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The Impact of Paternal Involvement on Feto-Infant Morbidity Among Whites, Blacks and Hispanics

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Abstract Few studies have examined paternal involvement in relation to feto-infant health; therefore we aim to assess the impact of absence of the father on birth outcomes among racial-ethnic subgroups. Florida vital statistics records for singleton births occurring between 1998 and 2005 were used for this study. Births to women less than 20 years of age and births outside the gestational age range of 20–44 weeks were excluded. Adjusted and unadjusted odds ratios and 95% confidence intervals were generated to examine the impact of paternal involvement, as defined by presence of paternal information on the birth certificate, on feto-infant morbidity across racial-ethnic sub-populations. There were higher rates of low birth weight, very low birth weight, preterm birth, very preterm birth, and small for gestational age (SGA) among father-absent births. Within each racial-ethnic subgroup, women with absent fathers had higher risks of poor birth outcomes than their counterparts with involved fathers. Black women with absent fathers had the highest risk of low birth weight, very low birth weight, preterm birth, very preterm birth, and SGA. Promoting paternal involvement during the perinatal period may provide a means to decrease the proportion of infants born of very low birth weight or very preterm, thus potentially reducing the black–white disparity in infant mortality.

Keywords Paternal involvement · Prenatal health behaviors · Preterm birth · Low birth weight

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Introduction

There is a growing body of literature that suggests that paternal involvement has a favorable influence on academic achievement, behavior, and cognitive development of young children [1–3]. In addition, there is some literature that implies that paternal involvement is critical for feto-infant health, but few studies have examined this construct [4–6]. Feto-infant health is of particular importance because of immediate increased risk of adverse birth outcomes and an increased risk of lifelong health problems such as heart disease, diabetes, and hypertension [7].

Studies that examined birth outcomes in relation to marital status, a surrogate indicator of paternal involvement, noted differences among married and unmarried women [8, 9]. Married women are less likely to smoke during pregnancy, more likely to seek early prenatal care, and less likely to have low birth weight infants [8, 9]. Further, women who have relationships that are considered intermediates between married and unmarried (i.e. cohabitating with the father) have birth outcomes that are better than those of unmarried women, but poorer than for married women [10]. Studies that have examined other indicators of paternal involvement, such as completeness of paternal information on the birth certificate, have noted higher infant mortality rates and higher preterm birth and low birth weight rates among father-absent births [4, 6]. There is very little information about the role of paternal

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involvement on feto-infant morbidities among different racial-ethnic sub-populations. Yet it is well-known that in the United States, almost 70% of black infants and 50% of Hispanic infants are born outside of marriage and as such have fathers that are less likely to be involved [11]. It is therefore, important to assess the impact of the absence of the father on birth outcomes among these racial/ethnic subgroups.

Accordingly, we undertook this study to examine the impact of paternal involvement, as defined by presence of paternal information on the birth certificate, on feto-infant morbidity across racial/ethnic sub-populations (blacks and Hispanics).

Materials and Methods

Data for this study were obtained from the birth certificate records for the State of Florida over the period 1998 through 2005. Overall, 1,578,986 women with live singleton births were considered for this study. Births to women less than 20 years of age (11.8%) and births outside the gestational age range of 20–44 weeks (0.2%) were excluded from the study, resulting in a final study population of 1,397,801 births.

In Florida, a married woman is required to list the husband's information on the birth certificate; however, there are circumstances in which she can refuse to offer such information, including when the father of the child is not her husband. Unmarried women do not have to list the father's name on the birth certificate, unless a paternity acknowledgment is obtained, in which case, the father's name will appear on the birth certificate. In either of these situations, the exclusion of paternal information suggests that the partner is uninvolved. Conversely, inclusion of paternal information suggests a closer or more involved relationship. Further, one study noted that there were similar proportions of fathers who were involved during the pregnancy and fathers who had their names on the birth certificate (87% and 90%, respectively) [12]. Using this methodology we divided the study population into two groups (father-involved pregnancies and father-absent pregnancies) using presence or absence of the father's first and/or last name on the birth certificate as a surrogate measure of paternal involvement during pregnancy. Father-involved pregnancies included infants whose birth certificates had the father's first and last name listed whereas father-absent pregnancies were those without paternal name listed. Father-absent pregnancies met one of the following criteria: father's first name is missing, father's last name is missing, father's first and last names is missing. There were 120,981 (8.7%) infants whose birth certificate had father's name missing entirely and 122,985 (8.8%) whose father's first or last names were missing on their birth certificates. Of the population with missing father's information, the proportion missing only the father's first name (white 30.4%, black 43.5%, Hispanic 21.4) and those with only the father's last name missing (white 29.7%, black 44.0%, Hispanic 21.6) were similar within each group.

The main outcomes of interest were low birth weight (<2,500 g), very low birth weight (<1,500 g), preterm birth (<37 weeks), very preterm birth (<33 weeks), and small for gestational age (SGA). We defined SGA as less than the 10th percentile of birth weight for a given gestational age using population-based national reference curves [13]. Gestational age was calculated in weeks while birth weight was measured immediately after birth and documented in grams. Gestational age was computed by taking the interval between date of last menstrual period reported by the mother at first prenatal visit and date of delivery. In situations where the menstrual estimate of gestational age was inconsistent with birth weight (for example very low birth weight at term), a clinical estimate computed by the physician was used.

The following covariates were considered: maternal age (<35 or ≥35 years), gravidity (primigravid or multigravid), race (non-Hispanic black, non-Hispanic white, Hispanic, and others which included all other races and ethnicities), marital status (married or unmarried), education (<12 or ≥12 years), cigarette smoking during pregnancy (yes or no), and adequacy of prenatal care (adequate or inadequate). Marital status was included as a covariate in order to measure the independent influence of paternal involvement on our outcomes. Adequacy of prenatal care was assessed using the revised graduated index algorithm, which has been found to be more accurate than several others, especially in describing the level of prenatal care utilization among groups that are high risk [14, 15]. This index assesses the adequacy of care based on the trimester prenatal care began, number of visits, and the gestational age of the infant at birth. We also compared the two groups with respect to the occurrence of several obstetrical complications coded as present or absent in the database (anemia, cardiac disease, type-1 diabetes, chronic hypertension, preeclampsia, eclampsia, abruption placenta, placenta previa, and renal disease). In addition, since pregnancy complications were highly correlated with each other (significant pair-wise correlation), to avoid the problem of multicollinearity, we constructed a composite variable defined as the occurrence of at least one of the following in the adjusted model: anemia, cardiac disease, type-1 diabetes, chronic hypertension, preeclampsia, eclampsia, abruption placenta, placenta previa, and renal disease.

Baseline characteristics between father-involved and father-absent births were compared using Chi-square tests

for categorical variables and *t* tests for continuous variables. The risk for feto-infant morbidity outcomes (low birth weight, very low birth weight, preterm, very preterm and small for gestational age) among the father-absent group were compared with the father-involved group using odds ratios and 95% confidence intervals after adjusting for baseline characteristics in multiple logistic models. The LOGISTIC procedure in SAS (SAS Institute, Inc., Cary, North Carolina, version 9.2) was used to conduct the analysis. This study was approved by the Institutional Review Board at the University of South Florida.

Results

A total of 1,397,801 singleton live births were considered in the study which covers the period from 1998 to 2005. Of these, 1,276,820 (91.3%) mothers were in the father-involved group and 120,981 (8.7%) mothers were in the father-absent group. Socio-demographic characteristics of mothers in the study are presented in Table 1. Mothers who were in the father-absent group were younger, more educated, and more likely to be black. This group also had a higher percentage of risk factors such as smoking and inadequate prenatal care than mothers in the father-involved group. Mothers who were in the father-involved group were more likely to be married and multiparous.

Obstetric complications differed by paternal presence (Table 1). Mothers in the father-absent group had a higher prevalence of anemia, eclampsia and placental abruption while mothers in the father-involved group were more likely to have cardiac disease and diabetes. There was no difference in the levels of preeclampsia, renal disease and placenta previa between the two groups.

Infants of mothers who were in the father-absent group were born slightly earlier than those in the father-involved group [Mean gestational age (±SD) = 38.32 weeks (±2.70 weeks) versus 38.64 weeks (±1.97), respectively; $P < 0.01$]. The mean birth weight of infants of the two study groups was significantly divergent. Infants of mothers in the father-absent group weighed on average 165 g less than those of mothers in the father-involved group [Mean (±SD) = 3,169.0 g (±639.3) versus 3,333.7 g (±559.7), respectively; $P < 0.01$].

Overall, 87,152 infants were of low birth weight (rate = 6.2%), 16,170 were very low birth weight (rate = 1.2%), 118,386 were SGA (rate = 8.5%), 120,310 were preterm (rate = 8.6%) and 19,013 were very preterm (rate = 1.4%). The breakdown of crude frequencies of feto-infant morbidity outcomes for the two groups across racial/ethnic categories is given in Fig. 1.

The adjusted odds ratios for the association between father-involvement and feto-infant morbidity outcomes are summarized in Table 2. Infants in the father-absent group were at elevated risk for low birth weight, very low birth weight, SGA, preterm, and very preterm. The greatest feto-infant morbidity risk was for very low birth weight (OR = 1.91, 95% CI = 1.84, 2.00) and very preterm (OR = 1.87 95% CI = 1.80, 1.94).

In order to evaluate the differences in the effects of paternal involvement on feto-infant morbidities by race and ethnicity, we further categorized infants by race and involvement status. Six subgroups were constructed: whites in the father-involved (referent group), whites in the father-absent group, blacks in the father-involved group, blacks in the father-absent group, Hispanics in the father-involved group and Hispanics in the father-absent group. We did not include in this analysis 83,329 (6.0%) mothers whose race and or ethnicity were unknown. The majority of women in the father-involved group were whites (n = 901,404; rate = 64.5%), followed by blacks (n = 219,699; rate = 15.7%) and Hispanics (n = 78,095; rate = 5.6%). In contrast, most absent fathers were black (n = 53,970; rate = 3.9%), followed by white (n = 53,767; rate = 3.8%) and Hispanic (n = 7,537; rate = 0.5%).

Subgroup analysis of the association between father involvement and feto-infant morbidity outcomes indicated that within each racial-ethnic group, those with absent fathers had a higher risk of feto-infant morbidities than their counterparts with fathers involved (Table 3). Among mothers with absent fathers, regardless of race/ethnicity, the greatest morbidity risk among their infants was very low birth weight followed by very preterm. For any of the morbidity outcomes, infants born to black mothers with the father-absent experienced the most elevated risk across all the racial/ethnic subgroups. The risk among black mothers without involved fathers was most pronounced for very low birth, with about a 5-fold increased risk (OR = 4.85, 95% CI = 4.56–5.15) as compared to the referent category. This was closely followed by very preterm birth (OR = 4.38, 95% CI = 4.14–4.64). Hispanic infants with absent fathers had lower adjusted risk estimates than their black counterparts for all morbidity outcomes ranging from 29% (for preterm) to 240% (for very low birth weight).

Discussion

Our results confirm earlier reports of higher rates of low birth weight, very low birth weight, preterm birth, and SGA among father-absent births, even after adjusting for a number of sociodemographics and obstetric factors [4, 6]. We also noted an 87% increased risk of very preterm birth. When compared to white women with involved fathers, white women with absent fathers had elevated risks of feto-infant morbidities as did Hispanic and black women, regardless of

Table 1 Distribution of selected maternal socio-demographic and pregnancy complications between father-involved and father-absent groups (Florida 1998–2005)

	Father-absent %	Father-involved %	*P* value
Advanced maternal age (≥35 years old)	10.09	16.39	<0.01
Education (≥12 years)	32.38	13.62	<0.01
Smoker	15.21	7.65	<0.01
Adequate prenatal care[a]	35.32	56.28	<0.01
Race			
White	44.44	70.6	<0.01
Black	44.61	17.21	
Hispanic	6.23	6.12	
Other	4.72	6.08	
Multiparous	25.77	29.83	<0.01
Prenatal high risk score (≥4)	29.99	9.28	<0.01
Mother married (yes)	10.86	72.26	<0.01
Anemia	3.36	2.42	<0.01
Cardiac disease	0.28	0.38	<0.01
Diabetes	2.17	2.92	<0.01
Preeclampsia	3.47	3.57	0.12
Chronic hypertension	0.89	0.76	<0.01
Renal disease	0.17	0.15	0.12
Eclampsia	0.47	0.31	<0.01
Abruption	0.54	0.39	<0.01
Placenta previa	0.34	0.36	0.39

[a] Adequacy of prenatal care was determined using the revised graduated index algorithm

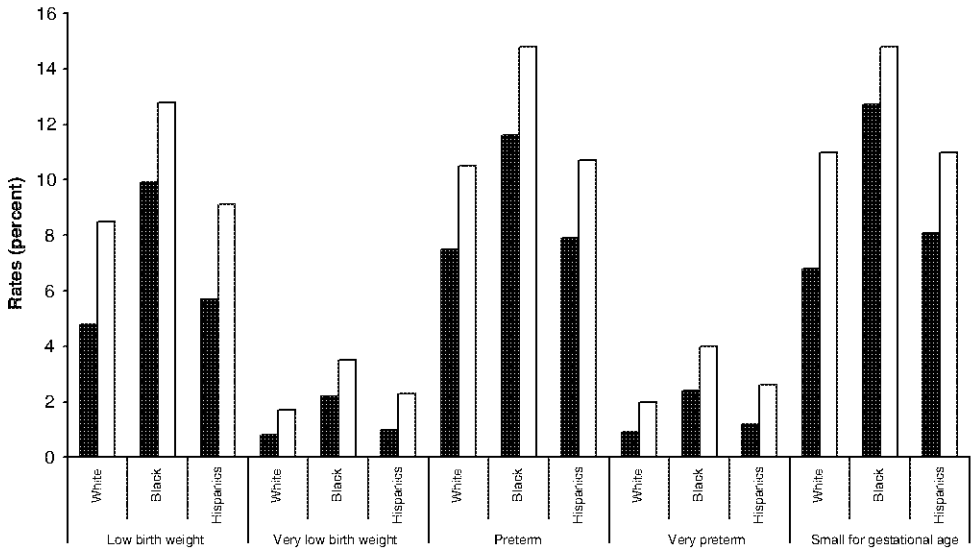

Fig. 1 Crude estimates of feto-infant morbidity outcomes by father involvement status. *Filled square* father-involved, *open square* father-absent. *P* values for all comparison was less than 0.01

paternal involvement status. Black women with absent fathers had the highest risk of low birth weight, very low birth weight, preterm birth, very preterm birth, and SGA. Within each racial-ethnic subgroup, women with absent fathers had higher risks of poor birth outcomes than their counterparts with involved fathers.

There are several possible explanations for these findings. First, paternal involvement may promote healthy prenatal behaviors. In our study, women classified as having absent fathers were more likely to report prenatal smoking and more likely to have inadequate prenatal care. Studies examining constructs related to paternal involvement such as marital status and cohabitation have also noted associations between a lack of paternal involvement or presence and low birth weight and SGA whereas indicators of paternal involvement increased the likelihood of obtaining early prenatal care and prenatal alcohol abstinence [16–18]. Maternal health behaviors may also be

Table 2 Adjusted odds ratio for feto-infant morbidity among mothers giving birth to singletons, Florida 1998–2005

Feto-infant morbidity	Adjusted odds ratio (95% confidence interval)	
	Father-involved	Father-absent
Low birth weight	1.00	1.44 (1.41–1.47)
Very low birth weight	1.00	1.91 (1.84–2.00)
Preterm	1.00	1.37 (1.34–1.40)
Very preterm	1.00	1.87 (1.80–1.94)
Small for gestation	1.00	1.23 (1.21–1.26)

Adjusted estimates were generated after controlling for the effects of maternal age, parity, race, smoking, education, marital status, adequacy of prenatal care, anemia, cardiac disease, diabetes, preeclampsia, chronic hypertension, renal disease, eclampsia, placenta abruption, and placenta previa

associated with pregnancy wantedness or intendedness. Previous studies have shown that intendedness prevents delayed initiation of prenatal care and there are fewer adverse outcomes among intended births [19, 20]. It is also plausible that paternal involvement decreases stress, a possible cause of adverse pregnancy outcome [21–23]. Stress alters the normal production of hormones such as cortisol and corticotrophin-releasing hormone with can cause preterm birth and fetal growth restriction [24–27]. Intimate partner violence has been associated with adverse reproductive outcomes such as low birth weight and preterm birth [28]. It is unclear whether affected women would provide paternal information on the birth certificate. Provision of paternal information in this case may bias results toward the null. Unfortunately, this study did not have any information on pregnancy intendedness, indicators of stress levels, or intimate partner violence.

Fathers can be involved in pregnancies in different ways through engagement, accessibility, and responsibility [29, 30]. Our study is limited by the absence of information about the amount, duration, or type of paternal involvement. It is unclear if different types of support are correlated with presence of paternal information on the birth certificate. However, previous studies have noted a correlation between presence of paternal information on the birth certificate and involvement [12]. A study by Teitler [12] noted that among unmarried women, 90% had the father's name on the birth certificate and 87% of the women reported that the father contributed during the pregnancy, but distributions were not presented by race.

In our study, marital status was correlated with our measure of paternal involvement (missing father's first and/or last name on the birth certificate). Nonetheless, marital status is not wholly indicative of paternal involvement. While 23.3% of unmarried women were missing father's name on the birth certificate, only 1.4% of married mothers were missing father's name. Controlling for marital status in our analyses allowed us to examine the importance of involvement independent of marital status.

The use of calculated and clinical estimate of gestational age also bears some limitations. Different methods of estimating gestational age (ultrasound versus obstetric) can impact the validity of the estimate and substituting the clinical estimate for last menstrual period (LMP) can impact risk estimates [31]. However, LMP is also an imperfect estimate of gestational age due to recall bias and bleeding in early pregnancy [31]. Further, agreement between LMP and clinical estimate of gestation, do vary by race and ethnicity [31]. Consequently, it is possible that there is some degree of non-differential misclassification in our study.

In spite of aforementioned limitations, this study also has several strengths, including its population-based design. Most importantly, this study highlights the high levels of very preterm birth and very low birth weight infants among black women and most notably among black women with absent fathers. Very preterm birth and very low birth weight infants have higher rates of complications, require extensive and costly medical intervention, and make significant contributions to infant mortality rates

Table 3 Adjusted odds ratio for the association between father involvement and feto-infant morbidity outcomes by race/ethnicity, Florida 1998–2005

	White mothers Father-absent	Black mothers Father-present	Black mothers Father-absent	Hispanic mothers Father-present	Hispanic mothers Father-absent
Low birth weight	1.53 (1.47–1.59)	2.22 (2.18–2.27)	2.73 (2.65–2.82)	1.15 (1.13–1.18)	1.52 (1.44–1.59)
Very low birth weight	2.26 (2.08–2.46)	3.02 (2.89–3.15)	4.85 (4.56–5.15)	1.29 (1.23–1.36)	2.40 (2.17–2.66)
Preterm	1.35 (1.30–1.40)	1.56 (1.54–1.59)	2.03 (1.98–2.09)	1.00 (0.98–1.01)	1.29 (1.23–1.34)
Very preterm	2.08 (1.91–2.25)	2.74 (2.63–2.85)	4.38 (4.14–4.64)	1.28 (1.23–1.34)	2.25 (2.05–2.47)
Small for gestational age	1.28 (1.23–1.32)	2.24 (2.20–2.28)	2.35 (2.29–2.42)	1.53 (1.47–1.60)	1.53 (1.47–1.60)

Referent group = White mothers in the father-involved group

Adjusted estimates were generated after controlling for the effects of maternal age, parity, smoking, education, marital status, adequacy of prenatal care, anemia, cardiac disease, diabetes, preeclampsia, chronic hypertension, renal disease, eclampsia, placenta abruption, and placenta previa

[32–35]. Very low birth weight and very preterm birth infants account for only a small proportion of the births in the United States (1.2%), but they account for more than 60% of the neonatal mortality rate [35]. Further, authors have noted that the black-white infant mortality gap can be reduced by decreasing the rates of very low birth weight and very preterm birth in the black population [34–36]. Data from our study suggests that improvements in paternal involvement during the perinatal period, especially among the black population, may provide a vehicle through which the proportion of infants born of very low birth weight or very preterm could be reduced. This may, in turn, decrease the black-white disparity in infant mortality. Increasing paternal involvement during the perinatal period may be especially important for the black population as they already bear a disproportionate burden of adverse birth outcomes and have a high proportion of births outside of marriage [9, 11]. Studies based on interventions designed to increase paternal involvement and subsequent pregnancy outcomes are needed in order to better assess the contribution of lack of paternal involvement to feto-infant morbidity outcomes.

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