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Association of Neighborhood Socioeconomic Disadvantage and Postpartum Readmission

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Abstract

We assessed whether neighborhood socioeconomic disadvantage, as measured by the Area Deprivation Index (ADI), was associated with an increased risk of postpartum readmission. This is a secondary analysis from the Nulliparous Pregnancy Outcomes Study: Monitoring Mothers-To-Be, a prospective cohort of nulliparous pregnant individuals from 2010 to 2013. The exposure was the ADI in quartiles, and the outcome was postpartum readmission; Poisson regression was used. Among 9,061 assessed individuals, 154 (1.7%) were readmitted postpartum within two weeks of delivery. Individuals living with the most neighborhood deprivation (ADI quartile 4) were at increased risk of postpartum readmission compared to those living with the lowest neighborhood deprivation (ADI quartile 1) (adjusted risk ratio, aRR: 1.80; 95% CI: 1.11 to 2.93). Measures of

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community-level adverse social determinants of health, such as the ADI, may inform postpartum care after delivery discharge.

Precis

Higher community-level adverse social determinants of health as measured by the Area Deprivation Index was associated with an increased risk of postpartum readmission after delivery discharge.

Keywords

postpartum readmission; neighborhood disadvantage; social determinants of health; pregnancy; hospitalization; area deprivation index

INTRODUCTION

About 1% of individuals in the United States (U.S.) have a postpartum readmission after their delivery.¹ Readmission is frequently associated with serious maternal morbidity and potentially avoidable costs.² It disproportionately affects individuals who experience a higher burden of adverse social determinants of health.³ Efforts to identify pregnant individuals at higher risk of postpartum readmission could be used as part of care pathways to better target individuals for care transition interventions and to risk-adjust readmission rates for the purpose of hospital comparison.⁴

The Area Deprivation Index (ADI) was created to better quantify how multiple community-level measures of adverse social determinants of health, including lack of income, less education, unemployment, structural racism, and poor housing quality, affect health outcomes including hospital readmission rate outside of pregnancy.⁵ Since its development in 2015, it has been refined, adapted, and validated to the Census Block Group neighborhood level.⁶ As opposed to individual-level social determinants of health which have been previously studied,⁷ community-level measures have yet to be widely evaluated in the peripartum period, including for postpartum readmission.

The objective of the current study was to assess whether neighborhood or community socioeconomic disadvantage as measured by the ADI was associated with an increased risk of postpartum readmission.

METHODS

This is a secondary analysis from the Nulliparous Pregnancy Outcomes Study: Monitoring Mothers-To-Be, a prospective cohort of nulliparous pregnant individuals from 2010 to 2013.⁸ Participant home addresses in the first trimester were geocoded at the census tract level and linked to the 2015 ADI to provide rankings of neighborhood socioeconomic disadvantage. Each site's institutional review board approved the study before initiation and all participants gave written informed consent for participation

The ADI combines metrics from the domains of income, education, employment, and housing quality into a composite score that is converted to a rank based on a locale's national percentile.⁵ The ADI can be accessed at <https://www.neighborhoodatlas.medicine.wisc.edu/>. The ADI was analyzed in quartiles within the study cohort from the lowest ADI or least deprivation (quartile 1 [Q1], reference) to the highest ADI or most deprivation (quartile 4 [Q4]). The outcome for this analysis was hospital readmission for any indication within 14 days of delivery discharge for any indication.

Poisson regression with robust error variance was used to estimate the adjusted relative risk (aRR) between ADI quartile and readmission. The adjusted model incorporated individual-level covariates (as individual measures are associated but not casually dependent on community-level measures such as the ADI) previously associated with postpartum readmission and based on a directed acyclic graph, including socio-demographic (age, Medicaid status, self-reported race and ethnicity as a social determinant of health), clinical (chronic hypertension, diabetes in pregnancy), and obstetric characteristics (gestational age at delivery). The model did not include mode of delivery because it was deemed to be on the causal pathway to postpartum readmission.⁹

RESULTS

Among 10,038 enrolled nulliparous pregnant individuals, 9,061 (90.3%) were included in the current analysis with ADI and follow-up outcome ascertainment (Appendix 1, available online at <http://links.lww.com/xxx>). Those who were excluded due to missing exposure (ADI) or outcome (readmission) data were more likely to identify as Black or Hispanic, be Medicaid-insured, have lower educational attainment, and have a higher ADI or more deprivation (for those without outcome ascertainment) ($p < 0.05$ for all) (Appendix 2, available online at <http://links.lww.com/xxx>).

Individuals with a higher ADI quartile were more likely to be of younger age, identify as Black or Hispanic, have lower educational attainment, report smoking, have a higher body mass index, report a lower household income, and be diagnosed with diabetes in pregnancy or chronic hypertension ($p < 0.05$ for all) (Appendix 3, available online at <http://links.lww.com/xxx>). Similarly, with the exception of age, these demographic and clinical characteristics were associated with a higher frequency of postpartum readmission ($p < 0.05$ for all) (Appendix 4, available online at <http://links.lww.com/xxx>). The distribution of ADI scores is presented in Appendix 5, available online at <http://links.lww.com/xxx>.

Among the study population, 154 (1.7%) were readmitted postpartum within two weeks of delivery, of whom 5.2% were readmitted more than once within 2 weeks. The primary indications (not mutually exclusive) for postpartum readmission were infection (33.7%), preeclampsia (23.5%), and bleeding (6.6%).

The frequency of readmission increased overall as quartiles of neighborhood deprivation increased: Q1: 1.3%; Q2: 1.8%; Q3: 1.6%; and Q4: 2.4% (overall p -value=0.02) (Table 1). In multivariable analysis, individuals living with the most neighborhood deprivation

(i.e., those residing in ADI Q4) were significantly more likely to be readmitted postpartum compared to those living with the lowest neighborhood deprivation (i.e., those residing in ADI Q1 (Table 1)): adjusted risk ratio, aRR: 1.80; 95% CI: 1.11 to 2.93.

DISCUSSION

In a cohort of nulliparous pregnant individuals from across the U.S., we found that residing within the most disadvantaged U.S. neighborhoods was associated with increased risk of postpartum readmission among nulliparous pregnant individuals. The ADI metric is accessible via a web-based portal, and can be determined from the electronic health record. Emerging data support an association between community-level measures of adverse social determinants of health, such as the ADI or the related Social Vulnerability Index, and adverse pregnancy outcomes.¹⁰ Outside of pregnancy, the ADI has been shown to be associated with an increased risk of hospital readmission. While prior studies in pregnancy have identified individual or patient-level factors, such as medical comorbidities, basic demographic data, and clinical variables associated with postpartum readmission,^{1,3,7} less attention has been focused on broader social and environmental factors that may also contribute to readmission risk.¹¹

Consistent with prior studies, the most common reasons for readmission included hypertensive disorder of pregnancy, infection, and postpartum hemorrhage.¹ Disparities in the risk of these postpartum complications have been shown to exist by individual-level measures of socioeconomic status and hospital quality.¹¹

Limitations of the current analysis include that this study was restricted to nulliparous individuals receiving care at larger medical centers, who entered prenatal care in the first trimester, and were enrolled in a longitudinal study, all of which may limit generalizability. The current study assessed readmissions only through 14 days postpartum, and frequently readmission is assessed through 30 days postpartum, however, most postpartum readmissions occur within 7 days of delivery.¹ We excluded individuals missing ADI or readmission data, and those who were excluded who were more likely to experience individual adverse social determinants of health, which likely resulted in nondifferential misclassification (i.e., bias results to the null). The data are now nearly a decade-old, but it is unlikely that the observed risk associated with ADI has changed, and in fact, may have increased during the recent COVID-19 pandemic.¹² The ADI was initiated in 2015, and using prior data in the current study would likely result in nondifferential misclassification. Since this study, Medicaid expansion as part of the Affordable Care Act may have improved access to postpartum coverage and healthcare utilization, and the impact on postpartum healthcare utilization requires further study.

A strength of this study is universal ascertainment of postpartum outcomes as part of a prospective cohort. The ADI is a measure of community-level adverse social determinants of health that is generalizable across the U.S.. This measure provides social context beyond that gained from typical assessments of individual-level drivers of health, and the relative contribution of community versus individual determinants requires further study.

Measures of neighborhood disadvantage, such as the ADI, could potentially be used to inform postpartum care after delivery discharge. Such measures account for community-level social determinants that impact health outcomes and could be integrated into care pathways. Health care professionals and healthcare systems may also consider providing additional monitoring, counseling, and services to postpartum individuals who experience a higher burden of adverse social determinants of health.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Frequency and association between Area Deprivation Index (ADI) and postpartum readmission

	Readmission (row percentage)		Unadjusted and adjusted analysis	
	Yes n (%) n=154	No n (%) n=8,907	Risk ratio (RR); 95% CI ¹	Adjusted risk ratio (ARR); 95% CI ^{1,2}
Area Deprivation Index ³				
Quartile 1 (least disadvantaged)	37 (1.3)	2,933 (98.8)	1.00	1.00
Quartile 2	45 (1.8)	2,506 (98.3)	1.42 (0.92 to 2.18)	1.39 (0.89 to 2.17)
Quartile 3	22 (1.6)	1,398 (98.5)	1.24 (0.74 to 2.10)	1.23 (0.71 to 2.11)
Quartile 4 (most disadvantaged)	50 (2.4)	2,070 (97.6)	1.89 (1.24 to 2.89)	1.80 (1.11 to 2.93)

¹Poisson regression with robust error variance was used.

²Model adjusted for socio-demographic (age, Medicaid status, self-reported race and ethnicity), clinical (chronic hypertension, diabetes in pregnancy), and obstetric characteristics (gestational age at delivery).

³Quartile 1 (Less than the 25th Percentile); Quartile 2 (25th – 50th Percentile); Quartile 3 (Higher than the 50th – Less than the 75th percentile); and Quartile 4 (75th Percentile or Higher) N=9,061 in the unadjusted model, and N=8,894 in the adjusted model.