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RESEARCH LETTER

Associations Between Maternal Sociodemographics and Hospital Mortality in Newborns With Prenatally Diagnosed Hypoplastic Left Heart Syndrome

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Race and ethnicity, socioeconomic status (SES), and geography have been associated with differential outcomes in congenital heart disease death. In patients with hypoplastic left heart syndrome (HLHS), lower SES has been associated with increased complications and lower 1-year survival.[1]

No previous study has examined how sociodemographics affect neonatal death among prenatally diagnosed patients with HLHS. The study goal was to investigate infants with a prenatal diagnosis of HLHS to understand associations between maternal sociodemographics and patient characteristics and hospital discharge mortality.

The data that support the findings of this study are available from the corresponding author on reasonable request.

STUDY DESIGN

Data from the Fetal Heart Society Research Collaborative multicenter retrospective cohort study were used to identify relationships between sociodemographics and newborn hospital mortality among those prenatally diagnosed with HLHS among 19 sites in the United States.[2] This study was approved by an institutional review committee. Participant consent was not needed, as the study was from a retrospective deidentified cohort.

STUDY POPULATION

Fetuses and infants <2 months of age with a prenatal diagnosis of HLHS from January 2012 to December 2016 were included. Classic variants of HLHS and double-outlet right ventricle with mitral atresia were included. Cardiac diagnoses were confirmed postnatally or during autopsy.

STUDY VARIABLES

Primary independent variables were maternal race and ethnicity, insurance, and neighborhood factors, including: (1) SES (from maternal census tract, as described previously[3]); (2) neighborhood poverty level >20%, race and ethnicity distribution, and rural residence; and (3) driving

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For Sources of Funding and Disclosures, see page 285.

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Nonstandard Abbreviations and Acronyms

HLHS	hypoplastic left heart syndrome
SES	socioeconomic status

distance and time to cardiac surgical center. Maternal variables (age at delivery and primary language) and infant characteristics known to be associated with worse HLHS outcomes (gestational age at birth, birth weight <2.5kg, restrictive or intact atrial septum, extracardiac birth defects, and any genetic conditions) were treated as covariates. Earliest insurance type was recorded from the fetal or neonatal record. The primary outcome variable was death before newborn hospital discharge. Termination of pregnancy was a secondary outcome.

STATISTICAL ANALYSIS

For the primary analysis, associations between maternal sociodemographics and infant characteristics and hospital discharge mortality were evaluated using logistic regression. For this analysis, those with termination, fetal demise, comfort care, and unknown outcome were excluded. Multiple multivariable models were created, accounting for clustering by site using generalized estimating equations. Causal mediation analysis was conducted to estimate direct and indirect effects in the fully adjusted models (CAUSALMED procedure). Secondary logistic regression analyses were conducted for associations between maternal sociodemographics and pregnancy termination. Analyses used SAS version 9.4 (SAS Institute Inc, Cary, NC); a value of $P=0.05$ was statistically significant.

A total of 952 fetuses were identified, with 46.4% (n=369) diagnosed at >24 weeks of gestation. Ninety-five (9.9%) died before birth due to miscarriage or intrauterine fetal demise (n=20), pregnancy termination (n=74), or unknown causes (n=1). Among those diagnosed at <24 weeks, the termination of pregnancy rate was 17.3%, and individuals with high SES and private insurance had higher percentages of termination compared with those with low SES (n=58 [13.2%] versus 16 [3.5%]; $P<0.0001$) and public insurance (n=50 [12.4%] versus 9 [2.8%]; $P<0.0001$). After the exclusion of these and cases with unknown pregnancy outcome (n=46), 811 live-born infants with HLHS underwent outcome analyses.

In multivariable analyses, prematurity, genetic disorder, restrictive atrial septum, presence of extracardiac birth defects, and maternal Black race were associated with higher death (Table). No association between geography, SES, or low birth weight and mortality was noted. Clustering by site had no impact on findings. In a mediation analysis for the effect of Black race on death before hospital discharge, only 4% of deaths were explained by low birth weight, 3.2% by preterm birth, and 9.2% by neighborhood SES.

Our study demonstrated that although SES is associated with termination of pregnancy, SES and geography were not associated with hospital discharge mortality among liveborn infants. Prematurity and presence of a genetic disorder or a restrictive atrial septum were associated with mortality. Geography may not be significantly associated, as risks contributing to short-term mortality (distance to a cardiac care center, late presentation

Table. Unadjusted and Adjusted Associations Between SES and Mortality by Logistic Regression

	Death before discharge				
	Unadjusted	Model 1	Model 2	Model 3	Model 4
Variables in model	OR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Low SES	1.45 (1.03–2.05)*	1.24 (0.83–1.88)	1.24 (0.83–1.86)	1.22 (0.81–1.84)	1.20 (0.76–1.89)
Maternal race and ethnicity	…				
White, non-Hispanic	…	Ref	Ref	Ref	Ref
Black, non-Hispanic	…	1.74 (1.01–3.00)*	1.77 (1.04–3.03)*	1.80 (1.04–3.10)*	1.76 (0.97–3.19)
Hispanic/Latino	…	1.16 (0.68–1.99)	1.09 (0.64–1.86)	1.17 (0.68–2.00)	1.25 (0.70–2.24)
Asian	…	1.63 (0.51–5.19)	1.76 (0.55–5.60)	1.77 (0.56–5.65)	1.29 (0.35–4.73)
Native American/Alaskan/Pacific Islander	…	2.44 (0.57–10.43)	3.56 (0.94–13.46)	2.59 (0.61–11.08)	1.03 (0.12–9.01)
Low birth weight	…	1.51 (0.90–2.53)	…	1.18 (0.66–2.12)	1.53 (0.84–2.79)
Preterm birth	…	…	1.91 (1.16–3.16)*	1.76 (0.99–3.14)	1.65 (0.89–3.01)
Restrictive atrial septum	…	2.59 (1.53–4.37)*	2.67 (1.60–4.46)*	2.64 (1.56–4.48)*	…†
Extracardiac birth defect	…	3.57 (2.10–6.10)*	3.14 (1.86–5.29)*	3.40 (1.98–5.83)*	2.92 (1.63–5.23)*
Any genetic defect	…	1.81 (0.81–4.07)	2.01 (0.90–4.47)	1.90 (0.85–4.29)	2.38 (1.01–5.63)*

aOR indicates adjusted odds ratio; OR, odds ratio; Ref, referent; and SES, socioeconomic status.
*P value <0.05.
†Patients with restrictive atrial septum excluded.

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due to lack of prenatal diagnosis, etc) are mitigated and largely "controlled" for with the patient being born at or near a tertiary cardiac care center. Perhaps most alarming was the finding that risk of death was 1.8× higher in Black compared with White infants, as well as mediation analyses demonstrating that the majority of the association (>80%) was due to unexplained or unmeasured factors or potentially structural racism described in previous studies of Black neonates.[4] This is particularly concerning, as congenital heart disease studies have found that rates of mortality remain highest in Black patients compared with patients of other races and ethnicities from birth until at least 35 years of age.[5]

Limitations of the study include its retrospective design, the inability to completely control for center characteristics or to determine maternal health during pregnancy, and limited assessment of the social determinants of health potentially driving demonstrated disparities in birth outcomes. Nonetheless, our study represents a large cohort of prenatally diagnosed patients with HLHS and factors associated with mortality. Future work is needed to identify modifiable factors that may contribute to worse outcomes in Black infants with HLHS to eliminate these disparities.

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Disclosures

None.

APPENDIX

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