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The Role of Father Involvement during Pregnancy in the Prevention of Adverse Pregnancy Outcomes

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A dissertation submitted to the Faculty of the James T. Laney Graduate School of Emory University
In partial fulfillment of the requirements for the degree of Doctor of Philosophy in Epidemiology

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Abstract
The Role of Father Involvement during Pregnancy in the Prevention of Adverse Pregnancy Outcomes

By Angela Milton Miller

Preterm birth, defined as any live birth before 37 completed weeks of gestation, is a leading cause of infant morbidity and mortality. Rates of preterm birth in the United States are much higher than in both developed and developing nations. Traditional risk markers account for only 25-30% of occurrences of preterm birth.

Paternal involvement has been extensively studied in relation to child development, but little attention has been paid to the role of fathers in reduction of adverse pregnancy outcomes. However, paternal involvement, as determined by presence of the father's name on the birth certificate, has been observed to be a predictor of both infant morbidity and mortality. The mechanism by which missing paternal demographics are associated with pregnancy outcomes is unknown.

The literature is limited by vague measurements of paternal involvement and limited understanding of the mechanism through which paternal involvement acts to affect pregnancy outcomes. Thus, the overall theme of this dissertation proposal is to explore the concept of "paternal involvement", particularly as it applies to pregnancy outcomes.

Mothers and fathers with at least a friendly relationship appear to give similar reports of father involvement, though fathers report higher levels of paternal involvement than mothers. Use of mothers' interviews may be a reasonable approach to assess paternal involvement, though findings can be applied only to fathers who are both accessible and willing to participate in studies.

In cohabiting couples, moderate or low paternal involvement may confer greater risk of preterm birth compared to high paternal involvement. Future research should explore the joint impact of relationship status and father involvement.

Contrary to *a priori* hypotheses, pregnant women with psychiatric illness may experience a non-significant increased risk of preterm birth despite high levels of partner support. This finding may indicate a more complicated relationship between women and their partners during pregnancy.

Future studies of father involvement and pregnancy outcomes should focus on further development of measures of father involvement during pregnancy, and place increased emphasis on recruiting mothers and fathers not in relationships.

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Introduction

Preterm birth, defined as any live birth before 37 completed weeks of gestation, is the second leading cause of neonatal mortality, and the leading cause of Black infant mortality.[1,2] In 2010, 12% of births in the United States were preterm, higher than in both developed and developing nations.[3,4] Known risk markers such as income, maternal age, maternal race, and infection account for just a fraction of all preterm births.[5]

Paternal involvement has been extensively studied in relation to child development, but little attention has been paid to the role that fathers may play in reduction of adverse pregnancy outcomes or child health. However, paternal involvement, as determined by presence of the father's name on the birth certificate, has been observed to be a predictor of both infant morbidity and mortality, including preterm birth.[6-10] Lane and colleagues found that accounting for paternal involvement reduced disparities in low birth weight in Syracuse, NY.[11,12] Alio and colleagues came to the same conclusion when their study of 1.3 million Florida birth certificates showed that 75% of excess infant mortality could be eliminated if the causal factor represented by the missing father's name was identified and removed.[9] These findings are especially striking, given that approximately 75% of African American infants are born out of wedlock, and rates of non-marital fertility are increasing most rapidly among Hispanics.[13,14] Infants born to unmarried women are at an increased risk of being born preterm, having low birth weight, and death before the first birthday.[8,15-17] Current literature has not examined the pathways through which father involvement is associated with pregnancy outcomes.

The literature is limited by vague measurements of paternal involvement during pregnancy and a limited understanding of the mechanism through which paternal

involvement acts to affect pregnancy outcomes. Father involvement may operate through a psychosocial pathway, where a father's presence and financial contributions result in less maternal stress. Studies have also shown that the paternal desire or intention of a pregnancy affects maternal prenatal behaviors.[18] Though not supported by the studies of birth certificate data, there is also evidence in favor of paternal biologic pathways.[10,19-23] Thus, the overall theme of this dissertation is to explore the psychosocial aspects of "paternal involvement" as it applies to pregnancy outcomes.

The aims of this dissertation are as follows:

Aim 1: Determine the level of agreement between maternal and paternal responses to questions on father involvement during pregnancy.

Aim 2: Use latent class analysis to determine categories of paternal involvement from mother's report for several measured indicators of involvement and evaluate the association of paternal involvement with preterm birth in a cohort of unmarried families participating in the Fragile Families and Child Wellbeing Study.

Aim 3: Determine the association of anticipated postpartum social support and parental relationship quality with preterm birth and low birth weight in a population of adult women with a history of psychiatric illness.

In the following chapters, there will be an introduction to preterm birth, followed by a discussion of observed associations between various measures of paternal involvement and pregnancy outcomes. Chapter 3 will examine concordance of maternal and paternal responses to measures of paternal involvement during pregnancy. Chapter 4 will describe the construction of an index of paternal involvement derived from six individual indicators of involvement from the mother's assessment, as well as the use of that indicator as a marker for preterm birth. Chapter 5 will examine the associations of other measures of relationship quality and partner support with preterm birth and low birth weight. Finally, the findings of the dissertation will be placed in context.

Chapter 1: Epidemiology of Preterm Birth

Preterm Birth

Preterm birth, defined as a live birth before 37 completed weeks of gestation, is the second leading cause of neonatal mortality, and the leading cause of Black infant mortality.[1,2] The proportion of preterm birth in the United States is much higher than in both developed and developing nations.[3] Despite the national goal of Healthy People 2010 to reduce rates to 7.6% from the 1999 baseline of 11%, the percentage of preterm birth continued to rise in the United States, reaching a peak of 12.8% in 2006.[4,24] A more modest goal has been set with Healthy People 2020 to reduce preterm births by 10%, or 11.7% of all live births.[25] Infants born preterm are at an increased risk of death, physical impairments, and neurodevelopmental delays. [1,26,27] Preterm infants accounted for nearly half of all infant hospitalization costs, totaling $26.2 billion, or approximately $33,000 in medical costs per preterm infant, compared to $3,000-5,000 per term infant.[2,28,29] The total societal costs are estimated to be $50,000 per infant.[29] Infants born preterm are at an increased risk of death, physical impairments, and neurodevelopmental delays. [1,26,27]

Trends in preterm birth

After steadily rising from 1980 to 2006, 2010 saw the fourth straight year of decline for rates of preterm birth to 12%.[4] However, this proportion was still higher than any year over the period 1981-2001.[4] The decrease was observed for White, Black and Hispanic mothers. In 2010, annual preterm births to Black mothers were the lowest they had been since 1981.[4]

Within the Unites States, percentages of preterm birth vary by geographic region. In 2008, the March of Dimes commissioned their first study to compare preterm birth proportions to the Healthy People 2010 benchmarks, and those set by the March of Dimes. Preterm birth had increased 15% over the year 2000 baseline of 11%, and was nearly twice the goal.[24] These poor findings were published in the “March of Dimes

Preterm Birth Report Card."[30] In 2012, only Vermont, Maine, New Hampshire and Oregon received an 'A' for having a preterm birth proportion ≤9.6%, the March of Dimes 2020 goal. Three states, plus Puerto Rico, received an 'F. As a whole, the nation received a 'C,' an improvement from the 'D' issued in 2008.[31] Visually, the map of preterm birth proportions published with the report card has a striking resemblance to the cardiovascular disease and stroke maps published by the Centers for Disease Control and Prevention.[32] The three maps collectively indicate strong regional influences on health outcomes, particularly in the southeastern United States (Figure 1.1).

Due to differences in reporting, it is difficult to make an international comparison of the frequency of preterm birth. However, a 2012 international comparison of the proportion of births before 37 weeks' gestation by the World Health Organization showed the US lagging behind both developed and developing nations. In that study, the U.S. ranked behind the United Kingdom (7.8% of live births), France (6.7%), Romania (7.3%), Sweden (5.9%), Iraq (6.5%), and Rwanda (9.5%), to name a few.[33]

Preterm birth subtypes

Preterm births can be divided into very, moderate, and late preterm births. Very preterm births are those births occurring before 32 completed weeks' of gestation. Moderate preterm births occur between 32 and 34 weeks of gestation, and late preterm births occur between 34 and 36 weeks' gestation. Most (75%) preterm births are late preterm.[34] Both the increase of the 1990s and the more recent decrease in preterm birth are reflective of declines in late preterm births.[4,35,36] While the total proportion of preterm births has increased, preterm births occurring at less than 32 weeks' gestation have remained constant, at less than 2% of all livebirths.[37] These changes are likely due to increases and then decreases in obstetric interventions.[38]

Mechanisms for preterm birth

Preterm births come about in 2 ways: either via spontaneous preterm labor or preterm premature rupture of membranes, or via obstetric intervention (iatrogenic) delivery. Iatrogenic preterm births are those medically indicated to prevent morbidity or mortality for the mother or child, as with preeclampsia, as well as "elective" preterm births. Iatrogenic births have contributed to the increase in preterm birth through the 1990s into the early 2000s. While the increase in iatrogenic births has been accompanied by a decrease in neonatal morbidity and mortality, there is controversy over whether the increase in iatrogenic deliveries is justified.[38-40] During this period, births due to spontaneous labor and premature rupture of membranes have remained constant.[38]

Preterm premature rupture of membranes (PPROM) is the rupture of the chorioamnionic membrane prior to the onset of labor occurring before 37 weeks of gestation. A Canadian hospital based study found that prevalence of PPROM was 3%, with evidence of chorioamnionitis present in half the cases.[41] Risk factors for PPROM include smoking, obstetric history of previous PPROM or preterm delivery, short cervical length, hydramnios, multiple gestations, and early pregnancy bleeding. Black women are 30% more likely (OR = 1.30; 95% CI: 1.2, 1.4) to experience premature rupture of membranes than White women.[42] Prevalence of PROM for other races and ethnicities are similar to that of Whites.[42] While the goal with preterm labor is to delay delivery to allow fetal maturation, with PPROM, the risk of infection is great, and delivery is indicated.

Known Risk Factors for Preterm Birth

Extensive research has been done to determine the causes of preterm birth. Traditional risk markers include socioeconomic factors such as marital status, education and income. Traditional risk factors (i.e., with an assumed biologic cause) include

maternal age and maternal/fetal infection, inflammation, uterine abnormalities, and history of previous preterm birth.[2,43] These traditional risk factors only account for 25-30% of occurrences of preterm birth.[5]

Race

There is a large racial/ethnic disparity in preterm birth. Among non-Hispanic White women, preterm birth proportions are 10.8%, compared to 17.2% in non-Hispanic Black women, and 11.8% in Hispanic women [1,43]. Despite a downward trend among African American women in recent years[2], rates are still remarkably high, and the disparities are unexplained by the traditional risk factors. This disparity is commonly attributed to inequalities in social status, however, after controlling for socioeconomic status, Black or African-American women still deliver a higher proportion of preterm infants than White women.[44]

Attention should also be drawn to the epidemiologic paradox, sometimes referred to as the Latino paradox, in which new immigrants to the US have lower incidence of preterm birth than US White women, despite having several of the traditional risk factors.[45,46] The better pregnancy outcomes for immigrant women may be related to the healthy migrant effect, in which those who successfully move to the United States are healthier than those remaining in the home country. However, with increasing duration of time in the US, risk of preterm birth and other negative health outcomes increase.[47] The increasing risks of preterm birth occurring with acculturation and assimilation, in conjunction with the high risks among native born racial and ethnic minorities, suggest that within the United States, there exists a socioeconomic structure which contributes to preterm birth.

Further, variation is seen among women of the African Diaspora. Among Black women in New York City, African women were 22% less likely than Black American

women to have a preterm delivery, and US-born non-Hispanic White women were 55% less likely to have a preterm delivery than Black American women.[48] Caribbean Black and African immigrants to the United States have lower rates of preterm birth and low birth weight than U.S. born Blacks.[49,50] As with the epidemiologic paradox, risk of preterm birth to foreign born Black women increases with time in the U.S. This variation in preterm birth by origin in Black women refutes the notion of genetic differences in Blacks contributing to increased risk for preterm birth. Further, the increased risk associated with acculturation suggests socio-cultural effects unique to residence in the United States.

Some have argued that Blacks have physiologically shorter gestations than Whites.[51-53] Investigators have observed that Black infants born preterm exhibit less neonatal mortality than White infants born at the same gestational age, with the curve of morbidity by gestational age for Black infants shifted one week to the left of the same curve for White infants.[51] While they argue that this implies greater fetal maturity at an earlier age for Black infants, they are unable to explain the excess infant mortality for Blacks compared to Whites. The phenomenon of greater than expected fetal maturity among preterm infants has been observed in other populations. In a South American cohort receiving serial ultrasounds, infants born preterm had accelerated fetal growth trajectories through the first and second trimesters compared to those born at term.[54]

Socioeconomic Status

Preterm birth, stillbirth, and infant deaths are more likely to occur to unmarried women, who tend to be less educated, with lower income.[55] Unmarried women are also less likely to seek prenatal care, and engage in unhealthy prenatal behaviors such as smoking.[18,55]

It has been thought that the excess preterm birth in the African-American community is due to inequalities in socioeconomic status (SES). However, after adjusting for SES, the disparities in preterm birth and other adverse pregnancy outcomes persist. In fact, the disparity widens with increasing SES. Over 10 per 1,000 preterm infants are born to Black college educated women, compared to 3.7 per 1,000 for White college educated women, and 9.9 per 1,000 for White high school dropouts.[56] These effects are intergenerational. Second generation college educated Black women were less likely to have preterm birth than their college educated mothers, but were still over 3 times as likely to deliver preterm compared to a cohort of college educated White women.[44]

Infection

Bacterial vaginosis has been associated with preterm birth. Bacterial vaginosis is a disturbance in naturally occurring vaginal flora. A meta-analysis of 18 studies showed that bacterial vaginosis during pregnancy doubles the likelihood of a preterm birth.[57] Pregnant women randomized to receive intensive treatment after a bacterial vaginosis diagnosis were less likely to deliver preterm compared to those women receiving only standard care of the bacterial vaginosis ($p=0.0001$).[58] However, a meta-analysis of 10 studies showed non-statistically significant effects of bacterial vaginosis treatment.[59]

Preconception Health

Large scale surveys have shown that half of all pregnancies in the US are unintended, and that most women at risk of pregnancy are not in optimum health. In one study, nearly half of women at risk of pregnancy were overweight or obese, and 75% ate less than 5 servings of fruits and vegetables daily. Forty-six percent of preconceptional women were unaware of the benefits of folic acid in preventing birth

defects, and more than a third did not take a multivitamin supplement of any kind.[60] Pregnant women who delivered preterm were more likely to have pre-pregnancy hypertension, self-reported poor physical function, and depressive symptoms in the three months before the pregnancy.[61] After adjustment for demographic characteristics, women who were classified by pre-pregnancy BMI as underweight were more than twice as likely to deliver a preterm infant.[61] Women suffering pregnancy associated hypertension had triple the risk of preterm delivery.[61] However, hypertension pre-existing the pregnancy also increases risk of preterm delivery.[61]

Obstetric History

Women with a history of adverse pregnancy outcomes are more likely to have subsequent pregnancies with the same outcome.[62] In women with a previous preterm birth, the risk of preterm birth is estimated to be between 15-50%.[43] Subsequent preterm births also occur in a similar window of gestational age as previous preterm births.

Interpregnancy intervals of ≤6 months and <12 months have been associated with an increased risk of preterm birth compared to women with in interpregnancy interval greater than 12 months.[63,64] Considering 18-23 months as the referent interpregnancy interval, an interpregnancy interval less than 6 months increases the risk of preterm birth by 40%.[65] African-American women are nearly twice as likely as Caucasian women to become pregnant within 6 months of delivery, and the increased proportion of short interpregnancy intervals may explain 8% of the racial disparity in preterm birth.[64,65]

Substance abuse

Substance abuse during pregnancy is a risk factor for preterm delivery, other adverse pregnancy outcomes, and developmental effects in the child. Cocaine and

tobacco use have both been associated with preterm birth and low birth weight.[66] African-American women are less likely to smoke than White women. In addition, Black women who smoke are less likely to be heavy smokers than White women who smoke.[67] Marijuana and alcohol consumption have not been associated with preterm birth.[66,68]

Maternal Age

Both the youngest and oldest mothers are at increased risk of preterm birth. Compared to women aged 20-24, teenaged mothers 10-19 were 20% were more likely to have a preterm birth and 26% more likely to have a very preterm birth. The youngest mothers, aged 10-15 were 65% more likely to deliver preterm birth.[69] In a meta-analysis of early age at first childbearing and pregnancy outcomes, Gibbs, et al, found that the youngest adolescents were 1.82 times as likely to deliver a low birth weight infant as older adolescents or adults, and young women <15 years of age were 1.5 times as likely to deliver a preterm infant.[70] The excess risk of preterm birth in the youngest adolescents is thought to be associated with reproductive immaturity and confounded by social factors associated with both teen pregnancy and preterm birth. Compared to women in their twenties, women over age 40 are 1.6-1.8 times as likely to have a preterm delivery.[71,72] The excess risk of preterm birth in older mothers is of concern given that births to mothers 40-45 are increasing.[4]

Stress

One of several key recommendations for preterm birth research made by the Institute of Medicine is to study the relationship of stress and preterm birth.[29] To date, a variety of types of stress have been examined, included general stress, major life events, stress from racism and discrimination, and pregnancy related stress. Stressful life events, such as loss of a loved one, have been associated with poor pregnancy outcomes.

An Australian population-based survey of pregnant women found that women experiencing 3 or more significant life events were more likely to have a low birth weight infant, more likely to delay entry into prenatal care, and more likely to report perceived discrimination.[73,74] Women experiencing at least one significant life event in each of four domains in the year preceding delivery were more than twice as likely to experience a stillbirth as women experiencing no significant life events.[75] Chronic experiences of high stress has also been associated with preterm birth.[76] Pregnancy related stress is anxiety surrounding progress and outcomes of the current pregnancy, as well as anxiety related to parenting ability. This pregnancy related stress has consistently been associated with preterm birth.[76,77]

When stress occurs in pregnancy is important. The physiologic response to stress is dampened as pregnancy progresses. In a small study of women experiencing a 6.8 magnitude earthquake during pregnancy or immediately postpartum, women who were in the first trimester rated the earthquake as more stressful than women who were at a later gestation, and had a mean gestation that was shorter than women who experienced the earthquake in the second or third trimesters, and shorter than the gestation of women who delivered before the earthquake.[78]

Large-scale events such as the terrorist attacks of September 11, 2001 have been associated with poor pregnancy outcomes. Pregnant women residing in New York City were more likely to deliver infants who were low birth weight or small for gestational age in the week following the attacks than women who delivered one month before the attacks.[79] The effects of such an event are far reaching. Dutch women with exposure to the attacks via the news media delivered smaller infants than women who gave birth one year later.[80]

Stress and Social Aging

One theory proposed to explain the Black-White racial disparity in perinatal outcomes is Geronimus's weathering hypothesis, which is a type of cumulative stress associated with lifetime experiences of stressful events such as discrimination and the results of poverty.[81] Under the weathering hypothesis, Geronimus posits that the effects of maternal age and psychosocial factors combine and any associations of perinatal or health outcomes with age are accelerated for Black or African-American women due to increased exposure to lifelong psychosocial stressors.[81,82] Geronimus based her hypothesis in part on the observation that the risk of poor pregnancy outcomes is lowest for the youngest African American mothers. To illustrate, Geronimus demonstrated that for African American mothers residing in Michigan, at low and average levels of socioeconomic status, maternal age was positively associated with low birth weight. No association between age and low birth weight was noted in high SES African-American women, and the effect of age was much sharper in women of the lowest socioeconomic class. In addition, there was no significant effect of socioeconomic status in women less than age 25. By age 34, low SES women had 2.6 times the odds of delivering a low birth weight infant as their high SES counterparts.[82] These associations were not observed in White women.

Applying the weathering hypothesis to preterm birth, a five year increase in age was associated with an 11% increase in the odds of preterm birth for primiparous White nonsmokers, a 17% increase for primiparous White smokers, a 20% increase in primiparous non-Hispanic Black nonsmokers, and a 56% increase in risk for non-Hispanic Black smokers.[83] In the same study, the association with age was greater with increasing neighborhood deprivation for all White women and Black nonsmokers. Among Black smokers, the effect of age was similar at all levels of neighborhood deprivation (OR Range 1.54-1.59).

Expanding on her work on weathering, Geronimus measured telomere length in a population of Black and White women.[84] Telomeres are the end segments of chromosomes, and their length shortens with age. Telomere shortening has also been observed in those with illnesses such as cancer. In Geronimus's study, middle aged Black women were found to be 7-8 biologic years older than White women of the same chronologic age.[84]

Social Support

Supporting the idea that reduced stress during pregnancy lowers the risk of adverse perinatal outcomes are results reported in a 2009 issue of *Morbidity and Mortality Weekly Review*. In the absence of changes in obstetric practice, the Black-White disparity in infant mortality disappeared in Dane County, Wisconsin, a state with one of the highest Black infant mortality rates in the nation.[85] Some have suggested that the observed sharp decline in preterm birth among African-American women in the region was due to an increase in social support services to pregnant women.[86]

CenteringPregnancy, a newer approach to prenatal care, combines standard prenatal care with prenatal education and peer support in a group setting. While women participating in CenteringPregnancy did not report increases in social support, they did report reductions in stress, anxiety, and depressive symptoms.[87] In a sample of adolescents participating in CenteringPregnancy, 10% of young women delivered preterm infants, compared to 25% in an external comparison group.[88]

Genetics and Heritability in Preterm Birth

Heritability in preterm birth has been estimated at 25-40%. [89] However, it is unknown if the patterns of heritability are equivalent in White and non-White populations.

Genetic factors have been associated with preterm birth, and these factors vary by race.[90-92] While genetic factors may play a role in preterm birth, it is unlikely that genetic patterns contribute greatly to the observed racial disparities present in preterm birth.

Racial disparities in preterm birth persist, even among middle to upper class, college educated, Black/African American women to whom the traditional social risk factors do not appear to apply. However, while income has increased over time for African Americans, the Black-White disparity in wealth has continued to widen.[93] Shapiro, et al, state each $1 increase in income results in only a $0.69 increase in wealth for Blacks, compared to $5.19 for Blacks.[93] Even in populations of low socioeconomic class, risks of preterm birth are greater for African American women than for White women.[94] These observations lead to the hypothesis that there may be an interaction between environment (e.g. stress), and other, possibly genetic, factors contributing to preterm birth.

Conclusion

In summary, 12% of infants born in the United States are born preterm each year, leaving them at increased risk of morbidity and mortality. Many risk factors for preterm birth have been identified, yet no effective interventions to prevent preterm birth have been developed. Stress reduction and social support interventions have shown promise, with support from the partner a largely untouched avenue of investigation. Paternal contributions to preterm birth will be discussed in Chapter 2.

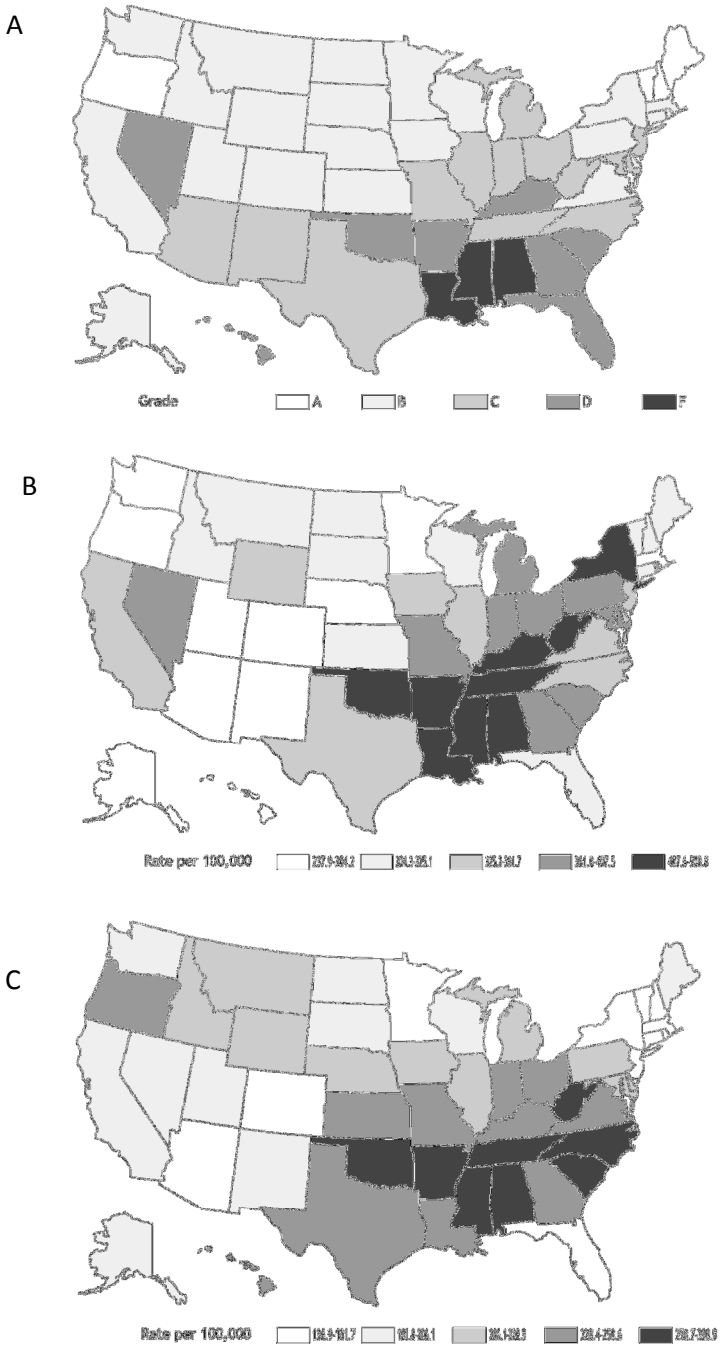

Figure 1.1: Geographic Comparison of Preterm Birth, Heart Disease Mortality, and Stroke Mortality in the US. A: March of Dimes Prematurity Report Card Grades.[31] B: Heart Disease Mortality for US Adults 35 and Older, 2008-2010. C: Stroke Mortality for US Adults 35 and Older, 2008-2010.[32]

Chapter 2: The Role of Fathers during Pregnancy and Pregnancy Outcomes

Reprinted from: Miller AM and Hogue CJ. The Role of Fathers during Pregnancy and Pregnancy Outcomes in African-American Perspectives: Family Dynamics, Health Care Issues and the Role of Ethnic Identity*, Harris MS, ed. with permission from Nova Science Publishers, Inc.*

Abstract

African American infants experience higher rates of preterm birth and low birth weight than infants of other races and ethnicities. These higher preterm and low birth weight rates contribute to persistent higher African American infant mortality and intellectual challenges for babies that do survive. Causes for these racial disparities are poorly understood. All too often, only maternal factors are considered in the exploration of causal factors, with any potential for paternal contributions disregarded. However, there is a growing body of evidence that paternal contributions, including involvement during pregnancy, may be important. For example, several studies have observed that if the father's name is missing from the birth certificate, the infant has a higher risk of low birth weight, preterm delivery, or death. Obviously, the missing name isn't the cause, but rather a marker for the cause. From these studies, it has been estimated that 60-70% of adverse pregnancy outcomes could be eliminated by identifying and mitigating that cause. If lack of father involvement contributes to that cause, interventions to improve couple dynamics within pregnancy could lead to reduced racial disparities since nearly 75% of African American infants are born outside of marriage.

However, it is important to note that not all African American men are "deadbeat" dads portrayed in media accounts. A large majority of unmarried couples are romantically involved at the child's birth. And, upon dissolution of the relationship, African American men maintain higher levels of involvement with their children, for longer periods of time, than their White or Hispanic peers maintain.

In this chapter, we present the growing body of evidence supporting the association of paternal involvement during pregnancy and adverse pregnancy outcomes. Next, we summarize the literature on paternal involvement during pregnancy including known barriers to paternal involvement, particularly as they relate to African American men.

Finally, we discuss some limitations and gaps in the current literature in this area and recommend directions for future research.

Introduction

Studies of fathers and childhood development date back to World War II, when researchers studied the effects on children of fathers absent because of the war. As social norms changed, and both divorce and non-marital births became more common, the question of how absent fathers affect children's wellbeing and development became more important. It is now known that children who grow up without an involved father or father figure are more likely to have lower educational achievement, and to have more behavioral problems than those with a strong father figure. However, little is known about the role of fathers during pregnancy, and the potential effects on pregnancy outcomes. In the African-American community, a majority of births occur outside of marriage, and African Americans bear a disproportionate burden of poor pregnancy outcomes.

Racial Disparities in Pregnancy Outcomes

Complications of preterm birth (<37 completed weeks gestation) and low birth weight (<2500g), taken together, are the leading cause of Black infant mortality and the second leading cause of infant mortality overall behind congenital malformations.[1,2,95] Annually, 12% of live births occur prior to 37 weeks gestation, and 8% have a birth weight less than 2,500 grams.[4,96] Rates of preterm birth in the United States are much higher than in all developed and many developing nations. In 2010, the United States represented 42% of preterm births in developed nations.[33] Despite the national goal of Healthy People 2010 to reduce rates to 7.6% from the 1999 baseline of 11%, preterm birth continued to rise in the United States, reaching a peak of 12.8% in 2006. [4,24] Since then, there has been a leveling off, followed by a slight decrease to 12% in 2010.[4] The current goal is to reduce preterm births to a level of 11.7% of all live births by the year 2020.[25] Though preterm births represented 12.8% of US live births in 2005, they

accounted for nearly half of all infant hospitalization costs, totaling $26.2 billion, or approximately $33,000 in medical costs per preterm infant, compared to $3,000-5,000 per term infant.[2,28,29] The Institute of Medicine estimates that the total societal costs are $50,000 per preterm infant.[29] Infants born preterm are not only at an increased risk of death, but also have an increased risk of physical impairments, and neurodevelopmental delays.[1,26,27] Effects of preterm birth may even extend to adult health, with young adults who were born preterm showing signs of cardiovascular disease as early as age 18.[97,98]

The high incidence of preterm birth in the United States is thought to be driven by the existence of a large racial/ethnic disparity. Among non-Hispanic Black women, 17.2% of infants are preterm, compared to 10.8% for non-Hispanic White women, and 11.8% in Hispanic women.[1,43] African American women are also almost twice as likely as Caucasian women (13.6% vs. 7.19%, respectively) to deliver low birth weight infants (<2,500 g).[96]

Despite an improving trend among African American women in recent years [2], rates of preterm birth and low birth weight are still remarkably high, and the disparities are unexplained by the "traditional risk" factors.

The excess preterm birth in the African-American community is often attributed to inequalities in socioeconomic status (SES). However, after adjusting for SES, the disparities in preterm birth and other adverse pregnancy outcomes persist. In fact, the disparity widens with increasing SES. Over 10 per 1,000 preterm infants are born to Black college educated women, compared to 3.7 per 1,000 for a White college educated woman, and 9.9 per 1,000 for White high school dropouts.[56] When compared to their White college educated peers, college educated Black women are more than twice as likely to deliver a low birth weight infant, 67% more likely to have a preterm birth, 82% more likely to have their infant die within the first year of life.[99,100] These effects are intergenerational. Second generation college educated Black women were less likely to

have a preterm birth than their college educated mothers, but were still over 3 times as likely to deliver preterm compared to a cohort of college educated White women.[44]

Variation is seen in preterm births to women of the African Diaspora. Among black women in New York City, African born women were 22% less likely than US-born black American women to have a preterm delivery, and US-born non-Hispanic white women were 55% less likely to have a preterm delivery than black American women.[48] Caribbean black and African immigrants to the United States have lower rates of preterm birth and low birth weight than U.S. born Blacks.[49,50] As seen in other immigrant populations, the risk of preterm birth to foreign born black women increases with time in the US.[45,46] This variation in preterm birth by origin in Black women refutes the notion of genetic differences in blacks contributing to increased risk for preterm birth. Further, the increased risk associated with acculturation suggests socio-cultural effects unique to residence in the United States such as poor diet, limited social support, and racism.

Preterm birth, stillbirth, and infant deaths are more likely to occur to unmarried women, who tend to be less educated, with lower income.[55,101] These women are also more likely to be black or African American. Unmarried women are also less likely to seek prenatal care, and engage in unhealthy prenatal behaviors such as smoking.[18,55] It is unclear if cohabiting offers protection from outcomes such as stillbirth when compared to women in non-cohabiting unions.[55,101]

Father's Biological Impact on Pregnancy Outcomes

Maternal risk factors for preterm birth such as age, race, education and income, are also paternal risk factors. Paternal demographic characteristics have been studied in relationship to both preterm birth and low birth weight. Paternal race has been associated with preterm birth, fetal growth restriction, and stillbirth. When the race of both the mother and father are considered, risk of poor pregnancy outcome increases if

either parent is Black, when compared to couples in which both the mother and father are white.[102-104] Gestational age and birth weight of the father have been linked to both of these outcomes in offspring through an interaction with gestational age and birth weight of the mother. [105] Paternal birth characteristics were not independently associated with preterm birth in offspring, however. When stratified by maternal birth weight, increasing paternal birth weight was associated with in increased risk of preterm birth only in low birth weight (<3kg) mothers. Lie and colleagues found that the gestational age of offspring was positively associated with paternal gestational age, yet inversely associated with paternal birth weight.[106] Because of the strong associations of maternal birth characteristics with preterm birth and low birth weight in the offspring, and very weak associations with paternal birth characteristics, Wilcox, et al, concluded that any heritable components were maternal.[107] Unfortunately, aside from education and income, where African-American males are often at a disadvantage, these risk factors are non-modifiable. The shared socioeconomic risk factors such as education and income may be an indication of patterns of romantic partnering, where low income men are more likely to partner with women of the same socioeconomic class or lower, while women tend to choose partners who can provide a financial benefit.

Multi-partnered fertility is quite common in the African-American community. Changing partners between pregnancies has been associated with a change in risk for poor outcomes such as preeclampsia, birth defects, and preterm birth. When a mother changes partners after a pregnancy ending in a preterm birth, the risk of preterm birth in the subsequent pregnancy may be lowered. Of four studies identified by Zhang and Patel in their systematic review, three studies conducted in Norwegian populations had mixed findings.[23] The fourth, conducted in California, included Black women and found that for births occurring before 34 weeks of gestation, the risk of preterm birth was reduced

by 33% after changing partners.[21] In this study, as well as studies of preeclampsia, HLA antigen matching between parents has been suggested as a potential mechanism.[19-22]

Father Involvement in Pregnancy

While paternal involvement after the baby's birth has been associated with child outcomes from early childhood through adolescence, little attention has been paid to how paternal involvement during the prenatal period may affect pregnancy outcomes.

In general, men have been largely overlooked in the field of maternal and child health. As it is the mother who carries the child, it is her health status and behaviors that are most proximal and thus directly affect the child. What is not appreciated is how the father may also affect the child through his effects on the mother's physical health (e.g. intimate partner violence, stress, sexually transmitted infections), mental health (e.g. self-esteem, social support), and socioeconomic status (e.g. marital status, income, financial/child support). For example, sexually transmitted infections (STIs) have been associated with both intimate partner violence (IPV) and adverse pregnancy outcomes [108]. Women who were victims of intimate partner violence during pregnancy were twice as likely to deliver low birth weight infants compared to women not experiencing violence.[109] Victims are also likely to experience an unplanned or unintended pregnancy as the male partner exerts reproductive control through both forced unprotected sex and contraceptive sabotage.[110,111] IPV can also result in isolation of the woman from sources of social support such as friends and family, and inadequate prenatal care.[112] Thus, there are many ways in which negative interactions with the male partner can influence pregnancy outcomes.

Two conceptual models have attempted to illustrate the ways in which father involvement may affect pregnancy outcomes.[113,114] The first shows the ways in which

social, psychosocial and biomedical characteristics of both the mother and father act independently and together to affect pregnancy outcomes (Figure 1).[113] However, this model is somewhat one sided in that arrows between the father and mother are unidirectional, with the father's characteristics affecting the mother. This model does not take into account that the degree of father involvement may be related to interactions with the mother. A non-residential father, for example, may limit his interactions with the mother if she frequently badgers or belittles him.

The second model expands upon Lamb's concepts of engagement, accessibility, and responsibility by including the couple's relationship (Figure 2).[114,115] By adding the couple's relationship and its dynamics to the model, the shortcomings of the previous model are addressed. Further, this model shows how the dimensions of father involvement may affect maternal prenatal behaviors, which in turn, determine pregnancy outcomes.

Calls for including men in maternal and child health research are growing in number and are quite compelling.[113,116,117] Studies involving fathers are less common because they are much more expensive and labor intensive than studies of women and their children. Compared to the usual mother-child dyad, the mother-father dyad is less stable over time as relationships dissolve and parents repartner. This makes it particularly difficult to retain fathers in longitudinal studies of father involvement. Any information on fathers is usually obtained from maternal interviews, but the validity of these proxy responses is unknown. Qualitative interviews with non-custodial fathers indicate that men want to be involved in such studies, yet they just aren't asked to participate. This leaves men feeling disrespected and unimportant.[118]

While little is known about the effects of father involvement during pregnancy, we do know that unmarried women exhibit worse prenatal health behaviors than married women and that maternal health behaviors during pregnancy vary by paternal

intention and wantedness of the pregnancy.[18,119] Pregnancies to unmarried women or those wanted by only one parent are 30-50% more likely to delay entry into prenatal care compared to pregnancies intended by both partners.[18,119] In studies of the Early Childhood Longitudinal Study- Birth Cohort, mothers with involved partners were 42% more likely to enter into prenatal care during the first trimester when compared to women with uninvolved partners. In the same study, there was a 40% increase in the odds of preterm birth when the pregnancy was intended by only the father.[119]

In one of few studies of father involvement during pregnancy and pregnancy outcomes, Padilla and Reichman found that unmarried women who received financial support from the child's father had a reduced risk of low birth weight.[120] Interestingly, while non-cohabiting women showed an increased risk of delivering a low birth weight infant compared to cohabiting women, women not involved with the father of their child were not at increased risk. Padilla and Reichmann suggest that unwed women not with a partner may avoid the stressful nature of a potentially volatile relationship.

The presence or absence of a father's name on the birth certificate appears to be the most widely studied indicator of paternal involvement, and has been associated with negative perinatal outcomes in several studies.[6-8,121-125] While easily accessible, these studies vary by the components used to assess paternal involvement. While some studies have used missing or partially missing names as an indicator, others have used missing race and age.

In two studies of over one million Florida birth records, Alio et al, found that records with a missing father's name were more likely to be preterm, low birth weight, or small for gestational age, and at an increased risk of infant mortality when compared to records with complete paternal name available.[6,121] These observations held true for both adult and teen mothers.[122] A similar study of birth records in Minnesota also found that marital status was associated with preterm birth and low birth weight.[8] In this

study, Ngui and colleagues found that infants born to unmarried couples with either voluntary or court established paternity were approximately 20% more likely to be born preterm compared to infants born to married couples. When there was no father of record, the odds of preterm birth were increased by 40-60% when compared to births to married couples. Similar patterns have been observed for other obstetric outcomes such as placental abruption.[123] Tan also studied presence of paternal demographic characteristics on the birth certificate and found that those missing either or both paternal age or race were at increased risk of fetal growth restriction, preterm birth, low Apgar scores, and infant mortality.[125] However, this study was of twin births, a population at increased risk of adverse pregnancy outcomes.

While the data obtained from birth certificates establishes a consistent association of missing fathers with poor pregnancy outcomes, it is obvious that these associations are non-causal. The act of indicating a father's name is merely a proxy for any of several ways in which a father is not present or involved during pregnancy. Another study using birth certificate records to evaluate the relationship between missing paternal information and low birth weight found no association between missing paternal demographics and low birth weight after propensity score matching for maternal demographic and socioeconomic characteristics, obstetric characteristics, maternal comorbidities and pregnancy complications.[124] The authors did find that the risk factors for low birth weight, such as marital status and maternal weight gain, were more prevalent in those with missing paternal information. From this, we gather that the increased risk of low birth weight among women with uninvolved partners may not be due to the missing partner, but due to the excess burden of other risk factors for low birth weight in this population. Thus, a deeper investigation of the causal relationships between these variables is warranted.

There are many reasons why a father's name may not be present on a birth certificate. For example, 80% of teen mothers aged 15-17 have partners over 18 years of age and may choose to not report father information to prevent statutory rape charges being brought against the father.[126] When the relationship between unmarried parents is strained or nonexistent, a mother's choice not to acknowledge the father on the birth certificate or not to give the child the father's last name can be seen as the ultimate insult.[127] However, the presence of a name is not necessarily indicative of an involved or actively engaged father. When combined with marital status, this indicator acts as a proxy for at least a basic level of paternal acknowledgement for unmarried women. While only 1% of married mothers fail to provide complete paternal information on the birth certificate, 52% of unmarried mothers do not complete this information.[7] The decision of an unmarried father to sign a paternity acknowledgement and of the mother to acknowledge the father indicates an ongoing relationship of some sort. While requirements for the reporting of paternal data for married couples varies by state, an unmarried woman generally cannot report paternal information without an acknowledgement of paternity from the father.

A few studies have examined pregnancy outcomes by a three-level variable of partner status at birth (married, cohabiting, unmarried and not cohabiting). For example, the Stillbirth Collaborative Research Network found that cohabiting parents had a similar risk of stillbirth as married couples, while unmarried and non-cohabiting mothers were 62% more likely to have a stillbirth when compared to married women.[101] A European study of preterm birth found that overall, the risk of preterm birth was 20% higher for cohabiting and 30% higher for non-cohabiting women compared to married women.[128] However, magnitude of the effect of marital status was greater (29% and 61%, respectively) in countries where nonmarital births were less common than in countries where nonmarital births were more common (12% and 10%). These studies suggest that

the father's presence in the mother's life attenuates the risk to infants associated with the partners not being married.

While the absence of a father's name on the birth certificate has been thought to represent low father involvement, there may be reasons unrelated to the father for the missing demographic information. There are maternal behaviors which may be associated with both pregnancy outcomes and missing paternal demographics. For example, a study using dried blood spots to assess the prevalence of prenatal cocaine use found that among unmarried women, 14.0 per 1,000 newborns tested positive for cocaine metabolites compared to 7.5 per 1,000 newborns when the father was identified on the birth certificate.[129] In addition, a study of congenital syphilis in an urban hospital found that infants born with congenital syphilis were less likely than those without syphilis to have a father's name on the birth certificate.[130] Over half (56.5%) of the congenital syphilis cases had inadequate or no prenatal care, though mother-to-child transmission is preventable with prenatal screening and treatment. Under current guidelines, pregnant women are screened for syphilis at the first prenatal care visit, and in the third trimester if they've previously tested positive or are considered high risk.[131] Women with risky sexual behaviors may have multiple partners, and the father may be unknown.

By addressing the issue of paternal involvement, there exists the potential to address the persistent racial/ethnic disparity in pregnancy outcomes. Lane and colleagues found that accounting for missing paternal demographics on the birth certificate essentially eliminated disparities in postneonatal mortality in Syracuse, NY.[12] They estimated that the postneonatal mortality rate (infant deaths occurring 28 days to 1 year of age), after removing the portion attributable to missing fathers, was 2.5 per 1,000 live births for Whites, and 2.7 per 1,000 live births for Blacks. Alio and colleagues came to the same conclusion when their study of 1.3 million Florida birth certificates showed

that 70% of excess infant mortality (deaths occurring <1 year of age) could be eliminated if those infants had involved fathers, as measured by missing paternal name.[9] These findings are especially striking, given that approximately 75% of African American infants are born out of wedlock, and rates of nonmarital fertility are increasing most rapidly among Hispanics.[13,14]

In the media, men who father children outside of marriage, particularly African American men, are often portrayed as "deadbeat dads." In reality, however, this is often not the case. The Fragile Families and Child Wellbeing study found that over eighty percent of unmarried parents are in romantic relationships at the birth of their child.[132] Continued paternal involvement is largely predicted by the relationship status of the parents. Half of parents in a non-cohabiting romantic relationship at birth are still romantically involved by the child's first birthday. [133] For parents no longer in romantic relationships, the probability of father involvement decreases over time as the mother and father each repartner, and decreases further still if either of the parents has additional children with their subsequent partners. It appears that fathering is seen as a "package deal," and when the father is no longer involved with the mother of his child, it also means that he is less likely to be involved in the child's life.[134-136] One year after unwed parents end their romantic relationship, 42% of fathers report having seen their children at least eight days in the previous month.[134] This figure falls dramatically, with only 8% reporting the same level of involvement four years after the breakup. The estimated probability of father involvement after five years of follow-up when the father has subsequent children with a new partner is .24 for Black men, compared to .15 for Hispanic men, and .08 for White men.[134]

Measuring Father Involvement

Currently, there are no "gold standard" instruments for measuring paternal involvement. Acting on fatherhood initiatives supported by the Clinton Administration, six nationally representative studies each studying families and childhood development united under the umbrella of the Developing a Daddy Survey (DADS) Study.[137,138] These studies can be classified as having two distinct purposes: to evaluate the actions of *becoming a dad* (National Survey of Family Growth, National Longitudinal Survey of Youth 1997, National Longitudinal Study of Adolescent Health), and the actions of *being a dad* (Fragile Families and Child Wellbeing Study, Early Head Start Evaluation – Fatherhood Component, Early Childhood Longitudinal Study – Birth Cohort).[138] Together, these studies sought to improve recruitment of fathers and improve the measurement of paternal involvement.

In what seems to be one of the only studies with the ability to study both father involvement and outcomes of pregnancy, the Fragile Families Child Wellbeing Study has used several dimensions of parental relationship quality, measured at the time of birth, to explore paternal involvement.[120] Going beyond the traditional dichotomous indicator of marriage, they evaluated relationship status (married, cohabiting, romantically involved/"visiting", just friends, or not involved), the length of time the parents knew each other before becoming pregnant, financial and material contributions, whether the father suggested abortion, whether the father visited the hospital at the time of birth, and whether the male self-identifies as the father (name on birth certificate). Given the very high positive responses to these questions for cohabiting (>93%) and visiting fathers (73-98%), they may not be the best measure of paternal involvement for unmarried couples who are romantically involved.[132] However, they may serve to distinguish couples who are not romantically involved from those who are. When interviewed after the birth of the child, only a third of mothers not in romantic relationships with the father reported

financial support from the father, compared to 97% for cohabiting fathers and 85% for visiting fathers.[132] In the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), paternal prenatal involvement was defined as discussing the pregnancy with the mother, seeing an ultrasound or sonogram, feeling the baby move, attending childbirth classes, or buying things for the baby. Residential fathers who reported any of these activities were more likely to be involved with their infants in both cognitive and nurturing activities.[139] It is unknown how well these measures capture the essence of father involvement during pregnancy, as neither study has related these activities, measured during pregnancy or at birth, to pregnancy outcomes.

Father involvement during childhood has often been measured by engagement (direct participation in activities), and accessibility (availability or indirect participation), and responsibility (securing and managing resources for the child).[115] These measures have often been evaluated through the use of time diaries in which the father records how his waking hours were spent. However, these measures cannot be directly measured, as originally described, during pregnancy.

Barriers to Unmarried Father Involvement

Fathers who want to be involved with their partners during their pregnancies may face considerable obstacles. Of the barriers to involvement cited by unmarried fathers, the three most prevalent factors are employment, maternal family members, and new romantic relationships. Most men still regard themselves as breadwinners for their families. For low income or non-residential fathers, this interpretation may drive them away. Involvement can be a transient experience if based solely upon employment status and income. When men are unable to contribute financially to their child's wellbeing, they may choose to not be present at all until they are able to provide some

type of child support. In addition, when the parents have a strained relationship, the mother may limit access to the child when child support is limited, with the father often feeling as if he is buying time with his child based upon the amount of child support he can provide.[140] For low income fathers working several jobs to make ends meet, time spent working to provide for the child is more important than time spent in activities with the child. Interestingly, employment status is also a barrier to involvement in fathers with higher SES. In this case, a more demanding and well-paying job also results in less time spent engaged in activities with the child.

Fathers often cite the mother and her extended family members as barriers to their being involved in the lives of their children.[118] Custodial mothers often act as gatekeepers, and prevent or limit interactions between the father and his child. Sometimes, this is due to her seeing the father as a poor influence due to addiction or involvement in criminal activity.[141] Other times, the mother's gatekeeping is a reflection of the quality of her own relationship with the father. Maternal kin also act as gatekeepers between the father and child, sometimes because of the father's past actions.

Lastly, new romantic relationships are cited as barriers to father involvement. Once a father has repartnered, in order to preserve the new relationship, he may be hesitant to be in contact with the mother of his child/children. Similarly, the mother may limit contact with her child's father if she has repartnered. In addition, the father's new partner may be resentful when household resources are distributed elsewhere.[118,134] This can be even more difficult when a father has several children residing in different households. These barriers are not unique to African American men, but as marriage is less common for African Americans, a greater proportion of children in these fragile families are affected by such barriers. A mediating factor for African American children may be that African American men seem better equipped at navigating around such barriers, with the eventual decline in involvement occurring at a slower rate.[134]

Limitations of the Current Literature

A key limitation of the current literature is that no single, validated measure of paternal involvement during pregnancy exists. This makes it difficult to compare findings across studies. Pregnancy studies often only enroll mothers, with paternal information collected via the mother as a proxy. The validity of the mother's responses is unknown, and would perhaps better be measured as her perceived receipt of social and/or financial support. Another measurement issue arises when researchers adopt a "maternal template" to measure father involvement.[142] The maternal template involves adapting existing measures of maternal involvement and nurturing for use in fathers, which does not always allow for variation in the ways in which mothers and fathers relate to and interact with their children.

Studies of father involvement tend to limit participation to biologic fathers, usually the residential biologic father.[143] In doing so, other father figures such as non-custodial or non-residential fathers, step fathers or social fathers are not represented. While most pregnant women remain romantically involved with the child's biologic father at birth, it may be important to consider the social and financial contributions of other male figures including new romantic partners during the woman's pregnancy. A similar limitation is the many assumptions made regarding married fathers' involvement. It is assumed that a pregnancy occurring within marriage is wanted and intended by both parents. However, while 40% of pregnancies occur outside of marriage, half of all pregnancies are unintended.[144,145] These types of assumptions have led to missed opportunities in existing studies. For example, the Fragile Families Study recruited over 1,000 married couples, but they were not asked the questions about father involvement during pregnancy.

To date, studies demonstrating an association between various measures of paternal involvement and adverse pregnancy outcomes are cross-sectional in nature, with measurement of both exposure and outcome occurring at the same time, usually at the birth of the child. The Early Childhood Longitudinal – Birth Cohort did measure paternal involvement during pregnancy, but contrasted this with paternal involvement after the child's birth, therefore missing the opportunity to study the outcomes of pregnancy.[139,146]

While the data obtained from birth certificates appears to be fairly consistent, the presence or absence of paternal name and demographics serves only as a proxy for the true mechanism underlying the observed associations. While proposed hypotheses suggest that increased paternal involvement is related to a reduction of maternal stress during pregnancy, there have been no investigations, to date, to test this hypothesis, or to test whether this association is psychosocial or economic in nature.

Finally, while many studies have evaluated health and behavior outcomes from early childhood and beyond, few have studied father involvement in the context of birth outcomes. Fewer still have directly recruited fathers.

Recommendations

The strong association of poor pregnancy outcomes with missing paternal vital statistics on the birth certificate point to the importance of studying father involvement during pregnancy. It is not yet known if missing data is an indicator of financial or social support, or some other unmeasured dimension. More sophisticated studies must be conducted to explore the meaning behind these consistent and disturbing findings. To increase our knowledge of the role that prenatal father involvement plays in preventing adverse pregnancy outcomes, there must first be a concerted effort to recruit men into studies of maternal and child health. These studies should include both married and

unmarried men, men whose partners are expecting, and for prospective or longitudinal studies, sexually active men who may produce a pregnancy.

Conclusion

It is well known that the presence of an involved father in a child's life leads to happier, healthier children. Growing evidence supports that the benefits of an involved father begin before birth. Though the mechanisms underlying this association are vague, and have not been fully explored, the potential for reducing the occurrence of adverse pregnancy outcomes such as preterm birth and low birth weight are great. This is particularly true for African Americans, where the both the risk of these outcomes and out of wedlock childbearing, are high.

Table 2.1: Summary of Studies of Preterm Birth (< 37 weeks' gestation) and Missing Paternal Data on Birth Certificate

Citation	Region/State	Indicator of Paternal Involvement	N	Crude OR (95% CI)	Adjusted OR (95% CI)	Findings by Race	Confounders
Alio AP et al, 2010[51]	Florida Birth certificate records, 1998-2005	Father's first and/or last name missing	1,397,801 live born singletons		Complete name: 1.00 (ref.) Name missing or incomplete: 1.37 (1.84-2.00)	White, father present: 1.00 (ref.) White, father absent: 1.35 (1.30-1.40) Black, father present: 1.56 (1.54-1.59) Black, father absent: 2.03 (1.98-2.09)	Maternal age, parity, race, smoking, education, marital status, adequate prenatal care, comorbidities and pregnancy complications

Table 2.1: Summary of Studies of Preterm Birth (< 37 weeks' gestation) and Missing Paternal Data on Birth Certificate (cont.)

Citation	Region/State	Indicator of Paternal Involvement	N	Crude OR (95% CI)	Adjusted OR (95% CI)	Findings by Race	Confounders
Alio AP et al, 2011[52]	Florida Birth certificates, 1998-2007	Father's full name missing	192,747 singleton live births to teenage women		Complete or partial name: 1.00 (ref.) Name missing: 1.21 (1.17-1.25)	White, father present: 1.00 (ref.) White, father absent: 1.20 (1.13-1.27) Black, father present: 1.43 (1.37-1.49(Black, father absent: 1.73 (1.65-1.82)	Year of birth, race, education, tobacco use, parity, marital status, adequate prenatal care, infant gender, maternal complications

Table 2.1: Summary of Studies of Preterm Birth (< 37 weeks' gestation) and Missing Paternal Data on Birth Certificate (cont.)

Citation	Region/State	Indicator of Paternal Involvement	N	Crude OR (95% CI)	Adjusted OR (95% CI)	Findings by Race	Confounders
Ngui E et al, 2009[54]	Milwaukee, Wisconsin Pooled birth certificate data 1993-2006	Marital Status			Married: 1.00 (ref.) Paternity acknowledgment: 1.17 (1.09-1.25) Court established paternity: 1.04 (0.97-1.11) No father on record: 1.53 (1.45-1.62)		Maternal education, age, race, parity, tobacco use, comorbidities, prenatal care, prior preterm birth
Tan H et al, 2004[57]	US National Center for Health Statistics Multiple Birth File 1995-1997	Father's age and/or race missing	152,233 twin pairs	Age and race present: 1.00 (ref.) Partly missing: RR = 1.08 P<.05 Completely Missing: 1.01 P<.05			

Table 2.2: Summary of Studies of Infant Mortality and Missing Paternal Data on Birth Certificate

Citation	Region/State	Indicator of Paternal Involvement	Outcome	N	Crude OR (95% CI)	Adjusted OR (or RR) (95% CI)	Findings by Race	Confounders
Alio, AP et al, 2011[50]	Florida Linked birth and death certificates, 1998-2005	Father's first and/or last name missing	Infant Mortality (< 1 year of age)	1,586,805 live born single-tons		Infant Mortality: 3.41 (3.22-3.62)	White, father present: 1.00(ref.) White, father absent: 3.78 (3.42-4.17) Black, father present: 2.02 (1.89-2.16) Black, father absent: 6.74 (6.22-7.31)	Maternal age, parity, race, smoking, education, marital status, adequate prenatal care, comorbidities and pregnancy complications
			Neonatal Mortality (< 28 days of age):			Neonatal Mortality: 4.00 (3.71-4.32)	White, father present: 1.00(ref.) White, father absent: 4.40 (3.87-5.00) Black, father present: 2.17 (1.99-2.36) Black, father absent: 8.06 (7.28-8.93)	

Table 2.2: Summary of Studies of Infant Mortality and Missing Paternal Data on Birth Certificate (cont.)

Citation	Region/State	Indicator of Paternal Involvement	Outcome	N	Crude OR (95% CI)	Adjusted OR (or RR) (95% CI)	Findings by Race	Confounders
			Post-neonatal Mortality (28 days – 1 yr)			Post-neonatal Mortality: 2.74 (2.49-3.01)	White, father present: 1.00(ref.) White, father absent: 2.99 (2.56-3.49) Black, father present: 1.79 (1.60-1.99) Black, father absent: 5.01 (4.40-5.70)	
Gaudino et al, 1999[55]	Georgia Linked birth and death certificates, 1989-1990	All fields for father's name (first, middle last) missing	Infant Mortality	217,043 infants	2.3 (2.1-2.5)	2.0 (1.6-2.4)	White, father missing: 2.0 (1.7-2.4) Black, father missing: 1.7 (1.5-1.9)	Gestational age, small for gestational age, maternal race, marital status, education, age, smoking during pregnancy, maternal comorbidities and pregnancy complications; birth weight, adequate prenatal care,congenital

								malformations as effect modifiers

Table 2.2: Summary of Studies of Infant Mortality and Missing Paternal Data on Birth Certificate (cont.)

Citation	Region/State	Indicator of Paternal Involvement	Outcome	N	Crude OR (95% CI)	Adjusted OR (or RR) (95% CI)	Findings by Race	Confounders
Tan H et al, 2004[57]	US National Center for Health Statistics Multiple Birth File 1995-1997	Father's age and/or race missing	Neonatal Mortality	152,233 twin pairs	Partly missing: 1.99 P<.05 Completely Missing: 2.03 P<.05			
			Post-neonatal Mortality	152,233 twin pairs	Partly missing: RR = 2.07 P<.05 Completely Missing: 2.43 P<.05			

Table 2.3: Summary of Studies of Low Birth Weight (<2500 g) and Missing Paternal Data on Birth Certificate

Citation	Region/State	Indicator of Paternal Involvement	N	Crude OR (95% CI)	Adjusted OR (or RR) (95% CI)	Findings by Race	Confounders
Alio AP et al, 2010[51]	Florida Birth certificate records, 1998-2005	Father's first and/or last name missing	1,397,801 live born singletons		1.44 (1.41-1.47)	White, father present: 1.00 (ref.) White, father absent: 1.53 (1.47-1.59) Black, father present: 2.22 (2.18-2.27) Black, father absent: 2.73 (2.65-2.82)	Maternal age, parity, race, smoking, education, marital status, adequate prenatal care, comorbidities and pregnancy complications
Alio AP et al, 2011[52]	Florida Birth certificates, 1998-2007	Father's full name missing	192,747 singleton live births to teenage women		1.19 (1.15-1.23)	White, father present: 1.00 (ref.) White, father absent:1.24 (1.16-1.32) Black, father present: 1.98 (1.89-2.07) Black, father absent: 2.28 (2.17-2.40)	Year of birth, race, education, tobacco use, parity, marital status, adequate prenatal care, infant gender, maternal complications

Table 2.3: Summary of Studies of Low Birth Weight (<2500 g) and Missing Paternal Data on Birth Certificate (cont.)

Citation	Region/State	Indicator of Paternal Involvement	N	Crude OR (95% CI)	Adjusted OR (or RR) (95% CI)	Findings by Race	Confounders
Bracero et al, 2009[56]	West Virginia Hospital administrative database, 1999-2002	Father's age, race or last name missing	9,934 live births 980 low birth weight infants	1.60 P<.001	1.01 P=0.954		Propensity matched on parity, adequate prenatal care, gestation type, weight gain, age, marital status, smoking, alcohol, drug use, pregnancy complications, maternal race, insurance, education, comorbidities

Table 2.3: Summary of Studies of Low Birth Weight (<2500 g) and Missing Paternal Data on Birth Certificate (cont.)

Citation	Region/State	Indicator of Paternal Involvement	N	Crude OR (95% CI)	Adjusted OR (or RR) (95% CI)	Findings by Race	Confounders
Ngui E et al, 2009[54]	Milwaukee, Wisconsin Pooled birth certificate data 1993-2006	Marital Status	151,869 singleton live births		Married: 1.00 (ref.) Paternity statement: 1.22 (1.13-1.31) Court established paternity: (1.12 (1.04-1.20) No father on record: 1.58 (1.48-1.67)	White, married: 1.0 (ref) White, paternity statement:1.19 (1.04-1.37) White, court established paternity:1.26 (1.07-1.48) White, no father on record: 1.66 (1.47-1.88) Black, married: 1.0 (ref) Black, paternity statement:1.09 (0.97-1.21) Black, court established paternity: 0.97 (0.89-1.06)	Maternal education, age, race, parity, tobacco use, comorbidities, prenatal care, prior preterm birth

						Black, no father on record: 1.38 (1.27-1.50)
Tan H et al, 2004[57]	US National Center for Health Statistics Multiple Birth File, 1995-1997	Father's age and/or race missing	152,233 twin pairs	Complete information : 1.00 (ref.) Partly missing: 1.17 P<.05 Completely Missing: 1.26 p<.05		

Figure 2.1: A Simple Framework for Father Involvement during Pregnancy

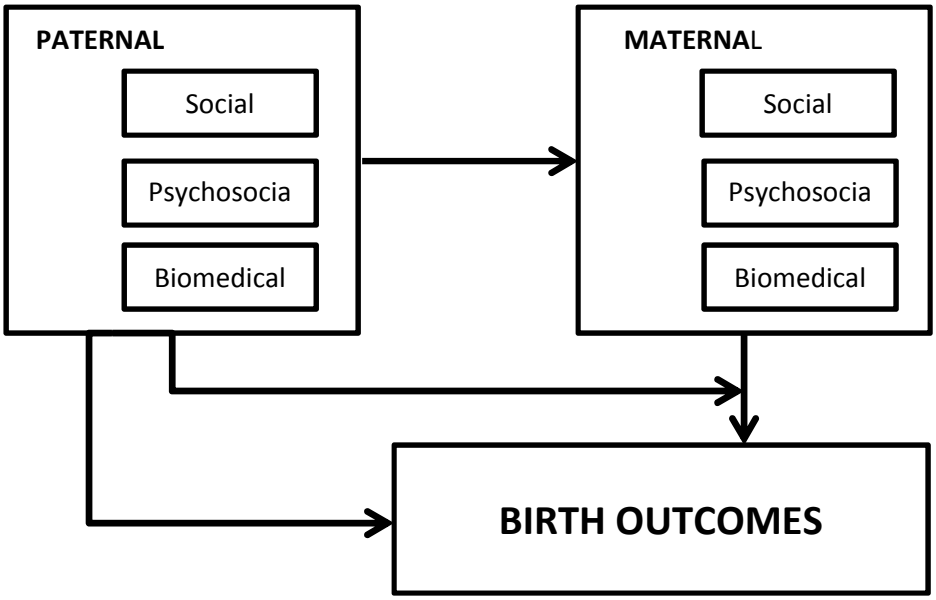

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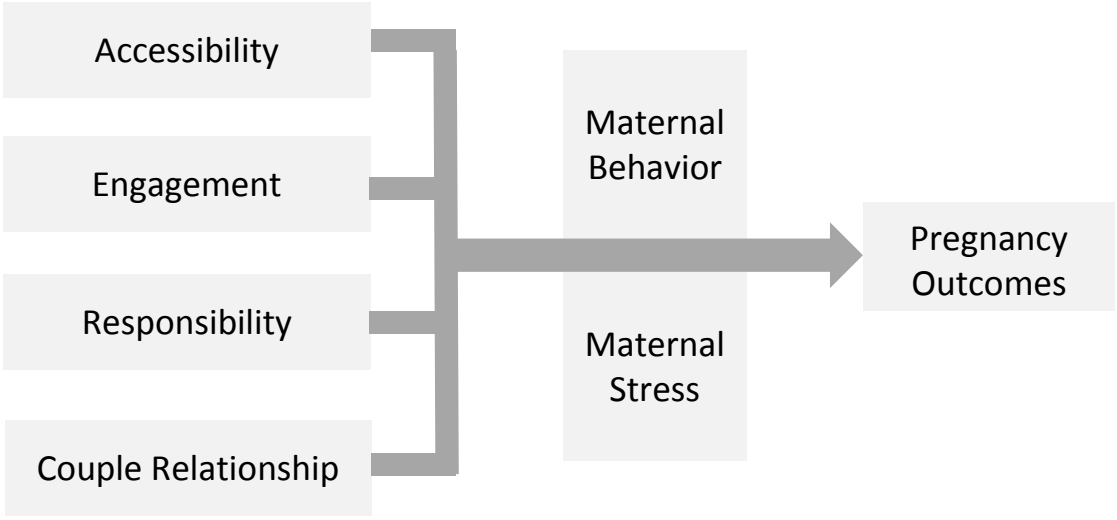
Figure 2.2: An Advanced Framework for Father Involvement During Pregnancy



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Chapter 3: Agreement between Maternal and Paternal Reports of Prenatal Father Involvement

Abstract

Background: The added cost and effort associated with including fathers in studies of women's and children's health has made it common to interview women about the father's involvement. To explore whether interviewing women provides a reasonable assessment of fathers' actions during the pregnancy, we sought to evaluate agreement between maternal and paternal responses of paternal involvement in unmarried parents.

Methods: We measured agreement between maternal and paternal responses to questions on paternal involvement, using Kappa (K) and a prevalence and bias adjusted kappa (PABAK), in a sample of unmarried women and their male partners (n=2,660 couples) with baseline interviews from the Fragile Families and Child Wellbeing Study. Latent class analysis (LCA) was used to create categories of paternal involvement.

Results: For all questions, K was fair to moderate (0.23-0.65), but generally, PABAK was much higher. Agreement was substantial for whether the father provided financial support during pregnancy (PABAK=0.77), or if the father had indicated that he would provide child support (PABAK=0.72). Agreement was almost perfect regarding whether the baby would have the father's last name (PABAK=0.88) and whether the father's name would be on the birth certificate (PABAK=0.89). PABAKs were highest for cohabiting couples and decreased with decreasing strength of the relationship (i.e., visiting, friends, or no contact). When all involvement questions were considered using LCA, fathers ranked themselves as more highly involved than by maternal report.

Conclusion: Unmarried women involved with their child's father report consistent levels of agreement about paternal involvement. Agreement for women with little to no contact with the child's father was less. Use of mothers' interviews appears to be a reasonable approach to assess paternal involvement, though findings can be applied only to those fathers who are both accessible and willing to participate in studies.

Introduction

Maternal and child health researchers have demonstrated a growing interest in the potential pregnancy health impact of fathers' involvement with the pregnant mother, with calls for inclusion of men in such studies.[10,113,118] Because of the added cost and effort associated with including men in studies of maternal and child health, paternal information is often assessed based on maternal report. In previous studies of agreement in couples, wives have been shown to be reliable reporters of their husbands' height, weight, and medication use.[147] Hatch, et al., found that women with private insurance were reliable reporters of their partners' employment status and job title, as well as smoking status, but they were less reliable in the reporting of alcohol consumption.[148] Women recruited from a public prenatal clinic were somewhat less able to reliably report this same information.[148] It is unknown if maternal and paternal perceptions of paternal involvement with the pregnant woman agree, so the added value of enrolling fathers is unknown.

There currently is no gold standard measure of father involvement during pregnancy. Father involvement during childhood has been centered around the concepts of responsibility, accessibility, and engagement, and is often measured through use of activity diaries, but the utility of such measurements is limited during pregnancy.[115] Father involvement during pregnancy has been measured previously by the presence or absence of paternal demographics on the birth certificate, paternal participation in childbirth classes, or paternal attendance at prenatal care visits.[6-8,121,122,139] Other studies, such as the Fragile Families and Child Wellbeing Study, have asked unmarried couples whether the father purchased or contributed towards purchasing items for the baby, or provided other non-material support to the mother during the pregnancy.[132,149] If mothers and fathers consistently report this information, there may be little need to enroll the fathers. However, if agreement between maternal and paternal responses is

affected by the quality of the relationship, there may be benefit to focusing recruitment resources on men who have less relationship with the women they impregnated.

In this paper, we evaluate the agreement of maternal and paternal responses related to paternal involvement in a population of unmarried couples enrolled in the Fragile Families and Child Wellbeing Study. We hypothesized that agreement between parents would be correlated with the nature of their relationship, in that more investment would be associated with greater agreement.

Methods

The Fragile Families and Child Wellbeing Study is a longitudinal study of the long term social trajectories of children born to unmarried parents.[150] The Fragile Families study sample was recruited to be nationally representative of non-marital births in US cities with populations greater than 200,000. All mothers were enrolled in the hospital following the birth. Timing of the father's next anticipated visit to the hospital was provided to the study staff, and attempts were made to enroll him at that time. When father interviews were not completed in the hospital prior to the mother's discharge, attempts were made to reach him by phone. Sixty-six percent of fathers were interviewed at the hospital, and 20% of paternal interviews were completed by phone. The method of contact for the remaining enrolled fathers is unknown.[151] Mothers and fathers were interviewed separately. Cases where the father was deceased, the child was being placed for adoption, or the pregnancy was a result of forced sex were not eligible for study participation.

In the Fragile Families Study, 87% of unmarried women completed the baseline interview. As fathers were enrolled after the mother was enrolled, participation was calculated relative to the number of mothers, and 75% of unmarried fathers completed baseline interviews. Each parent received a small incentive for completion of their

interview. The current analysis included 2,660 unmarried couples where both the mother and father were aged 18 or older and completed the baseline interview.

We chose paternal involvement questions based upon their being asked of both the mother and the father. These include questions related to the decision not to seek abortion, as well as financial and social support provided to the mother during pregnancy and the father's intentions to pay child support. Couples were also asked if the father's name would be listed on the birth certificate and if the child would have the father's last name. Based upon the skip patterns present in the Fragile Families interview, paternal involvement questions were not asked of married couples; thus they are unavailable for comparison.

The Kappa statistic (K) estimates the proportion of agreement between two raters beyond that due to chance. To categorize the level of agreement, we used suggested cut-points published by Landis and Koch (0-.20, "slight"; 0.21-0.40, "fair"; 0.41-0.60, "moderate"; 0.61-0.80, "substantial"; 0.81-1.0, "almost perfect").[152]

Though K is widely used, it is known to be influenced by the prevalence of responses.[153-156] When the prevalence of responses for either or both of the raters is not balanced (i.e, 50% yes, 50% no), K is reduced. This can result in a very high level of observed agreement, yet a very low K. Kappa also has the paradox that given two scenarios with different distributions of responses but equivalent percent agreement, the scenario with less bias between the raters is penalized and yields a smaller Kappa.[153,155-157]

To address these issues, Byrt, et al., published the prevalence and bias adjusted kappa (PABAK), which accounts for unbalanced prevalence and inter-rater bias.[155] PABAK is calculated by replacing the values of the concordant and discordant cells with their respective averages, and applying the usual formula for K. In addition to PABAK, Byrt calculated the bias and prevalence index. The bias index is the difference in the proportion of "yes" responses between the raters, and is a measure of rater

disagreement. Ranging from -1 to 1, the bias index is 0 when there is no inter-rater bias. The prevalence index is the difference in the probability of "yes" responses averaged across raters and the probability of "no" responses averaged across raters. The prevalence index ranges from -1 to 1, and equals 0 when the probability of "yes" responses is equivalent to the probability of "no" responses. We calculated the absolute percent agreement, K, PABAK and bias and prevalence indices for each of several paternal involvement questions. These varied dimensions of inter-rater agreement are presented to provide a broader view of inter-rater agreement than a single measurement of K or PABAK alone.[156,158]

The selected father involvement questions were not originally designed to produce a single measure of paternal involvement. However, through use of latent class analysis, participants were classified into categories of father involvement.[159] Because cohabiting couples were not asked if the father had stated intentions to pay child support, this question was not included in the latent class analysis. Father involvement group membership was assigned based upon the highest membership probability as determined by latent class analysis. Models with two, three, and four involvement categories were compared for fit using the Akaike Information Criterion (AIC). The model with the lowest AIC was selected as the best model. Latent class analysis was performed using the PROC LCA (version 1.2.7) add-on package publicly available from the Pennsylvania State University Methodology Center.[160]

Data from the Fragile Families and Child Wellbeing Study were obtained via a public use dataset (http://www.fragilefamilies.princeton.edu), and analyses were approved by the Emory University Institutional Review Board. All analyses were performed in SAS 9.3 (Cary, NC).

Results

The complete Fragile Families sample consisted of 3,710 unmarried mothers enrolled at the time of the birth, with or without an enrolled father. Observations were excluded because either the mother or father was less than 18 years old, or age was missing (n=1,049; 28.3 %). After women who did not have a paternal interview were excluded (1 additional woman), 2,660 pairs remained in the analysis. Women excluded from the analysis were similar in age, race, nativity, education, and insurance status to those included (Supplemental Table 3.1).

The mean age of the mothers was 24.1 (±5.5) years old. Thirteen percent of mothers were born outside of the United States, and over half (55.3%; n=1,442) were Black or African-American. Most had a high school diploma (35.1%) or less (37.7%), while only 3.1% had a bachelor's degree or higher (Table 3.1). By maternal report, 59.0% of couples were cohabiting, and 32.3% were in a non-cohabiting romantic relationship ("visiting"). Five and a half (5.5%) percent of study pairs were just friends, and 3.2% reported little to no contact with the child's father.

Fathers were an average of 26.8 (±6.9) years old. Most (85.1%) were born in the U.S., and 58% were Black or African American. The majority of men (76.6%) reported having regular employment in the last week (Table 3.1).

Response Characteristics by Relationship Status

The proportion of completed father interviews differed by relationship status. Of mothers who reported cohabiting, 90% (n=1,570) had a completed father interview. Seventy two percent (n=860) of visiting mothers had completed father interviews. For mothers who reported being friends or having no relationship with the father, the proportion with enrolled fathers was 53.3% (n=147) and 25.1% (n=84), respectively. Mothers whose partner also completed an interview were more likely to report positive paternal involvement activities than mothers without father interviews. Similarity in

maternal reports of paternal involvement behaviors between women with or without a partner interview decreased with relationship status, with the difference in proportions of "yes" responses being greatest for mothers reporting no relationship with the father (Table 3.2).

The distribution of positive responses by each participating parent is shown in Figure 3.1. When all couples were considered, the proportion of "yes" responses is similar for mothers and fathers. The percentage of "yes" responses for all questions except suggestion of abortion decreased with relationship status, and the difference between the proportion of maternal and paternal "yes" responses increased with decreasing relationship strength.

Use of Individual Father Involvement Measures

Percent agreement, K, PABAK, and indices of bias and prevalence for each question are shown in Table 3.3. When asked whether or not the father had provided any financial support during the pregnancy, agreement was fair (K=0.32) for all couples, but became substantial (PABAK=0.77) after adjustment for prevalence and bias. PABAK was highest for cohabiting couples (PABAK=0.87), and decreased with the strength of the relationship.

When asked whether the father had indicated that he would provide child support after the birth, agreement was substantial for visiting couples (PABAK=0.76) or those who were just friends (PABAK=0.62), and moderate for those with no relationship (PABAK=0.49). Mothers and fathers were consistent in reporting if the father suggested an abortion (PABAK=0.75). Agreement was lowest among couples with little or no contact, but still moderate with a PABAK of 0.49.

When couples were asked if the baby would have the father's last name, PABAK was high for cohabiting and visiting couples, as well as those who were just friends (PABAK=0.78-0.94), but fair (PABAK=0.28) for those with no relationship. Adjusted

agreement was also quite high when asked if the father's name would be on the birth certificate (PABAK=0.46-0.95).

In analysis of discordant couples, mothers were more likely than the fathers to report that the father intended to pay child support and that his name would be on the birth certificate. Mothers were less likely than the fathers to report that the father had provided financial or other support during the pregnancy, that the child would have the father's last name, or that the father suggested abortion (Figure 3.2).

When stratified by race, agreement showed little variation (Table 3.4). Agreement on financial and other support provided during pregnancy was higher among college educated women when compared to those with less education. Agreement was similar by education for other involvement questions (Table 3.5). Compared to younger women, those 40 years or older had lower agreement on financial support, but had higher agreement with the father on provision of child support and suggestion of abortion (Table 3.6).

Use of a Combined Father Involvement Measure

Latent class analysis yielded a four level indicator of father involvement as having the best fit by AIC (Table 3.7). Categories of involvement were assigned based upon the probabilities determined by the statistical output. Categories were labeled as "high", "moderate", "low", and "no" involvement. As seen in Appendix 3.1, the algorithm by which probabilities are assigned does not appear to give equal weighting to factors. For example, response profiles 18 and 25 each have a response of "yes" to 3 of the 5 questions, yet profile 18 is ranked as low involvement, while profile 25 is ranked as moderate involvement.

Comparing the levels of paternal involvement determined by maternal and paternal reports, fathers ranked themselves as having greater involvement than did mothers. Among mothers who ranked their partner as being moderately involved, 77.2%

of fathers ranked themselves as highly involved. Of mothers who ranked their partners as not involved, over 80% of fathers ranked themselves as highly or moderately involved (Table 3.8).

We also repeated the analysis adding a dichotomous indicator of relationship status to the LCA analysis. Cohabiting and visiting couples were classified as involved, and couples who were just friends or had no relationship were classified as uninvolved. Comparing LCA classifications generated by maternal and paternal responses, paternal response resulted in a greater probability of being classified as highly involved. By maternal report, 78.5% (n=1536) of fathers were highly involved, compared to 87.4% (n=1711) by paternal report. Only 21% of fathers ranked moderately involved by maternal report were also moderately involved by paternal report. Seventy-two percent of moderately involved fathers by maternal report were ranked as highly involved by paternal report. Sixty-three percent of fathers categorized as having a low level of involvement by maternal report were classified as highly involved by paternal report. Less than a third of fathers with no involvement by maternal report ranked themselves as being uninvolved (Table 3.9).

The set of questions, taken together with relationship, yielded as a measure of internal consistency, a Cronbach's alpha of 0.6.

Discussion

In this study of unmarried couples, use of maternal interviews to obtain information on individual questions on paternal involvement during pregnancy yielded very good agreement with paternal reports from accessible fathers when assessed by a kappa statistic adjusted for prevalence and inter-rater bias. Agreement between parents decreased with diminishing relationship quality, but was relatively high for couples who were cohabiting, visiting, or just friends. Agreement between maternal and paternal reports of father involvement was lowest for parents reporting no relationship, and this

group was the least likely to have a father interview. In contrast, when all paternal involvement items were considered together, on average, fathers reported higher levels of involvement than did mothers. Study findings may not be applicable to women with little to no contact with the father of their child, or those whose partners do not participate in studies.

In previous studies of partner agreement, questions were limited to demographic questions, cigarette smoking and alcohol use.[147,148] Our study extended the questions to selected queries about paternal financial and other support during the pregnancy and anticipated financial support after the delivery. Two specific questions about the father's name on the birth certificate reflected each parents' understanding of the relationship of the father to the child. Based upon observed agreement to the question of whether or not abortion was suggested, we may also be able to extend our conclusion to more sensitive, or polarizing questions.

The potential role of father involvement during pregnancy has gained attention in recent years with the publication of several papers showing associations of the absence of a father's name on the birth certificate with poor pregnancy outcomes and infant mortality.[6-8,121,122] Several investigators have called for inclusion of fathers in studies of maternal and child health.[113,116,117] While focus groups with non-custodial fathers have indicated that men are willing to participate in studies, it is more difficult to recruit and retain fathers for participation in research. We do not know if this is because fathers are unable to participate due to work responsibilities, are not identified by the mother for study contact, are in fact uninvolved, or choose not to participate for other reasons. Additional analyses comparing the proportion of mothers responding "yes" to the father involvement questions among mothers with completed father interviews to those without completed father interviews indicates that women whose partners did not participate were less likely to have favorable responses than those women with partner

interviews. The proportion of positive responses by mothers with and without partner interviews was most similar among cohabiting women, with decreasing similarity in responses by decreasing relationship status. We infer that father involvement is associated with study participation. The lack of participation by uninvolved fathers is likely to persist in future studies, but having some knowledge that unmarried mothers may report paternal involvement consistently with paternal self-report is beneficial. If equivalent responses can be obtained from both the mother and father, then little value may be added by also interviewing all available fathers. Rather, if fathers are to be recruited for such studies, it may be preferable to attempt recruitment of the least related, unmarried fathers while relying on maternal report for cohabitating and dating partners. This extends the assumption that the father's role will be accurately portrayed by the mother from just the married couples (as was done for the Fragile Families study) to cohabiting and dating couples as well.

Use of the PABAK has been criticized by Hoehler, who argued that the averaging that occurs as part of the PABAK calculation creates an artificial situation, and that K should never be adjusted.[161] Others suggest that adjustments may have merit, but only when considered in conjunction with the standard K.[155,156,158] As such, we have presented the K and PABAK, along with indices of bias and prevalence. As evidenced by the low bias indices and high prevalence indices, the differences in K and PABAK were primarily driven by the prevalence of responses being very different from 50%. As the bias index was near zero for all questions, any effects of inter-rater bias are likely minimal. This is supported by data presented in Figure 3.1, where mothers and fathers had similar proportions of positive responses to each involvement question.

Results from the PABAK analysis indicated that mothers and fathers gave similar reports of father involvement. However, when all father involvement questions were combined into a single indicator, we observed that fathers ranked themselves as having

greater involvement than did mothers. This is likely due to social desirability, with fathers not wanting to portray themselves as absent fathers.

We were limited in our assessment of agreement by relationship status, due to some paternal involvement questions, such as the father's intention to pay child support, not being asked of cohabiting couples. However, a strength of this study is its large sample size, which allowed for stratification by several strata of relationship status, including those couples who have little to no interaction. We observed that even in those couples reporting little contact, agreement was still "fair" to "moderate" using the guidelines of Landis and Koch.[152] Despite this, we recognize that our study included only those families where a father was available and willing to participate in the study.

A final limitation is the classification scheme used by the latent class analysis program. As previously mentioned, assignment on class membership probabilities did not appear to be consistent across response profiles (Appendix 3.1). This could be due to the model selection process, with the three level model actually being a better fit despite use of the AIC. This also could be due to using five questions to create four categories of father involvement.

At present, there exists no gold standard measure of father involvement. While the questions used in this analysis have not been formally validated, they have face validity to address the ways in which father involvement may be manifested. Responses to these questions reflect the father's apparent actions and intentions to have an active relationship with his child. Though internal consistency of the selected paternal involvement questions does not reach the acceptable range for Cronbach's alpha (>0.7), the observed value of alpha suggests that either additional or modified father involvement questions may improve the overall construct. One such modification could be to ask separate questions about other types of support received from the father, rather than the single, global question on all types of non-material support from the father that

was asked here. Internal consistency might also be improved with additional questions such as whether the father attended prenatal care visits.

We also have no measure of the truth of either maternal or paternal responses. One could build an argument for either the mother's or the father's responses as representing the gold standard for selected questions. For example, as the recipient of any financial support and an active participant in any discussion of abortion, mothers could represent the gold standard. However, her responses may be tempered by her perception of events. Similarly, as the provider of such support, the father could also be regarded as the gold standard. However, his responses may be affected by his desire to be perceived as a responsible or involved father. As such, the findings presented here should be regarded as a study of agreement, rather than a validation study.

Conclusion

Compared to recruiting fathers directly, the use of maternal interviews in studies of maternal and child health appears to be an acceptable method of obtaining data related to paternal involvement in accessible fathers, including more sensitive questions such as those relating to abortion. Since this is a less labor intensive and more cost effective approach to measuring paternal support, it can be recommended in future studies attempting to address the role of father involvement during pregnancy.

Acknowledgements

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Table 3.1: Demographic Characteristics of 2,660 Unmarried Parents in the Fragile Families and Child Wellbeing Study

	Mothers N (%)	Fathers N (%)
Age (years)		
<20	522 (19.6)	241 (9.1)
20-24	1156 (43.5)	999 (37.6)
25-29	562 (21.1)	665 (25.0)
30-34	247 (9.3)	372 (14.0)
35-39	126 (4.7)	216 (8.1)
≥40	47 (1.8)	167 (6.3)
Foreign Born	342 (12.9)	395 (14.9)
Race		
White	675 (25.9)	549 (21.1)
Black	1442 (55.3)	1508 (58.0)
Asian	44 (1.7)	44 (1.7)
American Indian	123 (4.7)	119 (4.6)
Other	322 (12.4)	382 (14.7)
Hispanic Ethnicity	746 (28.2)	769 (29.2)
Education		
Less than HS	1002 (37.7)	979 (36.8)
HS Diploma or GED	932 (35.1)	1059 (39.8)
Some College or Trade School	639 (24.1)	524 (19.7)
Bachelor's Degree or Higher	83 (3.1)	98 (3.7)
Insurance Status		
Medicaid	1933 (73.1)	
Other	140 (5.3)	
Private	572 (21.6)	
Regular Employment in Last week		2033 (76.6)
Employer Provided Insurance		1447 (56.2)

HS, High School; GED, General Educational Development.

Table 3.2: Prevalence of "Yes" Maternal Responses to Questions of Paternal Involvement among Mothers with and without Enrolled Fathers by Relationship Status

	Total Sample			Cohabiting			Visiting			Friends			No Relationship		
Father	Not Enrolled (N=888)	Enrolled (N=2,661)		Not Enrolled (N=176)	Enrolled (N=1,570)		Not Enrolled (N=332)	Enrolled (N=860)		Not Enrolled (N=129)	Enrolled (N=147)		Not Enrolled (N=251)	Enrolled (N=84)	
	N (%)	N (%)	P-value	N (%)	N (%)	P-value	N (%)	N (%)	P-value	N (%)	N (%)	P-value	N (%)	N (%)	P-value
Did father provide financial support?	495 (58.0)	2368 (89.5)	<.0001	166 (94.3)	1495 (95.2)	0.7883	247 (74.4)	749 (87.1)	<.0001	63 (48.8)	96 (65.3)	0.0057	19 (7.6)	28 (33.3)	<.0001
Did father provide other support?	453 (52.9)	2340 (88.2)	<.0001	167 (94.9)	1527 (97.3)	0.3081	221 (66.6)	711 (82.3)	<.0001	49 (38.0)	76 (51.7)	0.0224	16 (6.4)	26 (31.0)	<.0001
Did father say he would pay child support?	436 (66.3)	978 (91.3)	<.0001	N/A	N/A	N/A	274 (82.5)	781 (90.8)	<.0001	90 (69.8)	115 (78.2)	0.1049	69 (27.5)	55 (65.5)	<.0001
Did father suggest abortion?	161 (19.0)	268 (10.2)	<.0001	18 (10.2)	100 (6.4)	0.05	43 (13.0)	109 (12.7)	0.86	29 (22.5)	32 (21.8)	0.9563	71 (28.29)	27 (32.1)	0.88
Will child have father's last name?	480 (57.2)	2250 (88.0)	<.0001	160 (90.9)	1426 (90.8)	0.45	217 (65.3)	698 (81.2)	<.0001	55 (42.6)	99 (67.4)	<.0001	48 (19.1)	27 (32.1)	0.03
Will father's name be on birth certificate?	550 (67.5)	2436 (94.3)	<.0001	162 (92.1)	1498 (95.4)	0.04	254 (76.5)	772 (89.8)	<.0001	71 (55.0)	121 (82.31)	<.0001	63 (25.1)	45 (53.6)	<.0001

N/A, Question not asked.

Table 3.3: Agreement of Maternal and Paternal Responses for 2,660 Unmarried Couples in the Fragile Families Study by Relationship Status

	Percent Agreement	Kappa	PABAK	Bias Index	Prevalence Index
Did father provide financial support or buy things for the baby?					
All	0.88	0.32	0.77	-0.02	0.81
Cohabiting	0.94	0.18	0.87	0.00	0.92
Visiting	0.84	0.23	0.68	-0.02	0.77
Friends	0.70	0.27	0.40	-0.15	0.45
No Relationship	0.66	0.36	0.32	0.27	-0.05
Did father provide other support during pregnancy?					
All	0.89	0.41	0.77	-0.02	0.79
Cohabiting	0.96	0.20	0.93	-0.01	0.95
Visiting	0.81	0.28	0.62	-0.03	0.68
Friends	0.65	0.29	0.30	-0.13	0.18
No Relationship	0.67	0.33	0.34	-0.16	-0.21
Did father say he would provide child support in the first year?					
All	0.86	0.23	0.72	0.02	0.80
Cohabiting	N/A	N/A	N/A	N/A	N/A
Visiting	0.88	0.09	0.76	0.04	0.86
Friends	0.81	0.31	0.62	-0.05	0.67
No Relationship	0.74	0.37	0.49	-0.03	0.43
Did father suggest abortion?					
All	0.87	0.39	0.75	-0.03	-0.77
Cohabiting	0.90	0.34	0.80	-0.03	-0.84
Visiting	0.84	0.40	0.69	-0.05	-0.69
Friends	0.83	0.45	0.66	0.06	-0.62
No Relationship	0.74	0.40	0.49	0.03	-0.38
Will child have father's last name?					
All	0.94	0.65	0.88	-0.03	0.84
Cohabiting	0.97	0.67	0.94	-0.01	0.91
Visiting	0.92	0.64	0.84	-0.02	0.75
Friends	0.89	0.67	0.78	-0.06	0.57
No Relationship	0.64	0.32	0.28	-0.25	-0.03
Will father's name be on birth certificate?					
All	0.95	0.32	0.89	-0.02	0.89
Cohabiting	0.97	0.38	0.95	-0.01	0.96
Visiting	0.92	0.19	0.84	-0.03	0.89
Friends	0.89	0.24	0.78	-0.02	0.84
No Relationship	0.73	0.43	0.46	-0.14	0.38

N/A, Question not asked.

Table 3.4: Agreement of Maternal and Paternal Responses for 2,660 Unmarried Couples in the Fragile Families Study by Maternal Race

	Percent Agreement	Kappa	PABAK	Bias Index	Prevalence Index
Did father provide financial support or buy things for the baby?					
White	0.90	0.35	0.81	-0.04	0.84
Black	0.87	0.28	0.74	-0.01	0.80
Asian	0.75	0.01	0.50	-0.16	0.70
American Indian	0.91	0.47	0.82	-0.02	0.81
Other	0.92	0.38	0.84	-0.04	0.86
Did father provide other support during pregnancy?					
White	0.93	0.54	0.86	-0.01	0.83
Black	0.85	0.38	0.71	-0.02	0.75
Asian	0.93	0.53	0.86	-0.07	0.84
American Indian	0.93	0.63	0.87	-0.05	0.80
Other	0.92	0.47	0.83	-0.04	0.83
Did father say he would provide child support in the first year?					
White	0.86	0.25	0.71	-0.03	0.78
Black	0.87	0.25	0.73	0.04	0.80
Asian[a]	1.00	1.00	1.00	0.00	1.00
American Indian	0.79	0.32	0.63	0.13	0.63
Other	0.84	0.05	0.82	-0.09	0.82
Did father suggest abortion?					
White	0.90	0.42	0.80	-0.02	-0.81
Black	0.85	0.38	0.70	-0.04	-0.72
Asian	0.89	0.22	0.77	-0.02	-0.84
American Indian	0.94	0.56	0.88	-0.01	-0.85
Other	0.90	0.38	0.79	-0.02	-0.82
Will child have father's last name?					
White	0.95	0.65	0.90	-0.04	0.85
Black	0.92	0.65	0.85	-0.03	0.75
Asian	0.93	0.63	0.86	-0.02	0.79
American Indian	0.97	0.71	0.95	-0.01	0.90
Other	0.97	0.49	0.95	-0.01	0.95
Will father's name be on birth certificate?					
White	0.95	0.44	0.90	-0.03	0.91
Black	0.93	0.24	0.87	-0.01	0.91
Asian	0.95	-0.02	0.91	-0.05	0.95
American Indian	0.96	0.48	0.93	-0.02	0.93
Other	0.97	0.46	0.94	0.00	0.95

[a]Calculations may not be valid, as there were few observations, and all fell in a single cell

Table 3.5: Agreement of Maternal and Paternal Responses for 2,660 Unmarried Couples in the Fragile Families Study by Maternal Education

	Percent Agreement	Kappa	PABAK	Bias Index	Prevalence Index
Did father provide financial support or buy things for the baby?					
Less than High School	0.87	0.29	0.74	-0.03	0.80
High School Diploma or GED	0.89	0.32	0.78	-0.02	0.82
Some College or Trade School	0.89	0.32	0.79	-0.02	0.83
Bachelor's Degree or Higher	0.93	0.46	0.85	0.00	0.85
Did father provide other support during pregnancy?					
Less than High School	0.89	0.47	0.79	-0.02	0.78
High School Diploma or GED	0.88	0.38	0.77	-0.02	0.79
Some College or Trade School	0.88	0.32	0.75	-0.03	0.80
Bachelor's Degree or Higher	0.95	0.64	0.90	0.00	0.85
Did father say he would provide child support in the first year?					
Less than High School	0.84	0.17	0.69	0.00	0.79
High School Diploma or GED	0.86	0.27	0.72	0.06	0.78
Some College or Trade School	0.89	0.26	0.78	-0.01	0.83
Bachelor's Degree or Higher	0.83	0.19	0.66	0.10	0.76
Did father suggest abortion?					
Less than High School	0.89	0.43	0.78	-0.02	-0.78
High School Diploma or GED	0.87	0.34	0.74	-0.06	-0.78
Some College or Trade School	0.85	0.37	0.71	0.00	-0.73
Bachelor's Degree or Higher	0.92	0.58	0.83	-0.06	-0.77
Will child have father's last name?					
Less than High School	0.94	0.65	0.88	-0.02	0.81
High School Diploma or GED	0.94	0.66	0.88	-0.03	0.81
Some College or Trade School	0.94	0.65	0.89	-0.04	0.82
Bachelor's Degree or Higher	0.94	0.51	0.87	0.01	0.86
Will father's name be on birth certificate?					
Less than High School	0.95	0.37	0.89	-0.02	0.91
High School Diploma or GED	0.94	0.29	0.88	-0.02	0.91
Some College or Trade School	0.95	0.30	0.89	-0.01	0.92
Bachelor's Degree or Higher	0.96	0.38	0.92	-0.01	0.94

Table 3.6: Agreement of Maternal and Paternal Responses for 2,660 Unmarried Couples in the Fragile Families Study by Maternal Age

	Percent Agreement	Kappa	PABAK	Bias Index	Prevalence Index
Did father provide financial support or buy things for the baby?					
<20	0.88	0.31	0.76	-0.02	0.76
20-29	0.88	0.30	0.77	-0.02	0.77
30-39	0.90	0.40	0.81	-0.03	0.81
≥40	0.80	0.19	0.60	0.07	0.60
Did father provide other support during pregnancy?					
<20	0.87	0.44	0.74	0.00	0.74
20-29	0.89	0.40	0.78	0.03	0.80
30-39	0.90	0.36	0.79	0.04	0.82
≥40	0.87	0.33	0.73	0.00	0.78
Did father say he would provide child support in the first year?					
<20	0.85	0.03	0.69	-0.01	0.83
20-29	0.86	0.25	0.72	0.04	0.79
30-39	0.87	0.40	0.74	0.01	0.75
≥40	0.92	0.62	0.85	-0.08	0.77
Did father suggest abortion?					
<20	0.86	0.38	0.72	-0.03	-0.75
20-29	0.88	0.38	0.75	-0.03	-0.77
30-39	0.88	0.40	0.77	-0.02	-0.78
≥40	0.91	0.66	0.83	-0.04	-0.70
Will child have father's last name?					
<20	0.94	0.68	0.88	-0.04	0.80
20-29	0.95	0.67	0.89	-0.02	0.82
30-39	0.92	0.53	0.84	-0.03	0.82
≥40	0.91	0.55	0.81	-0.09	0.77
Will father's name be on birth certificate?					
<20	0.94	0.31	0.87	-0.03	0.90
20-29	0.95	0.34	0.90	-0.02	0.92
30-39	0.93	0.29	0.86	-0.02	0.89
≥40	0.94	0.37	0.87	0.02	0.89

Table 3.7: Comparison of Akaike's Information Criterion for Latent Class Analysis using Maternal Responses of Father Involvement

	Number of Father Involvement Categories		
	2	3	4
Five Indicators	202.3	81.9	57.9
Five Indicators plus Relationship Indicator	297.3	176.5	114.3

Indicators of involvement: Financial support during pregnancy, other support during pregnancy, payment of child support, father suggested abortion, child will have father's last name, father's name will be on birth certificate. Relationship Indicator: Involved (cohabiting, visiting) or Uninvolved (just friends, no relationship).

Table 3.8: Comparison of Father Involvement Category Using Six Indicators of Father Involvement, by Maternal and Paternal Reports

		Paternal Report			
		High Involvement	Moderate Involvement	Low Involvement	No Involvement
Maternal Report	High Involvement	1427 (91.6)	35 (2.3)	89 (5.7)	7 (0.5)
	Moderate Involvement	547 (77.2)	58 (8.2)	92 (13.0)	12 (1.7)
	Low Involvement	87 (40.9)	34 (16.0)	72 (33.8)	20 (9.4)
	No Involvement	66 (37.1)	82 (46.1)	18 (10.1)	12 (6.7)

Table 3.9: Comparison of Father Involvement Category Using Six Indicators of Father Involvement and Relationship Status, by Maternal and Paternal Reports

		Paternal Report			
		High Involvement	Moderate Involvement	Low Involvement	No Involvement
Maternal Report	High Involvement	1462 (95.2)	9 (0.6)	63 (4.1)	2 (0.1)
	Moderate Involvement	113 (72.0)	33 (21.0)	6 (3.8)	5 (3.2)
	Low Involvement	124 (62.9)	2 (1.0)	63 (32.0)	8 (4.1)
	No Involvement	12 (17.9)	14 (21.0)	20 (30.0)	21 (31.3)

Supplemental Table 3.1: Demographic Characteristics of Women Excluded from Present Analysis

	Unmarried with Paternal Interview (Included in Analysis)		Married		Unmarried with No Paternal Interview	
	N (%)	Mean (SD)	N (%)	Mean (SD)	N (%)	Mean (SD)
Age				29.3 (5.6)		24.9 (5.5)
Foreign Born	342 (12.9)		324 (27.3)		150 (16.9)	
Race						
White	675 (25.9)		609 (51.4)		178 (20.4)	
Black	1442 (55.3)		310 (26.1)		527 (60.4)	
Asian	44 (1.7)		77 (6.5)		12 (1.4)	
American Indian	123 (4.7)		45 (3.8)		51 (5.9)	
Other	675 (25.9)		129 (10.9)		104 (11.9)	
Hispanic Ethnicity	746 (28.2)		301 (25.4)		240 (27.4)	
Education						
Less than HS	1002 (37.7)		196 (16.5)		360 (40.5)	
HS Diploma/GED	932 (35.1)		238 (20.1)		293 (33.0)	
Some College/Trade School	639 (24.1)		342 (28.8)		204 (23.0)	
Bachelor's Degree or Higher	83 (3.1)		410 (34.6)		31 (3.5)	
Insurance Status						
Medicaid	1933 (73.1)		317 (26.9)		671 (75.8)	
Private	572 (21.6)		805 (68.3)		155 (17.5)	
Other	140 (5.3)		57 (4.8)		59 (6.7)	

HS, High School; GED, General Educational Development

Appendix 3.1: Paternal Involvement Response and LCA Category, Maternal Report

	Paternal Response	Maternal Response	Financial Support	Other Support	Did NOT suggest abortion	Name on Birth Certificate	Last Name
1	High	High	Y	Y	Y	Y	Y
2	Low	Low	Y	N	Y	Y	Y
3	Low	Low	N	Y	Y	Y	Y
4	Low	Low	N	N	Y	Y	Y
5	High	High	Y	Y	N	Y	Y
6	Low	Low	Y	N	N	Y	Y
7	Low	Low	N	Y	N	Y	Y
8	Low	Low	N	N	N	Y	Y
9	Moderate	Moderate	Y	Y	Y	N	Y
10	Moderate	Moderate	Y	N	Y	N	Y
11	--	Moderate	N	Y	Y	N	Y
12	None	None	N	N	Y	N	Y
13	Moderate	Moderate	Y	Y	N	N	Y
14	None	Moderate	Y	N	N	N	Y
15	None	--	N	Y	N	N	Y
16	None	None	N	N	N	N	Y
17	Moderate	High	Y	Y	Y	Y	N
18	Moderate	Low	Y	N	Y	Y	N
19	Moderate	Low	N	Y	Y	Y	N
20	None	Low	N	N	Y	Y	N
21	Moderate	High	Y	Y	N	Y	N
22	None	Low	Y	N	N	Y	N
23	None	Low	N	Y	N	Y	N
24	None	None	N	N	N	N	N
25	Moderate	Moderate	Y	Y	Y	N	N
26	Moderate	Moderate	Y	N	Y	N	N
27	Moderate	Moderate	N	Y	Y	N	N
28	None	None	N	N	Y	N	N
29	Moderate	Moderate	Y	Y	N	N	N
30	None	None	Y	N	N	N	N
31	--	Moderate	N	Y	N	N	N
32	None	None	N	N	N	N	N

--None with that response profile. Y, Yes. N, No.

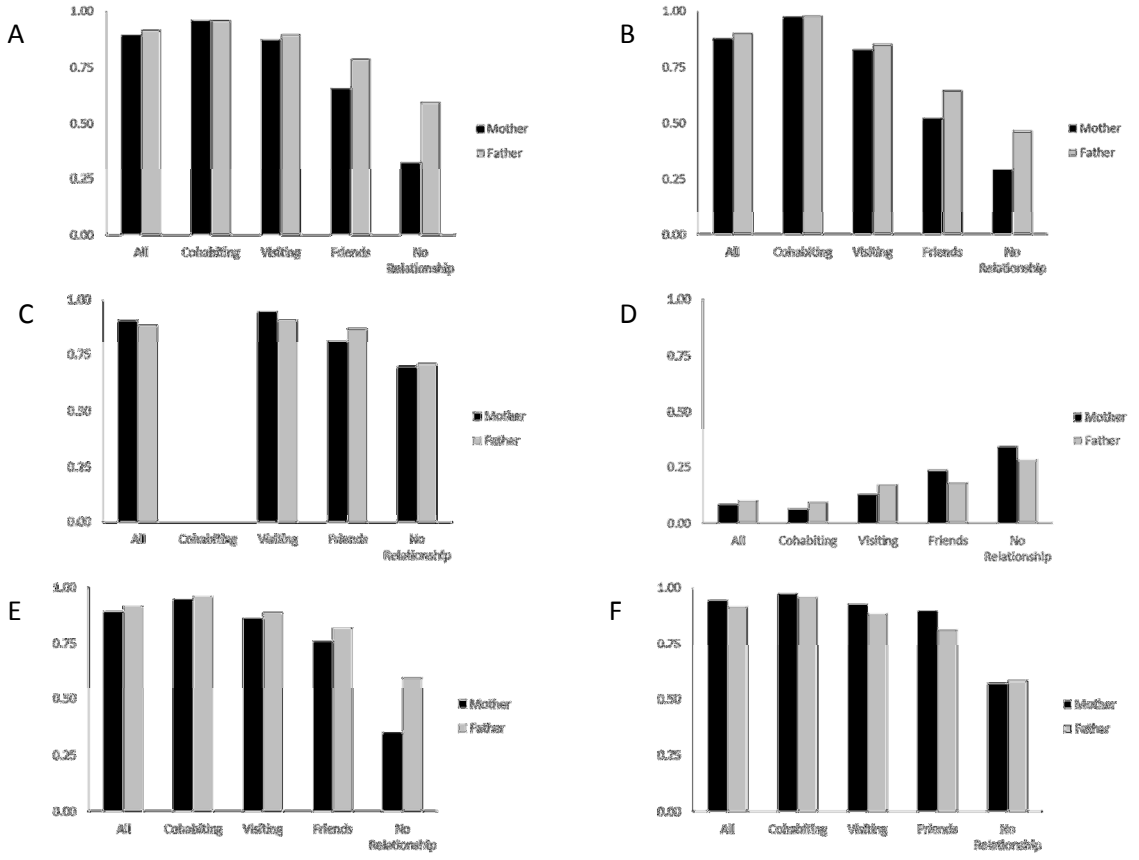
Appendix 3.2: Paternal Involvement Response with Relationship Status and LCA Category, Maternal Report

	LCA Involvement Category							
	Paternal Response	Maternal Response	Financial Support	Other Support	Did NOT suggest abortion	Name on Birth Certificate	Last Name	Involved
1	High	High	Y	Y	Y	Y	Y	Y
2	Low	Low	Y	N	Y	Y	Y	Y
3	High	High	N	Y	Y	Y	Y	Y
4	Moderate	Low	N	N	Y	Y	Y	Y
5	High	High	Y	Y	N	Y	Y	Y
6	Low	Low	Y	N	N	Y	Y	Y
7	High	Low	N	Y	N	Y	Y	Y
8	Low	Low	N	N	N	Y	Y	Y
9	High	High	Y	Y	Y	N	Y	Y
10	Low	Low	Y	N	Y	N	Y	Y
11	--	Low	N	Y	Y	N	Y	Y
12	Low	Low	N	N	Y	N	Y	Y
13	High	High	Y	Y	N	N	Y	Y
14	Low	Low	Y	N	N	N	Y	Y
15	--	--	N	Y	N	N	Y	Y
16	--	Low	N	N	N	N	Y	Y
17	High	Moderate	Y	Y	Y	Y	N	Y
18	moderate	Moderate	Y	N	Y	Y	N	Y
19	None	Moderate	N	Y	Y	Y	N	Y
20	None	Low	N	N	Y	Y	N	Y
21	Moderate	Moderate	Y	Y	N	Y	N	Y
22	Low	Low	Y	N	N	Y	N	Y
23	Low	Low	N	Y	N	Y	N	Y
24	None	Low	N	N	N	N	N	Y
25	Moderate	Moderate	Y	Y	Y	N	N	Y
26	Moderate	Moderate	Y	N	Y	N	N	Y
27	Moderate	Moderate	N	Y	Y	N	N	Y
28	--	None	N	N	Y	N	N	Y
29	Moderate	Moderate	Y	Y	N	N	N	Y
30	--	None	Y	N	N	N	N	Y
31	--	--	N	Y	N	N	N	Y
32	None	--	N	N	N	N	N	Y
33	High	High	Y	Y	Y	Y	Y	N
34	Low	Low	Y	N	Y	Y	Y	N
35	Low	Low	N	Y	Y	Y	Y	N
36	Low	Low	N	N	Y	Y	Y	N
37	High	High	Y	Y	N	Y	Y	N

38	Low	Low	Y	N	N	Y	Y	N
39	Low	Low	N	Y	N	Y	Y	N
40	Low	Low	N	N	N	Y	Y	N
41	High	--	Y	Y	Y	N	Y	N
42	--	--	Y	N	Y	N	Y	N
43	--	--	N	Y	Y	N	Y	N
44	None	Low	N	N	Y	N	Y	N
45	--	--	Y	Y	N	N	Y	N
46	--	--	Y	N	N	N	Y	N
47	Low	--	N	Y	N	N	Y	N
48	None	Low	N	N	N	N	Y	N
49	Moderate	Moderate	Y	Y	Y	Y	N	N
50	Low	None	Y	N	Y	Y	N	N
51	moderate	--	N	Y	Y	Y	N	N
52	None	None	N	N	Y	Y	N	N
53	Moderate	--	Y	Y	N	Y	N	N
54	--	None	Y	N	N	Y	N	N
55	--	None	N	Y	N	Y	N	N
56	None	None	N	N	N	N	N	N
57	Moderate	Moderate	Y	Y	Y	N	N	N
58	None	None	Y	N	Y	N	N	N
59	--	None	N	Y	Y	N	N	N
60	None	None	N	N	Y	N	N	N
61	--	None	Y	Y	N	N	N	N
62	None	None	Y	N	N	N	N	N
63	--	None	N	Y	N	N	N	N
64	None	None	N	N	N	N	N	N

--None with that response profile. Y, Yes. N, No.

Figure 3.1: Percent of "Yes" Responses to Father Involvement Questions for each Parent, by Relationship Status



A: Financial Support during Pregnancy; B: Other Support during Pregnancy; C: Child Support; D: Suggested Abortion; E: Father's Last Name; F: Father's Name on Birth Certificate.

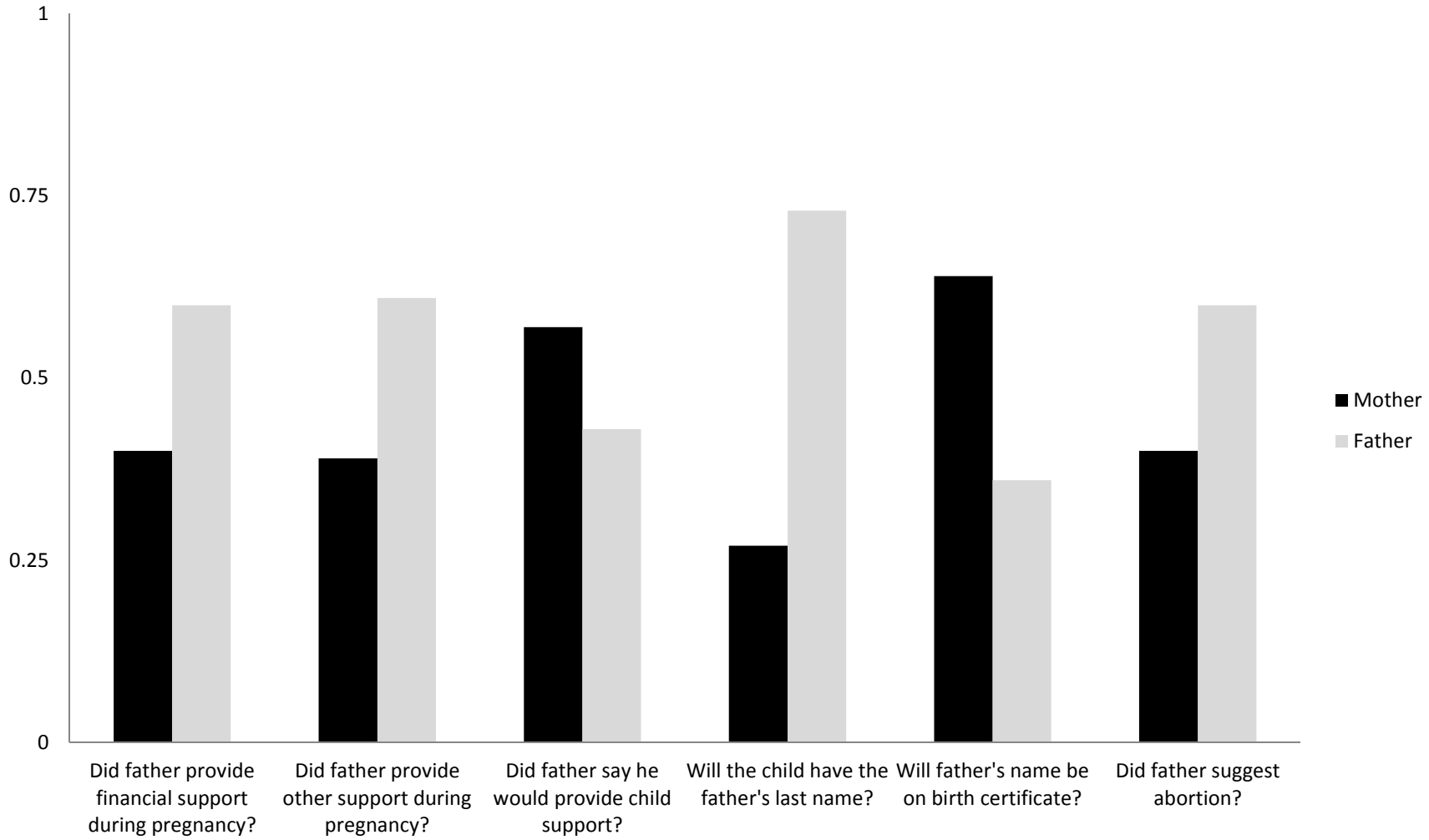


Figure 3.2: Prevalence of Positive Responses to Father Involvement Questions among Discordant Couples

Chapter 4: Father Involvement and Preterm Birth in the Fragile Families and Child Wellbeing Study

Abstract

Background: Thought to reflect lack of paternal involvement, missing paternal demographics on the birth certificate has been associated with preterm birth, low birth weight, and infant mortality. We sought to explore the ways in which father involvement may act upon preterm birth.

Methods: A sample of 2,579 unmarried women enrolled in the Fragile Families and Child Wellbeing Study were asked 6 questions on father involvement. We used latent class analysis to create categories of father involvement, and evaluated their association with preterm birth. All models were adjusted for maternal race, relationship status, and history of preterm birth. The interaction between relationship status and involvement was investigated.

Results: Mothers who delivered preterm (n=314) were more likely to be Black (p=0.002) than other races and less likely to be Hispanic than non-Hispanic (p=0.02), less likely to have Medicaid (p=0.03) versus private insurance, and more likely to have had a previous preterm birth (p<0.0001) than those who delivered at term. Mothers of preterm infants were less likely than mothers of full-term infants to report that the father gave financial support during pregnancy (adjusted odds ratio, aOR=0.7; 95%CI= 0.3, 1.7), or intended to pay child support (aOR=0.4; 95% CI=0.1, 1.4). Compared to mothers with a highly involved partner, mothers delivering preterm were most likely to have a moderately involved partner (aOR=1.8; 95% CI=0.4, 8.3). No association between preterm birth and father involvement was observed for mothers who were either just friends or in with no relationship with the child's father.

Conclusion: In unmarried couples, moderate or low paternal involvement may confer greater risk of preterm birth compared to high paternal involvement. Future research should explore the joint impact of relationship status and father involvement.

Introduction

Preterm birth (live birth <37 weeks' completed gestation) is a leading cause of infant mortality and individuals born preterm can carry a substantial lifetime burden of morbidity. After a five year period of decline beginning in 2006, preterm births represented 12% of all live births in the US in 2011.[4]

Maternal marital status has consistently been seen as a risk marker for preterm birth, and more recently, missing paternal demographics on the birth certificate have also been associated with adverse pregnancy outcomes.[6-8,121,122,124] When the father's name, age, or race is missing from the birth certificate, infants are twice as likely to have been born preterm or to have low birth weight, and three times as likely to die in the first year of life.[6,121] Missing paternal demographics have been thought to represent lack of father involvement during pregnancy, though it is not known how the concept of father involvement operates to affect pregnancy outcomes. However, if there is an identifiable causal linkage, an estimated 70% of excess infant mortality could be prevented by eliminating the cause associated with a missing father's name, and racial disparities could potentially be eliminated.[12,121]

Currently, there is no gold standard measure of father involvement during pregnancy. Several studies have assumed that presence or absence paternal demographics on the birth certificate reflected presence or absence of paternal involvement, while others have measured father involvement as participation in childbirth classes or attending prenatal care visits.[6-8,121,122,139] Other studies, such as the Fragile Families and Child Wellbeing Study, have asked unmarried couples whether the father purchased or contributed towards purchasing items for the baby, or provided other non-material support to the mother during the pregnancy.[132,149] It is unknown whether father's information on the birth certificate is associated with father's

involvement as measured by these other indicators, or if any of these other indicators, individually or jointly, are associated with preterm birth.

We utilized contract data files available from the Fragile Families and Child Wellbeing Study to evaluate the impact of several measures of paternal involvement during pregnancy on risk of preterm birth via a cross sectional analysis nested within the longitudinal Fragile Families and Child Wellbeing Study cohort.

Methods

The Fragile Families and Child Wellbeing Study is a longitudinal study of developmental outcomes in children born to unmarried parents.[150] Participants were recruited from 1998-2000 from birthing hospitals in 20 US cities with 1994 populations over 200,000. All mothers were enrolled in the hospital following the birth. Timing of the father's next anticipated visit to the hospital was provided to the study staff, and attempts were made to enroll him at that time. When father interviews were not completed in the hospital prior to the mother's discharge, attempts were made to reach him by phone. Sixty-six percent of fathers were interviewed at the hospital, and 20% of paternal interviews were completed by phone. The method of contact for the remaining enrolled fathers is unknown.[151] Mothers and fathers were interviewed separately. Cases where the father was deceased, the child was being placed for adoption, or the pregnancy was a result of forced sex were not eligible for study participation. In the Fragile Families Study 87% of unmarried women completed the baseline study, and of those, 75% of fathers were also interviewed. The current analysis included 2,660 unmarried couples where both the mother and father were aged 18 or older and completed the baseline interview.

Our primary outcome is preterm birth, defined as a live birth occurring before 37 completed weeks of gestation. Fragile Families study personnel obtained pregnancy outcomes and other obstetric data through medical record abstraction. We obtained these for purposes of this analysis via a data user contract with the Office of Population Research at Princeton University.

Our primary exposure of interest is father involvement, determined by maternal responses to six questions including whether the father had provided financial or other non-material support during the pregnancy, if he had stated intentions to pay child support, whether he had suggested terminating the pregnancy, if the child would be given the father's last name and if the father's name would be on the birth certificate. Responses to these questions were considered both individually and together, and through use of latent class analysis, participants were classified into categories of father involvement. Because cohabiting couples were not asked if the father had stated intentions to pay child support, this question was not included in the latent class analysis. Father involvement group membership was assigned based upon the highest membership probability as determined by latent class analysis. Models with two, three, and four involvement categories were compared for fit using the Akaike Information Criterion (AIC). The four level indicator of involvement was selected as the best model (See Chapter 3). Latent class analysis was performed using the PROC LCA (version 1.2.7) add-on package publicly available from the Pennsylvania State University Methodology Center.[160]

We performed unweighted logistic regression. Though sampling weights were available, they were not used in this analysis because we controlled for the primary sampling factor, marital status, by restricting the analysis to unmarried participants. We investigated the interaction of paternal involvement with relationship status. In models using the latent class indicator, the addition of cross product terms for relationship

status by paternal involvement yielded a quasi-separation of data points. This was due to no preterm births occurring in the stratum of no relationship with high paternal involvement. As a result, results are stratified by relationship status. Confounders were determined through the use of a directed acyclic graph.[162] All models were adjusted for maternal race, and history of preterm birth.

All analysis was performed using SAS 9.3 (Cary, NC).

This analysis was approved by the Emory University Institutional Review Board.

Results

There were 2,579 observations of singleton, live births to unmarried women over age 18 with abstracted medical records available, representing 72.5% of the total sample of unmarried women over age 18 in the sample (n=3,558). Of those included in the analysis, 314 (12.1%) delivered preterm. Mothers who delivered preterm were similar in age to those who delivered at term (Table 4.1). Mothers delivering preterm infants were more likely to be Black or African American, but less likely to be of Hispanic ethnicity than mothers delivering at term. Mothers in the preterm birth group were less likely to be in a cohabiting relationship, and were more likely to report not being in a relationship with the father of the child than those delivering at term. Educational attainment did not differ by pregnancy outcome, but mothers delivering preterm were more likely to have been on Medicaid (p=0.01). There was no difference in gravidity or parity, but those delivering preterm were three times as likely to have had a previous preterm delivery (22.4% vs. 7.0%; p<0.0001). Mothers delivering preterm were more likely to have experienced complications such as pre-eclampsia (37.1% vs. 5.8%; p<0.01), premature rupture of membranes (9.7% vs. 4.2%; p<0.0001), incompetent cervix (2.5% vs 1.0%; p=0.04), and use of tocolytics (22.8% vs. 5.2%; <0.0001). There was no difference in occurrence of bacterial vaginosis or genito-urinary infections.

As seen in Table4.2, categories of father involvement, as determined by latent class analysis, were closely associated with relationship status. Over 60% of mothers with high paternal involvement were cohabiting, while 65% of those in the no involvement group reported no relationship with the child's father ($p<0.0001$). Educational attainment of mothers did not vary by paternal involvement.

There was no significant interaction between relationship type and paternal involvement for individual predictors of paternal involvement. After adjustment for relationship type, maternal race, and history of preterm birth, mothers delivering preterm were less likely to report having received financial support (aOR=0.5, 95% CI: 0.4, 0.8) than mothers who delivered at term (Table 4.3). While not statistically significant, mothers of preterm infants were also less likely to report that the child would have the father's last name (aOR=0.7, 95% CI: 0.5, 1.0) or that his name would be on the birth certificate (aOR=0.9, 0.6, 1.4). There was no difference in the odds of receiving other support from the father during pregnancy by pregnancy outcome in crude or adjusted analyses. After adjustment for confounders, there was no difference in the odds of a mother reporting that the father would pay child support by pregnancy outcome (aOR=1.0, 95% CI: 0.6, 1.7). No difference was seen in reporting of whether the father had suggested an abortion.

As discussed in chapter 3, a four level indicator of paternal involvement was selected. Categories were labeled as "high", "moderate", "low", and "none", with "high" serving as the reference. In crude analyses, preterm births had greater odds of low father involvement compared to high father involvement (OR=1.5, 95% CI: 1.1, 2.1) than term births (Table 4.3). The odds of a moderately involved father compared to a highly involved father were 20% higher but not statistically significant (OR=1.2, 95% CI: 0.7, 1.9) for preterm births than term births. No difference was seen in the odds of preterm birth with an uninvolved father compared to highly involved fathers. After stratifying by

relationship type and adjusting for confounders, preterm birth was associated with increased odds of a father with low involvement for cohabiting and visiting mothers, but not for those who were only friends or had no relationship (Table 4.4).

Restricting the analysis to those observations where there was both a maternal and paternal baseline interview (n=1,975), only low paternal involvement was associated with an increased risk of preterm birth (OR=1.9; 95% CI: 1.3, 2.7) in crude analyses. After adjusting for maternal age and previous preterm birth, cohabiting and visiting mothers with low or moderately involved partners were more than twice as likely to deliver a preterm infant as mothers with highly involved partners (Table 4.5). Results for the no paternal involvement group are not shown as only 4 of 59 observations were preterm.

We also repeated the analysis adding a dichotomous indicator of relationship status to the LCA analysis. Cohabiting and visiting couples were classified as involved, and couples who were just friends or had no relationship were classified as uninvolved. The latent class analysis was also run for paternal responses. Table 4.6 compares the associations of father involvement using involvement indicators plus relationship status with preterm birth by maternal and paternal reports, in the subpopulation of participants where there was both a maternal and paternal interview. No associations are observed when using maternal responses. When paternal responses are considered, moderately involved fathers had a greater odds of preterm birth than highly involved fathers (aOR=1.7; 95% CI: 1.1, 2.7).

Discussion

Unmarried women with preterm deliveries were less likely than mothers of full-term deliveries to report receiving financial support from the father of the child during pregnancy, that the child would have the father's last name, or that his name would be

on the birth certificate. A combined indicator of maternally reported father involvement was associated with preterm birth for mothers in either cohabiting or visiting relationships but not for mothers who were friends or had no relationship with the father.

Relationship status was closely linked to categories of father involvement with 63% of the highly involved group in cohabiting unions and 65% of mothers with the lowest paternal involvement reporting no relationship with the child's father. Previous studies have shown that marital status is associated with preterm birth. In our analysis of unmarried women, we did observe a statistically significant association, though it was not as expected. We observed that, compared to women delivering at term, mothers delivering preterm were more likely to be in the less stable situations of a visiting relationship or just friends. It may be that women reporting no relationship with the father of their child may have effectively rescued themselves from the negative effects of a bad relationship,[120] while some cohabiting women enjoy some of the supportive roles assumed by husbands of married women. Compared with cohabiting women with a highly involved partner, cohabiting women who reported receiving little support from their partners were more likely to have a preterm birth.

Our findings align with previously published studies of missing paternal demographics on the birth certificate and adverse pregnancy outcomes. While there may be several reasons for the absence of a father's name on the birth certificate, one such reason is relationship status. Only 1% of married mothers fail to provide complete paternal information on the birth certificate, whereas 52% of unmarried mothers do not complete this information.[7] In addition, Edin and Kefalas, in qualitative interviews with young, unmarried mothers found that not giving the child the father's last name is the ultimate insult to the father.[127]

Results presented in chapter 3 indicated that mothers and fathers gave similar reports of father involvement. The difference in classifications between maternal and paternal reports had a small effect on these findings, with paternally reported father involvement showing a somewhat larger association with preterm birth.

Relationship status and paternal involvement, as measured here, are also related to known risk factors or markers for preterm birth. For example, women in this study averaged 9 prenatal care visits, which is fewer than would be expected for a term pregnancy with initiation of prenatal care in the first trimester. Martin, et al, has shown that initiation of prenatal care is associated with father involvement as well as the father's intention and desire for the pregnancy.[18] In their study, mothers were 42% more likely to enter prenatal care in the first trimester when the father was involved in the pregnancy. Prenatal cigarette smoking was also reduced 36% more in women with involved partners than in women with uninvolved partners.[18] In our study, 75% of women in this study had their deliveries covered by Medicaid, and few had earned a college degree. More effort is needed in understanding such factors as poverty and their mechanisms of action on preterm birth.

A key benefit of this study is data reduction due to using latent class analysis. With the five indicators of father involvement, there are 32 possible combinations of father involvement responses, which increases to 64 when adding dichotomous relationship status. Latent class analysis reduced the 64 possibilities to 4 more interpretable categories.

A limitation of our study is the unknown validity of our measures of father involvement, although they have face validity and address some of the ways in which father involvement may be manifested. At present, no gold standard measure of paternal involvement during pregnancy exists, and construct validity cannot be evaluated. However, in an attempt to measure internal consistency, the father

involvement questions yielded a Cronbach's alpha of 0.6. Though less than the suggested cutpoint of 0.7, the observed value of alpha suggests that either additional or modified father involvement questions may improve the overall construct (see Chapter 3).

Another potential limitation of this study is selection bias. It is possible that participation in the study was related to the pregnancy outcome. For example, the mother of a preterm infant could be less likely to participate in a study if her infant was experiencing complications of prematurity. Conversely, a mother of a preterm infant could be more likely to participate if she thought participation would result in knowing the cause of the preterm birth. An additional source of bias related to pregnancy outcome may be due to greater access to fathers of preterm infants related to longer hospital stays for preterm infants. Mothers experiencing complications may also have had a longer hospital stay, giving a longer time frame to be enrolled in the study. Study participation could also have been related to relationship status. Mothers not wanting the father to be involved may have been less likely to enroll in the study to avoid contact with him. In this analysis, preterm births occurred in 12.5% (n=237) of enrolled families with a paternal interview, compared to 12.0% (n=77) being preterm when there was no paternal interview.

A final limitation is the classification scheme used by the latent class analysis program. Categories of involvement were assigned based upon the probabilities determined by the statistical output. As discussed previously in chapter 3, there may be an unequal weighting of response items in the latent class analysis model. This could be due to the model selection process, or the limited number of items included in the analysis relative to the number of involvement categories.

Conclusion

For unmarried couples, provision of financial support during pregnancy is associated with a decreased risk of preterm birth. Among cohabiting and visiting partners, preterm birth risk is lower for partners with an involved father, suggesting that discordance of roles and relationships may increase maternal stress-associated preterm birth risk. Father involvement, linked closely to relationship status, may be an indicator of other factors with a more causal link to preterm birth. However, items used to assess father involvement could be enhanced through use of additional or different questions.

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Table 4.1: Characteristics of 2,579 Women Enrolled in the Fragile Families Study

	Preterm* (n=314)		Term (n=2265)		
	Mean (SD)	N (%)	Mean (SD)	N (%)	P-Value
Age	25.2 (6.1)		24 (5.3)		<0.001
Race					
White		75 (24.2)		552 (24.8)	0.01
Black		193 (62.3)		1230 (55.2)	
Asian		8 (2.6)		35 (1.6)	
American Indian		10 (3.2)		113 (5.1)	
Other		24 (7.7)		299 (13.4)	
Hispanic ethnicity		67 (21.5)		655 (29.2)	<0.01
Foreign Born		28 (8.9)		335 (14.8)	0.01
Relationship Status					0.04
Cohabiting		144 (45.9)		1129 (49.9)	
Visiting		118 (37.6)		744 (32.9)	
Friends		33 (10.5)		179 (7.9)	
No Relationship		19 (6.1)		213 (9.4)	
Gravidity	3.4 (2.2)		3.0 (1.9)		0.001
Parity	1.5 (1.6)		1.2 (1.4)		0.005
Prenatal Care Visits	6.1 (4.4)		8.8 (4.1)		<0.0001
Previous Preterm Birth		70 (22.4)		158 (7.0)	
Highest Completed Education					
Less than High School		141 (45.1)		894 (39.5)	
High School Diploma/GED		107 (34.2)		768 (33.9)	
Some college, technical or trade school		55 (17.6)		534 (23.6)	
Bachelor's Degree or Greater		10 (3.2)		67 (3.0)	
Insurance Status					0.03
Medicaid		239 (77.1)		1676 (74.3)	
Private Insurance		48 (15.5)		468 (20.7)	
Other		23 (7.4)		112 (5.0)	

*Preterm is defined as live birth <37 completed weeks' gestation.

Table 4.2: Demographic and Obstetric Characteristics for 2,579 Unmarried Women in the Fragile Families and Child Wellbeing Study by Degree of Father Involvement

	High Involvement (N=1,878)		Moderate Involvement (N=137)		Low Involvement (N=327)		No Involvement (N=237)		
	N (%)	Mean (SD)	N (%)	Mean (SD)	N (%)	Mean (SD)	N (%)	Mean (SD)	P-Value
Age		24.0 (5.4)		24.1 (5.5)		24.4 (5.3)		24.8 (5.7)	0.1529
Race									0.001
White	465 (25.1)		32 (23.7)		53 (16.6)		77 (32.9)		
Black	1036 (56.0)		86 (63.7)		191 (59.7)		110 (47.0)		
Asian	28 (1.5)		1 (0.7)		9 (2.8)		5 (2.1)		
American Indian	82 (4.4)		5 (3.7)		20 (6.3)		16 (6.8)		
Other	239 (12.9)		11 (8.2)		47 (14.7)		26 (11.1)		
Hispanic Ethnicity	528 (28.3)		25 (18.3)		94 (29.1)		75 (31.9)		0.04
Foreign Born	271 (14.4)		14 (10.2)		49 (15.0)		29 (12.2)		0.04
Relationship Status									<0.0001
Cohabiting	1176 (62.6)		28 (20.4)		65 (19.9)		4 (1.7)		
Visiting	613 (32.6)		55 (40.2)		155 (47.4)		39 (16.5)		
Friends	74 (3.9)		26 (19.0)		72 (22.0)		40 (16.9)		
No Relationship	15 (0.8)		28 (20.4)		35 (10.7)		154 (65.0)		
Highest Completed Education									0.3
Less than HS	737 (39.3)		56 (40.9)		134 (41.0)		108 (45.6)		
HS Diploma /GED	642 (34.2)		49 (35.8)		113 (34.6)		71 (30.0)		
Some College/Trade School	436 (23.3)		28 (20.4)		68 (20.8)		57 (24.1)		
Bachelor's Degree or Greater	60 (3.2)		4 (2.9)		12 (3.7)		1 (0.4)		

*Categories of involvement determined by latent class analysis using five indicators of paternal involvement: financial support during pregnancy, other support during pregnancy, intentions to pay child support, father suggested abortion, father's name on birth certificate, and child will have father's last name

Table 4.2: Demographic and Obstetric Characteristics for 2,579 Unmarried Women in the Fragile Families and Child Wellbeing Study by Degree of Father Involvement (cont.)

	High Involvement (N=1878)		Moderate Involvement (N=137)		Low Involvement (N=327)		No Involvement (N=237)		
	N (%)	Mean (SD)	N (%)	Mean (SD)	N (%)	Mean (SD)	N (%)	Mean (SD)	P-Value
Insurance Status									0.01
Medicaid	1358 (72.7)		112 (81.8)		257 (79.1)		188 (79.7)		
Private	409 (21.9)		17 (12.4)		52 (16.0)		52 (16.0)		
Other	101 (5.4)		8 (5.8)		16 (4.9)		16 (4.9)		
Gravidity		2.9 (1.9)		3.2 (2.2)		3.1 (2.0)		3.2 (2.5)	0.3
Parity		1.2 (1.3)		1.4 (1.7)		1.3 (1.4)		1.4 (1.8)	0.3
History of Preterm Birth	164 (8.8)		14 (10.3)		36 (11.2)		14 (5.9)		0.2
Number Prenatal Care Visits		8.6 (4.1)		7.8 (4.9)		8.2 (4.1)		8.4 (5.0)	0.2

*Categories of involvement determined by latent class analysis using five indicators of paternal involvement: financial support during pregnancy, other support during pregnancy, intentions to pay child support, father suggested abortion, father's name on birth certificate, and child will have father's last name.

Table 4.3: Crude and Adjusted Models of the Association of Individual and Combined Measures of Father Involvement and Preterm Birth

	Preterm	Term	OR (95% CI)	aOR (95% CI)
Did father provide financial support or buy things for the baby?				
Yes	243	1859	0.7 (0.5, 1.0)	0.5 (0.4, 0.8)
No	69	374	1.0 Reference	
Did father provide other support during pregnancy				
Yes	252	1782	1.1 (0.8, 1.5)	1.0 (0.8, 1.4)
No	60	459	1.0 Reference	
Did father say he would provide child support in the first year?				
Yes	145	889	1.4 (0.9, 2.3)	1.0 (0.6, 1.7)
No	23	199	1.0 Reference	
Did father suggest an abortion?				
Yes	41	280	1.1 (0.7, 1.5)	1.1 (0.8, 1.6)
No	269	1935	1.0 Reference	
Will child have father's last name?				
Yes	236	1773	0.8 (0.5, 1.1)	0.7 (0.5, 1.0)
No	68	401	1.0 Reference	
Will father's name be on birth certificate?				
Yes	267	1934	1.0 (0.7, 1.4)	0.9 (0.6, 1.4)
No	35	251	1.0 Reference	
Latent Class Involvement Indicator				
None	27	210	1.0 (0.6, 1.5)	1.5 (0.9, 2.6)
Low	53	274	1.5 (1.1, 2.1)	1.6 (1.1, 2.2)
Moderate	18	119	1.2 (0.7, 1.9)	1.1 (0.7, 2.0)
High	216	1662	1.0 Reference	

OR, Odds Ratio; CI, Confidence Interval; aOR, Adjusted Odds Ratio; All models adjusted for maternal race, relationship status, and history of preterm birth

Table 4.4: Associations of Preterm Birth with Categorical Father Involvement Variable for 2,579 Women in the Fragile Families Study, Maternal Response

	Relationship Type			
Paternal Involvement	Cohabiting	Visiting	Friends	No Relationship
None	0	1.4 (0.6, 3.6)	1.0 (0.3, 2.6)	1.5 (0.3, 7.6)
Low	**2.4 (1.3, 4.5)**	**1.8 (1.1, 2.9)**	0.4 (0.1, 1.2)	1.0 (0.2, 7.0)
Moderate	0.6 (0.1, 2.8)	1.2 (0.5, 2.7)	1.1 (0.4, 3.6)	1.0 (reference)
High	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)

All models adjusted for maternal race, and previous preterm birth. Paternal involvement status determined from latent class analysis with five indicators of involvement.

Table 4.5: Associations of Preterm Birth with Categorical Father Involvement Indicator Variable by Maternal Response Restricted to 1,975 Cases with Father Interview in the Fragile Families Study

	Cohabiting	Visiting	Friends
None	1.1 (0.1, 9.9)	1.1 (0.3, 3.7)	0.8 (0.2, 3.6)
Low	**2.5 (1.3, 4.9)**	**2.3 (1.3, 4.0)**	0.4 (0.1, 1.5)
Moderate	**2.2 (1.2, 4.0)**	1.2 (0.6, 2.5)	0.5 (0.1, 4.8)
High	1.0 (ref.)	1.0 (ref.)	1.0 (ref.)

Models adjusted for maternal age and previous preterm birth.

Table 4.6: Associations of Father Involvement with Preterm Birth for 1,975 Observations with Maternal and Paternal Interviews, Maternal and Paternal Response

	Maternal Response		Paternal Response	
	OR (95% CI)	aOR* (95% CI)	OR (95% CI)	aOR* (95% CI)
No Involvement	0.6 (0.2, 1.6)	0.6 (0.2, 1.6)	0.7 (0.2, 2.3)	0.7 (0.2, 2.3)
Low Involvement	1.3 (0.8, 2.0)	1.3 (0.8, 2.2)	1.7 (1.1, 2.7)	1.7 (1.1, 2.7)
Moderate Involvement	1.5 (0.9, 2.3)	1.3 (0.8, 2.2)	1.2 (0.6, 2.6)	1.3 (0.6, 2.9)
High Involvement	1.0 (ref.)		1.0 (ref.)	

*Adjusted for history of preterm birth and maternal race. Paternal involvement status determined from latent class analysis with five indicators of involvement plus relationship status.

Chapter 5: Partner Support during Pregnancy and Risk of Preterm Birth

Abstract

Background Little is known about the role of partner support during pregnancy and the prevention of adverse pregnancy outcomes, especially among women with psychiatric illness. These women are at increased risk for adverse outcomes such as preterm birth.

Methods Pregnant women (n=189) with histories of psychiatric illness completed the Dyadic Adjustment Scale (DAS) to measure partner relationship quality and the modified Postpartum Social Support Questionnaire (PSSQ) to measure anticipated postpartum social support from multiple sources (partner, parents, in-laws, friends). We evaluated the association of relationship quality and partner support with preterm birth, defined as a live birth before 37 completed weeks of gestation. DAS and PSSQ scores were dichotomized at the median.

Results Low affective expression was associated with a decreased risk of preterm birth (OR = 0.38; 95% CI: 0.15, 0.93). Low support from the partner was not associated with preterm birth (OR=0.66; 96% CI: 0.28, 1.52), nor was low social support from all sources (OR=1.15; 95% CI: 0.50, 2.64). Adjustment for maternal age and previous preterm birth did not modify observed associations.

Conclusion For pregnant women with psychiatric illness, high levels of partner support may be associated with an increased risk of preterm birth. This finding, though imprecise, and contrary to *a priori* expectations, may indicate a more complicated relationship between women, their support system, and their partners during pregnancy. These findings may not extend to the general population, and this study should be repeated in healthy pregnant women and a larger sample of women with psychiatric illness.

Introduction

Preterm birth, defined as any live birth before 37 completed weeks of gestation, is a leading cause of neonatal and infant mortality.[1,2] Traditional risk markers for preterm birth include sociodemographic factors, e.g., education, income, maternal age, and marital status, in addition to maternal/fetal infection, inflammation, uterine abnormalities, and history of previous preterm birth.[2,43]

Women with mental illness are also at increased risk of preterm delivery.[163,164] In a cohort of women with a variety of psychiatric diagnoses, 15% of pregnancies ended with a preterm delivery whereas only 12% of births are preterm in the general population.[4,165,166] African American women with depressive symptoms in the highest 10%, as measured by the Center for Epidemiologic Studies Depression Scale, were nearly twice as likely to deliver preterm, compared to those with lower scores.[163] A European cohort found depression, but not anxiety, to be associated with preterm birth.[167]

In population based studies, the absence of a father's name on the birth certificate has been associated with preterm birth and other poor pregnancy outcomes.[6,7,121,122] These observed associations are thought to represent father involvement.[10] Though the mechanism by which father involvement may affect pregnancy outcomes is unknown, it may represent social support from the partner. In women with unknown psychiatric history, prevalence of depression during pregnancy was 8%, with reduced partner support strongly associated with the occurrence of depression.[168]

Poor social support has also been associated with an increased risk of preterm birth and mental illness. In women with a history of mental illness, reduced social support has been associated with both antenatal and postpartum depression.[168,169] The role of fathers in preventing preterm birth in women with mental disorders is unknown.

In this study, we describe the associations between the exposures of relationship quality and social support received during pregnancy and the risk of preterm birth (<37 weeks gestation) in a population of adult females with a lifetime history of psychiatric illnesses. We hypothesized that pregnant women with psychiatric conditions who anticipated greater partner support after the birth of their child or had a better relationship with the child's father would be less likely to deliver a preterm infant than those women who anticipated lower levels of social support from their partners.

Methods

This study employed a prospective cohort design with social support and relationship status/quality measured in the third trimester of pregnancy (at approximately 31 weeks gestation), and pregnancy outcomes determined at time of delivery.

Study participants were recruited from a sample of pregnant women 18-45 years old fulfilling *DSM-IV* criteria for major depressive disorder, bipolar disorder, panic disorder, obsessive compulsive disorder, generalized anxiety disorder, or post-traumatic stress disorder, and receiving treatment at the Emory Women's Mental Health Program (WMHP). Women were referred to WMHP from community obstetric and psychiatric providers. The Emory WMHP was established in 1991 to provide care for mental disorders during pregnancy and postpartum.

Per study protocol, women were evaluated at 6-week intervals during pregnancy, and more frequently when indicated by their clinical needs. For each participant, multiple observations across multiple pregnancies were possible. To avoid autocorrelation in the data, only the first observation for the first pregnancy for each woman was used. One hundred eighty-nine (189) participants with complete prenatal

Postpartum Social Support data were included in the analytic data set. Care provided at WMHP was independent of obstetric care.

This study was approved by the Emory University Institutional Review Board.

As a proxy of social support during pregnancy, we measured levels of social support anticipated to be received during the postpartum period. Anticipated social support was measured using a version of the Postpartum Social Support Questionnaire modified for administration during pregnancy.

The Postpartum Social Support Questionnaire (PSSQ) is a 50 item self-administered questionnaire designed to measure social support received by new mothers in the postpartum period.[170] The PSSQ measures social support received from the husband/partner, parents, in-laws, and other family and friends. Summary and subscale scores are available. In our sample, the PSSQ was modified for administration during pregnancy to measure *anticipated* levels of support to be received postpartum. In the modified PSSQ, the verb tense of the questions was changed from present to future, but questions otherwise remained the same. An example of the modifications made is shown in Figure 5.1. The modified PSSQ was validated in this study population through confirmatory factor analysis using the maximum likelihood method of factor selection and an orthogonal varimax rotation.[171] Loading factors were higher than those published by Hopkins and Campbell for the original PSSQ, and the patterns for each factor were nearly identical.[170,171]

Relationship quality was measured using the Dyadic Adjustment Scale (DAS).[172] The Dyadic Adjustment Scale is a 32 item self-administered instrument designed for use in couples, whether married or cohabiting, and assesses the individuals' perceptions of the relationship. The DAS measures four domains of relationship quality: dyadic consensus, dyadic satisfaction, dyadic cohesion, and affectional expression [172,173]. Dyadic consensus is the degree of agreement between partners on issues fundamental to the

relationship such as religion, division of household tasks, and recreational activities. Dyadic satisfaction measures satisfaction with the relationship, and whether or not the respondent has considered ending the relationship. The dyadic cohesion subscale measures the level of shared interests present between the dyad partners. Affective expression measures the satisfaction of the partners with expressed affection and their sexual activity. The Dyadic Adjustment Scale can be used as a whole, or the four subscales can be used individually.

The primary outcome of interest is preterm birth. Preterm birth, defined as a live birth occurring prior to 37 completed weeks of gestation, was obtained from the obstetric record.

Variables chosen for evaluation as potential confounders were selected after reviewing the literature for factors known or thought to be associated with both father involvement and preterm birth. Potential confounders include maternal age, maternal race, obstetric history (previous preterm birth, gravidity and parity), pregnancy desire and intention, education, employment, and marital status.

Descriptive analyses were used to characterize the study population. Covariates thought to be associated with either of the exposure variables and/or the outcome were described by means, medians, or proportions, as appropriate. The distribution of these variables was examined by exposure status and outcome status separately. Statistical differences across exposure and/or outcome were determined by tests of means (t-test) or proportions (X^2), as appropriate. Fisher's exact test was used for comparisons with small expected cell sizes.

Both the modified PSSQ and the DAS were treated continuously and categorically. Because there were no *a priori* assumptions regarding cut points for either measure, measures were dichotomized at the median. We analyzed the full PSSQ scale as well as the partner scale separately.

Logistic regression was used in separate models for the association between the modified PSSQ and the DAS with preterm birth.

To assess confounding, we used both a directed acyclic graph (DAG) and data-based assessments.[162] We used the DAG to represent our assumptions regarding the associations between paternal involvement and preterm birth. The hypothesized DAG is shown in Figure 5.2.

Covariates shown to have either a statistically significant association or a strong association ($p \leq 0.10$) with both the exposure and the outcome were eligible for inclusion in the final model. All eligible confounders were put into the model together (full model). Models for each possible combination of the covariates were compared to the full model. Changes in the estimate of the odds ratio greater than 10% were assumed to indicate the presence of uncontrolled confounding. The most parsimonious model having an odds ratio within 10% of the full model and with the greatest statistical precision was chosen as the final model.

For all analyses, a two sided alpha level of 0.05 was used. All analyses were performed in SAS 9.3 (Cary,NC).

Results

After exclusions for missing PSSQ (n=39), multiples (n=6), stillbirth (n=1) and missing gestational age (n=3), 189 women remained in the analytic data set. Study participants were a mean age of 32.8 (SD= 4.6) years. They had experienced a mean of 2.3 (SD=1.4) pregnancies, with a mean of 0.7 (SD=0.8) live births (Table 1). Participants were predominately white (84.7%, n=160), non-Hispanic (97.9%, n=185), and married (85.6%, n=160). Most worked full time (66.5%, n=125) and had a college degree or higher (75.6%, n=143).

Nearly 75% of the index pregnancies were planned, and 83.2% (n=154) were desired. A variety of non-mutually exclusive psychiatric diagnoses were represented in the study sample. Few women had active psychiatric illness at the time of the study enrollment (Table 5.1).

Total Social Support

Women with total Postpartum Social Support Questionnaire scores at or below the median (low support) were older than women with scores above the median (33.5±4.5 vs. 32.1±4.7; p=0.05), and also had experienced more pregnancies (2.6±1.6 vs. 2.0±1.0; p<0.01). There was no difference in parity. Women with PSSQ scores above the median were more likely to be married than women with scores at or below the median (89.3% vs. 81.1%; p=0.04) Regardless of parity, women who had experienced previous pregnancy losses were more likely to report less social support than women with no losses. This finding was not statistically significant. The proportion of women with history of preterm birth did not vary by PSSQ score (Table 5.2).

There was no difference in mean total PSSQ score by preterm birth status (209.3 [27.9] vs. 210.4 [39.3]). In unadjusted analyses, women reporting low total social support had similar odds of having a preterm birth as those with high social support (OR =1.2; 95%CI: 0.5, 2.6). There was no change in the estimate after adjustment for maternal age, race, and history of preterm birth, (Table 5.3).

Partner Social Support

Women reporting low social support from the partner had experienced more pregnancies than women reporting more support (2.6±1.6 vs. 2.0±1.1; p=0.01). Women with low partner support were less likely to be married (77.3% vs. 94.4%; p<0.01). Women with less partner support were more likely to have an unplanned pregnancy than women with more supportive partners (32.3 vs. 17.8%; p=0.02) (Table 5.2).

Women reporting low social support from their husband/partner were no less likely to have a preterm birth than those women reporting high support from the partner (OR=0.7; 95% CI: 0.3, 1.5). There was no change in the estimate after adjustment for confounders.

Relationship Quality

Women with total DAS scores below the median had a higher mean gravidity than those with higher DAS scores (2.4 ±1.6 vs. 2.0±1.1; p=0.04), though there was no difference in parity or other obstetric characteristics (Table 5.4). Women with DAS scores below the median were more likely to have a college education than women with scores above the median (83.2% (n=89) vs. 68.5% (n=48); p=0.02). After adjustment for confounders, women who delivered a preterm infant had a higher mean total DAS score than women who delivered at term (122.3±11.7 vs. 116.6±17.0; p=0.05). Women with low relationship quality were no less likely to deliver preterm than women with higher relationship quality (OR=0.5; 95% CI: 0.2, 1.3).

On all relationship quality subscales, women who had a preterm birth had higher mean scores than women with term births, though only the satisfaction subscale reached statistical significance (42.4±4.0 vs. 40.4±6.3; p=0.04). For three of the four relationship quality subscales (cohesion, consensus, and satisfaction), women with scores below the median were less likely to deliver preterm than women with better relationship quality, though not statistically significant. Women with low scores on the affective expression subscale were 62% less likely to deliver preterm than those with higher scores (OR=0.4; 95% CI: 0.2, 0.9), though estimates were imprecise.

In this dataset, there was a subset of fathers (n=87) who also completed the DAS during the pregnancy. The mean difference between maternal and paternal ratings on the total DAS was 0.67 (±17.5), though there was a range in the difference from -69 to 77.

The mean difference in dyadic adjustment total and subscale scores did not vary by pregnancy outcome (Table 5.5).

Discussion

In this study of 189 women with a history of psychiatric illness, we observed that women reporting higher partner support and relationship quality during pregnancy were no more likely to deliver a preterm infant than women reporting lower partner support. While not statistically significant, the direction of the observed effect is in opposition to the hypothesis that pregnant women with highly involved partners would be less likely to experience an adverse pregnancy outcome. In contrast, greater anticipated postpartum social support from all sources (husband/partner, parents, in-laws, other family and friends) is associated with a reduced, albeit non-statistically significant, risk of preterm birth. Our lack of statistically significant findings is likely due to small sample size, with only 26 preterm births.

One explanation for these findings is that the conceptualization of an "involved" father is incorrect. Here, we have made two assumptions.

First, under our main hypothesis, we assumed that a very involved father or partner is beneficial. Anecdotally, Emory Women's Mental Health investigators have observed that women whose husbands attend every WMHP visit have poorer psychiatric outcomes compared to those women whose partners attend WMHP visits less frequently. This could be a reflection of the overall severity of the mental illness, with partners more likely to attend WMHP visits when the mental illness is not well controlled. However, partner attendance could also be a reflection of the relationship, in that women with less self-autonomy may be more likely to stay with a more domineering partner. Unfortunately, data on WMHP visit partner attendance beyond the first visit were not recorded.

Second, we assumed that higher levels of father involvement promote improved pregnancy outcomes through increased maternal wellbeing. It is possible that the partner becomes very involved in response to either a clinical aspect of the psychiatric illness, an obstetric complication, or both. While our outcomes were recorded at delivery, it is possible that an event such as threatened preterm labor occurred prior to PSSQ or DAS administration, prompting increased involvement from the father. Similarly, we presented data on active mental illness. These data were captured at all WMHP visits, but undocumented episodes between visits would not have been included in the clinical record. However, if such episodes were detected by the partner, they may have prompted increased involvement. Both of these events may be associated with the pregnancy outcome, leaving the potential for unmeasured confounding.

We observed that women with lower scores on the affective expression subscale of the DAS were less likely to deliver preterm. The affective expression subscale includes four questions, two of which specifically address agreement towards frequency of sexual relations. If the frequency of sexual intercourse during pregnancy is reduced due to pregnancy complications leading to pelvic rest, or if more frequent intercourse in the third trimester increases the risk of pelvic inflammation leading to preterm delivery, then these findings are not unexpected.

Gravidity showed a consistent inverse association with partner support. Similarly, women with partner support and relationship quality scores below the median were slightly older than women with higher scores. This suggests that experienced mothers may have either lower or more realistic expectations of support from their partners, given prior experiences.

In this study, we had the benefit of prospective data collection, with measures of anticipated partner support and relationship quality collected prior to the outcome, though not necessarily prior to obstetric complications which may have led to increased

partner support. An additional strength was our ability to measure social support with two different instruments. The PSSQ measures social support from multiple sources, including the partner or spouse, while the DAS specifically addresses the couple's relationship. The direction of the observed effects was consistent for each measure.

This study has several limitations. The first is the non-random nature of our sample. Participants were those referred to the Emory Women's Mental Health Program based on pre-existing psychiatric diagnoses. The sample of 189 women is relatively small, which limited our statistical power and ability to make meaningful conclusions. Our study also has limited generalizability as the sample is fairly homogenous, with nearly all participants being Caucasian and married. In addition, these women have psychiatric conditions requiring treatment, as well as the means to receive treatment. A final limitation is the use of a proxy measure of social support. While we have shown that the modified PSSQ is a valid measure of anticipated postpartum social support when administered during pregnancy, this instrument has not been tested to determine associations with currently received social support. However, we believe that it is reasonable to infer that anticipated social support and current social support are highly correlated. The consistency of PSSQ findings with DAS findings is reassuring in this regard.

Conclusion

Though not statistically significant, lower levels of affective expression from the partner may be associated with a decreased risk of preterm birth among women with histories of psychiatric illness. This finding, though contrary to what was expected, may indicate a more complicated relationship between women and their partners during pregnancy. These findings may not extend to the general population, and studies of partner support should be repeated in healthy pregnant women.

Figure 5.1: Comparison of Original PSSQ Items to Items Modified For Administration during Pregnancy

Original Item	How often ***does*** your husband/partner help to take care of the baby?
Modified Item	How often ***will*** your husband/partner help to take care of the baby?

Figure 5.2: Proposed Causal Diagram for the Relationship between Father Involvement and Preterm Birth

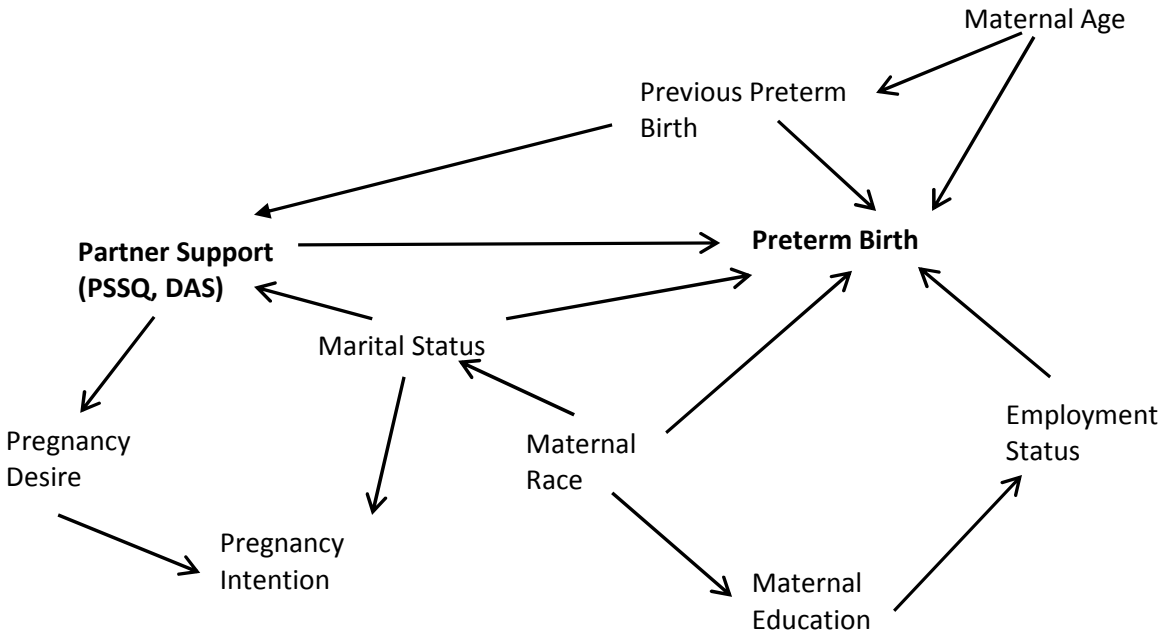

Table 5.1: Sociodemographic Characteristics of 189 Pregnant Women with History of Psychiatric Illness, Atlanta, GA

	N (%)	Mean (SD)
Age		32.8 (4.6)
Race		
White	160 (84.7)	
Other	29 (15.3)	
Hispanic Ethnicity	4 (2.1)	
Marital Status		
Married	160 (85.6)	
Previously Married	6 (3.2)	
Never Married	21 (11.2)	
Living Situation		
Cohabiting	73 (91.5)	
Other	15 (7.9)	
Education		
Some College or Less (<16 years)	46 (24.3)	
College Graduate or Greater (≥16 years)	143 (75.7)	
Employment Status		
Full Time	125 (66.5)	
Part Time	42 (22.3)	
Unemployed	21 (11.2)	
Gravidity		2.3 (1.4)
Parity		0.7 (0.8)
Obstetric History		
Nulliparous, no pregnancy losses	71 (37.6)	
Nulliparous, with pregnancy losses	18 (9.5)	
Multiparous, no pregnancy losses	70 (37.0)	
Multiparous, with pregnancy losses	30 (15.9)	
Previous Preterm Birth	10 (5.3)	
Pregnancy Planned	139 (74.7)	
Pregnancy Desired		
Yes	154 (83.2)	
No	3 (1.6)	
Ambivalent	28 (15.1)	

Table 5.1: Sociodemographic Characteristics of 189 Pregnant Women with History of Psychiatric Illness, Atlanta, GA (cont.)

	N (%)	Mean (SD)
Lifetime SCID Diagnosis		
Bipolar Disorder	62 (32.8)	
Major Depressive Disorder	103 (54.5)	
Depression NOS	3 (1.6)	
Schizophrenia	1 (0.5)	
Panic Disorder	51 (27.0)	
Obsessive Compulsive Disorder	26 (13.8)	
Post-Traumatic Stress Disorder	42 (22.2)	
Social Anxiety	31 (16.4)	
General Anxiety	50 (26.5)	
Current SCID Diagnosis		
Hypomania	1 (0.5)	
Major Depressive Episode	20 (10.8)	
Mixed Mood Episode	3 (1.6)	
Panic Disorder	7 (4.0)	
Obsessive Compulsive Disorder	8 (4.5)	
Post Traumatic Stress Disorder	4 (2.3)	
Social Anxiety	3 (1.7)	
General Anxiety	10 (5.7)	
Drug Weeks of CNS Drug Exposure		
Any CNS Drugs		53.1 (33.4)
Antidepressants		27.5 (22.6)
Mood Stabilizers		13.2 (21.2)
Anxiolytics		4.4 (10.5)
Hypnotics		5.4 (11.0)
Typical Antipsychotics		0.2 (2.4)
CNS Stimulants		1.0 (5.9)
Other		0.4 (3.2)

Table 5.2: Sociodemographic Characteristics of 189 Women with History of Psychiatric Illness by Level of Total Anticipated Social Support, Atlanta, GA

	Total PSSQ ≤Median (N=96)		Total PSSQ>Median (N=93)			Partner PSSQ≤Median (N=97)		Partner PSSQ>Median (N=92)		
	N (%)	Mean (SD)	N (%)	Mean (SD)	P-Value	N (%)	Mean (SD)	N (%)	Mean (SD)	P-Value
Maternal Age		33.5 (4.5)		32.1 (4.7)	0.05		33.0 (4.9)		32.7 (4.4)	0.68
Race										
White	79 (82.3)		81 (87.1)		0.36	82 (84.5)		78 (84.8)		0.96
Other	17 (17.7)		12 (12.9)			15 (15.5)		14 (15.2)		
Hispanic Ethnicity	3 (3.1)		1 (1.1)		0.62	3 (3.1)		1 (1.1)		
Marital Status										
Married	77 (81.1)		83 (89.3)		0.04	75 (77.3)		85 (94.4)		<.01
Previously Married	6 (6.3)		0 (0.0)			6 (6.2)		0 (0.0)		
Never Married	12 (12.6)		9 (9.7)			16 (16.5)		5 (5.6)		
Living Situation										
Cohabiting										
Other										
Education										
Some College or Less (<16 years)	23 (24.0)		23 (24.7)		0.90	26 (26.8)		20 (21.7)		0.42
College Graduate or Greater (≥16 years)	73 (76.0)		70 (75.3)			71 (73.2)		72 (78.3)		
Employment Status										
Full Time	65 (67.7)		60 (65.2)		0.92	61 (63.5)		64 (69.6)		0.67
Part Time	21 (21.9)		21 (22.8)			23 (24.0)		19 (20.7)		
Unemployed	10 (10.4)		11 (12.0)			12 (12.5)		9 (9.8)		

Table 5.2: Sociodemographic Characteristics of 189 Women with History of Psychiatric Illness by Level of Total Anticipated Social Support, Atlanta, GA (cont.)

	Total PSSQ ≤Median (N=96)		Total PSSQ>Median (N=93)			Partner PSSQ≤Median (N=97)		Partner PSSQ>Median (N=92)		
	N (%)	Mean (SD)	N (%)	Mean (SD)	P-Value	N (%)	Mean (SD)	N (%)	Mean (SD)	P-Value
Gravidity	2.6 (1.6)		2.0 (1.0)		<0.01		2.6 (1.6)		2.0 (1.1)	0.01
Parity	0.7 (0.8)		0.6 (0.7)		0.39		0.7 (0.9)		0.6 (0.6)	0.19
Obstetric History										
Nulliparous, no pregnancy losses	33 (34.4)		36 (40.9)		0.41	35 (36.1)		36 (39.1)		0.86
Nulliparous, with pregnancy losses	12 (12.5)		6 (6.5)			10 (10.3)		8 (8.7)		
Multiparous, no pregnancy losses	34 (35.4)		36 (38.7)			38 (39.2)		32 (34.8)		
Multiparous, with pregnancy losses	17 (17.7)		13 (14.0)			14 (14.4)		16 (17.4)		
Previous Preterm Birth	4 (4.2)		6 (6.5)		0.53	4 (4.1)		6 (6.5)		
Pregnancy Planned	69 (71.9)		70 (77.8)		0.35	65 (67.7)		74 (82.2)		0.02
Pregnancy Desired										
Yes	80 (84.2)		74 (83.2)		0.88	79 (83.2)		75 (83.3)		0.82
No	1 (1.1)		2 (2.2)			1 (1.1)		2 (2.2)		
Ambivalent	14 (14.7)		14 (15.6)			15 (15.8)		13 (14.4)		
Lifetime SCID Diagnosis										
Bipolar Disorder	34 (35.4)		28 (30.1)		0.44	37 (38.1)		25 (27.2)		0.11
Major Depressive Disorder	55 (35.42)		48 (51.61)		0.43	51 (52.6)		52 (56.5)		0.59
Depression NOS	1 (35.4)		2 (2.2)		0.62	2 (2.1)		1 (1.1)		1.00
Schizophrenia	0 (0)		1 (1.1)		0.49	0 (0)		1 (1.09)		0.49
Panic Disorder	28 (29.2)		23 (24.7)		0.49	28 (28.9)		23 (25.0)		0.55

Table 5.2: Sociodemographic Characteristics of 189 Women with History of Psychiatric Illness by Level of Anticipated Social Support, Atlanta, GA (cont.)

	Total PSSQ ≤Median (N=96)		Total PSSQ>Median (N=93)			Partner PSSQ≤Median (N=97)		Partner PSSQ>Median (N=92)		
	N (%)	Mean (SD)	N (%)	Mean (SD)	P-Value	N (%)	Mean (SD)	N (%)	Mean (SD)	P-Value
Obsessive Compulsive Disorder	9 (9.4)		17 (18.3)		0.08	15 (15.5)		11 (12.0)		0.48
Post-Traumatic Stress Disorder	24 (25.0)		18 (19.4)		0.35	25 (25.8)		17 (18.5)		0.23
Social Anxiety	17 (17.7)		14 (15.1)		0.62	18 (18.6)		13 (14.1)		0.41
General Anxiety	26 (27.1)		24 (25.8)		0.84	26 (26.8)		24 (26.1)		0.91
Drug Weeks of CNS Drug Exposure										
Any CNS Drug		52.4 (32.4)		53.9 (34.6)	0.76		51.6 (31.5)		54.7 (35.4)	0.53
Antidepressants		28.1 (22.5)		26.8 (22.7)	0.69		26.3 (21.1)		28.7 (24.1)	0.48
Mood Stabilizers		11.3 (17.5)		15.2 (24.4)	0.21		12.5 (18.7)		14.0 (23.6)	0.64
Anxiolytics		4.6 (11.4)		4.1 (9.5)	0.72		4.7 (10.9)		4.0 (10.1)	0.67
Hypnotics		5.6 (11.7)		5.2 (10.3)	0.80		5.7 (11.4)		5.1 (10.7)	0.72
Typical antipsychotics		0.1 (0.6)		0.4 (3.4)	0.33		0.1 (0.6)		0.4 (3.4)	0.29
CNS Stimulants		0.5 (4.1)		1.6 (7.3)	0.19		0.7 (4.6)		1.4 (7.1)	0.41
Other		0.1 (0.4)		0.7 (4.6)	0.21		0.2 (1.8)		0.5 (4.2)	0.65

Table 5.3: Associations of Partner Support and Relationship Quality with Preterm Birth

		≤Median	>Median	OR (95% CI)	aOR *(95% CI)
Total PSSQ	Preterm Birth	14	12	1.2 (0.5, 2.6)	1.2 (0.5, 2.7)
	Term Birth	82	81	1.0 (ref.)	
Partner PSSQ	Preterm Birth	11	15	0.7 (0.3, 1.5)	0.7 (0.3, 1.6)
	Term Birth	86	77	1.0 (ref.)	
DAS Total	Preterm Birth	11	13	0.5 (0.2, 1.3)	0.5 (0.2, 1.3)
	Term Birth	96	60	1.0 (ref.)	
DAS Cohesion	Preterm Birth	14	10	0.7 (0.3, 1.8)	0.8 (0.3, 2.1)
	Term Birth	102	54	1.0 (ref.)	
DAS Consensus	Preterm Birth	10	14	0.6 (0.3, 1.5)	0.6 (0.3, 1.5)
	Term Birth	83	73	1.0 (ref.)	
DAS Satisfaction	Preterm Birth	10	14	0.6 (0.2, 1.4)	0.5 (0.2, 1.2)
	Term Birth	87	69	1.0 (ref.)	
DAS Affective Expression	Preterm Birth	8	16	0.4 (0.2, 0.9)	0.3 (0.1, 0.8)
	Term Birth	89	67	1.0 (ref.)	

OR, Odds Ratio; aOR, Adjusted Odds Ratio; CI, Confidence Interval; PSSQ, Postpartum Social Support Questionnaire; DAS, Dyadic Adjustment Scale. *Odds ratios adjusted for previous preterm birth, maternal age, and race

Table 5.4: Sociodemographic Characteristics of 189 Women with History of Psychiatric Illness by Relationship Quality Domain, Atlanta, GA

	Total DAS ≤ Median (N=107)		Total DAS ≤ Median (N=73)		P-Value
	N (%)	Mean (SD)	N (%)	Mean (SD)	
Maternal Age		38.6 (1.4)		38.5 (1.8)	0.64
Race					
White	89 (83.2)		18 (16.8)		0.57
Other	18 (16.8)		10 (13.7)		
Hispanic Ethnicity	3 (2.8)		1 (1.4)		0.65
Marital Status					
Married	91 (85.8)		65 (90.3)		0.67
Previously Married	3 (2.8)		1 (1.4)		
Never Married	12 (11.3)		6 (8.3)		
Education					
Some College or Less (<16 years)	18 (16.8)		23 (31.5)		0.02
College Graduate or Greater (≥16 years)	89 (83.2)		50 (68.5)		
Employment Status					0.55
Full Time	72 (67.9)		48 (65.8)		
Part Time	20 (18.9)		18 (24.7)		
Unemployed	14 (13.2)		7 (9.6)		
Gravidity		2.4 (1.6)		2.0 (1.1)	0.04
Parity		0.7 (0.8)		0.6 (0.7)	0.21
Obstetric History					0.75
Nulliparous, no pregnancy losses	38 (35.5)		30 (41.1)		
Nulliparous, with pregnancy losses	9 (8.4)		8 (11.0)		
Multiparous, no pregnancy losses	43 (40.2)		25 (34.2)		
Multiparous, with pregnancy losses	17 (15.9)		10 (13.7)		
Previous Preterm Birth	4 (3.7)		5 (6.8)		0.49
Pregnancy Planned	77 (74.0)		58 (79.5)		0.40
Pregnancy Desired					0.55
Yes	85 (82.5)		58 (79.5)		
No	1 (1.0)		2 (2.7)		
Ambivalent	17 (16.5)		9 (12.3)		

Table 5.4: Sociodemographic Characteristics of 189 Women with History of Psychiatric Illness by Relationship Quality Domain, Atlanta, GA (cont.)

	Total DAS ≤ Median (N=107)		Total DAS ≤ Median (N=73)		
	N (%)	Mean (SD)	N (%)	Mean (SD)	P-value
Lifetime SCID Diagnosis					
Bipolar Disorder	34 (31.8)		24 (32.9)		0.88
Major Depressive Disorder	61 (57.0)		37 (50.7)		0.40
Depression NOS	1 (0.9)		2 (2.7)		0.57
Schizophrenia	1 (0.9)		0 (0.0)		0.41
Panic Disorder	32 (29.9)		15 (20.5)		0.16
Obsessive Compulsive Disorder	17 (15.9)		9 (12.3)		0.50
Post-Traumatic Stress Disorder	27 (25.2)		12 (16.4)		0.16
Social Anxiety	20 (18.7)		8 (11.0)		0.16
General Anxiety	29 (27.1)		19 (22.6)		0.87

Table 5.5: Mean Difference in Maternal and Paternal Relationship Quality Scores

	Overall Difference	Term	Preterm	Difference
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (95% CI)
DAS Total	0.7 (17.5)	0.1 (17.8)	4.8 (15.1)	-4.8 (-16.0, 6.5)
DAS Cohesion	0.2 (4.2)	0.2 (4.3)	0.3 (3.5)	-0.0 (-2.7, 2.6)
DAS Consensus	0.3 (8.7)	-0.0 (8.6)	2.6 (9.0)	-2.6 (-8.2, 2.9)
DAS Satisfaction	-0.1 (5.7)	-0.2 (5.8)	0.7 (4.9)	-0.9 (-4.6, 2.8)
DAS Affective Expression	0.2 (2.4)	0.0 (2.3)	1.2 (2.6)	-1.1 (-2.7, 0.4)

Chapter 6: The Dissertation in Context

Despite numerous studies of preterm birth, very little is known as to why it occurs. Even less is known about which women will experience a preterm birth, and for what reasons. What is known is that certain populations, namely African-American women, experience preterm birth disproportionately to women of other races and ethnicities. Much attention has been paid to potential genetic contributions to racial disparities in preterm birth, despite race being a social construct.

Socioeconomic factors such as low income, limited access to healthcare, and marital status have all been associated with an increased risk of preterm birth. Given that 75% of births to African-American women occur outside of marriage, reports that paternal involvement could eliminate nearly 70% of excess preterm births were both exciting and promising.[12,16] Findings presented here are mixed in supporting previous findings of low father involvement, measured by no father's name on the birth certificate, being associated with an increase in preterm birth.

Relationship status appears to play a mediating role in the association between paternal involvement and preterm birth. For cohabitating couples, the risk of preterm birth was doubled when fathers were less involved. For these women, the less involved father may be a stressor rather than a source of support. Interestingly, father involvement was not associated with preterm birth for couples not in romantic relationships (either just friends or not in a relationship). The U-shaped curve by relationship status observed in the Fragile Families Study indicates that women reporting no relationship with the child's father may have been spared the deleterious effects of remaining in a negative relationship.[120] However, unmarried women in general, and especially those not involved with the father of their child, remain more likely have additional characteristics associated with increased risk of preterm birth.

There is also a differential in prenatal care utilization and other health behaviors by marital status, with married women being more likely to have adequate prenatal care

and less likely to smoke during pregnancy compared to their non-married peers.[16,174] In addition, children with absent fathers remain at a disadvantage over the life course. They are faced with the economic disadvantage of being raised in a single earner home, as well as the psychosocial disadvantages of not having a male presence.

Despite these mixed findings, the association of father involvement with pregnancy outcomes is a topic that cannot be ignored. With changes in social norms, over 40% of US infants are now born out of wedlock.[175] Pregnancies to unwed mothers overall are at an increased risk of adverse pregnancy outcomes. Though findings were not significant, evidence for the need to improve psychosocial support for women who lack this support from their partners can be inferred. It is important to establish whether unmarried status *per se* is the public health issue or whether the maternal stress associated with poor partner relationships and support coupled with financial strain of single parenting are contributing to higher pregnancy risks. The nature of public health interventions would differ by the underlying mechanism of the observed association of marital status and pregnancy outcome.

There appears to exist a more complicated inter-play between the psychosocial and biologic contributors to preterm birth in women with psychiatric illness. As the associations between relationship status/paternal support and preterm birth did not follow hypothesized patterns, studying relationship dynamics in the context of pregnancy outcomes may be worthwhile.

This dissertation has focused exclusively on the psychosocial elements of father involvement on pregnancy outcomes. No attention was paid to the paternal biologic factors which may impact preterm birth. Dekker's studies of preeclampsia and studies of the effects of changing paternity point to the possibility of male biologic factors.[20-22]

Contribution of Dissertation to Scientific Knowledge

This dissertation makes two key contributions to the area of father involvement in maternal and child health. It is obvious that the absence of a father's name on the birth certificate is a surrogate marker for some other factor associated with preterm birth. Here, steps were made to measure father involvement during pregnancy. Questions related to father involvement were considered individually and jointly, with greater effects seen when the questions were considered as a set through latent class analysis. Further development of an enhanced set of father involvement questions may be worthwhile to create a profile for the involved father. This profile could potentially be used in conjunction with current risk factors for preterm birth as a marker for needing enhanced social support during pregnancy.

We also have been able to show that there may be little additional knowledge gained from enrolling men into studies of paternal involvement relative to the additional costs associated with enrolling men. Mothers and fathers with at least a friendly relationship appear to give similar reports of father involvement, though as seen in Chapter 3, fathers report higher levels of paternal involvement than do mothers. Differences in classification of exposure between maternal and paternal supports of father involvement did yield differences in the magnitude of the observed association with preterm birth (Chapter 4). However, these differences were small. Given the practical difficulties in recruiting fathers into studies, investigators can have greater confidence in interviewing only mothers when they are in relationships with the father of their child. While the reliability of reports from women not in relationships is unknown, the majority of unmarried couples are romantically involved at the time of their child's birth.

Future Directions

Mathematica Policy Research, in 2011, reviewed the results of 70 programs promoting responsible fatherhood in young and unmarried men. [176] Of the 70 programs, few recruited fathers during pregnancy or in the perinatal period.[177-179] While these programs showed improvements in relationship strength, co-parenting abilities, and fathers' employability, none had pregnancy outcomes as a study endpoint.[177-179] As with the ECLS-B, these studies failed to measure pregnancy outcomes, and missed the opportunity to study the contributions fathers may make toward reducing poor outcomes such as preterm birth.

Future studies of father involvement and pregnancy outcomes should focus their recruitment efforts on those couples, both the mothers and the fathers, who are not in relationships. As the Fragile Families study relied on mothers to provide contact information for fathers, the study may serve as an example of maternal gatekeeping behaviors. Non-custodial and non-residential fathers have indicated their desire to participate in studies, yet they are not asked to participate.[118] Focusing on these families could shed light on the dynamics of formerly partnered individuals who share a child.

Studies have also focused on the biological father. It is possible that while the biological father is not involved, a new partner may be present at the time of the birth.

In addition, further development of defining and measuring father involvement during pregnancy is needed. The conceptual model of father involvement in pregnancy published by Alio, et al, provides a good starting place by enhancing the foundations laid by Lamb in his work of father involvement in early childhood and applying them to the prenatal period.[114,115]

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