

Race, Maternal Age, and Social Vulnerability Affect Risk of Severe Maternal Morbidity

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Last updated 28 November 2023 • Check for updates at EpicResearch.org

Key Findings:

- Women who are Black, aged 35 or older, or in the highest social vulnerability index (SVI) quartile have greater odds of being diagnosed with a severe maternal morbidity (SMM) condition than women who are White, 25-35 years old, or in the lowest SVI quartile, respectively.
- Black race has a stronger correlation with a SMM condition diagnosis than any other factors studied, including maternal age or SVI.

Severe maternal morbidity (SMM) is a group of complications that occur during pregnancy or delivery and that have an impact on a woman's health, such as embolism, sepsis, and acute renal failure. The Centers for Disease Control and Prevention (CDC) reported that these complications have been on the rise.¹ Because these complications can have lasting impacts, Healthy People 2030, an initiative set forth by the U.S. Department of Health and Human Services (HHS), aims to reduce rates of SMM, as well as disparities in the incidence of SMM by race and ethnicity.² Previous studies have found that women of color and those with advanced age were associated with higher odds of SMM.^{3,4}

To understand whether race/ethnicity, maternal age, or social vulnerability index (SVI) is most correlated with an SMM condition diagnosis, we evaluated 3,654,905 pregnant women between January 1, 2017, and June 30, 2023, for maternal morbidity outcomes. After controlling for other potential factors, such as age and SVI, we found that Black women have 54% greater odds of being diagnosed with an SMM condition than White women. Other non-Hispanic women have 6% greater odds and Hispanic women have 1% greater odds than White women. Women aged 35 and over have 34% greater odds of being diagnosed than women aged 25-34. Those aged 12 to 18 have 14% decreased odds and those aged 18 to 25 have 16% decreased odds. Finally, women in the most vulnerable SVI quartile (quartile 4) have 23% greater odds of being diagnosed with an SMM condition than women in the least vulnerable quartile (quartile 1), while those in quartile 3 have 14% greater odds, and those in quartile 2 have 8% greater odds.

Likelihood of Maternal Morbidity by Maternal Characteristic

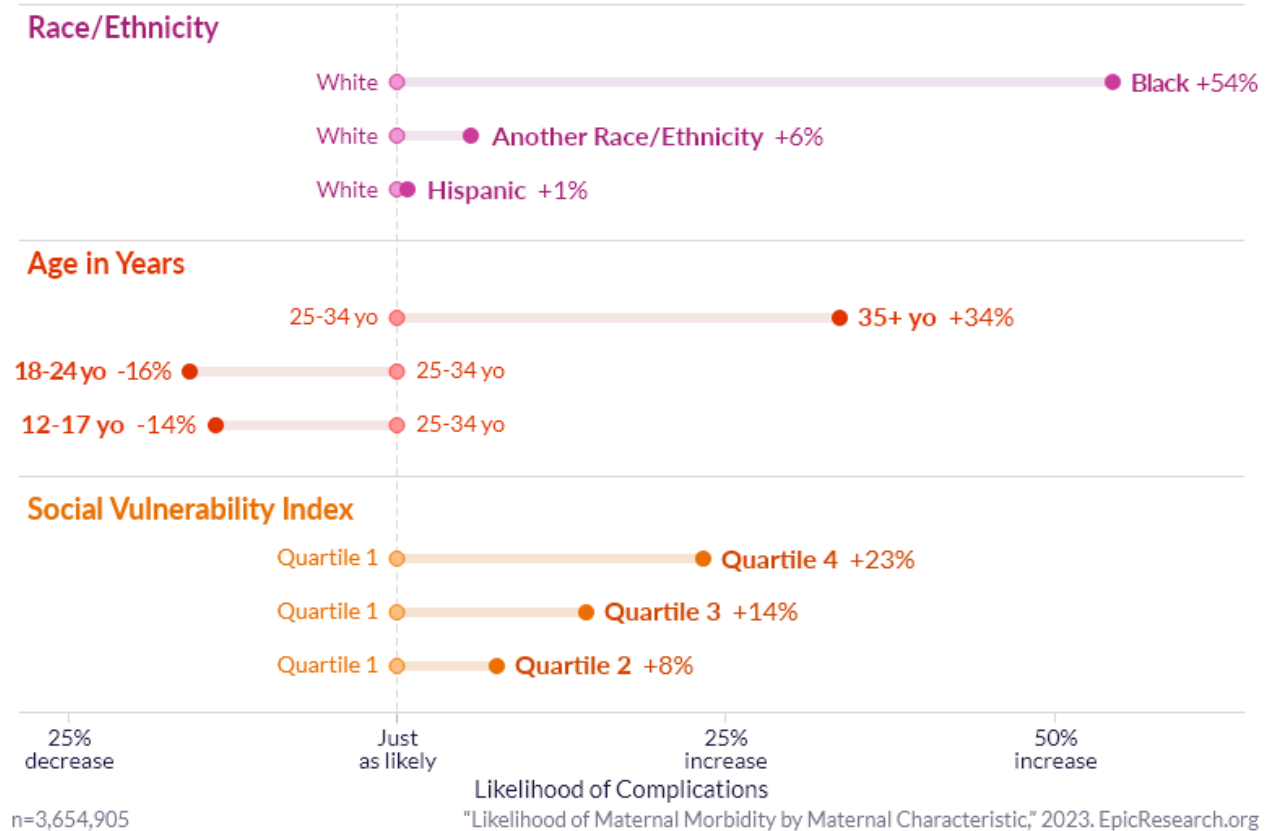


Figure 1. The likelihood of a maternal morbidity diagnosis by maternal characteristic.

A sensitivity analysis using Area Deprivation Index (ADI) instead of SVI to assess the degree to which a patient’s environment might affect their vulnerability also found that women who are Black, women who are over age 35, or who are in the most vulnerable ADI quartiles are at the highest risk of SMM diagnosis. Race remained the most correlated variable across both analyses. This racial disparity may be reduced through improved hospital quality, standardization of care, and timely recognition and response to acute illness.⁵

These data come from Cosmos, a collaboration of 222 Epic health systems representing over 220 million patient records from 1,272 hospitals and more than 27,200 clinics from all 50 states and Lebanon. This study was completed by two teams that worked independently, each composed of a clinician and research scientists. The two teams came to similar conclusions. Graphics by Brian Olson.

References

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Data Definitions

Term	Definition
Study period	1/1/2017 – 6/30/2023
Study population	A birth during the study period or a documented delivery or termination diagnosis . The pregnancy needs to be the first pregnancy and the birthing woman needs to have at least two outpatient face-to-face visits in the two years prior to birth. Latest residence of the women is within the United States. Excludes births with twins or multiples.
Regression model parameters	Covariates: Comorbidities, SVI/ADI, Race/Ethnicity and age group. Measured outcomes: Whether a maternal morbidity diagnosis occurred in the 42 days following the patient’s delivery or termination diagnosis .
First pregnancy	The first ever delivery or termination diagnosis or documented birth. Excluding birth events with a former maternal morbidity , even when there was no prior documented pregnancy.
Delivery or termination diagnosis	Diagnoses with ICD-10-CM code 000*, 003*, or Z37*, documented birth, or a documented stillborn/miscarriage .
Multiple simultaneous births	Multiple birth events occurring within one week of each other for a single patient or a diagnosis with ICD-10-CM code Z37.2*, Z37.3*, Z37.4*, Z37.5*, Z37.6*, Z37.7*.
Stillborn/miscarriage	A diagnosis within 30 days of the delivery with an ICD-10-CM code Z37.1*, Z37.3*, Z37.4*, Z37.6*, Z37.7*, O00*, or O03*.
Comorbidities	A diagnosis of cardiovascular disease, asthma, obesity , or documentation of tobacco usage, alcohol usage, or drug usage .
Cardiovascular disease	A diagnosis with ICD-10-CM code I10* or I11*.
Asthma	A diagnosis with ICD-10-CM code J45*.
Obesity	A diagnosis with ICD-10-CM code E66.9 or O99.21*.
Tobacco usage	A diagnosis with ICD-10-CM code O99.33* or a current SDOH value of current or former smoker/smokeless tobacco user.
Alcohol usage	A diagnosis with ICD-10-CM code O99.31*.
Drug usage	A diagnosis with ICD-10-CM code O99.32*.

Maternal morbidity	A diagnosis of acute myocardial infarction, aneurysm, acute renal failure, acute respiratory distress syndrome, amniotic fluid embolism, cardiac arrest/ventricular fibrillation, disseminated intravascular coagulation, eclampsia, heart failure/arrest during surgery or procedure, puerperal cerebrovascular disorders, pulmonary edema/acute heart failure, severe anesthesia complications, sepsis, shock, sickle cell disease with crisis, or air and thrombotic embolism.
Social Vulnerability Index (SVI)	The SVI quartile for the ZIP Code of the patient’s most recent address.
Area Deprivation Index (ADI)	The ADI quartile for the census block group of the patient’s most recent address. <i>ADI Funding acknowledgment: This project was supported by the National Institute on Aging of the National Institutes of Health under Award Number RF1AG057784 (PI: Kind), the National Institute On Minority Health And Health Disparities of the National Institutes of Health under Award Number R01MD010243 (PI: Kind); the University of Wisconsin School of Medicine and Public Health (UWSMPH) Center for Health Disparities Research and the Department of Medicine. Content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or of the University of Wisconsin.</i>
Acute myocardial infarction	A diagnosis with ICD-10-CM code I21* or I22*.
Aneurysm	A diagnosis with ICD-10-CM code I71* or I79.0.
Acute renal failure	A diagnosis with ICD-10-CM code N17* or O90.4.
Acute respiratory distress syndrome	A diagnosis with ICD-10-CM code J80, J95.1, J95.2, J95.3, J95.82*, J96.0*, J96.2*, J96.9*, R06.03, or R09.2.
Amniotic fluid embolism	A diagnosis with ICD-10-CM code O88.112, O88.113, O88.119, O88.12, or O88.13.
Cardiac arrest/ventricular fibrillation	A diagnosis with ICD-10-CM code I46* or I49.0*.
Disseminated intravascular coagulation	A diagnosis with ICD-10-CM code D65, D68.8, D68.9, O45.002, O45.003, O45.009, O45.012, O45.013, O45.019, O45.022, O45.023, O45.029, O45.092, O45.093, O45.099, O46.002, O46.003, O46.009, O46.012, O46.013, O46.019, O46.022, O46.023, O46.029, O46.092, O46.093, O46.099, O67.0, or O72.3.
Eclampsia	A diagnosis with ICD-10-CM code O15*.
Heart failure/arrest during surgery or procedure	A diagnosis with ICD-10-CM code I97.120, I97.121, I97.130, I97.131, I97.710, or I97.711.
Puerperal cerebrovascular disorders	A diagnosis with ICD-10-CM code A81.2, G45*, G46*, G93.49, H34.0*, I60*, I61*, I62*, I63.00*, I63.01*, I63.1*, I63.2*, I63.3*, I63.4*, I63.5*, I63.6*, I63.7*, I63.8*, I63.9*, I65*, I66*, I67*, I68*, O22.50, O22.52, O22.53, I97.8*, or O87.3.

Pulmonary edema/acute heart failure	A diagnosis with ICD-10-CM code I50.1, I50.20, I50.21, I50.23, I50.30, I50.31, I50.33, I50.40, I50.41, I50.43, I50.810, I50.811, I50.813, I50.814, I50.82, I50.83, I50.84, I50.89, I50.9, or J81.0.
Severe anesthesia complications	A diagnosis with ICD-10-CM code O29.112, O29.113, O29.114, O29.115, O29.116, O29.117, O29.118, O29.119, O29.122, O29.123, O29.124, O29.125, O29.126, O29.127, O29.128, O29.129, O29.192, O29.193, O29.194, O29.195, O29.196, O29.197, O29.198, O29.199, O29.212, O29.213, O29.214, O29.215, O29.216, O29.217, O29.218, O29.219, O29.292, O29.293, O29.294, O29.295, O29.296, O29.297, O29.298, O29.299, O74.0, O74.1, O74.2, O74.3, O89.0*, O89.1*, O89.2*, T88.2XXA, or T88.3XXA.
Sepsis	A diagnosis with ICD-10-CM code A32.7, A40*, A41*, I76, O85, O86.04, R65.20, R65.21, T81.12XA, or T81.44XA.
Shock	A diagnosis with ICD-10-CM code O75.1, R57*, T78.2XXA, T81.10XA, T81.11XA, T81.19XA, or T88.6XXA.
Sickle cell disease with crisis	A diagnosis with ICD-10-CM code D57.00, D57.01, D57.02, D57.211, D57.212, D57.219, D57.411, D57.412, D57.419, D57.811, D57.812, or D57.819.
Air and thrombotic embolism	A diagnosis with ICD-10-CM code I26.*, O88.012, O88.013, O88.019, O88.212, O88.213, O88.219, O88.312, O88.313, O88.319, O88.812, O88.813, O88.819, O88.02, O88.03, O88.22, O88.23, O88.32, O88.33, O88.82, O88.83, or T80.0XXA.

Table 1: Likelihood of Maternal Morbidity by Maternal Characteristic (SVI)

Variable	Odds Ratio	Lower CI (95%)	Upper CI (95%)
Age Bucket: [12-18)	0.862	0.849	0.875
Age Bucket: [18,25)	0.842	0.834	0.850
Age Bucket: [25,35)	Reference		
Age Bucket: 35+	1.337	1.324	1.350
Race/Ethnicity: Black/Non-Hispanic	1.544	1.531	1.557
Race/Ethnicity: Hispanic or Latino	1.008	0.997	1.018
Race/Ethnicity: Other/Non-Hispanic	1.056	1.045	1.068
Race/Ethnicity: White	Reference		
SVI [0,25)	Reference		
SVI [25,50)	1.076	1.063	1.089
SVI [50,75)	1.144	1.133	1.155
SVI [75,100]	1.233	1.192	1.276

Table 2: Likelihood of Maternal Morbidity by Maternal Characteristic (ADI)

Variable	Odds Ratio	Lower CI (95%)	Upper CI (95%)
ADI [0,25)	Reference		
ADI [25,50)	1.094	1.061	1.129
ADI [50,75)	1.151	1.129	1.174
ADI [75,100]	1.192	1.090	1.302

Age Bucket: [12-18)	1.022	0.998	1.047
Age Bucket: [18,25)	0.857	0.835	0.880
Age Bucket: [25,35)	Reference		
Age Bucket: 35+	1.353	1.327	1.380
Race/Ethnicity: Black/Non-Hispanic	1.715	1.682	1.749
Race/Ethnicity: Hispanic or Latino	1.121	1.091	1.152
Race/Ethnicity: Other/Non-Hispanic	1.097	1.058	1.138
Race/Ethnicity: White	Reference		