

The Hispanic Paradox in Twin Pregnancies

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The objective of this study was to compare length of gestation, fetal growth, and birthweight by race/ethnicity and pregravid weight groups in twin pregnancies. Three thousand and thirty-six twin pregnancies of 28 weeks or more gestation were divided by race/ethnicity (White, Black and Hispanic), and pregravid body mass index (BMI) groups (less than 25.0 vs. 25.0 or more). Outcomes were modeled using multiple regression, controlling for confounders, with White non-Hispanic women as the reference group. Hispanic women had the highest average birthweight and the longest gestation, as well as the lowest proportions of low birthweight, very low birthweight, preterm and early preterm births of the 3 race/ethnicity groups. In the multivariate analyses, Hispanic women had significantly longer gestations (by 7.8 days) and faster rates of fetal growth midgestation (20 to 28 weeks, by 17.4 g/week) and late gestation (after 28 weeks, by 5.3 g/week), whereas Black women had significantly slower rates of fetal growth (by 5.7 g/week and by 4.5 g/week, respectively). These findings in twins reflect the racial and ethnic disparities previously shown in singletons, including the Hispanic paradox of longer gestations and higher rates of fetal growth.

In 2003, the poverty rate among Hispanics and Blacks in the United States of America (US) was comparable (22.5% and 24.4%, respectively), and nearly threefold higher than the rate among non-Hispanic Whites (8.2%; DeNavas-Walt et al., 2004). Despite this socioeconomic disadvantage, Hispanics as a group generally have health status and health outcomes equal to or surprisingly better than non-Hispanics, a phenomenon known as the Hispanic Paradox (Abraído-Lanza et al., 1999; Franzini et al., 2001; Hunt et al., 2003; Hunt et al., 2002; Palloni & Morenoff, 2001; Patel et al., 2004; Sorlie et al.,

1993). As the fastest growing minority in the US, individuals of Hispanic origin currently represent about 13% of the total population, but account for nearly 22% of all births (Martin et al., 2003). In 2002 more than 75% of women of Hispanic origin received prenatal care in the first trimester, a proportion which was higher than non-Hispanic Black and American Indian mothers, but lower than non-Hispanic White and Asian or Pacific Islander mothers (Martin et al., 2003). The low birthweight and preterm birth rates for Hispanic women are slightly higher than for non-Hispanic White mothers, but are substantially lower than the rates for non-Hispanic Black mothers (Martin et al., 2003). The goal of this analysis is to evaluate differences in perinatal outcomes in twin pregnancies by maternal race/ethnicity, and to test if the Hispanic Paradox, which has been demonstrated in singletons, also occurs in twins.

Materials and Methods

Study Population

The study population included twin pregnancies delivered between 1990 and 2002 from: (1) Johns Hopkins University, Baltimore, Maryland; (2) University of Michigan, Ann Arbor, Michigan; (3) University of Miami, Florida; (4) Medical University of South Carolina, Charleston, South Carolina; (5) University of Texas Medical Branch at Galveston, Columbia University, New York; (6) University of Pennsylvania, Philadelphia, Pennsylvania; and (7) University of Kansas, Wichita, Kansas. The study

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population was limited to pregnancies that met the following inclusion criteria: (1) both twins born alive; (2) 28 weeks or more gestation by the last menstrual period, first trimester ultrasound scan, or best obstetric estimate (a combination of clinical and ultrasonographic estimates); (3) nonpregestational or nongestational diabetic mother; (4) documented screening glucose concentration between 24 and 28 weeks gestation; (5) prenatal weights at each visit, including the last within one week of delivery; (6) documented genders and birthweights of both infants in the twin pair; and (7) absence of major congenital anomalies as documented by normal findings in the newborn medical record. A total of 141 pregnancies were excluded, including 110 pregnancies with gestational diabetes. Excluded pregnancies were significantly more likely to have Medicaid insurance, lower average birthweight, to be younger mothers, and to require cerclage or be complicated by preterm premature rupture of membranes (PPROM), preterm labor (PTL), or preeclampsia. All data were abstracted from hospital charts. This study was approved by the institutional review boards at the respective institutions.

Study Variables

The abstracted data included maternal age, race/ethnicity (Black non-Hispanic, White non-Hispanic and Hispanic), smoking during pregnancy, parity (primiparous vs. multiparous), infertility treatment, chorionicity, number of males per twin pair, maternal size variables (height, pregravid weight, maternal weights at all prenatal visits), all fetal weights estimated by ultrasonography, birthweights, and infant genders. Complications included PPROM, pregnancy-induced hypertension (PIH), PTL, and oligo- or polyhydramnios.

Maternal pregravid body mass index (BMI) was calculated as $[\text{weight}/(\text{height})^2]$ and categorized as underweight (less than 18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²) and obese (30.0 kg/m² or more) according to national standards (National Institutes of Health, 1998). For comparison, the study population was divided into women with prepregnancy BMIs of less than 25.0 kg/m² (underweight and normal weight) to women with BMIs 25.0 kg/m² or more (overweight and obese). The rates of maternal weight gain were estimated from regression curves fit to measured prenatal weights minus pregravid weight over time. From the regression equations, the rate of maternal weight gain to 20 weeks gestation, between 20 and 28 weeks gestation, and between 28 weeks gestation and birth was predicted. These gestational periods have been shown in prior studies on weight gain in twin pregnancies to be more important for fetal growth, rather than traditional trimesters (Luke et al., 1997; Luke et al., 1998). Fetal growth was characterized as the rate of growth (grams per week) in each gestational interval (0 to 20 weeks, 20 to 28 weeks, and 28 weeks to birth). These rates were estimated from regression

models of weight by gestational age for each twin, similar to the above-described models of maternal weight gain. Linear regression including quadratic terms with no intercept was found to fit the data well. In addition, the proportional upward bias in ultrasonographic estimated fetal weights near birth was corrected for, forcing the regression curve through the actual birthweight (Luke et al., 1998). Rates of fetal growth were calculated as the predicted gain in each gestational interval, with birthweight used as the last measurement. Length of gestation was based on the last menstrual period if it was within 10 days of the earliest ultrasonographic estimate; if not, the latter was used to calculate length of gestation.

Statistical Analyses

The study population was first compared by univariate analysis across the three race/ethnicity groups using analysis of variance for continuous variables and chi-square for categorical variables. The outcomes of length of gestation, average twin pair birthweight, and average fetal growth rate between 20 and 28 weeks and after 28 weeks were modeled using general linear regression, controlling for confounding factors. Outcomes of Black non-Hispanic women and Hispanic women were compared to outcomes of White non-Hispanic women as the reference group, overall and by the two BMI groups.

Results

The study population included 3036 twin pregnancies. The distribution by study site and by race/ethnicity within study sites is given in Table 1. A description of the characteristics of the study population by race/ethnicity group is given in Table 2. Women in the three race/ethnicity groups differed significantly by every factor. Black non-Hispanic women were significantly younger, of higher parity, heavier pregravid weight, and had the highest rate of chronic hypertension. White non-Hispanic women were significantly older, of lower parity, were more likely to be smokers, to have had infertility treatments, fetal reduction, and cerclage. Hispanic women were significantly more likely to have Medicaid insurance, and to be of shorter height and overweight before pregnancy. Perinatal outcomes by maternal race and ethnicity are given in Table 3. Hispanic women had the highest proportion of monochorionic placentation, highest rate of preeclampsia, and the lowest rate of preterm labor. They also had the lowest proportions of slowed fetal growth during midgestation (20 to 28 weeks) and late gestation (after 28 weeks), the highest average birthweight and the longest length of gestation, as well as the lowest proportions of low birthweight, very low birthweight, preterm and early preterm births of the three race/ethnicity groups.

The results of the multivariate analyses are given in Table 4. Multiple regression models were adjusted for maternal age, parity, height, insurance status, infertility

Table 1

Distribution of the Study Population by Study Site

(N)	Percentage distribution by study site (3036)		Percentage distribution within study site		
			White Non-Hispanic (1227)	Black Non-Hispanic (1215)	Hispanic (594)
Study sites	N	%			
Johns Hopkins University	565	18.4%	41.9%	57.2%	0.9%
University of Miami	1169	38.3%	10.1%	47.3%	42.6%
University of Michigan	666	21.5%	90.0%	9.4%	0.6%
Medical University of South Carolina	438	14.3%	42.6%	55.8%	1.6%
University of Texas Medical Branch	69	2.3%	24.6%	21.7%	53.6%
Columbia University	92	2.9%	38.6%	11.4%	50.0%
University of Kansas	38	1.3%	94.7%	2.6%	2.6%
University of Pennsylvania	33	1.1%	51.5%	48.5%	0.0%

Table 2

Characteristics of the Study Population

(N)	All (3036)	White non-Hispanic (1227)	Black non-Hispanic (1215)	Hispanic (594)	Significance
Maternal age (years)	27.5 (6.4)	29.8 (5.8)	25.2 (6.1)	27.5 (6.3)	< .0001
> 35 years (%)	14.0%	20.9%	7.6%	15.3%	< .0001
Parity (mean)	1.2 (1.4)	0.8 (1.0)	1.5 (1.6)	1.1 (1.3)	< .0001
Nulliparas (%)	41%	52.3%	30.4%	38.0%	< .0001
Medicaid Insurance (%)	16.0%	10.1%	18.1%	22.0%	< .0001
Smoking (%)	10.8%	13.0%	11.1%	5.7%	< .0001
Chronic hypertension (%)	2.5%	1.5%	3.5%	2.7%	.011
Height (inches)	64.5 (2.8)	64.8 (2.8)	64.7 (2.8)	63.3 (2.5)	< .0001
< 62 inches (%)	13.1%	9.9%	11.7%	21.7%	< .0001
Pregravid weight (pounds)	150.8 (39.5)	145.6 (34.3)	160.1 (45.4)	142.5 (32.2)	< .0001
Body Mass Index (wt/ht ²)	25.4 (6.3)	24.2 (5.4)	26.8 (7.2)	25.0 (5.5)	< .0001
Underweight (%)	4.8%	5.2%	4.4%	4.7%]]]
Normal weight (%)	56.0%	65.2%	46.3%	56.1%	
Overweight (%)	20.9%]	16.4%]	22.9%]	26.5%]	
Obese (%)	18.3%] 39.2%	13.2%] 29.6%	26.4%] 49.3%	12.7%] 39.2%]]] < .0001
Infertility Treatment (%)	16.7%	35.3%	2.9%	5.7%	< .0001
Fetal reduction (%)	2.8%	5.8%	0.4%	1.0%	< .0001
Cerclage (%)	3.1%	4.2%	2.7%	1.9%	.017

Note: Values are presented as percentages or means with standard deviations in parentheses.

treatments, fetal reduction, chronic hypertension, smoking status, placental chorionicity, cerclage, preeclampsia, males per twin pair, gestational weight gain, and screening glucose in the highest quartile. The models compared length of gestation and birthweight outcomes in White non-Hispanic women (the reference group) to Black non-Hispanic women and Hispanic women overall and within each of the two

BMI groups. Black non-Hispanic women, overall and among those with BMIs less than 25.0 kg/m², had significantly longer length of gestation, but lower average birthweight, and slower rates of fetal growth during midgestation and late gestation. Hispanic women, overall and for both BMI groups, had significantly longer gestations averaging more than 7 days, or twice the effect for Black non-Hispanic women, and faster

Table 3
Perinatal Outcomes by Maternal Race and Ethnicity

	All	White non-Hispanic	Black non-Hispanic	Hispanic	Significance
(N)	(3036)	(1227)	(1215)	(594)	
Prenatal Care					
Week of first visit	17.2 (9.2)	14.7 (8.3)	18.9 (9.2)	18.8 (9.5)	< .0001
Total visits	7.9 (5.4)	8.8 (4.8)	7.2 (4.4)	7.2 (7.5)	< .0001
Total ultrasound exams	2.4 (1.9)	2.8 (2.0)	2.2 (1.8)	2.3 (1.8)	< .0001
Males per pair					
None (%)	32.2%	29.3%	31.7%	38.3]] < .0001
One (%)	33.3%	35.0%	36.2%	24.7%	
Two (%)	34.5%	35.7%	32.1%	37.0%	
Monochorionic (%)	17.0%	17.8%	14.2%	20.6%	.002
Cesarean birth (%)	56.1%	58.9%	53.2%	56.5%	.024
Oligo- or Polyhydramnios (%)	4.2%	4.8%	4.2%	2.7%	.105
Preterm PROM* (%)	19.4%	20.0%	20.7%	15.8%	.038
Preeclampsia (%)	15.5%	13.9%	15.6%	19.2%	.013
Preterm labor (%)	33.1%	34.2%	34.0%	29.0%	.056
Screening glucose (mg/dL)					
Lowest quartile (%)	113 (24)	117 (25)	109 (22)	110 (22)	< .0001
Middle quartiles (%)	25.3%	21.4%	30.0%	29.6%]] < .0001
Highest quartile (%)	48.8%	47.0%	50.6%	50.4%	
	25.9%	31.6%	19.4%	20.0%	
Average rate of fetal growth (g/week)					
0–20 weeks	16.0 (5.2)	16.3 (4.8)	15.6 (5.4)	16.1 (5.8)	.068
20–28 weeks	90.8 (35.5)	92.7 (35.5)	82.7 (39.7)	103.5 (17.2)	< .0001
28 weeks–birth	151.9 (25.6)	153.6 (25.7)	148.6 (24.6)	155.1 (26.4)	.001
Slowed rates of fetal growth (%)					
< 14 g/week, 0–20 weeks (%)	26.6%	22.7%	30.5%	28.9%	.007
< 90 g/week, 20–28 weeks (%)	28.3%	25.7%	36.8%	15.9%	< .0001
< 168 g/week, after 28 weeks (%)	72.1%	69.3%	78.9%	65.9%	< .0001
Average Twin Pair Birthweight (g)	2282 (624)	2265 (631)	2233 (607)	2424 (624)	< .0001
Low birthweight (< 2500 g) (%)	58.8%	58.8%	63.3%	48.8%	< .0001
Very low birthweight (< 1500 g) (%)	12.5%	13.9%	13.0%	8.2%	.002
Length of gestation (weeks)					
< 36 weeks (%)	35.4 (3.4)	35.1 (3.2)	35.5 (3.5)	36.0 (3.5)	< .0001
< 32 weeks (%)	41.5%	46.2%	40.7%	34.1%	< .0001
	14.6%	16.4%	14.2%	11.3%	.013

Note: Values are presented as percentages or means with standard deviations in parentheses.

*PROM = premature rupture of membranes.

rates of fetal growth during midgestation; overall, they also had significantly faster rates of fetal growth during late gestation.

Discussion

The findings of this study confirm that the Hispanic paradox also occurs in twin pregnancies. Despite higher levels of poverty than the other race/ethnicity groups (22% Medicaid insurance vs. 10% for non-Hispanic Whites and 18% for non-Hispanic Blacks), Hispanic mothers had significantly longer gestations and better rates of fetal growth. Other researchers

have also reported better outcomes in Hispanic mothers compared to non-Hispanic Black mothers, but worse outcomes compared to their non-Hispanic White counterparts (Buekens et al., 2000; Chung et al., 2003; Hessol & Fuentes-Affleck, 2000; Hopkins et al., 1999; Kieffer et al., 1999; Leslie et al., 2003; Scholl et al., 2002). In our study, Hispanic mothers had the highest average birthweight and the longest length of gestation, as well as the lowest proportions of low birthweight, very low birthweight, preterm and early preterm births of the three race/ethnicity groups. While Hispanic neonates born at term are not necessarily

Table 4

Comparison of Perinatal Outcomes by Pregravid BMI Groups and Race and Ethnicity Versus White Non-Hispanic Women

Perinatal outcomes and race and ethnic groups	All BMIs			Pregravid BMI < 25.0			Pregravid BMI ≥ 25.0		
	Regression coefficient	SE	Significance	Regression coefficient	SE	Significance	Regression coefficient	SE	Significance
Length of gestation (days)*									
Black non-Hispanic	+ 3.31	1.19	.005	+ 4.44	1.55	.004	+ 1.94	1.91	.311
Hispanic	+ 7.84	1.38	<.0001	+ 7.86	1.71	<.0001	+ 7.80	2.41	.001
Average twin birthweight (g)**									
Black non-Hispanic	-81.00	17.80	<.0001	-90.83	22.66	<.0001	-73.07	29.40	.013
Hispanic	+ 27.87	20.64	.177	+ 29.74	24.54	.226	+ 19.76	38.54	.608
Average rate of fetal growth (g/week)*									
20–28 weeks gestation									
Black non-Hispanic	-5.72	2.48	.021	-9.41	3.42	.006	+ 0.16	3.58	.964
Hispanic	+ 17.35	2.58	<.0001	+ 18.08	3.21	<.0001	+ 14.38	4.49	.002
Average rate of fetal growth (g/week)*									
After 28 weeks gestation									
Black non-Hispanic	-4.50	1.81	.013	-5.07	2.38	.034	-4.36	2.86	.128
Hispanic	+ 5.34	2.13	.012	+ 4.56	2.55	.075	+ 5.68	4.02	.159

Note: *models adjusted for maternal age, parity, height, insurance status, infertility treatments, fetal reduction, chronic hypertension, smoking status, placental chorionicity, cerclage, preeclampsia, males per twin pair, rates of maternal weight gain, and screening glucose in the highest quartile (> 128 mg/dl).

**models adjusted for all of the above factors, plus length of gestation.

larger, the several birthweight-for-gestational-age distributions that have been derived from vital statistics data for Hispanic singletons have shown that Hispanic fetuses born between 30 and 37 weeks gestation tend to be larger (Alexander et al., 1999; Overpeck et al., 1999). This is consistent with the findings in our study of faster rates of fetal growth for Hispanic twins from 20 weeks gestation onwards, and may contribute to the better outcomes among Hispanics, regardless of plurality.

Physiologic differences in glucose metabolism and/or body build, such as body fat distribution or waist-to-hip ratio may underlie this relationship, as suggested by Kieffer et al. (1999) and Scholl et al. (2002). There may also be an intergenerational effect, which was not assessed in the current study (Collins et al., 2002; Lawlor et al., 2003; Veena et al., 2004). Hispanic mothers are also not a homogeneous group — a wide range of outcomes have been reported within various Hispanic subgroups (Martin et al., 2003). For example, the rate of preterm births in the US in 2002 was 11.6% for all Hispanic births, ranging from 10.5% for Cubans, 11.2% for Central and South Americans, 11.4% for Mexican Americans, to 14.0% for Puerto Ricans (Martin et al., 2003). These rates are generally higher for mothers who were US-born versus foreign-born, within each Hispanic subgroup. The rankings are similar for the rates of low birthweight and very low birthweight as well. Other researchers have suggested that it is the combination of favorable factors — higher education, lower history of preterm delivery and tobacco use, earlier

prenatal care — that is responsible for the perinatal advantage of Hispanic women.

Our final study sample was 40.4% White non-Hispanic, 40% Black non-Hispanic, and 19.6% Hispanic, compared to US figures of 65%, 17%, and 13%, respectively, plus 5% other races and ethnicities. Perhaps because of our exclusion criteria and limiting our study sample to births of 28 weeks gestation or more, the mean birthweights and gestations compared to national estimates differ slightly. Within each race and ethnicity group, the mean birthweight and gestation in our study versus US estimates were: White non-Hispanic: 2265 g at 35.1 weeks versus 2407 g at 35.6; Black non-Hispanic: 2233 g at 35.5 weeks versus 2188 g at 34.9 weeks; and Hispanic: 2424 g at 36.0 weeks versus 2377 g at 35.7 weeks.

Limitations of the current study include incomplete data regarding country of origin and factors associated with acculturation, as well as more specific anthropometric (waist-to-hip ratio, skinfold thickness) and social (education and marital status) data. Despite these limitations, this study adds to the growing literature regarding racial and ethnic health disparities in the United States, and provides additional evidence supporting the Hispanic paradox. There is a need for further research to clarify the possible biological mechanisms underlying this phenomenon.

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