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ORIGINAL RESEARCH

Cardiomyopathy Prevalence and Pregnancy-Related Mortality

United States, 2010 to 2020

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ABSTRACT

BACKGROUND Cardiomyopathies, particularly peripartum cardiomyopathy (PPCM), significantly contribute to maternal morbidity in the United States.

OBJECTIVES The authors estimated the prevalence and mortality of PPCM and other cardiomyopathies (OCMs) during pregnancy among women aged 15 to 55 years from 2010 to 2020 in the United States using a cross-sectional analysis of multiple data sets.

METHODS We identified PPCM, OCM, and deliveries using International Classification of Diseases and diagnosis related group codes in the National Inpatient Sample. We calculated PPCM and OCM prevalence and adjusted prevalence ratios (aPRs) by select covariates.

We identified pregnancy-related deaths from all cardiomyopathies combined and PPCM exclusively from 2015 to 2020 Pregnancy Mortality Surveillance System. We calculated pregnancy-related mortality ratios (PRMR) by select covariates.

RESULTS The overall PPCM and OCM prevalence were 105.1 (95% CI: 101.8-108.3) and 76.1 (95% CI: 73.6-78.7) cases per 100,000 delivery hospitalizations, respectively. PPCM prevalence increased with advancing maternal age and decreasing neighborhood income and exhibited marked differences among Black and American Indian or Alaska Native women (aPR: 3.58 [95% CI: 3.36-3.82] and aPR: 1.96 [95% CI: 1.57-2.45], respectively). PPCM prevalence was higher among those with chronic hypertension and diabetes (aPR: 12.17 [95% CI: 11.51-12.88] and aPR: 6.25 [95% CI: 5.77-6.78], respectively). The overall cardiomyopathy and PPCM PRMR were 2.1 and 1.0 deaths per 100,000 live births, respectively. PRMR were highest among those aged ≥40 years and among American Indian and Black women (overall cardiomyopathy PRMR: 7.3, 6.0 deaths per 100,000 live births respectively).

CONCLUSIONS Intensifying efforts to address cardiomyopathies and enhance cardiovascular health before, during, and following pregnancy may reduce the burden of maternal morbidity. (JACC Adv. 2025;4:101692) © 2025 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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ABBREVIATIONS AND ACRONYMS

AAPC = average annual percent change

AI/AN = American Indian and Alaska Native

ANHOPI = Asian, Native Hawaiian and Other Pacific Islander

aPR = Adjusted prevalence ratio

CDC = Centers for Disease Control and Prevention

CVD = cardiovascular disease

HDP = hypertensive disorders of pregnancy

LV = left ventricular

NIS = National Inpatient Sample

OCM = other cardiomyopathy

PMSS = Pregnancy Mortality Surveillance System

PPCM = peripartum cardiomyopathy

PRMR = pregnancy-related mortality ratio

Cardiovascular disease (CVD) affects 1% to 4% of pregnancies and is a predominant cause of adverse maternal outcomes.[1] During 2017 to 2019, cardiovascular conditions contributed to more than one-third of pregnancy-related deaths in the United States, with cardiomyopathy alone causing 12.1% and 8.3% of pregnancy-related deaths in 2017 to 2019 and 2020, respectively.[2]

Peripartum cardiomyopathy (PPCM) is the most common form of pregnancy-related cardiomyopathy.[3] The European Society of Cardiology defines PPCM as idiopathic cardiomyopathy presenting with heart failure secondary to left ventricular (LV) systolic dysfunction with no other identified cause of heart failure.[4] Although most PPCM cases occur between 1 month prior to and 5 months after delivery, PPCM has been observed outside this window.[5-7] In the United States, PPCM prevalence ranged from 38.7[8] to 103[9] per 100,000 live births, depending on study design, case definition, and ascertainment method. Approximately 50% of pregnancy-related mortality associated with PPCM occurs between 43 days and 1 year postpartum.[10]

In addition to PPCM, other cardiomyopathies (OCMs) may exist before pregnancy or be triggered by cardiovascular changes during pregnancy. OCM includes both primary cardiomyopathies, such as hypertrophic and dilated cardiomyopathy and cardiomyopathies that are secondary to systemic disorders, including metabolic and multiorgan syndromes.[11-13] Cardiomyopathies of all types can result in heart failure, atrial fibrillation, and sudden cardiac death, including among pregnant women.[3]

Although PPCM impacts all races and ethnicities, differences by race exist. Black women have higher prevalence and worse outcomes compared to White women.[9,11-15] Other PPCM risk factors include increased maternal age, multiparity, multifetal gestations, genetic factors, and comorbidities including chronic hypertension, diabetes, and preeclampsia.[13]

However, gaps remain in the literature. Data on the PPCM prevalence and mortality among Asian, Native Hawaiian, and Other Pacific Islander (ANHOPI), and American Indian/Alaska Native (AI/AN) women are limited. Few previous studies have focused on OCM.[16-18] One recent study examined cardiomyopathies among delivery-related hospitalizations, but did not report prevalence.[19] Additionally, PPCM mortality studies have used claims data[9,20] or medical records,[21,22] with few using Pregnancy Mortality Surveillance System (PMSS)[23] data that include mortality after discharge. No national studies have reported cardiomyopathy-related maternal mortality by race and ethnicity, sociodemographic characteristics, and risk factors during the period at risk. Identifying PPCM-associated factors is a crucial first step in designing prevention and management strategies to improve outcomes. Therefore, this study uses a cross-sectional design to estimate prevalence, describe mortality, and identify correlates of PPCM and OCM using national hospital discharge data and PMSS.

METHODS

DATA SOURCE FOR PREVALENCE ANALYSIS. For prevalence analyses, we obtained data from the 2010 to 2020 National Inpatient Sample (NIS), produced by the Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality.[24] NIS is a nationally representative data set containing 20% of hospital discharges using all-payer inpatient data. It includes records from state inpatient databases from 48 states (excluding Alabama and Idaho) and the District of Columbia starting in 2017. Before 2017, 44 to 46 states participated.

STUDY POPULATION FOR PREVALENCE ANALYSIS. Our study population included all pregnancy-related hospitalizations among women aged 15 to 55 years. Using an established algorithm, we identified pregnancy-related hospitalizations using International Classification of Diseases-Ninth Revision-Clinical Modification and International Classification of Diseases-10th Revision-Clinical Modification (ICD-9-CM and ICD-10-CM) diagnosis and procedure codes and diagnosis related group codes (Supplemental Table 1).[25] A pregnancy-related hospitalization was defined as any hospital discharge record related to pregnancy, including postpartum visits and visits for nonpregnancy-related conditions while pregnant. From pregnancy-related discharges we identified delivery discharges as any hospital discharge record related to delivery of live or still birth. These delivery discharges were denominators of prevalence calculations.

Among pregnancy-related hospitalizations, we defined PPCM as a discharge diagnosis using ICD-9-CM codes 674.50 to 674.54 or ICD-10-CM code O90.3. OCM was defined as a discharge diagnosis using ICD-9-CM codes 425.0 to 425.9, 429.83 or ICD-10-CM codes I42.0 to I42.9, I25.5, I51.81. PPCM is a diagnosis of exclusion.[7,26] Therefore, the presence of cardiomyopathy codes other than PPCM indicates that the condition was attributed to another cause of heart failure. Consequently, discharges with both

PPCM and OCM codes were categorized as OCM. We also analyzed OCM cases excluding those with a PPCM diagnosis.

PATIENT CHARACTERISTICS. Delivery hospitalizations were stratified by year, race and ethnicity, age group, and income quartile. Discharges missing race and ethnicity or age were removed from the final analytical set (Supplemental Figure 1). NIS uses the following racial categories: Asian or Pacific Islander, Black, Hispanic, Native American, White, and Other. Patients are coded as Hispanic if Hispanic/Latino ethnicity is included on their discharge record; otherwise, patients are coded as the identified race. We used 5-year age groups from ages 15 to 55 years. NIS income quartiles were defined based on U.S. Census Bureau estimates of the median income of the patient's residential zip code in the discharge year. To examine geographic variation, we estimated PPCM and OCM prevalence by U.S. Census Bureau divisions, overall and stratified by race and ethnicity.[27]

We used ICD-CM codes from discharge records to identify the following comorbidities of interest: preexisting hypertension, hypertensive disorders of pregnancy (HDP) (gestational hypertension, preeclampsia, or eclampsia), severe HDP (severe preeclampsia or eclampsia), obesity, diabetes, and tobacco use during pregnancy (Supplemental Table 2). HDP and severe HDP were analyzed as distinct comorbidities.

PREVALENCE AND STATISTICAL ANALYSIS. We calculated cardiomyopathy prevalence as the number of PPCM or OCM cases per 100,000 delivery hospitalizations. We based prevalence on NIS delivery discharges rather than the standard of National Vital Statistics Systems (NVSS) live birth data. NIS delivery discharges approximate the number of live births, underestimating them by about 5%, but include key comorbidity data that NVSS excludes.[25] All analyses use discharge weights, strata, clustering, and variance calculations defined by NIS.[28] Weights for 2010 and 2011 were replaced based on NIS analytic guidance to match discharge weights from 2012 onward.[29]

Using Joinpoint analysis,[30] we assessed temporal trends in the overall prevalence of each outcome by calculating average annual percent change (AAPC) using log-linear models with calculated standard error.[31] As a sensitivity analysis, we also ran these models excluding 2020 to account for changes due to COVID-19 pandemic.

To estimate associations between PPCM or OCM and each sociodemographic variable or comorbidity, we used Poisson regression on individual-level data with delivery discharges as the offset to calculate crude prevalence ratios and adjusted prevalence ratio (aPR).[32] aPR were adjusted for age, race and ethnicity, income, and census division.

All prevalence analyses were conducted using the survey package[33] in R v4.4.0.[34]

DATA SOURCE FOR MORTALITY ANALYSIS. Pregnancy-related mortality data were obtained from PMSS for 2015 to 2020. Our use of this time period ensures consistency in data collection and coding methods. Details have been published previously.[35] Briefly, Centers for Disease Control and Prevention (CDC)'s Division of Reproductive Health requests all states, District of Columbia, and New York City to voluntarily send death records, linked live birth or fetal death records (if applicable), and additional available data on deaths occurring during pregnancy or within 1 year after the end of pregnancy. Individual deaths are reviewed by medically trained epidemiologists to determine pregnancy-relatedness and cause. A death is determined to be pregnancy-related if the death was from any cause related to or aggravated by the pregnancy. Underlying cause of death is classified into 10 mutually exclusive classifications (eg, cardiomyopathy).[35,36] Within each classification, a more specific subclassification of the underlying cause of death (eg, PPCM) is assigned to each death.

MORTALITY STATISTICAL ANALYSIS. Pregnancy-related mortality ratios (PRMRs) (number of pregnancy-related deaths per 100,000 live births) were calculated using counts from combined cardiomyopathy (ie, the total of PPCM and OCM) and PPCM exclusively. The PRMR denominator was the number of live births obtained from NVSS natality files.[37] Maternal education and race and ethnicity data are unavailable for births occurring in 2015 in two states due to the use of the 1989 revision of the United States. standard birth certificate. We calculated counts and PRMRs by year, age group (15-19, 20-24, 25-29, 30-34, 35-39, ≥40 years), race and ethnicity (using U.S. Office of Management and Budget guidelines[38]), rural-urban classification,[39] U.S. Department of Health and Human Services region, and maternal educational status. As described above, temporal trends were calculated using Joinpoint analysis.[30]

Mortality counts and PRMRs were suppressed when based on <9 deaths.

USING RACE AND ETHNICITY. In this analysis, race and ethnicity data are reported to describe known differences.[8,9,12-16,20,40] To better align our prevalence and mortality data, we report NIS results using the terms AI/AN when referring to the Native American race category and ANHOPI to refer to the Asian and Pacific Islander race category. We chose White as

TABLE 1 PPCM and OCMs' Prevalence, U.S. Women Aged 15 to 55 Y, National Inpatient Sample, 2010 to 2020

	Delivery Hospitalizations	PPCM Cases[a]	OCM Cases[a]	PPCM Prevalence[a] (per 100,000 Delivery Hospitalizations) (95% CI)	OCM Prevalence[a] (per 100,000 Delivery Hospitalizations) (95% CI)
Total	38,239,412	40,188	29,110	105.1 (101.7-108.1)	76.0 (73.4-78.5)
Race and ethnicity					
White	20,177,395	15,650	12,040	77.6 (74.4-80.9)	59.7 (57.0-62.5)
Black	5,670,522	17,371	11,192	306.3 (292.3-320.9)	197.4 (187.6-207.5)
ANHOPI	2,220,112	1,104	944	49.7 (43.3-56.9)	42.5 (36.3-49.5)
AI/AN	293,596	455	340	154.8 (123.4-191.8)	115.9 (89.8-147.3)
Hispanic	8,099,985	4,161	3,551	51.4 (47.7-55.3)	43.8 (40.4-47.4)
Other	1,777,802	1,447	1,044	81.4 (72.1-91.5)	58.7 (50.0-68.5)
Age group (y)					
15-19	2,435,918	1,493	956	61.4 (54.2-69.3)	39.3 (33.7-45.6)
20-24	8,155,294	5,789	3,887	71.1 (66.5-75.9)	47.7 (44.2-51.4)
25-29	10,933,911	9,243	6,528	84.7 (80.4-89.2)	59.8 (56.3-63.5)
30-34	10,416,815	10,462	8,278	100.6 (95.8-105.6)	79.6 (75.4-84.0)
35-39	5,170,617	8,341	6,529	161.7 (152.8-171.0)	126.6 (119.1-134.5)
40-44	1,122,318	3,171	2,299	283.5 (259.5-309.1)	205.5 (186.3-226.1)
45-49	72,202	1,132	409	1,574.6 (1,354.5-1819.9)	568.9 (445.2-716.0)
50-55	5,982	494	190	8,301.9 (6,678.1-10172.3)	3,189.9 (2,267.7-4,351.2)
Income quartile[b]					
0-25 (lowest)	10,732,941	16,940	11,365	157.8 (150.8-165.1)	105.9 (100.8-111.1)
26-50	9,374,565	9,786	7,304	104.4 (99.3-109.7)	77.9 (73.5-82.5)
51-75	9,315,704	7,820	5,638	83.9 (79.5-88.6)	60.5 (56.8-64.4)
76-100 (highest)	8,317,570	5,045	4,361	60.7 (56.6-64.9)	52.4 (48.6-56.5)

Values are n or prevalence (95% CI). All races include only individuals of non-Hispanic ethnicity. [a]All estimates are weighted using National Inpatient Sample survey weights. [b]Income quartile is determined by U.S. Census Bureau estimates of the median income of the patient's residential zip code.

AI/AN = American Indian/Alaska Native; ANHOPI = Asian, Native Hawaiian, and Other Pacific Islander; OCM = other cardiomyopathy; PPCM = peripartum cardiomyopathy.

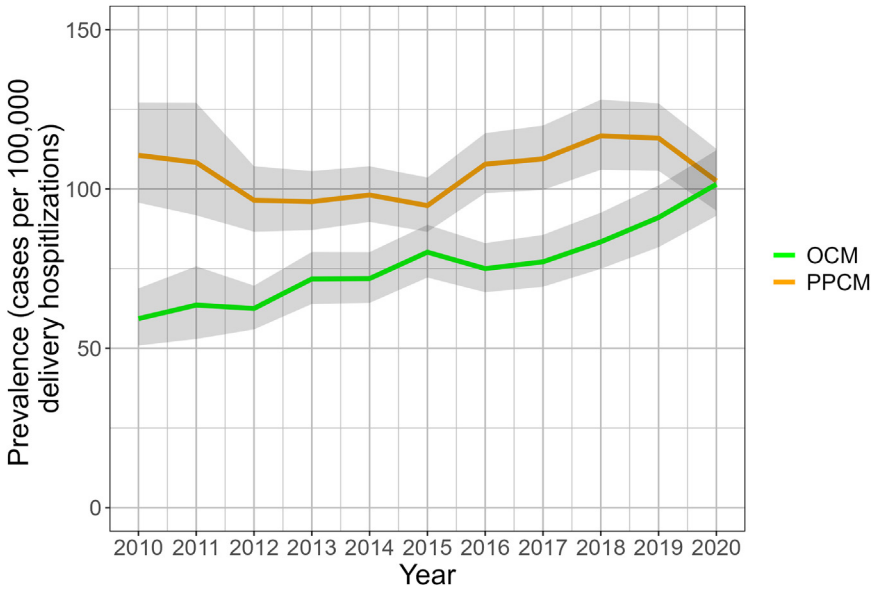
the reference group for prevalence ratios as it is the largest group and therefore produces statistically robust measures.

RESULTS

PPCM AND OCM PREVALENCE. In total, we identified 8,247,086 delivery hospitalizations. After excluding those missing race and ethnicity (n = 507,484) and those aged <15 or >55 years (n = 5,773), our analytic set included 7,733,829 delivery hospitalizations. After weighting, these hospitalizations represented 38,239,412 delivery hospitalizations, 40,188 PPCM cases, and 29,110 OCM cases (Table 1). Of OCM cases, 6,638 (19.9%) included a PPCM code. The prevalence of PPCM and OCM during 2010 to 2020 were 105.1 (95% CI: 101.8-108.3) and 76.1 (95% CI: 73.6-78.7) cases per 100,000 delivery hospitalizations, respectively (Table 1). During this period, prevalence remained unchanged for PPCM (AAPC: 1.3% [95% CI: −1.1% to 4.0%]) and increased for OCM (AAPC: 4.9% [95% CI: 3.0%-7.1%]) (Figure 1). Excluding 2020 from the Joinpoint analysis did not change overall trends or statistical significance.

PPCM prevalence varied by race and ethnicity (Table 1 and Table 2), with the highest prevalence among Black women, followed by AI/AN women (306.3 [95% CI: 293.3-320.9] and 154.8 [95% CI: 123.4-191.8] cases per 100,000 delivery hospitalizations, respectively) and lowest among Hispanic and ANHOPI women (51.4 [95% CI: 47.7-55.3] and 49.7 [95% CI: 43.3-56.9] cases per 100,000 delivery hospitalizations, respectively). The same pattern held for OCM, with the highest prevalence among Black and AI/AN women (197.4 [95% CI: 187.6-207.5] and 115.9 [95% CI: 89.8-147.3] cases per 100,000 delivery hospitalizations, respectively) and the lowest prevalence among Hispanic and ANHOPI women (43.8 [95% CI: 40.4-47.4] and 42.5 [95% CI: 36.3-49.5] cases per 100,000 delivery hospitalizations). Both PPCM and OCM prevalence increased with advancing maternal age and decreased with increasing income quartile

FIGURE 1 **Peripartum Cardiomyopathy and Other Cardiomyopathies' Prevalence (95% CI) by Year, Ages 15 to 55 Years, National Inpatient Sample, United States, 2010 to 2020**



Yearly peripartum cardiomyopathy and other cardiomyopathy prevalence was estimated from National Inpatient Sample data. Other cardiomyopathy prevalence significantly increased (average annual percent change: 4.9% [95% CI: 3.0%-7.1%]) from 2010 to 2020. Peripartum cardiomyopathy prevalence did not statistically change (average annual percent change: 1.3% [95% CI: −1.1% to 4.0%]). OCM = other cardiomyopathy; PPCM = peripartum cardiomyopathy.

(**Table 1**). The highest income quartile was half as likely to have PPCM or OCM compared to the lowest income quartile (PPCM aPR: 0.44 [95% CI: 0.42-0.46], OCM aPR: 0.48 [95% CI: 0.44-0.52]).

Both PPCM and OCM prevalence were higher among women with comorbidities in both adjusted and unadjusted models (**Table 2**). Notably, delivery hospitalizations with prepregnancy hypertension were markedly more likely to have PPCM and OCM (PPCM: aPR: 12.17 [95% CI: 11.51-12.88], OCM aPR: 12.81 [95% CI: 12.05-13.63]). Likewise, PPCM and OCM prevalence were greater in delivery hospitalizations listing diabetes (PPCM aPR: 6.25 [95% CI: 5.77-6.78], OCM aPR: 6.39 [95% CI: 5.84-6.99]).

Geographically, the highest PPCM prevalence were in the South Atlantic and East South-Central divisions (143.7 [95% CI: 135.1-152.7] and 146.7 [95% CI: 129.2-165.7] cases per 100,000 delivery hospitalizations, respectively) (**Figure 2**). Geographic patterns of PPCM and OCM prevalence varied by race and ethnicity (Supplemental Figure 1).

Removing cases with codes for both PPCM and OCM from our OCM set led to a decrease in OCM prevalence but no changes in the observed patterns (Supplemental Table 1).

PREGNANCY-RELATED MORTALITY FROM CARDIOMYOPATHY.

From 2015 to 2020, there were 480 pregnancy-related deaths from cardiomyopathy (PRMR: 2.1 deaths per 100,000 live births), and 231 deaths from PPCM exclusively (PRMR: 1.0 deaths per 100,000 live births) (**Table 3**). Both PRMRs remained unchanged over this period (AAPC for all cardiomyopathies: −1.7% [95% CI: −4.5% to 1.3%] and PPCM: −5.8% [95% CI: −13.0 to 2.1]). Excluding 2020 made minor differences to the AAPC but did not change statistical significance of the trends.

AI/AN and Black women had the highest cardiomyopathy PRMRs (7.3 and 6.0 deaths per 100,000 live births, respectively), and Hispanic and Asian women had the lowest (0.9 and 1.0 deaths per 100,000 live births, respectively). Black women had the highest PPCM PRMR (3.1 per 100,000 live births). The PRMR from all cardiomyopathies and from PPCM exclusively increased with increasing age. The lowest PRMR was among women aged 15 to 19 years and

TABLE 2 Unadjusted and Adjusted Associations of Select Characteristics With PPCM and OCMs' Prevalence, U.S. Women Aged 15 to 55 Years, National Inpatient Sample, 2010 to 2020[a]

	PPCM PR (95% CI)	PPCM aPR[b] (95% CI)	OCM PR (95% CI)	OCM aPR[b] (95% CI)
Race and ethnicity				
White (ref)	1.00	1.00	1.00	1.00
Black	3.95 (3.73-4.19)	3.58 (3.36-3.82)	3.31 (3.11-3.52)	3.18 (2.97-3.40)
ANHOPI	0.66 (0.61-0.72)	0.67 (0.58-0.77)	0.71 (0.61-0.83)	0.65 (0.55-0.76)
AI/AN	2.00 (1.61-2.48)	1.96 (1.57-2.45)	1.94 (1.52-2.48)	1.96 (1.52-2.52)
Hispanic	0.64 (0.56-0.74)	0.66 (0.60-0.72)	0.73 (0.67-0.80)	0.73 (0.66-0.80)
Other	1.05 (0.93-1.19)	1.03 (0.91-1.17)	0.98 (0.84-1.15)	0.96 (0.82-1.13)
Age group (years)				
15-19 (ref)	1.00	1.00	1.00	1.00
20-24	1.16 (1.01-1.33)	1.24 (1.08-1.42)	1.21 (1.03-1.43)	1.28 (1.09-1.51)
25-29	1.38 (1.21-1.57)	1.78 (1.56-2.03)	1.52 (1.30-1.78)	1.88 (1.60-2.20)
30-34	1.64 (1.44-1.86)	2.50 (2.19-2.85)	2.02 (1.74-2.36)	2.88 (2.46-3.37)
35-39	2.63 (2.31-3.00)	4.19 (3.66-4.80)	3.22 (2.75-3.77)	4.71 (4.00-5.53)
40-44	4.62 (3.98-5.35)	7.20 (6.19-8.37)	5.23 (4.39-6.22)	7.47 (6.26-8.90)
45-49	25.65 (21.31-30.87)	39.95 (33.15-48.16)	14.46 (11.10-18.85)	20.74 (15.89-27.06)
50-55	135.24 (106.93-171.05)	184.67 (145.66-234.12)	81.11 (57.27-114.88)	104.75 (74.14-148.01)
Income quartile[c]				
0-25 (ref)	1.00	1.00	1.00	1.00
26-50	0.73 (0.71-0.75)	0.76 (0.74-0.78)	0.78 (0.76-0.80)	0.78 (0.76-0.80)
51-75	0.53 (0.51-0.56)	0.58 (0.56-0.59)	0.61 (0.58-0.64)	0.61 (0.58-0.65)
76-100	0.39 (0.36-0.42)	0.44 (0.42-0.46)	0.48 (0.44-0.52)	0.48 (0.44-0.52)
Comorbidity				
No comorbidities	1.00	1.00	1.00	1.00
Prepregnancy hypertension	20.58 (19.59-21.63)	12.17 (11.51-12.88)	20.05 (18.97-21.20)	12.81 (12.05-13.63)
HDP	3.37 (3.19-3.55)	2.67 (2.52-2.83)	2.40 (2.25-2.56)	1.97 (1.85-2.11)
Severe HDP	4.43 (4.09-4.81)	3.50 (3.21-3.80)	2.82 (2.52-3.16)	2.29 (2.04-2.57)
Obesity	3.53 (3.33-3.74)	2.57 (2.42-2.73)	3.52 (3.31-3.75)	2.69 (250-2.84)
Smoking	2.11 (1.96-2.28)	1.89 (1.75-2.04)	2.65 (2.44-2.87)	2.47 (2.27-2.69)
Diabetes	10.10 (9.33-10.93)	6.25 (5.77-6.78)	9.90 (9.07-10.81)	6.39 (5.84-6.99)

Values are prevalence ratios (PR) and 95% CI. All races include only individuals of non-Hispanic ethnicity. [a]All estimates are weighted using National Inpatient Sample survey weights. [b]Adjusted prevalence ratios are adjusted for age group, race and ethnicity, and income quartile. [c]Income is based on U.S. Census Bureau estimates of the median income of the residential zip code.

AI/AN = American Indian/Alaska Native; ANHOPI= Asian, Native Hawaiian, and Other Pacific Islander; aPR = adjusted prevalence ratio; HDP = hypertensive disorders of pregnancy; OCM = other cardiomyopathy; PPCM = peripartum cardiomyopathy; PR = prevalence ratio.

highest among those aged ≥40 years (1.5 and 5.4 deaths per 100,000 live births, respectively).

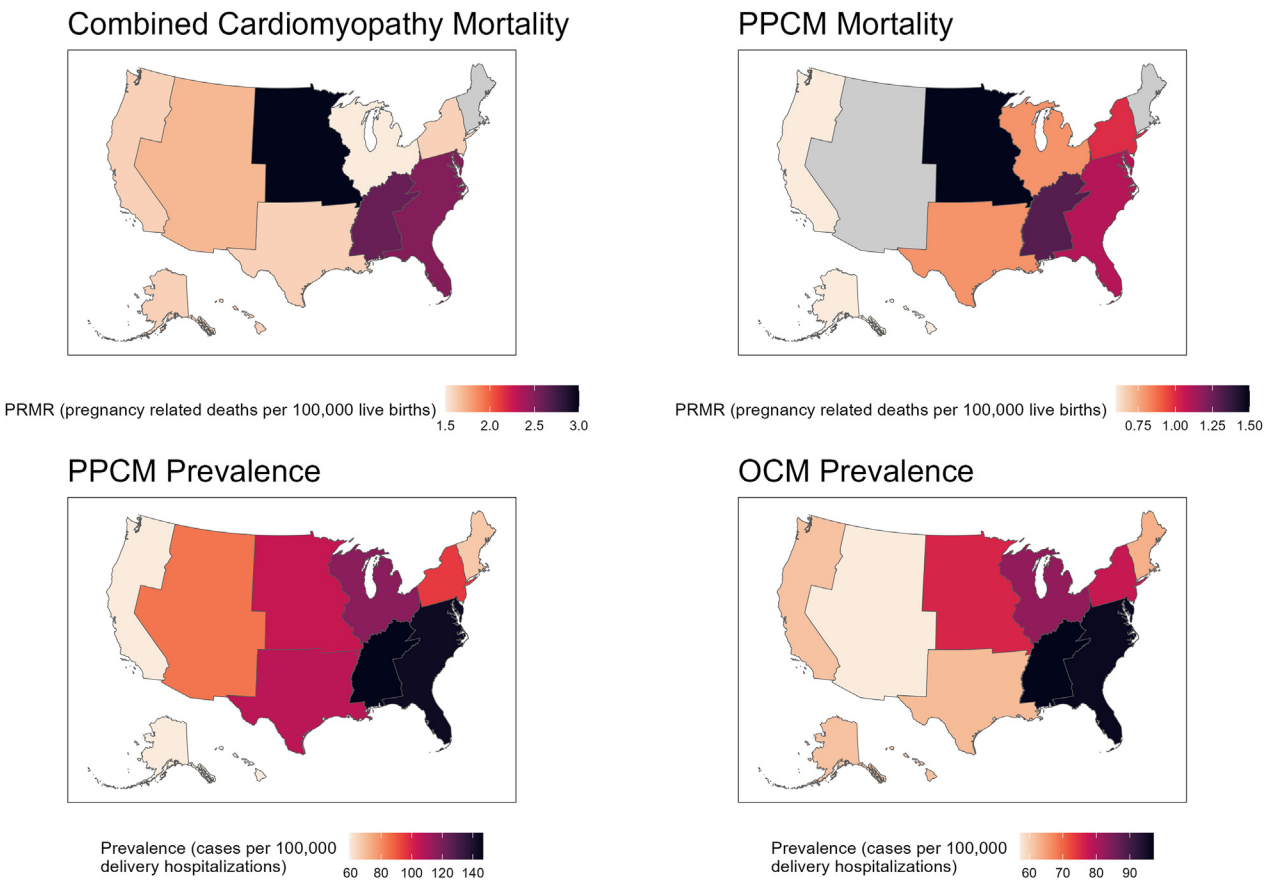
PRMRs in rural areas were higher for all cardiomyopathies (rural: 3.3, urban: 1.6 deaths per 100,000 live births, respectively) and PPCM alone (rural: 1.8, urban: 0.9 deaths per 100,000 live births). Women with ≥12 years of education had a lower PRMR from cardiomyopathy than those with <12 years of education. The highest PRMR was observed in the South Atlantic region (Department of Health and Human Services region 4) (all cardiomyopathies: 3.0, PPCM: 1.5 per 100,000 live births).

DISCUSSION

Our national analysis updates the descriptive epidemiology of PPCM and OCM through 2020. We identified increasing OCM prevalence over this period, with Black and AI/AN women experiencing markedly higher prevalence and mortality compared to women of other racial groups. Likewise, we observed differences across sociodemographic characteristics. Although all examined comorbidities were associated with higher prevalence of PPCM and OCM, the highest was among women with prepregnancy hypertension.

In our study, Black and AI/AN women had approximately four and two times greater PPCM prevalence, respectively, compared to White women. Likewise, the PRMR for all types of cardiomyopathies among Black and AI/AN women was almost triple that of White women. Further, the highest numbers of PPCM and OCM cases and pregnancy-related deaths due to all cardiomyopathies and PPCM exclusively occurred among Black women, despite Black women

FIGURE 2 **Pregnancy-Related Cardiomyopathy Prevalence and Mortality by Region, United States[a,b]**



Prevalence and mortality from pregnancy-related cardiomyopathies were mapped to document geographic differences within the United States. [a]Maps of mortality use regions defined by the U.S. Department of Health and Human Services with data from the Pregnancy Mortality Surveillance System, 2015 to 2019. Maps of prevalence use divisions defined by the U.S. Census Bureau with data from the National Inpatient Sample, 2010 to 2020. [b]Regions shaded gray are suppressed because they have <9 events. OCM = other cardiomyopathy; PPCM = peripartum cardiomyopathy; PRMR = pregnancy-related mortality ratio.

comprising only 14.8% of delivery hospitalizations (**Central Illustration**). Several national studies from the United States have noted persistent differences between Black and White women in maternal cardiomyopathies.[8,20,40] To our knowledge, only two studies have reported PPCM prevalence or cardiomyopathy-related maternal mortality among AI/AN women, due to small sample sizes and misclassification.[16,41] Estimates within these groups are key to improving these maternal outcomes.

The observed association of PPCM with prepregnancy hypertension and HDP supports previous findings. Preeclampsia has been associated with lower 1-year survival, but higher LV recovery rates.[42] Our results align with PPCM risk prediction models that include prepregnancy diabetes, obesity, and low socioeconomic status.[43]

Cardiomyopathies complicating pregnancy and the postpartum period are associated with adverse outcomes, including mortality, pulmonary edema, thromboembolic complications, and the need for transplantation. Timely diagnosis and management by a multidisciplinary team are critical to survival and recovery of LV function.[44] Consultation with a cardiologist and consideration of referral or transfer to a facility providing risk appropriate care are recommended.[45] Ideally, women diagnosed with PPCM during pregnancy receive care from a multidisciplinary pregnancy heart team or cardio-obstetrics team that minimally includes obstetric care professionals, maternal-fetal medicine specialists, cardiologists, and an anesthesiologist.

Pregnancy is a time of hemodynamic changes which are accentuated during delivery and continue

TABLE 3 PRMRs for Cardiomyopathies by Maternal Characteristic, Ages 15 to 54 Years, United States, PMSS 2016 to 2020[a]

	Pregnancy-Related Deaths From All Cardiomyopathies	Pregnancy-Related Deaths From PPCM	All Cardiomyopathy PRMR (Deaths per 100,000 Live Births)	PPCM PRMR (Deaths per 100,000 Live Births)
Overall	480	231	2.1	1.0
Race and ethnicity				
White	197	89	1.7	0.8
Black	198	103	6.0	3.1
Asian	13	Suppressed	0.9	Suppressed
NHOPI	Suppressed	Suppressed	Suppressed	Suppressed
AI/AN	13	Suppressed	7.3	Suppressed
Hispanic	51	25	1.0	0.5
Other/unknown[b]	4	0		
Age (y)				
15-19	17	9	1.5	0.8
20-24	83	40	1.8	0.9
25-29	129	68	1.9	1.0
30-34	119	57	1.8	0.9
35-39	91	45	2.7	1.3
≥40	41	12	5.4	1.6
Urbanization of residence				
Rural	101	50	3.3	1.6
Urban	359	173	1.8	0.9
Missing	20	8		
Education status of mother				
<12 y	79	37	2.7	1.3
12 y	184	89	3.2	1.5
>12 y	163	77	1.2	0.6
Missing	54	28		
Year				
2015	85	41	2.1	1.0
2016	81	46	2.1	1.2
2017	86	42	2.2	1.1
2018	81	38	2.1	1.0
2019	73	35	1.9	0.9
2020	74	29	2.0	0.8
HHS region				
Region 1	Suppressed	Suppressed	Suppressed	Suppressed
Region 2	32	19	1.6	1.0
Region 3	32	17	1.5	0.8
Region 4	134	69	3.0	1.5
Region 5	92	40	2.5	1.1
Region 6	88	45	2.6	1.3
Region 7	17	8	1.6	0.8
Region 8	16	Suppressed	1.7	Suppressed
Region 9	59	22	1.6	0.6
Region 10	Suppressed	Suppressed	Suppressed	Suppressed

Values are counts of deaths and pregnancy-related mortality ratios (PRMR). All races include only individuals of non-Hispanic ethnicity. [a]PRMR based on <9 cases are suppressed. [b]Other/unknown includes individuals reporting multiple races.

AI/AN = American Indian/Alaska Native; HHS = Department of Health and Human Services; NHOPI = Native Hawaiian and Other Pacific Islander; PPCM = peripartum cardiomyopathy; PPMR = pregnancy-related mortality ratio.

into the postpartum period. Hence, postpartum monitoring is critical in women with or at risk for CVD and hypertension.[46] The intensity and frequency of postpartum follow-up care depends upon disease severity and delivery events.[46,47] All pregnant women are recommended a first follow-up within 3 weeks postpartum, with a comprehensive visit within 12 weeks.[48] Women with cardiovascular disorders and HDP are recommended an early outpatient visit 7 to 14 and 7 to 10 days, respectively, after delivery.[46-48] Women with severe hypertension should be seen within 72 hours following delivery.[48] These

CENTRAL ILLUSTRATION **Peripartum Cardiomyopathy and Other Cardiomyopathies' Prevalence Present Notable Differences**

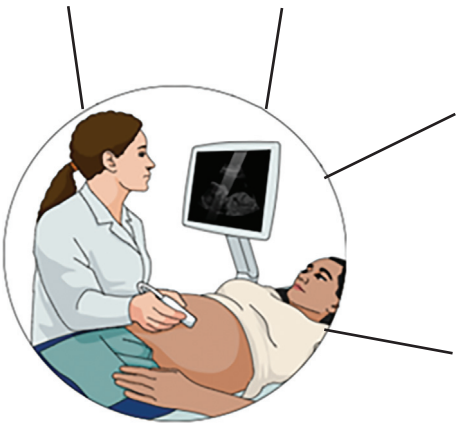
Peripartum cardiomyopathy (PPCM) and other cardiomyopathies (OCM) prevalence present significant differences by race and income

Overall PPCM and OCM prevalence were 105.1 (95% CI: 101.8-108.3) and 76.1 (95% CI: 73.6-78.7) cases per 100,000 delivery hospitalizations, respectively.

Contributing factors to differences in PPCM and OCM prevalence

Age
Both PPCM and OCM prevalence increased sharply with advancing maternal age.

Race
Black women had approximately 4 times greater prevalence of PPCM and OCM, AI/AN women had 2 times greater prevalence, compared to White women.



Neighborhood Income Level
The lowest income quartile had more than double the prevalence of PPCM and OCM compared to the highest quartile.

Comorbidities
Both PPCM and OCM prevalence were higher among people with comorbidities, notably pre-pregnancy hypertension and diabetes.

Pregnancy-Related Mortality From Cardiomyopathy

The highest numbers of pregnancy-related deaths due to all cardiomyopathies and PPCM exclusively occurred among Black women, despite Black women comprising only 14.8% of delivery hospitalizations.

Pathak I, et al. JACC Adv. 2025;4(5):101692.

Several populations are at higher risk for peripartum cardiomyopathy and other cardiomyopathies during pregnancy, including older women, Black and AI/AN women, people from lower income neighborhoods, and those with cardiovascular risk factors including hypertension, diabetes, and obesity.

visits facilitate assessment of well-being, symptoms, blood pressure, and functional status. They represent key opportunities to discuss pregnancy complications, their implications for future childbearing and long-term maternal health, and barriers to postpartum care and the primary care transition.[48,49] CVD assessment algorithms in the antepartum and postpartum periods are available for use in multiple settings, including emergency rooms.[50-52] Laboratory testing may include natriuretic peptides concentrations, which are markedly elevated in PPCM.[50]

The association of chronic and pregnancy-associated hypertension with PPCM suggests the importance of prioritizing timely detection and management of hypertension during and following pregnancy. The Million Hearts Hypertension in Pregnancy Change Package is designed by and for outpatient clinicians to adopt effective approaches that focus on early identification, optimal management, and prevention of complications of hypertension in pregnancy, including cardiomyopathies.[53] Likewise, CDC's Division of Reproductive Health's *Hear Her* campaign seeks to raise awareness of maternal warning signs, including those of cardiomyopathy, and to improve communication between patients and health care providers and to educate patients and health care professionals.[54] Materials for patients and clinicians are available, as well as examples of facility-based educational programs.

Future research could examine interventions to reduce the incidence and adverse outcomes of PPCM and OCMs. Research may also explore barriers and facilitators of timely cardiomyopathy diagnosis. Although clinical trials may provide the most robust

answers, administrative data sets (eg, claims and electronic health records) can prove useful in examining these questions. Other factors, including rural residence and low educational attainment were associated with increased PPCM mortality. Women from rural areas may have limited access to health care facilities and specialists,[55,56] while those with low education may lack knowledge about the signs and symptoms,[57,58] leading to delayed recognition and treatment of PPCM.

STRENGTHS AND LIMITATIONS. Our study has several strengths. First, our analysis produced national estimates rather than estimates based on cohorts or local areas. Second, we used definitions of PPCM and OCM that acknowledge the subtleties and difficulties in making these diagnoses, limiting bias caused by other definitions. The strength of using PMSS for pregnancy-related mortality includes full national participation and the ability to evaluate subclassifications of causes of death.

Our study is also subject to several limitations. First, our study period coincided with the change from ICD-9-CM to ICD-10-CM and the COVID-19 pandemic, which could impact estimates. Second, NIS does not collect data on parity, which has been associated with PPCM.[59] Furthermore, disaggregation by race and ethnicity or by cardiomyopathy subtypes may reveal different patterns. Finally, our use of discharge records relies on accurate and consistent reporting from all hospitals included in NIS, which may lead to misclassification of included outcomes and comorbidities. This misclassification may differ across hospitals, states, and years. Comorbidities, such as prepregnancy hypertension[60] and tobacco use, may be less likely to be recorded at discharge for pregnancies without complications, leading overestimates.

CONCLUSIONS

PPCM and OCM prevalence and mortality exhibit significant differences by race and economic factors. The higher prevalence among those with diabetes and hypertension emphasizes the need to improve management of pre-existing chronic conditions. Intensifying efforts to address root causes of these differences and to enhance cardiovascular health before and during pregnancy may reduce the burden of cardiomyopathies during pregnancy.

DISCLAIMER

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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PERSPECTIVES

COMPETENCY IN PATIENT CARE AND PROCEDURAL SKILLS: Timely diagnosis and management by a multidisciplinary pregnancy heart team or cardio-obstetrics team that minimally includes obstetric care professionals, maternal-fetal medicine specialists, cardiologists, and an anesthesiologist is critical to survival and recovery of pregnant women with cardiomyopathies. Consultation with a cardiologist and consideration of referral or transfer to a facility providing risk appropriate care is recommended by the American College of Obstetricians and Gynecologists.

TRANSLATIONAL OUTLOOK: Cardiovascular disease assessment algorithms and laboratory testing to promote early detection of cardiomyopathies in the antepartum and postpartum periods are available for use in multiple settings, including emergency rooms. Laboratory testing may include natriuretic peptides concentrations, which are markedly elevated in peripartum cardiomyopathy. Postpartum monitoring is critical in women with or at risk for cardiomyopathy. The intensity and frequency of postpartum follow-up care depends upon disease severity and delivery events. Postpartum visits within the first 2 weeks following delivery are recommended for prompt detection and management of complications.

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KEY WORDS cardiomyopathy, cardiovascular disease, maternal mortality, peripartum cardiomyopathy, pregnancy

APPENDIX For supplemental tables and figures, please see the online version of this paper.