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REVIEW

Worldwide prevalence of suicide attempt in pregnant and postpartum women: a meta-analysis of observational studies

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Abstract

Purpose Past suicide attempts (SA) are a major contributor to suicide. The prevalence of SA in pregnant and postpartum women varied significantly across studies. Therefore, this meta-analysis was conducted to examine the prevalence of SA and its mediating factors in this population.

Methods Relevant articles published in PubMed, EMBASE, Web of Science, PsycINFO, Medline complete, Chinese National Knowledge Infrastructure database (CNKI), Chinese Wanfang and Chongqing VIP database were systematically searched from inception to March 28, 2019. Titles, abstracts and full texts were reviewed independently by three researchers. Studies were included if they reported data on SA prevalence or provided relevant data that enabled the calculation of SA prevalence. Data were extracted by two researchers and checked by one senior researcher. The random-effects model was used to analyze data by the CMA 2.0 and Stata 12.0, with the high degree of statistical heterogeneity present. The primary outcomes were prevalence of SA with 95% CI during pregnancy and during the first-year postpartum.

Results Fourteen studies covering 6,406,245 pregnant and postpartum women were included. The pooled prevalence of SA was 680 per 100,000 (95% confidence interval 0.10–4.69%) during pregnancy and 210 per 100,000 (95% confidence interval 0.01–3.21%) during the first-year postpartum. Data source was significantly associated with prevalence of SA in the subgroup analysis (pregnancy, $p < 0.001$; the first-year postpartum, $p = 0.013$).

Conclusion The prevalence of SA is not high in pregnant and postpartum women. Due to the potential loss of life and negative impact of SA on health outcomes, however, careful screening and effective preventive measures should be implemented for this population.

Keywords Suicide attempt · Pregnant and postpartum women · Meta-analysis · Prevalence

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Introduction

Suicide is a major global public health challenge [1, 2]. Approximately, 800,000 individuals (annual rate of 10.6 per 100,000 population) die from suicide annually, with a suicide rate of 13.5 per 100,000 population in men and 7.7 per 100,000 population in women [3]. Persons with a past suicide attempt (SA) [4] usually have 20–30 times higher risk of future completed suicide than those without [5]. The global annual prevalence of self-reported SA is approximately 0.3% [6, 7]. Apart from increased likelihood of completed suicide, SA is highly associated with other negative outcomes, such as physical injuries, hospitalization, and increased treatment burden [8, 9]. For instance, a study found that global rate of years of life lost (YLL) associated with suicidality was 458.4 (438.5–506.1) per 100 000, accounting for 2.18% (1.9–2.2%) of total YLL [10]. Another study in Switzerland found that the extrapolated direct medical cost for medical treatment of SA per year amounted to 191 million Swiss Francs (CHF) [11].

Pregnant and postpartum women with SA also have various negative outcomes; for example, suicidality was associated with 2.2–13% of maternal deaths [12–15], greater risk of premature labor and caesarean delivery, and increased need for blood transfusion [16, 17]. To allocate health resources, develop relevant policies, implement effective preventive measures and treatment, and reduce poor SA-related health outcomes of in pregnant and postpartum women, better understanding of SA patterns is important. In the past years, a range of studies have examined the prevalence of SA and its correlates among pregnant and postpartum women, with mixed findings. For instance, one study found that the prevalence of SA was 40 per 100,000 pregnant women and risk factors included premature labor, cesarean delivery, and need for blood transfusion [18], while another study found that the prevalence of SA was 5190 per 100,000 pregnant women and risk factors included anxiety/depression, and experience of verbal or physical/sexual abuse [19]. In contrast, a study found that prevalence of SA was 10 per 100,000 postpartum women and risk factors included single, widowed or divorced marital status, history of a caesarean delivery or suicidality, and postpartum depression [20].

To date, no meta-analysis or systematic review synthesized the prevalence and correlates of SA; thus, we conducted this meta-analysis to examine the prevalence and moderating factors (e.g., study design and sites, sample size and mean age) of SA in pregnant and postpartum women. Based on previous findings that pregnant and postpartum depression was common [21–24] and the association between depression and suicidality [25, 26], we hypothesized that SA in pregnant and postpartum women would be common.

Methods

Data sources and search strategies

The study protocol has been reviewed in the International Prospective Register of Systematic Reviews (PROSPERO: CRD42020188798). This meta-analysis followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guideline. A systematic review of relevant publications in PubMed, EMBASE, Web of Science, PsycINFO, Medline complete, Chinese National Knowledge Infrastructure database (CNKI), Chinese Wanfang and Chongqing VIP database was independently searched by three researchers (WWR, YY and TJM) from the inception dates of the target databases up to March 28, 2019. The following search terms were used: attempted suicide, suicide attempt, suicide attempt*, parasuicide*, suicide*, self-injurious behavior, postpartum, perinatal, antenatal, mother, mom, maternal, wife, pregnant women.

Study eligibility

Titles and abstracts of relevant publications were screened, and then the full texts were read independently by the same three researchers. Any disagreements were resolved by a discussion and consensus, with final arbitration by with a senior researcher (YTX) if necessary. Studies were included if they met the following inclusion criteria: (a) SA occurred during pregnancy or the first-year postpartum; (b) cross-sectional or cohort studies; (c) studies reporting prevalence of SA or providing relevant data that enabled the calculation of prevalence of SA. Case reports, study protocols, editorials, systematic reviews and those conducted in special populations [such as those with mental disorders or major medical conditions, or health professionals] were excluded.

Data extraction

Data of study and participant characteristics were independently extracted by two researchers (YY and TJM). Any disagreements were resolved by a discussion, consensus, or consulting another researcher (WWR). Study (publication year and language, country, continent, study design, initial sample size, actual sample size, attrition rate, study site, source of data, and year of survey) and participant characteristics (period, time, mean age and standard deviation, age range and primipara), and suicide attempt-related data (i.e., frequency) were extracted.

Quality assessment

Study quality was assessed using the Parker's quality evaluation tool for prevalence studies [27], which has been widely used [28–30]. The tool contains six items, including definition and representativeness of targeted population, sampling methods, response rate, definition of the target symptom or diagnosis and validation of the assessment instrument. Each item was rated as "1 (yes)" or "0 (no or unclear)". The total score ranges from 1 to 6 with a higher score indicating better quality [31]. All studies were independently assessed by two researchers (YY and TJM).

Statistical analyses

Prevalence of SA with 95% CI was calculated using the DerSimonian and Laird random-effects model with Natural Log transformation. Heterogeneity was examined using the Q and I^2 statistic, and significant heterogeneity was defined as p value ≤ 0.05 in the Q test and $I^2 > 50\%$. Publication bias was assessed by visual inspection of the funnel plots, Begg's and Egger's tests. The "metatrim" command with the linear trimming estimator was performed in trim and fill adjusted analysis [32]. Subgroup analyses were performed to examine the moderating associations between SA prevalence and the following categorical variables: publication language (English or Chinese), type of study site (hospital, community, or mixed), study design (cross-sectional or longitudinal), and continent (i.e., Asia, America, Europe or Africa). The associations between prevalence of SA and continuous variables including year of publication, survey year based on end year, sample size, age and study quality were analyzed by meta-regression analyses [33]. Sensitivity analyses were used to examine the robustness of the primary results by excluding the included studies one by one. STATA, Version 12.0 for Windows (Stata Corporation, College Station, Texas, USA) and CMA, Version 2 (Biostat Inc., Englewood, New Jersey, USA). Significance level was set at 0.05 (two-sided).

Results

Study selection and characteristics

In the literature search, 1464 relevant studies were identified; of them, 420 were excluded due to duplicates, 955 were excluded by screening titles and abstracts, then 75 were excluded by reviewing the full texts. Finally, 14 studies with 6,406,245 participants were included. The procedure of study selection is summarized in Fig. 1. One study provided data of SA in both antenatal and postnatal women; therefore, the data were extracted and analyzed in two separate groups [34]. Study and participant characteristics are shown in Table 1. The included studies (antenatal: $n=8$; postnatal: $n=5$; antenatal and postnatal: $n=1$) were published between 2006 and 2019, with the sample size ranging from 32 to 4,833,286. Five studies were conducted in Asia, two in Europe, two in Africa, four in North America, and one in South America. Two studies were longitudinal [34, 35], while the remaining were cross-sectional.

Quality assessment, publication bias and sensitivity analysis

Table S1 shows that quality assessment scores of the 14 studies, ranging from 3 to 6, with the median of 4. The funnel plot was symmetrical, and Egger's and Begg's tests did not suggest publication bias [antenatal: (Egger: $t=2.21$, $p=0.063$; Begg: $Z=-0.63$, $p=0.532$); postnatal: (Egger: $t=0.87$, $p=0.435$; Begg: $Z=-0.19$, $P=0.851$); Fig. 2]. The Duval and Tweedies's trim and fill analysis did not reveal any missing studies, which indicates that no missing effect size qualitatively affected the pooled results. Sensitivity analyses did not find individual study which could significantly change the robustness of the primary results.

Prevalence of suicide attempt, subgroup and meta-regression analyses

During pregnancy, the pooled prevalence of SA was 680 per 100,000 ($n=4,883,231$; 95% CI 0.10–4.69%; $I^2=99.6\%$; Fig. 3). During the first year of postpartum, the pooled prevalence of SA was 210 per 100,000 ($n=1,568,376$; 95% CI 0.01–3.21%; $I^2=99.5\%$; Fig. 3). Subgroup analyses found that data collected in field surveys were associated with higher prevalence of SA in both pregnancy and the first year of postpartum (both $p<0.05$), while other study characteristics were not associated with prevalence of SA (Table 2). The prevalence estimates of SA by study site and continent are presented in Figures S1 and S2. Meta-regression analysis did not find any study characteristics significantly associated with prevalence of SA (p values >0.05, Table 2).

Discussion

To the best of our knowledge, this was the first meta-analysis to examine the worldwide prevalence of SA in pregnant and postpartum women. The prevalence of SA was 680 per 100,000 (95% CI 0.10–4.69%) within the pregnancy period and 210 per 100,000 (95% CI 0.01–3.21%) within the first postpartum year. The SA during prenatal and postpartum period could be due to several reasons. First, prenatal and postpartum depression is common [36, 37], which is a major risk factor for suicide-related behaviours including SA [38]. Second, prenatal and postpartum women often

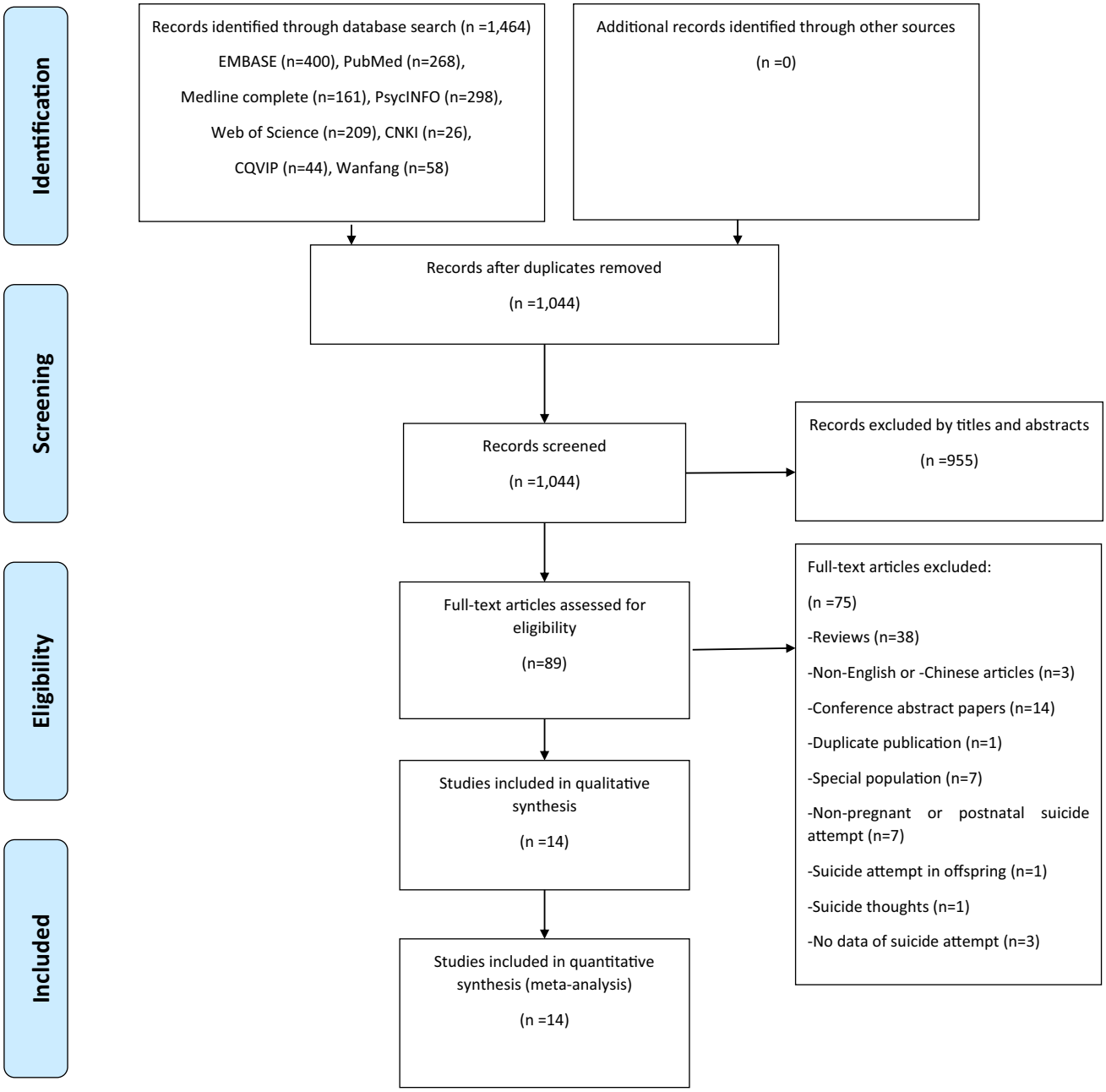

Fig. 1 Flowchart of literature selection

experience psychological symptoms related to suicide-related behaviours, such as premenstrual irritability, perceived pregnancy complications, negative attitude toward pregnancy, anxiety about birth, and social withdrawal [35, 39, 40]. Third, some studies [41, 42] found that certain delivery methods, such as caesarean delivery, were associated with increased SA risk [20] among women who are introverted and have high emotionality [43] and lower self-efficacy [44]. Fourth, intimate partner violence, including verbal abuse, physical and/or sexual violence, is associated with increased risk of SA during pregnancy [19].

To date, no meta-analysis on SA among pregnant and postpartum women was published; therefore, we cannot directly compare our findings with estimates from previous studies. We chose to examine differences between our study estimates and those derived from studies of one-year prevalence of SA in other populations. Prevalence of SA in this meta-analysis is similar to the one-year prevalence of SA in

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

No.	First author	Publication year	Publication language	Survey year	Study location	Study design	Source of data[b]	Period	Time	Initial sample size	Actual sample size	Attrition rate (%)[a]	Number of SA	Mean age (mean ± SD)	Age range	Country	Continent	Primipara	Quality score	References
1	Asad et al.	2010	EN	NR	CM	CS	Survey	Antenatal	20–26 W	1879	1369	27.14	67	NR	NR	Pakistan	Asia	NR	4	[19]
2	Gandhi et al.	2006	EN	1991–1999	HP	CS	Databases	Antenatal	≥19 W	NR	4,833,286	NR	2132	NR	NR	USA	America	NR	5	[18]
3	Girardi et al.	2011	EN	2009	HP	CS	Survey	Antenatal	NR	98	92	6.12	0	32.26 ± 4.87	22–42	Italy	Europe	Mix	6	[53]
4	Mota et al.	2019	EN	2006–2015	MIX	CH	Databases	Antenatal	NR	NR	45,362	NR	12	28.64 ± 5.64	18–45	Canada	America	Mix	5	[34]
								Postnatal	NR	NR	45,362	NR	25							
5	Newport et al.	2007	EN	NR	HP	CH	Survey	Antenatal	NR	NR	383	NR	1	32.4 ± 5.1	NR	USA	America	Mix	3	[35]
6	Onah et al.	2017	EN	2011–2012	CM	CS	Survey	Antenatal	NR	559	376	32.74	9	NR	NR	South Africa	Africa	NR	4	[54]
7	Paris et al.	2009	EN	2005–2007	CM	CS	Survey	Postnatal	NR	NR	32	NR	0	32.5 ± 5.6	23–43	USA	America	Mix	3	[55]
8	Saurel-Cubizolles et al.	2007	EN	2000	CM	CS	Survey	Postnatal	NR	NR	307	NR	0	30.5 ± 3.0	NR	France	Europe	Mix	4	[56]
9	Su et al.	2010	CH	2008	MIX	CS	Survey	Antenatal	NR	1821	1789	1.86	15	25.88 ± 3.21	NR	Mainland China	Asia	NR	5	[57, 58]
10	Shamu et al.	2016	EN	2011	HP	CS	Survey	Postnatal	6 W	886	842	4.97	34	NR	15–49	Zimbabwe	Africa	NR	6	[59]
11	Supraja et al.	2016	EN	2014–2015	HP	CS	Survey	Antenatal	5–20 W	NR	462	NR	8	23 ± 3.38	18–39	India	Asia	Mix	4	[60]
12	Vergel et al.	2019	EN	2014	HP	CS	Survey	Antenatal	NR	NR	112	NR	5	24 ± 9	13–45	Colombia	America	Mix	4	[61]
13	Wen et al.	2016	EN	2002–2012	HP	CS	Databases	Postnatal	NR	2,312,084	1,521,107	34.21	139	NR	18–50	Taiwan, China	Asia	Mix	6	[20]
14	Yang	2007	CH	2006	HP	CS	Survey	Postnatal	NR	NR	726	NR	1	31 ± NR	20–42	Mainland China	Asia	NR	4	[62]

[a]Attrition rate was defined as the difference between the initial number of samples minus the number of samples that completed the study, divided by the initial number of samples

[b]Survey: fieldwork survey. Database: health system-based database

CH Chinese, *EN* English, *CM* community, *HP* hospital, *CS* cross-sectional study, *CH* cohort, *W* weeks, *D* days, *M* months, *NR* not reported, *SD* standard deviation

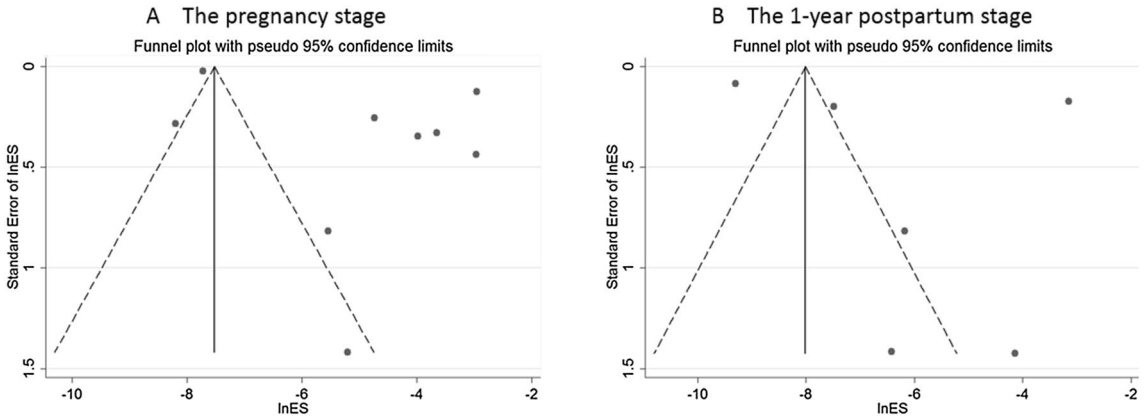

Fig. 2 Funnel plot of publication bias

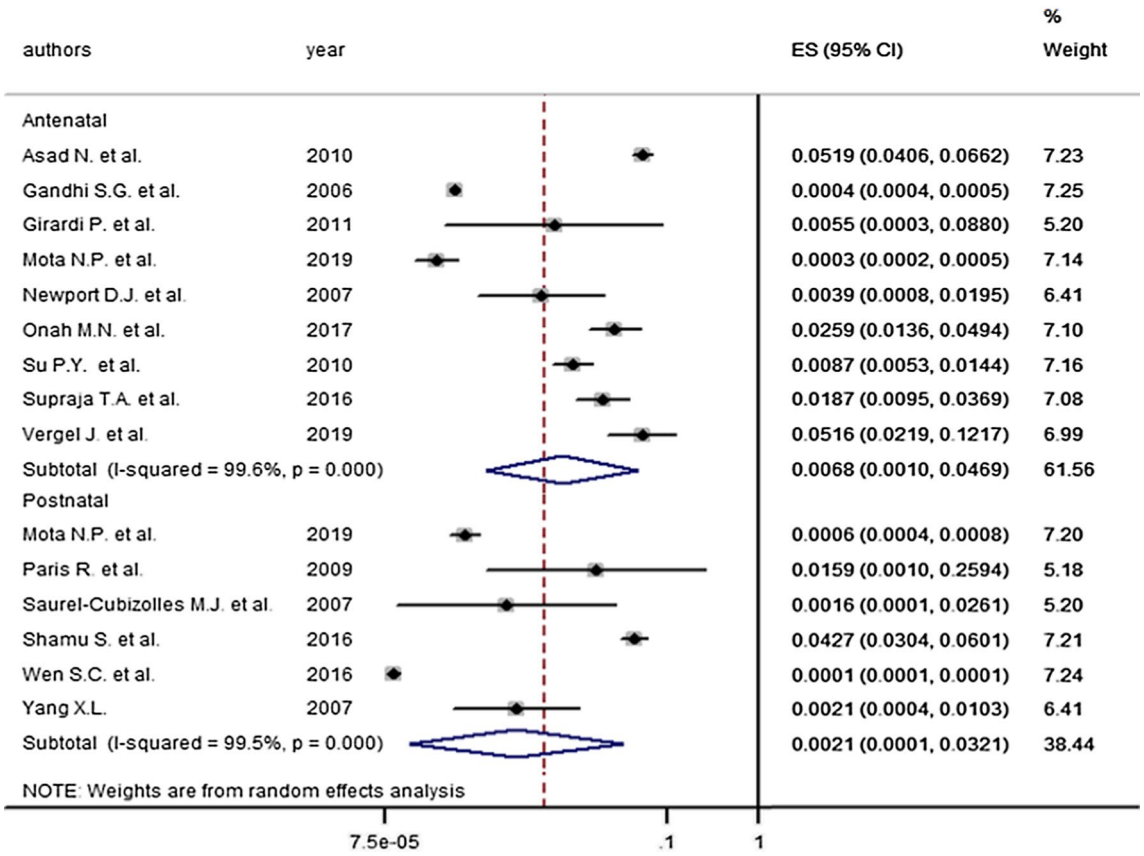

Fig. 3 Forest plot of the prevalence of suicide attempts in pregnant and postpartum women

the female general population in some studies, e.g., the figure was 300 per 100,000 in high-income countries and 500 per 100,000 in low- and middle-income countries [7]. However, our result is lower than the figures in college female students worldwide (1260 per 100,000, 95% CI 0.82–1.8%) [45] and in Korean female adolescents (6300 per 100,000) [46]. It should be noted that different population characteristics and prevalence timeframe (e.g., during pregnancy and the postpartum period vs. 1 year) hinder direct comparisons between studies. The prevalence of SA in this study was not as high as we hypothesized, which probably may be due to the following reason. Depression is a major contributor of SA [47, 48]. However, most previous studies reporting common pregnant and postpartum depression only focused on mild-moderate depressive symptoms as measured by screening scales [49, 50], rather than the clinical diagnosis

Table 2 Subgroup and meta-regression analyses

Category	Variables	Classification	Sample size	Effect size	95% CI Lower	95% CI Upper	I^2	*P* across subgroup
Subgroup analysis	Antenatal							
	Continent	Asia (3)	3620	0.02	0.004	0.094	95.36	0.142
		America (4)	4,879,143	0.002	< 0.001	0.008	97.27	
		Europe (1)	92	0.005	< 0.001	0.221	–	
		Africa (1)	376	0.024	0.001	0.308	–	
	Publication language	EN (8)	4,881,442	0.006	0.001	0.049	99.60	0.917
		CN (1)	1789	0.008	< 0.001	0.759	–	
	Study design	CS (7)	4,837,486	0.011	0.001	0.102	99.68	0.291
		CH (2)	45,745	0.001	< 0.001	0.058	79.33	
	Study site	CM (2)	1745	0.034	0.001	0.459	76.42	0.377
		HP (5)	4,834,335	0.006	0.001	0.043	98.15	
		Mix (2)	47,151	0.001	< 0.001	0.035	98.75	
	Data source	Databases (2)	4,878,648	< 0.001	< 0.001	0..001	67.96	< 0.001
		Survey (7)	4583	0.018	0.008	0.039	88.60	
	Postnatal							
	Continent	Asia (2)	1,521,833	< 0.001	< 0.001	0.005	86.31	0.230
		America (2)	45,394	0.002	< 0.001	0.036	81.31	
		Europe (1)	307	0.002	< 0.001	0.145	–	
		Africa (1)	842	0.040	0.001	0.639	–	
	Publication language	EN (5)	1,567,650	0.002	< 0.001	0.041	99.60	0.912
		CN (1)	726	0.001	< 0.001	0.553	–	
	Study design	CS (5)	1,523,014	0.003	< 0.001	0.104	99.60	0.738
		CH (1)	45,362	0.001	< 0.001	0.685	–	
	Study site	CM (2)	339	0.005	0.001	0.034	20.12	0.915
		HP (3)	1,522,675	0.002	< 0.001	0.183	99.80	
		Mix (1)	45,362	0.001	< 0.001	0.698	–	
	Data source	Databases (2)	1,566,469	< 0.001	< 0.001	0.001	98.54	0.013
		Survey (4)	1907	0.007	0.001	0.056	81.89	

Category	Group	Variables	Slope	SE	95% CI Lower	95% CI Upper	*t*	*P*
Meta-regression	Antenatal	Year of publication	0.084	0.146	−0.261	0.429	0.58	0.582
		Survey year	0.154	0.146	−0.221	0.529	1.06	0.339
		Sample size	-6.53×10^{-7}	3.84×10^{-7}	-1.56×10^{-6}	2.55×10^{-7}	−1.70	0.133
		Age	−0.268	0.202	−0.828	0.291	−1.33	0.254
		Study quality	−1.113	0.812	−3.033	0.806	−1.37	0.212
	Postnatal	Year of publication	−0.105	0.220	−0.715	0.505	−0.48	0.658
		Survey year	−0.104	0.222	−0.720	0.512	−0.47	0.664
		Sample size	-2.57×10^{-6}	1.32×10^{-6}	-6.24×10^{-6}	1.09×10^{-6}	−1.95	0.123
		Age	0.690	0.250	−0.388	1.767	2.75	0.110
		Study quality	−0.467	0.974	−3.171	2.237	−0.48	0.657

CH Chinese, *EN* English, *CM* community, *HP* hospital, *CS* cross-sectional study, *CH* cohort, *NR* not reported

of major depressive disorder (MDD). Mild-moderate depressive symptoms may be more likely to increase the risk of suicidal ideation and suicide plan, rather than severe suicidality, such as SA and suicide in clinical practice. As expected, a positive association between data collected in field surveys and the prevalence of SA was found. Data scrutinized from databases were often underestimated because some useful information could not be recorded due to lack of face-to-face

interviews and use of standardized instruments which were often used in field surveys.

Strengths of this study include the large sample size and use of sophisticated data analyses (e.g., subgroup and meta-regression analyses, and sensitivity analysis). However, some limitations should be noted in this meta-analysis. First, only articles in English and the Chinese languages were included, thus, those published in other languages may be missed. Second, similar to other meta-analyses of epidemiological studies on suicidality [4, 51], high heterogeneity still remained, even though subgroup analyses were performed. The source of heterogeneity may be related to certain unreported factors, such as pregnancy care, way of delivery, and family relationships. Third, some variables related to SA, such as economic status, information of prior SA in people who died of suicide, history of psychiatric disorders, substance use [8, 52], were not analyzed due to insufficient data reported by included studies. Fourth, the large difference in sample size between studies was mainly due to different source of data (e.g., secondary analyses of databases vs. survey-based samples). However, no moderating effect of the sample size on the results was found in subgroup analyses. In addition, sensitivity analyses did not find outlying studies with large or small sample size that could significantly affect the primary results. Fifth, some studies included in this meta-analysis had lower scores in quality assessment, which might bias the results. Sixth, fatal SAs were not recorded in included studies, which might bias the results. Seventh, due to the relatively low prevalence of SA and/or small sample size in some studies, the confidence intervals were large in the forest plot. Finally, most studies were conducted in Asia and North America, which limits the generalizability of the findings.

In summary, this meta-analysis found that SA is not high in pregnant and postpartum women compared to 1-year prevalence of SA in other populations. Considering the negative impact of SA on health outcomes and potential loss of life, hence clinicians should routinely screen SA in pregnant and postpartum women and undertake effective treatments if necessary, such as public education on suicide prevention and providing hotline services. Appropriate psychotropic treatments should be prescribed for those with severe psychiatric symptoms. Prospective studies on the association between SA and other demographic and clinical variables in pregnant and postpartum women are warranted in the future. In addition, international studies could be conducted to explore the impact of different sociocultural and economic factors on suicide attempt in this population.

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Compliance with ethical standards

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

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