ORIGINAL CONTRIBUTIONS

Relation of Parental Birth Weights to Infant Birth Weight among African Americans and Whites in Illinois

A Transgenerational Study

Russell Coutinho,1 Richard J. David,1 and James W. Collins, Jr.2

The authors used a transgenerational data set of Illinois vital records to ascertain the relation between parental birth weights and infant birth weight. The infant generation consisted of all African Americans and whites born in Illinois during 1989-1991. The parent generation included the mothers and fathers who were also born in Illinois between 1956 and 1975. In the infant cohort, the rate of low birth weight (LBW) (<2,500 g) was 11.7% for African Americans (n = 15,287) versus 5.0% for whites (n = 117,708) (relative risk (RR) = 2.3, 95% confidence interval (CI) 2.2–2.5). For African Americans, the LBW rate was 17.9% among those born to LBW mothers (n = 1,943) compared with 10.8% among those born to non-LBW mothers (n = 13,344) (RR = 1.8, 95% CI 1.6–1.9). For whites, the LBW rate was 8.5% among those born to LBW mothers (n = 2,174) compared with 4.8% among those born to non-LBW mothers (n = 115,534) (RR = 1.7, 95% CI 1.6–2.0). A weaker association was observed between paternal birth weight and infant birth weight. The authors conclude that parental birth weights are important risk factors for LBW in both African Americans and whites. Am J Epidemiol 1997;146:804–9.

birth weight; blacks; infant, low birth weight; parents; whites

Editor’s note: An invited commentary on this article and the following article by Lumey and Stein appears on page 820.

For unclear reasons, African Americans have a two-fold greater incidence of low birth weight (LBW) (<2,500 g) births and consequently a greater first-year mortality rate than do whites (1, 2). Numerous investigations have shown that traditional risk factors fail to explain African Americans’ pregnancy disadvantage (1–4). However, few studies have examined the impact of transgenerational factors on this phenomenon (5, 6). The available data suggest that maternal LBW is a risk factor for poor reproductive outcomes (5–10). Klebanoff and Yip (5) matched the vital records of the 1979–1984 Tennessee birth cohort with mothers born after 1959. Although the analysis was limited to younger mothers, they found a significant association between maternal and infant birth weight for both African Americans and whites. Sanderson et al. (6) reported similar results from their investigation of the National Maternal and Infant Health Survey data in which mothers were asked to recall their own birth weight categories. In another investigation of the same data set, Wang et al. (11) found a strong familial aggregation of LBW among African Americans and whites that was independent of maternal sociodemographic factors. Interestingly, the racial disparity persisted among those born to non-LBW mothers (5, 6).

The contribution of paternal birth weight to the racial differential in infant birth weight is unknown. Very little work has been done linking paternal and infant birth weights (12, 13). There have been no studies, to our knowledge, among African Americans. Using data from the British National Birthday Trust Fund cohort, Alberman et al. (12) found paternal LBW to be correlated with lower mean offspring birth weight. However, none of the birth records contained information on both maternal and paternal birth weight.

The birth certificates of the state of Illinois contain more complete information covering a longer period of time and a larger, more heterogeneous population...
than sources used in prior studies. Therefore, we used Illinois vital records to better delineate the effects of maternal and paternal birth weight on infant birth weight among African Americans and whites.

MATERIALS AND METHODS

We obtained computerized birth certificates for all African-American and white infants born in the state of Illinois during the years 1989-1991 (the infant generation). The vital records of parents of these infants who were also born in Illinois between 1956 and 1975 (the parent generation) were eligible for linking. We used a matching technique similar to that described by Klebanoff and Yip (5) and Chike-Obi et al. (14). There were 338,028 potentially matchable infants in the 1989-1991 birth cohort. On the basis of each mother’s maiden name (first and last) and exact date of birth, we linked 267,604 (79 percent) maternal birth records to infant records. Failure to match usually arose from minor spelling errors in maternal or infant records. Of the 267,604 mother-infant pairs, 152,562 had fathers born in Illinois. Of these, 128,152 (84 percent) were successfully linked to the mother-infant records, yielding the final data set for analysis. Failure to match often arose from minor spelling variations in paternal and infant records. Matching efficiency was also based on certain sociodemographic factors. It was easier to match fathers who were older, married, more educated, and white and who resided outside of Chicago. Duplicate matches occurred for 0.09 percent of infants and were eliminated.

Parental birth weights were converted from pounds and ounces to grams and were grouped into 250-g categories. For African Americans and whites, mean infant birth weight and rates of LBW by parental birth weight were determined. The 95 percent confidence intervals for the relative risk (RR) were calculated by the Taylor series method (15).

To better estimate the public health consequences of exposure to parental LBW, we calculated the etiologic fraction (EF) percentage (15): EF = $P_e(RR - 1)/(1 + P_e(RR - 1))$, where $P_e$ is the proportion of the infant population with LBW mothers or fathers (i.e., the proportion of infants “exposed” to parental LBW).

Multiple linear regression analysis was used to evaluate the independent effects of paternal and maternal birth weight on infant birth weight (16).

RESULTS

In the 1989-1991 infant generation, the mean birth weight of African Americans ($n = 15,287$) was 3,139 g as compared with 3,434 g for whites ($n = 117,708$) ($p < 0.01$). The LBW rate of African Americans was twice that of whites (11.7 percent vs. 5.0 percent; RR = 2.3, 95 percent confidence interval (CI) 2.2-2.5). Approximately 2 percent of African-American infants and 2 percent of white infants were products of multiple gestations. In 1991, LBW rates for the general population of African Americans and whites were 15.0 percent and 5.7 percent, respectively. African-American and white parents in our transgenerational file had a slightly better sociodemographic profile than the parents of the 1991 population of Illinois births (table 1). In the 1956-1975 parent generation, the mean birth weight of African Americans ($n = 30,522$) was 3,133 g versus 3,377 g for whites ($n = 225,284$) ($p < 0.01$). The LBW rate among African Americans was 10.9 percent, as compared with 4.9 percent for whites.

Figure 1 shows the relation of mean infant birth weight with maternal birth weight. For African Americans, a linear association was observed at maternal birth weights above 2,500 g. For whites, a linear association started at maternal birth weights above 2,750 g. The position of African Americans relative to whites was essentially independent of maternal birth weight.

Table 2 shows the proportions of LBW African-American and white infants according to maternal birth weight. Race-specific LBW rates declined as maternal birth weight rose. For African Americans, the LBW rate was 17.9 percent among those born to LBW mothers compared with 10.8 percent among those born to non-LBW mothers (RR = 1.8, 95 percent CI 1.6-1.9). For whites, the LBW rate was 8.5 percent among those born to LBW mothers compared with 4.8

<table>
<thead>
<tr>
<th>Variable</th>
<th>Transgenerational file</th>
<th>General population</th>
</tr>
</thead>
<tbody>
<tr>
<td>African Americans</td>
<td>Whites</td>
<td>African Americans</td>
</tr>
<tr>
<td>Maternal age &lt;18 years</td>
<td>9.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Paternal age &lt;18 years</td>
<td>2.7</td>
<td>0.6</td>
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<tr>
<td>Maternal education &lt;12 years</td>
<td>27.4</td>
<td>10.0</td>
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<tr>
<td>Paternal education &lt;12 years</td>
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<td>9.2</td>
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<tr>
<td>Unmarried parents</td>
<td>71</td>
<td>11</td>
</tr>
<tr>
<td>Inadequate parental care</td>
<td>34</td>
<td>12</td>
</tr>
</tbody>
</table>

* Matched to both parents.
† 1991 data.
‡ No parental care or care initiated after the first trimester of pregnancy.
percent among those born to non-LBW mothers (RR = 1.7, 95 percent CI 1.6–2.0). The racial disparity in LBW rates persisted independently of maternal birth weight: The relative risk of LBW for African Americans (compared with whites) fluctuated around 2.0.

Figure 2 illustrates the association between mean infant birth weight and paternal birth weight. For both races, there was a linear relation above 2,750 g. The racial gap persisted independently of paternal birth weight.

Race-specific LBW rates according to paternal birth weight are presented in table 3. The proportion of LBW infants was lowest among those born to fathers with birth weights above 3,750 g. For African Americans, the LBW rate was 14.3 percent among those born to LBW fathers compared with 11.5 percent among those born to non-LBW fathers (RR = 1.3, 95 percent CI 1.1–1.5). For whites, the LBW rate was 5.7 percent among those born to LBW fathers compared with 5.0 percent among those born to non-LBW fathers (RR = 1.2, 95 percent CI 1.0–1.2). The racial disparity in LBW rates persisted within each paternal birth weight stratum.

The etiologic fraction of maternal LBW was 7.7 percent within the African-American population versus 3.8 percent within the white population. The etiologic fraction of paternal LBW was 2.6 percent among African Americans and 0.8 percent among whites.

Multiple linear regression was performed on infants born to parents who had birth weights above 2,500 g (table 4). Maternal and paternal birth weight exerted independent effects on infant birth weight. Together they accounted for approximately 5 percent and 4 percent of the birth weight variance among African Americans and whites, respectively. A 100-g increase in maternal birth weight predicted a 24- to 27-g increase in infant birth weight. A 100-g increase in paternal birth weight predicted a 9- to 14-g increase in infant birth weight. This trend was consistent for all four race/sex groups.

**DISCUSSION**

To our knowledge, this is the first study that has addressed the relation of both maternal and paternal birth weight to the racial disparity in infant birth weight. We found that as parental birth weights in-

![FIGURE 1. Birth weight (BW) (g) of infants born in Illinois in 1989–1991, by maternal birth weight (g).](image-url)
crease, the proportion of LBW African-American and white infants declines. As expected, maternal birth weight has a greater impact on infant birth weight than does paternal birth weight. The consistency of parent-infant birth weight associations among African Americans and whites supports a causal interpretation. However, since the African-American: white LBW rate ratio still approximates 2 among those born to non-LBW parents, the mechanism underlying the racial disparity in infant birth weight remains an epidemiologic enigma.

In findings consistent with earlier studies (5–10), our data show that white, female LBW infants are more likely than their non-LBW counterparts to grow up and deliver LBW babies. Moreover, we have extended this observation to a large African-American population. Reflecting the greater proportion of African-American infants born to parents who were themselves LBW, the etiologic fraction and consequent public health implications of LBW for African Americans exceeds that of whites. Approximately 8 percent of LBW births among African Americans, compared with 4 percent among whites, would be eliminated by the removal of maternal LBW. Thus, the racial disparity in the prevalence of maternal LBW perpetuates racial differentials in infant LBW rates. Our data were not able to delineate whether the maternal transgenerational birth weight effect is mediated by environmental versus genetic factors. However, it suggests that the ultimate influence of adequate prenatal care, diet, and housing may take more than one generation to fully manifest.

Given the strong association between socioeconomic status and LBW rates, we suspect that maternal birth weight is in large part a proxy for familial wealth. As such, the high LBW rate among African Americans may reflect the detrimental impact of generational poverty on women’s health (17, 18). A plausible biologic mechanism is that formerly LBW women born into impoverished families who subsequently achieve higher socioeconomic status as adults are at increased risk of delivering LBW infants, reflecting an injury to their procreative potential that dates from an inadequate intrauterine environment when they were fetuses (18). This fits with the observation that college-educated African-American women who

<table>
<thead>
<tr>
<th>Paternal birth weight (g)</th>
<th>Low birth weight (&lt;2,500 g) infants</th>
<th>Relative risk*</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>African Americans (n = 15,083)</td>
<td>Whites (n = 111,532)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>&lt;1,251†</td>
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<tr>
<td>1,251–1,500</td>
<td>48</td>
<td>27</td>
<td>8.1</td>
</tr>
<tr>
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<td>13</td>
<td>115</td>
<td>4.1</td>
</tr>
<tr>
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<td>14.9</td>
<td>168</td>
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</tr>
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<td>2,001–2,250</td>
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<td>361</td>
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<td>751</td>
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</tr>
<tr>
<td>2,751–3,000</td>
<td>12.8</td>
<td>2,236</td>
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<td>3,001–3,250</td>
<td>11.9</td>
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</tr>
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<td>3,251–3,500</td>
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<td>10.6</td>
<td>2,214</td>
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<td>3,751–4,000</td>
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<td>4.4</td>
</tr>
<tr>
<td>&gt;4,000</td>
<td>10.9</td>
<td>850</td>
<td>4.1</td>
</tr>
</tbody>
</table>

* African Americans versus whites.
† 500–750 g (n = 22), 750–1,000 g (n = 8), or 1,000–1,250 g (n = 29).
‡ Undefined (<60 infants).
receive adequate prenatal care still have a twofold greater LBW rate than whites (3, 4).

The limited available data suggest that paternal (as compared with maternal) factors play a lesser role in reproductive outcome (11, 12). We previously found that paternal race has no effect on LBW rates when data are controlled for maternal sociodemographic characteristics (19). The present study shows that paternal birth weight is minimally related to infant birth weight among African Americans and whites. This relation may reflect the tendency of high birth weight fathers to end up as tall adults who associate with tall women. More detailed studies are needed to ascertain the extent to which maternal sociodemographic characteristics and adult size explain the association of paternal and infant birth weight.

We were disappointed to learn that the racial disparity in the proportion of LBW births persists among those born to non-LBW parents. An extensive body of literature shows that traditional risk factors—maternal age, education, marital status, substance abuse, and prenatal care usage—do not confound the association between race and birth weight (1-4). We can now add maternal and paternal birth weight to the list. Clearly, unidentified variables are antecedent to these risk factors. A societal mechanism fits with the observation that in the United States, native-born blacks have a greater LBW rate than foreign-born blacks (20-22). Additional transgenerational studies may help disentangle the contribution of environmental and alleged genetic factors to the racial disparity in reproductive outcome and, hopefully, lead to strategies for its elimination.

The present investigation had certain limitations. There was selection bias present in construction of the transgenerational file: Infants of low socioeconomic status were more likely to have an unsuccessful parental match (14). This may be partly related to class differences in the frequency of nontraditional first names and unusual spelling of common names. Thus, the generalizability of this study is restricted to the more advantaged portion of the population. In addition, because of the high mortality rate of very low birth weight (<1,500 g) infants in the parent generation, fewer of these babies would have survived to procreate, thus never appearing in the transgenerational file. This caused the distribution of the parent generation to be attenuated at the lower end. The extent to which very low birth weight rates in the parent generation are associated with birth weight in the infant generation is unclear. Lastly, we were unable to ascertain the impact of economic factors across generations, since the majority of vital records in the parent generation lacked socioeconomic data.

Notwithstanding these limitations, a transgenerational birth file is a potentially rich source of information. The accuracy of birth weights is far superior to that obtained by maternal self-report. The findings are generalizable to a larger portion of the population than those derived from survey data. We have shown that the matching technique of Klebanoff and Yip (5) is applicable to large populations.

In summary, our data suggest that maternal and paternal birth weights are important risk factors that researchers should take into account when examining the relation between race and infant birth weight. Although parental birth weights fail to explain the racial differential in infant birth weight, they contribute to a substantial proportion of LBW births among African Americans.

ACKNOWLEDGMENTS

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REFERENCES