**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 with PPCM-related outcomes was assessed. Results: Of the 23,634,510 deliveries, 34,214 women developed PPCM. Prevalence of adverse outcomes, including in-hospital mortality, cardiac arrest, heart transplant, mechanical circulatory support, acute pulmonary edema, thromboembolism, arrhythmic events, and cardiogenic shock, was significantly higher among Black women. Conclusion: PPCM is associated with significant cardiovascular (CV) morbidity and in-hospital mortality. These findings highlight the need for targeted interventions to reduce racial disparities in outcomes.
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.

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 (interquartile range) if not normally distributed. For comparison of categorical variables, \( \chi^2 \) 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. 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, 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. Furthermore, a prior study using NIS data (2004-2011) also showed a temporal trend toward an increasing prevalence of PPCM in...
Native American women over time. 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**. However, a recent study showed that the burden of **titin**-truncating variants did not differ across geographic regions and racial backgrounds. 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. 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.

### Study limitations

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

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**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                            | 2,755,943 (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 |
| Cesarean section                         | 291,670 (3) | 291,445 (3) | 150 (1.7) |

Values are n (%), unless otherwise indicated.

IQR, interquartile range.
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,

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.
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. 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.

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

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

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Supplementary Material

To access the supplementary material accompanying this article, visit CJC Open at https://www.cjcopen.ca/ and at https://doi.org/10.1016/j.cjco.2021.12.004.