Published in final edited form as:

J Psychosom Obstet Gynaecol. 2019 March ; 40(1): 48–56. doi:10.1080/0167482X.2017.1398725.

Paternal involvement and support and risk of preterm birth: Findings from the Boston Birth Cohort

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Abstract

Objective: To investigate to what extent paternal involvement and support during pregnancy were associated with preterm (PTB) and small-for-gestational age (SGA) births.

Methods: Using data from the Boston Birth Cohort (n=7,047), multiple logistic regression models were performed to estimate the log odds of either PTB or SGA birth, with paternal

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involvement, paternal social support, and family and friend social support variables as the primary independent variables.

Results: About 10% of participating mothers reported their husbands' not being involved or supportive during their pregnancies. Lack of paternal involvement was associated with 22% higher risk of PTB (OR=1.21, 95% CI:1.01–1.45). Similarly, lack of paternal support was borderline associated with PTB (OR=1.13, 95% CI:0.94–1.35). Also marginally significant, lack of paternal involvement (OR=1.18, 95% CI:0.95–1.47) and father's support (OR=1.19, 95% CI:0.96–1.48) were associated with higher odds of SGA birth. No associations were found between familial/friend support during pregnancy and PTB or SGA.

Conclusion: Among predominantly low-income African Americans, lack of paternal involvement and support during pregnancy was associated with an increased risk of PTB, and possibly SGA birth. These findings, if confirmed in future research, underscore the important role a father can play in reducing PTB and/or SGA.

Keywords

preterm birth; small-for-gestational age; paternal involvement; social support; birth outcomes

Introduction

Both preterm birth (PTB) and growth restriction in newborns are risk factors for adverse short- and long-term health outcomes (Arpino et al. 2010, Christian et al. 2014, Jaquet and Czernichow 2003, Katz et al. 2013, Lawn et al. 2014, McIntire and Leveno 2008, Moster et al. 2008, Saigal and Doyle 2008). These include higher likelihoods of neonatal and post-neonatal morbidity and mortality (Arpino, et al. 2010, Christian, et al. 2014, Katz, et al. 2013, McIntire and Leveno 2008), poor neurocognitive functioning in childhood (Arcangeli et al. 2012, Arpino, et al. 2010), and long-term chronic health and social disabilities (Jaquet and Czernichow 2003, Lawn, et al. 2014, Moster, et al. 2008, Saigal and Doyle 2008). In addition, small-for-gestational age (SGA) birth predicts lower adult socio-economic status (Black 2015), and short gestation is associated with educational and social disadvantage (Lindström et al. 2007, Moster, et al. 2008). Substantial evidence now suggests that prenatal stress is linked to adverse birth outcomes (Ciesielski et al. 2015, Ding et al. 2014, Littleton et al. 2010). Pooled estimates show that maternal prenatal stress - measured through a variety of subjective, diagnostic, biological, indicators – predict both PTB and low birthweight (LBW) (Ding, et al. 2014). Such adverse birth outcomes, along with SGA, tend to occur disproportionally among African-Americans (Bryant et al. 2010, Zhang et al. 2013), who also face multiple stressors affecting their health, such as poverty and racism (Williams 1999), which are thought to predispose them to adverse birth outcomes (Giscombe and Lobel 2005, Kramer et al. 2000).

Prior theory and research suggest that social support, specifically from a partner, can protect from the deleterious effects of stress (Cutrona 1996). The stress-buffering hypothesis posits that social support can act as a shield, attenuating the stress appraisal response to a particular event and influence the associated physiological reactions (Cohen and Wills 1985). Currently, epigenetic modifications that could change the gene expression have been

increasingly studied to identify the biological pathways through which social environment/factors exert effects on PTB (Burris et al. 2016, Gudsnuk and Champagne 2012, King et al. 2015). Nonetheless, the importance of social support during pregnancy, and the types of social support, that impact adverse birth outcomes is unclear. Furthermore, little research in this area has included SGA as a birth outcome, although the etiology of PTB and SGA are considered to be distinct.

Taking advantage of a cohort at risk of poor birth outcomes, i.e. primarily low-income urban African-Americans, the aim of this study, therefore, was to study whether paternal involvement, paternal support and support from family and friends was associated with preterm and SGA births. Secondarily, we aimed to evaluate if the importance of these relationships differed by marital status or stress levels during pregnancy.

Methods

The present study included 7047 mothers from the Boston Birth Cohort (BBC) recruited at birth with rolling enrollment between 1998–2015 (Wang et al. 2002). Multiple-gestation pregnancies (e.g, twins and triplets) and infants born with major birth defects were excluded. Cohort participation among eligible participants approached by the research staff was over 90% for initial enrollment (Wang et al. 2014).

Maternal variables were defined based on a standard maternal questionnaire interview. They included maternal age (<20, 20–25, 25–30, 30–35, >35 years), self-reported race/ethnicity (Black, Hispanic, White, or other), education (elementary/secondary school or high school, some college or college degree and above), marital status (married, unmarried), smoking (never smoked, ever smoked, current smoking), parity (nulliparous, multiparous), perceived stress during pregnancy (no or average stress, very stressful) and hypertensive disorders (Yes, No). Data on marital status were originally collected based on the five categories: married, widowed, divorced, separated and single. We generated a binary variable by classifying the latter four categories as unmarried. Perceived stress during pregnancy was based on the question: “How would you characterize the amount of stress in your life during pregnancy?” Answers were coded as ‘not stressful’, ‘average’ and ‘very stressful’ (Yu et al. 2013), and we generated a binary variable by collapsing the ‘not stressful’ and ‘average’ categories . Medical records were used to define hypertensive disorders occurring anytime during pregnancy. Occurrence of any of the following conditions was coded as yes: preeclampsia, eclampsia, HELLP syndrome, or chronic hypertension; otherwise, coded as no.

The independent variables of interest were asked within the first three days after delivery, and included father involvement “How would you describe the amount of involvement there was during your pregnancy from the father of the baby?”, classified not at all involved versus at least somewhat involved (i.e. including ‘a little involved’, ‘mostly involved’, ‘very involved’). The second support question asked specifically about support from the father “How would you rate the amount of social support you received from the father of your baby during your pregnancy.” Social support from family and friends was based on the question “How would you rate the amount of support you received during your pregnancy from your

other family members and your friends?" Both of these last two support variables were categorized as no support versus any (including 'a little', 'a good amount', or 'excellent amount'). The decision to dichotomize support variables between none and any amount was theoretically based on the idea that having no support is qualitatively different than having support from at least one other person. In order to examine the combined effects of marital status and our support variables, we formed four indicators for the combination of the categories for each support variable: 1) married mothers with support (reference), 2) unmarried mothers with support, 3) married mothers without support, 4) unmarried mothers without support. Similarly, indicators were also generated for perceived stress combined with the support variables, with the reference group being women who perceived no or average stress and had support.

`Information on birth outcomes was based on medical records, gestational age was both assessed using first day of the last menstrual period and early prenatal ultrasound (Wang, et al. 2002). Preterm birth was defined as having a gestational age of <37 weeks. Birthweight for-gestational age was calculated according to an internal reference population based on birthweight standardized by the mean and variance in the stratum of the corresponding ethnic group, sex and gestational week in the reference population. It was then categorized into small-for-gestational age (defined as birthweight for gestational age <10th percentile), in contrast to appropriate-for-gestational age and large-for-gestational age births, which were combined (10th-100th percentile) according to the same sex- and race- and gestational week- specific reference population (Wang et al. 2006).

The study protocol was approved by the institutional review boards of Boston University Medical Center, the Ann & Robert H. Lurie Children's Hospital of Chicago (formerly Children's Memorial Hospital of Chicago), and the Johns Hopkins Bloomberg School of Public Health. Written informed consent was obtained from the mothers.

Statistical Methods

Sample characteristics were examined using cross-tabulation and are presented as N (column %) for the total sample, and N (row %) for participants with the outcomes of interest. Chisquared tests were conducted to examine the associations between each of the independent variables and the outcomes. Complete case analysis was used such that we included only participants with all variables of interest. Multiple logistic regression models were performed to model the log odds of either PTB or SGA birth, with each of the support variables being the primary independent variable, respectively. Covariates included in the models were age, race, education, marital status, parity, maternal smoking, perceived stress during pregnancy, and hypertensive disorders. Because of small sample sizes, we did not perform these analyses for effect-modification with SGA.

As a sensitivity analysis, we also implemented Markov Chain Monte Carlo Multivariate Imputation by Chained Equations (MICE). This method required two set of variables: variables in the analytical model and variables contributing to the missing mechanisms. The analytical model included all the variables in the final logistic regression model. The missing mechanism model included how many prenatal appointments a mother missed, mother's country of origin, and baby's date of birth. We generated 20 multiple-imputed complete

datasets. The point estimates were calculated based on the mean of coefficients of these 20 complete datasets.

All analyses were performed using STATA version 14 (Stata Corporation, College Station, TX). All significance tests were evaluated two-sided at the level of 0.05.

Results

Significant crude associations were observed in the expected directions between all socio-demographic and health related variables and PTB and SGA, with the exception of race, which was not related to SGA (Table 1). Regarding our independent variables, 33.0% of women who reported no involvement of the baby's father during pregnancy had PTBs, versus 26.9% among those reporting at least some involvement (p=0.001). Likewise, 17.2% of infants born to women who reported the baby's father was not involved were SGA, compared to 12.5% among those with at least some involvement (p<0.001). Results regarding social support from the baby's father during the pregnancy were similar (31.7% versus 27.0% PTB and 17.4% versus 12.4% SGA, for non-supportive versus at least somewhat supportive, respectively). Social support from family and friends was borderline statistically significantly related to SGA (16.9% for women who did not receive support versus 12.8% among those who did receive support from these sources), but not to PTB (Table 1).

In multivariable analyses controlling for demographic characteristics, health-related variables and perceived stress during pregnancy as covariates, lack of the involvement from the baby's father during pregnancy was associated with higher odds of PTB (adjusted odds ratio (Adj. OR)=1.21, 95% confidence interval (CI) 1.01, 1.45) while lack of his support during pregnancy was less strongly and associated (Adj. OR=1.13, 95% CI 0.94, 1.35). There was no clear relation between lack of social support from family and friends during pregnancy and PTB (Adj. OR=0.95, 95% CI 0.68, 1.32) (Models 1–3, Table 2). Adjusted models showed both lack of involvement and support from father during pregnancy were related to approximately 20% elevated odds of SGA births (Adj. OR=1.18, 95% CI 0.95, 1.47 for father's involvement; Adj. OR=1.19, 95% CI 0.96, 1.48 for father's support). The association between support from friends or family in relation to SGA was of the same magnitude (Adj. OR=1.24, 95% CI 0.84, 1.84). (Models 4–6, Table 2) Exclusion of self-reported stress during pregnancy, from otherwise identically adjusted multivariable models, either did not change or only changed these estimates negligibly (data not shown).

Notably, lack of involvement from the father of the baby and being unmarried was associated with 1.5 higher odds of PTB (OR=1.52, 95% CI 1.24, 1.87), compared to married women who reported any involvement of the baby's father during the pregnancy (Table 3). This pattern was similar for support from the baby's father during the pregnancy; women who both lacked the father's support and weren't married had higher odds of PTB (OR=1.43, 95% CI 1.16, 1.76), compared to married women with support. Interestingly, though suggestive of slightly weaker associations, being unmarried even when having involvement or support from the baby's father was associated with higher risk of PTB (OR=1.21, 95% CI 1.06, 1.38 and OR=1.22, 95% CI 1.07, 1.39, respectively), compared to

mothers with involved (or supportive) married partners. Finally, results suggested unmarried mothers with or without support from family or friends were at higher risk of PTB (OR=1.25, 95% CI 1.10, 1.43 for not married with support; OR=1.20, 95% CI 0.82, 1.78 for not married without support), (Table 3).

We found that compared to women who had support and did not experience stress, those with support but had high stress levels were at elevated risk (father's involvement: OR=1.20, 95% CI 1.03, 1.39; father's support: OR=1.20, 95% CI 1.03, 1.40; family and friends' support: OR=1.18, 95% CI 1.03, 1.36). Higher risk of PTB was also observed for mothers who lacked involvement from the baby's father but did not report experiencing high stress levels (OR=1.28, 95% CI 1.03, 1.58), compared to those with involvement of the baby's father and without high stress. (Table 3)

Results of the imputed analyses that were done as a sensitivity analysis (N=8494) were largely consistent with the non-imputed results, though the precision of the estimates slightly decreased (data not shown).

Discussion

Our study found that perceived lack of involvement during pregnancy from the baby's father was a significant predictor of PTB. Although it did not reach statistical significance, results also suggest an elevated risk of PTB and SGA among mothers reporting lack of support from the baby's father. In contrast, support from other family/friends did not appear to be related to either of these outcomes. Preterm birth outcomes were also more likely under circumstances, including 1) if the mother was not married, regardless of whether she reported involvement or support from the baby's father (compared to married mothers with partner involvement), and 2) when the mother experienced either high stress or low involvement from the baby's father during pregnancy (compared to having mothers with no stress and partner involvement).

Our results, indicating that mothers lacking paternal involvement during pregnancy were at higher risk of delivering PTBs, suggest the potential importance of the involvement of the baby's father among low-income African Americans, such as those in our sample. In a review of eight studies, a pooled analysis found that social support in pregnancy was associated with overall higher odds of PTB, compared to the odds among women lacking social support (Hetherington et al. 2015). However, in that review, only three US studies evaluated partner support specifically, all three failing to find statistically significant associations between partner support and PTB (Jesse et al. 2003, Jesse et al. 2009, Straughen et al. 2013). Furthermore, only one of these three drew from a predominately African American population (Straughen, et al. 2013). Other research, using father's name on state birth certificates as a proxy for paternal involvement, has reported elevated risks of PTB and very PTB for births for which no father was listed, notably showing an especially strong association among African-Americans (Alio et al. 2010).

Findings from our study also suggested that lack of paternal support and involvement in pregnancy may be associated with risk of SGA, though our results did not reach statistical

significance. Lack of significance may have been due to insufficient power, given the relatively small number of SGA births. To our knowledge, the only other study that has that specifically investigated support from the baby's father in relation to SGA was in Sweden. Authors reported no association between low paternal support and SGA births among native or foreign-born mothers (Dejin-Karlsson and Ostergren 2004). They did, however, report higher risk of SGA for foreign-born women lacking social anchorage (defined as the extent of a woman's association with social groups), compared to Swedish-born women who were socially anchored. Given the very small sample size of women with low paternal support in that study, it is possible that an association was not observed due to low power (Dejin-Karlsson and Ostergren 2004). In the study that used a proxy for father involvement based on presence of the father's name on the birth certificate, father-absent births were associated with higher risk of SGA birth (Alio, et al. 2010). Another study from New Zealand, which used an indicator of general support, has reported associations between support and SGA births (Pryor et al. 2003), but did not have information on whether support was received from the father or someone else.

From literature on social support interventions, it has been suggested that among high-risk populations, social support may improve health through direct pathways through emotional or instrumental support as well as through indirect pathways, e.g. by improving receipt of healthcare services like prenatal care (Shapiro et al. 2013). A review concluded that while the results of the majority of support-oriented interventions to improve birth outcomes have not been successful, trials that based eligibility on low support were more likely to show significant treatment effects (Orr 2004). Authors concluded that targeting women with low support from the baby's father, from female relatives, or designing programs for especially younger mothers could be promising (Orr 2004).

Prior work has identified marital status as an important predictor of support for the baby's father (Sagrestano et al. 1999). Notably, we observed that not being married either with or without partner involvement was associated with a higher risk of PTB, relative to married women who had involved partners. Likewise, being unmarried was associated with higher risk of PTB, regardless of whether or not the mother had support from the baby's father. These findings may be particularly important for African-American populations, since marriage rates among African-Americans tend to be lower than for other racial/ethnic groups (Raley et al. 2015). We also found that pregnant women reporting high stress but who had involved partners as well as pregnant women with high stress but who had support from the father of the baby both had elevated risk of PTB, compared to women who didn't report high levels of stress and were with partners who were involved or supportive, respectively. Prior research shows stress in pregnancy to be associated with PTB (Ding, et al. 2014). So, insofar as lack of involvement of the father is also a stressor, these findings would be expected.

In terms of mechanisms, it is likely there are a number of factors contributing to how poor or lack of father support increases the risk of PTB. Research has suggested that support from a woman's partner during pregnancy to be beneficial for maternal well-being (Dunkel Schetter 2011). Women may feel less stress and feel better able to handle stressors. One biologic component that may unite all these factors would be oxytocin. Oxytocin is a hormone that is important in bonding, thought to be anxiolytic, and also involved in partuition (Jones et al.

2017, Kuessel et al. 2013). Another interesting mechanism that warrants further investigation is inflammation as a mediator of poor partner support and PTB. Poor partner relationships may be related to pro-inflammatory responses, e.g., women reporting low positive or indifferent partner relationship quality have shown greater increases in maternal serum interleukin-6 and IL10 ratios, while women with high positive relationships with partners had low and stable IL6:IL10 ratios suggesting and anti-inflammatory phenotype (Ross et al 2016). Thus, negative relationships may be related to pro-inflammatory responses (Ross et al 2016). Furthermore, pro-inflammatory responses have been linked to poorer birth outcomes such as preterm births (Mor et al. 2017). Likely for any one woman it may be varying combinations of the stress, oxytocin and the immune systems that mediate the relationship between partner support and PTB. Furthermore, by studying the relationship of partner support to PTB, may lead to better understanding of how these complex systems such the stress, immune and hormonal systems are interacting.

Use of BBC data allowed us to examine social support, a potentially modifiable resilience factor, among a large cohort of mostly low-income women. An advantage of our study was the focus on a largely African-American urban sample, given that this group is also at high risk for social isolation (Almeida et al. 2014) and poor birth outcomes (Bryant, et al. 2010, Zhang, et al. 2013). A main limitation was that our support measures were based on single questions. However, we did benefit from being able to distinguish from whom support was received. Likewise, the phrasing of the questions tapped into received support (that actually occurred) rather than anticipatory available support. Another limitation relates to the retrospective report of social support during pregnancy, leading to the possibility that for some women post-partum depression at the time of survey administration may have colored recall of women's pregnancy experiences. Also, regarding the concept of father involvement, it is possible that affirmative responses to our question could reflect both positive and negative interactions. In contrast, it may be expected that "social support from the father" would reflect positive interactions.

Given the recognized importance of extended family networks in African-American culture, we were surprised at our finding that support from other family and friends (apart from the baby's father) was not significantly related to birth outcomes. However, very few women in our study (~3%) did not report support from family and friends. Our finding of no association contrasts with other research suggesting that, specifically among African-American single mothers, support from a pregnant woman's mother has been associated better birth outcomes (Norbeck and Anderson 1989). More research is needed to understand how particular family members, beside the baby's father, may also be important in some circumstances.

Overall, our results suggest that lack of paternal involvement was related to PTB in a sample of predominantly low-income African Americans. Associations between support from the baby's father specifically, may be important in the context of health disparities, for example, African-American teens tend to have less support from the baby's father than the extended family during pregnancy (Gee and Rhodes 2003). In light of research suggesting that the timing of support could be important (Da Costa et al. 2000), future research could determine the relative importance of the timing as well as nature of paternal support for birth outcomes.

Other evidence suggests that certain characteristics of partner relationships during pregnancy, e.g. related to its quality, emotional closeness, and equity, may make that support more effective (Rini et al. 2006). Likewise, women's satisfaction with support during pregnancy (rather than number of supportive contacts available) has been associated with infant birthweight (Abadi et al. 2013).

Thus, future research is needed to confirm our study's findings and to identify what type and timing of father involvement could have the potential to improve birth outcomes, especially among vulnerable populations who lack many of these supports.

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Current knowledge on the subject

- Prenatal stress is linked to adverse birth outcomes.
- Social support can act as a buffer against stress.
- Women with lower social anchorage may be at higher risk of having a small-for-gestational age birth.

What this study adds

- Lack of paternal involvement during pregnancy is associated with higher odds of preterm birth among women.
- Being unmarried, despite the level of paternal or friend or family involvement or social support during pregnancy, is associated with a higher risk of preterm birth.
- We observed no association between support from family and friends during pregnancy and preterm or small-for-gestational age birth.

Table 1.

Characteristics of study participants from the Boston Birth Cohort

Variable	Total	Preterm Birth		Small-for-Gestational Age	
	N (row %)	N (row %)	*p* value	N (row %)	*p* value
Total	7047 (100.0)	1938 (27.5)		910 (12.9)	
Father's involvement			0.001		<0.001
Yes [a]	6353 (90.2)	1709 (26.9)		791 (12.5)	
No	694 (9.9)	229 (33.0)		119 (17.2)	
Father's support			0.009		<0.001
Yes [b]	6350 (90.1)	1717 (27.0)		789 (12.4)	
No	697 (9.9)	221 (31.7)		121 (17.4)	
Family/friends' support			0.823		0.090
Yes [b]	6852 (97.2)	1883 (27.5)		877 (12.8)	
No	195 (2.8)	55 (28.2)		33 (16.9)	
Age			<0.001		<0.001
<20	731 (10.4)	180 (24.6)		134 (18.3)	
20–25	1703 (24.2)	444 (26.1)		264 (15.5)	
25–30	1855 (26.3)	470 (25.3)		206 (11.1)	
30–35	1595 (22.6)	444 (27.8)		190 (11.9)	
>35	1163 (16.5)	400 (34.4)		116 (10.0)	
Race/Ethnicity			0.002		0.282
White	857 (12.2)	252 (29.4)		125 (14.6)	
Black	3482 (49.4)	1007 (28.9)		442 (12.7)	
Hispanic	2165 (30.7)	532 (24.6)		266 (12.3)	
Others	543 (7.7)	147 (27.1)		77 (14.2)	
Education			0.047		0.061
High school and below	4528 (64.3)	1281 (28.3)		610 (13.5)	
Above high school	2519 (35.7)	657 (26.1)		300 (11.9)	
Marital status			<0.001		<0.001
Yes	2456 (34.8)	606 (24.7)		232 (9.5)	
No	4591 (65.2)	1332 (29.0)		678 (14.8)	
Parity			0.516		<0.001
Nulliparous	3051 (43.3)	827 (27.1)		475 (15.6)	
Multiparous	3996 (56.7)	1111 (27.8)		435 (10.9)	
Maternal smoking			<0.001		<0.001
Never smoker	5635 (80.0)	1448 (25.7)		631 (11.2)	
Quitter	515 (7.3)	172 (33.4)		78 (15.2)	
Current smoker	897 (12.7)	318 (35.5)		201 (22.4)	
Perceived stress during pregnancy			<0.001		<0.001
No/average stress	5733 (81.4)	1513 (26.4)		693 (12.1)	
Very stressful	1314 (18.6)	425 (32.3)		217 (16.5)	

Variable	Total	Preterm Birth		Small-for-Gestational Age	
	N (row %)	N (row %)	*p* value	N (row %)	*p* value
Hypertensive disorder			<0.001		<0.001
Yes	918 (13.0)	490 (53.4)		176 (19.2)	
No	6129 (87.0)	1448 (23.6)		734 (12.0)	

[a]Yes included “little involved”, “mostly involved”, or” very involved”.

[b]Yes included “a little, a good amount”, or” an excellent amount”.

Table 2.

Multiple logistic regression of the association between social support and preterm and small-for-gestational age birth

Variables related to Social Support during Pregnancy			
PRETERM BIRTH OUTCOME			
	Model 1 OR (95% CI)	**Model 2 OR (95% CI)**	**Model 3 OR (95% CI)**
Lack of father involvement (vs involvement)	1.21 (1.01, 1.45)*		
Lack of father's support (vs support)		1.13 (0.94, 1.35)	
Lack of family/friends' support (vs support)			0.95 (0.68, 1.32)
SMALL-FOR-GESTATIONAL AGE OUTCOME			
	Model 4 OR (95% CI)	**Model 5 OR (95% CI)**	**Model 6 OR (95% CI)**
Lack of father involvement (vs involvement)	1.18 (0.95, 1.47)^		
Lack of father's support (vs support)		1.19 (0.96, 1.48)^	
Lack of family/friends' support (vs support)			1.24 (0.84, 1.84)

N=7,047 for all models in the table.

All six models were adjusted for age (<20, 20–25 (ref),25–30, 30–35, >35), race/ethnicity (White, Black (ref), Hispanic, other), education (≤ high school (ref), > high school); marital status (married versus single, divorced, widowed), parity (nulliparous (ref) versus multiparous); maternal smoking (never smoked, quitter, current smoker); perceived stress during pregnancy (none or average versus (ref) versus very stressful); hypertensive disorder (no (ref) versus yes).

* Indicates a p-value of ≤ 0.05

^ Indicates a p-value of ≤ 0.1.

Abbreviations: OR, odds ratio; 95% CI, 95% confidence interval.

Table 3.

Modification of the association between support and preterm birth, by marital status and perceived stress in pregnancy

		Preterm Birth OR (95% CI)
Marital Status		
Model 1	Father's Involvement	
	With involvement, married	Reference
	With involvement, not married	1.21 (1.06, 1.38) *
	Lack of involvement, married	0.75 (0.38, 1.48)
	Lack of involvement, not married	1.52 (1.24, 1.87) *
Model 2	Father's Support	
	With support, married	Reference
	With support, not married	1.22 (1.07, 1.39) *
	Lack of support, married	0.70 (0.35, 1.41)
	Lack of support, not married	1.43 (1.16, 1.76) *
Model 3	Family and Friends' Support	
	With support, married	Reference
	With support, not married	1.25 (1.10, 1.43) *
	Lack of support, married	0.91 (0.47, 1.76)
	Lack of support, not married	1.20 (0.82, 1.78)
Perceived stress during pregnancy		
Model 1	Father's Involvement	
	With involvement, no/average stress	Reference
	With involvement, very stressful	1.20 (1.03, 1.39) *
	Lack of involvement, no/average stress	1.28 (1.03, 1.58) *
	Lack of involvement, very stressful	1.29 (0.95, 1.74)
Model 2	Father's Support	
	With support, no/average stress	Reference
	With support, very stressful	1.20 (1.03, 1.40) *
	Lack of support, no/average stress	1.20 (0.96, 1.48)
	Lack of support, very stressful	1.20 (0.90, 1.62)
Model 3	Family and Friends' Support	
	With support, no/average stress	Reference
	With support, very stressful	1.18 (1.03, 1.36) *
	Lack of support, no/average stress	0.96 (0.63, 1.46)
	Lack of support, very stressful	1.11 (0.67, 1.84)

N=7,047 for all models in the table.

* Indicates a p-value of ≤ 0.05;

^ Indicates a p-value of ≤ 0.1.

Abbreviations: OR, odds ratio; 95% CI, 95% confidence interval. [a] p values were obtained from the likelihood ratio tests to examine the statistical significance of the interaction effects.