

Stress Processes in Pregnancy and Birth: Psychological, Biological, and Sociocultural Influences



Christine Dunkel-Schetter

Regan A. R. Gurung
University of California, Los Angeles

Marci Lobel
State University of New York, Stony Brook

Pathik D. Wadhwa
University of Kentucky College of Medicine

From the time of its inception, health psychology has accumulated a strong record of research on psychological aspects of various diseases such as heart disease and cancer. In contrast, the field has not delved much into reproductive health. Research in nursing, public health, and medicine has been conducted on the biopsychosocial aspects of infertility, contraception, abortion, miscarriage and stillbirth, on prenatal genetic screening and health behaviors, on labor and delivery, and on maternal and infant health in general. Such issues are prime research topics for attention by health psychology, as any quick reading of the available literature indicates. This chapter focuses on pregnancy and birth specifically, although this is only one of a plethora of important underresearched topics in reproductive health.

A central event in most women's reproductive life cycles is the prenatal period culminated by the birth of a child. During these 9 months, numerous well-established changes in physiology take place. These changes are accompanied by psychological changes that are not as well documented, nor are the interrelations of the physiological changes to psycho-

logical factors well mapped out as yet. The effects of pregnancy on mood or affect, social resources, coping processes, and various behaviors are highly variable from woman to woman depending on her circumstances and her condition. To what extent are women anxious about having a first or a subsequent birth? Does prenatal anxiety vary as a function of her available coping resources? Do women with close relationships with the father of the baby have better health and well-being in pregnancy than women who do not have this relationship? Are certain personal characteristics such as self-esteem associated with positive prenatal health behavior? Does the way a woman perceives and copes with challenges in her pregnancy influence her emotional adjustment or her infant's health? What are the mechanisms accounting for relations of maternal psychosocial factors and maternal, fetal, and infant outcomes? These are the kinds of health psychology questions that can be considered in building a better understanding of pregnancy.

Pregnancy is an ideal condition for study by health psychologists for many reasons. First, it has a clear-cut and finite

time frame. Second, millions of women experience it annually. Third, many of the issues such as the prevention of infant mortality are international in scope. Finally, evidence for interactions of mind and body are numerous. For example, it is known that having a companion present during labor to provide support has beneficial effects on labor outcomes (Kennell, Klaus, McGrath, Robertson, & Hinkley, 1991; Sosa, Kennell, Klaus, Robertson, & Úrrutia, 1980). It is also well established that behaviors such as smoking, diet, and adherence to medical regimens have effects on fetal growth and infant health (McCormick et al., 1990). Emerging research also indicates that life stress and its emotional effects are risk factors for adverse birth outcomes for mother and infant. It is this latter topic—prenatal stress processes and effects on birth outcomes—that is the central focus in this chapter. By studying stress processes in pregnancy, the many interactions of psychological, sociocultural, and biological systems and their effects on birth outcomes can be examined. More specifically, the mechanisms accounting for the links between stress and birth outcomes are unknown, and can be probed within a broad-based stress framework.

PREGNANCY AND STRESS

Although biological perspectives sometimes view pregnancy as a physical stressor to the body, there are limitations of such models for studying pregnancy. For one, the human body has many adaptive mechanisms to ensure the health of mother and fetus (Amiel-Tison & Pettigrew, 1991). In fact, pregnancy is best conceptualized as a normative developmental transition involving changes of many kinds that may or may not be perceived as stressful. This may be especially true in a first pregnancy. A woman's social network may change, with her family and marital relationships growing stronger or more strained. She may develop new friendships with other expecting mothers or parents, and become less close with others who do not have children. Emotions may range over the course of pregnancy from happy to anxious, "blue," or sad. Behaviors such as abstinence from smoking, alcohol, and drug use, and regular prenatal care, healthy diet, and moderate exercise may differ markedly from prepregnancy behaviors. Variability in these issues among women is even greater in second, third, or further pregnancies, as a function of the experiences of earlier pregnancies and the conditions of the current one. Understanding the variability in responses to pregnancy and determining the factors that predict such variation is one goal of the research.

MULTILEVEL STRESS MODELS AS APPLIED TO PREGNANCY

Many factors at different levels of theoretical analysis influence the degree to which a woman experiences particular changes, emotional responses, and events in pregnancy. These levels include sociological, cultural, familial, dyadic, and individual. For example, maternal socioeconomic status has been shown to influence substance use, prenatal care utilization, and diet, as well as stress levels in pregnancy (Feldman, 1997;

Gazmararian, Adams, & Pamuk, 1996; Kramer, 1998; Moore et al., 1991). Ethnic and cultural differences have been found in attitudes about a particular pregnancy, about pregnancy in general, and in health behaviors (Schaffer, Velie, Shaw, & Todoroff, 1998; Scrimshaw, Zambrana, & Dunkel-Schetter, 1997; Zambrana & Scrimshaw, 1997; Zambrana, Scrimshaw, N. Collins, & Dunkel-Schetter, 1997). Some of these factors—socioeconomic indicators, attitudes toward pregnancy, and health behaviors, in particular—have been shown in turn to influence rates of medical complications and outcomes such as prematurity and infant birthweight (J. W. Collins, Herman, & David, 1997; Gudmundsson, Bjorgvinsdottir, Molin, Gunnarsson, & Marsal, 1997; Safonova & Leparsky, 1998; Zimmer-Gembeck & Helfand, 1996). Age also plays a part, with teenage pregnancy creating a vulnerable group of women for whom prenatal changes are perhaps the most stressful and pose the most risk (McAnarney, 1987). For example, teens are at high risk for substance use and inadequate health care in pregnancy (Kosher, Lee, Goss, Heilemann, & Stinson, 1998). Marital status has also been found to be important to pregnancy processes and outcomes, with married women at lower risk of many adverse outcomes (Ahmed, 1990; Arntzen, Moum, Magnus, & Bakketeig, 1996; McIntosh, Roumayah, & Botoms, 1995). Psychosocial mechanisms such as availability and receipt of support of all kinds are likely explanations for these marital effects.

At the individual level, a host of factors such as maternal personality, coping style, and coping resources influence the degree and rate of changes in pregnancy and outcomes. For example, women with high perceived control or mastery appear to have better pregnancy outcomes (Rini, Dunkel-Schetter, Sandman, & Wadhwa, 1999). Women who cope with challenges in pregnancy in certain ways (e.g., Yali & Lobel, 1999), and who have ample resources to cope (e.g., Dunkel-Schetter, Sagrestano, Feldman, & Killingsworth, 1996), also appear to fare much better. For example, naturally occurring social support has been associated with larger birth weight infants and with fewer labor complications (N. L. Collins, Dunkel-Schetter, Lobel, & Scrimshaw, 1993).

Variability in response to pregnancy may also be due to biological factors such as genetic predisposition, obstetrical and gynecological history, and state of prepregnancy health. Possible pathways between psychosocial factors and outcomes such as maternal complications or infant health include processes at many biological levels of analysis that range from systemic (endocrine and immune processes) to molecular (gene expression). Historically, pregnancy has been studied at only single levels of analysis, but current trends in perinatal research are toward multilevel analyses in which biological, psychological, and sociocultural factors are examined jointly.

In short, there are many factors at many different levels of analysis that influence exposure to stress in pregnancy, appraisals of stress, emotional responses to stressors, and effects of them on mental and physical health outcomes. Furthermore, these factors interact and work together in complex causal sequences in their effects on maternal, fetal, and infant outcomes. Thus, a broad biopsychosocial approach to

understanding pregnancy and birth, similar to that found in much of health psychology, is appropriate in this context, and offers avenues for productive research.

This chapter overviews some of the biopsychosocial interrelationships in pregnancy and birth with special attention to stress processes. Stress processes are inherently biopsychosocial and provide a useful entry point to the broader arena of study. It begins with a review of the mainly descriptive research on the prevalence and variability of emotional responses in pregnancy. The next section lays out the array of potential pregnancy and birth outcomes that may be studied. Because of their significance as health issues, special attention is devoted to length of gestation, preterm delivery, and to low birth weight. To provide some groundwork for examining links between stress and these particular outcomes, the etiology of preterm delivery and low birthweight is also briefly discussed. Next, the chapter reviews recent evidence regarding stress as an independent risk factor for adverse outcomes. The next section is devoted to mechanisms or pathways that may account for stress–birth outcome effects. Two general mechanisms are discussed: physiological pathways and behavioral pathways. Following the discussion of mechanisms, two moderators of stress outcome effects are examined. These are coping processes and social support processes. Inasmuch as there is very little research on coping, this topic is treated briefly. In contrast, there is both a solid existing research literature and a growing body of work on social support in pregnancy; thus this topic is covered in some depth. The section on social support provides a brief conceptual basis for the study of support in pregnancy, and then reviews research on the relation of social support to birth outcomes.

EMOTIONAL RESPONSES IN PREGNANCY

Some experts have suggested that heightened levels of estrogen and progesterone in pregnancy make pregnant women more emotionally vulnerable, although the impact of hormones on prenatal mood has not been established empirically (Leifer, 1980). For the most part, prenatal emotion has not been examined as a topic in its own right, but rather it has been described in the coverage of other topics, mainly in studies focusing on the impact of maternal emotion on birth outcomes or on postpartum adjustment (cf. Leifer, 1980). In these studies, mean levels of emotion are often not reported, and when reported, are not usually compared to population means, or otherwise given meaningful interpretation (e.g., Affonso, Mayberry, Lovett, & Paul, 1994; Brooke, Anderson, Bland, Peacock, & Stewart, 1989; Chalmers, 1983; Farber, Vaughn, & Egeland, 1981; Kalil, Gruber, Conley, & Syntiac, 1993). Furthermore, of the limited number of studies of women's emotional state during pregnancy, a fair portion were published 20 or more years ago. These studies may offer an inaccurate view of emotions in pregnant women of today due to important societal changes that are likely to have altered the experience of pregnancy. For example, more pregnant women are in the workforce now than in previous decades, which has affected societal views of pregnancy and the way pregnant women view themselves (Horgan, 1983; Lobel, 1998). Al-

though the tendency to treat pregnancy as a sickness has receded over the last few decades (Seegmiller, 1993), pregnancy has been increasingly medicalized. Most women now routinely undergo prenatal tests such as ultrasonography, amniocentesis, chorionic villus sampling, and alpha-fetoprotein testing. There is conflicting evidence about whether such testing, and the greater availability of medical interventions, provides reassurance to pregnant women or focuses their attention on the number of things that can go wrong (Diaz & Lobel, 1998; Tunis & Golbus, 1991). Because of these changes, research must be fairly current to accurately represent the emotional state of pregnant women today.

Three types of studies comprise the research literature on prenatal emotion. One type, which includes many of the older studies, examines the prevalence of various indicators of psychopathology in pregnant women and compares these to population norms. Studies of psychosis, suicide, and admission to psychiatric hospitals have generally found that these are less common in pregnant than nonpregnant women, and in those who do experience psychiatric disorders, a history of disorder prior to pregnancy is often present (reviewed by Elliott, 1984; Leifer, 1980). A second type of study, comprised of qualitative interviews with pregnant women, is the primary source of data on positive emotions (e.g., Mercer, 1986) and on emotional fluctuations in pregnancy. The media and other popular sources often depict pregnant women as displaying what one best-selling women's health guide calls "dramatic emotional changes" (Carlson, Eisenstat, & Ziporyn, 1996). Qualitative reports suggest that a portion of women do experience emotional lability during pregnancy (Leifer, 1980; Mercer, 1986), but there appears to be high interindividual variation. Furthermore, it is unknown whether emotional lability is any more common in pregnant women than in other groups. More controlled studies with repeated measures over the course of pregnancy are needed to examine emotional states in pregnant women and appropriate comparison groups.

A third type of study has employed standard measures of emotion in pregnant women, occasionally comparing sample means to population norms. Studies of this type have focused almost exclusively on negative emotions, particularly anxiety and depression, although "distress" (e.g., Hedegaard, Henriksen, Sabroe, & Secher, 1993) and "tension" (e.g., Elliott, Rugg, Watson, & Brough, 1983; Mercer & Ferketich, 1988) have been measured in a few studies. These quantitative studies of prenatal state anxiety and prenatal depression yield information about normative levels of negative emotion in pregnant women and to some extent about stability and change in negative emotion over the course of pregnancy.

Prenatal State Anxiety

Studies using standardized measures such as the State-Trait Anxiety Inventory (STAI; Spielberger, 1983) have produced extremely similar estimates of prenatal levels of state anxiety, and the levels reported are close to published norms for these instruments for nonpregnant women (e.g., Crandon, 1979; Molfese, Bricker, Manion, Beadnell et al., 1987; Pagel, Smilkstein, Regen, & Montano, 1990;

Park, Moore, Turner, & Adler, 1997). Thus, on average, pregnant women in these studies do not appear to experience elevated anxiety. However, study participants have been mostly socioeconomically advantaged, White, and married or partnered. There is conflicting evidence about whether anxiety is greater in women of lower socioeconomic status or in other demographically at-risk groups (e.g., Norbeck & Anderson, 1989a; Pond & Kemp, 1992).

There is a high degree of interindividual variability in anxiety in these studies. For example, variation from the mean by approximately 10 or 11 points on the STAI appears to be common in samples of pregnant women, and is approximately equal to the standard deviation derived from population norms. Thus, levels of anxiety in both pregnant and nonpregnant women commonly range within a spread of approximately 20 points (10 points below the mean to 10 points above), which constitutes about a third of the entire STAI response range. In essence, these data indicate that there are fairly large differences in anxiety from woman to woman, whether pregnant or not.

A few studies have assessed anxiety at multiple time points, providing a way to examine whether prenatal anxiety is stable across the 9-month period. These studies also enable determination of whether using single assessments offers valid estimates of prenatal emotion. Although studies employing repeated measurement have utilized samples of quite different composition, there is an impressive convergence of evidence that state anxiety is fairly stable across pregnancy (Elliott et al., 1983; Lobel & Dunkel-Schetter, 1990; Norbeck & Anderson, 1989a; Perkin, Bland, Peacock, & Anderson, 1993; Zax, Sameroff, & Farnum, 1975). One of the most methodologically rigorous and comprehensive of these investigations was conducted among married, working-class urbanites in Britain (Elliott et al., 1983). For the sample as a whole, no significant change in anxiety was observed across pregnancy. However, the authors noted that variance in individual patterns of change was "striking." That is, some women did experience changes in anxious emotion, although as Elliott et al. cautioned, these patterns of change are difficult to interpret and individual variation across pregnancy was not associated with any particular maternal characteristics.

Three older studies have been cited frequently as demonstrating variation in anxiety levels during pregnancy, but on close examination, they offer little evidence to support this claim (Edwards & Jones, 1970; Gorsuch & Key, 1974; Lubin, Gardener, & Roth, 1975). For example, Lubin et al. found an exceptionally small (1.5 points out of a 21-point range), but statistically significant, difference between anxiety in the second trimester compared to the first or third trimesters using one measure. But they found no difference on a second standard measure of anxiety between trimesters. Furthermore, anxiety in this sample was low and comparable to population levels. The remaining two studies found small changes in anxiety over time, but neither study examined whether the changes were statistically significant. For participants in both of these studies, anxiety scores at virtually every time point were well within one standard deviation of the population norm.

To summarize, across samples with great variability in socioeconomic status, racial characteristics, marital status, medical risk, and parity, a consistent pattern of temporal variation in anxiety over the course of pregnancy does not appear to exist. Women experience normal levels of anxiety throughout their pregnancy, although a minority of women experience some changes over time. However, even for these women, there does not appear to be a consistent pattern of variation associated with the progression of pregnancy.

Prenatal Depression

As with data on anxiety during pregnancy, information about depression is available almost exclusively from investigations conducted for other purposes. These studies, less numerous than those of anxiety, concur that most women do not experience clinical levels of depression during pregnancy. The more recent studies indicate that mean scores on the Beck Depression Inventory, the most common measure used, are below cutoffs for mild depression (Cameron et al., 1996; Molfese, Bricker, Manion, Beadnell et al., 1987; O'Hara, Zekoski, Philipps, & Wright, 1990; Steer, Scholl, Hediger, & Fischer, 1992). Older studies (reviewed by Kaplan, 1986) and those using other depression measures (Elliott et al., 1983; Lubin et al., 1975; Mercer & Ferketich, 1988; Neter, Collins, Lobel, & Dunkel-Schetter, 1995; Perkin et al., 1993; Rofe, Lewin, & Padeh, 1981) also find that the majority of women do not report depression. Similarly, in the few studies examining prenatal depression at multiple time points, it appears to be fairly stable for the majority of women (Cameron et al., 1996; Chapman, Hobfoll, & Ritter, 1997; Elliott et al., 1983; Lubin et al., 1975; and see review by Kaplan, 1986), although there are notable exceptions (e.g., O'Hara et al., 1990).

O'Hara and colleagues (1990) have demonstrated the importance of distinguishing between major depression, minor depression, and depressive symptomatology or dysphoric mood in pregnant women. They found that pregnant women are not more likely to exhibit clinically notable levels of depression (minor or major) than nonpregnant women, but they do experience more depressive symptomatology, especially in late pregnancy. Thus, according to these results, pregnant women are likely to experience some emotional distress during the last trimester, but not at levels considered harmful or requiring clinical intervention.

The next section considers the specific pregnancy and birth outcomes that may be influenced by emotional state during pregnancy, as well as by the other psychosocial and psychobiological factors mentioned earlier.

PREGNANCY AND BIRTH OUTCOMES

The study of stress processes in pregnancy involves a wide continuum of possible variables and outcomes for study. These can be broadly classified by the time of their occurrence into *prenatal*, *labor and delivery*, and *postpartum* periods. This developmental continuum can be extended to include prepregnancy conditions such as infertility and, at the other end of the continuum, parenting and child development

outcomes. Factors of interest during pregnancy can be further classified into maternal factors versus fetal and neonatal factors (see Table 30.1). *Maternal prenatal* variables include prenatal affect and well-being and maternal complications such as gestational diabetes and pregnancy-induced hypertension. *Maternal labor and delivery* outcomes include variables such as length of labor, mode of delivery, use of analgesia and anesthesia, and dysfunctions of labor. *Maternal postpartum* variables include postpartum depression, postpartum medical complications such as maternal hemorrhaging, and parenting variables such as difficulty in breastfeeding or caring for the infant. *Fetal variables* include growth and development parameters and fetal neurobehavioral maturation. *Infant outcomes* (at and after birth) include birth complications and infant health and behavior. Another important infant outcome is *birth weight*, which is described further later.

An outcome of special interest cuts across these categories because it involves both mother and fetus (i.e., the maternal-fetal unit), as well as pregnancy and delivery. This outcome is the *timing of delivery*, also referred to as *length of gestation*. *Preterm birth* (delivery before 37 weeks gestation) is one of the major causes of *low birth weight* (less than or equal to 2,500 grams). Fetuses with less time in utero have less time to grow and develop normally. Thus, infants born preterm, especially very preterm (under 35 weeks), are more likely to be low in birth weight. Low birth weight infants in turn are at risk for many complications medically and developmentally (Newnham, 1998; Thompson et al., 1997). Most notably, very low birth weight babies are at significantly higher risk for infant mortality. Preterm delivery and low birth weight are among the largest contributors to infant mortality (McCormick, 1985). Thus, infant mortality, low birth weight, and preterm delivery constitute

important targets for programmatic public health efforts (Alexander, 1998; Berendes, Kessel, & Yaffe, 1991; Paneth, 1995; Shiono & Behrman, 1995).

Of special interest in studying pregnancy and birth in the United States is the nation's very high rate of low birth weight (and preterm delivery) relative to other industrialized nations. The United States compares unfavorably to 36 countries reporting infant mortality data to the World Health Organization (25th), with 8.4% of infants born at low birth weight in the United States each year. This rate has been climbing steadily over the past 10 years, and there are stable and important demographic differences with rates of low birth weight as high as 13% in non-Hispanic Blacks, 9.4% in Puerto Ricans living in the continental United States, and closer to 6% in other groups (David & Collins, 1997). Similarly, rates of preterm delivery are disproportionately high in non-Hispanic Blacks (Rowley, Hogue, Blackmore, Ferre, Hatfield-Timajchy, Branch, & Atrash, 1993).

Very low socioeconomic status is one contributor to risk of low birth weight in the United States, but it does not appear to account for all the variation among groups in the population (Frisbie, Biegler, deTurk, Forbes, & Pullum, 1997). Psychosocial factors have shown impressive power to predict variation in birth weight when demographic differences such as age, education, income, and race/ethnicity are controlled (Copper et al., 1996; Goldenberg et al., 1991; Herrera, Salmeron, & Hurtado, 1997; Paariberg, Vingerhoets, Passchier, Dekker, & Van Geijn, 1995; Orr et al., 1996; Shiono, Rauh, Park, Lederman, & Zuskar, 1997; Zimmer-Gembeck & Helfand, 1996). Thus, biopsychosocial models of birth weight and preterm delivery are currently the most accepted and most researched models in this area, having edged out narrower biomedical models some time ago. Work has focused on the link

TABLE 30.1
Schema for the Clarification of Outcomes in Perinatal Research

Developmental Continuum	Maternal	Fetal and Infant
Prepregnancy	Ob-Gyn conditions (e.g., infertility)	(Not applicable)
Prenatal (prepartum)	Pregnancy loss Medical complications Neuroendocrine, immune, and hemodynamic parameters Affect and well-being Health behaviors	Fetal growth Neuroendocrine, immune, and hemodynamic parameters Fetal neurobehavioral development
Labor & Delivery (intrapartum)	Analgesia Mode of delivery Abnormal labor Gestational length and preterm delivery	Fetal distress Neonatal complications (respiration, asphyxia) Infant birthweight
Post-birth (postpartum and first years of life)	Medical complications Depression & "blues" Caregiving/parenting Breastfeeding	Infant health Infant development

between psychosocial factors (especially stress) and preterm delivery and low birth weight. These outcomes are the focus of the following review on stress and birth outcomes.

THE ETIOLOGY OF PRETERM DELIVERY AND LOW BIRTH WEIGHT

The etiology of preterm delivery is not well understood (Adams, Sarno, Harlass, Rawlings, & Read, 1995; Moore et al., 1994), although it is believed that early delivery may occur as a result of more than one disorder or pathway. There are at least two categories of preterm birth that appear to have somewhat different etiologies (Berkowitz, Blackmore-Prince, Lapinski, & Savitz, 1998; Meis, 1998). *Spontaneous preterm birth* appears to account for approximately three quarters of all preterm births and may be accompanied by preterm labor or preterm rupture of membranes (Klebanoff, 1998). Early labor or rupture of membranes may occur due to infection or other causes (Bryant-Greenwood, Millar, Yamamoto, Bogic, & Tashima, 1998). *Indicated preterm birth* accounts for the remaining one quarter of preterm births. These result from complications leading to mandated delivery by either Caesarian section or labor induction with or without Cesarean section. Studies of preterm delivery may look at whether the delivery occurred at less than 37 weeks, or they may use a more stringent criterion such as 35 weeks. Other research examines *gestational age* (also referred to as *gestational length*) in weeks (or days) as a continuous variable. Similarly, studies of *low birth weight* may examine infants of 2,500 grams or less, or may use the more stringent category of very *low birth weight* infants of 1,500 grams or less. They may also examine the continuous distribution of birth weight in grams.

At least two processes appear to be intertwined here. The length of gestation and the weight of the infant are highly correlated, typically sharing approximately 10% to 30% variance. This reflects the fact that the etiology of low birth weight involves processes that contribute to fetal growth and growth retardation independent of preterm delivery. In order to disentangle the processes leading to preterm delivery from those leading to fetal growth retardation, birth weight as an outcome variable must be examined after controlling for the length of gestation. Very little research has addressed this issue in analyses. Research on either of these two endpoints (PTD and LBW) is useful in understanding the possible contribution of stress to adverse outcomes of pregnancy and research that takes both length of gestation and birth weight into account is especially valuable.

STRESS AS AN INDEPENDENT RISK FACTOR FOR ADVERSE OUTCOMES

Since the 1970s, many empirical studies have been published addressing the role of stress in preterm delivery, infant birth weight, and related outcomes. Studies in the past 10 years have been the most sophisticated with larger samples, better measures, and more controlled analyses that address the issues of confounding and independence of any effects of

stress. This is a very rapidly developing area of research with growing interest in medicine and public health.

However, differences in design and samples across investigations continue to make it difficult to compare results. For example, characteristics of samples vary in the nationality, ethnicity, social class, risk status, and parity (birth history) of pregnant women. The number and timing of prenatal assessments varies from single assessments at various times in gestation to repeated assessments, most often in the second or third trimester. Few studies conduct assessments in the first trimester, which may be a particularly vulnerable time for effects of stress on some birth outcomes (e.g., birth defects). At the same time, early prenatal assessment creates biases in sampling because socioeconomically disadvantaged women are much less likely to be in prenatal care at this point (Gazmararian et al., 1996). Most studies conduct prenatal assessments late in pregnancy with the advantage of lowering attrition and loss prior to collection of labor and delivery data. The disadvantage of this approach is that women delivering preterm can then be missing prenatal data by virtue of having already delivered their infants. Thus, the issues involved in selecting a research design are very complex and are important to consider in evaluating the research.

Conceptualizations of stress have been quite diverse in this literature, including assessments of stress exposure, emotional responses, and appraisals of stress (Lobel & Dunkel-Schetter, 1990). Self-report methods are the norm, due mainly to the difficulty of measuring stress more objectively, but there are also advantages of a phenomenological approach to studying stress (Cohen, Kessler, & Gordon, 1995; Lazarus & Folkman, 1984). Life events and state anxiety are the constructs most often assessed, but measures of depression and generalized distress also appear in the literature. In addition to these, quite a few studies have focused on occupational stress and physical strain or exertion (see Woo, 1997, for a review). This work is relevant but not as well developed as research on life stress. Nonetheless, distinguishing physical exertion from psychological stress is very important to understanding mechanisms. Adverse outcomes may result from physical strain in strenuous daily activities or from perceiving that the demands of life stressors exceed people's coping capacity. It is unlikely that physical strain and appraised stress have the same effects on physiology and outcomes of pregnancy.

Finally, many studies include other constructs such as mastery or self-esteem in approaches to understanding stress and birth outcomes. Sometimes these psychosocial variables are combined with stress variables into broader psychosocial risk indices (e.g., Nuckolls, Kaplan, & Cassel, 1992). It can be argued that this strategy maximizes empirical predictive power at the expense of theoretical clarity, which is only obtained by examining stress variables and related moderators and mediators separately.

Existing research has not yet focused on chronic stress and its effects on pregnancy, despite plausible mechanisms whereby chronic stress might influence both fetal growth and preterm labor and delivery. Some work has included an instrument assessing perceived stress (PSS; Cohen, Kamarck, & Mermelstein, 1983; Cohen & Williamson, 1988). Although

not designed to assess chronic stress per se, this instrument appears to capture the extent to which a woman feels overwhelmed by stress from any and all sources, unable to cope with or control the stress, and emotionally distressed. This scale has been associated with both gestational length and birth weight (Lobel, Dunkel-Schetter, & Scrimshaw, 1992; Zambrana et al., 1997). Additional research incorporating direct approaches to the study of chronic stress in pregnancy (Lepore, 1995) would be very valuable.

Several review articles have been published, each addressing certain aspects of the literature on stress and birth outcomes (Istvan, 1986; R. P. Lederman, 1986; Levin & DeFrank, 1988; Lobel, 1994). Some address stress as a risk factor for low birth weight specifically (Brooks-Gunn, 1991; McAnarney & Stevens-Simon, 1990). In a comprehensive review on the determinants of low birth weight, Kramer (1987) concluded cautiously that "stress and anxiety may provoke pre-term labour in some susceptible women" (p. 684), and they are important risk factors to study along with physical activity, maternal employment, antenatal care, and genital tract infection.

Since the publication of this review, newer evidence strengthens the case that stress is a risk factor for preterm labor and delivery. Approximately 20 studies on stress and preterm delivery, most of which are well controlled, have appeared since 1986. For example, Nordentoft et al. (1996) studied 2,432 Danish women at 20 weeks gestation using the most sophisticated life events assessment methods available (i.e., those of Brown & Harris, 1978). They found that severity of life events was associated with preterm delivery after controlling for education, age, and cohabitation. Similarly, Hedegaard, Henriksen, Secher, Hatch, and Sabroe (1996) found that the presence of one or more highly stressful life events during pregnancy was associated with risk of preterm delivery in 5,873 Danish women studied prospectively. Together these studies and others provide fairly convincing evidence that life event exposure may pose a risk for preterm delivery, although the risk ratios were relatively small.

Other studies using measures of stress other than life events support the role of stress in the etiology of preterm delivery. In a multicenter study of 2,593 women in the United States who were assessed at approximately 26 weeks gestation, a two-item stress measure (part of a larger psychosocial risk index) was significantly associated with preterm delivery after controlling for race, age, marital status, insurance, education, and substance abuse (Copper et al., 1996). The two items were "There is a great deal of nervous strain associated with my daily activities" and "In general, I am very tense and nervous." The content of this measure raises the question of whether stress as a risk factor is based in environmental circumstances or is more reflective of personality predispositions of women. That is, the risk may lie either in the exposure to stressors or in the patterns of appraising and responding to stressors. Some contribution from each is expected within a transactional model of stress (Lazarus & Folkman, 1984). However, this issue has been addressed to some extent.

Lobel, Dunkel-Schetter, and Scrimshaw (1992) studied 130 pregnant women from early gestation throughout preg-

nancy with assessments at every prenatal visit. Multiple measures of stress (including life events, state anxiety, and perceived stress) were included in each assessment. Structural equation modeling methods were used to combine stress variables into a latent factor, providing the advantages of minimizing the effects of measurement error and using a common core of shared variance among stress measures as the predictor of outcomes (Lobel & Dunkel-Schetter, 1990). The best latent factor to represent stress was composed of state anxiety, perceived stress, and ratings of perceived distress from life events. The total number of life events (or exposure alone) did not correlate with the latent factor or with outcomes. However, the latent stress factor predicted both birth weight and gestational age at delivery after controlling for medical risk factors including smoking.

In a subsequent study, Wadhwa, Sandman, Porto, Dunkel-Schetter, and Garite (1993) included a more contextually based measure of stress in which anxiety and concerns about the pregnancy were assessed in questionnaires administered to 90 pregnant women. In contrast to more general stress or anxiety measures, a 5-item index assessing *pregnancy anxiety* was most significantly associated with risk of early labor and delivery. Recently, these results have been replicated in studies in which life events, state anxiety, perceived stress, and pregnancy anxiety were measured in structured interviews with two samples of pregnant women. In both samples, results indicate that pregnancy anxiety is an important component of stress in predicting preterm delivery (Dunkel-Schetter, 1998). For example, Rini et al. (1999) found that pregnancy anxiety and state anxiety were moderately intercorrelated. When modeled as a latent factor, this anxiety factor predicted length of gestation in a sample of 230 women (half Hispanic and half non-Hispanic White) after controlling for the effects of obstetric and sociodemographic risk factors.

In addition, this study distinguished psychosocial resources (i.e., self-esteem, mastery, and dispositional optimism) from stress variables by assessing the former with standard scales and combining the scores into a latent factor. Labeled *personal resources*, this factor significantly predicted birth weight. Thus, stress was associated with length of gestation and not with intrauterine growth, whereas personal resources (mastery, self-esteem, optimism) were associated with birth weight and not length of gestation. Prior studies reporting significant associations between stress and birth weight or intrauterine growth have not controlled for personality factors or personal resources such as these, nor have they addressed the issue of confounding of different psychosocial constructs in multivariate analyses (e.g. Goldenberg et al., 1991). Possible mechanisms explaining these effects are discussed in the next section, but briefly, it seems likely that different mechanisms are involved. Neuroendocrine and immune pathways are implicated in the stress-preterm findings in the literature, whereas behavioral pathways appear to be more promising in linking personality (or personal resources) and birth weight. As noted earlier, pinpointing the mechanisms responsible for links between psychosocial factors and birth outcomes is critical.

MECHANISMS OF STRESS-BIRTH OUTCOMES EFFECTS

There are two major classes of mechanisms through which psychosocial factors such as stress influence health in humans: a direct, physiological pathway mediated primarily by central and peripheral stress responses of the nervous, endocrine, and immune systems; and an indirect, behavioral pathway mediated by health-related behaviors such as smoking, alcohol and drug abuse, nutrition, exercise and physical activity, and reduced compliance or adherence to other aspects of health care. Each of these possible mechanisms is discussed in the context of the effects of maternal psychosocial factors on pregnancy outcomes.

Physiological Mechanisms

The responses of the nervous, endocrine, and immune systems to psychological stress are well-established (see, e.g., Axelrod & Reisine, 1984; Herbert & Cohen, 1993, for reviews) and have been proposed as central mechanisms linking psychosocial factors to health outcomes (Chrousos & Gold, 1992; McEwen, 1998). Several researchers have suggested that stress-related responses of the neuro-immuno-endocrine axis during pregnancy may contribute to adverse outcomes such as preterm birth, fetal growth restriction/low birth weight, and neurodevelopmental deficits. For instance, elevated levels of hypothalamic, pituitary, and placental stress hormones have been implicated in the initiation of preterm labor and delivery (Hobel, Dunkel-Schetter, & Roesch, 1998; McLean et al., 1995; Wadhwa, Porto, Garite, Chicz-DeMet, & Sandman, 1998). The immunosuppressive effects of stress and hypothalamic-pituitary-adrenal (HPA) activation may increase susceptibility to infection (DeSouza, 1993; Jemmot & Locke, 1984), which in turn plays a role in the etiology of premature rupture of membranes and preterm birth (Garite, 1994; Lockwood, 1994; Romero et al., 1994). Vasoconstriction and hypoxia in response to sympathetic-adrenal-medullary (SAM) activation decrease uteroplacental perfusion, and may thereby contribute to fetal growth restriction and low birth weight (Cosmi, Luzi, Gori, & Chiodi, 1990; Myers, 1975; Shepherd, Stanczyk, Bethea, & Novy, 1992).

Stress-related processes involving the nervous, endocrine, and immune systems may also play an important role in embryonic and fetal brain development (Glover, 1997). Normal brain development requires precise interactions between environmental signals and genes that regulate cell differentiation, migration, and circuit formation. Experimental studies using animal models have demonstrated that intrauterine environmental influences, including alterations in the biochemical milieu effected by stress, stress hormones, immune products, and vascular dynamics, can modulate cell fate choice and neuronal growth, with permanent consequences for cognitive, affective, and behavioral outcomes over the life span (Wadhwa, 1998).

To date, there have been very few systematic investigations of these physiological processes as potential mediators of the prenatal stress and pregnancy outcome link in humans.

A few studies have examined the association between catecholamines and anxiety at the onset of labor (e.g., R. P. Lederman, E. Lederman, Work, & McCann, 1985), and between catecholamines and physical activity during pregnancy (e.g., Katz, Jenkins, Haley, & Bowes, 1991). In one study (Dorn, Susman, & Petersen, 1993), a sample of 40 pregnant adolescents was assessed during the middle and latter part of gestation and postpartum. Subjects with an increase in cortisol levels across a 40-minute period measured before 20 weeks gestation and again at 2 to 3 weeks postpartum had fewer symptoms of anxiety and depression than subjects with no cortisol increase. There was, however, no relation between cortisol and symptoms of anxiety or depression at the 34 to 36 week gestation assessment. In a sample of 54 adult pregnant women, maternal plasma levels of the principal pituitary-adrenal stress hormones (adrenocorticotropin hormone, ACTH; β -endorphin, bE; and cortisol) measured at the beginning of the third trimester of pregnancy were significantly correlated with psychosocial factors. Subjects reporting higher levels of prenatal stress had higher plasma levels of ACTH and cortisol, whereas subjects reporting higher levels of social support had lower plasma levels of ACTH and cortisol. After controlling for the effects of factors known to influence hormone levels during pregnancy, including gestational age, circadian variation, and obstetric risk, a combination of maternal psychosocial and sociodemographic factors accounted for 36% of the variance in ACTH, 13% of the variance in cortisol, and 3% of the variance in bE (Wadhwa, Dunkel-Schetter, Chicz-DeMet, Porto, & Sandman, 1996). Another study addressed the link between maternal psychosocial factors and immune parameters. In a sample of 72 pregnant women, high levels of stress and low or inadequate social support were associated with depression of lymphocyte activity (Herrera, Alvarado, & Martinez, 1988).

With reference to fetal outcomes, again, a very small number of studies have examined the relations between maternal psychosocial factors and fetal physiology. Recently, a series of longitudinal studies were conducted by DiPietro and colleagues to study the functional development of the fetal central nervous system over the course of gestation and to identify risk factors for neurodevelopmental delays (DiPietro, Hodgson, Costigan, Hilton, & Johnson, 1996a, 1996b). In these studies, the sequence and characteristics of fetal neurobehavioral development and maturation (i.e., fetal autonomic, motoric, state, and interactive functioning) were assessed serially at six time points between 20 and 38 weeks gestation. Findings indicated that chronic maternal psychological distress was significantly associated with delayed and impaired neurobehavioral maturation of the fetus—that is, greater maternal stress was associated with reduced fetal heart rate variability and reduced coupling between fetal heart rate and movement (DiPietro et al., 1996a, 1996b). In another study of 37 women, maternal levels of trait anxiety were significantly associated with uteroplacental and fetal blood flow. Using measures of pulsatility index (PI) derived from doppler flow studies of the umbilical and fetal middle cerebral artery at from 37 to 40 weeks gestation, results indicated that fetuses of mothers with high trait anxiety had significantly higher PI values in

the umbilical artery, significantly lower PI values in the fetal middle cerebral artery, and a significantly lower cerebro-umbilical PI ratio (signs of fetal hypoxia and compensatory redistribution of blood flow to the fetal brain; Sjöstrom, Valentin, Thelin, & Marsal, 1997).

Finally, one study with a sample of 40 low risk pregnant women examined maternal blood pressure responses to a laboratory-based behavioral stressor (interactive arithmetic task) during pregnancy. Infant birth outcomes were subsequently obtained from medical records. Results indicated that mothers with greater psychophysiological stress reactivity (in this case, larger diastolic blood pressure responses to behavioral stress) delivered infants with significantly lower birth weights and decreased gestational age (McCubbin et al., 1996).

Two sets of issues warrant consideration when thinking about physiological mediators of the effects of maternal psychosocial factors in pregnancy. First, progressive changes that occur in maternal physiology over the course of gestation may produce changes in the typical pattern of biological responses to stress. For example, neuroendocrine alterations in pregnancy, which are characterized by the evolution of a transient endocrine unit, the placenta, and by modification of negative feedback mechanisms, result in a significant and progressive increase in plasma concentrations of HPA and placental hormones (corticotropin-releasing hormone, CRH; adrenocorticotrophic hormone, ACTH; beta-endorphin, β E; cortisol; estrogens; progesterone) over the course of gestation (Petraglia, Florio, Nappi, & Genazzani, 1996). These increases of peripherally circulating hormones may exert inhibitory influences on the hypothalamus and pituitary, and thereby attenuate endocrine responsivity to exogenous stimuli (Goland, Conwell, Warren, & Wardlaw, 1992; Schulte, Weidner, & Allolio, 1990). Similarly, cardiovascular alterations in pregnancy, which include a progressive diminution of the sensitivity of baroreceptor reflex mechanisms and an increase in plasma volume with advancing gestation (Monga & Creasy, 1994), may result in a blunted sympathetic (noradrenergic) response to exogenous stimuli (Barron, Mujais, Zinaman, Bravo, & Lindheimer, 1986).

Consistent with this premise, studies of physiological reactivity in pregnancy have reported attenuated responses to exogenous challenges. For instance, pregnancy has been associated with blunted sympathetic-adrenal-medullary responses, including vascular responses to norepinephrine and epinephrine infusion (Nisell, Hjemdahl, & Linde, 1985); blunted heart rate and catecholamine responses to physical maneuvers such as standing, upright tilt, isometric handgrip, and cold pressor (Barron et al., 1986; Nisell, Hjemdahl, Linde, & Lunell, 1985a, 1985b); blunted plasma renin activity response to thermal stress (Vaha-Eskeli, Erkkola, Scheinin, & Seppanen, 1992); and blunted blood pressure responses to physical and mental challenges (Matthews & Rodin, 1992). Attenuated HPA responses have also been reported in late gestation, including ACTH and cortisol responses to administration of exogenous CRH in humans and baboons (Goland et al., 1992; Schulte et al., 1990). A recent preliminary study of maternal physiological responses to behavioral stress (speech/math task) at various gestational ages

suggested, first, a progressive attenuation of the maternal psychophysiological stress response over the course of gestation, and second, that the degree of attenuation was accounted for in substantial part by maternal baseline stress hormone levels, namely, ACTH and cortisol (Wadhwa, Sandman, Chicz-DeMet, & Porto, 1997). At present, the function of these changes is not known, but these advances in stress pathophysiology research appear to be important to untangling the mechanisms involved in stress-outcome links.

The second set of issues relates to the ontogeny of fetal development. Fetal growth and development is a logarithmic process, with rapid mitosis at early stages and cellular hypertrophy and accumulation of fat, glycogen, and connective tissue later in gestation (Lockwood & Weiner, 1986). It is well-established that there are several sensitive or critical periods in development. The presence or absence of a particular experience at a critical period in the life cycle may exert an extraordinary and dramatic influence over structure and/or function well beyond that point in development. There may be critical periods during pregnancy when the developing fetus is especially vulnerable to pre- and perinatal insults (Bornstein, 1989; Dunkel-Schetter & Lobel, 1998). For example, the effects of hypoxia on the developing fetus not only depend on the severity and duration of hypoxia but also on the time period during gestation when hypoxia occurs. Although the effects of equivalent degrees of chronic hypoxia during early and late gestation on fetal growth restriction may appear to be similar in magnitude, hypoxia experienced early in gestation produces greater fetal nervous system disability than hypoxia experienced later in gestation, when mechanisms to evoke the brain-sparing effect have developed and are in place (Amiel-Tison & Pettigrew, 1991; Wadhwa, 1998). For these reasons, psychobiological interactions in models of pregnancy should not only incorporate explanations of mechanisms through which maternal signals are relayed to the placenta and/or fetus, but they should take into account alterations in maternal psychophysiological responses over the course of gestation and the fetal developmental time line.

Behavioral Mechanisms

The effects of prenatal health-related behaviors such as poor eating habits, smoking, alcohol, and drug abuse on fetal development are well-documented. An increased risk of spontaneous abortion, fetal growth restriction, preterm delivery, and cognitive and motor deficits of the central nervous system are among these (Abrams, 1994; Andres & Jones, 1994).

An emerging literature supports a significant role for psychosocial variables such as prenatal stress and depression in countertherapeutic health behaviors in pregnancy. For example, many studies between 1975 and 1997 examined the associations between maternal psychosocial factors and smoking, alcohol, or drug abuse in human pregnancy (Barnet, Duggan, Wilson, & Joffe, 1995; Borrelli, Bock, King, Pinto, & Marcus, 1996; Bresnahan, Zuckerman, & Cabral, 1992; Hutchins & DiPietro, 1997; McCormick et al., 1990; Pritchard, 1994; Zuckerman, Amaro, Bauchner, & Cabral, 1989). Most studies rely on self-reports of health behaviors, but a very small

number include biological screens such as cotinine assays for smoking or toxicological assays for alcohol and other illicit drugs. Psychosocial factors examined in these studies include social support, depression, stress, maternal personality (self-esteem, locus of control, hostility, coping style), and whether the pregnancy was intended or unintended.

Approximately 80% of the studies reported significant associations between maternal psychosocial factors and prenatal health behaviors. Higher levels of prenatal stress or depression were associated with increased incidence of risk posing behaviors. Higher levels of social support were associated with decreased incidence of these behaviors. Among personality and individual difference variables, higher levels of self-esteem, locus of control, and an intended pregnancy were associated with decreased incidence, and higher levels of hostility and defensive coping style were associated with increased incidence of these behaviors, respectively. In addition to these correlational findings, emerging evidence suggests psychosocial factors such as stress, depression, and partner support may play an important role in the success of prenatal intervention programs to reduce the incidence of these behavioral practices (Ingersoll, Lu, & Haller, 1995; Wiemann & Berenson, 1998).

Overall, this literature provides strong support for the hypothesis that psychosocial factors are related to one or more of the risk posing behaviors in human pregnancy both because of the consistency of findings and because of methodological strengths of studies including the range of populations studied. The study samples were representative of the general population, and ranged from middle-class, married, Anglo women to low socioeconomic class, single, African American women and teenagers. The majority of the research is prospective and studies assess both psychosocial factors and health behaviors at one or more times during pregnancy.

MODERATORS OF STRESS-BIRTH OUTCOME EFFECTS

Not only is stress ubiquitous in the course of living, but pregnancy entails a number of changes that women may find stressful, as described earlier. However, the fact that pregnant women on average do not experience high levels of emotional distress suggests that intervening factors moderate the influences of prenatal stress on women's emotional state. These factors may account for individual differences among pregnant women in levels of prenatal anxiety and depression. Coping, or the way that women manage problems during pregnancy, is one likely factor. Social support is another commonly studied resource that may facilitate successful adaptation. Existing research on coping and social support in pregnancy is described next. It must be noted, however, that research on coping in pregnancy is in its infancy, whereas there is a considerable body of work on social support in pregnancy.

COPING IN PREGNANCY

A large number of studies substantiate that people who cope successfully with stressful situations are least likely to experi-

ence negative mood; conversely, maladaptive coping exacerbates or increases negative mood. The predominant view of coping is that it includes anything people do to manage problems or emotional responses, whether or not successful (Carver & Scheier, 1994; Lazarus & Folkman, 1984; Pearlin & Schooler, 1978). Despite a voluminous literature on coping within other health contexts, studies of coping in pregnancy have been rare.

Although this research is limited, the findings provide a fairly clear picture of the impact of the three most commonly studied types of coping: avoidance, problem solving, and positive appraisal. *Avoidant coping*, which involves behavioral or cognitive disengagement from problems, is associated with greater emotional distress in pregnancy (Hansell, 1993; Martinez, 1989; Perez, 1982; Spirito et al., 1991; Yali, 1998; Yali & Lobel, 1999). This corroborates a large body of work demonstrating the deleterious emotional impact of avoidant coping in a variety of populations (e.g., Aldwin & Revenson, 1987; Fleishman & Fogel, 1994; Stanton & Snider, 1993). Avoidance may exacerbate emotional distress in pregnant women because ironically, people often become preoccupied with the thoughts that they attempt to suppress, and because the inhibition of thoughts, feelings, and behaviors can cause autonomic arousal (cf. Lobel, Yali, Zhu, & DeVincent, 1998). Also, the use of avoidant coping requires sustained effort to screen out stressor-relevant cues (cf. Lazarus & Folkman, 1984); this can be taxing and is likely to deplete pregnant women's already limited physical energy. Avoidant coping may have harmful nonemotional consequences as well. For example, women who use avoidant coping may neglect to get appropriate assistance or necessary medical attention.

A second type of coping, labeled *problem solving, active coping, or approach-oriented coping*, tends to be effective in nonpregnant populations (e.g., Aspinwall & Taylor, 1992; Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986), but the evidence in pregnancy is mixed (see Hansell, 1993; Martinez, 1989; Spirito et al., 1991; Yali, 1998; Yali & Lobel, 1999). One reason is that active ways of coping may lead to an increased focus on problems, some of which may not be remediable in pregnancy. For example, Yali and Lobel (1999) found that women at high medical risk who coped by preparing for the baby (e.g., acquiring furniture and supplies) were emotionally worse off than women who did not cope in this way. They reasoned that this type of coping focuses attention on the baby, which is distressing among women whose pregnancy may not result in a healthy child. Although problem-focused coping strategies such as preparation are associated with positive outcomes in some stressful situations (Compas, Malcarne, & Fondacaro, 1988; Holahan & Moos, 1990, 1991; Roth & Cohen, 1986), they may not be efficacious for people facing imminent or severe threats (cf. Bolger, 1990; Carver & Scheier, 1994). Thus, coping through preparation and other types of problem solving may be more adaptive for pregnant women at low medical risk. This possibility has yet to be tested empirically.

Positive appraisal is the only type of coping that has consistently been associated with lower distress in pregnant women (Barth & Schinke, 1983; Perez, 1982; Spirito et al.,

1991; Yali, 1998; Yali & Lobel, 1999). This way of coping involves viewing a stressful situation positively, emphasizing what can be gained or what benefits might accrue from it. Positive appraisal has been shown to be an adaptive form of coping in a variety of populations undergoing stressful events (Dunkel-Schetter, Folkman, & Lazarus, 1987).

Issues of measurement are important considerations in research on prenatal coping. Standard versions of coping instruments such as the Ways of Coping, or the COPE (Carver, Scheier, & Weintraub, 1989; Folkman & Lazarus, 1985), may not be appropriate for use in pregnant women because they do not capture the situationally specific ways in which women may manage the strains and challenges of being pregnant and they contain some items inappropriate in the context of pregnancy. To address this issue, Lobel and colleagues developed a pregnancy-specific coping instrument that has been used in two samples of pregnant women of different socioeconomic, racial, and other composition (Lobel et al., 1998; Yali, 1998; Yali & Lobel, 1999). The Prenatal Coping Inventory (PCI) includes items from standard coping measures and items that pregnant women endorsed during open-ended interviews and pilot testing. Similar factors were derived from factor analyses of the PCI in both samples. These include factors reflecting preparation for motherhood, avoidance, positive appraisal, and prayer. The first three correspond to categories of coping that have been identified in the few previous studies of pregnant women. Prayer, a type of coping not examined previously, was the most frequently reported type of coping used by women in both of these studies. Unexpectedly, use of prayer was associated with increased emotional distress. The authors suggested that the type of prayer practiced by study participants may have been a form of rumination, which typically produces unfavorable emotional consequences (Nolen-Hoeksema, 1991; Nolen-Hoeksema & Morrow, 1993; Park & Cohen, 1993). The high reliance on prayer in these two studies in conjunction with its adverse impact highlight the value of further research on this coping strategy among pregnant women.

Although it serves as a useful starting point, several important questions about the impact of coping and the psychological mechanisms involved have yet to be addressed. For example, are pregnant women who cope with stress adaptively at lower risk for adverse birth outcomes? Conversely, does maladaptive coping with stress in pregnancy increase risk? What leads women to select and exercise particular ways of coping? Researchers have begun to look at the latter question by examining the role of disposition, or individual traits, and the role of appraisal, or the way that pregnant women evaluate their situation. They find that women who are dispositionally optimistic and those who view their pregnancy as controllable select more efficacious ways of coping, and thereby experience lower emotional distress (Yali, 1998). However, virtually nothing is known about how other types of dispositional characteristics or appraisal influence coping in pregnancy. Knowledge about these factors may help clinicians identify women at emotional risk in pregnancy and give us useful information about the sorts of coping training that might be effective for particular groups of women.

SOCIAL SUPPORT AND RELATIONSHIPS IN PREGNANCY

The birth of an infant is a major life event and transition for parents, and usually influences many others close to the baby's mother. By virtue of the ties of kinship, the extended families of both parents are often intricately involved in the pregnancy and may be major sources of support for the pregnant woman. Close interpersonal relationships and the social support derived from them influence how individuals cope with stress. Thus, these are important topics in the study of pregnancy (Berthiaume, David, Saucier, & Borgeat, 1998; Dunkel-Schetter et al., 1996; Elbourne & Oakley, 1991; Nuckolls et al., 1972). This chapter focuses primarily on the supportive aspects of close relationships and does not address other relationship issues such as marital satisfaction, intimacy, and commitment (for a review see Berscheid & Reis, 1998).

Although the association between social support and health has been well-documented (Cohen & Syme, 1985; House, 1987; B. R. Sarason, I. G. Sarason, & Gurung, 1997), research on the role of specific relationships and the mechanisms that might account for their association with healthier pregnancies has been limited. This section has reviewed correlational pregnancy research on global support, on specific sources or providers of support, on various functions or types of support, and on negative aspects of social relationships. The chapter concludes with a review of research on supportive interventions and on mechanisms whereby support may influence outcomes.

The term *social support* has been principally defined as either *available* or *perceived support*, or alternatively as *received* or *enacted support*. These terms differentiate between support individuals believe to be available if they should need it and the amount of support that they actually receive or report to have received (Barrera, 1986; Dunkel-Schetter & Bennett, 1990; Gottlieb, 1985). Beyond the distinction between perceived and received support, social support has been further categorized in many different (although not mutually exclusive) ways. For example, support can be distinguished by *function* or *type* of support (emotional, informational, instrumental). Other distinctions such as *global versus specific* support (support for general stressors or specific stressors) have also been used. Finally, categories may be created by focusing on who is providing the support (or *source of support*; e.g., spouse, family, friends, doctors, and medical staff). These different categories can be fit into a hierarchy with the general approach (received or perceived) as the primary dimension. Within each, the dimension of source of support can be distinguished and finally different types or functions of support can be embedded within each source (Schwarzer, Dunkel-Schetter, & Kemeny, 1994). For example, emotional support received from baby's father, or perceived emotional support from baby's father can be studied, and either received or perceived support can be studied with reference to family or friends.

As documented by a number of reviews (cf., Dunkel-Schetter et al., 1996; R. P. Lederman, 1995; Paarlberg et al., 1995; Scholl, Hediger, & Belsky, 1994), social support and

close relationship processes play an important role in both the psychological well-being of pregnant women as well as in determining the course of labor and birth outcomes. A large number of correlational and experimental intervention studies have shown that, in general, social support is related to lower levels of stress, anxiety, and depression during pregnancy (Albrecht & Rankin, 1989; N. L. Collins et al., 1993; Clifford, Weaver, & Hays, 1989; Gurung, Dunkel-Schetter, Collins, & Hobel, 1998; MacDonald, Peacock, & Andersson, 1992; O'Hara, 1986; Thorpe, Dragonas, & Golding, 1992; Tilden, 1983; Zuckerman, Amaro, Bauchner, & Cabral, 1989). For example, Zuckerman et al. (1989) examined the effects of different types of support on depressive symptoms in a low income multiethnic sample and showed that total support was negatively related to reports of depressive symptoms. More recently, Berthiaume et al. (1998) interviewed 350 French Canadian women at the beginning of their second semester of pregnancy and found that satisfaction with social support was significantly related to lower levels of prepartum depression, as were employment and self-esteem.

In work on social support in pregnancy, several constructs have been conceptualized and measured and the best ways to combine these measures of social support have been investigated (e.g., N. L. Collins et al., 1993; Gurung et al., 1998). For example, Gurung et al. (1998) used structural equation modeling to compare competing models of support in pregnancy. Three main types of support (perceived, received, and network), two primary sources of support (friends/family and baby's father), and three major functions of support (tangible, informational, and advice) were measured. The best fitting model was one with two factors (one for each source of support), each with received and perceived support measures included and that collapsed across the type/function measures. The empirical validity of conceptualizing support primarily by source is also consistent with similar analyses of support measures and concepts in other contexts (e.g., men with HIV, Schwarzer et al., 1994).

SPECIFIC SOURCES OR PROVIDERS OF SOCIAL SUPPORT IN PREGNANCY

Past pregnancy research has both focused on different sources of support (Gurung et al., 1998; Davis, Rhodes, & Hamilton-Leaks, 1997; Sagrestano, Feldman, Rini, Woo, & Dunkel-Schetter, in press), and examined the positive and negative implications of perceiving or receiving social support from specific relationships or sources (Cramer & McDonald, 1996; Zimmermann-Tansella, Bertagni, Siani, & Micciolo, 1994). The major comparison is between support transactions at the level of a dyad (e.g., support provided to the baby's mother from the baby's father), versus at the level of a network or group (e.g., support provided by friends and family). Yet a different set of studies has focused on the impact of support from professional sources (e.g., nurses and doctors; Blondel, 1998).

The baby's father has been a critical focus of attention, and his role as a major source of support has been reported in a number of different studies (Casper & Hogan, 1990; N. L. Collins et

al., 1993; Giblin, Poland, & Ager, 1990; Lantican & Corona, 1992; Zayas & Busch-Rossnagel, 1992). Social support from baby's father has been shown to significantly influence outcomes such as prenatal care utilization and emotional distress (e.g., Gurung et al., 1998; Hobfoll & Leiberman, 1987; Kalil et al., 1993; MacDonald et al., 1992; Norbeck & Anderson, 1989b; Norbeck, Lindsey, & Carrieri, 1981; Norbeck & Tilden, 1983; O'Hara, 1986; Tietjen & Bradley, 1985). For example, Sable, Stockbauer, Schramm, and Land (1990), in a sample of 1,464 women, showed that support from the baby's father was a stronger predictor of prenatal care than was support from others. Women who were at a greater risk for receiving inadequate prenatal care were African American, less educated, poor, had unwanted pregnancies, higher parity, and perhaps most importantly, were single (see also, Giblin et al., 1990).

Support from the baby's father has been found to be especially important among certain ethnic groups (e.g., Zambrana et al., 1997). For example, in a study of acculturation and psychosocial risk factors in pregnant Mexican American and Mexican immigrant women, Zambrana et al. (1997) found that support from the baby's father was associated with significantly less stress, less substance abuse, and more positive attitudes toward the pregnancy. These results further indicated that acculturation was a significant factor in relationship status, with Mexican-immigrant women being more likely to live with and be married to the baby's father than the more acculturated Mexican American women.

In contrast to the baby's father, support from the family does not seem to be as significant a predictor of pregnancy outcomes. Although the expected positive associations of family support with outcomes such as well-being and birth weight are seen, the relation with the initiation of health care, even among low income groups who might depend more on their families for material support, is not as uniform (Dunkel-Schetter et al., 1996; St. Clair, Smeriglio, Alexander, & Celantano, 1989; St. John & Winstin, 1989; Zambrana, Hernandez, Dunkel-Schetter, & Scrimshaw, 1991). However, this relation may vary depending on the age and ethnicity of the pregnant women. For example, Turner, Grindstaff, and Phillips (1990) found that family support is especially crucial for pregnant teenagers. Specifically, teenagers who reported higher levels of family support had babies with higher birth weights and experienced less postpartum depression. Similarly, Boyce, Schaefer, and Uitti (1985) showed that pregnant teenagers who perceived their family to be more helpful had fewer neonatal complications.

Studies of ethnic minority groups in the United States show that for some groups (e.g., African Americans, Latinas) the family is a critical source of support in pregnancy, particularly female relatives (Knouse, 1991; Zuniga, 1992). Mexican American families tend to live in close units with extensive bonds to other family units and the extended family serving as the primary source of support (Chilman, 1993; Keefe, Padilla, & Carlos, 1979). Similarly, the family is the most important source of support to African Americans (Cauce, Felner, & Primavera, 1982; Miller, 1992). In one of the most cited studies of ethnic differences in support, Norbeck and Anderson (1989b) measured life stress, social support, anxiety state, and

substance use at mid- and late pregnancy in Hispanic, European American, and African American low income women. They found that none of the social support measures were significant predictors of gestational age, birth weight, or gestation and labor complications when the sample was analyzed as a whole. However, for African Americans, lack of social support from the woman's partner or mother was a significant predictor of gestational complications and of the likelihood of prolonged labor and cesarean section complications. For Whites, social support was significantly related to length of labor and to drug use, although high levels of social support were associated with longer labor. Similarly, White women with high stress and high support from relatives also had more delivery complications. None of the support measures were statistically significant predictors of complications or birth outcomes for the Hispanics.

In a direct test of ethnic differences in social support, Sagrestano et al. (in press) analyzed data from two multiethnic prospective studies of 246 and 504 African American, Latina, and non-Hispanic White pregnant women, and found strong ethnic differences in support from family and friends. Multivariate analyses of ethnic differences controlling for sociodemographic variables showed that African American women reported receiving the most support from family followed by Latinas and White women. However, White women reported more family members in their social networks than did Latinas. Furthermore, Latinas reported higher quality interactions with family.

How do the effects of support from different sources compare? In a recent study designed to answer this question, Gurung et al. (1998) compared the support received from the baby's father with that received from her friends and family in an ethnically diverse sample of 480 women (African American, Latin American, and non-Hispanic White). Various types of support measures were assessed at multiple time points before the birth, together with standard measures of depression and anxiety. Different sources of support were associated with different outcomes. Specifically, social support from the baby's father predicted significantly less anxiety but not significant differences in depressed mood. Support from the mother's friends and family were significant predictors of maternal depressed mood, but did not predict anxiety (cf. Kalil et al., 1993). Social support from the baby's father predicted maternal changes in anxiety independent of sociodemographic variables such as age, ethnicity, and SES and individual difference measures such as mastery and coping. This difference in support effects by source is consistent with the theory and some results in the social support literature indicating that support is most effective when there is a match between the type of support a person needs and the type provided (e.g., Cutrona, 1990) for support to be effective. Others discuss the existence of an optimal support provider for different specific needs (Cantor, 1979; Litwak, 1985).

Taken together, these results present a compelling set of findings for pregnancy researchers and health psychologists, suggesting that different sources of support cannot be thought of as interchangeable. Support from the baby's father has been shown to be significantly related to less stress, anxiety and de-

pression, better utilization of prenatal care, and better birth outcomes even when other sources of support are available. Focusing on support from specific sources (e.g., partners and spouses) has greatly advanced the understanding of stress and coping with chronic and terminal illnesses like cancer and AIDS (e.g., Hays, Turner, & Coates, 1992; Helgeson & Cohen, 1996). Similarly, the documented positive impact of support from the baby's father on pregnancy outcomes opens up new avenues of research in which the father may be more central. Furthermore, studies with greater emphasis on close relationship processes and those that include both the pregnant mother and the baby's father in their designs, currently an uncommon procedure in prenatal research, will undoubtedly prove to be highly effective in advancing prediction of psychological, labor, and birth outcomes in pregnancy. In summary, whereas support from the baby's father seems generally effective, support from friends and family is only effective for certain samples, such as teenagers and certain ethnic groups (including African American and Latinas).

FUNCTIONS OR TYPES OF SOCIAL SUPPORT IN PREGNANCY

Three functional aspects of social support have been most commonly studied and primarily as received support: instrumental (tangible or material) support, informational (or advice) support, and emotional support. Some studies on pregnancy included analyses of several functions of support. For example, Norbeck and Tilden (1983) compared the different functions of support in a group of low risk pregnant women and found moderating effects of instrumental support and indirect effects of emotional and informational support on pregnancy outcomes. Low support was detrimental, although the effects varied as a function of stress level. Women who reported high stress during pregnancy and low levels of instrumental support experienced more infant and gestation complications (e.g., premature labor and poor infant status), whereas women who reported low tangible support in the context of low stress during pregnancy reported more labor and delivery problems (e.g., prolonged labor and cesarean delivery).

N. L. Collins et al. (1993) measured four types of social support (material aid, assistance with tasks, advice and information, and the amount of listening) and computed partial correlations between the four types and four outcomes (birth weight, abnormal labor, postpartum depression, and a 5-minute Apgar) controlling for many factors. Results indicated that a relation between greater support and higher Apgar scores was due to receipt of prenatal task and informational support rather than emotional support. Furthermore, the association of social support with labor progress was primarily a function of task and material support. Finally, although an overall index of the four types of support did not relate to depression, women who received more material support tended to be less depressed after childbirth.

In general, evidence suggests that different types of support are likely to be beneficial in pregnancy, although it is important to factor in the context and stressfulness of the

situations in which it is offered (Dunkel-Schetter, Blasband, Feinstein, & Herbert, 1992).

NEGATIVE ASPECTS OF CLOSE RELATIONSHIPS IN PREGNANCY

A discussion of the association between close relationships and psychological well-being and health outcomes during pregnancy cannot be complete without a consideration of the negative aspects of relationships. Whereas a majority of past research has emphasized the health promoting effects of social support, there has been rising concern that the absence of negative social interactions may be even more important for mental health (Cutrona, 1996; Schuster, Kessler, & Aseltine, 1990). *Emerging findings from research in the area of marital conflict and close relationships suggests that support from romantic partners and families can have negative as well as positive consequences* (Pasch & Bradbury, 1998; Ramsey, Abell, & Baker, 1986; Rook, 1992). Cramer and McDonald (1996) interviewed 42 young low income mothers and found that although family assistance helps many teenagers who have to cope with the challenges of poverty and childrearing, such support was perceived to entail conflict, stress, frustration, and disappointment due to interpersonal tensions, conflicting interests, or relatives with limited ability to provide support. They also found a consistent discrepancy between the young mother's high expectations and her support network's lower performance. Rhodes and Woods (1995) found similar results in a study of 157 pregnant minority teenagers whose network members were the sources of interpersonal problems (including criticism, intrusiveness, conflict, and disappointment) and support. These studies illustrate the frequently noted dual nature of supportive relationships, that is, their capacity to be beneficial and harmful.

Evidence of the darker side of close personal relationships also comes from newer literature on violence during pregnancy (Ballard et al., 1998; McFarlane, Parker, & Soeken, 1996a). Although no pregnancy outcome was consistently found to be associated with violence during pregnancy in a review by Petersen, Gazmararian, Spitz, and Rowley (1997), one study (McFarlane, Parker, & Soeken, 1996b) found that abuse during pregnancy was a significant risk for low birth weight as well as maternal low weight gain, infections, anemia, smoking, and use of alcohol and drugs (see also Parker, McFarlane, & Soeken, 1994). Of greater importance is the fact that abuse and violence during pregnancy appear to be quite common. A review by Gazmararian et al. (1996) indicates that the prevalence of violence during pregnancy ranges from 9% to 20%. Similarly, McFarlane, Parker, and Soeken (1996b) found that the prevalence of physical or sexual abuse during pregnancy was high (16%). Estimates of violence in women in general are generally somewhat lower than these rates. In fact, family violence may be a more common problem for pregnant women than some conditions for which they are routinely screened and evaluated. One correlate of violence in pregnancy seems to be an unwanted pregnancy. Gazmararian et al. (1995) showed that women of all socioeconomic groups with unwanted pregnancies had 4.1 times the

odds of experiencing physical violence compared to women with pregnancies that were wanted. In studying close relationships in pregnancy, and the potentially beneficial social support they can provide, pregnancy researchers must consider the negative sides of these relations as well.

SUPPORT INTERVENTIONS IN PREGNANCY AND OUTCOMES

In contrast to the correlational work on close relationships in pregnancy, the majority of studies assessing the influence of professional support are experimental, with interventions utilizing either nurses, social workers, midwives, or other trained medical practitioners. Three extensive reviews of the intervention literature (Blondel, 1998; Elbourne & Oakley, 1991; Elbourne, Oakley & Chalmers, 1989) agree that there was a trend toward better birth outcomes (e.g., lower preterm delivery), more positive affect, higher satisfaction with antenatal care, better communication with medical staff, and fewer gestation and labor complications in the intervention groups, although in general the reviews note considerable methodological problems in the literature despite many promising findings.

More recent studies are among the most rigorous and these are therefore mentioned briefly despite some remaining concerns with methodological issues. Studies assessing social support interventions have documented improvements in birth weight (e.g., Heins, Nance, McCarthy, & Eford, 1990; Oakley, Rajan, & Grant, 1990; Olds, Henderson, Tatelbaum, & Chamberlin, 1986), prenatal mortality (e.g., Sokol, Woolf, Rosen, & Weingarden, 1980) utilization of labor and delivery interventions (Oakley et al., 1990), and infant health (e.g., Olds et al., 1998). Norbeck, DeJoseph, and R. T. Smith (1996) used focus groups to develop culturally relevant standardized face-to-face interventions that provided the support usually provided by the participants' mother or male partners. One hundred and fourteen at-risk African American women were randomly assigned to the control group or the support group. The rate of low birth weight (LBW) was 9.1% in the social support intervention group compared to 22.4% in the control group. Similarly, Rogers, Peoples-Sheps, and Suchindran (1996) evaluated the impact of an intervention using paraprofessionals to provide social support to pregnant teenagers through home visits. The support focused on helping the teenagers better use the resources provided by network members, and also consisted of advice and the provision of emotional support. The intervention group consisted of 1,901 primiparous teenagers in intervention counties who were compared to 4,613 teenagers from counties in which the program was not offered. Results indicated that the intervention teenagers initiated prenatal care earlier and were less likely to have a preterm birth. Olds et al. (1998), conducted two randomized trials of prenatal and infancy home visitation using registered nurses and involving four prenatal visits. In contrast to women in a control group, nurse-visited women showed improved maternal caregiving and better health care behaviors. Furthermore, among women who smoked, those who were nurse-visited had 75% fewer preterm deliveries.

Interventions have also been shown to have some long-term effects. In one study, Oakley, Hickey, Rajan, and Rigby (1996) compared the health of 255 women who were offered a social support intervention provided by midwives during pregnancy with 254 controls who received normal care only. The participants were followed up at 6 weeks, 1 year, and 7 years. At the 7-year follow-up, factors such as child and mother health, child development, and health and welfare service use were assessed. Results showed that mothers and infants in the intervention group had significantly better physical and psychological health than those in the control groups 7 years after the intervention. The development of better social support interventions in pregnancy and methodologically rigorous evaluations of them is critical.

PATHWAYS BETWEEN PRENATAL SUPPORT AND BIRTH OUTCOMES

The general finding that social support and personal relationships have beneficial effects on the psychological well-being of the pregnant mother and on labor, delivery, and birth outcomes still leaves unanswered the question of the pathways or mechanisms of the social support effect. The two main models of support-outcome relations have been the *direct effects* model and the *stress buffering* model. If support truly was a moderator of stress effects on outcomes of pregnancy, then there should be evidence for the stress buffering model. However, most of the correlational studies provide fairly consistent evidence that prenatal social support has main effects on birth weight (Hoffman & Hatch, 1996; Molfese, Bricker, Manion, & Yapple, 1987; Norbeck & Tilden, 1983; Reeb, Graham, Zyzanski, & Kitson, 1987; Zacariah, 1996). For example, Turner et al. (1990) measured perceived social support from family, friends, and romantic partner in a study of 243 pregnant teenagers and found that family support had a significant direct effect on birth weight adjusted for length of gestation.

This support for main effects notwithstanding, theories have tended to emphasize the buffering model in which social support is protective primarily or solely for those in stressful circumstances (Norbeck & Anderson, 1989b; Norbeck & Tilden, 1983; Nuckolls et al., 1972). Nuckolls et al. (1972), for example, showed that life stress and social support interacted such that among high stress women, high social support was associated with fewer complications but there was no effect of social support in low stress women. The stress buffering process conceivably operates either during the appraisal process to reduce stress appraisals or, for events appraised as highly stressful, at the time of coping.

The absence of much comparison of the two models in prenatal social support research (i.e., main effect and buffering or interactions with stress) is due to two trends in this literature. First, comparisons of effects is hampered by the fact that studies testing for main effects of social support do not usually measure stress and test for buffering. Second, different conceptualizations of support make comparisons of findings across studies difficult. Although no clear patterns can be seen in the pregnancy literature, the social support literature on other health populations suggests that network measures

of support tend to have direct effects whereas measures of emotional support tend to have buffering effects (Pierce, I. G. Sarason, & B. R. Sarason, 1996). This may be worth following up in pregnancy research.

In terms of mediators, there are many ways in which social support could promote positive pregnancy outcomes other than by buffering stress, including promoting adaptive health behaviors. To date, a few pregnancy studies have explored the relation between social support and health behaviors such as drinking, smoking, and substance use (Aaronson, 1989; Albrecht & Rankin, 1989; Ramsey, Abell, & Baker, 1986). For example, Giblin et al. (1990) in a sample of African American pregnant women and MacDonald et al. (1992) in a sample of British pregnant women, both found that social support reduced the incidence of maladaptive health behaviors such as smoking and alcohol consumption. Given the links between these maladaptive health behaviors and negative pregnancy outcomes (Archie, 1992), health behaviors appear to be important mediators of the effects of social support in pregnancy on outcomes.

The fact remains that social support in general benefits some people, in some situations, and under some conditions (Coyne & D. A. Smith, 1991; Dakof & Taylor, 1990; Sandler & Lakey, 1982), and the key for health psychologists is to identify which people do best under what conditions. The research on the effects of a companion during labor provide a good example of this issue. The presence of a supportive woman, or *doula*, during childbirth has been associated with significantly shorter labor and fewer complications during delivery (Kennel et al., 1991; Sosa et al., 1980). However, studies investigating the effects of the presence of the baby's father during delivery have been ambiguous (e.g., Henneborn & Cogan, 1975). Studies designed to pinpoint moderators of the effects of support in labor have revealed that the personality of the women in labor plays a major part in their distress during labor and delivery; the presence of the baby's father benefited only those women high in anxiety and who were more dependent (Keinan, Ezer, & Feigin, 1992; Keinan & Hobfoll, 1989). The inclusion of measures of constructs such as this can help to formulate new directions in pregnancy research.

CONCLUSIONS

The scope of this chapter is quite broad, but a unifying focus is the role of stress as an independent risk factor for adverse outcomes of pregnancy. In order to scientifically study this issue properly, there needs to be an appreciation of the multiple levels of analysis involved as both antecedents and consequences of stress, and also an understanding of the outcomes of interest and their etiology. Having covered these issues, albeit briefly, research on the pattern of emotions in pregnancy was reviewed. Such research is of descriptive use in and of itself, and it also sets the stage for considering the links between stress and birth outcomes, particularly because the predictive components of stress appear to be emotion-based. Research on stress and outcomes was reviewed. It was suggested that anxiety, and pregnancy anxiety, in particular may be the most risk-posing components of stress for preterm de-

livery. Mechanisms, both physiological and behavioral, were elaborated in light of current research findings. Two possible moderators of stress, coping behavior, and social support were covered in separate sections. Research on coping behavior in pregnancy is in its infancy, but promising new directions are emerging. Research on social support in pregnancy is much more developed, although support appears to operate more as a resource (with main effects on outcomes) than as a stress buffer (i.e., moderator). Understanding potential moderators is an important step in eventually intervening to improve maternal, fetal, and infant outcomes.

What are some promising directions for future research? Regarding stress as an independent risk factor for adverse outcomes of pregnancy (especially preterm delivery), the following directions merit attention: (a) What types of stress are most potent? A comparison of chronic and acute stressors is warranted and may be informed in part by emerging research on chronic stress and allostatic load (McEwen & Stellar, 1993) in which biopsychological mechanisms are proposed whereby chronic stress may lead to poor health outcomes. (b) To what extent is stress exposure, versus emotional responses to stress, responsible for risk in pregnancy? This is an open issue with important implications for understanding mechanisms. Some combination of the two may prove to be most detrimental. (c) When in pregnancy is stress most potent? The timing of stress in pregnancy is a key issue, and it is not yet known whether there are vulnerable periods for risk of preterm delivery or low birth weight, and it is not known whether a particular duration of exposure to stress is necessary for adverse effects (i.e., thresholds exist). If vulnerable periods or threshold levels of exposure exist, these might be different for various outcomes (e.g., preterm delivery, low birth weight). Understanding the precise timing of stress in predicting specific adverse effects is essential to planning any intervention efforts.

With respect to emotions in pregnancy, future research might focus on the following issues: the nature of the emotions studied; the confounding of emotion measures with somatic complaints common in pregnancy, and the distinction between mean levels of emotion and individual variation.

Few studies have distinguished traditional emotions from pregnancy-specific worries, concerns, or fears. Yet there is considerable theoretical and empirical value in measuring pregnancy-specific concerns (Elliott et al., 1983; Glazer, 1980; Levin, 1991; Rini et al., 1999; Roesch, Dunkel-Schetter, & Hobel, 1998; Wadhwa et al., 1993; Yali & Lobel, 1999). Women may experience a number of specific concerns about their pregnancies and babies, and these tend to change in content and strength across pregnancy. Better understanding of these contextually based emotions and their associations with traditional emotional states, such as anxiety, is an important issue for future research.

Regarding measures of emotion, many of the standard measures typically used contain somatic indicators of negative emotion, including fatigue, changes in appetite, decreased sexual interest, or sleep disturbance, which can produce inflated negative emotion scores because women usually experience these symptoms in the course of a normal pregnancy (cf.

Kaplan, 1986). Some researchers have resolved this problem by removing items with somatic content from measures such as the Beck Depression Inventory (e.g., Chapman, Hobfoll, & Ritter, 1997; O'Hara, Zekoski, Philipps, & Wright, 1990), but a number of studies examining prenatal mood have not used corrected measures. The validity of standard depression measures in pregnancy and postpartum is unknown and should be addressed in future research.

The distinction between mean differences in emotion and individual variation over time in pregnancy is one of the most important issues raised by this body of research. As Elliott et al.'s (1983) work demonstrates, a sample of women might not differ in emotion on average—either over time or relative to a comparison group—although individual members of the sample might experience substantial changes in their emotions over the course of pregnancy, or might experience levels of emotion that are different from the comparison group. For this reason, it is useful for researchers to provide more detailed information than the standard tests of between-group differences. Ipsative approaches have rarely been used and may be quite useful in targeting women at risk. More research designs with repeated assessment of emotions and stress in pregnancy are also needed.

Regarding social support, an important goal for further study is to develop a better understanding of when support is beneficial and when it is not, and to specify the conditions under which each holds true. One direction is to consider various sociocultural milieus in which women experience pregnancy. In studies of predominantly Hispanic and African American pregnant women, some important differences have been observed between groups in support, as well as attitudes and behaviors in pregnancy (Sagrestano et al., in press; Zambrana et al., 1997; Zambrana, Dunkel-Schetter, Collins, & Scrimshaw, 1999). Furthermore, there is a relative dearth of research concerning support processes in pregnancy in Asian families. Like Hispanics, Asian Americans (Chinese, Japanese, Indian, Korean among others) are also known for their collectivist values and strong family orientations (Gaines, 1997; Gurung & Mehta, 1998). For example, in Indian families it is not uncommon for the pregnant woman's mother-in-law, rather than her mother, to move into her son's home to help her daughter-in-law during gestation and to help take care of the baby after it is born. To what extent does this attenuate the stressfulness of pregnancy for Indian American women? Asians and Asian Americans of various origin raise new categories of empirical questions for further research. Moreover, the broader domain of sociocultural influences on stress processes in pregnancy is an exciting opportunity for interdisciplinary research.

Another issue in the support arena is the need to gain more than simply the pregnant woman's perspective on prenatal support conditions. By studying multiple perspectives, including that of the baby's father, researchers may gain a multifaceted and more accurate view of support relationships than by assessing the maternal perspective alone. This direction raises new questions: Do the pregnant woman and her partner agree about how much support he provides? What characteristics of fathers enable them to be better prenatal support providers? Do

individual differences such as the mother's level of mastery, or relationship characteristics such as marital satisfaction, influence how much support is given by the baby's father during pregnancy? These questions can be optimally answered by involving both parents in research designs.

There are two further research directions that should be mentioned. Interestingly, they concern the generation before, and the generation after the pregnant mothers that are being studied today. With reference to earlier generations, newer research on intergenerational risk factors has developed in conjunction with research on ethnicity and socioeconomic status in pregnancy. For example, a recent study by Coutinho, David, and J. W. Collins (1997) examined a transgenerational data set of Illinois vital records to test whether parental birth weight was related to infant birth weight among African Americans and Whites born between 1989 and 1991. The authors found that parental birth weights were important risk factors for low birth weight (LBW) in both ethnic groups. However, the effects were particularly dramatic in African Americans for whom the rate of LBW among those born to LBW mothers was 17.9% compared to 10.8% among African Americans born of non-LBW mothers (rates for Whites were 8.5 and 4.8, respectively). Similarly, a Dutch study by Lumey and Stein (1997) of women born between 1944 and 1946 during a Dutch famine found evidence of long-term biologic effects of maternal intrauterine undernutrition, extending even into the next generation (Lumey & Stein, 1997). Emanuel (1997) highlighted some of the research directions suggested by these remarkable findings. A similar set of results is emerging with respect to preterm delivery. Porter, Fraser, Hunter, Ward, and Varner (1997) found that risk of preterm birth was higher among mothers who were themselves born before 37 weeks gestation. With respect to the focus of this chapter, these intergenerational effects suggest that a number of socioeconomic, cultural, and psychosocial factors may have long-term influences on maternal health and on the health of subsequent generations. Health psychology has much to bring to an understanding of these provocative and important issues.

A second future direction concerns the offspring of the pregnant women studied today. Work suggests that prenatal experience may have important consequences for the length of gestation and the growth of the fetus. Little research, however, has extended the paradigm to look at the influence of prenatal factors on infant health and well-being during infancy, childhood, adolescence, or adulthood. Hypotheses can be derived from current research concerning the consequences of prenatal stress for health and well-being of the offspring across the life span (Wadhwa, 1998). An evolving view is that the blueprint for brain development is not contained in genetic makeup alone, but is the result of a dynamic process involving interactions between genes and environment. The prenatal environment is the earliest setting in which such interactions may occur. Researchers working with animal and human models of pregnancy are discovering in numerous ways that the influence of the prenatal environment on brain and nervous system development may have far-reaching consequences for the cognitive and emotional functioning of the offspring later in life.

These possibilities open up a new horizon for researchers interested in biopsychosocial models of pregnancy.

In conclusion, the study of stress in pregnancy and its many ramifications is a large research arena with numerous exciting frontiers. Biopsychosocial approaches to the study of pregnancy and birth are accepted across disciplines, and interdisciplinary research collaboration is essential. Health psychology is in a unique position to contribute to this endeavor in the next millennium.

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