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Birth Weight and Body Composition of Neonates Born to Caucasian Compared with African-American Mothers

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Abstract

OBJECTIVE—To estimate whether neonates of African American women have lower birth weights because of either decreased lean body mass or fat mass.

METHODS—A secondary analysis of a cohort of 104 African American and 274 Caucasian term, singleton, healthy pregnancies were identified. Women with existing gestational or gestional diabetes were excluded. Neonatal body composition was estimated using anthropometric measurements.

RESULTS—There were significant differences in maternal age (29.5 versus 25.8, p <0.001), pre-pregnancy body mass index (26.2 compared with 30.9 kg/m^2, p<0.001), and weight gain during pregnancy (15.2 compared with 13.4 kg, p=0.03) in Caucasian compared with African American women, respectively. After adjusting for these factors, African American women's neonates had significantly lower birthweights (3.20 compared with 3.36 kg, p=.003), less lean body mass (2.80 compared with 2.94 kg, p=0.002), and no difference in fat mass (392 compared with 417g, p=0.071).

CONCLUSION—Decreased birthweight in African American neonates is due to lower lean body mass and not a difference in adiposity.

Keywords

body composition; pregnancy; neonate; race

LEVEL OF EVIDENCE: II

Both inadequate and excessive fetal growth are related to complications at delivery, during the neonatal period, and later in life[1–2]. Therefore, investigation of determinants of birth weight continues to be explored. Studying the composition of birth weight by estimating fat mass and lean body mass provides further information as to potential causes of growth disturbance.[3–5]

Multiple factors play a role in the determination of birth weight and neonatal body composition. Some of these factors are related to the maternal in utero environment, whereas

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others are very likely due to genetic and/or epigenetic contributions or both. Environmental and nutritional status can also affect birth weight. Factors such as high altitude[6], smoke exposure[7], and maternal medical disorders such as hypertension are known to reduce birth weight and alter neonatal body composition. Diabetes in pregnancy and increased pre-pregnancy body max index (BMI) are associated with larger birth weights and increased neonatal fat mass[8–11]. There are also genetic or other constitutional contributions explaining differences in birth weight. Several studies have noted that male neonates weigh more at birth than female neonates because of greater lean body mass[12–14]. Race is another factor that plays a role in the determination of birth weight. Several studies have reported that African American neonates weighed less at birth compared with Caucasian neonates after controlling for gestational age[15–18]..

Hence, the objective of this study was to evaluate the differences in neonatal body composition in African American and Caucasian women. Examining the other factors that contribute to neonatal body composition were secondary objectives. We hypothesized that neonates of African American mothers weigh less at birth than Caucasians neonates because of a combination both decreased lean and fat mass.

Materials and Methods

The study was approved by the Institutional Review Board at MetroHealth Medical Center/ Case Western Reserve University. An approved informed consent was signed by each parturient before enrollment. Women receiving care at MetroHealth Medical Center were recruited. Healthy, singleton, term pregnancies greater than or equal to 37 weeks of gestation or more were included. Only term pregnancies were evaluated in this study to decrease other confounders associated with prematurity such as abruption, infections, or other medical problems that often are associated with pre-term births. Pregnancies complicated by medical complications, such as hypertension, preeclampsia renal disease, multiple gestation, or known feta anomalies, were also excluded. Pregnancies complicated by pre-exiting or gestational diabetes were excluded. Diagnosis of gestational diabetes was made according to the criteria described by Carpenter and Coustan[19]. Women of other racial backgrounds were excluded because our population is limited and would not allow for a meaning full analysis. Data was collected from June 2005 through July 2008. Before delivery, patients were interviewed regarding their previous medical and obstetric histories, and information was confirmed by the electronic medical record.

The primary outcome was neonatal body composition as estimated by anthropometric measurements. Anthropometric measurements were performed within 4 days of birth. Ninety-five percent of neonates were measured in the first 48 hours, 3% were measured on day of life 3, and 2% on day of life 4. Measurements were obtained by trained personnel using Harpenden Calipers (British Indicators, Sussex, UK) for skin fold measurements, a calibrated scale for birth weights, and a measuring board for birth lengths. Several skin fold and body circumference measurements were taken to ensure accurate readings. Unilateral measurements were taken on the left side. Body compaosition was calculated as decribed previously. Skin fold measurements, specifically the flank skin fold, were used in a calculation to determine fat mass. This method has been previously validated by comparison with total body electrical conductivity with a correlation coefficient of 0.84 ($P<.001$). The coefficient of variation of a skin fold measurement is approximately 6% (or 8.4 g in the fat mass calculation) as previously studies.[20]

This study was secondary analysis of data collected for a study examining how different maternal factors affect fetal growth.[11] The objective of the initial study was to compare neonatal body composition of neonates born to obese compared with lean women. The conclusion of this study was the obese women have heavier neonates with increased fat mass as compared with neonates of lean women. The initial study population included 466 women. A total of 378 women remained after using the exclusion criteria outlined above.

Because this was a secondary analysis, a power calculation was not performed before the study. However, based on previous reports, [11,21] a power calculation was performed using a neonatal mean lean body weight of 3000 g with a standard deviation of 400g. A total of 160 women would be needed to detect a 200-g or 7% difference in lean body mass, with an alpha of 0.05 and a power of 80%. The Shapiro-Wilk test and normality curves were used to assess normality. Two-group t tests and the wilcoxon rank sum test used for continuous variables and X^2 was used for categorical variables. Analysis of Covariance was used to estimate differences in fetal body composition when controlling for confounding variables. Forward stepwise linear regression was used to estimate correlations between different factors that effect birth weight and neonatal body composition. Statistical analyses were performed using Statistix s 8.0 for Windows (Analytical Software, Tallahassee, FL). Data were reported as a mean plus or minus the standard reviation. A P value less than .05 was used to determine significance.

Results

A total of 378 women, 104 African American and 274 Caucasian, were included in the analysis. The mean age of the study subjects was 28.5 ± 5.8 years, and the average gestational age at delivery was 39.0 ± 0.9 weeks. The demographic characteristics between African American and Caucasian women are shown in Table 1. There were differences in maternal age, pre-pregnancy BMI, and weight gain during pregnancy in African American compared Caucasian women. The neonatal body composition data are reported in Table 2. There were no significant differences between the groups in percent body fat and fat mass. However, neonates of African American women did have lower birth weights (P=0.003) and lean body mass (P<0.001) compared to Caucasian neonates. We looked at differences between specific anthropometric measurements between the groups, and found that African American neonates had smaller birth lengths (P<0.001) and smaller head circumferences (P=0.002) but no other significant anthropometric differences (Table 4). When we adjusted for the differences in maternal age, pre-pregnancy BMI and weight gain during pregnancy, African Americans neonates persisted in having lower birth weights (P=0.003) and less lean body mass (P=0.002) as shown in Table 2. There was no significant difference in fat mass or percent body fat. We next examined the differences between specific anthropometric measurements of the two groups (Table 3) and found that Africian-American neonates had short birth lengths (P<.001) and smaller head circumferences (P=.002) but no other significant anthropometric differences.

A forward stepwise linear regression was then performed to examine factors that may be related to neonatal body composition in the cohort (Table 4). Gestational age, tobacco use, male sex, race, maternal age, parity, tobacco use, prepregnancy BMI, and weight gain in pregnancy were included in the analysis. In the model, birth weight was correlated with gestational age, tobacco use male sex, race, prepregnancy BMI and weight gain in prepregnancy. Lean body mass was correlated with gestational age, tobacco use, male sex, race weight gain, prepregnancy BMI, and maternal age. Percent body fat was correlated with prepregnancy BMI, weight gain in pregnancy, tobacco use, and gestational age.

DISCUSSION

Our results are consistent with previously reported data given that in our cohort of healthy, term pregnancies, we report that African American neonates have lower birth weights than

Caucasian neonates. Birth weight is likely a summation of multiple processes and the contribution of each of these is still being elucidated. In our study, African American women had higher pre-pregnancy BMIs, hence one would expect them to have larger babies with increased fat mass as compared with Caucasian women. Our findings showed no difference in fat mass, suggesting that other determinants are involved.

Other investigators have examined the reason for racial differences in birth weight. Goedhart et al[22] described birth weight differences in variable ethnic populations living in a similar environment and showed that newborns of African-American descent weighed less than those of other Dutch newborns. Goldenberg et al[23] explored racial differences in birth weight while controlling for socioeconomic differences between the groups and found that neonates of Caucasion women weigh more at birth.

Our study is unique in that it focuses on neonatal body composition. Determining the contribution of lean body mass and fat mass to birth weight can be helpful in investigating the physiology in a variation of birth weight. Fat mass is usually a more sensitive indicator of the maternal in utero environment and of nutritional status, where lean body mass may have a greater genetic infuluence[3,21,24]. Some authors have hypothesized that African American neonates are smaller due to under-nutrition. Cohen et al[25] addressed this concept by evaluating nutrition in relation to ethnic groups and birth outcomes. The investigators found that nutritional status did not alter the birth weight discrepancy between women of different ethnic backgrounds. Our finding that African American neonates have lower lean body mass and no difference in fat mass or percent body fat suggests that under-nutrition is unlikely to be the cause. Instead, this decreased lean body mass points towards a genetic origin. Supporting this hypothesis, Yajnik et al[26] looked at differences in Indian and Caucasian neonates and found that the Indian babies weighed less at birth less with lower lean body mass but preserved fat mass. This population is reported to have increased abdominal fat in their neonates,[27] which may be a risk factor for metabolic disease later in life. Future studies involving differential expression of growth factors among racial groups may be helpful. Differences in placental blood flow and in genotypes between the groups may add further information.

A strength of this study is that the pregnancies were evaluated prospectively. Only healthy, non-diabetic pregnancies were included, limiting the effect of diabetes or medical problems as potential confounders. Multiple measurements of neonatal body composition were taken in a standardized manner. The measurements provided additional support to the conclusions. There were differences in body length and head circumference, both involved in the composition lean body mass.

A limitation of this study is that it is a secondary analysis. Another limitation is that only African-American and Caucasian women were analyzed. In the future, it would be interesting to study other racial groups as well. Anthropometric measurements were used for body composition without the ability of confirming the results with mechanical methods, such as total body electrical conductivity or air displacement plethysmography. Another limitation is that we evaluated only subcutaneous fat mass, leaving out information with regards to the amount of visceral fat, a known variant among persons of different racial backgrounds. Information regarding visceral fat may provide additional information related to risks of metabolic disease later in life.

Body composition and its contributors have been a long-term focus of interest in our group. Although a 140-g difference in lean body mass may not make a difference in the clinical outcome of one patient, it is important to look at trends over large numbers of patients. This may help us to elucidate potential long-term effects. With increasing maternal obesity, increasing neonatal birth weight, increasing cesarean delivery rates, and the association of neonatal adiposity with metabolic disease later in life, body composition is important to study.

In summary, our study supports previous data that African American neonates weigh less at birth compared to Caucasians neonates. We were able to examine anthropometric measurements to determine that lean body mass explains the majority of the difference between birth weights. African American newborns had smaller birth lengths and head circumferences, which both are components of lean body mass. There was no difference in skin fold measurements, supporting no significant diffeence in fat mass. The results of this study led us to conclude that fat mass at birth, although important, is not the only potential risk factor for the long term risk of obesity and related problems. Future studies are needed to further explore factors in the in utero environment such as genetic and epigenetic contributions that may have long term metabolic implications for the offspring.

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Table 1

Maternal and Neonatal Demographic Information

	African American (n=104)	Caucasian (n+274)	P
Age (years)	28.5 (5.3)	29.5 (5.6)	**<.001**
Parity (%>1)	52.9	45.8	0.22
Smoking (%)	16.3	20.4	0.37
Pre-pregnancy BMI (kg/m2)	30.9 (8.0)	26.2 (7.5)	**<.001**
Weight gain (kg)	13.4 (6.5)	15.2 (8)	**0.03**
Family History Diabetes (%)	44.7	48.1	0.55
Paternal BMI (kg/m2)	27.3 (5.0)	27.0 (5.3)	0.67
Gestational age (weeks)	39.0 (0.89)	39.0 (1.0)	0.64
Neonatal sex (% male)	55.8	52.2	0.53
Cesarean Section Rate (%)	32.6	27.9	0.77
1-h Glucose Screen (mg/dL)	106 (23.2)	111 (27.5)	0.16

BMI, body mass index. Data are mean (standard deviation) unless otherwise indicated

Table 2

Neonatal Body Composition

	African American	Caucasian	Difference Between Groups	Unadjusted *P*	*P* *
Birth Weight (kg)	3.20 (0.5)	3.36 (0.5)	**166**	**0.003**	**0.003**
Lean Mass (kg)	2.80 (0.3)	2.94 (0.3)	**139**	**<0.0001**	**0.002**
Fat Mass (g)	392 (0.2)	417 (0.2)	25	0.178	0.071
Percent Body Fat	11.8 (3.5)	12.0 (3.4)	0.2	0.507	0.750

Data are mean (standard deviation).

* Adjusted for maternal age, pre-pregnancy BMI, weight gain in pregnancy.

Table 3

Anthropometric measurements in African American compared Caucasian women

	African American	Caucasian	P
Birth Length (cm)	48.6 (2.2)	50.0 (2.0)	**<0.001**
Head Circumference (cm)	34.2 (1.4)	34.7 (1.4)	**0.002**
Chest Circumference (cm)	32.2 (2.0)	32.5 (2.0)	0.13
Abdominal Circumference/Liver (cm)	32.4 (1.9)	32.9 (2.0)	0.20
Thigh Circumference (cm)	15.3 (1.4)	15.0 (1.5)	0.23
Tricep Skin fold (mm)	3.9 (0.8)	4.2 (1.0)	0.12
Subscapular Skin fold (mm)	4.3 (1.0)	4.6 (1.2)	0.17
Flank Skin fold (mm)	3.7 (0.88)	3.88 (1.0)	0.21
Thigh Skin fold (mm)	5.1 (1.4)	5.5 (1.5)	0.15
Abdominal Skin fold (mm)	3.0 (1.0)	3.0 (0.8)	0.88

Data are mean (standard deviation)

Table 4

Multiple Stepwise Regression of Factors that Influence Neonatal Body Composition for Both African-American and Caucasian Neonates

	Cumulative R^{2*}	Coefficient*	Standard Error
Birth weight			
Gestational Age	0.098	0.142	0.023
Tobacco use	0.141	−0.284	0.056
Infant Sex (Male)	0.175	0.164	0.044
Race (Caucasian)	0.201	0.215	0.051
Pre-Pregnancy BMI	0.232	0.013	0.003
Weight Gain	0.262	0.012	0.003
Lean Body Mass			
Gestational Age	0.132	0.114	0.016
Tobacco use	0.185	−0.195	0.038
Infant Sex (Male)	0.231	0.138	0.029
Race (Caucasian)	0.270	0.147	0.035
Weight Gain	0.288	0.008	0.002
Pre-Pregnancy BMI	0.310	0.007	0.002
Maternal Age	0.316	0.004	0.003
Percent Body Fat			
Pre-Pregnancy BMI	0.056	0.138	0.022
Weight Gain	0.093	0.092	0.025
Tobacco use	0.106	−0.910	0.433
Gestational Age	0.117	0.381	0.182

R2 coefficient of determination; BMI, body mass index.

*P <.05