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Racial/Ethnic and Nativity Differences in Birth Outcomes Among Mothers in New York City: The Role of Social Ties and Social Support

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Abstract Immigrants have lower rates of low birth weight (LBW) and to some extent preterm birth (PTB), than their US-born counterparts. This pattern has been termed the 'immigrant health paradox'. Social ties and support are one proposed explanation for this phenomenon. We examined the contribution of social ties and social support to LBW and PTB by race/ethnicity and nativity among women in New York City (NYC). The NYC Pregnancy Risk Assessment Monitoring System survey (2004–2007) data, linked with the selected items from birth certificates, were used to examine LBW and PTB by race/ethnicity and nativity status and the role of social ties and social support to adverse birth outcomes using bivariate and multivariable analyses. SUDAAN software was used to adjust for complex survey design and sampling weights. US- and foreign-born Blacks had significantly increased odds of PTB [adjusted odds ratio (AOR) = 2.43, 95 % CI 1.56, 3.77 and AOR = 2.6, 95 % CI 1.66, 4.24, respectively] compared to US-born Whites. Odds of PTB among foreign-born Other Latinas, Island-born Puerto Ricans' and foreign-born Asians' were not significantly different from US-born Whites, while odds of PTB for foreign-born Whites were significantly lower (AOR = 0.47, 95 % CI 0.26, 0.84). US and foreign-born Blacks' odds of LBW were 2.5 fold that of US-born Whites. Fewer social ties were associated with 32–39 % lower odds of PTB. Lower social support was associated with decreased odds of LBW (AOR 0.69, 95 % CI 0.50, 0.96). We found stronger evidence of the immigrant health paradox across racial/ethnic groups for PTB than for LBW. Results also point to the importance of accurately assessing social ties and social support during pregnancy and to considering the potential downside of social ties.

Keywords Low birth weight · Preterm birth · Race/ethnicity · Immigrants · Social ties · Social support

Disclaimer: The findings and conclusions of this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Introduction

Low birth weight (LBW) and preterm birth (PTB) are associated with increased risk of developmental delays and higher rates of morbidity and mortality [1–4]. While many factors contribute to LBW and PTB, sociodemographic and economic factors, such as minority race/ethnicity and low socioeconomic status (SES), have been identified as risk factors [5–8]. Although immigrants are a heterogeneous group, they are generally quite socioeconomically disadvantaged relative to persons who are native US-born [9]. This difference is especially true of racial/ethnic minority immigrants such as Latinos [10, 11]. Despite their socioeconomic disadvantage, however, foreign-born women tend to have

lower rates of LBW and PTB than their US-born counterparts [1, 12–16]. This health pattern is notable because it contradicts the well-documented socioeconomic gradient in health, whereby individuals of higher SES have better health than those of lower SES [13, 17–19]. The phenomenon has been termed the immigrant health paradox, and has been observed for LBW and to some extent for PTB, most notably among Latino immigrants from Mexico [1–3, 15–17, 20–26].

A commonly proposed explanation for the immigrant health paradox, particularly among Latinos are social ties and social support [16, 27, 28]. Social ties and social support are thought to buffer the adverse effects of low SES to protect health. Despite the frequency with which it has been proposed as an explanation and repeated calls for investigation, the roles of social ties and social support in explaining immigrants', especially Latinas' and most notably Mexican immigrants' good birth outcomes, has received little attention [2, 7, 17, 29–32]. Because some evidence has shown that social ties and social support during pregnancy are associated with positive birth outcomes, including those related to birth weight, it is important to examine this hypothesis [2, 3, 7, 12, 21, 22, 28, 31, 33–35]. In addition, previous research found differences in social support by race/ethnicity and nativity status [36]. These findings point to the possibility that high social support among certain groups such as Latinas may be associated with their relatively good birth outcomes.

The goal of this study was to examine the relative contributions of social ties and social support to rates of LBW and PTB across women defined by race/ethnicity and nativity status among mothers who participated in the New York City (NYC) Pregnancy Risk Assessment Monitoring System (PRAMS) survey for the years 2004–2007. The specific aims were: (1) to examine risk of LBW and PTB by race/ethnicity and nativity status; (2) to examine the bivariate relationships between social ties and LBW and PTB, and between social support and LBW and PTB; and (3) to examine the extent to which observed differences in LBW and PTB among groups defined by race/ethnicity and nativity status can be explained by social ties and social support. Based on previous literature, we hypothesized that social tie and social support would be positively associated with both LBW and PTB [30, 35, 37, 38]. Additionally, we hypothesized that social ties and support would account for some of the differences in LBW and PTB between racial/ethnic and nativity status groups, particularly between foreign-born Latinas and Whites [36].

Materials and Methods

The NYC PRAMS survey data, linked with the selected items from the birth certificate, were used for this analysis. PRAMS is an ongoing surveillance system designed to monitor maternal experiences and behaviors before, during, and shortly after pregnancy. The NYC PRAMS sample is selected by stratified random sampling without replacement. Each month in NYC, approximately 180 women who delivered a live infant in the previous 2–4 months are randomly selected using birth certificate records. Women who delivered a LBW infant (<2,500 g) were oversampled such that 30 % of the PRAMS sample is LBW compared with 8.6 % in the 2007 NYC birth cohort (https://a816-healthpsi.nyc.gov/epiquery/Birth/index.html). The final PRAMS dataset is weighted for sample design, non-response, and non-coverage. More information about PRAMS methods can be found at http://www.cdc.gov/prams/methodology.htm. This analysis is based on partial year datasets for 2004 (July–December) and 2005 (May–December) births, and the full year for 2006–2007 births in NYC [39]. The response rate was 70 % for 2004–2006 and 65 % for 2007. A total of 4,813 women completed the survey. The datasets for 2004–2005 are limited to the months in which a 70 % response rate was achieved. Women who gave birth to multiples of ≥4 infants, surrogate and adoptive mothers, and resident women who give birth outside of NYC, as well as non-resident women who give birth within NYC are excluded from this analysis. Three-hundred seventy responses were deleted because the respondents had plural births or were missing race/ethnicity or nativity status, which resulted in a final analytic sample of 4,443 mothers with singleton births who reported their race/ethnicity as non-Hispanic White, non-Hispanic Black, Asian/Pacific Islander, Puerto Rican or Other Hispanic. The term "Hispanic" was used on the birth certificate, however, we use the term "Latina" in the remainder of the paper. After weighting, the 4,443 responses represent the experiences of 369,825 NYC resident women who gave birth during 2004–2007. This study was approved by the NYC Department of Health and Mental Hygiene Institutional Review Board (IRB), and all procedures followed were in accord with the ethical standards set forth by the IRB.

Birth Outcome Measure

The two birth outcomes examined were LBW and PTB. LBW was categorized as a birth weight <2,500 or ≥2,500 g [39]. We examined PTB dichotomously as any birth occurring prior to 37 completed weeks of gestation. We measured gestational age as the interval between the first day of the mother's most recent menstrual period and the date of birth, except when gestational age was inconsistent with birth weight and plurality, in which case the clinical estimate was used. These methods have been described in detail elsewhere [39].

Independent Variable

Maternal race/ethnicity and nativity status were ascertained from birth records of the infant. Since 56 % of the NYC sample was foreign-born, we were able to distinguish the nativity status of women in each race/ethnicity. The resulting predictor variable combined race/ethnicity and nativity status into the following ten categories: US-born White; foreign-born White; US-born Black; foreign-born Black; US-born Asian/Pacific Islander; foreign-born Asian/Pacific Islander; US-born Puerto Rican (mainland born); Island-born Puerto Rican; US-born Other Latina (all non-Puerto Ricans) and foreign-born Other Latina. The decision to distinguish between Puerto Rican and other Latinas was based on the fact that relative to Other Latinas, Puerto Ricans have higher rates of LBW [3, 4, 17] and PTB [40].

Social Ties and Social Support

Social ties were measured using a question from the PRAMS survey that asked "During your most recent pregnancy, who would have helped you if a problem had come up?" Response options included: husband or partner; mother, father or in-laws; other family member or relative; a friend; someone else; and no one. Women were able to check multiple options. Because several of the options listed more than one person we refer to our measure as 'number of social ties'. We operationalized 'number of social ties' by summing the total number of options checked and then generating an ordinal variable with the categories of 0–1, 2–3, and 4+ social ties. Perceived social support was assessed with a question from the PRAMS survey that asked about availability of different kinds of support during the most recent pregnancy. Response options to each item were given as yes/no, and kinds of support assessed included: someone to loan $50; someone to help if I were sick in bed; someone to take me to the clinic/doctor's office, and someone to talk to about my problems. We conducted factor analysis to confirm that all four items loaded highly on one factor. Our test of internal consistency reliability yielded a Cronbach's alpha of 0.77. For the analysis, mothers were categorized as having high, medium, or low perceived social support based on responses to the items. High social support indicated 'yes' responses to 4 types of support; medium refers to 'yes' responses to 2–3 types of support, and mothers who reported 'yes' to 0–1 types of support were categorized as having low social support. This method has been used in a previous study [38].

Covariates

We accounted for sociodemographic covariates including maternal age (<35 vs. ≥35 years at time of birth), marital status at time of birth (married/partnered vs. single/divorced/widowed), education level (≤high school vs. >high school) and insurance coverage before pregnancy (Medicaid vs. other third party insurance vs. no insurance). We accounted for medical risks including hypertension during pregnancy (Y/N); chronic or gestational diabetes (Y/N); weight gain during pregnancy (too little; adequate; too much based on pre-pregnancy BMI); first birth (Y/N); and previous PTB (Y/N). Weight gain based on pre-pregnancy BMI was based on the 1990 Institute of Medicine Guidelines [40], which were in place during the study period. Women who gained less than the recommended amount of weight for their BMI category were categorized as gaining too little weight and those who gained more than the recommended amount for their BMI category were categorized as gaining too much. Women who gained within the recommended amount were categorized as having adequate weight gain. Behavioral variables we included were any alcohol use during last 3 months of pregnancy (Y/N); any tobacco use during last 3 months of pregnancy (Y/N); experience of intimate partner violence (IPV) during pregnancy (Y/N), all of which are self-reported on the PRAMS survey, and prenatal care initiation in the first trimester (Y/N), which was based on the birth certificate data. All women with 1st trimester prenatal care were categorized as having initiated care in the first trimester or later, and women with no prenatal care were coded as 'not having initiated care in the first trimester'.

Statistical Analysis

Bivariate analyses were conducted to examine associations between the two outcome variables across race/ethnicity/nativity status groups using χ^2 statistics. We also examined sources of support and social support across race/ethnicity/nativity status using χ^2 test statistics. We then examined the bivariate relationships between sources of support and social support and the two birth outcomes using χ^2 test statistics. In our multivariable analyses, we constructed four different logistic regression models for each of our outcomes. First we estimated the unadjusted odds of LBW and PTB for each racial/ethnic nativity status group relative to US-born Whites. In Model 2, we added the block of sociodemographic covariates to the previous crude model. In Model 3, we added behavioral and medical risk factors to the previous model, and in Model 4 we added number of social ties and perceived social support. Due to small sample size (n = 52), only descriptive information about US-born Asian/Pacific Islanders is presented.

Results

The overall prevalence of LBW was 6.9 % and PTB was 8.0 %. Rates of LBW and PTB were highest among

US-born Blacks (11.6–14.6 %, respectively) and lowest among foreign-born Whites (3.5–2.8 %, respectively). We found nativity differences for each racial/ethnic group for LBW, and for all but Puerto Ricans for PTB, such that foreign-born women had lower rates of LBW and PTB than their US-born counterparts. Table 1 shows that there were significant differences by race/ethnicity and nativity status on all sociodemographic, behavioral and medical variables, except previous PTB. Compared to US-born non-Latino Whites, all groups except foreign-born Whites were more socioeconomically disadvantaged based on maternal education and insurance coverage. We also found significant differences in the number of social ties and perceived social support by race/ethnicity/nativity status. US-born Whites reported higher prevalence of having 4+ social ties (41.4 %) compared to all other US-born racial/ethnic nativity status groups we were able to include in the analysis. Perceived social support also was significantly higher among US-born Whites relative to other racial/ethnic nativity status groups. Approximately 91 % of US-born Whites had high perceived social support.

Figure 1 shows the associations between number of social ties, perceived social support and LBW and PTB. Number of social ties was not significantly associated with LBW. However, it was significantly associated with PTB. PTB was higher among women with 4+ social ties (10.2 %) compared to those with 2–3 social ties (7.3 %), and those with 0–1 social ties (7.4 %), $p = 0.03$. The relationship between perceived social support and LBW was characterized by an inverted U-shape; women who reported low and high social support were significantly less likely to have a LBW infant (6.2–6.6 %, respectively) than women who had medium social support (7.9 %),($p < 0.05$). The relationship between perceived social support and PTB was not statistically significant.

Multivariable Analyses: LBW

Model 1 of Table 2 shows the unadjusted odds of LBW by race/ethnicity and nativity status with US-born Whites as the reference group. All groups had significantly higher odds of LBW relative to US-born Whites, with the exception of foreign-born Whites whose odds were not significantly different. Notably, US-born Blacks and Island-born Puerto Ricans had almost a three-fold increased odds of LBW compared to US-born Whites (OR = 2.98, 95 % CI 2.39, 3.70 and OR = 2.79, 95 % CI 1.78, 4.37, respectively). Model 2 is adjusted for sociodemographics, and odds of LBW by race/ethnicity and nativity remained largely unchanged. In Model 3 we added behavioral and medical variables which attenuated the differences in LBW. Compared with US-born Whites, however, the odds of LBW among US-born Other Latinas were no longer statistically significant (OR = 1.46, 95 % CI 1.00, 2.13). Model 4 is fully adjusted with number of social ties and perceived social support. The addition of these variables further attenuated the odds of each racial/ethnic nativity status group compared to US-born Whites. Low social support was protective of LBW; women categorized as having low social support had 31 % lower odds of LBW relative to women categorized as having high social support (OR = 0.69, 95 % CI 0.50,0.96). We tested the interaction between race/ethnicity/nativity and perceived social support for LBW and it was not significant.

Multivariable Analyses: PTB

Model 1 in Table 3 shows the unadjusted odds of PTB by race/ethnicity and nativity status. Only foreign-born Whites had significantly lower odds of PTB (OR = 0.51, 95 % CI 0.30, 0.87) relative to US-born Whites. US- and foreign-born Blacks and Island-born Puerto Ricans had significantly higher odds of PTB (OR = 3.01, 95 % CI 2.08, 4.37; OR = 2.60, 95 % CI 1.75, 3.86; OR = 2.53, 95 % CI 1.02, 6.25 and OR = 2.10, 95 % 1.03, 4.29, respectively). Odds of PTB among foreign-born Asian/Pacific Islanders, foreign-born Other Latinas, US-born Puerto Ricans and US-born Other Latinas were not significantly different from the referent. The addition of sociodemographics (Model 2) did little to change the increased odds of PTB among all racial/ethnic nativity status groups. Inclusion of behavioral and medical risk factors (Model 3) rendered differences in PTB between Island-born Puerto Ricans and US-born Other Latinas, and US-born Whites statistically insignificant (OR = 1.56, 95 % CI 0.67, 3.65; OR = 1.69, 95 % CI 0.91, 3.13, respectively). Model 4 is fully adjusted to test the effects of number of social ties and perceived social support. The notable changes were the 13–10 % increase in odds of PTB among foreign-born Other Latinas and Island-born Puerto Ricans from the previous model (OR = 1.53, 95 % CI 0.95, 2.49; and 1.72, 95 % CI 0.73, 4.06, respectively), although their odds of PTB overall were not significantly different from those of US-born Whites. US- and foreign-born Blacks continued to have approximately a 2.5-fold increased odds of PTB relative to US-born Whites (OR = 2.43, 95 % CI 1.56, 3.77 and OR = 2.60, 95 % CI 1.60, 4.24, respectively). Compared to women with 4+ social ties, those with either 2–3 social ties or 0–1 social ties had 34–40 % lower odds of PTB (OR = 0.68, 95 % CI 0.49, 0.93, and OR = 0.61, 95 % CI 0.43, 0.86, respectively). We tested the interaction between race/ethnicity/nativity and social ties for PTB and it was not significant.

Discussion

We found stronger evidence of the immigrant paradox for PTB than for LBW. The odds of PTB among foreign-born

Table 1 Descriptive statistics of sample by race/ethnicity and nativity, (n = 4,433) New York City Pregnancy Risk Assessment Monitoring System 2004–2007

Characteristic	US born						Foreign born				
	Total n (%)	Non-Latina White (n = 757) n (%)	Non-Latina Black (n = 676) n (%)	Asian (n = 52) n (%)	Puerto Rican (n = 285) n (%)	All Other Latinas (n = 233) n (%)	Non-Latina White (n = 371) n (%)	Non-Latina Black (n = 555) n (%)	Asian (n = 447) n (%)	Puerto Rican (n = 86) n (%)	All Other Latinas (n = 981) n (%)
Low birth weight	1,769 (6.9)	221 (4.2)	368 (11.6)	21 (7.1)	137 (9.7)	90 (6.5)	93 (3.5)	275 (9.7)	180 (6.7)	45 (10)	339 (5.7)
Preterm birth	1,194 (8.0)	143 (5.4)	265 (14.6)	16 (12.5)	77 (6.9)	64 (8.9)	49 (2.8)	201 (12.8)	101 (6.3)	32 (16)	246 (6.9)
First born	2,012 (44.6)	391 (47.2)	298 (42.5)	34 (64.1)	132 (51.0)	129 (53.0)	182 (46.7)	224 (41.4)	234 (51.8)	(33.5)	359 (36.8)
Maternal age >35 year	949 (19.1)	232 (27.4)	105 (12.1)	15 (33.8)	36 (11.4)	15 (7.0)	94 (23.4)	16 (26.4)	113 (21.0)	15 (11.4)	156 (13.8)
Marital status											
Married/partnered	1,092 (23.7)	36 (5.4)	317 (46.2)	4 (8.5)	100 (38.7)	75 (33.2)	17 (4.7)	186 (34.1)	28 (7.9)	37 (50.1)	292 (31.2)
Unmarried	3,245 (76.4)	714 (94.6)	338 (53.8)	48 (91.5)	180 (61.3)	153 (66.9)	354 (95.3)	350 (65.9)	409 (92.1)	48 (50.0)	651 (68.8)
Education											
≤High school	2,268 (53.3)	237 (36.4)	350 (52.5)	8 (14.9)	180 (63.9)	124 (56.4)	100 (32.8)	314 (56.6)	180 (46.5)	58 (72.3)	717 (76.4)
>High school	2,163 (46.7)	520 (63.6)	324 (47.6)	44 (85.1)	105 (36.1)	109 (43.6)	270 (67.2)	237 (43.4)	265 (53.5)	28 (27.7)	261 (23.6)
Insurance coverage											
Medicaid	1,206 (27.2)	153 (23.3)	292 (45.1)	2 (0.8)	119 (42.9)	95 (38.2)	60 (20.1)	113 (19.2)	87 (18.5)	49 (58.7)	236 (24.1)
Other insurance	1,943 (43.1)	532 (67.4)	270 (38.5)	44 (83.2)	110 (39.3)	92 (29.9)	228 (58.6)	211 (37.1)	229 (46.3)	23 (23.4)	204 (20.1)
No insurance	1,273 (29.6)	70 (9.3)	1,113 (16.4)	6 (16.0)	55 (17.7)	44 (21.9)	81 (20.4)	229 (43.7)	129 (35.2)	14 (17.9)	532 (55.8)
Behavioral risk factors											
Alcohol use	404 (9.4)	146 (17.6)	37 (7.6)	8 (14.5)	12 (4.0)	24 (11.5)	64 (16.7)	34 (6.6)	21 (3.4)	5 (4.5)	53 (5.1)
Tobacco use	220 (5.0)	37 (3.7)	68 (11.0)	1 (3.0)	31 (8.9)	15 (7.7)	23 (6.5)	9 (1.6)	9 (2.9)	7 (14.6)	20 (2.4)
Intimate partner violence (during pregnancy)	156 (3.5)	9 (1.8)	45 (6.7)	1 (0.3)	16 (6.2)	10 (6.2)	2 (0.3)	19 (4.0)	10 (0.6)	2 (3.8)	42 (4.7)
Late prenatal care	950 (21.7)	95 (13.7)	186 (26.8)	3 (13.0)	55 (19.0)	60 (26.6)	49 (15.5)	137 (27.0)	92 (19.9)	25 (31.9)	248 (26.3)
Medical risk factors											
Hypertension	586 (8.2)	66 (6.0)	152 (15.8)	4 (10.6)	47 (11.6)	40 (11.8)	29 (5.7)	84 (8.0)	32 (4.6)	18 (13.7)	114 (6.2)
Any diabetes	532 (11.3)	45 (5.3)	76 (11.8)	7 (12.9)	24 (8.0)	15 (5.7)	44 (12.2)	79 (13.8)	88 (16.4)	11 (10.3)	143 (14.6)
Previous preterm birth	396 (6.5)	47 (4.4)	80 (10)	2 (6.9)	29 (5.9)	16 (4.5)	24 (7.6)	57 (5.2)	38 (5.7)	11 (10.5)	92 (7.4)
Weight gain											
Inadequate	1,168 (21.6)	205 (23.0)	198 (24.7)	13 (11.8)	62 (14.8)	54 (17.5)	79 (18.3)	157 (22.4)	150 (26.7)	27 (20.5)	223 (18.0)
Adequate	1,518 (35.0)	305 (42.1)	1,015 (26.4	25 (55.0)	104 (36.2)	88 (36.7)	163 (43.1)	182 (35.3)	166 (38.0)	21 (29.5)	269 (27.4)
Too much	1,316 (34.2)	223 (32.7)	235 (42.3)	12 (27.8)	105 (45.0)	86 (45.0)	102 (31.7)	162 (33.4)	98 (27.8)	32 (44.2)	261 (29.8)
Number of social ties											
0–1	1,505 (34.1)	130 (19.1)	160 (23.2)	12 (25.5)	91 (30.6)	55 (21.9)	124 (31.8)	237 (42.8)	194 (44.3)	34 (43.0)	468 (48.5)
2–3	1,807 (41.6)	290 (39.5)	294 (42.2)	19 (25.7)	122 (43.9)	113 (52.2)	157 (46.1)	202 (37.6)	165 (38.8)	36 (37.1)	409 (42.7)

Table 1 continued

Characteristic	US born						Foreign born				
	Total	Non-Latina White (n = 757)	Non-Latina Black (n = 676)	Asian (n = 52)	Puerto Rican (n = 285)	All Other Latinas (n = 233)	Non-Latina White (n = 371)	Non-Latina Black (n = 555)	Asian (n = 447)	Puerto Rican (n = 86)	All Other Latinas (n = 981)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
4+	1,046 (24.3)	330 (41.4)	204 (34.6)	20 (48.8)	69 (25.5)	57 (25.9)	83 (22.1)	106 (19.7)	74 (16.9)	15 (19.9)	88 (8.8)
Perceived social support											
Low	355 (8.9)	16 (2.4)	37 (5.3)	0 (0)	21 (7.4)	13 (5.8)	28 (8.7)	46 (10.5)	68 (17.3)	11 (16.0)	115 (13.3)
Medium	877 (19.8)	55 (7.1)	117 (17.8)	7 (12.3)	56 (21.2)	54 (25.2)	58 (16.4)	139 (25.6)	115 (28.9)	22 (32.7)	254 (24.8)
High	3,075 (71.3)	678 (90.5)	502 (76.6)	44 (87.7)	204 (71.4)	159 (69.0)	279 (74.9)	354 (63.9)	239 (53.8)	52 (51.3)	564 (61.9)

Note: All *p*-values <0.0001 except for previous preterm birth ($p = 0.08$) based on χ^2 test. US born Asian women are not included in comparisons due to small numbers

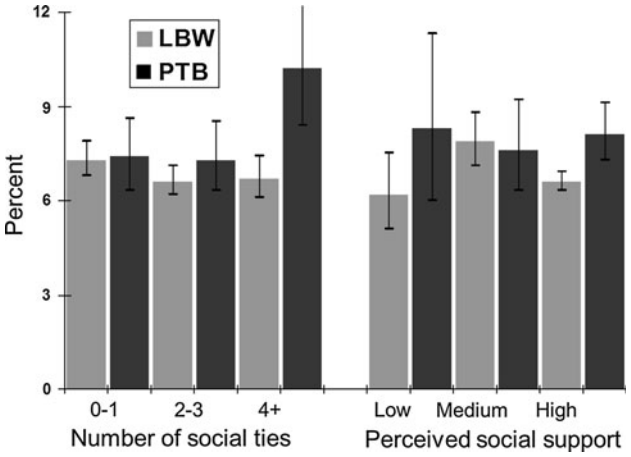

Fig. 1 Association between number of social ties and perceived social support with low birth (LBW) and preterm birth (PTB)

Other Latinas, Island-born Puerto Ricans, and foreign-born Asians were comparable to those of US-born Whites, while odds of PTB for foreign-born Whites were significantly lower. These findings demonstrate that the immigrant paradox may hold for PTB, and for Asians and Whites as well as Latinas, among whom the paradox has most consistently been observed. For LBW, foreign-born women of all race/ethnicities except Whites had significantly higher odds than US-born Whites. The finding that foreign-born Other Latinas had significantly higher odds of LBW than US-born Whites was surprising, as work done in NYC found rates of LBW among foreign-born Colombians, Dominicans, Ecuadorians, and Mexicans that resembled those of Whites [4, 39]. This result may be due to our inability to disaggregate Other foreign-born Latinas by country of origin, and reflects Rosenberg's results showing that LBW among US- and foreign-born Dominicans demonstrates a paradoxical pattern [4]. Almost one-third of non-Puerto Rican Latinas in our sample, which captures our 'Other Latina' category, was Dominican. Another explanation relates to our inability to assess acculturation among the foreign-born women in the sample [41]. We know that 25 % of this group came to the US when they were younger than 15 years of age, and might therefore, be relatively acculturated. Among other immigrant women, 29 % of Blacks, 28 % of Asian/Pacific Islanders and 17 % of Whites came to the US when they were younger than 15. Because advantageous birth outcomes among immigrants deteriorate with increased years of residence in the US, the fact that, on average, foreign-born women in our sample came to the US at an early age could elucidate the surprising finding regarding increased risk of LBW among this group [42].

We found inconsistent and unexpected relationships between social ties and LBW and PTB, and between social support and LBW and PTB. Specifically, in the bivariate

Table 2 Odds of low birth weight among mothers in NYC Pregnancy Risk Assessment Monitoring System, 2004–2007

Variable	Model 1 OR (95 % CI)	Model 2 OR (95 % CI)	Model 3 OR (95 % CI)	Model 4 OR (95 % CI)
Race/ethnicity nativity status				
Non-Latino White (US born)	1.0	1.0	1.0	1.0
Non-Latino White (foreign born)	0.82 (0.62, 1.09)	0.86 (0.65, 1.14)	0.81 (0.58, 1.14)	0.79 (0.56, 1.12)
Non-Latino Black (US born)	2.98 (2.39, 3.70)	2.94 (2.32, 3.71)	2.56 (1.94, 3.39)	2.52 (1.90, 3.33)
Non-Latino Black (foreign born)	2.41 (1.92, 3.03)	2.30 (1.80, 2.93)	2.30 (1.74, 3.05)	2.24 (1.68, 2.99)
Asian/Pacific Islander (foreign born)	1.63 (1.27, 2.08)	1.67 (1.29 (2.16)	1.50 (1.12, 2.02)	1.47 (1.08, 2.00)
Puerto Rican (Mainland born)	2.43 (1.84, 3.21)	2.34 (1.75, 3.15)	2.12 (1.49, 3.02)	2.04 (1.43, 2.91)
Puerto Rican (Island born)	2.79 (1.78, 4.37)	2.68 (1.67, 4.28)	2.12 (1.20, 3.76)	2.07 (1.17, 3.67)
Other Latino (US born)	1.58 (1.17, 2.14)	1.61 (1.17, 2.21)	1.46 (1.00, 2.13)	1.44 (0.98, 2.12)
Other Latino (foreign born)	1.37 (1.12, 1.68)	1.30 (1.04, 1.63)	1.36 (1.04, 1.78)	1.35 (1.02, 1.78)
Maternal age				
≥35		1.0	1.0	1.0
<35		0.67 (0.57, 0.78)	0.65 (0.53, 0.80)	0.64 (0.52, 0.79)
Marital status				
Married/partnered		1.0	1.0	1.0
Single/divorced/widowed		0.85 (0.73, 0.99)	0.96 (0.79, 1.17)	0.94 (0.78, 1.15)
Education				
>High school		1.0	1.0	1.0
≤High school		1.25 (1.08, 1.45)	1.18 (0.98, 1.41)	1.18 (0.99, 1.42)
Insurance coverage				
Other insurance		1.0	1.0	1.0
Medicaid		1.02 (0.86, 1.22)	1.01 (0.82, 1.25)	1.02 (0.83, 1.26)
No insurance		0.93 (0.77, 1.11)	0.90 (0.72, 1.11)	0.92 (0.74, 1.15)
Behavioral risk factors				
Alcohol use			0.99 (0.75, 1.31)	0.95 (0.72, 1.27)
Tobacco use			1.12 (0.75, 1.31)	1.13 (0.78, 1.64)
IPV (during pregnancy)			1.03 (0.69, 1.52)	0.97 (0.64, 1.47)
Late prenatal care initiation			1.25 (1.03, 1.51)	1.28 (1.06, 1.55)
Medical risk factors				
Hypertension			3.64 (2.89, 4.59)	3.75 (2.98, 4.72)
Any diabetes			1.10 (0.86, 1.40)	1.18 (0.92, 1.50)
Weight gain during pregnancy				
Adequate			1.0	1.0
Inadequate			2.04 (1.68, 2.48)	2.07 (1.70, 2.51)
Too much			0.62 (0.51, 0.75)	0.62 (0.51, 0.75)
Missing			1.23 (0.92, 1.66)	1.19 (0.88, 1.61)
Sources of support				
4+				1.0
2–3				0.98 (0.80, 1.20)
0–1				1.11 (0.89, 1.38)
Social support				
High				1.0
Medium				1.03 (0.84, 1.27)
Low				0.69 (0.50, 0.96)
Adjusted R^2	0.011	0.0138	0.0451	0.0464

Table 3 Odds of preterm birth among mothers in NYC Pregnancy Risk Assessment Monitoring System, 2004–2007

Variable	Model 1 OR (95 % CI)	Model 2 OR (95 % CI)	Model 3 OR (95 % CI)	Model 4 OR (95 % CI)
Race/ethnicity nativity status				
Non-Latino White (US born)	1.0	1.0	1.0	1.0
Non-Latino White (foreign born)	0.51 (0.30, 0.87)	0.52 (0.31, 0.89)	0.43 (0.24, 0.77)	0.47 (0.26, 0.84)
Non-Latino Black (US born)	3.01 (2.08, 4.37)	2.87 (1.92, 4.30)	2.39 (1.54, 3.71)	2.43, 1.56, 3.77)
Non-Latino Black (foreign born)	2.60 (1.75, 3.86)	2.53 (1.65, 3.87)	2.43 (1.50, 3.93)	2.60 (1.60, 4.24)
Asian/Pacific Islander (foreign born)	1.18 (0.74, 1.88)	1.22 (0.76, 1.97)	1.16 (0.68, 1.98)	1.23 (0.71, 2.14)
Puerto Rican (Mainland born)	1.32 (0.81, 2.15)	1.27 (0.77, 2.09)	1.10 (0.61, 1.99)	1.17 (0.66, 2.09)
Puerto Rican (Island born)	2.10 (1.03, 4.29)	2.09 (1.01, 4.34)	1.56 (0.67, 3.65)	1.72 (0.73, 4.06)
Other Latino (US born)	1.72 (1.00, 2.96)	1.77 (1.01, 3.09)	1.69 (0.91, 3.13)	1.84 (0.99, 3.41)
Other Latino (foreign born)	1.30 (0.90, 1.87)	1.33 (0.87, 2.01)	1.34 (0.83, 2.16)	1.53 (0.95, 2.49)
Maternal age				
≥35		1.0	1.0	1.0
<35		0.77 (0.60, 0.99)	0.87 (0.64, 1.19)	0.81 (0.59, 1.11)
Marital status				
Married/partnered		1.0	1.0	1.0
Single/divorced/widowed		0.76, 0.58, 0.99)	0.79 (0.58, 1.09)	0.77 (0.56, 1.06)
Education				
>High school		1.0	1.0	1.0
≤High school		1.06 (0.84, 1.35)	0.95 (0.72, 1.24)	1.00 (0.76, 1.32)
Insurance coverage				
Other insurance		1.0	1.0	1.0
Medicaid		0.82 (0.62, 1.10)	0.80 (0.57, 1.11)	0.83 (0.59, 1.16)
No insurance		0.84 (0.62, 1.15)	0.78 (0.54, 1.12)	0.84 (0.58, 1.22)
Behavioral risk factors				
Alcohol use			1.23 (0.79, 1.91)	1.23 (0.79, 1.92)
Tobacco use			1.35 (0.76, 2.40)	1.37 (0.76, 2.47)
Late prenatal care initiation			1.07 (0.80, 1.44)	1.06 (0.79, 1.42)
IPV (during pregnancy)			1.57 (0.85, 2.88)	1.75 (0.94, 3.26)
Medical risk factors				
Hypertension			3.16 (2.34, 4.26)	3.23 (2.39, 4.38)
Any diabetes			1.11 (0.77, 1.61)	1.21 (0.84, 1.75)
Previous PTB			3.08 (2.10, 4.50)	3.21 (2.19, 4.70)
Weight gain during pregnancy				
Adequate			1.0	1.0
Inadequate			1.81 (1.34, 2.47)	1.83 (1.34, 2.49)
Too much			0.72 (0.52, 0.99)	0.71 (0.51, 0.97)
Missing			1.11 (0.69, 1.78)	1.07 (0.66, 1.74)
Sources of support				
4+				1.0
2–3				0.68 (0.49, 0.93)
0–1				0.61 (0.43, 0.86)
Social support				
High				1.0
Medium				0.90 (0.65, 1.23)
Low				1.06 (0.66, 1.70)
Adjusted R^2	0.0172	0.0193	0.0477	0.052

analysis the rate of PTB was highest among women who reported the most sources of social support, which is in contrast to what we expected. In multivariable regression, women with a lower number of social ties had significantly lower odds of PTB compared to women with more social ties. With regard to LBW, in bivariate analyses, women with low and high perceived social support had significantly lower rates relative to women with medium social support. In multivariable analysis, women with low social support had significantly lower odds of LBW relative to those with high support. Several potential explanations exist for why we did not find a consistently protective effect of increased social ties and higher perceived social support. The first explanation is related to assessment of these constructs. Although the measures captured the quantity of social ties and support, they did not capture the quality of ties and support. Social ties may be positive or negative depending on the context in which they occur, unfortunately the measure is unable to capture any information about the quality or the depth of these interactions. Given this, it is possible that respondents' perceived availability of support may not correspond with the actual provision of support, leaving interpretation of what the questions actually measure open to debate [43, 44]. Additionally, even if a woman perceives that social ties and support are available during pregnancy, if the context in which they occur is conflictual, particularly with her partner, adverse birth outcomes are more likely to occur [45].

Another explanation, especially related to our finding that women who reported having the most sources of support had the highest rate of PTB, may point to the downside of social ties, which is rarely discussed [46]. While some studies have found that social ties and support during pregnancy are protective [35, 47, 48], other studies did not find a significantly protective effect [45, 49]. In fact, having numerous social ties may imply excessive obligations to provide support to others. This association is often patterned by gender, with women more burdened than men to provide support, and as such, they may be more vulnerable to the related potential negative consequences [28, 46].

Our final aim was to test the extent to which observed disparities in LBW and PTB by race/ethnicity and nativity status could be explained by differences in social ties and social support. While adding these variables slightly improved the fit of the models, it did little to change differences in risk of LBW or PTB between racial/ethnic and nativity status groups. Despite the significant differences in social ties and support by race/ethnicity and nativity status, they seemed to contribute little to differences in LBW and PTB across these population groups. The possibility that the measures of social ties and social support used in PRAMS data do not fully capture the full extent of their influence on LBW or PTB should be considered. Additionally, there may be other protective factors such as access to formal sources of support [50], protective neighborhood social environment [47], or religiosity [51] that we have not measured, but which contribute to racial/ethnic and nativity status differences in adverse birth outcomes.

The Institute of Medicine weight gain guidelines were updated in 2009 (Institute of Medicine 2009), so we repeated the analyses with the new guidelines and found no differences in the results. The 1990 guidelines were used for this analysis because the data were collected prior to the revised 2009 guidelines. Results of this study must be considered with the following limitations in mind. First, because our measures of social ties and social support were crude, we may not have fully captured their true effects on LBW and PTB. As such, future work should include validated measures of social ties and support, which move beyond measuring quantity to assess the quality of the ties and support. Second, while we were able to disaggregate Puerto Ricans from Other Latinas, due to small sample sizes, we were unable to examine the relationships of interest among Mexicans, where the immigrant paradox has been most consistently observed [12, 32, 52]. Furthermore, small sample sizes precluded us from disaggregating Asians by country of origin to examine the immigrant paradox among this diverse group. Previous studies have shown that Indian immigrant women had greater risk of LBW compared to US-born Whites [53], and studies have shown that the immigrant paradox may exist for only certain Asian groups [16]. Notwithstanding these limitations, our study has several strengths. For example, this study is among the first to use a population-based sample to examine associations between social ties and perceived social support, and birth outcomes. Second, results of this study help to answer the question of whether social ties and support may contribute to immigrants' relatively good birth outcomes. Finally, we were also able to disaggregate US- versus foreign-born women in each racial/ethnic group rather than simply controlling for nativity.

Conclusion

While we did not find a consistently protective effect of social ties and support on LBW and PTB, the practical implications do not negate the importance of such protective social resources during pregnancy for healthy birth outcomes. Our findings that women with lower social support were at decreased risk of LBW, and those with fewer social ties were at decreased risk of PTB point to the importance of both researchers and clinicians accurately

assessing social ties and support during pregnancy, and to considering the possible downside of social ties and the demands or obligations they may entail [28, 46]. Therefore, future research should include examination of both quantity and quality of social ties and support (both the beneficial, as well as potentially detrimental effects) on birth outcomes. Identifying and augmenting sources and types of support that are protective of birth outcomes should continue to be a goal of public health researchers and prenatal clinicians [44].

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