Title

Trends in racial/ethnic disparities in postpartum hospital readmissions in California from 1997 to 2018.

Journal

AJOG Global Reports, 4(2)

Authors

Tucker, Curisa

Ma, Chen

Mujahid, Mahasin

et al.

Publication Date

2024-05-01

DOI

10.1016/j.xagr.2024.100331

Peer reviewed

Trends in racial/ethnic disparities in postpartum hospital readmissions in California from 1997 to 2018

Curisa M. Tucker, PhD, RN; Chen Ma, MS; Mahasin S. Mujahid, PhD, MS, FAHA; Alexander J. Butwick, MBBS, FRCA, MS; Anna I. Girsen, MD, PhD; Ronald S. Gibbs, MD; Suzan L. Carmichael, PhD, MS

BACKGROUND: Postpartum readmission is an important indicator of postpartum morbidity. The likelihood of postpartum readmission is highest for Black individuals. However, it is unclear whether the likelihood of postpartum readmission has changed over time according to race/ethnicity. Little is also known about the factors that contribute to these trends.

OBJECTIVE: This study aimed to: (1) examine trends in postpartum readmission by race/ethnicity, (2) examine if prenatal or clinical factors explain the trends, and (3) investigate if racial/ethnic disparities changed over time.

STUDY DESIGN: We examined trends in postpartum readmission, defined as hospitalization within 42 days after birth hospitalization discharge, using live birth and fetal death certificates linked to delivery discharge records from 10,711,289 births in California from 1997 to 2018. We used multivariable logistic regression models that included year and year-squared (to allow for nonlinear trends), overall and stratified by race/ethnicity, to estimate the annual change in postpartum readmission during the study period, represented by odds ratios and 95% confidence intervals. We then adjusted models for prenatal (eg, patient demographics) and clinical (eg, gestational age, mode of birth) factors. To determine whether racial/ethnic disparities changed over time, we calculated risk ratios for 1997 and 2018 by comparing the predicted probabilities from the race-specific, unadjusted logistic regression models.

RESULTS: The overall incidence of postpartum readmission was 10 per 1000 births (17.4/1000 births for non-Hispanic Black, 10/1000 for non-Hispanic White, 7.9/1000 for non-Hispanic Asian/Pacific Islander, and 9.6/1000 for Hispanic individuals). Odds of readmission increased for all groups during the study period; the increase was greatest for Black individuals (42% vs 21%–29% for the other groups). After adjustment for prenatal and clinical factors, the increase in odds was similar for Black and White individuals (12%). The disparity in postpartum readmission rates relative to White individuals increased for Black individuals (risk ratio, 1.68 in 1997 and 1.90 in 2018) and more modestly for Hispanic individuals (risk ratio, 1.02 in 1997 and 1.05 in 2018) during the study period. Asian/Pacific Islander individuals continued to have lower risk than White individuals during the study period (risk ratio, 0.87 in 1997 and 0.82 in 2018).

CONCLUSION: The rate of postpartum readmissions increased from 1997 to 2018 in California across all racial/ethnic groups, with the greatest increase observed for Black individuals. Racial/ethnic differences in the trend were more modest after adjustment for prenatal and clinical factors. It is important to find ways to prevent further increases in postpartum readmission, especially among groups at highest risk.

Key words: Black individuals, health disparity, hospitalization, postpartum, readmissions

From the Biobehavioral Health & Nursing Science, College of Nursing, University of South Carolina, Columbia, SC (Dr Tucker); Division of Neonatal and Developmental Medicine, Department of Pediatrics, Stanford University, Stanford, CA (Dr Tucker, Ms. Ma, and Dr Carmichael); School of Public Health, University of California Berkeley, Berkeley, CA (Dr Mujahid); Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University, Stanford, CA (Dr Butwick); Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Stanford University, Stanford, CA (Drs Girsen, Gibbs, and Carmichael)

The authors report no conflict of interest.

This study was funded by the National Institute of Nursing Research (R01NR017020 and R01NR020335). The funder had no role in the development of this article. Dr. Tucker is currently funded by the NIH Common Fund through the Office of the Director, National Institutes of Health (OD) and under Award Number U54CA272171. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Patient consent was not required because no personal information or details were included.

This work was presented as a poster at the following meetings: (1) the 5th Annual Research Symposium of Stanford University's Maternal & Child Health Research Institute, Palo Alto, CA, October 20, 2022; and (2) the 2023 Annual Meeting of the Society for Pediatric and Perinatal Epidemiologic Research, Portland, OR, June 12–13, 2023.

Cite this article as: Tucker CM, Ma C, Mujahid M, et al. Trends in racial/ethnic disparities in postpartum hospital readmissions in California from 1997 to 2018. Am J Obstet Gynecol Glob Rep 2024;4:100331.

Corresponding author: Curisa M. Tucker, PhD, RN.
tuckercm@mailbox.sc.edu

2666-5778/$36.00

http://dx.doi.org/10.1016/j.xagr.2024.100331

AJOG Global Reports at a Glance

Why was this study conducted?

There is a gap in knowledge about recent trends of postpartum readmissions, what factors may explain these trends, and whether racial/ethnic disparities have changed over time.

Key findings

Postpartum readmissions increased for all groups during the study period. These trends were partially attributable to prenatal and clinical factors. The Black−White disparity in readmissions increased.

What does this add to what is known?

To mitigate the increase in postpartum readmissions, strategies must be implemented to improve the labor and birth discharge process and prioritize intervention strategies for racial/ethnic groups that are most at risk.

Introduction

According to a report of 9 state maternal mortality review committees, over half of maternal deaths in the United States are preventable, and 63% of pregnancy-related deaths occur during the postpartum period.[1] Between 14% and 16% of de novo severe maternal morbidity cases occurred during the postpartum period from 2010 to 2014 in a cohort study of US birth hospitalizations.[2] A postpartum readmission (PPR) is a useful indicator of impending maternal mortality or severe maternal morbidity. Racial/ethnic disparities have been well documented in both maternal mortality and severe maternal morbidity, indicating the need for focused investigations of PPRs for groups at highest risk. A PPR puts significant strain on the mother and the family.[3] Furthermore, the PPR metric has been cited as an important but also complex indicator of health care quality.[4−6]

The rate of PPR has consistently been 1% to 2% of birth hospitalizations in the United States over the past 20 years.[7−10] However, in a multistate analysis of California, New York, and Florida birth hospitalizations, the rate of PPR increased by 25% from 1.7% to 2.2% between 2004 and 2011.[8] Evidence also points to disparities in PPR. In a cross-sectional study using the Nationwide Inpatient Sample from 2012 to 2014, in which White individuals were the reference group, the likelihood of PPR was 80% greater for Black individuals and 11% lower for Hispanic individuals.[11] However, trends over time in PPR are poorly described, and it is unclear whether trends in PPR differ among different racial/ethnic groups.

Racial/ethnic disparities in adverse maternal outcomes are rooted in multidimensional layers of structural racism.[12,13] Structural racism refers to policies and practices in society that have historically reduced access to desirable resources for minoritized populations.[14] Racial/ethnic minoritized groups are more commonly affected by negative social determinants of health (poverty, low education) and adverse birth outcomes that are associated with PPR (eg, pregnancy and birth complications, maternal comorbidities).[3,9,11,15] Although PPR may be necessary to prevent further patient deterioration, we have yet to fully understand the drivers that impact a PPR to prevent it from occurring in the first place.

The objectives of this study were to: (1) examine trends in PPR by race/ethnicity, (2) examine if prenatal or clinical factors explain the trends, and (3) compare racial/ethnic disparities over time. We explored these objectives by analyzing data from over 10 million births in California from 1997 to 2018. We hypothesized that PPR would increase over time overall and have a higher incidence in racial/ethnic minoritized groups.

Materials and Methods

Data

We used population-based cohort data from the California Department of Health Care Access and Information (HCAI), comprising vital records (live birth and fetal death certificates) longitudinally linked with hospital discharge records up to 12 months postpartum for births in California from 1997 to 2018. Data were linked using a probabilistic matching algorithm with a success rate over 96%.[16] The protocol for this study was approved by the State of California Committee for the Protection of Human Subjects and the Stanford University Institutional Review Board.

Study population

We included patients who had a birth hospitalization in California between 1997 and 2018 (n=11,508,144) (Supplemental Figure). We excluded patients who had an unsuccessful linkage of the birth hospital discharge record and vital record (n=486,756), patients with a gestational age of <20 or >45 weeks (n=310,099) because of likely inaccurate data reporting,[17] and records with missing covariates (n=379,284). The final analysis included n=10,332,005 births.

Measures

The outcome of interest was PPR defined as any readmission that occurred up to 42 days after discharge from birth hospitalization. This allows for comparability with most previous observational studies of PPR and also aligns with maternal mortality reporting and traditional duration of the puerperium up to 42 days after birth.[3,8,10] To identify a PPR, we used patient discharge records from hospital inpatient readmissions occurring after birth hospitalization discharge, and considered only the first occurrence if there were multiple readmissions for 1 patient. We did not consider hospital transfers to be readmissions. If the discharge was within or to another facility, we considered it a hospital transfer.

We collected maternal race/ethnicity from the vital record and identified the following groups in our final analysis based on the available data and similar studies[18]: non-Hispanic (NH) American Indian/Alaska Native (AIAN), NH Asian/Pacific Islander (API) (Chinese, Filipino, Indian, Japanese, Korean, Vietnamese, Native Hawaiian, Guamanian/

Chamorro, Samoan, or other API), NH (no Hispanic origin) Black, Hispanic (Hispanic/Spanish/Latina), NH (no Hispanic origin) White, and "Other." The NH AIAN and "Other" race group (defined as other-specified, unknown, or declined to state) were excluded from model-based analyses because of small numbers (each comprised <1% of the study population).

We selected prenatal and clinical factors a priori from available data after creating causal diagrams and according to their known relationship with maternal outcomes.[8,10,15,19] Prenatal factors included maternal age, education, nativity, parity with cesarean status, payer insurance type, and time at prenatal care initiation, and were derived from the vital record as described in Appendix 1. Clinical factors included birth status (live birth or fetal death), gestational age, length of stay from date of birth to discharge, mode of birth, obstetrical comorbidity score, plurality, and severe maternal morbidity, as described in Appendix 1. We used a validated scoring system to define obstetrical comorbidity.[20] We defined severe maternal morbidity by the Centers for Disease Control and Prevention recommended 21 indicators (Appendix 2).[21] The obstetrical comorbidity scoring system is an adapted weighted algorithm of pregnancy-related conditions (eg, bleeding disorders, preexisting cardiac disease, placenta previa, etc.). Both the severe maternal morbidity and obstetrical comorbidity factors were derived from hospital discharge records. Clinical outcomes were measured using International Classification of Diseases (ICD), 9th and 10th Revision, Clinical Modification diagnosis and procedure codes.

Statistical analysis

We first examined the overall distribution of study variables among the entire population during the study period. We then plotted the daily and cumulative incidence of PPR from 1 to 42 days, overall and separately by race/ethnicity. We conducted overall and race/ethnicity-specific multivariable logistic regression models to estimate the annual change in PPR from 1997 to 2018 and report estimated odds ratios (ORs) and 95% confidence intervals (CIs). We included year-squared in the models to allow for nonlinearity of trends. We consider ORs as an estimate of risk ratios because the outcome of PPR is rare. Trends of PPR among AIAN people and those categorized as other race/ethnicity were not analyzed because of low case counts. We sequentially adjusted models for first prenatal (maternal age, education, nativity, parity with cesarean status, payer insurance type, and time at prenatal care initiation) and then clinical factors (birth status [live birth or fetal death], gestational age, length of stay from date of birth to discharge, mode of birth, obstetrical comorbidity score, plurality, and severe maternal morbidity) using a complete case analysis. In a post hoc analysis, to better understand the contribution of specific clinical factors to the change in PPR over time, we examined models that added one clinical factor at a time to the model that otherwise only included the prenatal factors. To estimate the racial/ethnic disparities in 2018 vs 1997, we used year-specific predicted probabilities generated from the race-stratified unadjusted logistic regression models and calculated the risk ratios by dividing the predicted probabilities and bootstrapping 95% CIs. The level of significance was set at $P<.05$. Data management and analyses were conducted in SAS, version 9.4 (SAS Institute, Cary, NC).

Results

The study included 10,332,005 births in California from 1997 to 2018. Fifty percent of individuals were Hispanic, 29% were White, 13% were API, 6% were Black, 0.4% were AIAN, and 0.1% were categorized as other race/ethnicity. Table 1 presents the PPR incidence and patient characteristics by race/ethnicity. PPR rates increased over time in all racial/ethnic groups. Over the study period, the PPR incidence (per 1000 births) was highest among NH Black patients (17) and lowest among NH API patients (8). Most PPRs, calculated per 1000 births across all racial groups, occurred on days 3 to 4 after discharge from the birth hospitalization. However, the disparity was most pronounced on day 3 (Figure 1). Figure 2 presents the cumulative incidence of PPR by race/ethnicity. The PPR rate within 42 days after birth was highest among Black individuals at 17.4 per 1000 births and lowest for API individuals at 7.9 per 1000 births. The overall PPR rate increased over time from 8.9 per 1000 births in 1997 to 12.9 per 1000 births in 2018 (Figure 3). From 1997 to 2018, the PPR absolute incidence rate increased by 36% in NH API individuals, 64% in NH Black individuals, 48% in Hispanic individuals, and 43% in NH White individuals.

In our race/ethnicity-specific unadjusted models, the increase in the odds of readmission in 2018 compared with 1997 was 42% for Black individuals (OR, 1.42; CI, 1.33−1.52), 29% for Hispanic individuals (OR, 1.29; CI, 1.25−1.33), 26% for White individuals (OR, 1.26; CI, 1.21−1.30), and 21% for API individuals (OR, 1.21; CI, 1.14−1.29) (Table 2). Statistical adjustment for prenatal and clinical factors attenuated but did not eliminate the increased risk of PPR in 2018 vs 1997 overall, but this finding varied by race/ethnicity. After adjustment, Black and White individuals had 12% increased odds of readmission, and API individuals had 10% increased odds. However, Hispanic individuals had 3% decreased odds of PPR. Post hoc analysis suggested that the obstetrical comorbidity score contributed most significantly to the attenuation of ORs from Model 1 (which only included the prenatal factors) to Model 2 (adding one clinical variable at a time) (Supplemental Table).

We used results from the race-stratified models to compare racial/ethnic disparities in PPR in 1997 vs 2018. Using White individuals as the reference group, the disparity in readmission was greatest for Black individuals, with a risk ratio that increased from 1.68 (95% CI, 1.58−1.77) in 1997 to 1.90 (95% CI, 1.78−2.02) in 2018 (Table 3). For Hispanic individuals, the disparity was modest but increased slightly from a risk ratio of 1.02 (95% CI, 0.98−1.06) in 1997 to 1.05 (95% CI, 1.01−1.09) in

TABLE 1
Incidence of postpartum readmission and distribution of prenatal and clinical variables overall and among racial/ethnic groups, for all births in California, 1997–2018[a]

Prenatal and Clinical Factors	Non-Hispanic American Indian/Alaska Native n=44,858 (0.4%)	Non-Hispanic Asian/Pacific Islander n=1,378,009 (13.3%)	Non-Hispanic Black n=595,855 (5.8%)	Hispanic n=5,239,018 (50.7%)	Non-Hispanic White n=3,044,320 (29.5%)	Other n=6720 (0.1%)	Overall n=10,332,005 (100%)
Incidence of postpartum readmission up to 42 d	1.6	0.8	1.7	1.0	1.0	1.2	1.0
Maternal age at delivery (y)							
<20	12.5	2.2	12.6	11.9	4.4	5.9	8.4
20–24	28.2	9.1	27.7	26.8	15.4	19.8	21.1
25–29	26.9	25.0	25.6	27.4	25.9	25.9	26.6
30–34	19.9	36.9	20.0	20.7	31.1	28.0	25.9
35–39	9.9	21.7	11.1	10.5	18.5	15.9	14.4
≥40	2.6	5.2	3.0	2.6	4.7	4.5	3.6
Born in United States	98.2	20.4	90.9	44.2	87.5	41.9	56.8
Education							
Less than high school	22.8	6.0	16.4	42.2	6.5	16.5	25.2
High school	38.2	16.2	35.6	30.5	22.7	24.0	26.6
Some college	28.1	22.2	32.7	19.1	27.2	29.0	22.7
Undergraduate degree	6.7	33.5	9.6	5.6	25.9	17.4	15.6
Postgraduate degree	4.3	22.1	5.7	2.7	17.6	13.1	9.9
Insurance							
Private	39.3	69.8	41.3	31.9	74.9	50.8	50.3
Other	60.7	30.2	58.7	68.1	25.1	49.2	49.7
Parity							
Primiparous	34.2	46.1	38.0	34.2	43.4	43.0	38.7
Multiparous with previous cesarean	11.5	7.7	11.5	7.3	9.7	8.8	8.4
Multiparous without previous cesarean	54.3	46.2	50.5	58.5	47.0	48.2	52.9
Trimester prenatal care began							
First	71.9	86.2	79.2	80.8	88.1	82.0	83.6
Second	20.0	10.2	15.2	14.4	8.9	12.5	12.3
Third or none	8.2	3.7	5.6	4.8	2.9	5.7	4.1

Tucker. Trends in postpartum readmissions. Am J Obstet Gynecol Glob Rep 2024.

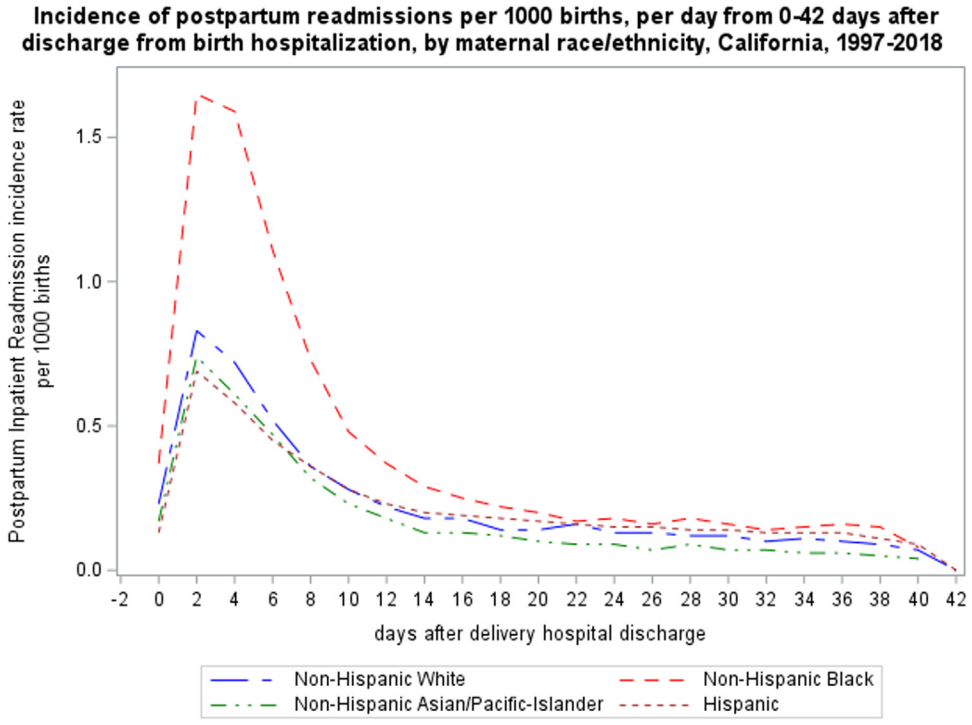
(continued)

TABLE 1
Incidence of postpartum readmission and distribution of prenatal and clinical variables overall and among racial/ethnic groups, for all births in California, 1997–2018a *(continued)*

Prenatal and Clinical Factors	Non-Hispanic American Indian/Alaska Native n=44,858 (0.4%)	Non-Hispanic Asian/Pacific Islander n=1,378,009 (13.3%)	Non-Hispanic Black n=595,855 (5.8%)	Hispanic n=5,239,018 (50.7%)	Non-Hispanic White n=3,044,320 (29.5%)	Other n=6720 (0.1%)	Overall n=10,332,005 (100%)
Cesarean delivery	30.0	29.9	33.8	29.3	29.5	33.0	29.7
Severe maternal morbidity	1.5	1.2	1.8	1.2	1.0	1.5	1.2
Comorbidity Score							
0	52.2	50.8	49.0	60.2	53.0	51.6	56.1
1–2	9.3	23.3	8.7	11.7	17.9	15.0	14.9
≥3	38.6	25.9	42.4	28.1	29.1	33.4	29.0
Gestational age[b]							
Preterm	10.7	8.5	13.2	9.2	8.1	10.0	9.0
Term	74.8	82.0	74.4	78.8	77.2	78.9	78.5
Postterm	14.5	9.4	12.4	12.0	14.7	11.1	12.5
Twin/multiple birth	1.4	1.5	2.1	1.1	2.1	1.8	1.5
Fetal death	0.3	0.3	0.7	0.4	0.3	0.6	0.4
Length of stay[c]							
0–1 d	33.8	24.5	24.2	30.7	31.6	23.8	29.8
2–3 d	59.1	65.4	65.4	63.3	59.6	64.5	62.6
≥4 d	7.0	10.1	10.3	6.0	8.7	11.5	7.6

[a] The data presented are per 100 individuals; [b] Gestational age: preterm (20–36.6 weeks), term (37–40.6 weeks), postterm (>41 weeks); [c] Length of stay calculated as days between giving birth and discharge from the birth hospitalization.
Tucker. Trends in postpartum readmissions. Am J Obstet Gynecol Glob Rep 2024.

FIGURE 1
Incidence of Postpartum Readmissions



Overall N=10,332,005.

Tucker. Trends in postpartum readmissions. Am J Obstet Gynecol Glob Rep 2024.

2018. Asian individuals were at lower risk of PPR compared with White individuals throughout the study period, with a risk ratio of 0.87 (95% CI, 0.81−0.93) in 1997 and 0.82 (95% CI, 0.77−0.86) in 2018.

Comment

Principal findings

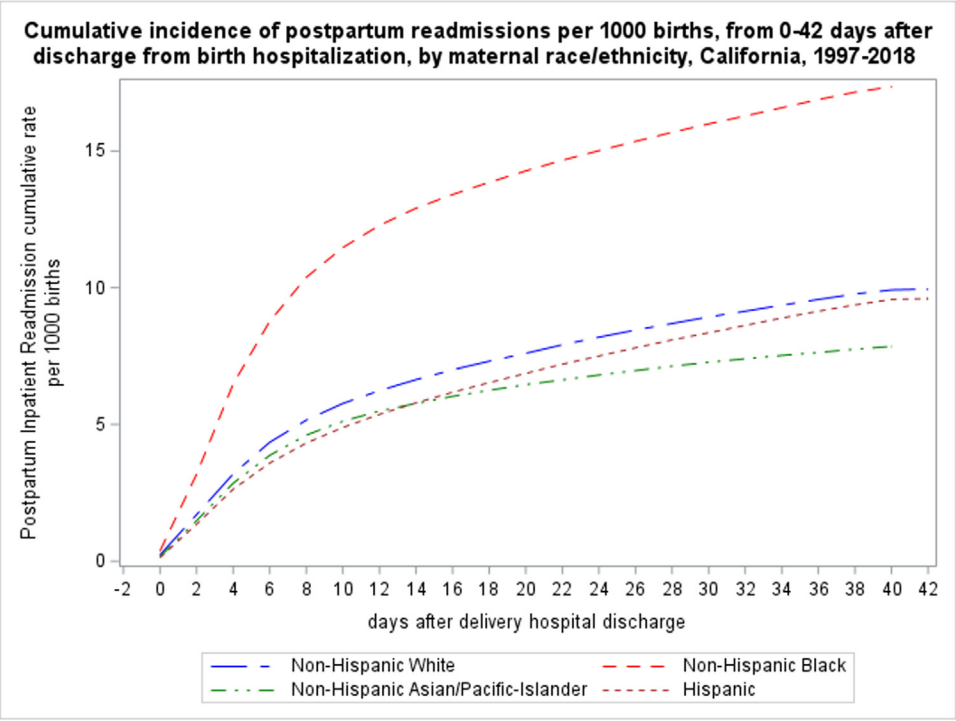
Using a large data set with linked vital records and hospital discharge records, we examined trends in PPR by race/ethnicity. The overall incidence of PPR in California increased from 8.9 per 1000 births in 1997 to 12.9 per 1000 births in 2018, an increase of 45%. It increased for all racial/ethnic groups during the study period, but the increase was greatest for Black individuals. Relative to NH White individuals, the odds of PPR increased from 1997 to 2018 for all studied racial/ethnic groups; the increase was greatest for Black individuals. The increases were not entirely explained by prenatal and clinical factors, except among Hispanic individuals. The racial/ethnic disparity in PPR was largest for Black individuals and increased substantially; the disparity increased but was modest for Hispanic individuals. The risk remained lower among API individuals compared with NH White individuals. Our results add limited evidence on the drivers of racial/ethnic disparities in PPR in California. We observed no improvement in PPR rates over time, with Black individuals being impacted the most. Prenatal/clinical factors only partially explain the trends, except among Hispanic individuals. These factors contributed to the trends, but their relative impact varied by race/ethnicity.

Results in the context of what is known

Our study is consistent with other trend analyses finding increases in PPR over time. In a trend analysis of California, Florida, and New York from 2004 to 2011, it was found that the PPR rate increased from 1.72% to 2.16%.[8] It was also found in another trend analysis of this same group of states that the increase in PPR coincided with an increase in the cesarean delivery rate, which ranged from 30.4% to 33.9%.[3] In both trend analyses, we do not know how the trend varied among racial/ethnic groups and if disparities were present.

We did find evidence of racial/ethnic disparities in PPR in the following studies. In a nationwide study of 25 states using data from the Healthcare Cost and Utilization Project from 2016 to 2018, Black individuals had 7.19 more PPRs per 1000 births compared with White individuals.[22] In a multistate trend analysis of New York (2007−2014), Florida (2007−2014), Maryland (2012−2014), and California (2007−2014) births, Black and Hispanic individuals were more likely to be readmitted within 30 days of delivery compared with White individuals.[23] In a study using hospitalization discharge data from Connecticut from 2005 to 2012, there were racial/ethnic disparities in 30-day PPR for Black and Hispanic individuals after both vaginal and

FIGURE 2
Cumulative Incidence of Postpartum Readmissions



Overall N=10,332,005.

Tucker. Trends in postpartum readmissions. Am J Obstet Gynecol Glob Rep 2024.

cesarean delivery. However, after controlling for prenatal and clinical factors similar to those used in our study, differences were not attenuated.[24] In our study, there was a modest disparity in the risk of PPR for Hispanic individuals compared with White individuals. These differences in findings warrant further investigations within the Hispanic population that may inform future policy. Although the latter 2 studies measured 30 days after discharge, which is consistent with the Centers for Medicare & Medicaid Services metric for hospital readmission, differences in results at 30 and 42 days are likely negligible.[6] We chose 42 days because it is the traditional duration of the puerperium. More evidence examining trends over time in PPR by race/ethnicity is needed.

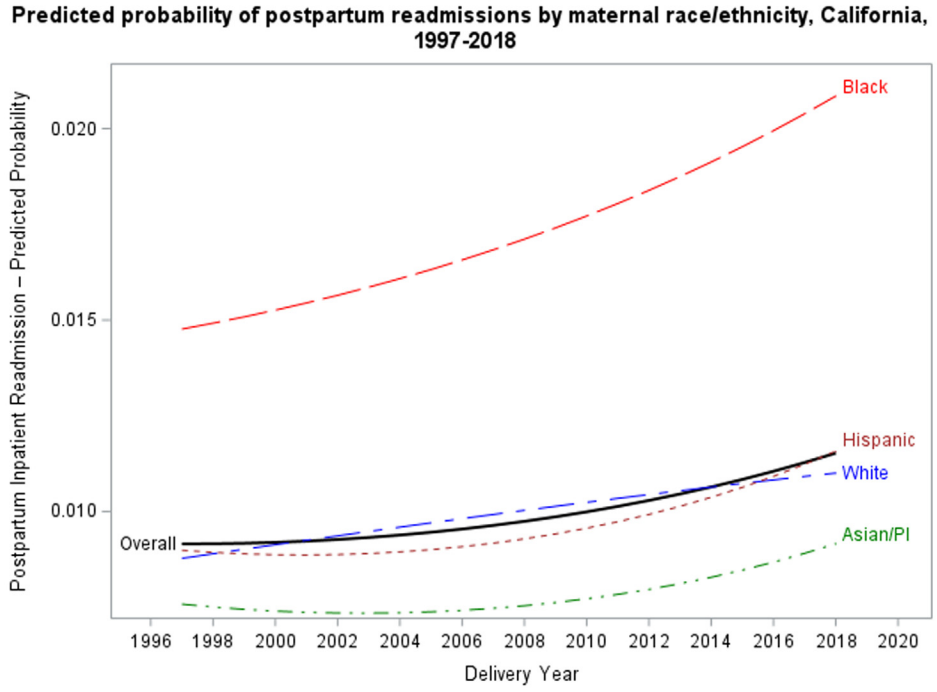
Another notable finding is that NH API individuals had lower risk of PPR compared with NH White individuals, and this difference was even greater at the end of the study period. A possible explanation for this could be differences in API postpartum cultural practices (eg, alterations in diet or activity levels postpartum) that may lower their risk for PPR and improve childbirth recovery.[25] Of note, 20% of the API sample are US-born, which may have considerable impact on the trend of this group, further reiterating the possible influence of differences in cultural practices, or selective migration. To the authors' knowledge, no other recent studies have found a lower risk of PPR in this racial/ethnic group.

Findings regarding timing of PPR are also notable because they indicate that the earlier the readmission, the more likely it may have been preventable by proper discharge planning. In a previous study investigating risk factors for PPRs in California from 2007 to 2018, results showed that those with early PPRs (0–6 days after discharge from birth hospitalization) were more likely to be Black compared with those with no PPR within 30 days.[26] Similarly, our study found that the Black–White disparity was greater for early rather than later PPR, as indicated in Figure 1. Although a PPR may be necessary, it is an unanticipated event that puts a burden on the family, disrupts the birth recovery process, and interferes with newborn bonding and the initiation of breastfeeding.[27] It is critical that we identify what explains these racial/ethnic disparities. Once these factors have been identified, we need to develop new systems to improve postpartum care for affected racial/ethnic groups.

Clinical implications

The racial/ethnic disparity in PPR was most marked for Black individuals, and this disparity worsened over time. PPR may be a marker that illuminates the barriers to accessing postpartum care in the community and the quality of outpatient postpartum care provided to these patients. Several studies have found associations between severe maternal morbidity at birth and PPR,[11,26,28] and there are opportunities for health care providers to engage in strategies to reduce PPR such as

FIGURE 3
Predicted Probability of Postpartum Readmissions



The predicted probabilities were derived from race/ethnicity-specific logistic regression models that included year and year-squared.

Tucker. Trends in postpartum readmissions. Am J Obstet Gynecol Glob Rep 2024.

assessing discharge readiness, implementing care coordination in the outpatient setting, addressing continuity of care, tackling barriers to services, and eliminating institutional racism.[6,12,29] Racial/ethnic disparities in adverse pregnancy-related outcomes have been found in several studies to be associated with the effects of structural racism in health care, as noted in a recent review.[30] In a nationwide study of obstetrical services in rural counties from 2004 to 2014, counties with the highest number of Black birthing people were most likely to lose or have a deficit in the number of obstetrical care services.[31] The higher risk of PPR among Black individuals in our study indicates

TABLE 2
Odds ratios reflecting the change in odds of postpartum readmission from 1997 to 2018, overall and stratified by maternal race/ethnicity, California[a]

Total Sample & Race/Ethnicity	Crude[b] OR (95% CI)	Model 1[c] OR (95% CI)	Model 2[d] OR (95% CI)
Overall (N=10,332,005)	1.26 (1.24–1.29)	1.14 (1.11–1.16)	1.04 (1.02–1.06)
Non-Hispanic Asian/Pacific Islander (N=1,378,009)	1.21 (1.14–1.29)	1.18 (1.10–1.26)	1.10 (1.03–1.18)
Non-Hispanic Black (N=595,855)	1.42 (1.33–1.52)	1.25 (1.17–1.34)	1.12 (1.05–1.20)
Hispanic (N=5,239,018)	1.29 (1.25–1.33)	1.05 (1.02–1.09)	0.97 (0.94–1.00)
Non-Hispanic White (N=3,044,320)	1.26 (1.21–1.30)	1.23 (1.18–1.28)	1.12 (1.08–1.17)

CI, confidence interval; *OR*, odds ratio.

[a] ORs reflect the change in odds of postpartum readmission from 1997 to 2018, derived from overall and race/ethnicity-specific multivariable logistic regression models that included year and year-squared to allow for nonlinearity of trends; [b] Overall N (each model)=10,332,005; [c] Adjusted for prenatal factors (age, education, nativity, parity, payer, and trimester of prenatal care initiation); [d] Additionally adjusted for clinical factors (stillbirth, gestational age, length of stay from date of birth hospitalization, cesarean delivery, obstetrical comorbidity score, plurality, severe maternal morbidity).

Tucker. Trends in postpartum readmissions. Am J Obstet Gynecol Glob Rep 2024.

TABLE 3
Racial/ethnic disparity in risk of postpartum readmission in 1997 and 2018, California[a]

Race/Ethnicity	Risk ratio, 1997 (95% CI)	Risk ratio, 2018 (95% CI)
Non-Hispanic Asian/Pacific Islander	0.87 (0.81–0.93)	0.82 (0.77–0.86)
Non-Hispanic Black	1.68 (1.58–1.77)	1.90 (1.78–2.02)
Hispanic	1.02 (0.98–1.06)	1.05 (1.01–1.09)
Non-Hispanic White	Reference	Reference

Overall N=10,332,005.

CI, confidence interval.

[a] Risk ratios (no adjustments) compare predicted probabilities of readmission in 1997 and 2018, which were derived from race/ethnicity-specific logistic regression models that included year and year-squared as the predictors.

Tucker. Trends in postpartum readmissions. Am J Obstet Gynecol Glob Rep 2024.

that strategies should be targeted to address the social determinants of health that contribute to these disparities (eg, poor housing, lack of transportation, etc.) in this racial/ethnic group. Addressing social determinants of health could potentially improve continuity of care, which may prevent PPR.

Research implications

Given that PPRs are increasing overall, future research should focus on understanding PPR rates, drivers for the increase, and opportunities for reducing unnecessary readmissions. In this study, most PPR cases occurred within the first 14 days of birth hospitalization discharge. Thus, a more granular understanding of the causes of racial/ethnic disparities within this time frame is warranted. In nonobstetrical literature, efforts for the reduction of hospital readmission rates are centered around improving the discharge process and transition to outpatient care. However, there is a lack of evidence in these interventions for PPRs.[6] Strategies that focus on upstream factors, or a root-cause approach, using methods such as community-based participatory research will help to advance perinatal equity.[32]

Strengths and limitations

A strength of our study is that we used a large, racially diverse population-based data set. Hospitalization data were linked during the pregnancy and through the postpartum period to vital records, which are not usually available. In addition, because of the size of our study population, we were able to investigate the rare outcome of PPR. However, we recognize that there is heterogeneity within the API group. In a population cohort study of API births in California from 2007 to 2018, Bane et al[33] found considerable differences in maternal outcomes and adverse risk factors among API subpopulations. Because of sample sizes and relatively low incidence of PPR, we did not further disaggregate this population, although we recognize this as a limitation.

Our study is also limited by the complexities of discharge records that use ICD codes. There is a potential risk of miscoding diseases and diagnoses and underreporting of outcomes.[34] Our data set is also limited in the factors we were able to measure (eg, lack of information on home births and changes in policies of care). During the time span of our study, the major data collection change was the addition of maternal weight to the California birth certificate. To address the potential bias introduced by the addition of this variable, we conducted a sensitivity analysis.

Measuring PPR as an outcome is difficult because the coded primary diagnosis may not be the true reason for PPR, and it may be coded as the secondary diagnosis. We also cannot easily account for provider and hospital-level factors (eg, differences in provider-level practices, obstetrical levels of care, etc.). Using PPR rates as a quality metric across hospitals should be done with caution unless other outcomes such as maternal mortality rates and severe maternal morbidities are accounted for.[6] In addition, findings from our study may not be generalizable to other states considering the differences in the California study population and health-related policies. For example, California was the first state to implement expanded postpartum Medicaid coverage up to 12 months postpartum.[35] We did not examine the impact of Medicaid expansion on PPR rates by race/ethnicity. The study time frame was long, and several key changes occurred to Medicaid during the study period (in 2010 and 2013). Despite these policy changes, it is slightly surprising that the PPR rates did not shift accordingly. One possible reason is that most PPRs occurred before the time when a postpartum visit would typically occur (approximately 6 weeks postpartum). Another limitation of this study is that we did not account analytically for repeat pregnancies (sibling births), which involved 22% of people who gave birth in the cohort, because of computing power constraints. However, a previous study of trends in severe maternal morbidity using similar data as our current study reported a sensitivity analysis demonstrating that results were not substantially different after adjustment for repeat births.[18]

Conclusions

In California, rates of PPR increased over time for all of the studied racial/ethnic groups. PPR was substantially more common among Black individuals compared with all other racial/ethnic groups, and the rate of PPR increased to a greater extent than for other racial/ethnic groups. The disparity in PPR rates among NH Black and Hispanic individuals relative to NH White individuals was worse in 2018 than in 1997. These trends were partially attributable to prenatal and clinical factors. Future research should involve implementation of strategies to overall decrease PPR rates, especially for racial/ethnic groups requiring culturally appropriate care to advance maternal health equity. ■

CRediT authorship contribution statement

Curisa M. Tucker: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Chen Ma:** Conceptualization, Formal analysis, Methodology, Writing – review & editing. **Mahasin S. Mujahid:** Conceptualization, Methodology, Writing – review & editing. **Alexander J. Butwick:** Conceptualization, Methodology, Writing – review & editing. **Anna I. Girsen:** Conceptualization, Methodology, Writing – review & editing. **Ronald S. Gibbs:** Conceptualization, Methodology, Writing – review & editing. **Suzan L. Carmichael:** Conceptualization, Funding acquisition, Methodology, Supervision, Writing – review & editing. ■

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.xagr.2024.100331.

REFERENCES

1. Zaharatos J, St Pierre A, Cornell A, Pasalic E, Goodman D. Building U.S. Capacity to review and prevent maternal deaths. J Womens Health (Larchmt) 2018;27:1–5.

2. Chen J, Cox S, Kuklina EV, Ferre C, Barfield W, Li R. Assessment of incidence and factors associated with severe maternal morbidity after delivery discharge among women in the US. JAMA Netw Open 2021;4:e2036148.

3. Clapp MA, Robinson JN, Little SE. The relationship between the rising cesarean delivery and postpartum readmission rates. J Perinatol 2017;37:355–9.

4. Dharmarajan K, Wang Y, Lin Z, et al. Association of changing hospital readmission rates with mortality rates after hospital discharge. JAMA 2017;318:270–8.

5. Zuckerman RB, Sheingold SH, Orav EJ, Ruhter J, Epstein AM. Readmissions, observation, and the hospital readmissions reduction program. N Engl J Med 2016;374:1543–51.

6. Society for Maternal-Fetal Medicine (SMFM) Combs CA, Goffman D, Pettker CM. Patient Safety and Quality Committee. Society for Maternal-Fetal Medicine Special Statement: a critique of postpartum readmission rate as a quality metric. Am J Obstet Gynecol 2022;226:B2–9.

7. Liu S, Heaman M, Kramer MS, et al. Length of hospital stay, obstetric conditions at childbirth, and maternal readmission: a population-based cohort study. Am J Obstet Gynecol 2002;187:681–7.

8. Clapp MA, Little SE, Zheng J, Robinson JN. A multi-state analysis of postpartum readmissions in the United States. Am J Obstet Gynecol 2016;215:113. e1–10.

9. Clapp MA, Little SE, Zheng J, Kaimal AJ, Robinson JN. Hospital-level variation in postpartum readmissions. JAMA 2017;317:2128–9.

10. Girsen AI, Sie L, Carmichael SL, et al. Rate and causes of severe maternal morbidity at readmission: California births in 2008-2012. J Perinatol 2020;40:25–9.

11. Aziz A, Gyamfi-Bannerman C, Siddiq Z, et al. Maternal outcomes by race during postpartum readmissions. Am J Obstet Gynecol 2019;220:484. e1–10.

12. Crear-Perry J, Correa-de-Araujo R, Lewis Johnson T, McLemore MR, Neilson E, Wallace M. Social and structural determinants of health inequities in maternal health. J Womens Health (Larchmt) 2021;30:230–5.

13. Chantarat T, Van Riper DC, Hardeman RR. Multidimensional structural racism predicts birth outcomes for Black and White Minnesotans. Health Serv Res 2022;57:448–57.

14. Williams DR, Lawrence JA, Davis BA. Racism and health: evidence and needed research. Annu Rev Public Health 2019;40:105–25.

15. Wang CY, Yee LM, Feinglass JM. Delivery complications and postpartum hospital use in California. Womens Health Issues 2022;32:57–66.

16. Lyndon A, Lee HC, Gilbert WM, Gould JB, Lee KA. Maternal morbidity during childbirth hospitalization in California. J Matern Fetal Neonatal Med 2012;25:2529–35.

17. MacDorman MF, Gregory EC. Fetal and perinatal mortality: United States, 2013. Natl Vital Stat Rep 2015;64:1–24.

18. Leonard SA, Main EK, Scott KA, Profit J, Carmichael SL. Racial and ethnic disparities in severe maternal morbidity prevalence and trends. Ann Epidemiol 2019;33:30–6.

19. Stanhope KK, Worrell N, Jamieson DJ, Geary FH, Boulet SL. Double, triple, and quadruple jeopardy: entering pregnancy with two or more multimorbid diagnoses and increased risk of severe maternal morbidity and postpartum readmission. Womens Health Issues 2022;32:607–14.

20. Leonard SA, Kennedy CJ, Carmichael SL, Lyell DJ, Main EK. An expanded obstetric comorbidity scoring system for predicting severe maternal morbidity. Obstet Gynecol 2020;136:440–9.

21. American College of Obstetricians and Gynecologists and the Society for Maternal–Fetal MedicineKilpatrick SK, Ecker JL. Severe maternal morbidity: screening and review. Am J Obstet Gynecol 2016;215:B17–22.

22. Reid LD, Weiss AJ, Fingar KR. Contributors to disparities in postpartum readmission rates between safety-net and non-safety-net hospitals: a decomposition analysis. J Hosp Med 2022;17:77–87.

23. Matthews KC, Tangel VE, Abramovitz SE, Riley LE, White RS. Disparities in obstetric readmissions: a multistate analysis, 2007-2014. Am J Perinatol 2022;39:125–33.

24. Aseltine Jr RH, Yan J, Fleischman S, Katz M, DeFrancesco M. Racial and ethnic disparities in hospital readmissions after delivery. Obstet Gynecol 2015;126:1040–7.

25. Nguyen VVT, Zheng MY, Liu SM, Kallen MA, Kay K, Ivey SL. Prevalence of traditional Asian postpartum practices at a federally qualified Health Center. J Immigr Minor Health 2022;24:1251–60.

26. Girsen AI, Leonard SA, Butwick AJ, Joudi N, Carmichael SL, Gibbs RS. Early postpartum readmissions: identifying risk factors at birth hospitalization. AJOG Glob Rep 2022;2:100094.

27. Kumar NR, Eucalitto PF, Trawick E, Lancki N, Yee LM. Examining changes in clinical management and postpartum readmissions for hypertensive disorders of pregnancy over time. Pregnancy Hypertens 2022;30:82–6.

28. Kaufman M, McConnell KJ, Carmichael SL, Rodriguez MI, Richardson D, Snowden JM. Postpartum readmissions with and without severe maternal morbidity within 1 year of birth, Oregon, 2012-2017. Am J Epidemiol 2023;192:158–70.

29. Scott KA, Britton L, McLemore MR. The ethics of perinatal care for Black women: dismantling the structural racism in "Mother Blame" narratives. J Perinat Neonatal Nurs 2019;33:108–15.

30. Hailu EM, Maddali SR, Snowden JM, Carmichael SL, Mujahid MS. Structural racism and adverse maternal health outcomes: a systematic review. Health Place 2022;78:102923.

31. Hung P, Henning-Smith CE, Casey MM, Kozhimannil KB. Access to obstetric services in rural counties still declining, with 9 percent losing services, 2004-14. Health Aff (Millwood) 2017;36:1663–71.

32. Butterfield PG. Thinking upstream: a 25-year retrospective and conceptual model aimed at reducing health inequities. ANS Adv Nurs Sci 2017;40:2–11.

33. Bane S, Abrams B, Mujahid M, et al. Risk factors and pregnancy outcomes vary among Asian American, Native Hawaiian, and Pacific Islander individuals giving birth in California. Ann Epidemiol 2022;76:128–35. e9.

34. Lydon-Rochelle MT, Holt VL, Nelson JC, et al. Accuracy of reporting maternal in-hospital diagnoses and intrapartum procedures in Washington State linked birth records. Paediatr Perinat Epidemiol 2005;19:460–71.

35. Medicaid postpartum coverage extension tracker. Kaiser Family Foundation; 2024. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi0x6eHnfOEAxVnzTgGHUAfDX0Q FnoECBQQAQ&url=https%3A%2F%2Fwww.kff.org%2Fmedicaid%2Fissue-brief%2Fmedicaid-postpartum-coverage-extension-tracker%2F&usg= AOvVaw1sF_Cmm8svxHte_xNHOzfp&opi=89978449. Accessed March 7, 2023.