

# FATHER'S LIFETIME SOCIOECONOMIC STATUS, SMALL FOR GESTATIONAL AGE INFANTS, AND INFANT MORTALITY: A POPULATION-BASED STUDY

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**Objective:** To ascertain the association between father's lifetime socioeconomic status (SES) and rates of small for gestational age (SGA, defined as weight for gestational age <10<sup>th</sup> percentile) and infant mortality (defined as <365 days).

**Methods:** The study sample was limited to the singleton births of African American (n=8,331), non-Latina White (n=18,200), and Latina (n=2,637) women. Stratified and multilevel, multivariable logistic regression analyses were conducted on the Illinois transgenerational dataset of infants (1989-1991) and their Chicago-born parents (1956-1976) with appended US census income data (n=29,168). The median family income of father's census tract residence during childhood and parenthood were used to assess lifetime SES.

**Results:** Births (n=8,113) to fathers with a lifetime low SES had a SGA rate of 13.3% compared with 6.6% for those (n=10,329) born to fathers with a lifetime high SES, RR = 1.97 (1.79, 2.17). The infant mortality rate of births to fathers with a lifetime low SES exceeded that of infant mortality rate of births to fathers with a lifetime high SES: 13/1,000 vs 5/1,000, respectively; RR = 2.71 (1.94, 3.77). The adjusted (controlling for mother's age, education, marital status, and race/ethnicity) OR of SGA for fathers with childhood, parenthood, and lifetime low (vs high) SES were 1.15 (1.01, 1.31), 1.13 (1.02, 1.26), and 1.19 (1.05, 1.34), respectively. The adjusted OR of infant mortality for births to fathers with childhood, parenthood, and lifetime low (vs high) SES were 1.14 (.78, 1.67), 1.40 (.90, 2.18), and 1.31 (.90, 1.92), respectively.

**Conclusions:** Low paternal socioeconomic status is a previously unrecognized determinant of SGA birth regardless of mother's de-

## INTRODUCTION

Small for gestational age (SGA, defined as birth weight for gestational age <10<sup>th</sup> percentile), is a major risk factor of infant mortality and morbidity.<sup>1-5</sup> Children born small for gestational age are also at increased risk of coronary artery disease, stroke, and type 2 diabetes during adulthood.<sup>4,5</sup> Moreover, there are transgenerational consequences with mothers born small for gestational age themselves having a nearly two-fold increased risk of delivering SGA infants than mothers who were of appropriate gestational age when born.<sup>6</sup> Mother's socioeconomic status (SES) is a well-known determinant of SGA birth.<sup>6-9</sup> In contrast, the association between paternal SES, not captured by marital status, and adverse birth outcome is incompletely understood.<sup>10</sup>

The limited literature shows that paternal biologic factors (ie, birth weight, height, and age) are associated with infant birth weight.<sup>11,12</sup> Most pertinent, a recent investigation found that paternal SES was a risk factor for low birth weight (LBW, defined as <2500g) independent of maternal demographic characteristics.<sup>13</sup> However, there are multiple causes of LBW infants with the vast majority defined according to preterm birth rates (PTB, defined as <37 weeks). One study by Blumenshine et al reported that father's educational attainment was associated with preterm birth.<sup>14</sup> To our knowledge, no study has examined if paternal SES is a risk factor for SGA birth or infant mortality.

For unclear reasons, African American women have twice the rate of SGA births than non-Latina White women even among the col-

mographic status. *Ethn Dis.* 2019;29(1):9-16; doi:10.18865/ed.29.1.9

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lege-educated.<sup>2,6,15</sup> In both groups, unmarried status is a major risk factor for SGA birth.<sup>16</sup> This finding strongly suggests a potentially important role of social and economic inequity based on father's SES for African American women's pregnancy outcome as measured by SGA rates.

We, therefore, used data from the Illinois vital records and US census data to investigate if father's SES is associated with SGA births and infant mortality rates (IMR, defined as <365 days). We hypothesized that: 1) paternal lifetime low SES is a risk factor for SGA and infant mortality independent of maternal age, marital status, education attainment, and race/ethnicity; and 2) the association of paternal lifetime SES and SGA rates is stronger among African American compared with non-Latina White women.

## METHODS

### Illinois Transgenerational Birth File

We analyzed the Illinois transgenerational birth file (TGBF) of infants born between 1989-1991 and their parents born between 1956-1976 and subsequently linked to US census data for 1960, 1970, and 1990.<sup>17</sup> These were the only years available, and included 267,303 mother-infant dyads.<sup>17</sup> Approximately 80% (n=125,949) of Illinois-born fathers birth certificates were linked to the mother-infant vital records as previously described.<sup>13,17</sup> The study sample was restricted to infants born in the Chicago metropolitan area (because of the availability of neighborhood

income data) whose fathers were acknowledged on their birth certificates. Approximately 80% (n=29,168) of Chicago-born fathers' birth certificates were linked to the maternal-infant vital records. The institutional review board of Ann & Robert H. Lurie Children's Hospital of Chicago approved the investigational protocol.

### Paternal Socioeconomic Status

In Chicago, there are 873 census tracts that usually reflect fairly homogeneous populations ranging from

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*Children born small for gestation age are also at increased risk of coronary artery disease, stroke, and type 2 diabetes during adulthood.*<sup>4,5</sup>

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1,500 to 8,000 in number and, with few exceptions, the census tract geography has remained constant.<sup>13</sup> Census tract level coding was unavailable for the 1956-1960 birth cohort. For this subgroup we used the community area code.<sup>13</sup> There are 77 community areas that were created in the 1920s to reflect naturally occurring neighborhoods and include approximately 11 census tracts (range 1 to 36).

Father's lifetime SES was based on median family income of the father's census tract of residence for the 1961-1976 birth (ie, childhood) cohort or the geographically broader community area for the 1956-1960

birth cohort (ie, childhood) and at the time of his infant's delivery (ie, parenthood). This contextual proxy measure was divided by median cut-offs separately for childhood and parenthood. Further, father's SES was empirically classified into 4 categories: 1) lifetime residence in bottom half neighborhoods (ie, lifetime low); 2) childhood residence in top half neighborhoods and parenthood residence in bottom half neighborhoods (ie, adulthood low); 3) childhood residence in bottom half neighborhoods and parenthood residence in top half neighborhoods (ie, childhood low); and 4) lifetime residence in top half neighborhoods (ie, lifetime high).

### Analytic Sample

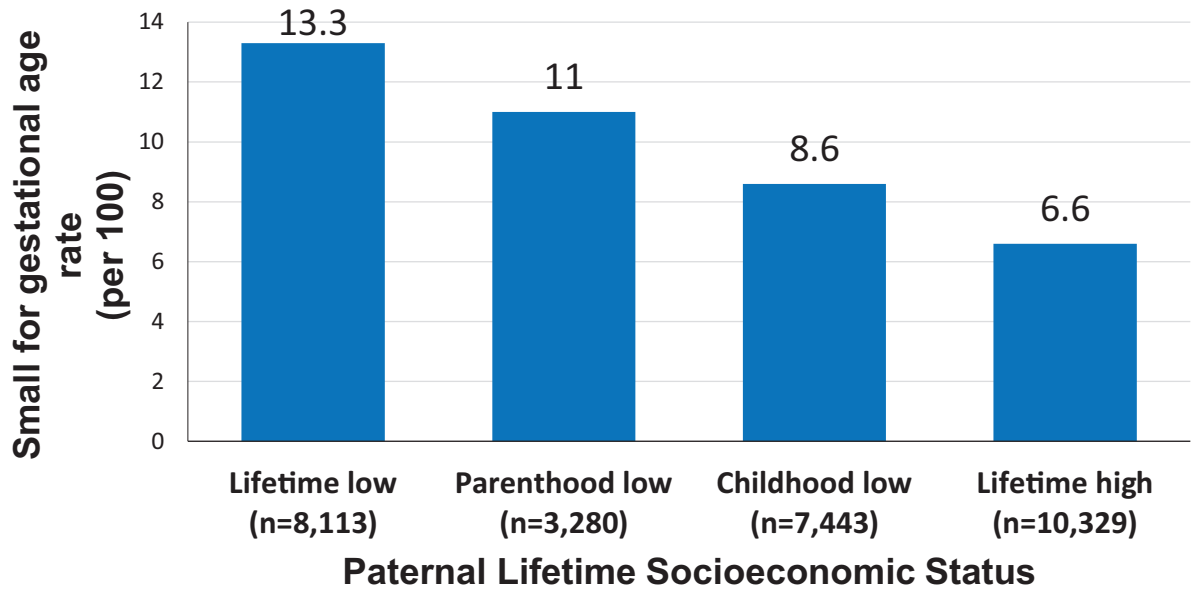
The study sample was limited to the singleton births of African American (n=8,331), non-Latina White (n=18,200), and Latina (n=2,637) women.

### Infant Outcome

Gestational age was calculated based on mother's last menstrual period. SGA and term-SGA (>37 weeks) rates were defined by gender according to published population-based norms<sup>18</sup> and expressed per 100 live births. Infant mortality was defined as a death occurring at <365 days from birth and calculated per 1,000 live births.

### Statistical Analyses

Rates of SGA and infant mortality according to paternal SES were calculated. Within each paternal SES subgroup, we computed: 1) the distribution of mother's age, education, marital status, and race/ethnicity; 2) SGA rates

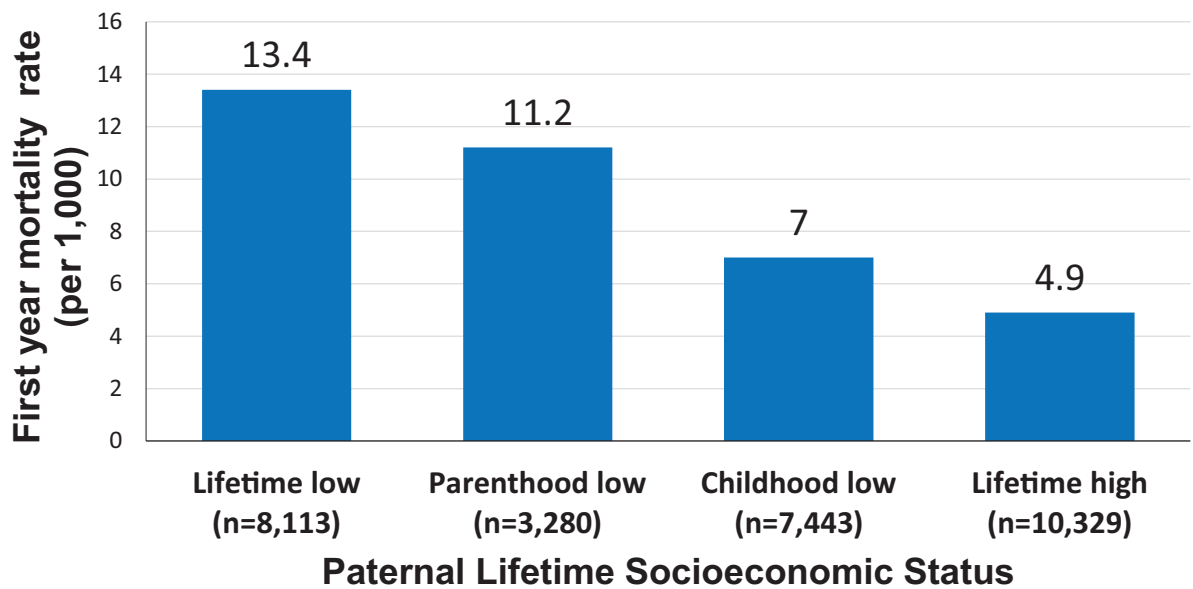


**Figure 1. Paternal lifetime socioeconomic status and small for gestational age rates. Cook County, Illinois, 1956–1976, 1989–1991**  
 The RR (95% CI) of SGA for births to men with a childhood, parenthood, or lifetime low (vs lifetime high) socioeconomic status equaled 1.26 (1.13, 1.41), 1.67 (1.47, 1.89), and 1.97 (1.79, 2.17) respectively.

according to the level of maternal demographic characteristics; and 3) race-specific SGA rates by maternal demographic variables. The sample size of

Latinas was too small for Latina-specific analyses. Relative risks (RR) and 95% CIs for SGA and paternal SES were calculated with paternal lifetime

high SES as the reference subgroup.<sup>19</sup> To better estimate the independent association of paternal SES and adverse birth outcome (as measured by



**Figure 2. Paternal lifetime socioeconomic status and first year mortality rates; Cook County, Illinois, 1956–1976, 1989–1991**  
 The RR (95% CI) of first year mortality for births to men with a childhood, parenthood, or lifetime low (vs lifetime high) socioeconomic status equaled 1.41 (.96, 2.08), 2.28 (1.49, 3.47), and 2.71 (1.94, 3.77), respectively.

the rates of SGA, term-SGA, and first-year mortality), multivariate, multi-level logistic regression analyses were performed.<sup>20</sup> Multilevel models were used because individuals were clustered in neighborhoods (census tracts). The only level 2 variable included in the models was the census tract number to account for clustering. The level 1 variables in the models were maternal age, education, marital status, and race/ethnicity (except in the models that were stratified by race/ethnicity). Lastly, race-specific models were established. The adjusted odds ratio (OR) and 95% CI were computed.<sup>20</sup>

## RESULTS

Figures 1 and 2 show the crude rates of SGA and first-year mortality according to paternal lifetime SES,

respectively. Births to fathers with a lifetime low SES had a SGA rate of 13.3% compared with 6.6% for births to fathers with a lifetime high SES, RR = 1.97 (1.79, 2.17). The crude first-year mortality rate of births (n=8,113) to fathers with a lifetime low SES exceeded that of births (n=10,329) to fathers with a lifetime high SES: 13/1,000 vs 5/1,000, respectively; RR = 2.71 (1.94, 3.77). Maternal factors such as educational attainment and marital status were positively associated with paternal lifetime SES (Table 1).

Table 2 presents race-specific SGA rates according to paternal lifetime SES and mother's demographic characteristics. Among married non-Latina White women, there was an increased risk of SGA births to fathers with lifetime low SES (vs high) (RR=1.5, 95% CI: 1.2, 1.8). For African American women, none of the associations

were statistically significant but in the expected direction. Similar findings occurred with respect to race-specific term-SGA rates by paternal SES and mother's demographics (data not shown, available on request). Because of the relatively small number of African American women in the paternal lifetime high subgroup, we repeated all stratified analyses using paternal lifetime low as the reference group. Although the CIs decreased, the results stayed substantively the same (data not shown, available on request).

In the multivariable, multilevel logistic regression models (data not shown), the adjusted (controlling for maternal age, education, marital status, and race/ethnicity) OR of 1) SGA births for paternal childhood, parent-hood, and lifetime low (vs lifetime high) SES were 1.15 (1.01, 1.31), 1.13 (1.02, 1.26), and 1.19 (1.05,

**Table 1. Distribution of maternal sociodemographic characteristics by paternal socioeconomic status (SES), Cook County, Illinois, 1956–1976, 1989–1991 transgenerational birth data**

	Paternal SES			
	Childhood Low n = 7,443 n (%)	Parenthood Low n = 3,280 n (%)	Lifetime Low n = 8,113 n (%)	Lifetime High n = 10,329 n (%)
Maternal age, yrs <sup>a</sup>				
< 20	326 (4.4)	988 (30.1)	1,596 (19.7)	576 (5.6)
20 - 24	1,269 (17.1)	1,062 (32.4)	2,648 (32.6)	1,866 (18.1)
25 - 29	3,590 (48.2)	844 (25.7)	2,725 (33.6)	4,798 (46.5)
30 - 35	2,258 (30.3)	386 (11.8)	1,144 (14.1)	3,089 (29.9)
Maternal education, yrs <sup>a</sup>				
<12	508 (6.8)	949 (28.9)	2,188 (27.0)	561 (5.4)
12	3,056 (41.1)	1,337 (40.8)	3,322 (41.0)	4,063 (39.3)
>12	3,879 (52.1)	994 (30.3)	2,603 (32.1)	5,705 (55.2)
Marital status <sup>a</sup>				
Married	6,364 (85.5)	1,753 (53.5)	3,958 (48.8)	9,376 (90.8)
Unmarried	1,079 (14.5)	1,527 (46.6)	4,155 (51.2)	953 (9.2)
Maternal race/ethnicity <sup>a</sup>				
African American	1,643 (22.1)	1,009 (30.8)	5,262 (64.9)	417 (4.0)
Non-Latina White	5,357 (72.0)	1,630 (49.7)	1,630 (20.1)	9,581 (92.8)
Latina	443 (6.0)	641 (19.5)	1,221 (15.1)	331 (3.20)

a. P<.0001.

**Table 2. Small for gestational age rates (SGA defined as weight-for-gestational-age <10<sup>th</sup> percentile) according to paternal socioeconomic status (SES) and selected maternal demographic characteristics among African American and White women; Cook County, Illinois, 1956–1976, 1989–1991**

	Paternal SES							
	Childhood Low		Parenthood Low		Lifetime Low		Lifetime High	
	SGA	RR (95 CI)	SGA	RR (95 CI)	SGA	RR (95 CI)	SGA	RR (95 CI)
African Americans	n = 1,643		n = 1,009		n = 5,262		n = 417	
Maternal age								
<20 years	16.9	1.4 (.8, 2.3)	15.6	1.3 (.8, 2.1)	14.8	1.2 (.8, 1.9)	12.5	Ref
20-24 years	16.2	1.3 (.8, 2.0)	13.1	1.0 (.6, 1.7)	14.2	1.1 (.7, 1.7)	12.8	Ref
25-29 years	11.2	1.5 (.7, 3.1)	14.9	2.0 (.9, 4.4)	14.0	1.9 (.9, 3.8)	7.5	Ref
30-35 years	12.9	1.0 (.4, 2.5)	14.3	1.1 (.4, 3.3)	17.1	1.4 (.6, 3.2)	12.5	Ref
Maternal education								
<12 years	20.4	1.7 (.8, 3.6)	19.2	1.6 (.8, 3.2)	17.8	1.5 (.8, 2.9)	11.9	Ref
12 years	14.8	1.5 (.9, 2.4)	12.6	1.2 (.7, 2.1)	15.0	1.5 (.9, 2.4)	10.2	Ref
>12 years	11.9	1.0 (.6, 1.4)	13.0	1.0 (.7, 1.7)	11.9	1.0 (.7, 1.4)	12.4	Ref
Marital status								
Married	12.2	1.6 (.9, 2.7)	14.3	1.8 (1.0, 3.3)	12.4	1.6 (.9, 2.7)	7.8	Ref
Unmarried	15.5	1.1 (.8, 1.6)	14.7	1.0 (.7, 1.5)	16.1	1.1 (.8, 1.6)	14.3	Ref
Whites	n = 5,357		n = 1,630		n = 1,630		n = 9,581	
Maternal age								
<20 years	12.9	1.2 (.7, 2.2)	10.4	1.0 (.6, 1.5)	14.2	1.3 (.8, 2.2)	10.9	Ref
20-24 years	8.7	1.1 (.9, 1.5)	8.4	1.1 (.8, 1.5)	10.6	1.4 (1.0, 1.9)	7.6	Ref
25-29 years	6.4	1.1 (.9, 1.3)	8.0	1.4 (1.0, 1.8)	8.2	1.4 (1.1, 1.8)	6.0	Ref
30–35 years	6.7	1.2 (.9, 1.5)	9.3	1.7 (1.1, 2.4)	10.4	1.9 (1.3, 2.6)	5.6	Ref
Maternal education								
<12 years	11.8	1.1 (.7, 1.7)	11.7	1.1 (.7, 1.6)	14.5	1.4 (.9, 2.0)	10.7	Ref
12 years	7.4	1.0 (.9, 1.2)	9.7	1.4 (1.1, 1.7)	9.1	1.3 (.9, 1.6)	7.2	Ref
>12 years	6.0	1.1 (.9, 1.3)	5.7	1.1 (.7, 1.5)	6.9	1.3 (.9, 1.8)	5.4	Ref
Marital status								
Married	6.5	1.1 (.9, 1.3)	8.6	1.5 (1.2, 1.8)	8.8	1.5 (1.2, 1.8)	5.9	Ref
Unmarried	12.8	1.0 (.7, 1.4)	9.0	.7 (.5, 1.0)	12.8	1.0 (.7, 1.4)	12.7	Ref

1.34), respectively; and 2) term SGA births for paternal childhood, parenthood, and lifetime low (vs lifetime high) SES were 1.17 (1.04, 1.32), 1.20 (1.05, 1.38), and 1.25 (1.10, 1.41), respectively. For White mothers, the adjusted (controlling for maternal age, education, and marital status) OR of 1) SGA births for paternal childhood, parenthood, and lifetime low (vs lifetime high) SES equaled 1.12 (.94, 1.34), 1.08 (.95, 1.23), and 1.25 (1.04, 1.51), respectively; and 2) term SGA births for paternal childhood, parenthood, and lifetime low (vs life-

time high) SES equaled 1.11 (.97, 1.27), 1.17 (.97, 1.42), and 1.30 (1.09, 1.56), respectively. For African American mothers, the adjusted (controlling for maternal age, education, and marital status) OR of 1) SGA births for paternal childhood, parenthood, and lifetime low (vs lifetime high) SES equaled 1.19 (.87, 1.64), 1.2 (.89, 1.62), and 1.17 (.88, 1.57), respectively; and 2) term SGA births for paternal childhood, parenthood, and lifetime low (vs lifetime high) SES equaled 1.34 (.94, 1.92), 1.33 (.93, 1.90), and 1.31 (.94, 1.82), respectively.

Finally, the adjusted (controlling for maternal age, education, marital status, and race/ethnicity) OR of infant mortality for paternal childhood, parenthood, and lifetime low (vs lifetime high) SES equaled 1.14 (.78, 1.67), 1.40 (.90, 2.18), and 1.31 (.90, 1.92), respectively.

## DISCUSSION

Our present study adds to the paucity of published data on the relationship between father's SES and birth

outcomes in the United States. We found that paternal childhood, parenthood, and lifetime low (vs lifetime high) SES are associated with rates of SGA births and first-year mortality. Our stratified analyses show that the relation of paternal SES to SGA births exists among women with the lowest risk sociodemographic characteristic (ie, college-educated). Most striking, births to men with a lifetime low (compared with lifetime high) SES have approximately a 20% greater odds of SGA, independent of maternal demographic

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*We found that paternal childhood, parenthood, and lifetime low (vs lifetime high) SES are associated with rates of SGA births and first-year mortality.*

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characteristics. These results appear to occur similarly among non-Latina White and African American women.

Our data provide new information that low paternal SES experienced in childhood, parenthood, and over the life-course was associated with modest risk of SGA (including term-SGA) independent of maternal age, education, marital status, and race/ethnicity. The findings extend the results of an earlier study, which

found an association between paternal SES and LBW rates.<sup>13</sup> These findings suggest a similar upstream etiologic process leading to LBW and SGA births. Notwithstanding, the importance of the direct provision of maternal economic and psychosocial support to reducing the risk of adverse birth outcome,<sup>21,22</sup> findings from our study suggest that indirect pathways are also plausible. Paternal low SES may lead to the increased occurrence of unhealthy maternal pregnancy related behaviors such as prenatal care usage, weight gain, and cigarette smoking.<sup>10</sup> Other possible indirect pathways include father's attitudes regarding the pregnancy and the relationship between the parents.<sup>10</sup> More research is needed to disentangle the causal pathways connecting paternal SES and SGA rates.

Interestingly, father's upward economic mobility (as measured by low SES limited to childhood) fails to blunt the effect of "inherited" lower class status on adverse birth outcome. Similarly, father's downward economic mobility (as measured by low SES limited to parenthood) does not exaggerate the effect of "inherited" lower class status on SGA rates. Father's childhood and parenthood low SES likely results in the decreased provision of financial resources and emotional support to pregnant women.

The association of paternal lifetime SES and SGA rates does not appear to differ between racial groups. This may reflect the smaller sample size of African American women in our study as the vast majority of the point estimates of paternal SES and SGA rates from our stratified and multivariable logistic analyses exceed-

ed unity but the 95% CI included the null value. However, African Americans are uniquely exposed to the double burden of racism and classism.<sup>23</sup> As such, the association of paternal SES and SGA among African American women may be stronger, reflecting the additional impact of racial discrimination on adverse birth outcome. For example, structural factors closely linked to discrimination underlie African American (compared with non-Latino White) men's lower educational attainment, higher prevalence of unemployment, and declining marriage rates.<sup>10</sup> We speculate that these phenomena are chronic stressors for African American women. Additionally, they are likely to contribute to the lack of partner support prior and during pregnancy. A prior study found that inadequate partner social support during pregnancy including their absence in the delivery room was a strong risk factor for LBW among a sample of urban African American women.<sup>22</sup> To our knowledge, there are no published data on the relationship between father's experiences with racial discrimination, African American women's social support, and adverse birth outcome.

Since weight-for-gestational age is a determinant of infant first year survival, it is not surprising that our present study shows that father's childhood, parenthood, and lifetime low (vs lifetime high) SES are associated with elevated IMR. However, the association of paternal SES and IMR weakens when adjusting for maternal demographic risk factors. More detailed studies with larger sample sizes are needed to better delineate the relation of paternal SES to IMR.

We encourage maternal and child health practitioners to take father's SES into account when designing intervention programs to improve birth outcomes. This could include targeted interventions such as group-centered prenatal care for women with significant others of low SES. In a comprehensive literature review, Thielen reported lower LBW rates among women who participated in group-centered (compared with individual) prenatal care.<sup>24</sup> An older investigation found that father's participation was associated with higher birth weights and had a strong effect for births of African American women compared to non-Latina Whites.<sup>25</sup> Non-traditional upstream public health initiatives, such as targeting the root sources of father's low SES, may also prove useful in improving birth outcomes.

### Study Limitations

The Illinois TGBF is one of the few US-derived databases of infant vital records linked to the vital records of both mothers and fathers.<sup>17</sup> Because of the addition of US census income data to each birth certificate, it uniquely allows for the investigation of father's childhood and parenthood SES (as objectively defined by neighborhood income at two time points) and SGA rates; however, it has four significant limitations.<sup>17</sup> First, the study sample was limited to infants whose fathers were acknowledged on their birth certificate. The absence of named or acknowledged fathers is a risk factor for poor birth outcome.<sup>26</sup> Therefore, our findings may be generalizable only to the lower risk births with named or acknowledged fathers (approximately 80% of our mother-

infant linked births).<sup>13,17</sup> Second, the objective assessment of father's SES during parenthood may be inaccurate for those who don't live in the same home or census tract as the mother.<sup>13,17</sup> However, this weakness would not apply to births of married parents. Third, our outcome variables (rates of SGA, term-SGA, and infant mortality) were from 1989-1991 and may not be generalizable to contemporary urban women's birth outcomes. Lastly, the number of births to Latina women were too few for us to investigate the relation of paternal SES to their risk of SGA delivery.

### CONCLUSION

Our study shows that paternal low SES (as measured during childhood and/or parenthood) is a previously unrecognized risk factor for SGA birth regardless of mother's demographic status.

#### CONFLICT OF INTEREST

No conflicts of interest to report.

#### AUTHOR CONTRIBUTIONS

Research concept and design: Enstad, Rankin, Collins; Acquisition of data: Collins; Data analysis and interpretation: Enstad, Rankin, Desisto, Collins; Manuscript draft: Enstad, Rankin, Desisto, Collins; Statistical expertise: Desisto; Acquisition of funding: Collins; Administrative: Enstad, Rankin, Collins; Supervision: Rankin, Collins

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