OBSTETRICS

Decreased term and postterm birthweight in the United States: impact of labor induction

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OBJECTIVE: We sought to assess recent trends in falling mean birthweight (BW) and gestational age (GA) among US non-Hispanic white singleton live births ≥37 weeks of gestation and the contribution of increased rates of induction to these trends.

STUDY DESIGN: This was an ecological study based on US vital statistics from 1992 through 2003.

RESULTS: From 1992 through 2003, mean BW fell by 37 g, mean GA by 3 days, and macrosomia rates by 25%. Rates of induction nearly doubled from 14% to 27%. Our ecological state-level analysis showed that the increased rate of induction was significantly associated with reduced mean BW (r = −0.54; 95% confidence interval [CI], −0.71 to −0.29), mean GA (r = −0.44; 95% CI, −0.65 to −0.17), and rate of macrosomia (r = −0.55; 95% CI, −0.74 to −0.32).

CONCLUSION: Increasing use of induction is a likely cause of the observed recent declines in BW and GA. The impact of these trends on infant and long-term health warrants attention and investigation.

Key words: birthweight, cesarean section, ecological analysis, gestational age, labor induction, vital statistics

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Birthweight (BW) and gestational age (GA) are key measures of maternal and infant health both for individuals and populations.[1,2] In industrialized countries, preterm birth (GA <37 completed weeks) is the leading cause of infant mortality, and survivors are at risk for major neurocognitive, pulmonary, and ophthalmologic morbidity.[1,3,4] Even among infants born at term, BW is a major determinant of survival[5,6] and has been associated with common chronic diseases in adulthood.[7]

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★ EDITORS' CHOICE ★

From the early 1970s to the early 1990s, increases in mean BW and rates of macrosomia were observed in several countries, including Canada,[8] the United States,[9] the United Kingdom,[10,11] and Norway,[12] despite a continued rise in preterm birth.[13-15] This trend can be attributed to temporal increases in maternal height, body mass, gestational weight gain, and diabetes; reduced maternal cigarette smoking; and changes in sociodemographic factors.[16,17]

More recently, however, rates of macrosomia have begun to fall in the United States.[18] Moreover, rates of labor induction have doubled since the early 1990s,[19-21] largely due to a rise in elective induction.[19,22-24] In examining recent trends in BW in US vital statistics, we noticed a recent decline and wondered whether the decline was entirely attributable to the well- recognized temporal increase in preterm (<37 weeks) birth, and if not, whether increased rates of induction and cesarean delivery might be contributing to the decline. To explore these hypotheses, we examined temporal trends in BW, GA, labor induction, and cesarean delivery among singleton live births born at term (37-41 weeks) or postterm (≥42 weeks) gestation and the association between the rising rates of labor induction and cesarean delivery and temporal changes in BW and GA. To avoid confounding by the medical indication for labor induction (ie, the pregnancy complications that affect BW and GA independently affect the risk of labor induction), we based our analysis on an ecological (state-level) approach.[25,26]

Materials and Methods

Our study was based on US live birth cohorts for the years from 1992 through 2003. Natality data files, compiled by the National Vital Statistics System of the National Center for Health Statistics, provide demographic and health data for births occurring during the calendar year. The data are based on information abstracted from birth certificates filed in vital statistics offices of each state and the District of Columbia. Demographic data include variables such as date of birth, age and educational attainment of the parents, marital status, live-birth order, race, sex, and geographic area. Health data include items such as BW, gestation, prenatal care, attendant at birth, mode of delivery, and labor management (including induction). For cesarean deliveries, the timing, ie, prelabor (elective) vs after onset of labor, is not recorded.

In the United States, GA is usually calculated from the first day of the mother's last menstrual period (LMP). It has been shown that GA derived from the LMP estimate is prone to error, especially for postterm dates.[27-30] The clinical estimate of gestation is also recorded, although prior to the 2003 revision, no instructions were provided for specifying the basis of the estimate.[27,31] The clinical estimate is based on the managing clinician's best estimate, including menstrual history, physical findings, laboratory values, and (if available) sonography.[27,31] Recent evidence suggests that the clinical estimate provides rates of preterm birth, postterm birth, and GA-specific rates and relative risks of adverse pregnancy outcomes that are more consistent with those reported in other countries.[32] In this study, therefore, our analyses were based on the clinical estimate of GA.

We restricted our principal analysis to singleton non-Hispanic white live births delivered at ≥37 completed weeks of gestation. The restriction by race was intended to control for potential confounding due to differences in induction and cesarean rates by race[19,20] and the changing racial composition over time. To assess the generalizability of our findings, however, we repeated the analysis in non-Hispanic blacks. Restriction to live births avoided the reverse causality inherent in the fact that induction is often used to deliver stillborn fetuses. Restriction to term and postterm singleton births ensured that our findings would not be driven by increases in multiple births and/or indicated preterm deliveries. California was excluded from the analyses because no data were available on clinical estimate of GA.[31]

We first calculated the mean BW from 1972 through 2003 for all white singleton live births delivered at term or postterm gestations based on the LMP estimate. (No data on Hispanic origin or clinical estimate of GA were available in the 1970s and the early 1980s.) The US birth certificate was revised in 1989 to include, among other data items, the clinical estimate of GA and use of induction. A substantial number of states did not report these data items in 1989 through 1991, however. We therefore began with 1992 and examined temporal trends in BW, GA, labor induction, and cesarean delivery for non-Hispanic whites from 1992 through 2003. Mean BW, mean GA, distributions of GA, and rates of macrosomia, labor induction, and cesarean delivery were calculated for each calendar year. Macrosomia was defined as a BW >4500 g.[33,34] Gender-specific mean BW-for-GA z-scores were calculated based on an internal reference, ie, the difference between the observed BW and mean BW divided by SD for each gender at each completed week of gestation; small for GA (SGA) was defined using the customary cutoff as <10th percentile, large for GA (LGA) as >90th percentile, and appropriate size for GA (AGA) as between the 10th and 90th percentiles. Our study sample consisted of 23,549,360 non-Hispanic white live births born at ≥37 weeks of gestation from 1992 through 2003. Missing values for induction and cesarean delivery were negligible (0.84% and 0.88%, respectively) and individuals with missing values were excluded from estimation of nationwide rates for these procedures.

The association between labor induction and BW or GA is likely to be confounded by the medical indication for labor induction. In other words, maternal or fetal conditions or complications leading to induction are likely to be responsible for lower BW or GA independently of the effects of induction. Although some adverse maternal and fetal conditions are reported on the US birth certificate, specific indications for induction are not, and thus cannot be controlled adequately at the individual level. To reduce confounding by medical indication, we therefore designed an ecological analysis.[25,26,35,36] The analysis was based on 48 ecological units: 47 states plus the District of Columbia. As noted earlier, California was excluded because no data are available on the clinical estimate of GA. Previous studies suggest that labor induction rates in Wisconsin and New York were unexpectedly high due to faulty reporting.[19,21,23] These 2 states were therefore also excluded from the analysis. We also conducted a sensitivity analysis with all the states (including California, New York, and Wisconsin), based on the LMP estimate of gestation.

In the ecological analysis, we used data for 1992 (n = 1,881,358) and 2003 (n = 1,739,197). It has been reported that the rate of induction in US vital statistics data is likely to be an overestimate of the true rate.[21] However, differences of induction rates between the 2 time points (1992 and 2003) are less likely to be affected by any systematic underreporting or overreporting within states. We calculated rates of induction and cesarean, mean BW, mean GA, rate of macrosomia, and mean BW-for-GA z-score for each of the 48 ecological units in the years 1992 and 2003, respectively. The z-score was based on an internal standard: all non-Hispanic white singleton live births from 1992 through 2003. We then calculated the changes in these means or rates for each of the 48 ecological units between 1992 and 2003, ie, the differences from the year 2003 vs the year 1992. Using these state-level aggregated data (ie, the differences between the 2 years for the 48 units), we then assessed the association between the change in rates of labor induction and changes in mean BW, mean GA, rates of macrosomia, and mean z-score and rates of SGA, LGA, and AGA between 1992 and 2003. Bivariate correlations between the change in induction and changes in mean BW, mean GA, rates of macrosomia, mean z-score, and SGA, LGA, and AGA rates were calculated, with each state weighted by its total number of births. Ecological multiple linear regression analysis was used to estimate the independent effect of change in labor induction on changes in mean BW, mean GA, rate of macrosomia, and mean z-score after adjustment for changes in parity, maternal age, and maternal education. Although the data file contained a substantial number of missing values for maternal education (4.7%), this state-level variable was calculated based on available data. Finally, we carried out similar analyses to assess the effects of changes in cesarean delivery rates and of changes in a composite of labor induction and/or cesarean delivery. All data