



Suicide and Maternal Mortality

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Abstract

Purpose of Review Suicide is a leading cause of death in the perinatal period (pregnancy and 1 year postpartum). We review recent findings on prevalence, risk factors, outcomes, and prevention and intervention for suicide during pregnancy and the first year postpartum.

Recent Findings Standardization of definitions and ascertainment of maternal deaths have improved identification of perinatal deaths by suicide and risk factors for perinatal suicide. Reports of a protective effect of pregnancy and postpartum on suicide risk may be inflated. Clinicians must be vigilant for risk of suicide among their perinatal patients, especially those with mental health diagnoses or prior suicide attempts.

Summary Pregnancy and the year postpartum are a time of increased access to healthcare for many, offering many opportunities to identify and intervene for suicide risk. Universal screening for suicide as part of assessment of depression and anxiety along with improved access to mental health treatments can reduce risk of perinatal suicide.

Keywords Perinatal · Suicide · Maternal mortality · Pregnancy · Postpartum

Introduction

Death by suicide in the perinatal period (pregnancy or the first 12 months postpartum) is a tragedy that can be difficult to imagine. Beyond the loss of life due to perinatal suicide, the effects on family and community are profound and have a lasting impact. It can be challenging to imagine that someone would take their own life during a period that is generally viewed as one of the happiest events in life. Yet death by suicide is a leading cause of maternal mortality and accounts for about 20% of postpartum deaths [1]. Rates

of perinatal death by suicide remain high even as maternal mortality due to more commonly recognized causes such as sepsis and hemorrhage decline.

Maternal mortality is a marker of population health and reducing maternal mortality rates is a priority for countries worldwide. It is estimated that between 2000 and 2017, there was a 38% reduction in global maternal mortality ratio (defined as the number of maternal deaths during a given time period per 100,000 live births during the same time period) [2]. Despite this drop across the world, in the USA, the maternal mortality ratio increased by 26.6% between 2000 and 2014 [3]. Although part of this increase is attributed to improved methods of identifying maternal deaths, maternal mortality rates in the USA are the highest among developed countries [3], and suicide is a leading cause of maternal mortality [4•].

Box 1 summarizes commonly used definitions regarding maternal mortality. The World Health Organization (WHO) definitions of maternal death and late maternal death [5] differ from the US Centers for Disease Control and Prevention (CDC) definitions of pregnancy-related deaths and pregnancy-associated deaths [6]. State Maternal Mortality Review Committees or Panels (MMRCs) track pregnancy-associated deaths and pregnancy-related deaths [7].

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While there is robust data surrounding medical conditions such as postpartum hemorrhage or hypertension as they relate to maternal mortality, research surrounding suicide and maternal mortality has been relatively limited. This is partly because until recently, deaths related to behavioral health were not considered to be pregnancy-related [8], and not counted towards maternal mortality rates. In 2019, a comprehensive review by Mangla et al. focused on maternal mortality due to suicide and overdose [9••]. In this paper, we assess recently published literature not included in that review, and with a focus only on suicide. We identified key words related to suicidality during pregnancy and postpartum in PUBMED. The search terms used were pregnancy, postpartum, peripartum, antepartum, maternal mortality, suicide, self-injurious behavior, and self-harm, yielding an initial 1995 results. After confining our search to literature published in English from 2018 to 2021, and removing duplicates, we were left with 483 results. We aimed to include articles that discussed suicide, suicidal ideation, and suicide attempts in pregnancy and up to 1 year postpartum. We included case reports, original research, and reviews. On reviewing title and abstract, we narrowed our search to 118 articles and further narrowed to 105 articles after reviewing full-text articles (Table 1). Bibliography search of included articles yielded an additional five relevant articles for a total of 110 articles reviewed. For each of the articles reviewed, we extracted information on prevalence, risk factors, outcomes, prevention, and interventions for perinatal suicide.

Box 1 Definitions associated with maternal mortality

Pregnancy-associated death: Death during pregnancy or within one year of the end of pregnancy, irrespective of cause.

Pregnancy-related death: Death during pregnancy or within 1 year of pregnancy from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by physiologic effects of pregnancy.

Maternal death: Death during pregnancy or within 42 days of the end of pregnancy, from any cause related to or aggravated by pregnancy or its management, but not from accidental or indirect causes.

Late maternal death: The death of a woman from direct or indirect obstetric causes more than 42 days but less than 1 year after termination of pregnancy.

Prevalence of Perinatal Suicide and Perinatal Suicidality

Measurement and Reporting of Perinatal Suicide

Accurate measurement of the prevalence of perinatal death by suicide is challenging for several reasons [10, 11]. Suicide is a rare outcome that is difficult to measure in any population, and additional considerations in measuring perinatal suicide include lack of standardization of terms that describe the timing and cause of maternal deaths, and a lack of uniformity in methods of ascertaining maternal deaths [12]. The broadest definition for maternal mortality is “death in pregnancy or the first year postpartum.” However, up until 1999, the International Classification of Diseases (ICD), ninth revision, definition included deaths during pregnancy and only up to 42 days postpartum as a maternal death. There is also a lack of standardization in how the term “postpartum” is used. It is variously defined as starting from the time of delivery date, registration of a live birth, or registration of fetal death, leading to further variation in reported rates [13].

Another factor to consider in determining the prevalence of perinatal suicide is how maternal deaths are ascertained. The US Centers for Disease Control and Prevention (CDC) uses ICD codes listed in medical records to track maternal deaths. They also use information listed in the death certificate, which has included a pregnancy status checkbox (indicates whether the decedent was or was not pregnant within 1 year of death) since 2003. However, the pregnancy checkbox alone does not address the issue of errors in measurement, and women who died by accidental or incidental means between 2001 and 2008 were not accurately identified as pregnant or postpartum in almost 50% of cases despite adoption of the pregnancy checkbox on the death certificate [9••].

Most importantly, until recently, deaths associated with suicide and overdose were not included in the “direct” maternal deaths counts [14]. The International Classification of Diseases for Maternal Mortality (ICD-MM) started classifying all suicides in pregnancy and up to 12 months postpartum as direct obstetric deaths only in 2012 [15]. Lommerse et al. examined the effect of the 2012 change in ICD 10 MM and found that reclassifying deaths by suicide as direct deaths did not change maternal mortality rates significantly when limited to 42 days postpartum but did significantly increase rates when extended to 1 year postpartum [16]. Thirteen to 36% of maternal deaths were attributed to suicide when the postpartum period was extended to 1 year postpartum [16].

Table 1 Summary of all included studies

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Admon et al. [56•••]	Trends in Suicidality 1 year before and after birth among commercially insured childbearing individuals in the United States, 2006–2017	Serial cross-sectional study	Childbearing individuals	593,237 individuals, 2714 diagnoses of suicidality	N/A	SI	The prevalence of suicidal ideation increased from 0.1 to 0.5% per 100 individuals from 2006 to 2017. Intentional self-harm prevalence increased from 0.1 to 0.2% per 100 individuals from 2006 to 2017. Suicidality prevalence increased from 0.2% per 100 individuals to 0.6% per 100 individuals from 2006 to 2017. Non-Hispanic Black individuals, and individuals with lower income, and younger individuals experienced larger increases in suicidality over the study period
Ahn et al. [130]	Initiatives to Reduce Maternal Mortality and Severe Maternal Morbidity in the United States: A Narrative Review	Narrative review	Multiple, perinatal	Varies	Varies	Severe maternal morbidity and maternal mortality	Description of the epidemiology of maternal mortality and severe maternal morbidity in the USA and selected initiatives to reduce maternal mortality and severe maternal morbidity in the areas of data and surveillance; clinical workforce training and patient education; telehealth; comprehensive models and strategies; and clinical guidelines, protocols, and bundles
Akram et al. [78]	Postpartum depression and suicidal ideation in new mothers with hearing loss: Perceived social support as a moderator, a multicenter study	Cross-sectional	Postpartum women with/without hearing loss from maternity clinics 2–6 weeks after delivery in Pakistan	547	EPDS	SI	Mothers with hearing loss were 1.97× more likely to exhibit PPD and 1.08× more likely to be at risk of suicidal ideation compared to those without hearing loss
Alluvula et al. [100]	One-Year Follow-Up of Women with Severe Acute Maternal Morbidity (SAMM): A Cohort Study	Prospective cohort study	Women with SAMM vs uneventful pregnancy, 1-year follow-up	86	EPDS	SI	Suicidal ideation was more prevalent in women with SAMM (18.42%, $p = 0.001$). Those with perinatal loss had higher EPDS score compared to those w/o; however, there was no significant difference in diagnosis of depression or suicidal ideation

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Ammerman et al. [88]	Interpersonal trauma and suicide attempts in low-income depressed mothers in home visiting	Cross-sectional	Low-income young, depressed mothers enrolled in an early childhood home visiting program	170	Suicide history questionnaire	SA	31.8% of mothers had previous suicide attempts; median number of lifetime attempts was 2. Those who had attempted suicide had more MDD symptoms and more childhood trauma
Arachchi et al. [46]	Suicidal ideation and intentional self-harm in pregnancy as a neglected agenda in maternal health: an experience from rural Sri Lanka	Cross-sectional	Pregnant women in tertiary care center in Sri Lanka, 3rd trimester	475	EPDS	SI, self-harm	0.8% answered “yes quite a lot” to SI question, 2.3% answered “yes sometimes,” and 2.7% answered “hardly ever.” 0.8% of women reported having a history of intentional self-harm during the current pregnancy. The study estimates around 500 pregnant women each year having SI and 130 Intentional Self Harm (ISH) annually in Anuradhapura
Ayre et al. [47]	The Prevalence and Correlates of Self-harm in the Perinatal Period	Systematic Review	Women in pregnant/postpartum period up to 1 year	39 articles, reporting 19,191,431 pregnancies	N/A	Self-harm	Self-harm prevalence during pregnancy ranged from 0 to 2.39%, self-harm during postpartum year 0 to 2.41%, and self-harm during postpartum year in women with severe mental illness from 0 to 21.9%. Correlates of self-harm include mental disorder, substance misuse, being younger age, being unmarried, and obstetric/neonatal complications
Bao et al. [84]	Poor sleep and Decision-Making Disturbance Are Associated with Suicidal Ideation in Pre-natal depression	Cross-sectional	Pregnant women in 3rd trimester of pregnancy ($n=30$ recent SI, $n=35$ prenatal depression w/o SI, $n=35$ healthy controls)	100 pregnant women	EPDS	SI	The prenatal depression with suicidal ideation group showed significantly higher score in subjective sleep quality and lower score in block 5 of the Iowa Gambling Task than the prenatal depression without suicidal ideation group. Suicidal ideation was positively correlated with subjective sleep quality, sleep duration, and daytime function and negatively correlated with IGT scores

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Belete and Misgan [67]	Suicidal behavior in postnatal mothers in northwestern Ethiopia: a cross-sectional study	Cross-sectional	Mothers > 18 years old in routine post-natal care	1065 mothers	N/A	SA	The prevalence of suicidal behavior (SI, plan, or attempt) was 14% in postpartum mothers. Poor wealth of the mother, unplanned pregnancy of the current child, history of rape, and sickness of the new child were significantly associated with suicidal behaviors
Belete et al. [64]	Prevalence and Cor-relates of Suicidal Ideation and Attempt among Pregnant Women Attending Antenatal Care Services at Public Hospitals in Southern Ethiopia	Cross-sectional	762 pregnant women attending ante-natal services at public hospitals in Hawassa southern Ethiopia, selected by systematic random sampling technique	762 pregnant women	CIDI	SI and SA	The prevalence of suicidal ideation among pregnant women was 11.8% and suicide attempt was 2.7%. Unplanned pregnancy, poor social support, common mental disorders, and lifetime suicidal ideation were significantly associated with SI. Social support was the only corre-lated factor with suicide attempt
Biggs et al. [118]	'I need help': Reasons new and re-engaging callers contact the PANDA-Perinatal Anxiety and Depression Australia National Helpline	Retrospective descriptive design	PANDA hotline	365	N/A	SI	Of the 365 calls, 98% were from pregnant women or postpartum women < 12 months. 110 were identified as at risk at intake, with 45 calls pertaining to suicidal thoughts and 8 with self-harm
Bondoc et al. [89]	Psychological and Bio-logical Markers of the Suicidal Behavior in Post-Partum Depressive Disorder	Retrospective study	Women with history of sub-clinical depression, addressing to psychotherapy in the last 5 years which gradually returned with post-partum depressive episode	30	N/A	Self-harm	Risk factors associated with suicidal behavior in patients with postpartum depressive disorder include age under 35, socio-familial and precarious economic status, childhood abuse, disharmonic family relationships, abuse, emotional instability, accentuated personality, subclinical psychiatric suffering, collateral history of mental illness, past history of suicide attempts, low cholesterol levels
Boutin et al. [18]	Database Autopsy: An Efficient and Effective Confidential Enquiry Into Maternal Deaths in Canada	Retrospective cohort study	Maternal deaths and late maternal deaths in Canada	85 maternal deaths, 120 late maternal deaths	Death certificates	Suicide	Of late maternal deaths, 16 were due to direct obstetric causes; 9 of these were deaths by suicide. Death by suicide was the leading direct cause of late maternal death in 2013–2017

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Campbell et al. [92]	Pregnancy-associated deaths from homicide, suicide, and drug overdose: Review of research and the inter-section with intimate partner violence	Review	Perinatal deaths due to homicide, suicide, and drug overdose	N/A	N/A	SI, SA, completed suicide	IPV is a significant risk factor for pregnancy associated suicide. Previous suicide attempts and suicidal ideation can be a risk factor for suicide completion
Soares et al. [107]	Suicide risk and prematurity: A study with pregnant adolescents	Prospective cohort study	Pregnant women aged between 12–19yo	645	MINI	SI	The prevalence of suicide risk was 12.6%. Adolescents who had suicide risk during pregnancy were approximately twice as likely to give birth prematurely
Chalise et al. [34]	Factors Associated with Postnatal Depression among Mothers Attending at Bharatpur Hospital, Chitwan	Cross-sectional	Postnatal women who gave birth in the past 6 months attending Bharatpur Hospital in Nepal	242	EPDS	SI	Prevalence of postnatal depression was 16.9% using EPDS cutoff point ≥ 12 . 13.6% of total participants endorsed ever having suicidal thoughts during the 6-month postnatal period
Collier and Molina [55]	Maternal Mortality in the United States: Updates on Trends, Causes, and Solutions	Review	Pregnancy-related deaths	N/A	N/A	Suicide	Pregnancy-related deaths have risen in the past 2 decades in the USA. For non-Hispanic white women, mental health conditions were the leading cause of death. Mental illness, substance use, and intimate partner violence are common risk factors among women who died of both medical and nonmedical causes
de la Rosa et al. [40]	Examining the Prevalence of Peripartum Depression Symptoms in a Border Community	Secondary data analysis of case series observational data	Health Start program participates in New Mexico, first trimester up to 8 weeks postpartum	1453 women	EPDS	SI	Older women (>35 years old) had significantly higher odds of scoring positive for thoughts of self-harm than younger women at all peripartum screenings (adjusted OR 3.38, 95% CI 1.41–8.08).

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Doherty et al. [80]	Suicidality in Women with Adjustment Disorder and Depressive Episodes Attending an Irish Perinatal Mental Health Service	Post hoc analysis of multicenter-case control study	Perinatal women attending Irish Perinatal Mental Health service	45 perinatal women, 109 matched controls	SIS, SSI, IDS-C30	SI	In the perinatal group, 22.2% reported SI or behaviors; this was more common in those w/ diagnosis of adjustment disorder rather than depressive episode although this was not statistically significant. The participants with AD had higher levels of intent as measured by SIS, but not statistically significant
Doi and Fujiwara [90]	Combined effect of adverse childhood experiences and young age on self-harm ideation among postpartum women in Japan	Cross-sectional	Mothers 3 months postpartum	8074	EPDS	SI	Postpartum women with 3 or more ACES and younger age were 10.3× more likely than those with no ACES and older age to have self-harm ideation
Duan et al. [131]	Relationship between trait neuroticism and suicidal ideation among postpartum women in China: Testing a mediation model	Cross-sectional	Postpartum women < 1-month post-birth in China	1027	PHQ9	SI	5.3% endorsed suicidal ideation. Anxiety and depression fully mediated the associated between neuroticism and suicidal ideation
Edler et al. [132]	Pregnancy-related and maternal deaths in Hamburg, Germany: an autopsy study from 1984–2018	Retrospective analysis	Autopsies of maternal deaths in Germany	57	N/A	Suicide	In this study, 9 women died by suicide, which was the leading cause of non-natural death
Enatescu et al. [38]	The role of personality dimensions and trait anxiety in increasing the likelihood of suicide ideation in women during the perinatal period	Longitudinal prospective study	Pregnant women, reassessed in 6- and 8-week postnatal period at university-based clinic in Romania	202	EPDS	SI	Rates of SI decreased from 13.9% in the antenatal period to 6.3% in the postnatal period. Lower level of education was associated with presence of postnatal suicidal ideation, whereas unemployed status was more frequent in women with antenatal SI. Trait anxiety was predictive for appearance of SI within the entire perinatal period assessed. Agreeableness and conscientiousness also predicted antenatal SI

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Faisal-Cury et al. [102]	The Relationship Between Mother–Child Bonding Impairment and Suicidal Ideation in Sao Paulo, Brazil	Cross-sectional	Low-income postpartum women with antenatal depression in Sao Paulo, Brazil	358	PHQ9	SI	10.3% of participants endorsed SI. Women presenting with bonding impairment were 6.6 times more likely to present with SI. Bonding impairment, postpartum depression, and higher family income were associated with SI
Fellmeth et al. [41]	Suicidal ideation in the perinatal period: findings from the Thailand–Myanmar border	Prospective cohort study	Migrant and refugee women living along the Thailand–Myanmar border. In brief, women attending antenatal clinics provided by the Shoklo Malaria Research Unit who were aged > 18 years, in their first trimester of pregnancy,	568	SCID	SI	5.3% (30/568) women experienced suicidal ideation. Refugee women were more likely to experience suicidal ideation than migrant women (8.0 versus 3.1%; $P = 0.01$). Most women with suicidal ideation did not have severe depression. Previous trauma (OR 2.32; 95% CI: 1.70–3.15) and unplanned pregnancy (OR 2.74; 95% CI: 1.10–6.86) were significantly associated with suicidal ideation after controlling for all other variables
Forray and Yonkers [111]	The Collision of Mental Health, Substance Use Disorder, and Suicide	Clinical expert series	Perinatal mental health and substance use	N/A	N/A	SI, self-harm, SA, suicide	SI and self-harm among perinatal women with comorbid substance use has increased over the past decade from 1.8% per 100 individuals to 9.3% per 100 individuals. Suicide accounts for 5–20% of deaths in pregnant and postpartum women, although rate of suicide is lower in perinatal women than in women who are not perinatal. Perinatal women with a suicide attempt are half as likely to be receiving treatment

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Garman et al. [79]	Association between perinatal depressive symptoms and suicidal risk among low-income South African women: a longitudinal study	Secondary analysis of RCT	Pregnant woman < 28 weeks pregnant, followed at 8 months gestation, followed at 3 months and 12 months	384	MINI, HDRS	Self-harm, SA	76 participants reported suicidal ideation (19.8%) and 64 (16.7%) reported having made suicide plans in the past month. 3.4% reported having made a suicide attempt in the past month. The proportion of participants at risk of suicide and reporting suicidal behaviors decreased steadily over the course of the study. Change in HDRS scores were positively correlated with suicide score, and with odds of being at moderate risk of suicide. Secondary analysis indicated that a decrease in HDRS score was associated with decrease in suicide scores, but an increase in HDRS was not associated with change in suicide score
Gelabert et al. [103]	The role of personality dimensions, depressive symptoms and other psychosocial variables in predicting postpartum suicidal ideation: a cohort study	Prospective cohort study	1795 Spanish women assessed early postpartum, 8 and 32 weeks postpartum	1795 women	EPDS	SI	7% of mothers reported SI during the first 8 months postpartum. 62% of women with SI had a major depressive episode at 8 weeks and 70% at 32 weeks. Neuroticism and psychosis predicted SI throughout the first 2 weeks after delivery. Early PPD symptoms, personal psych history, and stressful life events during pregnancy were predictors of postpartum SI
Gelaye et al. [105]	Association of antepartum suicidal ideation during the third trimester with infant birth weight and gestational age at delivery	Cohort study	Pregnant women receiving prenatal care in Lima Peru	1108	PHQ9	SI	The prevalence of suicidal ideation was 8.7%. Women who experienced SI were more likely to have < 12 years education, more likely to have difficulty accessing the basics including food, to have unplanned pregnancy, and more likely to have depression. Average infant birthweight was 96.5 g lower for participants with SI compared to those without, and 94.2 g lower after adjusting for confounders. After adjusting for confounders, women with SI had 3.73× increased odds of small for gestational age infants

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Glasser et al. [24]	The tip of the iceberg: postpartum suicidality in Israel	Review/meta-analysis	Published and unpublished literature on SI in Israel, and analysis of data on death within a year of childbirth	N/A	EPDS for SI, Analysis of 193 deaths within a year of childbirth for SA	SI and SA	Of the 20,259 suicide attempts recorded in EDs of general hospitals in Israel, 565 (2.8%) were by women in the postpartum period. The suicide attempt rate for non-postpartum women was 3–5 × that of postpartum women. 7 postpartum suicides were recorded, a rate of 0.43 per 100,000 births
Goldman-Mellor et al. [57]	Maternal drug-related death and suicide are leading causes of postpartum death in California	Retrospective, population-based cohort study	Women who delivered infant in California	10,590,713	N/A	Suicide	A total of 300 women died during follow-up, with a rate of 28.33 deaths per 100,000 person-years. Drug-related deaths were the second leading cause of death, whereas suicide was the 7th leading cause of death. 2/3 of women who died, including 74% of those who died by drugs/suicide made > 1 emergency department/hospital visit between their delivery and death
Gordon et al. [129]	Self-harm, Self-harm Ideation, and Mother-Infant Interactions: A Prospective Cohort Study	Prospective cohort study	Women attending antenatal appointments	545	EPDS	SI	The prevalence of history of self-harm was 7.9% and current self-harm ideation was 2.3%. Self-harm ideation was associated with elevated depressive symptoms in the perinatal period and poorer quality mother-infant interactions
Govender et al. [60]	Antenatal and Postpartum Depression: Prevalence and Associated Risk Factors among Adolescents' in KwaZulu-Natal, South Africa	Cross-sectional	Adolescent females accessing maternal health services in KwaZulu-Natal, South Africa	326	EPDS	SI	The prevalence of depression among pregnant participants was 15.9% and 8.8% in postpartum participants. The desire to incur self-harm was reported by 9.8% of participants
Crywacheski et al. [87]	Opioid and Cannabis Use During Pregnancy and Breastfeeding in relation to sociodemographic and mental health status: a descriptive study	Cross-sectional	Canadian women who gave birth between January and June 2018	7111	EPDS	SI	10.4% of women reported thoughts of self-harm. Thoughts of self-harm were significantly associated with cannabis use during pregnancy and breastfeeding

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Guglielminotti et al. [71]	Exposure to General Anesthesia for Cesarean Delivery and Odds of Severe Postpartum Depression Requiring Hospitalization	Retrospective cohort study	Pregnant women who had cesarean delivery in New York State Hospital during study period	428,204 cesarean delivery cases	Discharge records	SI, Self-harm	General anesthesia in cesarean delivery was associated with 54% increased odds of PPD and 91% increased odd of suicidal ideation or self-inflicted injury
Halim et al. [96]	Intimate partner violence during pregnancy and perinatal mental disorders in low and lower middle income countries: A systematic review of literature, 1990–2017	Systematic review	Population: Pregnant and postpartum women in low and lower-middle income countries	24 studies	N/A	SI	Suicidal ideation ranged between 5 and 11% during pregnancy and 2 and 22% during the postpartum period. Participants who experienced IPV had 1.69–3.76 and 1.46–7.04 times higher odds of antenatal and postnatal depression compared to those who did not.
Hasegawa et al. [8]	How should maternal death due to suicide be classified? Discrepancy between ICD-10 and ICD-MM	Commentary	Japanese women who completed suicide during or after pregnancy	24	N/A	Suicide	Categorization of suicide when mother does/does not have underlying mental disorder diagnosis is complicated, and there is a discrepancy between ICD-10 and ICDMM
Heck et al. [25]	Maternal Mortality Among American Indian/Alaska Native Women: A scoping review	Review	Maternal mortality literature concerning AI/AN women (21 studies)	N/A	N/A	Suicide	An intimate partner conflict potentially contributed to 54.3% of pregnancy-associated suicides. Nine studies investigated AI/AN maternal death by suicide, however small samples and categorization as other precluded data analysis
Howard et al. [15]	Perinatal mental health: a review of progress and challenges	Review	Perinatal mental health in low and high income countries	N/A	N/A	Self-harm, suicide	Suicide is a leading cause of death during the perinatal period in high income countries (5–20%), but it is a modest contributor to deaths in low-middle income countries. Suicide risk is particularly related to depression. Deaths more often occur in the 2nd half of the first postpartum year. A significant proportion of women self-harm before suicide

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Islam et al. [93]	Do Maternal Depression and Self-Esteem Mediate and Mediate the Association Between Intimate Partner Violence After Childbirth and Postpartum Suicidal Ideation?	Cross-sectional	New mothers in first 6 months postpartum in Bangladesh	426	N/A	SI	Prevalence of postpartum SI was 30.8%. Postpartum SI was significantly higher among women who reported physical IPV during the first 6 months postpartum. Postpartum depression also increased postpartum SI while high self-esteem significantly reduced reports of SI
Jago et al. [72]	Mental Health and Maternal Mortality –When New Life Doesn't Bring Joy	Retrospective cohort study	Perinatal maternal deaths in Alberta (during pregnancy up to 1 year postpartum)	206	Data from Alberta Perinatal Health Program	Suicide	Of 206 perinatal maternal deaths, 16 deaths were a result of suicide (including 6 from overdose). The mean age of women who died from suicide was 27 years old \pm 8.3. 29.% of deaths by suicide occurred in pregnancy and 70.6% occurred in the first postpartum year. Of the postpartum deaths, 11.8% occurred in early postpartum (up to 42 days), and 58.8% in late postpartum. The pregnancy-related MMR for suicide up to 365 days after birth was 2.05 per 100,000 deliveries. Those who died by suicide were more likely to have a history of psychiatric disorder and were more likely to be taking medication for psychiatric disorder
Jashti et al. [91]	Associations Between Adverse Childhood Experiences and prenatal mental health and substance use among urban, low-income women	Single-center retrospective cohort study	Pregnant women referred to mental health care manager at urban OB clinic	98 women	EPDS	SI	28% reported current suicidality. ACE \geq 4 associated with increased risk of suicidal thoughts (4.1 higher odds of suicidal thoughts during pregnancy). Participants that reported any form of abuse had 3.9 higher odds of suicidal thoughts (95% CI 1.1–13.9)
Johannsen et al. [74]	Prophylactic use of ketamine reduces postpartum depression in Chinese women undergoing cesarean section(★)	RCT	Chinese women undergoing c-section	654	EPDS	SI	The prevalence of postpartum blues and postpartum depression were significantly lower in the ketamine compared to control group. Ketamine administration protected against PPD and PPD-associated risk factors, including stress during pregnancy, antenatal depressive symptoms, and antenatal suicidal ideation

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Kalmbach et al. [85]	Self-harm in women with postpartum mental disorders	Register-based cohort study	Danish women born after Jan 1 1963	1554	N/A	Self-harm	Among the 1554 participants with severe first-onset PPMD, 64 had first-ever hospital record of self-harm. Women with PPMD had HR of 6.2 for self-harm compared to mothers without mental disorders, but self-harm risk was lower in PPMD women compared to mothers with non-PPMD, and childless women with mental disorders
Kambach et al. [94]	Depression and suicidal ideation in pregnancy: exploring relationships with insomnia, short sleep, and nocturnal rumination	Cross-sectional	267 pregnant women	267	EPDS	SI	10.1% endorsed SI; high rumination and insomnia are associated with suicidal ideation
Kimmel [116]	Nocturnal cognitive hyperarousal, perinatal-focused rumination, and insomnia are associated with suicidal ideation in perinatal women with mild to moderate depression	Prospective observational study	Women from late pregnancy through early postpartum	39	EPDS	SI	Nocturnal cognitive hyperarousal at baseline and women with prior perinatal loss were at increased risk for new onset SI. SI risk was highest when women reported both insomnia combined with nocturnal cognitive hyperarousal or perinatal-focused rumination
Kitsantas et al. [26•]	Maternal Mental Health Matters	Invited commentary	N/A	N/A	N/A	Suicide	Suicide as reports in the National Violent Death Reporting System between 2003 and 2007 accounted for more death than obstetric complications. Massachusetts Child Psychiatry Access Project for Moms and North Carolina MATTERS program can help expand care for maternal mental health

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Knasmuller et al. [12]	Prevalence and correlates of suicidal behaviors during pregnancy: evidence from the National Survey on Drug Use and Health	Cross-sectional	Pregnant women in the USA	7479	National survey on drug use and health	SI, self-harm, SA	Suicidal behavior (including ideation, plans, or attempts) was estimated at 3.4% for the entire sample, with 4.4% among women in the first trimester and 2.9% for women in the second/third trimester. Women who received mental health treatment in the past 12 months and perceived unmet mental health treatment had a significantly higher likelihood of displaying suicidal behaviors
Knettel et al. [69]	Maternal suicide during pregnancy and the first postpartum year in Austria: Findings from 2004 to 2017	Retrospective study	Suicides in Austria during pregnancy and first postpartum year	10	N/A	Suicide	Of the 9978 women of childbearing age in Austria who died, 1102 died by suicide. Ten women were identified as having been pregnant or postpartum; however, 67% of death certificates specified pregnancies as unknown and only 15.3% specifically noted that the woman had not been pregnant at time of death. The maternal suicide rate was 0.89 per 100,000 birth events but low number may be due to methodological issues in identifying perinatal suicides
Knight [11]	Exploring patterns and predictors of suicidal ideation among pregnant and postpartum women living with HIV in Kilimanjaro, Tanzania	Longitudinal cohort study	Pregnant/6-month postpartum women with HIV in Kilimanjaro, Tanzania	200	EPDS and PHQ9	SI	SI was endorsed by 12.8% of women during pregnancy which decreased to 3.9% by 6 months postpartum. Suicidal ideation was associated with depression, anxiety, HIV stigma, single relationship status, unknown HIV status of the father of the baby, negative attitudes about ART, and low social support
Kubota et al. [62]	A View From the UK: The UK and Ireland Confidential Enquiry into Maternal Deaths and Morbidity	Commentary	N/A	N/A	N/A	Suicide	Maternal suicide is recognized as a major contributor to maternal mortality. Over half of the women who died by suicide had a diagnosis of recurrent mental health disorder, yet this history often was not identified at their initial antenatal appointment. Women's symptoms were often downgraded or expressions of acts of violent self-harm were dismissed as impulsive

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Kugbey et al. [97]	The Risk Factors Predicting Suicidal Ideation Among Perinatal Women in Japan	Prospective cohort study	Women in Nagoya Japan (early pregnancy, late postpartum, and 1 month postpartum)	430	EPDS	SI	The rate of participants who were suspected of having SI at any four time points was 13.0%. The highest time point was during late pregnancy (5.8%)
Lega et al. [73]	Prevalence and Correlates of Prenatal Depression, Anxiety, and Suicidal Behaviors in the Volta Region of Ghana	Cross-sectional	Pregnant women from 2 hospitals in Volta Region of Ghana	214 pregnant women	Single-item questions developed by researchers	Suicidal behaviors (ideation, plan, attempt)	Prevalence of prenatal depression was 50.5% and current suicidal behaviors were 3.3%. Lifetime suicidal behaviors and current intimate partner violence were the only factors significantly associated with current suicidal behavior
Levey et al. [58]	Maternal suicide in Italy	Retrospective analysis	Maternal suicides in Italy	67	N/A	Suicides	67 cases of maternal suicide were identified, corresponding to a maternal suicide ratio of 2.3 per 100,000 live births. The suicide rate was 1.18 per 100,000 after giving birth, and 2.77 after and induced abortion, and 2.9 after a miscarriage. The majority of women who died by maternal suicide had a previous psychiatric history
Lewkowitz et al. [133]	Suicide risk assessment: examining transitions in suicidal behaviors among pregnant women in Peru	Cross-sectional	Peruvian pregnant women	2062	Suicide questionnaire from WHO CIDI	SI, Self-harm, SA	Of the 2062 participants, suicidal behaviors were endorsed by 22.6%. 22.4% endorsed lifetime history of SI, 7.2% reported history of planning, and 6% endorsed suicide attempts. Being unmarried was associated with planning and attempting suicide. Difficulty accessing medical care was associated with SI and planning. Difficulty accessing food, history of childhood abuse, and IPV were statistically significantly associated with SI, planning, and attempt

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Li et al. [45]	Association between stillbirth \geq 23 weeks gestation and acute psychiatric illness within 1 year of delivery	Retrospective cohort study	Female residents in Florida aged 13–55 years old with stillborn $>$ 23 weeks gestation within 1 year of delivery	8292 stillbirths (compared to 1,194,758 live births)	N/A	SA	Depression and anxiety were significantly higher after stillbirth vs livebirth (aOR 2.75 for depression, 2.29 for anxiety). Excluding women with severe intrapartum maternal morbidity, there were 11 suicide attempts in the stillborn group compared to 554 in the liveborn singleton group, for an adjusted odds ratio of 3.07 (1.68–5.58)
Lillie et al. [37]	Suicide attempt and its associated factors amongst women who were pregnant as adolescents in Bangladesh: a cross-sectional study	Cross-sectional	First pregnancy at age of 17 or younger from 5 hospitals in urban Bangladesh	940 participants	Survey w/ question; Have you ever tried to kill yourself in the past 12 months	SA	6.5% reported suicide attempts in the past 12 months, the majority (88.5%) occurred within 1 year after pregnancy. Participants with suicide attempts were significantly younger than those without. Those with suicide attempts had significantly less perceived social support
Lin et al. [83]	Prevalence and Cor-relates of Depression Among Pregnant Women Enrolled in a Maternal and Newborn Health Program in Rural Northern Ghana: A Cross-sectional Survey	Cross-sectional	374 pregnant women in low resource setting in Northern Ghana	374	PHQ9	SI	14.2% of participants endorsed thoughts of self-harm or suicide within the past 2 weeks. About 1/5 of the population screened for moderate to moderately severe depression. Low hopefulness, moderate/severe hunger, IPV, and insufficient social support were associated with moderate to severe depression
Liu et al. [43]	Intergenerational transmission of emotion dysregulation: Part I. Psychopathology, self-injury, and parasym pathetic responsibility among pregnant women	Cross-sectional	Pregnant women	162	Lifetime suicide attempt self-injury interview	Self-harm	20% of women endorsed self-harm at some point during pregnancy. 4 women endorsed nonsuicidal self-injury during pregnancy, and one reported that she tried to commit suicide during pregnancy. Those who reported antenatal Self Injurious Thoughts and Behaviors (SITBs) were less likely to be married, were less educated, more likely to endorse lifetime SITBs, and more likely to report that their pregnancy was unwanted. Self-reported emotional dysregulation was more strongly correlated with antenatal SITBs than lifetime self-injury

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Lommerse et al. [16]	Mental health among pregnant women with COVID-19 -related stressors and worries in the United States	Cross-sectional	US pregnant women	715 pregnant women	EPDS	SI	43.3% of respondents had either depression and/or anxiety, which was at least 2.5 times higher than prepandemic prevalence among pregnant women. Losing a family member because of COVID and worrying about getting financial support were positively associated with thoughts of self-harm. Adults working from home were inversely associated with thoughts of self-harm
Luykx et al. [120]	The impact of reclassifying suicides in pregnancy and in the postnatal period on maternal mortality ratios	Review	Classification of maternal deaths in pregnancy and postpartum	N/A	N/A	Suicide	There was a minimal impact on new WHO approach on maternal mortality rates reported when maternal mortality definition was limited to 42 days postpartum. Reclassification of suicides as late direct deaths up to 1 year postpartum shows a significant increase in direct maternal mortality rates. The proportions of suicides are between 13–36% of maternal deaths when late deaths of up to 1-year postpartum are included
Lysell et al. [53]	Prevention of Infanticide and Suicide in the Postpartum Period—the Importance of Emergency Care	Review/expert opinion	Emergency care in the postpartum period	N/A	N/A	Suicide	30% of mothers who commit filicide also commit suicide. Recognition and treatment of postpartum psychosis may help prevent filicide and suicide
Ma et al. [126]	Maternal suicide—Register based study of all suicides occurring after delivery in Sweden 1974–2009	Nested case control design	All women who gave birth in Sweden during 1974–2009 were considered, then all mothers who died by suicide	1786 mothers who died by suicide	N/A	Suicide	Among 1786 suicides, 141 (7.9%) had delivered within 1 year before their suicide, and 4.0% within 6 months before death. Childbirth within the preceding year was negatively associated with suicide. 20.7% had admission due to self-harm before the suicide. Maternal suicide within the first year after childbirth was strongly associated with current mental disorder, in particular affective, psychotic, and substance use disorder

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Machado et al. [125]	Esketamine for Postpartum suicidality	Case report	39 years old postpartum woman	1	N/A	SA	Patient with PPD with psychotic features 4 months after preterm delivery of her twins, with suicidal and delusional thoughts. Pt attempted suicide by ingesting alprazolam pills. Patient was treated with esketamine 0.5 mg/kg SC×2 and had complete remission of SI. Seven days after final dose of esketamine (dose 3), previous symptoms disappeared Prevalence and risk factors for maternal suicide/opioid related deaths
Mangla [9••]	Maternal self-harm deaths: an unrecognized and preventable outcome	Review	Suicide and opioid related deaths in pregnancy and postpartum	N/A	N/A	Suicide	
Mare [82]	Perinatal suicidality: prevalence and correlates in a South African Birth Cohort	Cross-sectional ante and postnatal data from DCHS birth cohort	748 women in South African birth cohort, measured antenatal and 6 months postpartum	748 total (347 prenatal, 522 postpartum, 121 assessed both time periods)	MINI	Self-harm	Antenatal self-harm prevalence was 19.9% and postpartum 22.6%. Self-harm associated with younger age 9 antepartum), PTSD (postpartum) and depression (ante and postpartum). Depression and PTSD predicted belonging in the high-risk self-harm group. Medium risk group was more likely to have depression, alcohol use during pregnancy, substance use
Martini et al. [61]	Predictors and outcomes of suicidal ideation during peripartum period	Prospective longitudinal study	Women in the Maternal Anxiety in Relation to Infant Development study (examined from early pregnancy until 16 months postpartum)	306	EPDS, CIDI, BSI	SI and self-harm	Peripartum suicidality (PS) (SI, plans, attempt) was found in 15 women. History of suicide attempt, not living with partner, and low social support were significant predictors for peripartum suicidality. As compared to women with no PS, infants of women with PS presented lower scores in neuropsychological development
Meltzer-Brody and Kimmel [117]	The Promise of Telepsychiatry to Reduce Maternal Mortality by Increasing Access to Maternal Mental Health and Addiction Services	Editorial	Telepsychiatry to improve access to perinatal mental health and substance treatment	N/A	N/A	N/A	Limited access to mental health and addiction services during the perinatal period has prevented patients from connecting with psychiatric services. Telepsychiatry provides an opportunity to deliver this to patients in need

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Meurk [13]	Suicidal behaviors in the peripartum period: a systematic scoping review of data linkage studies	Scoping review	Review of 18 studies related to suicidal behaviors in the peripartum period	N/A	N/A	Suicidal behaviors	Data linkage can be used to improve understandings of risk factors and pathways and to examine both health and social services utilization among women and children
Miksic et al. [30]	Depression and Suicidality during Pregnancy	Cross-sectional	Pregnant women	110	EPDS	SI	26.36% scored positive for perinatal depression. 2.73% endorsed rarely having SI
Modimi et al. [66]	Maternal deaths by suicide in Queensland, Australia, 2004–2017: an analysis of maternal demographic, psychosocial and clinical characteristics	Retrospective analysis	Suicide deaths of women in Queensland during pregnancy or within 1 year after the end of pregnancy	65 maternal deaths by suicide (all cause <i>n</i> = 286)	N/A	Suicide	Most maternal suicides followed live birth (46%), and 1/3 occurred in the 12 months after a termination of pregnancy. Most suicides were a late maternal death. The average age of women dying by suicide was 26 years old. Most women had at least one prior mental health diagnosis (71%). The most common diagnosis was depression (51%) followed by anxiety (17%), and postpartum depression (12%). Many women had a history of expressing or presenting with suicidal ideation (62% or had previously attempted suicide (37%). Antidepressants were the most commonly prescribed medication (29% at the time of death
Monaghan et al. [31]	Prevalence and Stigma of Postpartum Common Mental Disorders in the Gurage Region of Ethiopia: A Mixed-Methods Observational Cohort Study	Cross-sectional	118 postpartum women who had given birth in the past 3 months	118 pregnant women	SRQ	SI	Of the women surveyed, 18% had a probable common mental disorder, and 2% admitted to suicidal thoughts
Moreyra et al. [36]	Implementing a standardized screening protocol for parental depression, anxiety, and PTSD symptoms in the Neonatal Intensive Care Unit	Cross-sectional	NICU parents [120 mothers, 30 fathers]	150	PHQ9	SI	23% of parents (includes both mothers and fathers) scored 10 or above on PHQ9, with 9% of positive screens (<i>n</i> = 3) scoring above a 0 on item 9 (related to suicidal thoughts)

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Mota et al. [51]	Mental Disorders and Suicide Attempts in the Pregnancy and Postpartum Periods Compared with Non-Pregnancy: A Population-Based Study	Retrospective cohort study	Perinatal vs non perinatal women in Manitoba	45,362 perinatal women, 139,705 non-perinatal	N/A	SA	Within the perinatal cohort, pregnancy was associated with lower rate of diagnosed mood or anxiety disorder, substance use disorder, and suicide attempt compared to pre-pregnancy. Compared with non-perinatal women, pregnancy was associated with lower rate of all outcomes. Postpartum had a higher rate of psychotic disorder compared with pre-pregnancy but a lower rate of mood/anxiety disorder and suicide attempt
Musyimi et al. [68]	Suicidal behavior risks during adolescent pregnancy in a low-resource setting: A qualitative study	Qualitative analysis of 27 focus group discussions	Healthcare workers, informal healthcare providers, adolescent, and adult pregnant and postnatal women	27 focus group discussion, 8 key informant interviews	N/A	Self-harm	5 themes associated with suicidal behavior risk among adolescent mothers include poverty, intimate partner violence, family rejection, social isolation and stigma from the community, and chronic physical illness
Mutiso et al. [99]	Prevalence of positive depression screen among post miscarriage women- A cross sectional study	Cross-sectional	Patients recruited at post-miscarriage clinic review at gynecology clinics at Nairobi, 2 weeks after miscarriage	182	EPDS	SI	34.1% screen positive for depression; of the patients who had positive depression screen, 33.1% had thoughts of self-harm
Nana et al. [104]	Hyperemesis gravidarum is associated with increased rates of termination of pregnancy and suicidal ideation: results from a survey completed by > 5000 participants	Cross-sectional	5071 participants from UK region	5071	14 item anonymous online survey	SI	25.5% reported occasional suicidal ideation owing to severe sickness, and 6.6% reported regular suicidal ideation owing to severe sickness
Ozturek and Ugras [108]	Pregnancy outcomes after suicide attempts by self-poisoning and drug overdose: experience of a clinical pharmacology consultation service in Izmir, Turkey	Case reports	Case studies of 9 attempted suicide by self-poisoning and overdose	9	N/A	Suicide attempt	Most of the women who attempted suicide were under 35 years old. Half of them had 3 pregnancies or more. None of the women who attempted suicide had a history of psychiatric disease or prior suicide attempt. Only 1 of the case reports resulted in spontaneous abortion

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Palagini et al. [86]	Stress-related sleep reactivity is associated with insomnia, psychopathology and suicidality in pregnant women: preliminary results	Cross-sectional	Pregnant women	62	EPDS	SI	Pregnant women with high-stress-related sleep reactivity had greater rates of depression, anxiety, and suicidality compared those with low reactivity
Palfreyman [59]	Addressing Psychosocial Vulnerabilities Through Antenatal Care—Depression, Suicidal Ideation, and Behavior: A study Among Urban Sri Lankan Women	Cross-sectional	Antenatal women in Gampaha District in Sri Lanka (Urban)	1000 antenatal women	EPDS, modified CSSRS, original Life stances questionnaire	SI and self-harm	25.7% of participants had lifetime history of self-harm (ideation/behaviors/or combo) with current pregnancy prevalence of self-harm of 7.4%. 4.1% of women reported current pregnancy SI which did not escalate to subsequent behaviors. 3.3% reported at least one at least one form of suicidal behavior, three quarters of which were suicide attempts while 1.9% disclosed non-suicidal self-harm during their current pregnancy. Exposure to intimate partner violence and lifetime self-harm was the strongest correlates to current pregnancy self-harm outcomes
Palladino et al. [95]	Thoughts of self-harm and associated risk factors among postpartum women in Canada	Cross-sectional	Postpartum women	6558	Survey on Maternal health	SI	10.4% of respondents reported thoughts of self-harm since the birth of their child. 54.2% of those who reported self-harm had symptoms of PPD, and 37.1% had symptoms of GAD

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Perotto et al. [14]	Maternal Mortality in Switzerland 2005–2014	Retrospective cohort study	Maternal deaths (up to 365 days after pregnancy)	96 maternal deaths	N/A (Death certificates)	Suicide	13 cases had cause of death classified as suicide, all of which were classified as indirect deaths. There was not enough information about mental health history to classify them as either direct deaths or non-pregnancy related deaths. If all suicides had been classified as a direct obstetric death in accordance with ICD-MM, then suicide would have been the leading cause of maternal deaths in Switzerland. In Switzerland, the suicide rate of women aged 15–44 years was 3.6/100,000 females; the suicide rate in relation to pregnancy and delivery was 1.65 per 100,000 live births
Phukata and Omole [134]	Prevalence and risk factors associated with postnatal depression in a South African primary care facility	Cross-sectional	Postnatal women in Levai Mbatha Community healthcare center in Evaton, South of Gauteng	227	EPDS	SI	38.8% of participants screened positive for postnatal depression. 32.5% of participants scored between 1 and 3 on Question 10 of EPDS "The thought of harming myself or my baby has occurred to me"
Rao et al. [44]	Worldwide prevalence of suicide attempts in pregnant and postpartum women: a meta-analysis of observational studies	Meta-analysis	Pregnant and postpartum women	6,406,245	N/A	SA	14 studies were included. The prevalence of suicide attempt was 680 per 100,000 during pregnancy (95% CI 0.1–4.69%) and 210 per 100,000 during the first year postpartum (95% CI 0.01–3.21%). Meta-regression analysis did not find any study characteristics significantly associated with prevalence of SA
Rathod et al. [32]	Characteristics of perinatal depression in rural central, India: a cross-sectional study	Population-based cross-sectional study	Perinatal women in rural central India	224 from Community Study, 130 from Facility study	PHQ-9	SI	Of the 224 perinatal women in the Community study, 6.2% reported suicidal ideation; and of the 130 women in the facility study, 5.4% reported SI. In total an average of 5.9% endorsed SI

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Rodriguez et al. [70]	Correlates of Suicidal Ideation During Pregnancy and Postpartum Among Women Living with HIV in Rural South Africa	Data drawn from larger longitudinal RCT	Pregnant women, reassessed at 12 months postpartum in rural South Africa	681	EPDS	SI	Prenatal suicidal ideation was 39% at 12 months; 13% experienced incident SI, and 19% SI had stopped postnatally. IPV and depression predicted sustained SI. Increased income and greater HIV stigma predicted incident SI. Younger age, disclosure of HIV status to partner, and greater stigma predicted postnatal cessation of SI
Rodriguez-Cabezas and Clarke [22]	Psychiatric Emergencies in Pregnancy and Postpartum	Review	Pregnant and postpartum women	N/A	N/A	SI	Suicide risk during the perinatal period is estimated to be 1.6–4.5 per 100,000 live births in the USA. Suicidal ideation is a predictor of suicide and PPD
Shafiei et al. [119]	Characteristics of women calling the PANDA Perinatal Anxiety & Depression Australia National Helpline: a cross-sectional study	Cross sectional	Initial risk assessment of callers to PANDA	2629	N/A	SI, self-harm	Of 2907 participants, 81.5% were recorded as no risk of suicide, 529 (18.2%) endorsed general thoughts of suicide, 100 or 3.4% endorsed thinking about details; and 4.7% were categorized as other (prior attempts, has a plan)
Shenai et al. [109]	Fetal Outcomes in Intentional Over-the-Counter Medication Overdoses in Pregnancy	Case report	Review of suicide attempts with over-the-counter medications, and clinical guidelines	3	N/A	SA	If overdose occurs, management in pregnancy is largely guided by toxicological guidelines in nonpregnant patients as there are limited data, and few studies examine fetal sequelae
Shi et al. [63]	Maternal depression and suicide at immediate prenatal and early postpartum periods and psychosocial risk factors	Short-term longitudinal survey at perinatal stages	Pregnant women after admission for childbirth (surveyed before delivery, and then between 3–7 days after childbirth)	213	EPDS	SI	Women reported lower depression scores and higher suicidal ideation incidence (11.74%) after childbirth. More mothers with SI reported marital dissatisfaction. Compared with mothers without SI, those with SI had relatively higher self-esteem. At early postpartum, more mothers with SI had previous miscarriage experiences, were relatively older, perceived more stress, and had higher prenatal SI

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Shigemi et al. [76]	Suicide attempts during pregnancy and perinatal outcomes	Retrospective cohort study	Pregnant women admitted to participating hospitals because of suicide attempts	319	N/A	SA	Approximately 58% of patients were in the 3rd trimester. 39.5% had mental and behavioral disorders on admission; the main diagnoses were depression (15.4%), schizophrenia (13.2%) and personality disorders (9.7%)
Shigemi et al. [76]	Suicide attempts among pregnant and postpartum women: A nationwide Retrospective Cohort Study	Retrospective cohort study	Pregnant and postpartum women who had psychoneurological disorders admitted to Japanese participating hospitals	3286	N/A	SA	Of 3286 women, 22 pregnant women and 16 postpartum women had attempted suicide. The prevalence of suicide was significantly higher among postpartum women (6.2%) compared to pregnant women (0.7%). Postpartum patients were more likely to be over 30 years old and have depression. Wrist cutting was the main method of suicide attempt among pregnant patients, whereas hanging was the main method among postpartum patients
Steinberg et al. [101]	The association between first abortion and first-time non-fatal suicide attempt: a longitudinal cohort study of Danish population registries	Prospective cohort study	Danish women > 18yo	523,280 women	N/A	SA	Women who had abortion were more likely to have suicide attempts. The increased risk was the same in the year before and after first abortion, thus this increased risk is not attributable to the abortion itself
Szpunar et al. [33]	Suicidal Ideation in Pregnant and Postpartum Women Veterans: An Initial Clinical Needs Assessment	Cross-sectional	Pregnant veterans during 3rd trimester and 6 weeks postpartum	28	CSSRS, EPDS, BHS	SI	30% of veteran women had past lifetime suicide attempts; over 10% had SI during the perinatal period. Depression and post-traumatic stress symptoms neared 30% during pregnancy. There was no correlation with current SI and depressive symptoms or post-traumatic stress symptoms
Tabb et al. [39]	Prevalence of antenatal suicidal ideation among racially and ethnically diverse WIC enrolled women receiving care in a Midwestern public health clinic	Cross-sectional	Low-income pregnant women in WIC program	736	EPDS	SI	The prevalence of SI was 4.6%. After adjusting for smoking, women with depression were 1.3× more likely to report SI

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Tabb et al. [98]	Intimate Partner Violence Is Associated with Suicidality Among Low-Income Postpartum Women	Cross-sectional	Postpartum women in Brazil	701	Clinical interview schedule	SI	The prevalence of postpartum SI was 4%. Of those who expressed postpartum SI, 70% reported IPV during the postpartum period. Postpartum women exposed to violence had a 3 × greater risk of having SI thoughts
Takegata et al. [128]	Perinatal self-report of thoughts of self-harm, depressive symptoms, and personality traits: Prospective study of Japanese community women	Secondary analysis from data using longitudinal study	Women at obstetric clinics in Japan	243	EPDS	SI	Mean scores for item 10 of EPDS were very low over the perinatal period. The rate of women who reported a score of 2 or 3 for item 10 was 5.6%, 1.6%, and 2.0% for waves 1,2,3. Women who reported “sometimes” or “quite often” were characterized by high anxiety and depression, low self-directed, low cooperativeness, and lack of affection and anger and rejection towards the baby
Vallee et al. [122]	Association between Antidepressant Treatment during Pregnancy and Postpartum Self-harm Ideation in Women with Psychiatric Disorders: A cross-sectional, multinational study	Cross-sectional	Postpartum women (five weeks post birth to end of first postpartum year)	187	EPDS	SI	52.9% of women took antidepressants during pregnancy. Frequent Self Harm Ideation (SHI) postpartum was reported by 15.2% of non-medicated women and 22% of women on past antidepressant treatment in pregnancy. There was no preventative association of antidepressant treatment in pregnancy on reporting frequent SHI postpartum
Van Niel and Payne [121]	Perinatal depression: a review	Review	N/A	N/A	N/A	Suicide	Suicide is the second-leading cause of death for women in the postpartum period, leading to 20% of deaths during the first year after birth. Thoughts of harming the baby occur in 41% of depressed mothers versus 7% of controls
Vawda [77]	Suicide attempts during pregnancy in South Africa	Retrospective pilot study	Female patients admitted following suicide attempts over a period of 1 year at a tertiary hospital in South Africa	27	N/A	SA	Of the 27 charts reviewed, 9 patients were pregnant at the time of attempt. The mean age was 23.4 years old. MDD was diagnosed in 33% of participants

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Vichi et al. [54]	Completed suicide during pregnancy and postpartum	Review	N/A	N/A	N/A	Suicide	Suicide during peripartum represents a leading cause of maternal mortality in late postpartum. Suicide prevention requires early screening, assessment, and monitoring
Vigod et al. [48]	Postpartum self-inflicted injury, suicide, assault and homicide in relation to immigrant status in Ontario: a retrospective population-based cohort study	Population-based retrospective cohort study	Immigrant/nonimmigrant mothers in Ontario 1 year after giving birth	327,278 immigrant and 942,502 nonimmigrants	N/A	SA, suicide	The rate of self-inflicted injury was similar among immigrants and nonimmigrants. There were 1411 nonfatal self-inflicted injury events (1.11 per 1000 births) and 44 deaths due to injury following self-inflicted injury or injury inflicted by others 0.03 per 1000 births
Weng et al. [81]	Do stillbirth, miscarriage, and termination of pregnancy increase risks of attempted and completed suicide within a year? A population-based nested case-control study	Nested case control design	Taiwanese national Health Insurance Research Database, National birth registry, and national death registry	Cases – 835; Controls—8350	N/A	SA, suicide	485 attempted suicide, 350 completed suicide within 1 year postnatally. The rates of completed suicide increased in women who experienced fetal loss—aOR 5.2 for women with stillbirth, 3.81 for miscarriage, and 3.12 for termination of pregnancy compared to those who had live birth
Worley and Wise-Ehleres [115]	Telepsychiatry in Obstetrics	Review/expert opinion	N/A	N/A	N/A	Suicide	Maternal suicide now exceeds hemorrhage and hypertensive disorders as a cause of maternal mortality in the first postpartum year. The peak time for deaths is 7–12 months postpartum
Wu et al. [42]	Perinatal depressive and anxiety symptoms of pregnant women during the coronavirus disease 2019 outbreak in China	Cross-sectional	Pregnant women during 3rd trimester in China	4124	EPDS	SI	Pregnant women after declaration of COVID-19 epidemic had significantly higher rates of depressive symptoms and were more likely to have thoughts of self-harm
Yadav et al. [28]	Postpartum Depression: Prevalence and Associated Risk Factors Among Women in Sindh Pakistan	Cross-sectional	Multi-center at 3 major tertiary care centers in Sindh, Pakistan	357	EPDS	SI	Of the 19.3% women with PPD, 12 (3.3%) of women had persistently thought about self-harming

Table 1 (continued)

Author and year	Title	Study type	Population studied	Sample size	Screening tool used	Outcome(s) measured	Summary
Zewdu et al. [35]	Prevalence of suicidal ideation and associated factors among HIV positive perinatal women on follow-up at Gondar town health institutions, Northwest Ethiopia: a cross-sectional study	Cross-sectional	HIV positive perinatal women in Gondar town health institutions in NW Ethiopia	422	CIDI	SI and SA	Prevalence of suicidal ideation was 8.2%. Perinatal depression, undisclosed HIV status, and unplanned pregnancy were associated with suicidal ideation. 0.97% of women endorsed suicide attempt
Zhang et al. [29]	Suicide ideation among pregnant women: The role of different experiences of childhood abuse	Cross-sectional survey based	Women at 28 weeks gestation or more attending prenatal care	1825	PHQ9	SI	Overall prevalence of SI was 5.2%. Women with any experience of childhood abuse had increased risk of suicidal ideation (OR 2.44, 95% CI 1.31–4.55). After adjustment for depression, only pregnant women with physical abuse had high risk of SI (OR 3.63, 95% CI 1.32–10.03). Pregnant women with both childhood abuse and depression had increased risk of SI compared to those with neither risk factor
Zhong et al. [49]	Use of natural language processing in electronic medical records to identify pregnant women with suicidal behavior: towards a solution to the complex classification problem	Cross-sectional electronic medical record-based study	Women with diagnostic codes related to pregnancy/postpartum and suicide attempt/behavior	275,843	N/A	Self-harm	Diagnostic validity of a natural language processing algorithm was checked against gold-standard labels obtained from manual chart review to identify pregnant women with suicidal behavior. The estimated prevalence of suicidal behavior among the study population was 515.87 per 100,000 pregnant women
Zipursky et al. [65]	Acute poisoning in pregnancy: a province-wide perspective from a poison center	Retrospective	Poisoning exposures in pregnant women aged 12–60 years	1716	N/A	SA	Intentional exposures accounted for 18% of calls; intentional exposures were more frequent in the first and second trimesters relative to third

BSI Brief Symptom Inventory, *CIDI* Composite International Diagnostic Interview, *EPDS* Edinburgh Postnatal Depression Scale, *HDRS* Hamilton Depression Rating Scale, *MINI* Mini International Neuropsychiatric Interview, *PHQ-9* Patient Health Questionnaire 9, *SA* suicide attempt, *SI* suicidal ideation, *SRQ* Self-Reporting Questionnaire, *SIS* Suicide Intent Scale, *SSI* Scale of Suicidal Ideation, *IDS-C30* Inventory of Depressive Symptom-Clinician Rated, *CSSRS* Columbia Suicide Severity Rating Scale, *BHS* Beck Hopelessness Scale

There are many ways to increase the accuracy of measurement of perinatal suicide prevalence, for example, increasing autopsy rates and using postmortem pregnancy tests [17] and “database autopsy” [18] in which national hospitalization records are used to create a sequential narrative to identify the cause of maternal death. Data gathered from multiple sources such as death certificates, reports of postmortem examinations linked to health administrative data for hospital admissions, and outpatient mental health codes [13] can increase accuracy of prevalence rates and also capture the multiple and variable clinical contacts that can occur through pregnancy and postpartum or shed light on socioeconomic factors which contribute to risk for perinatal mental health problems such as interpersonal violence, housing stability, or poverty [13].

In the USA, the Preventing Maternal Deaths Act was passed in 2018 to standardize the definitions of maternal mortality and fund state MMRCs to better track maternal death [19]. With more states forming MMRCs and standardizing the way in which maternal deaths are measured and reported, it is hoped that we will have more accurate reports of maternal mortality in the years to come.

Prevalence Rates of Perinatal Suicide

The most recent reports on maternal mortality in the USA by the CDC indicate that 754 women died of maternal causes in the USA for a maternal mortality rate of 20.1 deaths per 100,000 live births, more than half of which occurred in the postpartum period [20]. There are severe and concerning racial and ethnic disparities in maternal mortality rates, and the maternal death ratio for Black women is 2.5 times the ratio for White women and three times the ratio for Hispanic women [21]. With regard to suicide as a cause of maternal mortality, perinatal suicide rates in the USA are estimated at 1.6 to 4.5 per 100,000 live births [22]. This compares to 5.3 to 5.5 per 100,000 nonperinatal women aged 10–54 years [23]. Global perinatal suicide rates range between 1.27 and 3.7 per 100,000 live births [22]. Israel reports a lower rate of 0.43 per 100,000 live births, or 3.6% of postpartum mortality [24], reasons for this being religion as a protective factor, or under-reporting of suicide due to mental health stigma. Trost et al. [4•] in reviewing pregnancy-related mental health deaths (including suicides and accidental overdoses) in 14 states, found that, 11% of pregnancy-related deaths were due to mental health conditions, and 63% of pregnancy-related mental health deaths were by suicide. Most (86%) of these deaths occurred in White people, which was a significant difference from the race and ethnicity distribution of pregnancy-related deaths from other causes [4•]. However, racial and ethnic differences in maternal mortality due to suicide can be difficult to evaluate; for example, American Indian/

Alaska (AI/AN) maternal mortality data for homicide and suicide often include small samples and may categorize AI/AN maternal deaths in an “Other” race/ethnicity category [25]. Furthermore, an evaluation of suicidal behaviors (thoughts, plans, and attempts) among 7479 pregnant women using the National Survey on Drug Use and Health found that all racial/ethnic groups of women in the third trimester were less likely to be suicidal relative to black non-Hispanic women [26•].

The percent of maternal deaths attributable to suicide varies between states, ranging from 4% in Philadelphia, 5% in Texas and New York, 7% in Virginia and Illinois, to 13% in Colorado [9••].

Prevalence of Suicidality and Suicide Attempts

In considering suicide as a cause of maternal mortality, it is also important to understand the prevalence of suicidal ideation and suicide attempts (sometimes together labeled as suicidal behavior) and self-harm, as these are major risk factors for suicide [27]. However, many reports of prevalence of self-harm are based on hospital discharge diagnoses which may not be accurate or comprehensive and do not capture those who self-harm but are not admitted to the hospital.

Prevalence of suicidal ideation in the perinatal period ranges from 2 to 5% among women seeking obstetrical care [28–32], 10% among women veterans between the third trimester and 6 weeks postpartum [33], 5 to 14% among perinatal women with depression or in mental health treatment [22, 34], 8% among perinatal women living with HIV [35], and 9% among those screening positive for postpartum depression among mothers of babies admitted to a neonatal intensive care unit (NICU) [36]. One cross-sectional study from Ghana reported a high rate of SI of 14.1% among women attending a maternal child health program [37]. A prospective study of 202 women attending prenatal care found that rates of SI decreased from 13.9% in the antenatal period to 6% in the postnatal period [38]. Among racially and ethnically diverse women enrolled in a Women Infant and Children (WIC) clinic, the prevalence of suicidal ideation was almost 5% and 13 times higher among women with depression [39]. In a town along the US-Mexico border, among women living in poverty with depressive symptoms, women > 35 years had higher odds of reporting thoughts of self-harm than younger women [40]. Among migrant and refugee perinatal women living on the Thailand-Myanmar border, 5% (30/568) experienced suicidal ideation [41]. Pregnant women had significantly higher rates of depressive symptoms and were more likely to have thoughts of self-harm after the onset of the COVID-19 pandemic compared to before [42], with rates as high as 20% reported [43].

A systematic review of 14 studies including 6,406,245 pregnant and postpartum women found that the pooled

worldwide prevalence of suicide attempts 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 [44]. Among pregnant and postpartum adolescents in Bangladesh, 6.5% (61/940) reported suicide attempts in the past 12 months, with the majority (88.5%) of the attempts occurring in the first postpartum year [45]. Among 475 women in their third trimester, 0.8% reported self-harm in the current pregnancy [46]. Prevalence of self-harm is as high as 20% among perinatal women with severe mental illness [47], and Vigod et al. found the rate of self-harm in the postpartum period to be 1.11 per 1000 births [48].

Recent studies have addressed the issue of under-reporting and inaccurate ascertainment of suicidal ideation and attempts by using natural language processing in electronic medical records [49]. Using these methods, the prevalence of suicidal ideation and attempts is 515.87 per 100,000 women. In addition to diagnostic codes related to pregnancy or delivery, including codifiable concepts such as “suicidal behavior” from clinical notes increased the sensitivity.

Is Pregnancy Protective of Suicide?

Just as it is challenging to accurately measure the prevalence of suicide in the perinatal period, it is also difficult to determine with certainty how the prevalence of suicide during pregnancy and postpartum compares to the prevalence of suicide among non-perinatal individuals. Comparator groups vary widely across studies, with the age range for “child-bearing age” ranging from 10 up to 54 years in different studies [13].

Some studies report that suicide attempt rates are lower in pregnancy compared to pre-pregnancy and postpartum. Older studies report the rate of suicide in the postnatal period to be six times lower than expected in a matched female population [50]. In a cohort study comparing 45,362 women who experienced live birth between 2011 and 2014 to 139,705 age-matched women with no pregnancies during the same period, Mota et al. found lower rates of suicide attempts during pregnancy compared to pre-pregnancy and compared to the postpartum period (0.06% compared to 0.12%). [51]. This study used physician visits and hospitalization for mental health concerns and suicide to calculate prevalence and is possible that rather than reflecting lower symptoms during pregnancy, the findings may reflect decreased mental health service treatment utilization.

Other studies have found higher rates of suicide and suicide attempts in the perinatal period. An analysis of data from 7479 pregnant women in the 2009–2018 National Survey on Drug Use and Health [26•] found the prevalence of suicidal behaviors (including ideation, planning and attempt)

to be 3.4%. Prevalence was higher in the first trimester (4.4%) compared to the second/third trimesters (2.9%). Among those with suicidal behaviors, 63.0% had ideation, 18.9% planned suicide, and 18.1% attempted suicide. A retrospective chart review of female patients hospitalized over a period of 1 year found that 33% (9 out of 27) were pregnant at the time of the suicide attempt [52].

Most studies which attempted to calculate comparative rates of suicide in the perinatal period used non-perinatal women as comparators. To account for any protective effect of motherhood itself, Lysell et al. [53] conducted a well-designed nested case control study of all women who had given birth in Sweden between 1974 and 2009. They used proximity to delivery as the explanatory variable to estimate risk of suicide among mothers. They found only weak negative association between childbirth during the preceding year and suicide, suggesting that previous studies may have overestimated the protective effect of recent delivery on suicide. Severe mental disorder after delivery and a history of self-harm were particularly noteworthy risk factors for suicide in the postpartum year. There is some indication that women who die by suicide during the peripartum period use violent and lethal means more frequently than non-perinatal women, perhaps pointing to the higher levels of distress and psychopathology in these women [54].

The postpartum period appears to be a higher risk period than pregnancy for suicide as two-thirds to three-quarters of all maternal deaths by suicide occur between 6 weeks and 1 year postpartum [16]. To summarize, while there are challenges in study design, it appears that any protective effect of pregnancy and postpartum against suicide, if present, is less than previously suggested, especially among those with severe postpartum mental disorder and history of self-harm.

Trends in Perinatal Suicide Rates

The rate of maternal mortality in the USA has increased from 9.8 per 100,000 live births in 2000 to 21.5 in 2014, a situation unique among high-income countries. Some part of this increase can be explained by improvements in detection such as that due to the addition of the pregnancy checkbox [55]: about 80% of the reported increase in maternal mortality between 2000 and 2014 could be due to the improved reporting [3]. However, even after correcting for improved reporting, the adjusted average MMR across 48 US states is still estimated to have risen by 27% from 18.8 to 23.8 per 100,000 live births from 2000 to 2014.

While perinatal suicide is more common among older non-Hispanic women, there is a disturbing trend of increase (nearly tripling among childbearing people between 2006 and 2017) in suicidality (including suicidal ideation and/or intentional self-harm reported in the diagnosis field among a large commercially insured population) among younger

and non-Hispanic Black women [56]. The greatest increases were found among Black, low-income, and younger individuals, and those with comorbid anxiety and depression or serious mental illness. It is of course not possible to state with certainty whether these data reflect actual increases in perinatal suicidality rates or increases in detection and reporting of suicidality. In addition, this study only included women with commercial insurance and the findings may not be generalizable to perinatal individuals insured by Medicaid.

Health Service Utilization Patterns

In a recent review of suicidal behaviors, Meurk et al. [13] comment on the health service utilization behaviors associated with suicide in the perinatal period, highlighting a study in which women who died of suicide were more likely to have had contact with healthcare services between delivery and death [13, 57]. Additionally, they note that peripartum women who died by suicide were more likely to have had a mental health contact (in primary care or in specialty care) in the year prior to their death than peripartum women who did not die.

Risk Factors for Perinatal Suicidality

Demographics

Risk factors for perinatal suicide and suicidal behavior are similar to risk factors in the general population. In the general population, risk factors include younger age, limited education, being unmarried, history of childhood abuse, intimate partner violence, and psychiatric comorbidity [58].

In perinatal populations, younger age, being unmarried, and marital dissatisfaction are risk factors [13, 26, 59, 60, 63], while social support and cohabitation with partner are associated with reduced odds of suicidality [61, 62]. In a study of 762 pregnant Ethiopian women, poor social support was the only variable to have been significantly correlated with suicide attempt during pregnancy [64].

Studies have also suggested that risk may vary by timeline during the perinatal period. An analysis of data from 2009 to 2018 National Survey on Drug Use and Health found that suicidal behavior was more prevalent in the first trimester [26]. Likewise, another study found that intentional poisoning was more common in the first and second trimester relative to the third trimester [65]. Most suicides are late maternal deaths, occurring between 43 and 365 days after the end of pregnancy [66].

Stressors including financial instability and sickness of the new baby have also been associated with increased suicidal behavior [67]. This finding was also supported by a

qualitative study of suicidal behavior in adolescent mothers [68]. Among women living with HIV, perinatal depression, anxiety, undisclosed HIV status, HIV stigma, and unplanned pregnancy are associated with suicidal ideation [35, 69, 70].

An observational study comparing postpartum depression and suicidality following cesarian deliveries found increased odds of PPD, suicidal ideation and self-inflicted injury among women who had the cesarian delivery under general anesthesia as compared to neuraxial anesthesia. These findings have not been replicated [71].

Most recently, Trost et al. [4] found that, among pregnancy-related mental health deaths (including suicide and overdose), three-quarters had a history of depression, and more than two-thirds had past or current substance use. They also found that 63% of pregnancy-related mental health deaths were covered by Medicaid during prenatal care or at the time of delivery.

History of Suicidal Ideation and Behavior

Lifetime history of suicidal ideation and behavior are significantly correlated with suicidality during current pregnancy [59]. This finding is replicated in several studies and is similar to the risk conferred by a history of suicidal ideation and behavior in general populations [61].

Comorbid Psychiatric Diagnosis

Having a psychiatric diagnosis is a strong risk factor for suicidality in the perinatal period [72, 73]. Women diagnosed with a postpartum mental disorder have a 6.2 times higher risk for self-harm compared to mothers without mental disorders [74]. Depression is one of the most common diagnoses among perinatal patients who report suicidal ideation [75] or who attempt or complete suicide [62]. For example, in a Japanese study examining suicide attempts during pregnancy, depression was the most common diagnosis, seen in 15.4% of those who made an attempt [76]. This finding was replicated in other studies, in which MDD was found in between 30% [77] and 50% [66] pregnant patients who died by suicide. Furthermore, a recent major depressive episode (within the past 12 months) is associated with 4.9 times higher odds of exhibiting suicidal behavior compared to women who did not experience a recent major depressive episode [26]. Among women with hearing loss, postpartum depression increased the risk of suicidal thoughts as measured by the suicidal ideation attributes scale, but the presence of social support decreased the risk [78]. Depressive symptom severity in perinatal women is positively correlated with suicide score; however, while a decrease in depression

severity (as measured by HDRS) was associated with decrease in suicide score, an increase in HDRS score was not correlated with an increase in suicide score [79].

In addition to depression, adjustment disorder may also contribute to increased risk of suicide. In a study of a population in an Irish perinatal mental health service, suicidal ideation or behavior was more common in the group with a diagnosis of adjustment disorder compared with those diagnosed with a depressive disorder, although this difference was not statistically significant [80]. Of note, the population of participants endorsing suicidal ideation or behaviors was relatively small in this study, with only 23 of the total 154 subjects expressing suicidal ideation and 26 demonstrating suicidal behaviors. However, pending larger studies, adjustment disorder can be considered a risk factor for perinatal suicide. Other diagnoses, such as anxiety, bipolar disorder, schizophrenia, post-traumatic stress disorder (PTSD), and personality disorders have been associated with suicide attempts as well [66, 76, 81, 82]. Finally, preliminary evidence indicates that self-reported emotional dysregulation [83] and poor sleep quality [84–86] are associated with antenatal self-injurious thoughts and behaviors.

Comorbid Substance Use

In a study of perinatal suicides in Queensland, Australia, alcohol consumption before death and history of illicit drug use were found in 42% of cases [66]. Pregnant women with alcohol abuse were 3.7 times more likely to feel suicidal compared to those without alcohol abuse [26], and cannabis use during pregnancy and breastfeeding is associated with thoughts of self-harm [87]. Opioid overdose as a cause of maternal mortality has been reviewed in detail elsewhere [9].

History of Trauma

A history of childhood abuse is strongly associated with perinatal suicidal behavior, accounting for 2.57 times increased odds of suicidal ideation, nearly threefold increased odds of suicide planning, and 2.43 times increased odds of suicide attempt [58]. A history of childhood trauma was associated with higher number of suicide attempts among low-income mothers in a home-visiting program [88]. The risk from experiencing depression and childhood abuse is additive: pregnant women with both childhood abuse and depression have increased risk of suicidal ideation compared to those with neither risk factor (OR = 17.78, 95% CI 7.20–43.92) [29, 89]. Those with three or more adverse childhood experiences (ACEs) are more likely than those with no ACEs to have suicidal ideation [90, 91]. Lifetime history of rape has also been associated with higher risk for suicidal behavior [67].

Intimate Partner Violence

Recent Intimate Partner Violence (IPV) is a common risk factor for perinatal suicide [92–94]. A study examining data from 17 states found that more than half of pregnancy-associated suicides involved intimate partner conflict [95]. Increased IPV during pregnancy was also associated with increased suicidal ideation and increased suicide attempts [96]. In a study from Ghana, current partner abuse was associated with 6.5 times increased odds for suicidal behaviors (OR = 6.5, 95% CI 1.14–37.05) [97]. In Brazil, among women of low income who reported postpartum suicidal ideation, 70% reported IPV during the postpartum period [98].

Stillbirth/Termination of Pregnancy

Pregnancy loss may be associated with increased risk of suicide. The prevalence of SI among women who screen positive for depression after a miscarriage was reported to be 33.1% [99]. A nested case–control study linking three nationwide population-based data sets in Taiwan found 485 cases of attempted and 350 cases completed suicide, and matched each case with ten controls. They found that the risk of completed suicide was higher in women who experienced a stillbirth [adjusted odds ratio (aOR) 5.2; 95% CI 1.77–15.32], miscarriage (aOR 3.81; 95% CI 2.81–5.15), or termination of pregnancy (aOR 3.12; 95% CI 1.77–5.5) than in those who had a live birth [81]. However, a small follow-up cohort study did not find any difference in suicidal ideation or depression diagnosis at 1 year among women with perinatal loss compared to those without [100]. In a Danish population cohort study, women who had abortions were more likely to have suicide attempts; however, the risk of nonfatal suicide attempt was the same in the year before the abortion compared to after the first abortion, which suggests that this risk was not attributable to the abortion itself [101].

Other Factors Associated with Perinatal Suicidality

Other studies have found factors such as bonding impairment with the baby, personality traits such as neuroticism and psychoticism, and hyperemesis gravidarum to be associated with perinatal SI [102–104]. However, these findings need to be replicated.

Outcomes of Non-fatal Suicide Attempts

Obstetric risks in pregnant women with suicidal behavior include increased risk of antepartum hemorrhage, placental abruption, postpartum hemorrhage, premature delivery, low

birth weight [105], stillbirth, poor fetal growth, and fetal abnormalities [106]. Pregnant adolescents who are at risk of suicide during pregnancy have a nearly twice higher risk of giving birth prematurely [107]. Violent methods of suicide attempts are associated with higher risk of critical perinatal outcomes [76]. In a limited study of 10 case reports of suicide attempts during pregnancy by overdose, although some agents resulted in bleeding and pregnancy complications, and in one case spontaneous abortion, overall, these pregnancies resulted in a healthy live birth [108]. In three cases of intentional overdose via over-the-counter medication during pregnancy, two of the three pregnancies ended in fetal demise [109]. Infants of women with perinatal suicidality had lower scores in neuropsychological development at 4 months postpartum [61].

Prevention and Intervention Strategies

Prevention and intervention strategies recommended specifically to address the risk of perinatal suicide include screening for mental health problems and suicidality, treatment of underlying psychiatric conditions, and improving access to care by using telepsychiatry and integrated mental health treatment approaches.

Screening for mental health problems, including suicidality, during the perinatal period is critical in efforts to help prevent suicide; however, universal screening is not yet widespread in practice. In a study of maternal suicides in Queensland, less than half of women who gave birth had records of screening for suicidal ideation, thus limiting the opportunities to identify those at risk [66]. In the USA, the American College of Obstetricians and Gynecologists currently recommends screening patients for depression at least once during the perinatal period using a validated tool [110]. The Edinburgh Postnatal Depression Scale (EPDS) is a validated tool that has been translated in 50 different languages, which consists of 10 questions, including one that asks specifically about thoughts of self-harm. The Patient Health Questionnaire-9 (PHQ-9) has also been validated in the perinatal population and similarly includes a question about passive or active suicidal ideation. If there is an affirmative response to either question above, clinicians should assess frequency and intensity of suicidal or self-harm thoughts, potential methods/plans, intent, reasons for living, and include assessment of suicide risk factors to assess overall suicide risk and determine appropriate level of clinical intervention (e.g., hospitalization, emergent psychiatric evaluation, ongoing outpatient care with pharmacotherapy and/or psychotherapy) [22]. For those with higher levels of risk, collateral information can be obtained from family or significant other who can also assist with means reduction from the patient's home [22].

There are many opportunities to screen for mental health problems and for suicidality among reproductive-aged women as they frequently interact with healthcare services [111]. However, non-psychiatric provider may not be comfortable assessing next steps when a patient screens positive for suicidality. The use of specific screening tools for suicide, including the National Institute of Mental Health "Ask Suicide-Screening Questions" and Columbia Suicide Severity Rating Scale [112], can help non-mental health clinicians assess whether emergent psychiatric evaluation is needed.

While increased screening is a key component in helping identify women at risk of suicide, screening alone cannot mitigate the risk of suicide. In order to prevent and intervene on suicidality, patients must receive mental health treatment and/or interventions for suicidality. A systematic review of 41 studies found that almost three-fifths of women who screen positive for perinatal depression do not take up referral offers after screening [113]. A 15-year UK study found that perinatal women who died by suicide were half as likely to be receiving pharmacological, psychological, or any other treatment at the time of their death compared to non-perinatal women who died by suicide [114]. Thus, connecting women at risk for suicide to treatment is of utmost importance. The entire process in suicide prevention through early screening, assessment, monitoring, and intervention is important for all perinatal patients, with some recommendations calling for OB/GYNs to screen at every contact during the first postpartum year, using the EPDS or PHQ-9. Those who report suicidal ideation should receive a suicide risk assessment with discussion of lethal means restriction, involving a patient's significant other or family member if possible. Pharmacotherapy can be considered for patients with mental health symptoms who have suicidal ideation, but who do not endorse plan or intent [22].

Telepsychiatry and integrated mental healthcare hold promise in bridging the gap between patients screening positive in the obstetrician's office and getting connected with mental health services, including in rural areas or areas with limited resources [115]. Programs such as Massachusetts Child Psychiatry Access Project (MCPAP) for Moms and North Carolina Maternal Mental Health MATTERS (Making Access to Treatment, Evaluation, Resources, and Screening Better) Program help build primary care and obstetric providers' capacity to treat perinatal depression through education, telephone perinatal psychiatric consultation, and care coordination [116]. These programs provide outreach and education for perinatal providers, screening toolkits for mental health disorders, a consultation line for providers, care coordination, and a perinatal telepsychiatry clinic [116]. Telepsychiatry and integrated care approaches may be able to reduce maternal mortality through improved access to perinatal mental health and substance use disorders services [117].

While provider-facing resources are important resources, patient-facing perinatal helplines may also help patients in crisis by increasing accessibility and decreasing barriers to mental healthcare. The Perinatal Anxiety & Depression Australia National Helpline (PANDA) in Australia identified one-third of callers as being at risk at intake; 73% of those at risk were deemed at risk due to their mental health status, with 40% endorsing suicidal thoughts and 7% endorsing self-harm [118, 119]. One intervention provided to 6.3% of callers during the study period was the ASIST (Applied Suicide Intervention Skills Training) Suicide Intervention Model [119].

Prompt recognition and treatment of mental health disorders that are associated with suicide and self-harm are an important consideration. For example, in women with postpartum psychosis, swift identification, treatment (ideally through inpatient care on a mother-infant unit), and management are needed to ensure safety and prevent suicide [22, 120]. Recognition and treatment of perinatal mental health disorders should extend beyond severe disorders such as psychosis to common mental disorders such as depression, which as we have seen, is an important risk factor for perinatal suicide [121].

There are few reports of treatments specifically geared toward treatment of perinatal suicidality. Antidepressants are the mainstay of treatments for moderate to severe perinatal depression, and adequate treatment of depression may be expected to reduce the risk of suicidal ideation associated with perinatal depression, although this has not yet been systematically studied. One study found no association between antidepressant treatment in pregnancy and reduced self-harm ideation postpartum as measured by the EPDS [122]. However, this finding has not been replicated and the study has several shortcomings such as retrospective report of antidepressant use, cross-sectional design, and possibility of unmeasured confounders. Medications such as lithium and clozapine have been shown to reduce the risk of suicide in general populations among those with bipolar disorder and schizophrenia [123, 124]. However, lithium and clozapine are not used frequently among pregnant or postpartum individuals given concern for teratogenicity and adverse fetal effects, and there are no studies of their use to reduce perinatal suicidality. We found one case report describing the use of esketamine for a woman who developed depression with psychotic features and attempted suicide at 4 months postpartum. The use of subcutaneous esketamine led to remission of her suicidal ideation [125]. Additionally, the use of prophylactic ketamine in women undergoing cesarean section was associated with lower incidence of postpartum depression even among those who experienced antenatal depression and suicidal ideation [126]. However, this study only included pregnant women undergoing caesarean section and excluded patients with known unstable psychiatric

disorders, and it may not be generalizable to the perinatal population most at risk for suicide. Regarding psychotherapy, dialectical behavior therapy is often an approach used to treat suicidality in patients [127]. However, little research has been done to examine its effect in reducing suicidality in the perinatal population. Aspects unique to the perinatal period such as the mother-baby relationship may need additional assessment and intervention in the context of suicidality. Perinatal women with thoughts of self-harm reported higher levels of lack of affection and rejection towards the baby [128], and SI in the postpartum period has been associated with poor quality of mother-baby interactions [129]. There is a critical need for more research into interventions for suicidality in the perinatal period.

Several system-level interventions have recently focused on reducing perinatal suicidality. A narrative review describing initiatives to reduce maternal mortality in the USA, while not focused on mental health related deaths, describe many initiatives which apply to suicide prevention [130]. One example of a system-level intervention is the Preventing Maternal Deaths Act (H.R. 1318) which authorized federal funding for state MMRCs. Other important interventions include data collection through the Maternal Mortality Review Information Application (MMRIA) Data System, and telehealth access program funding through HRSA's Screening and Treatment for Maternal Depression and Related Behavioral Disorders program.

Conclusions

Maternal deaths are an indicator of the overall public health of a country. While there is still work to be done to improve the measurement and reporting of maternal deaths, in the USA, the establishment of maternal mortality review panels in several states is an important first step toward obtaining uniform and high-quality data regarding perinatal deaths. There is also important ongoing research to develop ways to predict risk for perinatal suicide, for example, using natural language processing in clinical notes [49]. In the meantime, there are several interventions that can help reduce maternal mortality, including universal screening for perinatal depression and substance use disorder, and integrating mental health treatments into primary and prenatal care. In addition, clinicians should be aware of important risk factors for perinatal suicide such as mental health and substance use diagnoses, interpersonal violence, a history of abuse, and poor social support. MMRC recommendations can inform public health strategies to mitigate the risk for maternal mortality from various causes including suicide. Given that many individuals

who attempt suicide or die from suicide in the perinatal period use health services, there are opportunities to identify and intervene for suicide risk, and this is an important step in reducing maternal mortality rates.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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