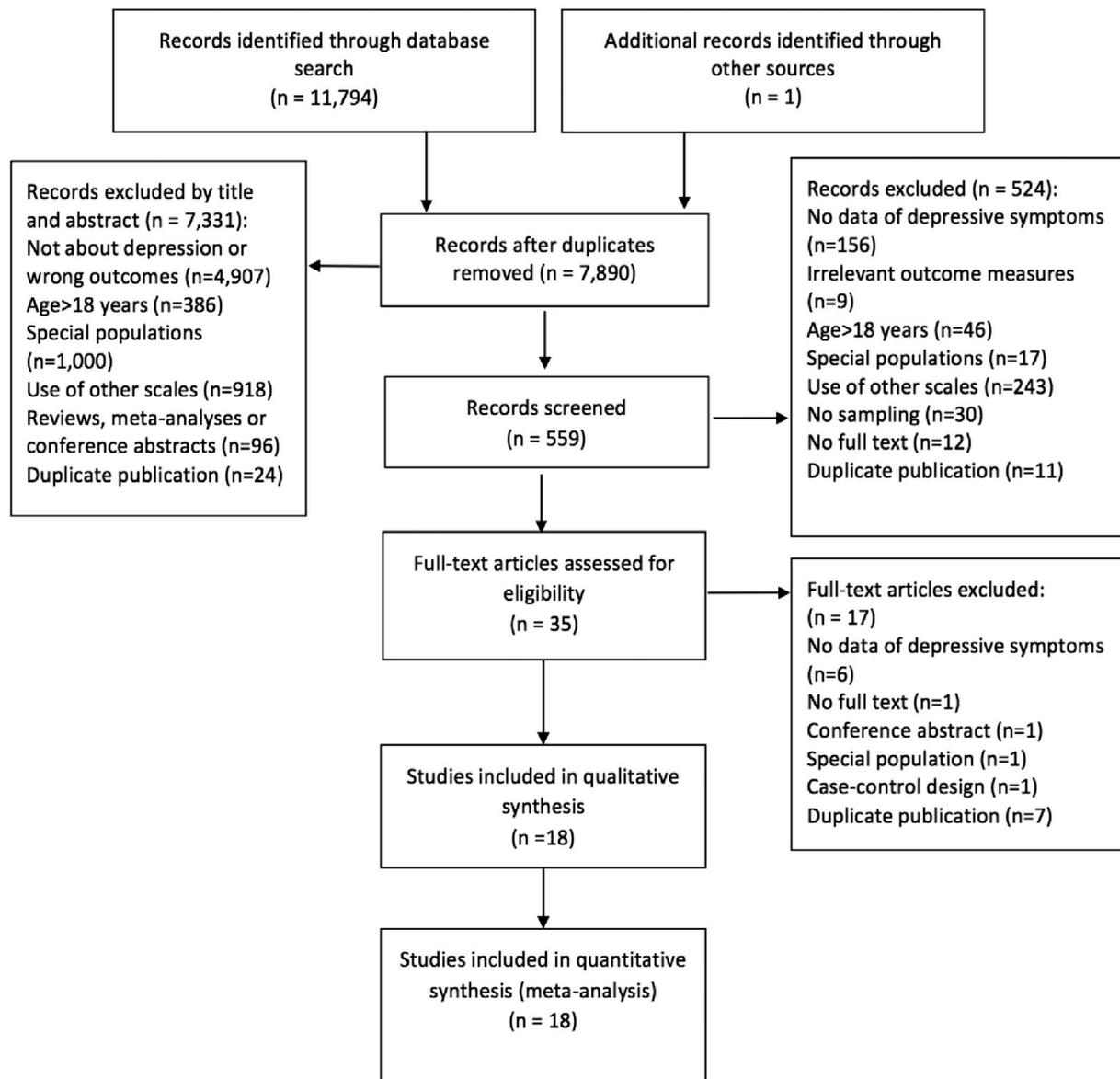


Fig. 1. Flowchart of literature selection.

effective rate and quality assessment). Level of significance was set at 0.05 (two-sided).

3. Results

3.1. Study selection and characteristics

Eighteen of the 11,794 articles were found eligible for analyses (Fig. 1); 10, 4, 3 and 1 studies were conducted in the eastern, central, western, and the northeast regions of China, respectively. The pooled sample size was 29,626 ranging from 209 to 5,268 across studies. The year of survey ranged from 2005 and 2016. The characteristics of the 18 studies are presented in Table 1.

3.2. Quality assessment and publication bias

The scores of quality assessment ranged from 4 to 6, with a median score of 5. All studies clearly defined the target population, provided eligible sampling methods and used a validated scale of depressive symptoms, while none described the characteristics of non-responders or reported the 95% CI or standard error (SE) of the prevalence of

depressive symptoms of the non-responders. In addition, two studies (Wang and Su, 2006; Gu et al., 2007) did not report response rate and another two studies (Dong et al., 2013; Zhang et al., 2016) did not use standardized data collection procedure; 6 studies (Gu et al., 2007; Yong et al., 2011; Cao et al., 2012; Xu et al., 2015; Xing et al., 2016; Zhang et al., 2016) were representative surveys. The details of the quality assessment are showed in Supplementary Table 1. The funnel plot, and Egger's and Begg's tests did not reveal publication bias (Egger linear regression: $t = 0.917$, $P = 0.373$; Begg rank correlation: $z = -0.038$, $P = 0.970$; Fig. 3).

3.3. Prevalence of depressive symptoms, subgroup, sensitive and meta-regression analyses

The pooled point prevalence of depressive symptoms was 19.85% (95% CI: 14.75%–24.96%) (Fig. 2). Table 2 and Supplementary Table 2 present the results of meta-regression and subgroup analyses. The prevalence of depressive symptoms was significantly associated with study region: it was 17.8% in eastern, 23.7% in central, 22.7% in western, and 14.5% in northeast regions of China (Supplementary Fig. 1; $P < 0.001$). Both univariate and multivariate meta-regression

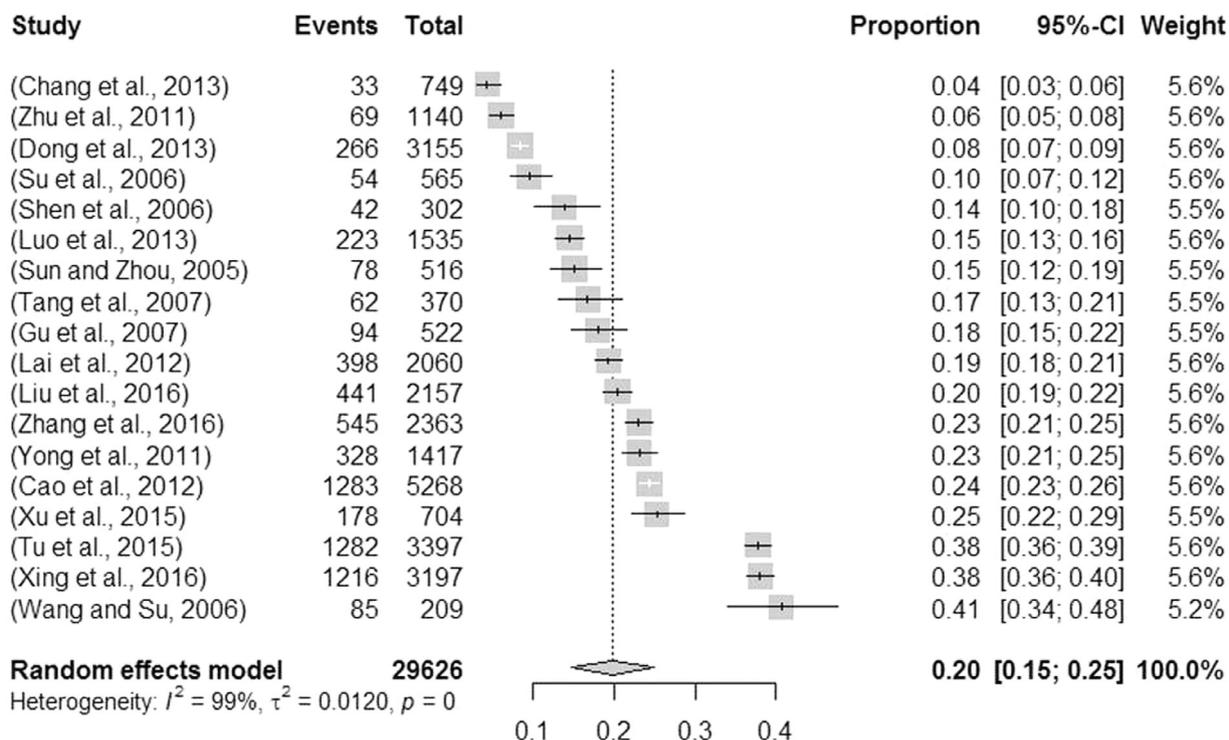


Fig. 2. Forest plot of the prevalence of depression symptoms in children and adolescents in China.

analyses showed that gender ratio, sample size, participation rate and quality score were not significantly associated with prevalence of depressive symptoms (P values > 0.05). Sensitive analysis revealed that after omitting each study sequentially, the primary results remained unchanged (Supplementary Fig. 2).

4. Discussion

This was the first meta-analysis that examined the prevalence of depressive symptoms in children and adolescents in China using the DSRSC. Depressive symptoms were common (19.85%) in Chinese children and adolescents. Given that the population of children and adolescents aged 0–17 years in China amounted to approximately 271 million in 2015 (National Bureau of Statistics of China 2017), this translates to around 53.7 million children and adolescents having depressive symptoms.

Higher prevalence of depressive symptoms was found in central and western regions of China, which may be explained by poor social support systems, low economic level and poor living conditions in these parts of China (Huang et al., 2010). Moreover, in the past decades the rapid economic development in China has shifted a massive workforce from rural to urban areas (Wen and Lin, 2012). The large number of disadvantaged ‘left-behind children’ (i.e., children who are left at home for more than 6 months while their parents moved elsewhere to work (Duan and Zhou, 2005)) who live in the economically relatively underdeveloped central and western regions could account for the increased risk of depressive symptoms (Wang et al., 2018). The prevalence of depressive symptoms varies greatly in studies using different measures on depressive symptoms; for example, the prevalence of depressive symptoms was 2.8% in studies using the International Neuropsychiatric Interview (MINI) (Zhong et al., 2013), 23.9% with the Children’s Depression Inventory (CDI) (Wang et al., 2016), 54.74% with

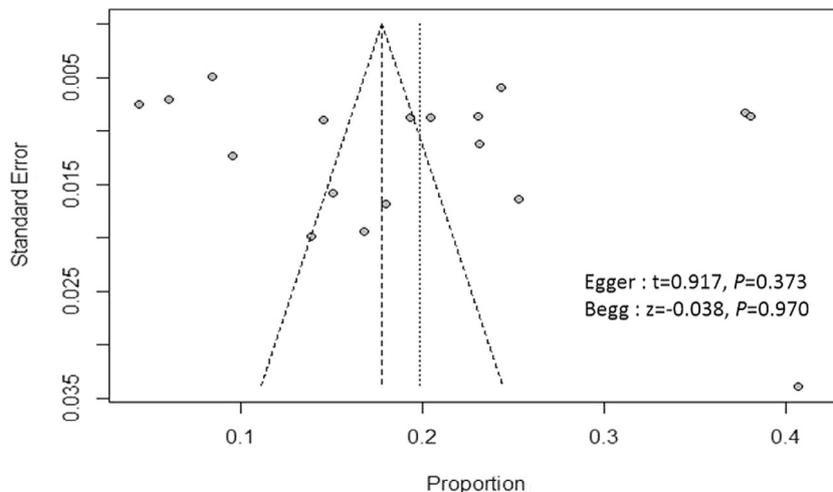


Fig. 3. Funnel plot of publication bias.

Table 2
Subgroup analyses of the prevalence of depressive symptoms in Chinese children and adolescents.

Subgroup	Category	Tau ²	Sample Size	Effect Size	95% CI	I ²	P across subgroup
Area	E (10)	0.02	15,408	0.178	0.094	0.262	99.6
	W (3)	0.0004	4278	0.227	0.200	0.254	75.8
	C (4)	0.01	8405	0.237	0.165	0.310	98.0
	NE (1)	–	1535	0.145	0.128	0.163	–
DSRSC cut-off value	≥15 (13)	0.01	20,128	0.200	0.141	0.258	99.2
	Others (4)	0.02	9128	0.202	0.059	0.344	99.7
	NR (1)	–	370	0.168	0.130	0.206	–
Sampling methods	C (7)	0.01	3812	0.183	0.114	0.251	97.4
	Others (11)	0.01	25,814	0.208	0.141	0.274	99.5

E = Eastern region; C = Central region; W = Western region; NE = Northeastern region; NR = Not Reported; C = Cluster sampling

the Self-rating Depression Scale (SDS) (Tan et al., 2018). This discrepancy is probably related to different psychometric properties across these measures in detecting depressive symptoms.

Some studies used the DSRSC, but the findings still varied greatly. For example, a Japanese study found prevalence of depressive symptoms in adolescents was 14.9% (DSRSC total score \geq 15) (Denda et al., 2006). Another study found that 8.8% of Swedish community-dwelling adolescents (Ivarsson and Gillberg, 1997) and 6.97% of (DSRSC score of 15 or more) primary school students (Ivarsson et al., 1994) had depressive symptoms (DSRSC total score \geq 14). The previous meta-analysis with 72,402 children/adolescents in China found that the prevalence of depressive symptoms was 15.4% (95% CI: 13.3%–17.8%) (Li et al., 2016), which was lower than the findings in our meta-analysis. However, the under-estimation of the prevalence of depressive symptoms is probably due to the study weaknesses previously mentioned especially the pooling together of results of both major depression and depressive symptoms.

The strengths of this meta-analysis are the inclusion of studies only using the DSRSC, the large pooled sample size and its comprehensive coverage of the literature. However, the results need to be interpreted with caution due to several limitations. First, 18 studies were included in this meta-analysis, which only covered 13 of the 34 provinces/municipalities/autonomous regions in China. Hence, the findings could not be generalized to all areas of China. Second, although subgroup and meta-regression analyses were conducted, substantial heterogeneity remained as this is unavoidable in meta-analyses of epidemiological surveys (Patsopoulos et al., 2008). Third, due to considerably different socioeconomic contexts, studies conducted in other Chinese regions and territories, such as Hong Kong, Macau and Taiwan were not included. Finally, relevant factors related to the development of depressive symptoms, such as demographic and socio-economic factors (e.g. rural/urban areas and education and income levels), the availability of the public health system, and family history of psychiatric disorders, were not analyzed because data were not available in most studies.

In summary, this meta-analysis found a high prevalence of depressive symptoms among children and adolescents in China, particularly in its central and western regions. Due to the negative impact of depressive symptoms on health outcomes, regular screening and treatment measures should be implemented to reduce the harmful effects in this vulnerable population.

5. Conflict of interest

The authors declare that they have no conflict of interest related to this work.

Acknowledgements

The study was supported by the University of Macau (MYRG2015-00230-FHS; MYRG2016-00005-FHS), National Key Research & Development Program of China (No. 2016YFC1307200), Beijing

Municipal Administration of Hospitals Clinical Medicine Development of Special Funding Support (No.ZYLX201607) and Beijing Municipal Administration of Hospitals' Ascent Plan (No. DFL20151801).

Contributors

Study Design: We-Wang Rao, Dan-Dan Xu, Yu-Tao Xiang. Analysis and interpretation of data: Dan-Dan Xu, We-Wang Rao, Xiao-Lan Cao, Si-Ying Wen, Weng-Ian Che. Drafting of the manuscript: Wen-Wang Rao, Fan He, Yu-Tao Xiang. Critical revision of the manuscript: Chee H. Ng, Gabor S. Ungvari. Approval of the final version for publication: All the authors.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2018.12.133](https://doi.org/10.1016/j.psychres.2018.12.133).

References

- Birleson, P., 1981. The validity of depressive disorder in childhood and the development of a self rating scale: a research report. *J. Child Psychol. Psychiatry* 22, 73–88.
- Boyle, M.H., 1998. Guidelines for evaluating prevalence studies. *Evid. Based Mental Health* 1, 37–39.
- Buysse, D.J., Angst, J., Gamma, A., Ajdacic, V., Eich, D., Rössler, W., 2008. Prevalence, course, and comorbidity of insomnia and depression in young adults. *Sleep* 31, 473–480.
- Cao, H., Qian, Q.W., Sun, Y., Weng, T.T., Wang, H., Tao, F.B., 2012. Relationship on the prevalence of physical activity to depressive symptoms and satisfaction of school life among middle school students in Bengbu, Anhui province (in Chinese). *Chin. J. Epidemiol.* 33, 154–159.
- Chang, X.L., Wang, H.Y., Zhang, Y., 2013. Investigation and analysis of depression status of pupils in Zhenjiang city (in Chinese). *Chin. J. Child Health Care* 21, 985–986 +1006.
- Compton, W.M., Conway, K.P., Stinson, F.S., Grant, B.F., 2006. Changes in the prevalence of major depression and comorbid substance use disorders in the United States between 1991–1992 and 2001–2002. *Am. J. Psychiatry* 163, 2141–2147.
- Cooper, C., Balamurali, T., Livingston, G., 2007. A systematic review of the prevalence and covariates of anxiety in caregivers of people with dementia. *Int. Psychogeriatr.* 19, 175–195.
- Denda, K., Kako, Y., Kitagawa, N., Koyama, T., 2006. Assessment of depressive symptoms in Japanese school children and adolescents using the Birleson Depression Self-Rating Scale. *Int. J. Psychiatry Med.* 36, 231–241.
- Dong, F., Cao, F., Cheng, P., Cui, N., Li, Y., 2013. Prevalence and associated factors of poly-victimization in Chinese adolescents. *Scand. J. Psychol.* 54, 415–422.
- Duan, C., Zhou, F., 2005. Research on the left-behind children in China (in Chinese). *Popul. Res.* 29, 29–36.
- Foley, D.L., Goldston, D.B., Costello, E.J., Angold, A., 2006. Proximal psychiatric risk factors for suicidality in youth: the great smoky mountains study. *Arch. Gen. Psychiatry* 63, 1017–1024.
- Fröjd, S.A., Nissinen, E.S., Pelkonen, M.U., Marttunen, M.J., Koivisto, A.-M., Kaltiala-Heino, R., 2008. Depression and school performance in middle adolescent boys and girls. *J. Adolesc.* 31, 485–498.
- Gu, J.X., Guo, L.X., Wang, J.Y., 2007. A survey of depressive symptoms in 522 children aged 8–10 years (in Chinese). *Matern. Child Health Care China* 22, 2949–2950.
- Huang, N., Ma, J., Sullivan, K., 2010. Economic development policies for Central and Western China. *China Business Review*. <https://www.chinabusinessreview.com/economic-development-policies-for-central-and-western-china/> accessed from May 2018.
- Ibrahim, A.K., Kelly, S.J., Adams, C.E., Glazebrook, C., 2013. A systematic review of studies of depression prevalence in university students. *J. Psychiatric Res.* 47,

- 391–400.
- Ivarsson, T., Gillberg, C., 1997. Depressive symptoms in Swedish adolescents: normative data using the Birlerson Depression Self-Rating Scale (DSRS). *J. Affect. Disord.* 42, 59–68.
- Ivarsson, T., Lidberg, A., Gillberg, C., 1994. The Birlerson Depression Self-Rating Scale (DSRS): clinical evaluation in an adolescent inpatient population. *J. Affect. Disord.* 32, 115–125.
- Klasen, F., Otto, C., Kriston, L., Patalay, P., Schlack, R., Ravens-Sieberer, U., 2015. Risk and protective factors for the development of depressive symptoms in children and adolescents: results of the longitudinal BELLA study. *Eur. Child Adolesc. Psychiatry* 24, 695–703.
- Kleinman, A., 2004. Culture and depression. *N. Engl. J. Med.* 351, 951–953.
- Lai, Y., Zhang, Q.L., Liu, S.G., Zhang, M.H., Yang, F.C., 2012. Study on anxiety and depression of middle school students in rural Beijing (in Chinese). *China J. Health Psychol.* 20, 1204–1207.
- Li, J.-L., Chen, X., Zhao, C.H., Xu, Y., 2016. Prevalence of depression in Chinese children and adolescents: a Meta-analysis (in Chinese). *Chin. J. Child Health Care* 24, 295–298.
- Liu, L.X., Xu, J.Y., Mi, R., 2016. Analysis of depression and related factors for uygur students (in Chinese). *Chin. J. School Health* 37, 698–700.
- Luo, K., He, L.N., Shang, J., Ren, X.F., Wang, Y.J., 2013. Study on depressive symptoms and associated family environment factors in primary and middle school students of Daqing (in Chinese). *Chin. J. Child Health Care* 21, 85–87.
- Lynch, F.L., Clarke, G.N., 2006. Estimating the economic burden of depression in children and adolescents. *Am. J. Prev. Med.* 31, 143–151.
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., Group, P., 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med.* 6, e1000097.
- Montgomery, S.A., Asberg, M., 1979. A new depression scale designed to be sensitive to change. *Br. J. Psychiatry* 134, 382–389.
- National Bureau of Statistics of China, United Nations Children's Fund, United Nations Population Fund, 2017. Population status of children in China in 2015- facts and figures. <http://www.unicef.cn/cn/uploadfile/2017/0927/20170927095135855.pdf> accessed from May 20170927095132018.
- Patsopoulos, N.A., Evangelou, E., Ioannidis, J.P., 2008. Sensitivity of between-study heterogeneity in meta-analysis: proposed metrics and empirical evaluation. *Int. J. Epidemiol.* 37, 1148–1157.
- Pringsheim, T., Jette, N., Frolkis, A., Steeves, T.D., 2014. The prevalence of Parkinson's disease: a systematic review and meta analysis. *Mov. Disord.* 29, 1583–1590.
- Rotenstein, L.S., Ramos, M.A., Torre, M., et al., 2016. Prevalence of depression, depressive symptoms, and suicidal ideation among medical students: a systematic review and meta-analysis. *JAMA* 316, 2214–2236.
- Rush, A.J., Trivedi, M.H., Ibrahim, H.M., Carmody, T.J., Arnow, B., Klein, D.N., et al., 2003. The 16-Item Quick Inventory of Depressive Symptomatology (QIDS), clinician rating (QIDS-C), and self-report (QIDS-SR): a psychometric evaluation in patients with chronic major depression. *Biol. Psychiatry* 54, 573–583.
- Rushton, J.L., Forcier, M., Schechtman, R.M., 2002. Epidemiology of depressive symptoms in the National Longitudinal Study of Adolescent Health. *J. Am. Acad. Child Adolesc. Psychiatry* 41, 199–205.
- Saluja, G., Iachan, R., Scheidt, P.C., Overpeck, M.D., Sun, W., Giedd, J.N., 2004. Prevalence of and risk factors for depressive symptoms among young adolescents. *Arch. Pediatr. Adolesc. Med.* 158, 760–765.
- Shen, Z.D., Chai, Y., Wang, J., Pang, Z.D., Zhu, Y.J., 2006. Prevalence of emotional problems and its psychological effects among students in a primary school in Hangzhou (in Chinese). *Chin. J. School Health* 27, 41–42.
- Su, L., Wang, K., Zhu, Y., Luo, X., Yang, Z., 2003. Norm of the depression self-rating scale for children in Chinese urban children (in Chinese). *Chin. Mental Health J.* 17, 547–549.
- Su, L.Y., Gao, X.P., Jin, Y., Liu, J., Luo, X.R., Wen, H., 2006. Comorbidity of anxiety and depression in a primary school sample (in Chinese). *Chin. Mental Health J.* 20, 1–4.
- Sun, L., Zhou, T.H., 2005. A survey of depressive symptoms in children and adolescents aged 8–15 years (in Chinese). *Chin. J. Behav. Med. Sci.* 14, 58.
- Tan, M., Chen, M., Li, J., He, X., Jiang, Z., Tan, H., et al., 2018. Depressive symptoms and associated factors among left-behind children in China: a cross-sectional study. *BMC Public Health* 18, 1059.
- Tang, G.Z., Cheng, H.W., Pan, S.Y., 2007. Influence of mental problems on subjective life quality in children (in Chinese). *Chin. J. School Health* 28, 337–339.
- Tu, C.Y., Zhou, W., Ma, Y., Fang, Y.R., 2015. A study on the detection rate and influencing factors of depression among junior middle school students (in Chinese). *Zhejiang J. Prev. Med.* 27, 784–787.
- Wang, K., Su, L.Y., 2006. A survey of depressive disorder in children aged 8–10 years (in Chinese). *Chin. J. Behav. Med. Sci.* 15, 159–161.
- Wang, L., Feng, Z., Yang, G., Yang, Y., Wang, K., Dai, Q., et al., 2016. Depressive symptoms among children and adolescents in western china: an epidemiological survey of prevalence and correlates. *Psychiatry Res.* 246, 267–274.
- Wang, Y.-Y., Xiao, L., Rao, W.-W., Chai, J.-X., Zhang, S.-F., Ng, C.H., et al., 2018. The prevalence of depressive symptoms in 'left-behind children' in China: a meta-analysis of comparative studies and epidemiological surveys. *J. Affect. Disord.* 244, 209–216.
- Wen, M., Lin, D.H., 2012. Child Development in rural China: children left behind by their migrant parents and children of nonmigrant families. *Child Dev.* 83, 120–136.
- Weng, T.T., Hao, J.H., Qian, Q.W., Cao, H., Fu, J.L., Sun, Y., et al., 2012. Is there any relationship between dietary patterns and depression and anxiety in Chinese adolescents? *Public Health Nutr.* 15, 673–682.
- World Health Organization, 2018. Adolescents: health risks and solutions. <http://www.who.int/news-room/fact-sheets/detail/adolescents-health-risks-and-solutions> Accessed from May 2018.
- Xing, C., Tao, F.B., Tu, C.Y., Fang, Y.R., Fu, L.J., Li, M., et al., 2016. Association of satisfaction to school life with depression and anxiety symptoms among middle school students in Shaoxing city (in Chinese). *Chin. J. Public Health* 32, 1397–1400.
- Xu, X.B., Wang, R., He, H.Y., Zhao, X.Z., An, P.H., Jiang, J., et al., 2015. A survey on emotional problems of students in a primary school in Lingwu City, Ningxia (in Chinese). *Ningxia Med. J.* 37, 1223–1225.
- Yin, H.F., Xu, G.-L., Zhen, L., Yang, G.F., 2012. Norms and reliability and validity of the depression self-rating scale for children in rural children of Henan Province (in Chinese). *J. Clin. Psychiatry* 22, 310–312.
- Yong, N., Wang, H., Hu, H., Meng, H.Q., Chen, P.H., Du, L., et al., 2011. Relationship among child-abuse, depressive symptoms and sleep quality in grade 4–6 primary students (in Chinese). *Chin. Mental Health J.* 25, 616–621.
- Zhang, L., 2012. Mental Health Status and Influencing Factors of Junior High School Students in Huojia Development Zone, Zhongshan city. South China Normal University, Guangzhou, China.
- Zhang, L., Li, F., Meng, R.H., 2016. A Correlated Factor Analysis of Depression and School Education of Changzhi's middle School Students (in Chinese). *China Health Industry*, pp. 81–83.
- Zhong, B.L., Ding, J., Chen, H.H., Li, Y., Xu, H.M., Tong, J., et al., 2013. Depressive disorders among children in the transforming China: an epidemiological survey of prevalence, correlates, and service use. *Depress. Anxiety* 30, 881–892.
- Zhu, H.C., Tang, X., Zou, X.B., Lin, J.X., 2011. Investigation and analysis of stress disorder with anxiety and depression in primary and middle school students (in Chinese). *Med. J. Chin. People's Health* 23, 438–439.