Maternal Social Support Predicts Birth Weight and Fetal Growth in Human Pregnancy

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Objective: Low birth weight is a primary cause of infant mortality and morbidity. Results of previous studies suggest that social support may be related to higher birth weight through fetal growth processes, although the findings have been inconsistent. The purpose of this investigation was to test a model of the association between a latent prenatal social support factor and fetal growth while taking into account relations between sociodemographic and obstetric risk factors and birth weight. **Method:** A prospective study was conducted among 247 women with a singleton, intrauterine pregnancy receiving care in two university-affiliated prenatal clinics. Measures of support included support from family, support from the baby's father, and general functional support. Sociodemographic characteristics were also assessed. Birth outcome and obstetric risk information were abstracted from patients' medical charts after delivery. **Results:** Structural equation modeling analyses showed that a latent social support factor significantly predicted fetal growth (birth weight adjusted for length of gestation) with infant sex, obstetric risk, and ethnicity in the model. Marital status and education were indirectly related to fetal growth through social support. The final model with social support and other variables accounted for 31% of the variance in fetal growth. **Conclusions:** These findings suggest that prenatal social support is associated with infant birth weight through processes involving fetal growth rather than those involving timing of delivery. Biological and behavioral factors may contribute to the association between support and fetal growth, although these mechanisms need to be further explored. These results pave the way for additional research on fetal growth mechanisms and provide a basis for support intervention research. **Key words:** social support, pregnancy, birth weight, fetal growth.

ACTH = adrenocorticotropin-releasing hormone; CFI = comparative fit index; IUGR = intrauterine growth restriction; SEM = structural equation modeling; SGA = small for gestational age.

A growing body of literature demonstrates that social relationships have a positive impact on physical health and psychological well-being (1, 2). Social relationships are thought to be supportive to the extent that they provide individuals with access to resources during times of life stress and transition as well as a general sense of self-worth, psychological well-being, and control over their environment (3, 4). During pregnancy, social support is considered essential to the health and well-being of the expectant mother (5). The provision of emotional, informational, and material resources may mitigate the physical and psychological strains associated with pregnancy (6, 7). Support may also motivate the mother to engage in positive health behaviors and to make lifestyle changes that can improve her physical health (7). Thus, there are multiple pathways through which social support may be linked to improved maternal and fetal health and consequently better birth outcomes.

Because the birth of a child occurs in the context of a family and community, sociodemographic factors may influence access to social support during pregnancy (7, 8). Social support theorists have noted the importance of taking a more ecological approach to studying support that examines how these contexts influence the transmission and availability of support rather than simply focusing on determinants within the individual (9, 10). A study of the same sample studied in the current investigation found that differences in birth weight among ethnic and socioeconomic status groups were accounted for in part by levels of dispositional resources during pregnancy (11). To the extent that social support is similarly related to birth outcomes, we can examine whether it constitutes a psychosocial pathway through which sociodemographic differences in birth outcomes are observed.

A number of prospective studies have examined the influence of social support during pregnancy on birth weight and length of gestation, which are considered the primary indicators of newborn health (12, 13). Early studies found that support was related to fewer pregnancy complications for women with high levels of stress but not for those with low levels of stress (14, 15); these findings are consistent with the "stress-buffering" model of social support (3, 16). However, more recent studies show a direct relation (or main effect) of social support on birth outcomes (12, 13).

A later, more comprehensive study of social support

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and maternal and infant outcomes found that different dimensions of support were related to different outcomes (17). The amount and quality of prenatal support received were associated with 5-minute Apgar scores (an indicator of newborn status), with a greater amount and higher quality of support being associated with better scores. A greater amount of support was also associated with fewer problems during labor. Furthermore, having more network resources predicted higher birth weight adjusted for length of gestation. Although most of the results suggest a direct relation between support and birth outcomes, there was also a stress-buffering effect for women with more life events during pregnancy; in these women higher quality of support was associated with greater birth weight (adjusted for length of gestation). This study provided evidence that different dimensions of support were associated with Apgar scores, labor progress, and birth weight through fetal growth processes but not with length of gestation or preterm delivery. Although the focus of the previous study (17) was on support received (ie, enacted support) during pregnancy, a few other studies suggest that the perception that support would be available if needed (ie, perceived support) is also related to better birth outcomes. For example, perceived support during the eighth month of pregnancy was associated with higher birth weight in a sample of primarily European American women but was not related to length of gestation or Apgar scores (18). Thus, these results from a study using a slightly different social support concept are consistent with those of earlier studies (17) that showed an effect of social support on birth weight but not length of gestation.

Results from several studies suggest that particular members of a woman's social network may be important in providing social support during pregnancy. For example, support from husbands or partners benefits expectant mothers in terms of better psychological and physical well-being and is related to improved infant birth outcomes (12). A British case-control study using a detailed interview to assess social support found that the lack of a close, confiding relationship with a husband or partner was related to greater risk of having a SGA[1] infant (19). Similarly, a study conducted in the United States found that being married and cohabiting with a partner (vs. an extended family) were both associated with higher infant birth weight (20). In another study that focused on low-income women in the United States, support from partners also predicted greater gestational age and fewer gestational complications among African American women but was not related to birth outcomes among European American or Latina women (21). It is important to note that in studies of pregnant teenagers, support from partners has not been similarly related to birth outcomes (22, 23).

Family support does not seem to be as beneficial to the health and psychological well-being of pregnant women as is support from husbands or partners (12), although some positive findings have been observed (21, 23, 24). For example, in a study of Canadian teenagers (23), perceived family support predicted greater fetal growth (cf, Ref. 22). There is also some evidence from pregnant adult African American women that social support from their mothers is important in terms of greater gestational age at delivery; having fewer gestational, labor, and delivery complications; and having a shorter labor (21). Nonetheless, evidence across studies suggests that the impact of family support on birth outcomes is in general weaker and less consistent than the impact of support from husbands or partners (7, 12).

In summary, the findings from existing research on social support in pregnancy suggest generally positive effects of support on the primary indicators of newborn health, infant birth weight, and gestational age, with greater evidence provided for the relation between social support and birth weight. Of the eight studies that measured these outcomes, five showed an association between social support and birth weight (or the categorical outcome of having a SGA infant) (17–20, 23). The studies that controlled for length of gestation or used SGA as an outcome suggest that support is more strongly related to birth weight through fetal growth processes than prematurity (17, 19, 23). Only one study showed an association between social support and length of gestation (21), and two showed no association of support with either outcome (22, 24). Differences in findings may be attributable to the ways in which studies measured support. Studies also varied in whether they controlled for obstetric, demographic, and behavioral variables that may provide alternative explanations for the associations found between support and birth outcomes.

Multiple etiologic processes contribute to infant birth weight. For example, low birth weight may result from 1) IUGR (ie, restriction of fetal growth in the uterus), 2) preterm delivery (before 37 weeks of gestation), or 3) a combination of these factors (25). These processes are important to distinguish given that they have different implications for infant morbidity and mortality. Although preterm low birth weight is asso-

[1] Infants are classified as SGA if they are in the lowest 10th percentile of birth weight for gestational age based on standard growth curves.

ciated with higher perinatal mortality, the babies who survive tend to catch up to normal-birth weight infants in terms of weight gain and developmental functioning (25). Low-birth weight IUGR infants are at higher risk for morbidity and rehospitalization during the first year of life (25). In addition, recent epidemiological studies have shown that reduced fetal growth predicts the development of hypertension, coronary heart disease, and non–insulin-dependent diabetes in adulthood (26–28). Thus, fetal growth restriction and low birth weight may have implications not only for infant morbidity and mortality but also for health outcomes later in life.

The general goal of the present study was to examine the extent to which a latent social support factor predicts higher infant birth weight while accounting for relations between sociodemographic and obstetric variables and birth weight. Unlike earlier studies, we created a latent support factor that captures the multiple forms of support (eg, both tangible and emotional) and providers of support (eg, both the baby's father and family) that women may encounter during pregnancy. In addition, we used SEM (29) to examine the etiologic processes through which support is related to birth weight. It was hypothesized that greater support is associated with higher birth weight through fetal growth processes. First, we tested a model that examines whether social support predicts fetal growth after controlling for the direct effects of sociodemographic and obstetric variables on birth weight. We then examined whether, in addition to these direct paths, there may be indirect effects of the sociodemographic variables on birth weight. Women from certain demographic groups may be more likely to have higher-birth weight infants because they have greater access to social support during pregnancy. To the best of our knowledge, these indirect pathways have not been previously tested.

METHODS

Participants

The current study used a subset of data from a 3-year prospective investigation of psychosocial factors in pregnancy conducted in the prenatal clinic of a university-affiliated hospital and a university-affiliated low-risk birth center. The sample included 247 adult women in the early third trimester of pregnancy (28 to 30 weeks of gestation) with singleton intrauterine pregnancies.

The majority of women in the sample were married (67%). Participants were between 18 and 40 years of age (mean = 26 years, SD = 5.62 years). Fifty-two percent of the sample was multiparous or had previously given birth (N = 129), and 48% was nulliparous (N = 118). The ethnic composition of the sample was primarily Latina and European American. The sample was 47% Latina (N = 115), 43% European American (N = 106), 1% African American (N = 4), 3% Asian or Pacific Islander (N = 8), 2% Native American (N = 4), and 4% multiracial ethnicity (N = 10). The sample completed an average of 12.3 years of education (SD = 3.57). Median household income was $30,000 to $40,000 annually (SD = 2.97) with a range from less than $10,000 to more than $90,000 annually. The major ethnic groups included in this sample differed in sociodemographic characteristics: Latina women were significantly younger, less likely to be married, had completed fewer years of school, and had lower annual household incomes than European American women (11).

Measures

Each participant completed interview and questionnaire measures as part of larger protocols. Interview and questionnaire instruments were designed with consideration of the cultural and linguistic diversity of the population being studied as well as the mixed educational level of the sample. Measures were translated into Spanish. Sixty-eight percent of the sample was interviewed in English (N = 169), and 32% was interviewed in Spanish (N = 78). Validation procedures involved extensive pretesting, back translation, and examination of psychometric criteria in each language in data analyses. The reliability of measures in both languages is reported.

Sociodemographic Questions

Demographic questions included the racial or ethnic group with which participants identified, age, years of education completed, income, and marital status. For annual household income, participants were asked to indicate whether their household income fell within one of 10 categories ranging from less than $10,000 to more than $90,000 per year with each category in between representing a range of $10,000 (eg, between $20,000 and $30,000).

Substance Use Measures

Health behavior measures were adapted from the California Human Population Laboratory survey (30). Participants were asked about their current smoking status and were coded as either current smokers or nonsmokers. The frequency and amount of alcohol and illegal drug use (marijuana, cocaine, heroin, phencyclidine, and other recreational drugs) since participants became pregnant were assessed. Participants rated their amount of alcohol use on a five-point scale ranging from 1 (none) to 5 (four or more drinks in one sitting). Frequency of alcohol and illegal drug use were rated on a six-point scale ranging from 1 (never) to 6 (daily). Because of the low frequency of reported illegal drug use in the sample, a dichotomous variable that indicated whether participants ever used drugs during pregnancy was used in the analyses.

Social Support Measures

Family support scale. A seven-item scale was taken from a study of pregnant teenagers (23) to measure family support. Participants were asked to indicate their agreement with statements that they could, for example, rely on their family for financial assistance if they needed it and that their family would always be there when they needed them. Responses were provided on a four-point scale ranging from 1 (strongly disagree) to 4 (strongly agree). Responses were averaged across items, and means on the scale ranged from 1 to 4, with a sample mean of 3.33 (SD = 0.53). This scale is reliable both in English (Cronbach's α = 0.85) and Spanish (Cronbach's α = 0.79).

Baby's father support scale. An eight-item scale of support from the baby's father was adapted from a measure used in a study of pregnant teenagers (23). Items assessed the extent to which participants perceived that the baby's father would provide financial assistance if it was needed, would be there if they needed him, and would provide help when the baby comes. Answers were given on a four-point scale ranging from 1 (strongly disagree) to 4 (strongly agree). Responses were averaged across items, and means on the scale ranged from 1.7 to 4.0, with a sample mean of 3.45 (SD = 0.47). This scale has high reliability in both English (Cronbach's $\alpha = 0.89$) and Spanish (Cronbach's $\alpha = 0.94$).

Interpersonal Support Evaluation List. The Interpersonal Support Evaluation List is a standard measure of social support (31) that has been used in pregnancy research (32). This 40-item scale measures four categories of support functions, including tangible support, appraisal support, self-esteem support, and belonging support. Participants are asked the extent to which they agree with statements such as "When I need suggestions for how to deal with a personal problem, I know someone I can turn to," and "I am closer to my friends than most people are to theirs." Responses are provided on a four-point scale ranging from 1 (strongly disagree) to 4 (strongly agree). Responses were averaged across items, and means on the scale ranged from 1 to 4 with a sample mean of 3.22 (SD = 0.53). This scale has high reliability in both English (Cronbach's $\alpha = 0.95$) and Spanish (Cronbach's $\alpha = 0.93$).

Obstetric Variables

Parity and fetal sex. Nulliparity, or giving birth for the first time, and fetal sex were used as dichotomous variables in these analyses because firstborn and female infants, on average, weigh less than subsequent births and male infants (33). Forty-seven percent (N = 116) of the sample had male infants, and 53% had female infants (N = 131).

Obstetric risk index. Obstetric risk for prematurity was determined by the presence of risk factors using a scale derived from the original work of Papiernik (34), validated by Creasy et al. (35) and Ross et al. (36). Obstetric risk information was abstracted from medical charts and used to calculate an obstetric risk score for each participant. Twenty-eight conditions were scored as present (1) or absent (0), including conditions related to each participants' pregnancy history (eg, history of stillbirth or spontaneous abortion), medical conditions in her history or current pregnancy (eg, history of epilepsy or hypertension), and obstetric complications in her current pregnancy (eg, urinary tract infection or placenta previa). An obstetric risk index for each participant was formed by summing across all 28 variables, resulting in an average obstetric risk score of 1.02 (SD = 1.10) with a range of 0 to 6 obstetric risk conditions.

Birth outcomes. Infant birth weight in grams was examined as a continuous variable. The standard cutoff for low-birth weight infants is 2500 g or less (37). In this sample, birth weight ranged from 1840 to 5219 g with a mean of 3374 g (SD = 551.9 g). Six percent of the sample (N = 14) had low-birth weight infants. Length of gestation at delivery was also treated as a continuous variable, measured as the number of weeks of gestation at delivery. Each pregnancy was dated on the basis of the last menstrual period, physical examination, and ultrasonographic biometry. The ultrasound measure took precedence if these measures did not agree in terms of dating gestational age at birth. Infants delivered before 37 weeks of gestation are generally considered premature. The mean length of gestation in this sample was 39.3 weeks (SD = 1.55) with a range of 33.7 to 43.1 weeks. Of the 14 low-birth weight infants, 9 were born prematurely and 5 were born at term. Of the remaining 233 normal-birth weight infants, 8 were born prematurely and 225 were born at term.

Procedure

Participants were interviewed during two closely spaced prenatal visits early in the third trimester of pregnancy (28–30 weeks) by trained bilingual graduate and undergraduate interviewers. At each visit, participants were taken to a private room to be interviewed and to complete a questionnaire. After the interviews, participants underwent fetal evaluations, including ultrasound tests, at the Fetal Diagnostic Center of the hospital in the course of a routine prenatal visit. Information on birth outcomes was abstracted from patients' medical charts by trained research assistants after delivery.

RESULTS

Analysis Plan

First, correlational analyses were conducted to examine whether the sociodemographic, social support, and obstetric variables were associated with birth weight. These analyses indicate potential pathways to include in the multivariate models of birth weight. Second, a confirmatory factor analysis was conducted to examine whether the support variables formed a single factor. Third, multivariate analyses were conducted using SEM techniques (29). SEM is considered a powerful technique for analyzing hypothesized relations among measured variables and latent variables or variables that are composed of several correlated predictors and represent complex constructs (eg, social support) (38). SEM was used to assess whether a latent factor representing social support predicts birth weight while controlling for relations of the sociodemographic and obstetric risk variables with birth weight. SEM is also appropriate for examining the effect of social support on birth weight through fetal growth because length of gestation can be included as a separate variable in the model. An advantage of SEM over multiple regression is the ability to test indirect or mediational pathways between constructs and measured variables. We used SEM to test indirect pathways between sociodemographic variables and birth weight through social support.

Because of the small percentage of women in this sample who reported using any substances during pregnancy, these variables were not examined in the analyses. Only 5% of the sample were current smokers, only 4% reported ever using drugs, and 99% reported never drinking or drinking once a month during pregnancy. Correlations verified that substance use variables were not associated with birth outcomes, presumably because of the low incidence and low frequency of use of any substance.

Bivariate Analyses

Correlational analyses were conducted to test the relations between sociodemographic, social support, and obstetric variables and birth weight (see Table 1). Married women had higher-birth weight infants than unmarried women. Ethnicity was related to birth weight such that women who were not of Latino origin had significantly higher-birth weight infants than Latina women.[2] Greater education was marginally related to having a higher-birth weight infant. Of the three social support variables, family support and general functional support were significantly related to birth weight. Women with more family support and general functional support had higher-birth weight infants. Of the obstetric variables, longer length of gestation was related to higher birth weight, and greater obstetric risk was associated with lower birth weight. In addition, male infants were higher in birth weight than female infants. Thus, the social support variables were generally associated with birth weight. Because ethnicity, education, marital status, infant sex, and obstetric risk were all associated with birth weight, these analyses suggest that they should be included in the multivariate model.

Correlations between the sociodemographic and social support variables were also examined (see Table 1). Ethnicity was related to all support measures such that women who were not of Latino origin reported more social support than Latina women. Education was similarly related to all support measures such that women with more years of education reported more support than women with fewer years of education. Married women reported significantly greater interpersonal support and support from the baby's father than women who were not married. Thus, these correlations suggest that marital status, education, and ethnicity may be indirectly associated with birth weight through greater social support in a multivariate model.

Confirmatory Factor Analysis on Social Support Measures

The three support variables were positively intercorrelated (see Table 1). Thus, a confirmatory factor analysis was conducted to assess whether the three support measures would form a latent factor. A principal-components factor analysis confirmed that the family support, baby's father support, and general functional support scales loaded onto one social support factor. The factor loadings were 0.78, 0.70, and 0.83, respectively.

Hypothesized Model

The hypothesized model of fetal growth included six independent variables: 1) a latent factor composed of the three support variables, 2) marital status, 3) education, 4) ethnicity, 5) infant sex, and 6) obstetric risk (see Fig. 1). The model tests the relations between these variables and the dependent variables (ie, infant

[2] To examine ethnic differences in birth weight, an analysis of variance was run and showed that European American women had higher-birth weight infants than Latina women ($F(5,241) = 2.65$, $p < .05$). Because we wanted to retain the entire sample for our analyses, we created a dummy variable for ethnicity that coded participants as being of Latino (0) or non-Latino origin (1). This variable was used in the correlational and multivariate analyses.

TABLE 1. Correlational Analyses

	1	2	3	4	5	6	7	8	9	10	11
1. Family support											
2. BF[a] support	.30**										
3. ISEL[a] support	.49**	.39**									
4. Age	.07	.11†	.23**								
5. Years of education	.25**	.24**	.42**	.47**							
6. Non-Latino ethnicity	.19**	.23**	.38**	.43**	.61**						
7. Married	−.01	.27**	.31**	.36**	.27**	.20**					
8. Multiparity	−.20**	−.11†	−.10	.20**	−.10	−.03	.20**				
9. Male infant sex	.17**	.06	.11†	−.04	.12†	−.02	.06	−.14*			
10. Obstetric risk	−.05	.01	.15*	.25**	.18**	.19**	.05	.09	.04		
11. Length of gestation	−.03	.02	−.04	−.15*	−.03	−.02	−.03	−.05	.08	−.18**	
12. Birth weight	.17**	.10	.17**	.03	.12†	.20**	.15*	.10	.20**	−.15*	.46**

[a] BF, baby's father; ISEL, interpersonal support evaluation list.
* $p < .05$; ** $p < .01$. † $p < .10$.

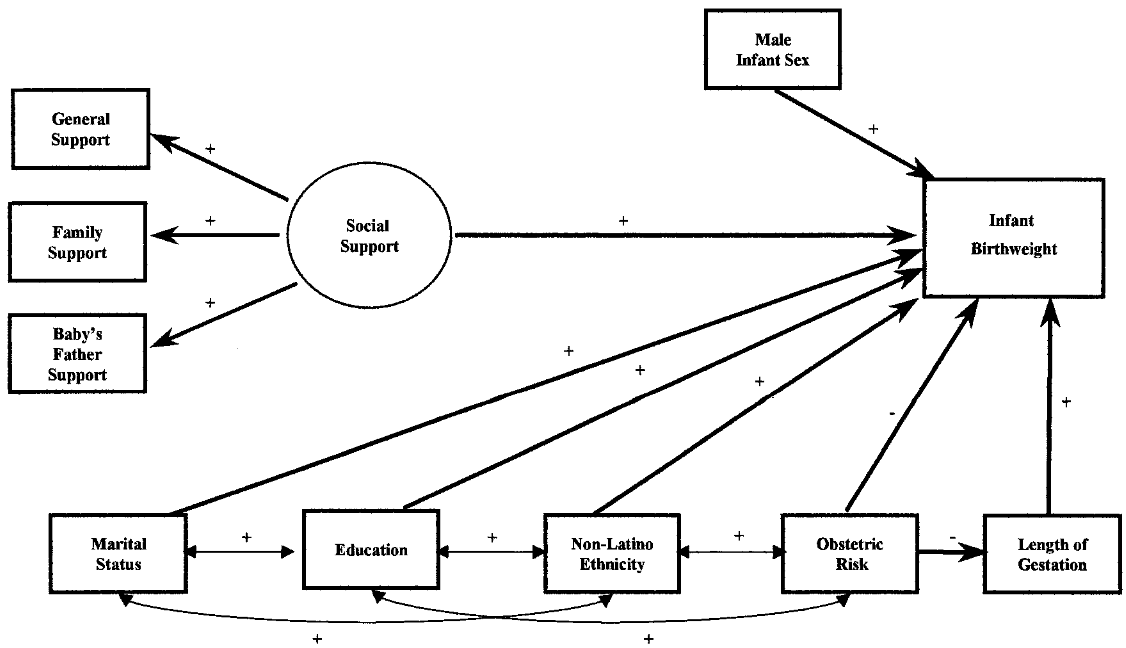

Fig. 1. Hypothesized model.

birth weight and length of gestation). Greater social support, male sex, less obstetric risk, and longer length of gestation were expected to predict higher birth weight in the hypothesized model. Being married, more years of education, and non-Latino ethnic origin were also expected to predict higher birth weight. Less obstetric risk was expected to directly predict longer length of gestation and to indirectly predict higher birth weight through longer length of gestation. Several relationships among the independent variables were also specified in the model based on the bivariate correlations. It was predicted that being married would be associated with more years of education. Non-Latino ethnic origin was expected to be associated with being married and more years of education. Greater years of education and non-Latino ethnic origin were also expected to be associated with greater obstetric risk.

We conducted SEM in several stages. In the first stage of analyses, the model of fetal growth incorporating hypothesized relationships of social support, sociodemographic variables, and obstetric variables to birth weight was tested. Following conventional procedures (29), the parameters in the model were estimated, and the fit of the model was tested. Next, we trimmed the model on the basis of results of post hoc tests, which identify any statistically indicated yet theoretically meaningful changes that would improve the fit of the model. In the second stage of analyses, indirect paths from the sociodemographic variables to birth weight were added to the model, and the same analytic procedures were followed.

Several indexes were used to assess model fit. A nonsignificant χ^2 value and a CFI greater than 0.90 generally indicate a good-fitting model (39). An additional indicator of model fit is the ratio of the χ^2 value to its degrees of freedom, with values closer to 1 and less than 3 indicating good fit (40).

Structural Model

The model of fetal growth was tested and resulted in a χ^2 value of 119 ($df = 29$, χ^2 $df = 4$, $p < .01$) and a CFI of 0.79 (see Fig. 2[3]). Because the fit of the model could be improved, the Wald test was used to identify paths that could be dropped from the model (29). Nonsignificant paths from education and marital status to birth weight were dropped, and the model was reestimated. This model resulted in a χ^2 value of 59.3 ($df = 18$, χ^2 $df = 3.3$, $p < .01$) and a CFI of 0.84. In the model, the paths between infant sex, gestational age, ethnicity, and birth weight were significant ($p < .01$) as hypothesized. The model indicates that male sex and longer gestation predict higher birth weight. Women of non-Latino origin had higher-birth weight infants than Latina women. The paths between social support, ob-

[3] In SEM, latent factors are typically indicated by ovals and measured variables are denoted by rectangles. Paths with double-headed arrows are interpreted as correlation coefficients, and paths with single-headed arrows are interpreted as standardized regression paths. Paths between latent variables and measured variables represent factor loadings.

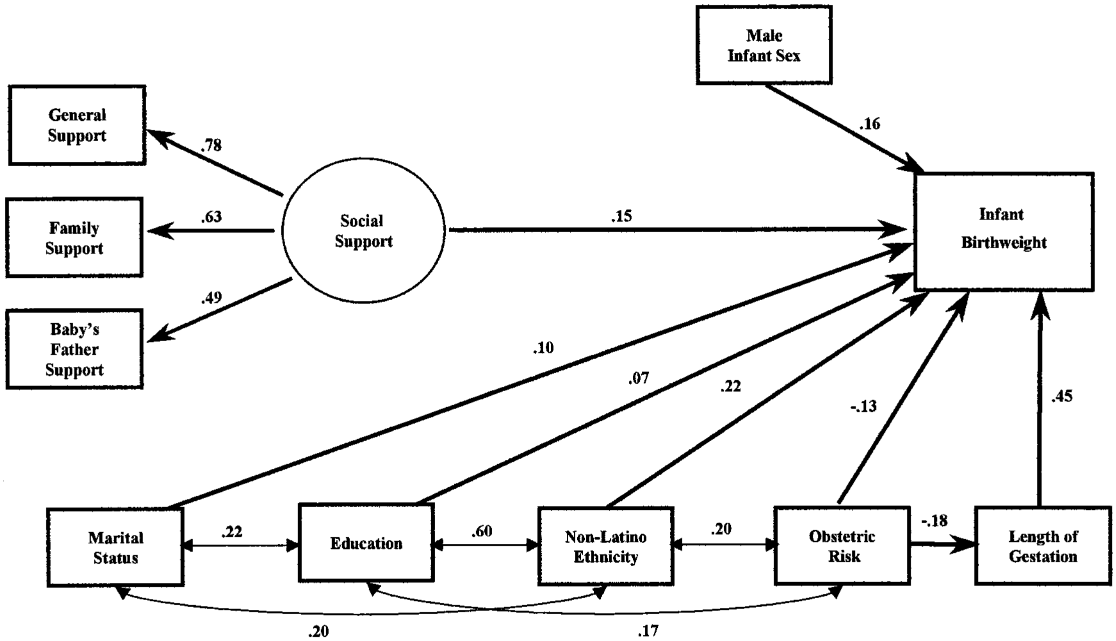

Fig. 2. Structural model of fetal growth. All paths are significant at $p < .05$ except the paths between marital status and birth weight and between education and birth weight.

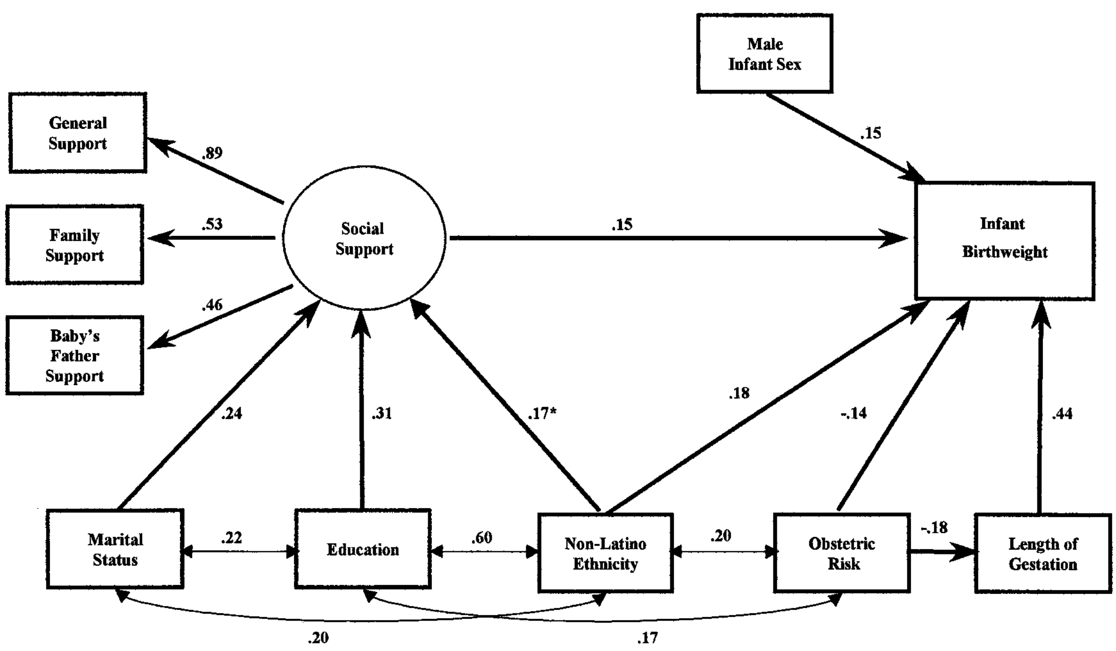

Fig. 3. Model with indirect paths. All paths are significant at $p < .05$.

stetric risk, and birth weight were also significant ($p < .05$). Greater social support and less obstetric risk predict higher birth weight. There was a direct effect of obstetric risk on length of gestation ($p < .01$) and an indirect effect of obstetric risk on birth weight through length of gestation (standardized indirect coefficient = -0.08, $p < .01$). Less obstetric risk predicts longer length of gestation and indirectly predicts higher birth weight through longer length of gestation. There were also associations among the sociodemographic and obstetric variables in the model that were consistent with those found in bivariate analyses. For the model, $R^2 = 0.31$, indicating that 31% of the variance in birth weight was explained by these variables. Although the model results supported the hypothesis that greater social support predicts better fetal growth after accounting for effects of the obstetric and sociodemographic variables on birth weight, they also suggest that the overall fit of the model could be improved.

To examine whether there were also indirect effects of the sociodemographic variables on birth weight through social support, indirect paths were added to the model, resulting in a χ^2 value of 56 ($df = 28$, χ^2 $df = 2$, $p < .01$) with a CFI of 0.94 (see Fig. 3), indicating a good fit between the model and the data. The results generally did not differ from those obtained earlier with the exception of the indirect effect findings. There were indirect effects of marital status on birth weight (standardized indirect coefficient = 0.04, $p < .05$) and of education on birth weight (standardized indirect coefficient = 0.05, $p < .05$) through social support. Women who were married and had more years of education had greater social support, which in turn was associated with having a higher birth weight infant. Findings of post hoc tests did not suggest that removal or addition of any theoretically meaningful pathways would improve the fit of the model. The model accounted for 31% of the variance in birth weight.

DISCUSSION

In this study, several types of social support (ie, family support, baby's father support, and general functional support) together predicted infant birth weight. Women with multiple types of support from different sources during pregnancy had higher-birth weight infants. Moreover, the relation between social support and birth weight held after controlling for length of gestation, suggesting that support is related to low birth weight through fetal growth processes rather than the timing of labor and delivery. The relation between social support and fetal growth held after controlling for obstetric risk factors predictive of birth weight. That social support is an important predictor of birth weight is emphasized by the finding that it predicts birth weight independently but to the same extent as these well-known medical determinants of birth weight (33).

Prenatal obstetric risk assessments predict, at most, one-third to two-thirds of all poor birth outcomes (36, 41, 42). In addition to identifying unknown medical and biological risk factors, attention is being paid to the potential role of psychosocial factors in birth weight and length of gestation (eg, Refs. 43 and 44). Birthweight and gestational length are important to examine separately because they involve different etiologic processes (45) and consequences for the health and development of the infant (46, 47). On the basis of the findings that support is related to birth weight independent of length of gestation, we can explore biological and behavioral mechanisms through which support may be associated with fetal growth processes and consequently higher-birth weight infants.

Fetal growth is primarily determined by the availability of, delivery to, and utilization of nutrients by the fetus (48). However, multiple etiologic processes involving genetic and epigenetic factors, such as maternal nutrition, uteroplacental hemodynamics, endocrine alterations, and placental pathophysiology, may lead to fetal growth disorders (33). Researchers have suggested that responses of the neuroendocrine axis to psychosocial factors during pregnancy may affect one or more of these processes and thereby contribute to fetal growth restriction and low birth weight. For instance, elevated levels of hypothalamic, pituitary, adrenal, and placental stress hormones (eg, corticotropin-releasing hormone and ACTH) have been implicated in low birth weight due to IUGR (49, 50). Similarly, vasoconstriction and hypoxia in response to activation of the sympathetic-adrenal-medullary system decrease uteroplacental perfusion and may thereby contribute to fetal growth restriction and low birth weight (51–53). Maternal plasma levels of the principal pituitary-adrenal stress hormones (ACTH, β-endorphin, and cortisol) measured at the beginning of the third trimester of pregnancy have been correlated with prenatal stress, personality factors, and social support (32). Specifically, higher levels of support were associated with lower plasma levels of ACTH and cortisol. Although there is growing evidence that stress-induced changes in neuroendocrine function help to explain the relation between prenatal stress and preterm birth (54), more research is needed to examine whether the effects of social support on birth weight and fetal growth may be explained by similar processes.

Social support may also influence etiologic processes related to fetal growth by enhancing positive health behavior and promoting healthier lifestyles in pregnant women. Behavioral risk factors linked to IUGR include inadequate nutrition, poor weight gain, smoking, and substance use (45), all of which may be less common in pregnant women with greater support (20, 55, 56).[4] Nutritional deficiencies and smoking are the most important pathways to examine given that they are the primary behavioral predictors of IUGR (37, 57). Women who perceive that more support is available during pregnancy may also seek health-related

[4] Alternatively, health behavior may have an effect on social support because poor health behavior may reduce social support.

information and receive prenatal care earlier in their pregnancy (58, 59) as well as treatment for diseases associated with IUGR, such as hypertension, heart disease, and sickle cell disease (60).

In addition to modeling etiologic processes through which support is linked to birth weight, a unique aspect this study is that we examined several different pathways between sociodemographic variables and birth weight. Together with the results of a study using the same sample as the current study (11), the findings suggest that women with more years of education and married women have greater access to social and dispositional (eg, mastery, optimism, and self-esteem) resources during pregnancy and in turn have better birth outcomes. Although Latina women reported less social support than non-Latina women in this study, ethnic differences in birth weight were not similarly explained by access to social support. In the other study (11), these differences were attributed in part to non-Latina women having more dispositional resources than Latina women. Unlike previous studies, which treated sociodemographic factors as control variables, these studies help to explain why certain subgroups of women are at greater risk of having low-birth weight infants and help to identify potential ways to intervene with these groups to increase birth weight.

The findings from this study have several important implications but are not without limitations. Social support was significantly associated with the continuous measure of birth weight, but post hoc analyses indicated that support was not significantly associated with the categorical variable of low birth weight (infant weight $<$2500 g). Because few women had low-birth weight infants ($N = 14$), insufficient power to detect an effect of support on the dichotomous outcome of whether a baby was of normal or low birth weight is one explanation. Another issue related to the birth outcome measures is that we assessed fetal growth statistically by controlling for the contribution of length of gestation to birth weight. More precise measures of growth, such as repeated ultrasound examinations, can be used in the future and would add to this area of scientific inquiry.

Although the findings from this study suggest that support interventions may be an effective approach to reducing rates of low birth weight, findings from intervention studies have been equivocal (12, 13). Support interventions generally involve the provision of informational and emotional support by a nurse, social worker, or lay educator several times over the course of pregnancy. The findings from our study suggest that multiple forms of support and support from different providers in the social network influence birth weight and fetal growth. Thus, interventions designed to bolster the support that is provided within a woman's existing social network may be more effective than those using only external sources of support. Support interventions may be most effective when they target certain subgroups of women who have less access to social support during pregnancy and are at greater risk of poor birth outcomes.

It is critical that psychosocial risk factors that contribute to low birth weight and fetal growth restriction are identified given the implications of these infant health outcomes for infant morbidity and mortality, healthcare costs, parenting stress, and other family and infant outcomes. The ability of social support to predict birth weight is as strong as that of traditional risk factors such as obstetric risk. Inasmuch as low birth weight may occur as a result of preterm delivery or IUGR, the strength of these findings is in identifying a possible key role of support in the etiology of low birth weight due to fetal growth processes. Future studies may build on these findings by investigating the biological and behavioral pathways that link social support to fetal growth. In addition, attention needs to be given to ways to improve support interventions to increase birth weight.

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