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Psychological Adaptation and Birth Outcomes: The Role of Personal Resources, Stress, and Sociocultural Context in Pregnancy

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Prenatal psychosocial predictors of infant birth weight and length of gestation were investigated in a prospective study of 120 Hispanic and 110 White pregnant women. Hypotheses specifying that personal resources (mastery, self-esteem, optimism), prenatal stress (state and pregnancy anxiety), and sociocultural factors (income, education, ethnicity) would have different effects on birth outcomes were tested using structural equation modeling. Results confirmed that women with stronger resources had higher birth weight babies ($\beta = .21$), whereas those reporting more stress had shorter gestations ($\beta = -.20$). Resources were also associated with lower stress ($\beta = -.67$), being married, being White, having higher income and education, and giving birth for the first time. There was no evidence that resources buffered the effects of stress. The importance of personal resources in pregnancy is highlighted along with implications for understanding the etiology of adverse birth outcomes.

Key words: pregnancy, stress, personal resources, adaptation, mastery

Pregnancy is a major life transition requiring adaptation of many kinds (Dunkel-Schetter, Gurung, Lobel, & Wadhwa, in press; Lederman, 1984; Lobel, 1998). A woman's ability to adapt to the changes and challenges of pregnancy affects her physical and mental health and appears to influence the health of her developing baby (Dunkel-Schetter & Lobel, 1998). Fully understanding psychological adaptation during pregnancy and its effects on birth outcomes requires consideration of the many factors that may affect prenatal adaptation. These factors include psychological resources and vulnerabilities and a woman's sociocultural milieu (Ane-

shensel, 1992; Pearlin, 1989; Taylor & Aspinwall, 1996; Taylor, Repetti, & Seeman, 1997).

Much health research on pregnancy is motivated by the serious social and medical ramifications of adverse birth outcomes, especially preterm delivery (PTD; birth before 37-weeks gestation) and low birth weight (LBW; birth weight $\leq 2,500$ g). LBW infants may be small because of PTD or because of inadequate growth, technically referred to as *fetal growth restriction* (FGR; U.S. Department of Health and Human Services [USDHHS], 1985). PTD and LBW occur in a substantial percentage of live births in the United States (11% and 7%, respectively; Guyer, Strobino, Ventura, MacDorman, & Martin, 1996; National Center for Health Statistics, 1993) and are the major causes of perinatal, neonatal, and infant mortality and morbidity in the United States (Berkowitz & Papiernik, 1993; Paneth, 1995). Despite considerable research attention, the etiology of PTD and LBW remains little understood, and their incidence has tended to increase in the United States in recent years (Guyer et al., 1996; National Center for Health Statistics, 1993).

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Stress in Pregnancy

There is growing evidence that women who experience more prenatal stress and anxiety have significantly higher rates of adverse birth outcomes (see Dunkel-Schetter, 1998; Lobel, 1994; Paarlberg, Vingerhoets, Passchier, Dekker, & Van Geijn, 1995). For instance, one prospective study provided evidence that high scores on a factor incorporating three phenomenological indicators of stress (state anxiety, perceived chronic stress, and life event distress) predicted

lower infant birth weight and shortened gestation after controlling for medical risk, parity, and maternal substance use (Lobel, Dunkel-Schetter, & Scrimshaw, 1992; see also Copper et al., 1996; Hedegaard, Henriksen, Secher, Hatch, & Sabroe, 1996; Nordentoft et al., 1996; Wadhwa, Sandman, Porto, Dunkel-Schetter, & Garite, 1993). In general, previous research has suggested that the relationship between multidimensional stress measures and adverse birth outcomes is stronger for shortened gestation than for birth weight or fetal growth (Lobel, 1994).

State anxiety—an emotional response to environmental stressors (S. Cohen, Kessler, & Gordon, 1995; Lobel & Dunkel-Schetter, 1990)—has been the most commonly studied affective state in pregnancy and is associated, albeit weakly, with birth outcomes in some studies (Lobel, 1994). In addition, a contextually tied form of anxiety, pregnancy-related anxiety, has been developed in our research and is conceptualized as a woman's fears about her baby's health, her own health, and labor and delivery. Most prior studies of stress in pregnancy have not examined this form of anxiety, yet evidence suggests that it predicts shortened gestation (Wadhwa et al., 1993).

In addition to psychosocial stress, we investigated the possibility that maternal personal characteristics or resources influence birth outcomes. These resources include generalized beliefs about oneself (self-esteem), one's future (dispositional optimism), and one's perceived ability to control important outcomes (mastery or perceived control; Hobfoll, 1985). Such beliefs have been shown to promote adaptation and resilience in nonpregnant women by influencing processes such as stress appraisals, health-related behaviors, coping behaviors, and physiological and emotional responses to stressors (e.g., Aspinwall & Taylor, 1992; Bandura, Cioffi, Taylor, & Brouillard, 1988; Carver & Gaines, 1987; DeLongis, Folkman, & Lazarus, 1988; Folkman, Lazarus, Gruen, & DeLongis, 1986; Frankenhaeuser, 1982; Hobfoll & Lieberman, 1987; Marshall & Lang, 1990; Pearlin, Menaghan, Lieberman, & Mullen, 1981; Wiedenfeld et al., 1990; see also Epel, McEwen, & Ickovics, 1998; Park, 1998).

Although personal resources have received little attention in pregnancy research, existing evidence suggests that self-esteem and mastery may be associated with birth outcomes. In one study (Norbeck & Tilden, 1983), an index of "emotional disequilibrium" that included self-esteem, anxiety, and depression predicted infant complications after controlling for medical risk, life stress, demographic variables, and emotional support. However, it was not possible to distinguish the unique effects of self-esteem in these results. A second study (Goldenberg et al., 1991) found that both low self-esteem and low mastery predicted a higher likelihood of giving birth to a baby who was small for gestational age after controlling for known risk factors such as smoking, maternal education, height, weight, and age. However, a more recent study of 2,593 pregnant women by the same research team did not replicate the association between mastery and FGR (Copper et al., 1996). Differences in sample characteristics, outcomes studied, and the mastery measures are possible reasons for this inconsistency.

Unlike self-esteem and mastery, dispositional optimism (the generalized expectancy of positive outcomes) has not been examined in published research on birth outcomes; however, it has been associated with better adaptation to stressful life circumstances in terms of both physical and mental health outcomes in community and student samples (Scheier & Carver, 1992). Furthermore, dispositional optimism has been found to predict lower levels of anxiety, more positive states of mind, and reduced substance use during pregnancy (Park, Moore, Turner, & Adler, 1997).

The social or sociocultural level of analysis is particularly important in pregnancy research, as considerable evidence has shown (see Hobel, 1996; Hughes & Simpson, 1995; Kramer, 1987). Variables such as ethnic background and culture can influence the occurrence of events and activities in one's life; the way in which events are interpreted and coped with; access to social and personal resources; and the unique constellation of norms, demands, and opportunities in the immediate social environment (Revenson, 1990; Szapocznik & Kurtines, 1993; Taylor et al., 1997). For instance, cultural norms and values shared by many Hispanics may influence pregnancy and birth outcomes (Collins & Shay, 1994) through their effect on health-related behaviors (Myers, Kagawa-Singer, Kumanyika, Lex, & Markides, 1995), unique stressor exposure (e.g., acculturative stress; Berry, 1994), and coping strategies (Jung, 1995). Moreover, Latin cultures have been characterized as tending toward *fatalism*, or the belief that the world "is controlled by external natural and supernatural forces" (Arce & Torres-Matrullo, 1982, p. 231). To the extent that this is the case, one would expect Hispanics to be lower in optimism and mastery (e.g., Mirowsky & Ross, 1984).

In the United States, ethnic minority status and poverty are highly correlated (Williams, 1990). Not only can ethnicity influence pregnancy and birth outcomes through cultural norms and values, it may also exert an influence through its association with socioeconomic status (SES), especially income and education. Research has shown that lower SES groups experience a greater number of stressors and higher levels of psychological distress (Seguin, Potvin, St. Denis, & Loiselle, 1995). They are more likely to engage in adverse health-related behaviors (Adler et al., 1994), to live and work in riskier environments (Anderson & Armstead, 1995; Taylor et al., 1997), and to have fewer of the social resources that buffer stress during pregnancy (Seguin et al., 1995).

With respect to birth outcomes, both ethnic minority status and low SES have been linked to higher infant mortality and morbidity, shorter gestations, lower infant birth weight, and higher rates of FGR (Flack et al., 1995; Gould & LeRoy, 1988; Hughes & Simpson, 1995; Kramer, 1987; Lieberman, Ryan, Monson, & Schoenbaum, 1987; Nersesian, 1988; Newton & Hunt, 1984; Paneth, Wallenstein, Keily, & Susser, 1982; USDHHS, 1985). Potential mediators of these relationships remain unexplained and thus are important targets of research efforts. We examined stress and personal resources as possible mediators in this study.

The objective of this study was to examine the relationships between prenatal psychosocial stress, personal re-

sources, the sociocultural context, and infant birth weight and gestational age at birth. Three possible roles for personal resources were investigated. The first was their possible direct effect on birth outcomes. Second, the possibility was examined that personal resources indirectly protect against poorer birth outcomes by reducing appraised stress for all women, regardless of their psychosocial stress level. This hypothesis required that the effects of personal resources on birth outcomes be at least partially mediated by reduced stress. Third, we examined whether personal resources act as stress buffers (S. Cohen & Edwards, 1989; Taylor & Aspinwall, 1996), modifying the relationship between stress and birth outcomes.

We expected that psychosocial stress (state anxiety and pregnancy-related anxiety) would be associated with length of gestation but not with birth weight (see Lobel, 1994). Conversely, the literature on self-esteem, mastery, and birth outcomes reviewed here suggests an association between these personal resources and birth weight (see Goldenberg et al., 1991; Norbeck & Tilden, 1983). Therefore, we predicted that personal resources would have a direct effect on birth weight (i.e., intrauterine growth), most likely by influencing variables not measured here, for instance, health behaviors such as nutrition, substance use, and self-care. However, personal resources have also been associated with resilience in the face of stressors because of more positive appraisals of potential stressors and more adaptive coping efforts (Jerusalem, 1993; Major, Richards, Cooper, Cozzarelli, & Zubek, 1998). Consequently, we expected personal resources to indirectly influence length of gestation through stress reduction. Finally, we expected that Hispanics and individuals with low incomes and relatively little education would report more stress and fewer personal resources and would exhibit higher rates of adverse birth outcomes.

Method

Participants

The sample consisted of 230 pregnant women receiving prenatal care over a 3-year period (1993–1996) at a southern California medical center and an affiliated low-risk birthing center. These sites served an ethnically diverse and low-income population of women from the surrounding urban metropolitan area in southern California. Participants were recruited into the study during the late second or early third trimester (22–28 weeks) of pregnancy. Sixty-two percent of the women who were approached agreed to participate. Data were available for 145 (44%) of those who declined; they did not differ in age or marital status from the women who participated. However, they did differ in their likelihood of being Hispanic and in parity. Decliners were more likely to be Hispanic (68%) than nondecliners (48%) and had, on average, higher parity ($M = 1.55$, $SD = 0.55$) than nondecliners ($M = 0.82$, $SD = 1.00$).

The initial sample of women who agreed to participate included 276 women older than 18 years of age. All participants fluently spoke English or Spanish and were pregnant with singleton intrauterine pregnancies. Twenty-two of these women dropped out after the first assessment, reducing the sample size to 254 (8% attrition). Analyses indicated that participants who dropped out after the first assessment did not differ from those who remained in

terms of age, income, education, parity, marital status, medical risk, or infant birth weight. They did differ in length of gestation, with women who dropped out giving birth nearly 1 week sooner ($M = 38.35$, $SD = 2.65$) than those who did not ($M = 39.26$, $SD = 1.54$, $p < .05$). Twelve of the remaining participants were excluded from analyses because they belonged to an ethnic group other than Hispanic or non-Hispanic White, and an additional 12 participants did not have complete birth outcome data because they delivered at sites other than the research sites. Thus, the final sample of 230 included women who self-identified as non-Hispanic White ($n = 110$) or Hispanic ($n = 120$) and had complete birth outcome data. The average age of the 230 participants was 25.73 years ($SD = 5.51$ years, range = 17–40 years). Half of the participants reported a household income of \$20,000 or less per year. Average educational attainment was 12.1 years ($SD = 3.62$ years). Sixty percent of the participants were married, and 47% had never given birth (i.e., were nulliparous). Of the 120 Hispanics in the sample, 66% completed interviews and questionnaires in Spanish. Seventy-seven percent of the Hispanic women were born in Mexico, 18% were born in the United States, and the remainder were born in other Latin American countries. Foreign-born Hispanics had lived in the United States for a mean of 7 years ($SD = 6.80$ years).

Procedure

Bilingual staff members were trained in recruitment and interview procedures. Patients were recruited in English and Spanish during prenatal visits and were formally enrolled in the study after completing informed-consent procedures. Data were collected over two appointments scheduled approximately 2 weeks apart during the early third trimester of pregnancy (28–30 weeks). During each appointment, participants completed questionnaires and then met with a trained, bilingual interviewer for a 30- to 45-min structured interview conducted in English or Spanish.

Measures

Means and standard deviations for all measures are shown in Table 1. Instruments were chosen and developed with the goals of yielding equivalent meanings in Spanish and English and of being easily understood by women with little formal education. Instruments not already available in Spanish were created for this study by a professional translator using forward and backward translation procedures, followed by extensive pretesting.

Mastery. Mastery, the generalized belief that one's outcomes are under one's own control, was measured using the 7-item Mastery Scale (Pearlin & Schooler, 1978). Participants rated each item on a scale ranging from 1 (*strongly agree*) to 5 (*strongly disagree*). Reliability analysis revealed that the 2 positively worded items on the Spanish version of the scale exhibited low correlations with the total scale. These items were dropped from both English and Spanish versions of the scale. The mastery score for each participant was the mean of her responses to the 5 remaining items, which concerned not feeling able to control events, solve problems, or change important things; feeling helpless when dealing with problems; and feeling pushed around in life. Items were coded such that higher scores reflected greater mastery. This 5-item scale exhibited adequate internal reliability in both English ($\alpha = .81$) and Spanish ($\alpha = .74$).

Dispositional optimism. Dispositional optimism was assessed with the 8-item Life Orientation Test, a well-validated instrument (Scheier & Carver, 1985). Items were rated on a scale ranging from 1 (*strongly agree*) to 5 (*strongly disagree*). Reliability analysis

Table 1
Participant Characteristics by Ethnicity (N = 230)

Variable	Non-Hispanic Whites		Hispanics	
	M	SD	M	SD
Sociodemographic variables				
Age (in years)***	28.11	5.58	23.54	4.47
Marital status (%) ***				
Single	28	—	50	
Married	72		50	
Years of school***	14.38	2.10	10.00	3.44
Household income***,a	4.86	3.00	2.25	1.94
<\$20,000	25%		77%	
\$20,000–\$40,000	27%		13%	
\$40,000–\$60,000	16%		6%	
\$60,000–\$80,000	17%		2%	
>\$80,000	15%		3%	
Birth-related outcomes				
Birth weight (in g)***	3,503.89	591.86	3,243.67	465.14
Low birth weight ($\leq 2,500$ g)	6%		5%	
Gestational age (in weeks)	39.22	1.59	39.26	1.46
Preterm delivery (<37 weeks)	8%		6%	
Parity	0.79	0.93	0.82	1.01
Nulliparous	47%		46%	
Psychosocial variables				
Mastery***	3.94	0.69	3.31	0.82
Optimism***	3.78	0.62	3.48	0.52
Self-esteem***	4.13	0.59	3.74	0.60
Pregnancy-related anxiety	1.69	0.32	1.75	0.44
State anxiety	1.85	0.59	1.91	0.52

Note. The sample included 110 non-Hispanic Whites and 120 Hispanics.

^aAnnual household income was measured using an ordinal scale ranging from 1 (*under \$10,000*) to 10 (*over \$90,000*), with each 1-unit increment corresponding to an increment of \$10,000. A score of 4.86 represents a mean annual household income of between \$30,000 and \$50,000 for non-Hispanic White women. A score of 2.25 represents a mean annual household income of between \$10,000 and \$30,000 for Hispanic women.

*** $p < .001$.

revealed good internal reliability for the English version of the scale ($\alpha = .81$) but poor reliability for the Spanish version ($\alpha = .38$). We examined item-total correlations and conducted a factor analysis in an attempt to identify a subset of items with adequate internal reliability in both languages. These were not successful. Accordingly, the full scale was used in both languages despite the poor internal reliability for the Spanish version.

Self-esteem. Self-esteem was measured with Rosenberg's (1965) 10-item scale. Items were rated on a scale ranging from 1 (*strongly agree*) to 5 (*strongly disagree*). Internal reliability for the English version of the self-esteem scale was similar to that found in past research ($\alpha = .89$), but reliability for the Spanish scale was substantially lower ($\alpha = .59$). Again, our attempt to find a subset of items with adequate internal reliability in both languages was unsuccessful. Accordingly, the full 10-item scale was used in both languages despite reduced internal reliability in the Spanish version of the scale.

State anxiety. State anxiety was measured by using a brief 10-item version of the State Anxiety Scale from Spielberger's (1983) State-Trait Anxiety Inventory. This version of the instrument was developed for brevity and has been found to have acceptable psychometric properties in past research (Spielberger, 1979). Items assessed the extent to which participants had experienced anxiety-related symptoms and emotions during "the last few days" by using a 4-point scale ranging from 1 (*not at all*) to 4 (*very*

much). Internal reliabilities for the English ($\alpha = .90$) and Spanish ($\alpha = .83$) versions of the scale were acceptable.

Pregnancy-related anxiety. Pregnancy-related anxiety was measured with an expanded set of items based on those developed by Wadhwa et al. (1993). Ten items assessed the frequency with which (or the extent to which) participants worried or felt concerned about their health, their baby's health, labor and delivery, and caring for a baby (see the Appendix). Responses were made on a scale ranging from 1 (*never or not at all*) to 4 (*a lot of the time or very much*). We conducted an exploratory factor analysis with oblique rotation to investigate the factor structure of these items in English and Spanish. Examination of the eigenvalues revealed that the scores were best represented by a single factor in both languages. As such, a pregnancy-related anxiety score was computed by reversing scores where appropriate and calculating the mean of responses to all items. The internal reliability of the scale was acceptable in both English (Cronbach's $\alpha = .78$) and Spanish (Cronbach's $\alpha = .80$).

Birth outcomes. Birth outcome data were abstracted from medical charts after delivery. Two birth outcomes were studied: (a) gestational age at delivery (in weeks; estimated by using the last menstrual period and verified by ultrasound) and (b) infant birth weight (in grams). Birth weights in this sample ranged from 1,840 to 5,020 g, with a mean of 3,367.53 g ($SD = 543.89$ g). Gestational ages at birth ranged from 33.71 to 43.14 weeks, with a mean of

39.25 weeks ($SD = 1.52$ weeks). Six percent of the women in this sample gave birth to LBW babies, and 7% delivered prematurely. These rates were similar to California's rates, which in 1996 were 6% for LBW and 10% for PTD (Department of Health Services, State of California, 1998).

Sociocultural and sociodemographic variables. Sociocultural and sociodemographic variables, including age, marital status, ethnicity, country of birth, years lived in the United States, maternal education (in years), and annual household income¹ (measured with an ordinal scale ranging from 1 [*less than \$10,000*] to 10 [*over \$90,000*]) were assessed by interview.

Nulliparity. Nulliparity was scored by giving a participant a score of 1 if she was currently pregnant with her first baby or a score of 0 if she had previously given birth. Nulliparity was included in this model because of evidence that it is associated with less favorable birth outcomes (Kramer, 1987) and with greater stress.

Results

We conducted analyses in three steps. First, we examined ethnic differences in the study variables. Second, we conducted structural equation modeling using EQS for Windows (Bentler & Wu, 1995) to evaluate hypothesized interrelationships between the variables. Following conventional procedures (Bentler, 1992), an initial model was specified, its parameters estimated, and its fit tested; then, the model was trimmed using standard procedures, including examination of the multivariate Lagrange Multiplier (LM) test for reducing restrictions on the model and the Wald test for dropping free parameters.² Testing the fit of a structural equation model involves examination of the chi-square and the comparative fit index (CFI). Good fit is indicated by a nonsignificant chi-square and a CFI of .90 or greater. One also can examine the ratio between the chi-square and its degrees of freedom, with ratios closer to 1 and less than 3 indicating good fit (Carmines & McIver, 1981). This latter index is useful because the chi-square test is sensitive to sample size. We also conducted analyses to test the possibility that different models were needed to predict birth outcomes for Hispanics and non-Hispanic Whites. In the third step of the analyses, we conducted multiple and logistic regression analyses to test hypothesized interactions.

Ethnic Differences in Study Variables and Birth Outcomes

We performed a one-way multivariate analysis of variance on the continuous dependent variables to test for ethnic differences in infant birth weight (in grams), gestational age at delivery (in weeks), age, years in school, annual household income, parity, mastery, self-esteem, optimism, state anxiety, and pregnancy-related anxiety. With use of the Wilks's criterion, the multivariate test of the combined dependent variables was significant, $F(11, 218) = 15.47$, $p < .001$. Univariate F tests were computed to determine the variables on which the two ethnic groups differed. Dichotomous variables (marital status, nulliparity, LBW, and PTD) were investigated with a series of chi-square tests. Inflated Type I error due to multiple univariate F tests and chi-square tests (14 in total) was controlled by applying Bonferroni

correction, resulting in a critical alpha level of .004 per test. The results of these tests are summarized in Table 1.

White women gave birth to babies who were significantly heavier than babies of Hispanic women, $F(1, 228) = 13.80$, $p < .001$, but there were no ethnic differences in gestational age at birth or in rates of LBW or PTD. There also were no ethnic differences in parity or in the percentage of women in each ethnic group who were giving birth for the first time (i.e., nulliparity). In terms of sociodemographics, the Hispanic sample was significantly younger, $F(1, 228) = 47.34$, $p < .001$, and less likely to be married, $\chi^2(1, N = 230) = 11.43$, $p < .001$, than the White sample. Hispanics also had completed fewer years of school, $F(1, 228) = 132.64$, $p < .001$, and had lower annual household incomes, $F(1, 228) = 60.21$, $p < .001$ (for a distribution of annual household incomes for each group, see Table 1). In addition, Hispanics scored lower on mastery, $F(1, 228) = 39.27$, $p < .001$; optimism, $F(1, 228) = 15.62$, $p < .001$; and self-esteem, $F(1, 228) = 24.30$, $p < .001$, than non-Hispanic Whites, but there were no ethnic differences in pregnancy-related anxiety or state anxiety. Given these group differences, ethnicity was controlled in the analyses, and in addition to the full model, separate models were tested for the White and Hispanic samples.

Structural Equation Model Predicting Birth Outcomes

Correlations between the study variables are shown in Table 2. As shown in the hypothesized model (see Figure 1), we expected that state anxiety and pregnancy anxiety would load on a single common factor labeled *Stress*. Because latent factors with only two indicators are underidentified, we randomly split the 10 items from the pregnancy-related anxiety scale into two parcels of 5 items each. Thus, there were three indicators for the *Stress* latent factor: state anxiety, Pregnancy-Related Anxiety A, and Pregnancy-Related Anxiety B. We expected the *Stress* latent factor to be negatively related to length of gestation, such that higher stress would predict shorter gestations. In addition, we expected that mastery, optimism, and self-esteem would load on a single common factor, depicted in Figure 1 as *Resources*. This latent factor was expected to predict higher birth weight. We also expected the *Resources* latent factor to be associated with reduced stress and, in turn, with longer gestations. Ethnicity (1 = *non-Hispanic White*, 0 = *Hispanic*) was expected to predict birth outcomes through its association with resources, and the socioeconomic variables

¹ The income variable was moderately skewed at 1.06 in the entire sample of 230. No transformation (square root, logarithmic, or inverse) changed the outcome of the reported analyses. Consequently, the income variable was used without transformation. Several analyses were conducted to investigate possible ethnic differences in the relationship between income and length of gestation, the birth outcome with which it was most highly associated. None of these analyses provided evidence for ethnic differences.

² Because this data set was not large enough to be split into two subsamples for cross-validation, replication will be required to verify the obtained model.

Table 2
Correlations for Major Study Variables (N = 230)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Birth weight (in g)	—												
2. Gestational age (in weeks)	.49***	—											
3. Household income	.06	-.17*	—										
4. Education (in years)	.16*	.01	.56***	—									
5. Marital status ^{a,b}	.13†	-.09	.44***	.27***	—								
6. Maternal age (in years)	.09	-.11	.54***	.45***	.27***	—							
7. Nulliparity ^c	-.09	.00	.02	.06	-.14*	-.17**	—						
8. White ethnicity ^{b,d}	.24***	-.01	.46***	.61***	.22***	.41***	.01	—					
9. Mastery	.19**	.01	.34***	.40***	.27***	.30***	.13*	.38***	—				
10. Optimism	.09	.01	.34***	.26***	.25***	.22***	.07	.25***	.62***	—			
11. Self-esteem	.10	-.05	.40***	.37***	.22**	.25***	.15*	.31***	.60***	.63***	—		
12. State anxiety	-.08	-.16**	-.07	-.01	-.16*	-.03	-.08	-.05	-.36***	-.46***	-.39***	—	
13. Pregnancy-related anxiety	-.08	-.12	-.03	-.05	-.16*	-.16*	.12	-.09	-.35***	-.28***	-.25***	.42***	—

^aMarital status is coded as 0 for single and 1 for married. ^bCorrelation coefficients shown are Pearson product-moment correlations. Note that product-moment correlations between continuous variables and dummy-coded variables coded as 0 or 1 are the same as point-biserial correlations (i.e., correlations between a continuous and a dichotomous variable). ^cNulliparity is coded as 0 for multiparity and 1 for nulliparity. ^dEthnicity is coded as 0 for Hispanic and 1 for non-Hispanic White. †p < .10 (marginally significant). *p < .05. **p < .01. ***p < .001.

(income and education) were expected to predict birth outcomes through their association with both resources and anxiety. Finally, nulliparity (1 = nulliparous, 0 = multiparous), maternal age (in years), and marital status (1 = married, 0 = single) were included in the model so that their influence on birth outcomes could be controlled. This allowed us to test the association of the two latent factors with birth outcomes independent of the effects of these factors.³ It is important to note that with length of gestation at birth controlled in this model, the birth weight variable represents fetal growth.

An important issue in analytic strategy was how to treat ethnicity. One option was to include ethnicity in the model as a variable, and another option was to test separate models for Whites and Hispanics. Our primary analyses used the former strategy for several reasons. First, it allowed us to use the full sample size of 230 to estimate parameters, providing greater power to test the hypotheses. It also enabled us to examine the relationships between ethnicity and other variables in the model. Finally, this strategy was consistent with our past research and theory about the effects of stress on birth outcomes, which have been highly consistent across ethnic groups. However, the question of whether these models differ by ethnic group is an important one. Thus, we tested separate models for White and Hispanic women after fitting the hypothesized overall model.

Once the hypothesized overall model was specified as shown in Figure 1, parameters were estimated, and the fit of the model was tested. The results of these analyses indicated that the model exhibited adequate fit to the data, $\chi^2(60, N = 230) = 140.99, p < .001$; CFI = .92; $\chi^2/df = 2.35$. However, the LM and Wald tests indicated that substantial improvements in model fit could be obtained by modifying the model in the following ways: (a) fixing the path from age to resources to zero, (b) fixing the path from education to stress to zero, (c) allowing state anxiety to load on resources (in addition to loading on anxiety), (d) freeing the path from nulliparity to Pregnancy-Related Anxiety B, (e) freeing the path from White ethnicity to Pregnancy-Related Anxiety A, (f) freeing the path from education to optimism, and (g) freeing the path from income to length of gestation. Making all of these changes except for allowing state anxiety to load on resources (which we chose not to do for theoretical reasons) resulted in a model with good fit, $\chi^2(58, N = 230) = 105.88, p < .01$; CFI = .95; $\chi^2/df = 1.83$. However, because these tests are analogous to post hoc tests, the modified model is not shown here.

The significant relationships illustrated in Figure 2, which shows the hypothesized model with parameter estimates,

³ A medical risk variable that included 26 medical and obstetrical risk factors was originally included in the model. Although higher medical risk predicted shortened gestations, its presence in the model did not alter or reduce the relationships among stress, resources, and birth outcomes. Thus, in the interest of producing a more parsimonious model, we dropped medical risk from further analyses. Details of the medical risk variable and its association with other variables in the model can be obtained by contacting Christine Killingsworth Rini.

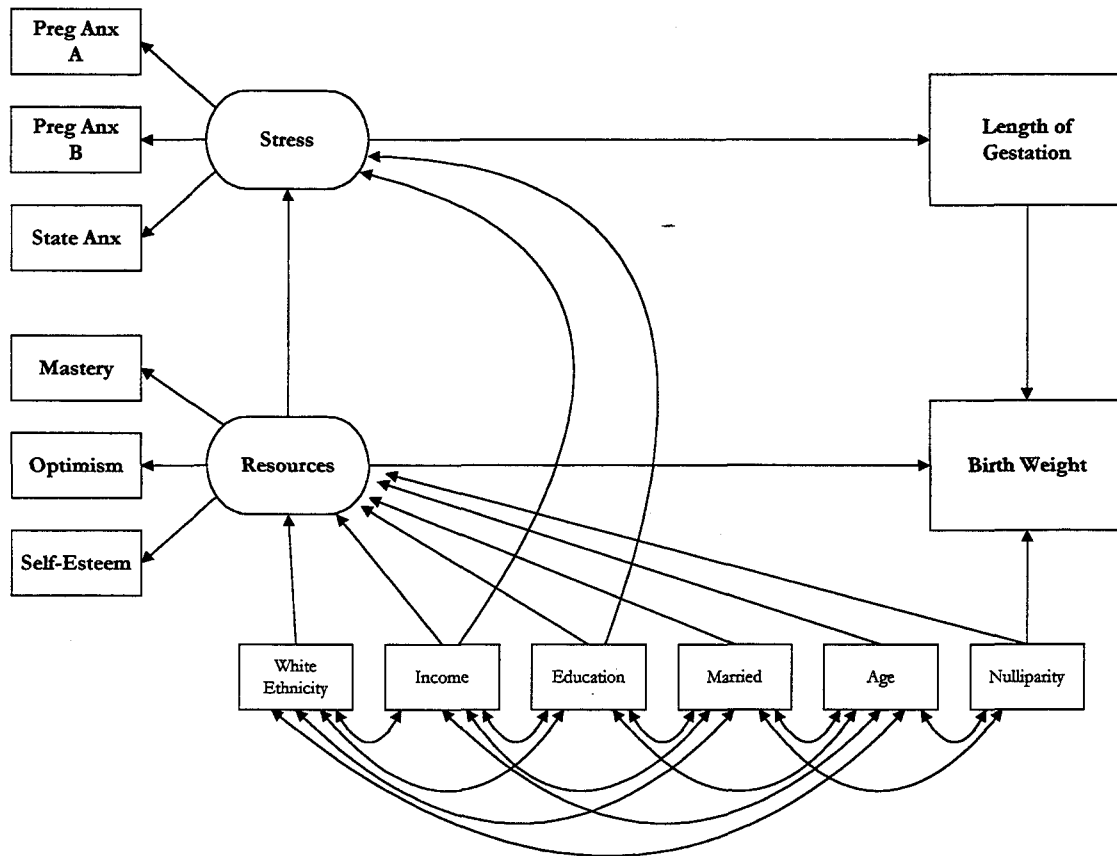


Figure 1. Hypothesized model of the relationship among prenatal psychosocial stress, personal resources, and sociocultural factors that affect adaptation during pregnancy and adverse birth outcomes. Preg = pregnancy-related; Anx = anxiety.

indicate that a longer gestation was strongly predictive of higher birth weight ($\beta = .48$). Furthermore, nulliparity was associated with having lower birth weight ($\beta = -.12$), being unmarried ($r = -.14$), and being of younger age ($r = -.19$). All of these relationships are in the direction expected and are consistent with past research.

Both stress and personal resources predicted birth outcomes independent of the effects of the other variables in the model. Women with higher stress delivered at an earlier gestational age ($\beta = -.20$). Controlling for all other variables in the model, stress was not associated with infant birth weight. Personal resources, in contrast, were directly associated with birth weight and indirectly associated with gestational age through stress reduction. Specifically, women with stronger resources gave birth to heavier babies ($\beta = .21$), controlling for age, marital status, nulliparity, ethnicity, and socioeconomic variables, and having stronger resources was associated with less stress ($\beta = -.67$). The indirect effect of resources on gestational age (mediated by stress reduction) was significant ($\beta = .13$, $z = 2.68$, $p < .05$). Although zero-order correlations suggest that mastery was more strongly associated with birth weight than the other personal resources studied here, examination of the loadings of each of the personal resource variables on the resources latent

variable suggests that the relationship between resources and birth weight was almost equally accounted for by all three resources. In addition, although zero-order correlations suggest a stronger association between state anxiety and length of gestation than between pregnancy-related anxiety and length of gestation, the factor loadings in the structural equation model suggest that state anxiety and pregnancy-related anxiety contributed comparably to shortened gestations.

Examination of the sociocultural variables revealed that non-Hispanic Whites had stronger personal resources ($\beta = .19$), with the other variables in the model controlled, but did not differ from Hispanics in stress. Also, non-Hispanic Whites were still more likely to be married ($r = .23$) and older ($r = .41$), with other variables in the model controlled. Ethnicity did not directly predict birth weight after other variables were included in the model. Instead, ethnic differences in infant birth weight appeared to be mediated by other variables. In particular, Hispanics had fewer personal resources than Whites, and women with fewer resources had lower birth weight babies. Ethnic differences in the socioeconomic variables and marital status were also implicated through their association with stronger personal resources. White women had higher household

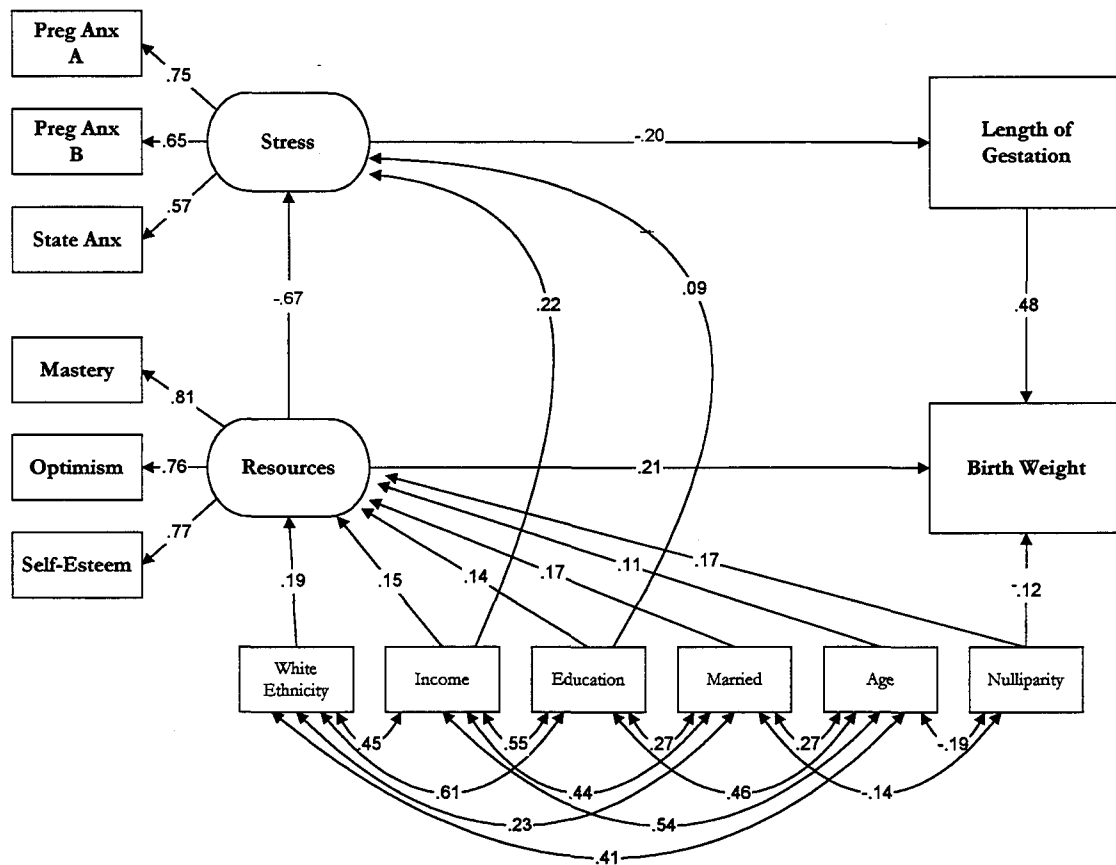


Figure 2. Final overall model. Parameter estimates are standardized. Model fit indices: $\chi^2(60, N = 230) = 140.99, p < .001$; CFI = .92; $\chi^2/df = 2.35$. All paths are significant at $p < .05$ except the paths between (a) age and resources and (b) education and stress. Coding of dichotomous variables: (a) married: 0 = single, 1 = married; (b) White: 0 = Hispanic, 1 = non-Hispanic White; (c) nulliparity: 0 = multiparous, 1 = nulliparous. Preg = pregnancy-related; Anx = anxiety.

incomes and more education and were more likely to be married than were Hispanic women, and these variables were associated with having greater personal resources and, in turn, higher birth weight babies.

Concerning socioeconomic factors, income and education were related to birth outcomes in different ways. Women with more education had stronger personal resources ($\beta = .14$), and personal resources were associated with higher birth weight, as noted above. Income, in contrast, was positively associated with stress ($\beta = .22$) as well as resources ($\beta = .15$). Moreover, there was some indication that income had a direct negative association with length of gestation (i.e., the changes suggested by the LM test). The fact that higher income appeared to contribute to shortened gestations was unexpected and is addressed in the Discussion section.

Not unexpectedly, results also showed that having a higher income was strongly associated with having more education ($r = .55$). Higher income and more education were associated with older age ($r_s = .54$ and $.46$, respectively), being married ($r_s = .44$ and $.27$, respectively), and White ethnicity ($r_s = .45$ and $.61$, respectively).

Ethnicity and Prediction of Adverse Birth Outcomes

To investigate the possibility that the models needed to explain birth outcomes differ for Whites and Hispanics, a separate structural equation model was estimated for each group. The predicted model for Hispanic women was identical to the full model except that ethnicity was not included in the model and income was removed because of the limited variability of income in this sample (i.e., 77% of the Hispanic women in the sample reported an annual household income of less than \$20,000). The model exhibited adequate fit for Hispanics, $\chi^2(45, N = 120) = 67.10, p < .05$; CFI = .92; $\chi^2/df = 1.49$. The predicted model for White women was identical to the full model except that ethnicity was not included in the model. This model also exhibited adequate fit, $\chi^2(52, N = 110) = 79.23, p < .01$; CFI = .93; $\chi^2/df = 1.52$.

Although both ethnic group models fit adequately, the low power of these analyses resulted in a number of parameter estimates failing to reach significance; however, the parameters were of a magnitude comparable to their counterparts in the full model. Thus, these analyses provide little

indication that different models are needed to explain birth outcomes for Whites and Hispanics. One possible exception is the association between resources and birth weight, which was considerably smaller in magnitude in the model estimated for White women ($\beta = .03$) compared with the model estimated for Hispanic women ($\beta = .17$) and the full model ($\beta = .20$). A simultaneous multiple regression analysis was conducted to test the possibility that the effect of resources on birth weight was moderated by ethnicity. However, the interaction between resources and ethnicity did not significantly predict birth weight ($\beta = -.04, p > .10$).

Examination of Interaction Effects

Simultaneous multiple regression analyses were conducted to examine the possibility that personal resources would modify the effect of stress on birth outcomes. An index of personal resources was created by summing standardized scores for mastery, optimism, and self-esteem. Similarly, an index of stress was created by summing standardized scores for state anxiety and pregnancy-related anxiety. Next, an interaction term was created by multiplying the resources index and the stress index. In the first analysis, infant birth weight was the dependent variable, and the predictors were weeks gestation at birth, marital status, maternal age, nulliparity, income, education, ethnicity, personal resources, stress, and the interaction term. As with the structural equation model, with weeks gestation at birth controlled, this model tested predictors of fetal growth. Results of the analysis indicated that the interaction between resources and stress was not significant ($\beta = .04, ns$). In the second analysis, length of gestation (in weeks) was the dependent variable, and the predictors were marital status, maternal age, nulliparity, income, education, ethnicity, personal resources, stress, and the interaction term. The interaction between stress and resources did not reach statistical significance in this test either ($\beta = -.03, ns$). Thus, there was no evidence that resources buffered stress in this study.

Testing Clinical Outcomes

To assess the ability of the study variables to predict the dichotomous outcomes used in obstetrics (birth weight <2,500 g or birth weight >2,500 g; delivery before 37-weeks gestation or delivery at or after 37-weeks gestation), two logistic regressions were conducted. Besides resources and stress, only predictors that were significant in the multiple regressions for birth weight and length of gestation were included in the corresponding logistic regressions. That is, weeks gestation and ethnicity were included for LBW, and education and income were included for PTD. The only study variable to predict LBW was weeks gestation at birth ($B = -1.38$, odds ratio = 0.25, $p < .001$). Both income ($B = 0.39$, $p < .01$) and stress ($B = 0.46$, $p < .05$) were significant predictors of PTD (odds ratios = 1.48 and 1.59, respectively). In addition, education was a marginally

significant predictor of PTD ($B = 0.20$, odds ratio = 0.47, $p = .06$).⁴

Discussion

This study examined several aspects of adaptation during pregnancy and their association with two important birth outcomes. Adaptation was conceptualized as prenatal psychosocial stress, personal resources, and some aspects of the woman's sociocultural context.

One important contribution of this study is to add to the sparse literature on the manner in which personal resources in the form of self-relevant beliefs affect maternal and fetal health. The results provide evidence for a beneficial role of these adaptive resources—self-esteem, optimism, and mastery—in pregnancy and birth. Specifically, these resources were associated with giving birth to larger babies even after controlling for psychosocial stress, length of gestation, marital status, maternal age, income, education, ethnicity, and parity. The mechanisms underlying this direct effect remain unexplained, although behavioral pathways are likely to be a promising avenue for future research. For instance, women with strong personal resources may seek out health-related information more actively or practice preventative health behaviors more often (Aspinwall & Brunhart, 1996; Rodin, 1986; Seeman & Seeman, 1983). Also, they may be more successful at undertaking necessary lifestyle changes such as refraining from smoking, alcohol, and drug use (DiClemente, 1986; Mechanic & Cleary, 1980; Yates & Thain, 1985). Additional research on specific mediators of this relationship is needed.

In addition, personal resources were indirectly associated with length of gestation through stress reduction, with stress operationalized as generalized and pregnancy-related anxiety. This finding is consistent with theory and research linking personal resources in the form of positive beliefs about the self to lower appraised stress (see S. Cohen & Edwards, 1989; Hobfoll, 1989; Jerusalem, 1993; Lazarus & Folkman, 1984; Rodin, 1986) and may tap into processes related to resilience, growth, and thriving (Epel et al., 1998; Park, 1998). Pregnant women with stronger self-esteem, higher mastery, and greater optimism appear to have lower perceived stress, although it is unclear whether this results from lower stress appraisals or better coping and stress management. Both may be operating.

There is no evidence to support a buffering role for personal resources in this study. Thus, having strong resources appears to be health-protective not only for women experiencing high stress but also for those experiencing low stress. Theoretical perspectives on self-esteem, optimism, and mastery suggest that they may be viewed as basic adaptational resources that are useful across a broad range of

⁴ Another series of logistic regressions was conducted to investigate the possibility that stress and resources would predict birth outcomes only for women at high medical risk, as suggested in previous research (Dunkel-Schetter, 1998). The medical risk index was dichotomized for these analyses. None of the interaction terms were significant predictors of PTD or LBW.

circumstances (e.g., Hobfoll, 1989; Scheier & Carver, 1992; Skinner, 1995; Taylor & Brown, 1988; Thompson & Spacapan, 1991). The results of this study strongly support this position. However, it is important to note that the lack of findings regarding buffering could be the result of the operationalization of psychosocial stress used here. Buffering may have been more likely if different measures of stress had been used, such as life event stress.

These analyses provide further evidence for an emerging pattern of results linking multidimensional measures of prenatal stress to length of gestation (Lobel, 1994). This replication adds to a growing understanding of the etiology of preterm labor and delivery. Past research has shown an association between stress and activation of the hypothalamic-pituitary-adrenal axis during pregnancy (Wadhwa, Dunkel-Schetter, Chiciz-DeMet, Porto, & Sandman, 1996). Furthermore, there is growing evidence that stress hormones such as corticotropin-releasing hormone and cortisol are implicated in the early onset of delivery (Hobel, Dunkel-Schetter, & Roesch, 1998) as well as in suppression of the immune system, which may lead to infections that increase the risk of preterm labor (Paarlberg et al., 1995). This work extends previous research by focusing on a new component of stress (i.e., pregnancy-related anxiety) that appears to play an important role in adverse birth outcomes (Dunkel-Schetter, 1998). Still unknown, however, is what factors other than weak self-relevant beliefs predispose a woman to worry about her pregnancy and her ability to care for her baby, and whether intervening in this process can improve birth outcomes.

In terms of sociocultural factors, the findings of this study suggest that ethnicity is related to several other variables that influence adaptation during pregnancy, thus exerting its influence on birth outcomes indirectly. Specifically, the association of ethnicity to infant birth weight was mediated by Hispanics' lower levels of personal resources. Although future research is needed to investigate why Hispanics in this population reported lower personal resources, difficulties commonly experienced by immigrants may be contributing factors. Language barriers, economic difficulties, separation from friends and family, the need to adjust to new norms, and racial discrimination may lead Mexicans and other Latin American immigrants to experience decrements in beliefs about themselves, their future, and their ability to control important outcomes. As noted earlier, cultural values such as a belief in fatalism may also contribute to lower personal resources.

Ethnicity was also associated with household income and education. These socioeconomic variables, in turn, appeared to influence birth outcomes through their association with age, marital status, resources, and stress. Women with less education and lower incomes had fewer personal resources, which predicted less fetal growth compared with women with more education and higher incomes. Lower income was also associated with less stress. This latter finding is inconsistent with past research (see Williams, 1990). However, univariate analyses of these data showed that income was not correlated with either state anxiety or pregnancy-

related anxiety; thus, it seems most likely that this is a suppression effect (J. Cohen & Cohen, 1983).

One strength of this study is its simultaneous consideration of adaptational resources and constraints operating at both the individual and contextual levels. The results provide insight into the interrelationships of these variables, as well as a more comprehensive understanding of their influence on birth outcomes. In particular, little research has been conducted to investigate the role of personal resources in pregnancy. These results, which provide evidence that resources influence birth outcomes both directly and indirectly, merit further attention. Moreover, this study provides some evidence that these processes hold for both Hispanics and non-Hispanic Whites.

In addition, researchers interested in the prediction of FGR, LBW, and PTD have acknowledged the need to recognize the different etiologies of these birth outcomes (e.g., Ernest, Michielutte, Meis, Moore, & Sharp, 1988; Selwyn, 1990). Our results provide evidence that the need to recognize different etiologies holds for psychological as well as biomedical variables. Specifically, the effects of resources and prenatal stress varied with the birth outcome being predicted. Resources were implicated in processes related to fetal growth but not to the timing of delivery, whereas stress was associated with length of gestation but not with fetal growth.

Some limitations of this study must be acknowledged. Although it appears from the evidence that the overall model holds well for both Whites and Hispanics, the ethnic subgroups were too small to be completely confident that the model fits both ethnic groups, and this must be tested in a larger sample. Sample size also limited the ability to detect relationships with dichotomous clinical outcome variables (i.e., LBW, PTD), which would be important to observe for purposes of risk assessment and intervention. These adverse outcomes occur with relatively low frequency in any given data set, and thus a sample of high-risk women is needed to predict them with adequate power. Finally, the study did not assess possible mediators of the relationship between personal resources and fetal growth (e.g., nutrition).

Although much has been made of the importance of studying the biopsychosocial determinants of health, many studies have focused on the biological and psychological aspects of this model, giving relatively little attention to the sociocultural aspects. This study provides evidence that investigating how these factors work together has the potential to help us better understand important health processes and outcomes, including the etiologies of adverse birth outcomes.

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Appendix

Pregnancy-Related Anxiety

1. I am confident of having a normal childbirth.
2. I think my labor and delivery will go normally.
3. I have a lot of fear regarding the health of my baby.
4. I am worried that the baby could be abnormal.
5. I am afraid that I will be harmed during delivery.
6. I am concerned (worried) about how the baby is growing and developing inside me.
7. I am concerned (worried) about losing the baby.
8. I am concerned (worried) about having a hard or difficult labor and delivery.
9. I am concerned (worried) about taking care of a new baby.
10. I am concerned (worried) about developing medical problems during my pregnancy.