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Perinatal Depression and Infant Mortality

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Abstract

IMPORTANCE Perinatal depression is the most common maternal morbidity, but few US studies have examined whether perinatal depression is associated with infant mortality.

OBJECTIVES To examine the association between maternal depressive symptoms and infant mortality, assess heterogeneity by maternal and infant demographic and socioeconomic characteristics and risk factors, and explore heterogeneity across leading causes of infant mortality.

DESIGN, SETTING, AND PARTICIPANTS This population-based retrospective cohort study used birth records from 2016 to 2020 linked to death records from 2016 to 2021 in New Jersey, which mandates screening for depressive symptoms in the immediate postpartum period. The cohort included singleton infants born in New Jersey between 2016 and 2020. Statistical analysis was performed between October 2025 and June 2026.

EXPOSURES Edinburgh Postnatal Depression Scale score of 10 or higher, which indicated maternal depressive symptoms.

MAIN OUTCOMES AND MEASURES The primary outcome was infant death within 364 days after birth. Adjusted relative risk (ARR) of infant death was estimated using log-link generalized linear models.

RESULTS Among the 414 890 infants (212 760 males [51.3%]) with complete data included in the analysis, 413 984 (99.8%) did not die and 906 (0.2%) died. Their mothers had a mean (SD) age of 30.5 (5.7) years, and 63.0% were born in the US, 60.0% were privately insured, and 70.6% completed high school or college. The infant mortality rate was 7.2 per 1000 births for infants whose mothers had depressive symptoms and 2.0 per 1000 births for infants whose mothers did not have depressive symptoms. After statistical adjustment for covariates, the relative risk of death within 364 days after birth was higher for infants of mothers with depressive symptoms compared with infants of mothers without depressive symptoms (model 2: ARR, 2.89; 95% CI, 2.36-3.54). This association was consistent across maternal race and ethnicity, educational level, insurance status, and infant preterm birth. Associations were found between maternal depressive symptoms and infant deaths with these leading causes: prematurity-related conditions (ARR, 4.07; 95% CI, 2.82-5.87), perinatal conditions (ARR, 5.12; 95% CI, 3.39-7.73), congenital malformations and chromosomal abnormalities (ARR, 3.56; 95% CI, 2.14-5.94), and sudden infant death syndrome (ARR, 2.08; 95% CI, 1.11-3.89).

CONCLUSIONS AND RELEVANCE In this cohort study, infants born to mothers with depressive symptoms had a higher risk of death before 1 year of age compared with infants whose mothers had no depressive symptoms. Expanding maternal depression screening and interventions for individuals with depressive symptoms is critical for improving maternal and infant health.

Key Points

Question What is the association between postpartum maternal depressive symptoms and infant mortality?

Findings In this cohort study of 414 890 infants, infants of mothers with depressive symptoms in the immediate postpartum period had higher relative risk of death within 364 days of birth than infants of mothers without depressive symptoms. This association remained consistent across maternal characteristics and for each of the leading causes of infant death.

Meaning The finding that maternal depressive symptoms in the immediate postpartum period are associated with infant deaths, even after accounting for potential confounders, suggests an urgent need to better understand the mechanisms driving this association and identify opportunities for risk mitigation.

+ Invited Commentary

+ Supplemental content

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Introduction

Reducing infant mortality remains a public health priority.[1] Each year in the US, more than 20 000 infants die before 1 year of age.[2] While the US infant mortality rate has decreased in the past 30 years, it still exceeds the rates in other high-income countries.[2,3] Racial and socioeconomic inequities persist, with Black infants dying at twice the rate of White infants.[2,4-7] Leading causes of US infant mortality include congenital malformations and chromosomal abnormalities, disorders related to preterm birth (PTB) and low birth weight (LBW), and sudden infant death syndrome (SIDS).[2]

Concurrently, the US faces a maternal health crisis, with higher maternal mortality and morbidity than similar nations.[8] Up to 20% of mothers experience depression during pregnancy and/or post partum, with higher rates among Black women.[9-12] Maternal depression is implicated in many pregnancy-related deaths, including deaths due to suicide,[8,13,14] and is associated with adverse infant outcomes and emergency health care use.[15-21] Emerging research also suggests prenatal depression is associated with fetal deaths.[22]

Despite significant risks to infant health, few studies have examined the association between maternal depression and infant mortality,[22,23] particularly in the US.[24,25] Research studies on depression and infant mortality generally measure mental health using diagnoses in health records, yet less than half of mothers with depressive symptoms receive a diagnosis, with notable racial inequities.[10,26] Consequently, prior findings may not be generalizable, as they likely reflect selected samples. Additionally, few studies adequately account for temporal confounding regarding the timing of depressive symptoms relative to mortality, potentially assessing depression after infant deaths.

To better elucidate the association between maternal depression and infant mortality, we leveraged linked birth and death records in New Jersey, which mandates universal screening for maternal depressive symptoms.[27,28] We aimed to examine the association between maternal depressive symptoms in the immediate postpartum period and infant mortality, assess heterogeneity by maternal and infant demographic and socioeconomic characteristics and risk factors, and explore heterogeneity across leading causes of infant mortality. Based on inequities in infant mortality and maternal depression,[2,4-7,9-12] we hypothesized that depressive symptoms would be associated with infant mortality, with larger effect sizes among Black individuals and economically underserved populations.

Methods

Study Design and Population

This retrospective cohort study analyzed New Jersey birth records from 2016 to 2020 linked with death records from 2016 to 2021.[29,30] The Rutgers University Institutional Review Board approved this study and waived the informed consent requirement because the study involved only secondary data analysis. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

We included singleton births and infant deaths in New Jersey and excluded nonsingleton births and births within 200 days linked to the same mother. Data were provided by the New Jersey Integrated Population Health Data Project, which linked records using probabilistic matching based on names, birth dates, addresses, and medical record numbers, among other data points. While not all people who give birth are mothers, for clarity, the terms *mother* and *maternal* are used hereinafter.

Measures

Depressive symptoms were measured by the 10-item Edinburgh Postnatal Depression Scale (EPDS; score range: 0-30, with higher scores indicating more frequent and severe depressive symptoms). The EPDS is a commonly used screening tool for maternal depressive symptoms and has been validated in pregnancy and post partum.[31-34] In New Jersey, EPDS screening is conducted in the

hospital after delivery and before discharge, and EPDS scores are documented in birth records. We created a binary variable indicating scores of 10 or higher, as New Jersey hospitals use this score as the clinical threshold to identify patients with potential depression.[35,36] In addition to the dichotomized EPDS scores, we also examined continuous EPDS scores (raw scores ranging from 0-30).

The primary outcome was infant death within 364 days after birth. The secondary outcome was infant death between 8 and 364 days after birth. Given that 99.8% of mothers in New Jersey were discharged from the hospital within 7 days of giving birth, this secondary outcome allowed us to isolate cases for which we had a high degree of confidence that EPDS screening occurred before infant death. Causes of death were listed on death records based on the National Center for Health Statistics 130 Selected Causes of Infant Death.[37] We then aggregated those causes into categories, in accordance with prior literature (eTable 1 in Supplement 1).[38-40]

Potential confounders were included as covariates.[4-7,9,10,24,41-43] Maternal demographic and socioeconomic characteristics were self-reported on birth records and included age, race and ethnicity (Hispanic, non-Hispanic Asian [hereinafter Asian], non-Hispanic Black [hereinafter Black], non-Hispanic White [hereinafter White], and non-Hispanic other [including those identifying as other race; hereinafter other]), nativity, parity, educational level, insurance status based on payment source for birth, use of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) during pregnancy, median annual household income in thousands based on maternal zip code using the 5-year estimates from the 2016 to 2020 American Community Survey, and infant birth year and sex. Risk factors for infant mortality included maternal tobacco use and substance use during pregnancy, hypertension, diabetes, delivery type (vaginal vs cesarean), and infant LBW (<2500 g) and PTB (<37 weeks' gestation).

Sensitivity Analyses

In sensitivity analyses, we used a chained equations multiple imputation approach to estimate missing values for EPDS scores and covariates. We also explored potential sensitivity to the exclusion of infant deaths that we were unable to match to birth records. This analysis is important because unobserved characteristics of matching status that are associated with perinatal depression could threaten the validity of results. We first assessed differences between matched and unmatched deaths (eTable 2 in Supplement 1). We then used variables available on death records (race and ethnicity, zip code–based median annual household income, birth year, and sex) to reweight the matched records to be representative of all infant deaths and applied these inverse probability weights to our main analysis models. Additionally, we implemented a bounds analysis. We appended the unmatched death records to the analytical dataset and used generalized linear models to estimate the association of infant death with maternal depressive symptoms using the death record variables as covariates (all of which have equivalents in the birth record). Because EPDS scores were missing for unmatched records, we examined the best and worst case scenarios for the missing scores. In the lower-bounds case, we assumed all unmatched infants had mothers without depressive symptoms. In the upper-bounds case, we assumed all unmatched infants had mothers with depressive symptoms.

Statistical Analysis

We used bivariate χ^2 tests and unpaired, 2-tailed *t* tests to examine differences in outcomes across independent variables. We used log-link generalized linear models to estimate associations between maternal depressive symptoms and infant death, clustering SEs to account for multiple births to mothers over the study period. We included covariates incrementally across models to assess potential confounding. Model 1 was unadjusted. Model 2 was adjusted for maternal and infant demographic and socioeconomic covariates. Model 3 was adjusted for all model 2 covariates in addition to maternal and infant risk factors; however, because some of these risk factors may lie on

the causal pathway between maternal depressive symptoms and infant death, we considered model 2 as the fully adjusted, preferred model.[44]

Given known inequities, we stratified models by maternal race and ethnicity, educational level, insurance status, tobacco use, and infant PTB, adjusting for all other maternal and infant demographic and socioeconomic covariates.[2,4-7] Furthermore, we examined associations between maternal depressive symptoms and infant death separately for each of the leading causes of death.

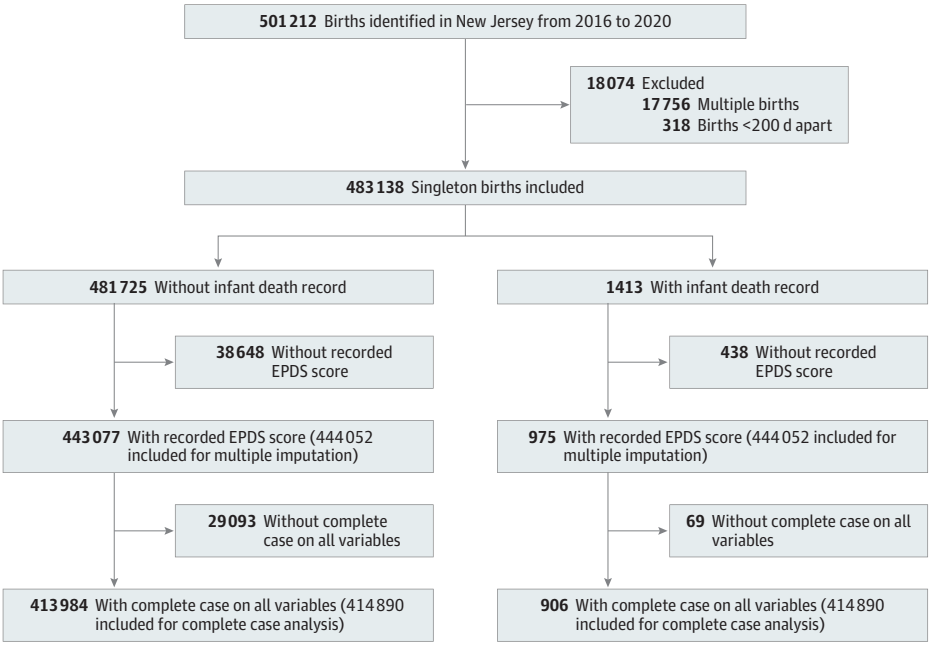
Statistical analysis was performed from October 2025 to June 2026 using Stata 19/MP (StataCorp LLC). Two-sided $P < .05$ indicated statistical significance.

Results

Figure 1 shows the study flow diagram. After exclusions, there were 483 138 singleton births to New Jersey residents. Of the 2094 infant deaths between 2016 and 2021 in the death records, 1608 (76.8%) had matching birth records. Of the 1608 matched infants who died, 1413 were singleton infants and thus were included in this analysis. On average, unmatched infant deaths occurred sooner after birth and were more common among White infants and infants with higher zip code–based median annual household incomes, and a higher proportion of deaths were due to prematurity-related conditions while a lower proportion were due to SIDS; no differences were found for infant sex (eTable 2 in Supplement 1). Among the 892 deaths between 8 and 364 days after birth, 742 (83.2%) were matched to birth records, 676 of whom were singleton infants and thus included in this analysis. A higher proportion of unmatched infant deaths between 8 and 364 days after birth were due to prematurity-related conditions while a lower proportion were due to SIDS. No differences across matched status were found by infant age, race and ethnicity, zip code–based median annual household income, or sex (eTable 2 in Supplement 1).

As shown in **Table 1**, the complete case analytical sample included 414 890 infants (212 760 males [51.3%], 202 130 females [48.7%]). Of these infants, 413 984 (99.8%) did not die and 906 (0.2%) died. Their mothers had a mean (SD) age of 30.5 (5.7) years, and 63.0% were born in the US, 60.8% were multiparous, 70.6% had a high school diploma or college degree, and 60.0% were

Figure 1. Study Flow Diagram of New Jersey 2016 to 2020 Births and 2016 to 2021 Infant Deaths



EPDS indicates Edinburgh Postnatal Depression Scale.

Table 1. Characteristics of the Complete Cohort

Characteristic	Sample, No. (%)			*P* value[a]
	All (N = 414 890)	Infants who did not die (n = 413 984)	Infants who died (n = 906)	
Infant death status				
Did not die	413 984 (99.8)	413 984 (100)	0	
Died 0-7 d after birth	349 (0.1)	0	349 (38.5)	NA
Died 8-364 d after birth	557 (0.1)	0	557 (61.5)	
Infant death cause (n = 906)				
Prematurity-related conditions	213 (23.5)	NA	NA	
Perinatal conditions	154 (17.0)	NA	NA	
Congenital malformations and chromosomal abnormalities	134 (14.8)	NA	NA	
SIDS	118 (13.0)	NA	NA	NA
Injuries	48 (5.3)	NA	NA	
Infections	46 (5.1)	NA	NA	
Other[b]	162 (17.9)	NA	NA	
Missing data	31 (3.4)	NA	NA	
Postpartum maternal depressive symptoms				
No	398 985 (96.2)	398 186 (96.2)	799 (88.2)	<.001
Yes	15 905 (3.8)	15 798 (3.8)	107 (11.8)	
Postpartum maternal depressive symptom scores, mean (SD)	2.63 (3.2)	2.63 (3.2)	3.99 (4.6)	<.001
Maternal age, y				
<20	12 014 (2.9)	11 973 (2.9)	41 (4.5)	
20-29	157 745 (38.0)	157 346 (38.0)	399 (44.0)	<.001
30-39	223 035 (53.8)	222 632 (53.8)	403 (44.5)	
≥40	22 096 (5.3)	22 033 (5.3)	63 (7.0)	
Maternal race and ethnicity[c]				
Hispanic	121 680 (29.3)	121 393 (29.3)	287 (31.7)	
Non-Hispanic Asian	45 070 (10.9)	45 007 (10.9)	63 (7.0)	
Non-Hispanic Black	55 837 (13.5)	55 537 (13.4)	300 (33.1)	<.001
Non-Hispanic White	187 210 (45.1)	186 963 (45.2)	247 (27.3)	
Non-Hispanic other[d]	5093 (1.2)	5084 (1.2)	<10	
Maternal nativity				
International-born	153 699 (37.1)	153 386 (37.1)	313 (34.6)	.12
US-born	261 191 (63.0)	260 598 (63.0)	593 (65.5)	
Maternal parity				
Multiparous	252 043 (60.8)	251 484 (60.8)	559 (61.7)	.56
Primiparous	162 847 (39.3)	162 500 (39.3)	347 (38.3)	
Maternal educational level				
<High school	46 158 (11.1)	46 004 (11.1)	154 (17.0)	
High school diploma or some college	154 323 (37.2)	153 857 (37.2)	466 (51.4)	<.001
Associate's or bachelor's degree	138 366 (33.4)	138 167 (33.4)	199 (22.0)	
Graduate degree	76 043 (18.3)	75 956 (18.4)	87 (9.6)	
Maternal insurance status				
Private insurance	248 741 (60.0)	248 395 (60.0)	346 (38.2)	
Public insurance	128 358 (30.9)	127 953 (30.9)	405 (44.7)	<.001
Other or no insurance[e]	37 791 (9.1)	37 636 (9.1)	155 (17.1)	
WIC use during pregnancy				
No	323 181 (77.9)	322 529 (77.9)	652 (72.0)	<.001
Yes	91 709 (22.1)	91 455 (22.1)	254 (28.0)	

(continued)

Table 1. Characteristics of the Complete Cohort (continued)

Characteristic	Sample, No. (%)			*P* value[a]
	All (N = 414 890)	Infants who did not die (n = 413 984)	Infants who died (n = 906)	
Zip code–based median annual household income, mean (SD), $	84 392 (35 563)	84 423 (35 567)	70 119 (30 394)	<.001
Infant birth year				
2016	82 187 (19.8)	82 030 (19.8)	157 (17.3)	.38
2017	83 402 (20.1)	83 215 (20.1)	187 (20.6)	
2018	84 217 (20.3)	84 036 (20.3)	181 (20.0)	
2019	84 209 (20.3)	84 013 (20.3)	196 (21.6)	
2020	80 875 (19.5)	80 690 (19.5)	185 (20.4)	
Infant sex				
Male	212 760 (51.3)	212 254 (51.3)	506 (55.9)	.006
Female	202 130 (48.7)	201 730 (48.7)	400 (44.2)	
Maternal tobacco use during pregnancy				
No	389 018 (93.8)	388 234 (93.8)	784 (86.5)	<.001
Yes	25 872 (6.2)	25 750 (6.2)	122 (13.5)	
Maternal substance use during pregnancy				
No	405 616 (97.8)	404 746 (97.8)	870 (96.0)	<.001
Yes	9274 (2.2)	9238 (2.2)	36 (4.0)	
Delivery type				
Vaginal	264 843 (63.8)	264 332 (63.9)	511 (56.4)	<.001
Cesarean	150 047 (36.2)	149 652 (36.2)	395 (43.6)	
Maternal hypertension				
No	384 910 (92.8)	384 115 (92.8)	795 (87.8)	<.001
Yes	29 980 (7.2)	29 869 (7.2)	111 (12.3)	
Maternal diabetes				
No	376 056 (90.6)	375 225 (90.6)	831 (91.7)	.26
Yes	38 834 (9.4)	38 759 (9.4)	75 (8.3)	
Infant low birth weight				
No	390 332 (94.1)	389 943 (94.2)	389 (42.9)	<.001
Yes	24 558 (5.9)	24 041 (5.8)	517 (57.1)	
Infant preterm birth				
No	383 842 (92.5)	383 459 (92.6)	383 (42.3)	<.001
Yes	31 048 (7.5)	30 525 (7.4)	523 (57.7)	

Abbreviations: NA, not applicable; SIDS, sudden infant death syndrome; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

[a] Calculated using a χ^2 test comparing infants who died with infants who did not die.

[b] Includes causes such as neoplasms; endocrine, nutritional, and metabolic diseases; and diseases of the genitourinary system.

[c] Self-reported on birth records.

[d] Includes "other race" as listed on the birth record. Further specification was not available.

[e] Includes forms of payment such as self-pay, charity care, and "other" as listed on the birth record.

privately insured. Mothers included 10.9% who self-reported as Asian, 13.5% as Black, 29.3% as Hispanic, and 45.1% as White individuals, with 1.2% identifying as having other race and ethnicity. Overall, 3.8% of mothers had depressive symptoms. Among the infants who died, the most common causes of death were prematurity-related conditions (23.5% [213 of 906]), perinatal conditions (17.0% [154 of 906]), congenital malformations and chromosomal abnormalities (14.8% [134 of 906]), and SIDS (13.0% [118 of 906]).

Table 1 also shows differences in study variables by infant death status. Of the 906 infant deaths, 107 (11.8%) occurred among infants with mothers who had depressive symptoms. Overall, the infant mortality rate was 7.2 per 1000 births for infants born to mothers with depressive symptoms and 2.0 per 1000 births for infants born to mothers without depressive symptoms. Compared with infants who did not die, infants who died had a greater proportion of mothers who were younger than 30 years (40.9% vs 48.5%) or 40 years or older (5.3% vs 7.0%), were Black individuals (13.4% vs 33.1%), did not have a college degree (48.3% vs 68.4%), had public or other insurance (40.0% vs 61.8%), used WIC (22.1% vs 28.0%), and had lower mean (SD) zip code–based median annual household income ($84 423 [$35 567] vs $70 119

[$30 394]). Additionally, tobacco use, substance use, cesarean delivery, hypertension, and infant LBW and PTB were each more common for mothers of infants who died than infants who did not die.

Primary Analyses

In the unadjusted model (model 1), infants born to mothers with depressive symptoms had higher relative risk (RR) of infant death (3.36; 95% CI, 2.75-4.11) (**Table 2**). The association was attenuated after adjusting for maternal and infant demographic and socioeconomic covariates (model 2: adjusted [ARR], 2.89; 95% CI, 2.36-3.54) and after additional adjustments for maternal and infant risk factors (model 3: ARR, 1.97; 95% CI, 1.61-2.42). Patterns were similar for infant deaths between 8 and 364 days after birth, although the coefficient magnitudes were smaller. In model 2, the probability of infant death was 0.006 (95% CI, 0.005-0.007) among infants whose mothers had depressive symptoms, which is 0.004 (95% CI, 0.003-0.005) higher than a baseline of 0.002 (95% CI, 0.002-0.002). Findings were similar for models using continuous EPDS scores (eTable 3 in Supplement 1).

Figure 2 and eTables 4 to 8 in Supplement 1 show stratified results. Infants whose mothers had depressive symptoms had higher RR of death within 364 days after birth compared with their counterparts in all subgroups, with the exception of infants whose mothers used tobacco during pregnancy. Interaction models confirmed no significant differences in these associations across subgroups, except by maternal tobacco use.

Table 3 shows associations between maternal depressive symptoms and infant death for the 4 leading causes of death. Infants born to mothers with depressive symptoms had higher RR of death within 364 days after birth caused by prematurity-related conditions (ARR, 4.07; 95% CI, 2.82-5.87), perinatal conditions (ARR, 5.12; 95% CI, 3.39-7.73), congenital malformations and chromosomal abnormalities (ARR, 3.56; 95% CI, 2.14-5.94), and SIDS (ARR, 2.08; 95% CI, 1.11-3.89). Additionally, maternal depressive symptoms were associated with deaths between 8 and 364 days after birth caused by prematurity-related conditions (ARR, 4.85; 95% CI, 2.55-9.23), perinatal conditions (ARR, 4.68; 95% CI, 2.12-10.33), and SIDS (ARR, 2.13; 95% CI, 1.13-4.00).

Estimates for Missing Values

Among the 483 138 infants in the study population, 39 086 (8.1%) had mothers without a documented EPDS score (eTable 9 in Supplement 1). Of the 444 052 infants remaining, an additional 29 162 (6.6%) infants had mothers with missing data on 1 or more covariates. Estimates using multiple imputation were consistent with the main results (eTable 10 in Supplement 1). When we accounted for the missing data using weights, results were substantively unaltered (eTable 11 in Supplement 1). For the bounding analysis, we confirmed

Table 2. Relative Risk of Infant Death by Postpartum Maternal Depressive Symptoms

		ARR (95% CI)	
	Model 1, RR (95% CI)[a]	Model 2[b]	Model 3[c]
Infant death 0-364 d after birth (n = 414 890)			
Postpartum maternal depressive symptoms			
No	1 [Reference]	1 [Reference]	1 [Reference]
Yes	3.36 (2.75-4.11)	2.89 (2.36-3.54)	1.97 (1.61-2.42)
Infant death 8-364 d after birth (n = 414 541)			
Postpartum maternal depressive symptoms			
No	1 [Reference]	1 [Reference]	1 [Reference]
Yes	2.48 (1.86-3.32)	2.10 (1.56-2.81)	1.52 (1.13-2.05)

Abbreviations: ARR, adjusted relative risk; RR, relative risk.

[a] Model 1 was not adjusted for any covariates.

[b] Model 2 was adjusted for maternal age, race and ethnicity, nativity, parity, educational level, insurance status, WIC (Special Supplemental Nutrition Program for Women, Infants, and Children) use during pregnancy, zip code–based median annual household income, and infant birth year and sex.

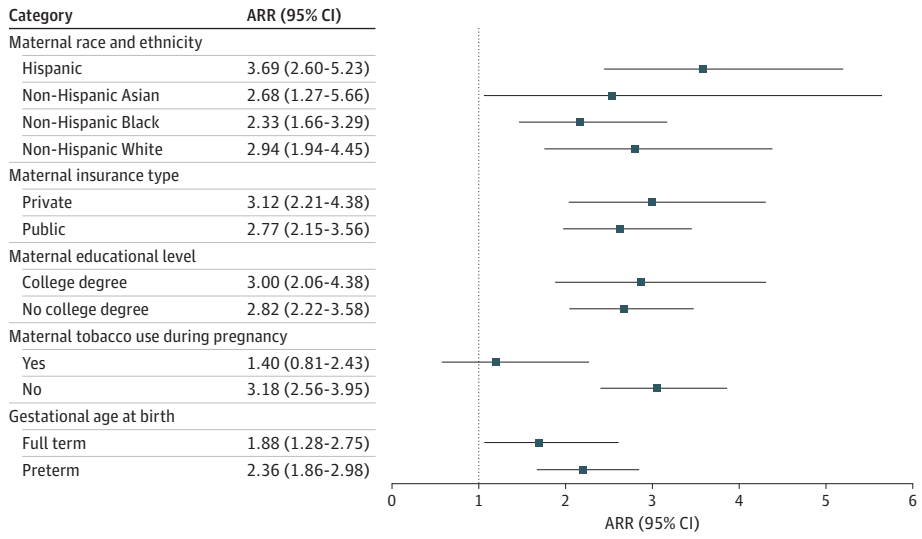
[c] Model 3 was adjusted for all covariates of model 2 and maternal tobacco use during pregnancy, substance use during pregnancy, delivery type, hypertension, diabetes, infant low birth weight, and infant preterm birth.

that we obtained similar results to our main analysis when we used the more limited set of covariates available on the death records (column 1 in eTable 12 in Supplement 1). Columns 2 and 3 in eTable 12 in Supplement 1 show the lower-bound (ARR, 1.94; 95% CI, 1.61-2.33) and upper-bound estimates (ARR, 18.58; 95% CI, 16.80-20.55). While the upper-bound estimate was too large to be informative, the lower-bound estimate indicated that even if all unmatched infants who died had mothers without depressive symptoms, the results still suggested a meaningful association between maternal depressive symptoms and infant death. We therefore found no evidence that unmatched death records led us to overestimate the association between maternal depressive symptoms and infant death.

Discussion

In this population-based cohort study in New Jersey, we found that infants born to mothers with depressive symptoms in the immediate postpartum period had nearly 3 times the risk of mortality

Figure 2. Dot Plot of Adjusted Relative Risks (ARRs) of Infant Deaths by Postpartum Maternal Depressive Symptoms Stratified by Maternal Characteristics



For all models, the outcome was infant death 0 to 364 days after birth and the covariates included maternal age, race and ethnicity, nativity, parity, educational level, insurance status, WIC (Special Supplemental Nutrition Program for Women, Infants, and Children) use during pregnancy, zip code–based median annual household income, and infant birth year and sex (except when stratifying by each variable). Error bars represent 95% CIs.

Table 3. Adjusted Relative Risk of Infant Death by Postpartum Maternal Depressive Symptoms for Leading Causes of Infant Death

	Infant deaths, ARR (95% CI)			
	Prematurity-related conditions	Perinatal conditions	Congenital anomalies and chromosomal abnormalities	SIDS
Infant death 0-364 d after birth[a]				
Postpartum maternal depressive symptoms, No.	414 197	414 138	414 118	414 102
No	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Yes	4.07 (2.82-5.87)	5.12 (3.39-7.73)	3.56 (2.14-5.94)	2.08 (1.11-3.89)
Infant death 8-364 d after birth[a]				
Postpartum maternal depressive symptoms, No.	414 047	414 031	414 052	414 099
No	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Yes	4.85 (2.55-9.23)	4.68 (2.12-10.33)	1.92 (0.77-4.75)	2.13 (1.13-4.00)

Abbreviations: ARR, adjusted relative risk; SIDS, sudden infant death syndrome.

[a] Models were adjusted for maternal age, race and ethnicity, nativity, parity, educational level, insurance status, WIC (Special Supplemental Nutrition Program for Women, Infants, and Children) use during pregnancy, zip code–based median annual household income, and infant birth year and sex.

within 364 days after birth compared with infants born to mothers without depressive symptoms. This association was consistent across maternal race and ethnicity, educational level, insurance status, and infant PTB. Maternal depressive symptoms were associated with infant deaths due to prematurity-related conditions, perinatal conditions, congenital malformations and chromosomal abnormalities, and SIDS.

Existing studies on maternal depression and infant mortality in higher-income countries have mixed results.[22-25] A recent population-based study in California, one of only a few studies in the US, found infants born to mothers with depression diagnoses had a higher risk of death than their counterparts.[24] After limiting to prenatal maternal depression diagnoses, the association was attenuated.[24] Similarly, to our knowledge, the only prior study to examine depressive symptoms from EPDS screenings found an association between depression and neonatal death in Australia.[41] Our findings contribute to this literature as we used data from a highly diverse state[45] with universal screening to measure depressive symptoms for the full population rather than relying on documented depression diagnoses.[10,26]

We found that maternal depressive symptoms were associated with infant mortality even after adjusting for known risk factors. While the exact mechanisms connecting maternal depression and infant mortality are currently unknown, several possibilities exist. Maternal depressive symptoms are associated with physiologic changes, including neuroendocrine dysregulation and microbiome disruption, which may affect fetal physiologic functions and, subsequently, infant health.[46-49] Prior literature demonstrating the association of maternal depression with adverse birth outcomes supports this hypothesis.[15,17,20,21] Additionally, maternal depression has been linked to infant care practices, including breastfeeding and health care seeking,[50-55] which could be factors in infant outcomes. Depression is also associated with and may be, at least partially, an outcome of social determinants that limit resources available to families.[56-61] Finally, given the associations with fetal anomalies and consequences of perinatal complications, it is possible that mothers who have knowledge of these underlying conditions that increase risk of infant death consequently develop depressive symptoms.

Our findings have clinical and policy implications. The American College of Obstetricians and Gynecologists and the American Academy of Pediatrics recommend that mothers be screened throughout the perinatal period,[35,62] yet substantial gaps remain.[63,64] Although screening mandates have been associated with increased screening rates,[36,65] New Jersey is 1 of only 8 states with a mandate (New Jersey, Arkansas, California, Florida, Illinois, Louisiana, Oklahoma, and West Virginia).[27,28,66] Screening in the hospital may be particularly useful due to barriers to accessing postpartum health care after discharge, especially for those with depression.[67-69] However, screening does not necessarily lead to diagnoses or mental health treatment.[10,26,64,70,71] In New Jersey, no statewide policies exist on appropriate procedures after depressive symptoms are identified. In most hospitals, an EPDS score of 10 or higher triggers additional evaluation, with the potential for subsequent diagnoses and referrals for treatment. However, prior research found the law did not change mental health treatment patterns among New Jersey mothers with Medicaid coverage.[70] Moreover, substantial barriers to mental health care exist, including cost, lack of insurance, social stigma, and medical mistrust.[72-76] Collaboration between obstetricians and pediatricians may help ensure continuity of care from pregnancy to post partum and improve both maternal and infant health.[77,78] Our results suggest that infants born to mothers without documented EPDS scores also have elevated mortality risk. Additional research on this group is necessary.

Limitations

This study has some limitations. First, findings from our New Jersey data may not generalize to other states. Second, while screening for depressive symptoms is required by law in New Jersey, 8.1% of birth records were missing EPDS screening scores, potentially due to patients declining the screening and/or administrative errors. Results from our multiple imputation analysis were almost identical to the main results. Nevertheless, these models assumed that data were missing at random, conditional on observed covariates. We expect that sometimes EPDS screening may not occur following an

infant death in hospital soon after delivery. Thus, our results were not expected to generalize to the population without completed screening. Third, we were unable to match all infant death records to birth records. We conducted several sensitivity analyses, which support the main results; however, our inverse probability model assumed no selection bias after adjusting for observed covariates. While our bounds analysis supports this hypothesis, future research should explore the validity of this assumption using alternative matching methods. Fourth, the prevalence of depressive symptoms was lower in our study than in national estimates,[9-11] likely due to the timing of screening, as many mothers develop depressive symptoms later in the postpartum period. Still, depressive symptoms in the immediate postpartum period may be indicative of later postpartum depression.[36] Fifth, while we were able to account for a range of maternal and infant characteristics, we could not account for unobserved confounding. Finally, given that New Jersey hospitals generally administer screening on the day of maternal discharge, we conducted an analysis limiting the sample to mothers who were discharged before the date of infant death. Coefficients were similar to those in the main analysis. However, even when screening occurs before death, awareness of adverse health conditions present at birth is likely to be associated with both depressive symptoms and risk of infant death. We found that results were consistent when adjusting for the available observed risk factors of infant health, specifically LBW and PTB, and when exploring deaths due to SIDS (which, by definition, are unexpected deaths). While these analyses suggest that reverse causality is unlikely to be the only relevant mechanism, future research should use alternative methods and data sources that can more fully account for reverse causality and unobserved confounding.

Conclusions

In this population-based retrospective cohort study, infants of mothers with depressive symptoms in the immediate postpartum period had substantially higher risk of mortality before 1 year of age compared with their counterparts. Findings were consistent across maternal subgroups and for each of the leading causes of infant deaths. Efforts are needed to better understand the mechanisms linking maternal depressive symptoms and infant mortality and to identify opportunities to mitigate risk of infant mortality.

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SUPPLEMENT 1.

eTable 1. Causes of Infant Deaths in the Total Cohort

eTable 2. Characteristics of Matched and Unmatched Infant Deaths in the Cohort

eTable 3. Relative Risk of Infant Death by Postpartum Maternal Depressive Symptom Scores