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Original Article

Racial Differences in Delivery Outcomes Among Women With Peripartum Cardiomyopathy

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ABSTRACT

Background: Peripartum cardiomyopathy (PPCM) is a rare idiopathic cardiomyopathy associated with pregnancy that occurs more frequently among Black women. However, less is known about the association of race/ethnicity with outcomes at the time of delivery in women with PPCM.

Methods: We used data from the 2016-2018 National Inpatient Sample (NIS) database to identify women with a diagnosis of PPCM based on International Classification of Diseases, 10th revision (ICD-10) codes. Using adjusted logistic regression, the association of race

RÉSUMÉ

Introduction : La cardiomyopathie du péripartum (CMPP) est une rare cardiomyopathie idiopathique associée à la grossesse qui apparaît plus fréquemment chez les femmes noires. Toutefois, on en connaît peu sur l'association entre la race/l'origine ethnique et les issues au moment de l'accouchement chez les femmes atteintes d'une CMPP.

Méthodes : Nous avons utilisé les données de la base de données de l'échantillon national des données de patients hospitalisés (NIS, de l'anglais *National Inpatient Sample*) de 2016-2018 pour trouver les femmes qui avaient un diagnostic de CMPP selon les codes de la

Peripartum cardiomyopathy (PPCM) is defined as an idiopathic cardiomyopathy that presents with left ventricular systolic dysfunction (ejection fraction $\leq$ 45%) toward the end of pregnancy or in the months after delivery, in the absence of any other identifiable cause of heart failure,[1] In the US, the incidence of PPCM is approximately 1 case per 1000-4000 deliveries, with Black women having an up to 15-fold higher risk compared to women of other races, as found in prior studies.[1-6]

PPCM is associated with significant cardiovascular (CV) morbidity and in-hospital mortality.[7] One study of 34,214 women with PPCM showed that 13% had major adverse events, including in-hospital mortality, cardiac arrest, heart transplant, mechanical circulatory support, acute pulmonary edema, thromboembolism, arrhythmic events, and cardiogenic shock.[5] However, little is known regarding racial differences in CV outcomes among delivering women who develop PPCM. Therefore, data from the US National Inpatient Sample (NIS) were used to evaluate adverse CV outcomes and their association with race in a contemporary cohort of women with PPCM at the time of delivery hospitalization.

Methods

We analyzed data from the 2016-2018 NIS hospital dataset.[8] The NIS is a database of hospital discharges representing 20% of all inpatient admissions to US community hospitals.[8] We identified delivery hospitalizations using diagnosis-related codes, and restricted analyses to delivery hospitalizations only. We used International Classification of Diseases, 10th edition, Clinical Modification (ICD-10-CM) codes to identify patients with PPCM, and for each CV outcome (see Supplemental Tables S1-S3 for ICD-10 codes). We then determined the prevalence of these outcomes in each racial/ethnic group. Race/ethnicity was defined per self-report.

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Ethics Statement: Our study was exempt from institutional board review approval because of the de-identified nature of the database, which is publicly available.

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with PPCM and adverse cardiovascular (CV) outcomes with PPCM was evaluated across racial/ethnic groups (White, Black, Hispanic, Asian/Pacific Islander).

Results: Among 11,304,996 delivery hospitalizations, PPCM was present in 8735 (0.08%). After adjusting for CV risk factors (chronic hypertension, diabetes, and obesity) and socioeconomic factors (insurance status, hospital income, and residential income), Black and Native American women had greater adjusted odds of developing PPCM (adjusted odds ratio [aOR] 1.89; 95% confidence interval [CI] 1.66-2.15; aOR 1.60; 95% CI 1.02-2.50, respectively), compared with White women. In stratified analysis of CV events, however, Asian/Pacific Islander women with PPCM were the most likely to have CV complications (aOR 98; 95% CI 29-333 for pulmonary edema).

Conclusions: In the US, at the time of delivery hospitalization, Black and Native American women are the most likely to develop PPCM, despite adjustment for CV and socioeconomic risk factors, but Asian women have higher odds of having CV complications.

Classification internationale des maladies, 10e révision (CIM-10). À l'aide de la régression logistique ajustée, nous avons évalué l'association de la race à la CMPP et les événements cardiovasculaires (CV) indésirables entre les groupes raciaux/ethniques (Blanches, Noires, Hispaniques, Asiatiques/îliennes du Pacifique).

Résultats : Parmi les 11 304 996 hospitalisations liées à l'accouchement, on a noté la présence de la CMPP 8 735 (0,08 %) fois. Après l'ajustement des facteurs de risque CV (hypertension chronique, diabète et obésité) et des facteurs socioéconomiques (statut en matière d'assurances, indemnités journalières en cas d'hospitalisation et revenu familial), le risque relatif ajusté (RRa) des femmes noires et autochtones de manifester une CMPP était plus élevé (RRa 1,89; intervalle de confiance [IC] à 95 % 1,66-2,15; RRa 1,60; IC à 95 % 1,02-2,50, respectivement) que les femmes blanches. Toutefois, dans l'analyse stratifiée des événements CV, les femmes asiatiques et des îles du Pacifique qui avaient une CMPP étaient plus susceptibles d'avoir des complications CV (RRa 98; IC à 95 % 29-333 pour l'œdème pulmonaire).

Conclusions : Aux É.-U., lors des hospitalisations liées à l'accouchement, les femmes noires et autochtones sont les plus susceptibles de manifester une CMPP, en dépit de l'ajustement des facteurs de risque CV et des facteurs socioéconomiques, mais les femmes asiatiques ont un risque plus élevé d'avoir des complications CV.

Our study was exempt from institutional board review approval because of the de-identified nature of the database, which is publicly available.

Data were analyzed using STATA, version 16 (StataCorp, College Station, TX). Descriptive statistics were used to compare demographics and comorbidities in women with PPCM, stratified by race/ethnicity. Continuous variables were described as mean ± standard deviation if normally distributed, and median (with interquartile range) if not normally distributed. For comparison of categorical variables, χ^2 testing was performed, and for continuous variables, the Student's *t*-test was performed if normally distributed, and the Mann-Whitney *U* test was performed if non-normally distributed. Adjusted logistic regression, stratified by race/ethnicity, was used to compared CV outcomes by race/ethnicity. Adjustment was performed for age, hypertension, diabetes mellitus, and obesity.

Results

A total of 8735 cases (0.08%) of PPCM occurred among the 11,304,996 patients admitted for delivery during the period 2016 to 2018. The median age of women with PPCM was 31 years (range: 26-35 years). Among patients with PPCM, 3555 (41%) were White, 3180 (17%) were Black, 935 (10%) were Hispanic, 315 (4%) were Asian/Pacific islander (PI), and 110 (1%) were Native American (Table 1). Following adjustment for age, CV risk factors (chronic hypertension, diabetes, and obesity) and socioeconomic factors (hospital location, median residential income by zip code, and insurance status), Black women, compared with White women, had the higher adjusted odds ratio (1.89; 95% confidence interval 1.66-2.15), followed by Native American women (1.60; 95% confidence interval 1.02-2.50), compared with White women. Asian/PI and Hispanic women were not more likely to develop PPCM, compared with White women.

The prevalence of CV comorbidities was higher in women with PPCM compared to those without PPCM (Table 1). Notably, Black women had higher rates of hypertension, preexisting diabetes, dyslipidemia, obesity, chronic kidney disease, and coronary artery disease, compared with women of other racial groups (Fig. 1A). Unadjusted acute CV complications by racial/ethnic groups showed comparable rates per 100,000 in Black and White women, with lower rates in Hispanic and Asian/PI women (Fig. 1B). After adjusting for CV risk factors (chronic hypertension, diabetes, and obesity), the risk of CV complications across races was heterogeneous, with Asian/PI women being the most likely to develop pulmonary edema and acute renal failure (Table 2).

Discussion

Our current analysis of patients with PPCM from contemporary NIS data reveals several important findings. Consistent with prior findings, White women were the largest racial group with PPCM, yet Black and Native American women have higher odds of developing the condition, despite adjustment for CV and socioeconomic factors.[5] Our analysis also confirms a relatively high prevalence of CV comorbidities among Black women, including hypertension, diabetes mellitus, and obesity. Black women, though, were not at the greatest risk of developing acute CV complications from PPCM, compared with other racial groups. However, important to note is that Black women with PPCM are overall at high risk for both short-term CV complications (shown herein) and long-term adverse outcomes due to PPCM,[6,9] and they require significant attention in terms of prevention and management of poor outcomes.

It is important to note that a genetic cause of PPCM is consistent with that found in prior studies.[3-5,9] Furthermore, a prior study using NIS data (2004-2011) also showed a temporal trend toward an increasing prevalence of PPCM in

Table 1. Baseline patient and hospitalization characteristics of delivering mothers with peripartum cardiomyopathy (PPCM)

Characteristics	Deliveries		
	All (n = 11,304,996)	Without PPCM (n = 11,296,326)	With PPCM (n = 8735)
Median (IQR) age, y	29 (25−33)	29 (25−33)	31 (26−35)
Median (IQR) hospital length of stay, d	2 (2−3)	2 (2−3)	3 (2−5)
Median (IQR) hospitalization cost, $	16,088 (10,770−24,458)	16,082 (10,767− 24,446)	29,557 (17,122−53,436)
Race/Ethnicity			
White	5,654,795 (50)	5,651,552 (50)	3555 (41)
Black	1,640,365 (15)	1,636,838 (15)	3180 (17)
Hispanic	2,233,880 (20)	2,232,154 (20)	935 (10)
Asian/Pacific Islander	670,390 (6)	669,872 (6)	315 (4)
Native American	80,265 (0.7)	79,074 (0.7)	110 (1)
Other	504,205 (4)	503,816 (4.5)	325 (4)
Missing	521,160 (5)	451,853 (4.6)	315 (4)
Hospital region			
New England	88,406 (4)	441,686 (3.9)	215 (2)
Middle Atlantic	1,361,129 (12)	1,360,078 (12)	839 (10)
East North Central	1,595,144 (14)	1,593,912 (14)	1335 (15)
West North Central	786,832 (7)	786,224 (7)	525 (6)
South Atlantic	2,164,919 (19)	2,165,245 (19)	2365 (27)
East South Central	697,522 (6)	696,983 (6)	715 (8)
West South Central	1,560,098 (14)	1,588,893 (14)	1250 (14)
Mountain	852,4012 (8)	851,743 (8)	570 (7)
Pacific	1,844,986 (16)	1,844,690 (16)	890 (10)
Median household income of residents in patient's zip code, $			
≤ 43,999	3,154,112 (28)	3,151,675 (28)	3315 (38)
44,000-55,999	2,846,614 (25)	2,844,415 (25)	2385 (27)
56,000-73,999	2,755,043 (24)	2,752,915 (24)	1850 (21)
≥ 74,000	2,440,763 (22)	2,440,006 (22)	1090 (12)
Missing	108,529 (1)	108,445 (1)	95 (1)
Primary insurance/payer			
Medicare	84,788 (0.7)	84,772 (0.8)	210 (2)
Medicaid	4,862,307 (43)	4,858,550 (43)	4685 (54)
Private insurance	5,744,101 (51)	5,740,793 (5)	3400 (38)
Self-pay	287,149 (2)	286,927 (3)	195 (2)
No charge	7,235 (< 0.1)	7,230 (< 0.1)	15 (0.2)
Other	304,106 (3)	303,871 (3)	225 (3)
Missing	13,566 (0.1)	13,556 (0.1)	5 (< 0.1)
Comorbidities			
Chronic hypertension	2,110 (24)	27,111 (0.2)	< 0.001
Diabetes mellitus	515 (6)	117,482 (1.0)	< 0.001
Obesity	2,015 (23)	994,077 (9)	< 0.001
Preeclampsia /eclampsia	1,865 (21)	591,927 (5)	< 0.001
Gestational hypertension	525 (6)	614,520 (5)	0.30
Gestational diabetes	375 (4)	843,836 (7)	< 0.001
Caesarean section	291,670 (3)	291,445 (3)	150 (1.7)

Values are n (%), unless otherwise indicated.
IQR, interquartile range.

Native American women over time.[5] The increased risk for PPCM for both races in a contemporary cohort persists despite adjustment for both CV and socioeconomic factors, suggesting that other factors may be important contributors to this increased risk, including environmental or genetic factors.

The following is particularly important to note: A genetic cause of PPCM had been recognized in up to 20% of studied patients, of which the most prominent is mutation in the sarcomeric gene *titin*.[10,11] However, a recent study showed that the burden of *titin*-truncating variants did not differ across geographic regions and racial backgrounds.[12] Currently, no specific environmental factors have been elucidated that predispose people to PPCM. However, some environmental factors, such as exposure to chemicals or toxins, may lead to dilated cardiomyopathy in the general population.[13] Therefore, environmental or genetic risk factors that predispose people to PPCM across racial groups may be unidentified as yet, and this possibility warrants further study.

Acute CV complications in PPCM, which reflect risk for severe morbidity and mortality, have not been studied previously across racial and ethnic groups. One previous study found higher mortality in PPCM for Asian women, but it did not investigate specific CV outcomes.[7] We reported previously on acute CV complications in women with preeclampsia, across racial groups, and similarly found heterogeneity in the risk of acute CV complications after development of preeclampsia, with Asian/PI women having the greatest risk.[14]

Study limitations

Our study has limitations inherent to retrospective studies using administrative data. The accuracy of the

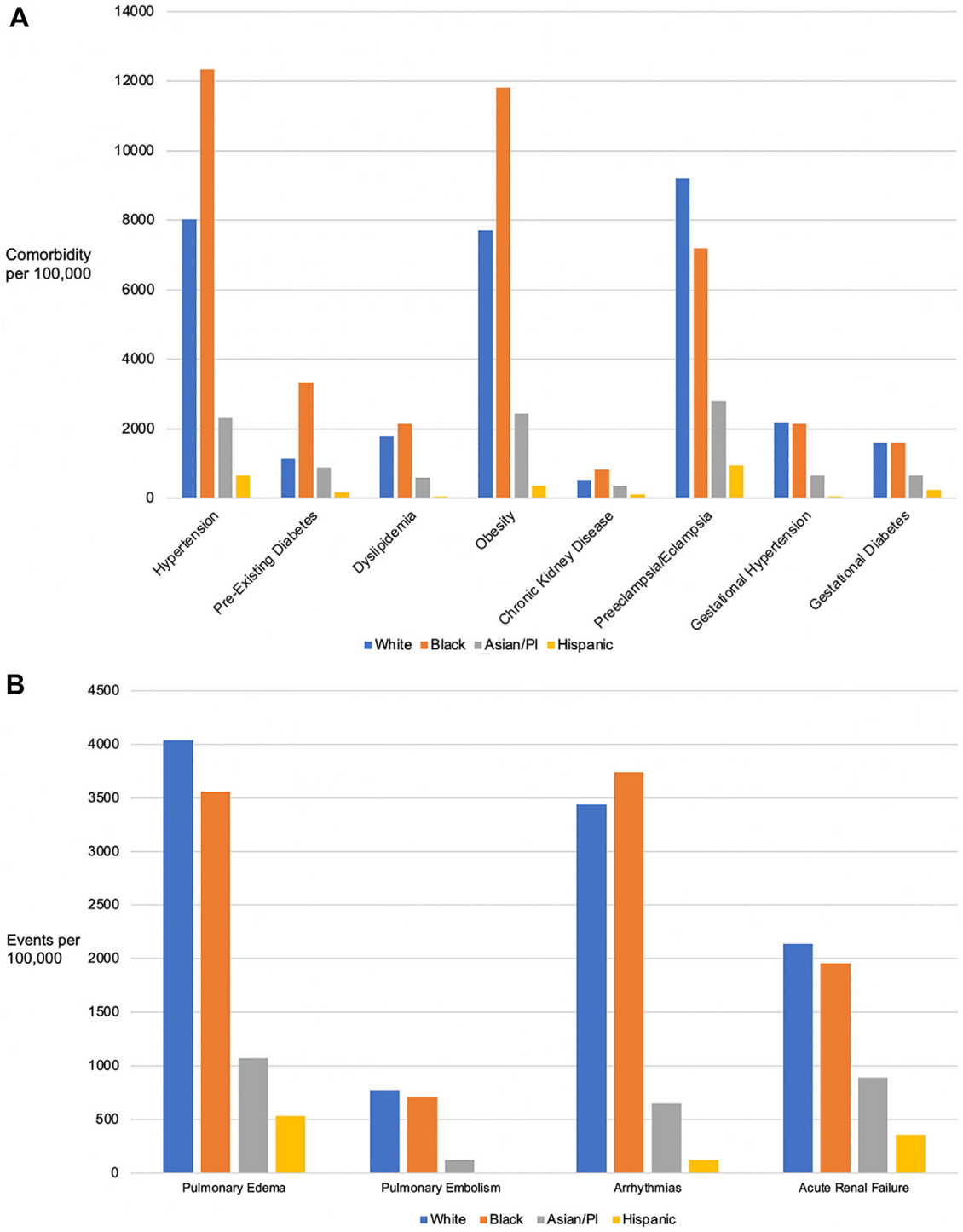

Figure 1. Comorbidities and acute complications of women with peripartum cardiomyopathy (PPCM), stratified by race/ethnicity. (**A**) Comorbidities of PPCM by race/ethnicity per 100,000. (**B**) Acute complications of PPCM by race/ethnicity, per 100,000. PI, Pacific Islander.

diagnosis of PPCM based on ICD-10-CM codes is less certain, including for coronary artery disease, as no patient charts or echocardiographic or other diagnostic parameters were queried. We limited our analysis to the years 2016-2018 mainly to evaluate a contemporary cohort that would be more likely to be on adequate background therapy for comorbidities such as hypertension and diabetes. Further, given the low number of events in Native American women in terms of CV complications, we could not include them in the analysis of outcomes. In addition, no post-discharge data were available to assess postpartum or long-term outcomes, such as readmission for heart failure; therefore,

Table 2. Adjusted association of peripartum cardiomyopathy (PPCM) with cardiovascular complications, stratified by race/ethnicity

Complication	Deliveries with PPCM (n = 8735)	P	*P* for interaction by race / ethnicity
Pulmonary edema			
White	69 (42−112)	< 0.001	< 0.001
Black	22 (13−38)	< 0.001	
Hispanic	60 (22−160)	< 0.001	
Asian / PI	98 (29−333)	< 0.001	
Pulmonary embolism			
White	48 (19−121)	< 0.001	0.178
Black	18 (6−55)	< 0.001	
Hispanic	11 (1−103)	0.038	
Asian / PI	−	-	
Arrhythmias			
White	19 (13−27)	< 0.001	0.693
Black	17 (11−23)	< 0.001	
Hispanic	29 (13−68)	< 0.001	
Asian / PI	13 (2−79)	0.005	
Acute renal failure			
White	17 (9−33)	< 0.001	< 0.001
Black	3 (2−5)	< 0.001	
Hispanic	9 (4−23)	< 0.001	
Asian / PI	21 (3−152)	0.002	

Values are odds ratios with 95% confidence intervals, unless otherwise indicated. Values are adjusted for age, chronic hypertension, diabetes, and obesity. Referent = 1.00, for deliveries without PPCM (n = 10,151,945). Events experienced by Native American women (< 15 per category) were too few to be included in analysis.

PI, Pacific Islander.

our assessment was limited to only immediate in-hospital outcomes.

Conclusions

Black and Native American women are at higher risk of developing PPCM, compared with White women, despite adjustment for CV and socioeconomic factors. However, in terms of CV complications in women with PPCM at the time of delivery hospitalization, we observed a heterogeneity of risk for acute complications, with Asian/PI women displaying the greatest risk. As the prevalence of heart disease is rising, particularly in younger women, PPCM remains an important public health concern.[15] Further studies are needed to better understand the contributing factors of increased risk for CV complications across racial subgroups.

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Disclosures

The authors have no conflicts of interest to disclose.

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Supplementary Material

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