Pregnancy smoking in context: The influence of multiple levels of stress

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Pregnancy smoking remains a major public health concern in the United States. Approximately 10.2% of women smoke during pregnancy, placing their offspring at increased risk for adverse perinatal and childhood outcomes. However, little is known about contextual influences on pregnancy smoking. This study examines the intimate social context, broader social context, and socioeconomic context as predictors of smoking in a sample of 113 pregnant women ($M_{age}=29.7$ years; 90.3% White, non-Hispanic). We developed latent variables at each contextual level comprising indicators of stress and resources measured during the first and second trimesters, to serve as predictors of both persistent pregnancy smoking and smoking intensity during the third trimester in a single comprehensive structural equation model. Results indicate that stressful socioeconomic context was positively associated with the probability of being a persistent pregnancy smoker (probit regression coefficient $=.70$, $p<.05$). Broader social context was the only significant predictor of smoking rate, with greater stress and fewer resources associated with a greater number of cigarettes smoked during the third trimester (standardized regression coefficient $=.81$, $p<.05$). Results suggest that pregnancy smoking is a complex phenomenon that may be influenced by psychosocial context at multiple levels. Elucidating mechanisms by which contextual influences affect pregnant women's smoking patterns may inform smoking cessation and reduction interventions with this population.

Introduction

Despite steadily declining rates during the past 15 years, smoking during pregnancy continues to be a public health concern. Although concern for the developing fetus, advice from medical care providers, and social pressure may prompt up to 45% of women to quit smoking upon learning they are pregnant (Ludman et al., 2000; Yu, Park, & Schwalberg, 2002), an estimated 10.2% of pregnant women in the United States smoke cigarettes throughout pregnancy (Martin et al., 2006). Further, public health pregnancy cessation interventions are consistently unsuccessful for a substantial proportion of women (Cnattingius, 2004; Fiore et al., 2000). The adverse perinatal outcomes including low birthweight, premature delivery, and infant mortality (Cnattingius, 2004; Horta, Victora, Menezes, Halpern, & Barros, 1997; Hoyert, Mathews, Menacker, Strobino, & Guyer, 2006) and long-term behavioral sequelae (Buka, Shenassa, & Niaura, 2003; Wakschlag, Leventhal, Pine, Pickett, & Carter, 2006) associated with pregnancy smoking are substantial. Intrauterine cigarette smoke exposure accounts for a substantial amount of attributable risk for these outcomes and may account for billions of dollars in medical expenditures, loss of life, and economic and social costs annually (Wakschlag, Leventhal, Cook, & Pickett, 2000). Thus more effective prevention efforts are needed for this subset of “hard-core” smokers (Cnattingius, 2004; Fiore et al., 2000). This requires characterization of differences between women who continue to smoke throughout their pregnancy.
(persistent pregnancy smokers) and women who either quit during pregnancy or do not smoke at all while pregnant. The focus of this paper is to test our hypothesis that stress and resources at multiple levels are major distinguishing factors between these groups, and influence not only whether a mother smokes during pregnancy, but also how heavily.

Stressful life circumstances and resources available to manage stress can be considered at many contextual levels. Most broadly, indicators of socioeconomic status such as income, poverty, education, and job classification can be considered as proxy variables for both life stresses associated with restricted opportunities related to low education, under-employment, and financial need, and as resources available to lessen the impact of other life stressors. Lower maternal socioeconomic status has been consistently linked with increased pregnancy smoking. United States birth certificate data show that among non-Hispanic, White women, 48% of pregnant women with 9–11 years of education smoke, compared with 22% of women with a high school education and 2% of women with a 4-year college degree (Mathews, 2001). Several studies have found increased rates of smoking during pregnancy among women with less than a high school education, compared with women with more education (Jesse, Graham, & Swanson, 2006; Pickett, Wakschlag, Rathouz, Leventhal, & Abrams, 2002; Song & Fish, 2006; Yu et al., 2002). A greater proportion of persistent pregnancy smokers report family income falling below the poverty line compared with nonsmokers (Yu et al., 2002), and women who persistently smoke during pregnancy report lower incomes than those who quit during pregnancy (Bailey, 2006). Although many studies focus on demographic differences between pregnancy smokers and nonsmokers, few include pregnancy quitters in the comparison group. The inclusion of this important group might be expected to lessen observed demographic differences.

Stress and resources can also be considered at the more immediate levels of intimate social context (i.e., quality of relationship with partner, including the presence of partner conflict and/or abuse, as well as closeness and support) and broader social context (i.e., stressful life events, support from family and friends, availability and use of community resources). Preliminary, descriptive analyses from this sample suggested that pregnancy smokers exhibited a higher prevalence of both interpersonal (i.e., antisocial behavior, poor marital adjustment, and aggressive, irritable relationships) and adaptive functioning (i.e., poor life education and occupational attainment, deviant behavior, and poor daily functioning) problems. Pregnancy quitters were not distinguishable from nonsmokers after controlling for demographic variables (Wakschlag et al., 2003). In a retrospective study of stress and smoking during pregnancy, Bullock and colleagues (Bullock, Mears, Woodcock, & Record, 2001) found that pregnant smokers report greater stress during pregnancy compared with nonsmokers and pregnancy quitters, especially in the areas of financial and family problems.

Stress also may influence ability to quit smoking during pregnancy. Ludman and colleagues (2000) found that women who quit smoking during early pregnancy reported less perceived stress than those women that continued to smoke. Differences in perceived stress were not observed between women who quit later in pregnancy (28 weeks) and those who did not. Pregnancy smokers also are more likely to have stressful intimate relationships, including partnerships characterized by domestic violence (Bullock et al., 2001) compared with pregnancy quitters and nonsmokers. Partner abuse also was associated with pregnancy smoking in a sample of Black and White Midwestern women (Jesse et al., 2006). Of note, the majority of these studies used a single scale to assess life stressfulness, typically assessments of global perceptions of stress or a checklist of stressful life events.

In addition to experiencing greater stress, pregnancy smokers may have fewer resources available to manage life stressors. For example, compared with nonsmokers, pregnant smokers reported receiving less support from others, including their partners (Bullock et al., 2001). Similarly, Song and Fish (2006) reported that women who smoked during pregnancy received less support from various intimate relationships and perceived their partner interactions as less positive and more negative compared with women who were not smoking during the third trimester.

Not all studies have shown significant relationships between stress and pregnancy smoking or social support and pregnancy smoking. Jesse and Reed (2004) found no relationship between satisfaction with social support or stress and smoking, after controlling for demographic variables. Relationships may have been obscured by limited variability in the smoking outcome (an ordinal smoking measure with four possible responses ranging from no smoking to smoking more than one pack per day). It is possible that stress and support are differentially related to smoking status (yes vs. no) and smoking intensity (amount smoked). One study reported a decreased prevalence of multiple stressful life events in pregnant smokers compared with pregnancy quitters and never-smokers (McCormick et al., 1990). This study was conducted among low-income women from Harlem, and it is unclear how the results might apply to the more general population of pregnant smokers, in which working class women of non-Hispanic, White ethnicity are the majority.
The existing literature linking stress, resources, and pregnancy smoking has several limitations. In particular, most of the studies assessed smoking at a single point during the pregnancy using self-report measures. Smoking is typically treated as a single dichotomous outcome. Nondisclosure of smoking or fluctuations in smoking during the course of the pregnancy may affect results. In addition, many of the studies relied on retrospective reports of smoking, stress, or both. This may introduce error due to recall bias, especially since pregnancy smoking may be characterized by repeated attempts to quit or cut down (Pickett, Rathouz, Kasza, Wakschlag, & Wright, 2005). Finally, many researchers have focused on distinguishing smokers and nonsmokers but have not examined psychosocial characteristics associated with smoking intensity. As many women attempt to reduce their smoking during pregnancy, identification of predictors of smoking intensity could guide smoking reduction intervention efforts.

The purpose of this study was to build on preliminary analyses suggesting important differences between pregnancy smokers and nonsmokers or quitters, to examine stress and resources at multiple contextual levels as predictors of both smoking status and intensity during pregnancy in a single comprehensive model. Repeated assessments of smoking behavior during the course of the pregnancy allowed the examination of longitudinal relationships between stress and resources and later smoking intensity. The predictors and outcomes were assessed in a comprehensive manner using multiple measures. Specific questions addressed by this study were as follows: (a) Can stress and resources available at the socioeconomic, broader social, and intimate contextual levels distinguish persistent pregnancy smokers from nonsmokers and pregnancy quitters? and (b) Are the three levels of stressful life context (measured during the first two trimesters) predictive of third trimester smoking intensity?

Method

Participants

This study used data from the Family Health and Development Project (Wakschlag et al., 2006; Wakschlag et al., 2003), a longitudinal study examining the effects of maternal smoking during pregnancy on infant behavioral vulnerability. All study procedures were approved by the university institutional review board and the review board of the affiliated hospital and clinics. Research staff screened for smoking approximately 1,200 healthy adult women during their first prenatal care appointment at several Midwestern family practice and obstetrics clinics, using a brief study screening questionnaire completed along with routine clinic paperwork. The screener was clearly identified as being part of a research study, and women could opt not to complete it at their discretion. Consistent with national rates of pregnancy smoking, approximately 9% of these women (n=111) were identified as smoking after knowledge of pregnancy. A total of 62 women who reported current smoking or quitting during pregnancy participated in the first assessment. Information provided on the screening questionnaire was used to recruit a comparison group of never and former smokers from these same prenatal clinics who were broadly group matched on ethnicity, education, and age (i.e., primarily White, non-Hispanic, non-college educated, non-teenage mothers). Nonparticipants were not significantly different from participants with regards to demographic characteristics, parity, marital status, or smoking intensity (all p values>.05). The analytic sample comprised 113 women who completed at least one assessment. Of these women, 96 had complete data from all three trimesters and 99 women had data from at least two trimesters.

Informed consent was obtained from all participants, and women were compensated US$25 for their participation at each assessment. Women were interviewed once during each trimester of their pregnancy and multiple times with their infants during the first 2 years of life (for details, see Wakschlag et al., 2006). The interviews were approximately 2 hours in length. Only pregnancy data were used in the present analyses. Psychosocial predictors used in these analyses were assessed during the first two trimesters, and smoking was assessed during all three trimesters.

Consistent with national patterns of pregnancy smoking (Mathews, 2001) the majority of the women were of non-Hispanic, White ethnicity, with a high school education or less, and low-to-moderate family income. Although not all the women were currently smoking, the majority had a history of regular smoking. Table 1 shows the demographic variables for the sample, and Table 2 shows the means and standard deviations for the predictor variables by pregnancy smoking status.

Measures

A multiple-method approach was used to measure pregnancy smoking and stressful life context. We were interested in two smoking outcomes: a dichotomous indicator of persistent smoking during pregnancy, and the intensity of smoking during the third trimester. To create our measures of context, we used multiple measures of stress and resources available to manage stress (e.g., social support and coping skills) to create latent variables at three levels of context: intimate,
broader social, and socioeconomic. All measures were coded so that higher scores indicated greater stress or fewer resources. All demographic and sample characteristic variables were assessed via self-report. Information on smoking history, nicotine dependence, and the presence of smokers in the household also was assessed via self-report.

Pregnancy smoking. Smoking during each trimester was assessed via detailed interviewing about the mother’s weekday and weekend smoking in each month of pregnancy and urinary cotinine level at each of the three visits. Maternal smoking was averaged across the trimester to yield a mean amount smoked based on self-report. Based on current guidelines for active smoking during pregnancy, a urinary cotinine level of 30 ng/ml was established as the cutpoint for maternal smoking. This cutoff is slightly lower than the 50 ng/ml typically used for nonpregnant populations (Benowitz et al., 2002) to account for the shorter half-life of nicotine metabolites during pregnancy. We combined the self-report and biological measures to derive a best-estimate indicator of persistent pregnancy smoking. Persistent pregnancy smoking was defined as self-report of daily smoking or urine cotinine level greater than 30 ng/ml in at least two trimesters. Because smoking during pregnancy can be highly variable (Pickett et al., 2005), it was felt that this definition characterized a group of women with relatively stable behavior that had the potential to result in negative consequences for the developing offspring.

For persistent pregnancy smokers, we also created a smoking intensity score based on the average number of cigarettes smoked per day during the third trimester. This allowed us to establish a longitudinal relationship between the stress measures collected during the first two trimesters and smoking intensity, measured during the third trimester. To account for nondisclosure and under-reporting, we used a recently developed deterministic modeling approach to calibrate the accuracy of maternal self-reports using urinary cotinine data (Dukic, Niessner, Benowitz, Hans, & Wakschlag, 2007). We asked women to report the number of cigarettes they smoked on the 3 days prior to the urine collection and then used a weighted value based on time of smoking to calculate the “net present value” of all cigarettes smoked during this time period. We then calculated an expected number of cigarettes smoked based on urinary cotinine values. The deviation between reported smoking and expected urinary cotinine values was used to classify women as over-reporters (self-report cotinine by 30%), accurate reporters (cotinine and self-report estimates within 30%), under-reporters (cotinine estimate by 30%–80%), or extreme under-reporters (nondisclosure by self-report or cotinine estimate by more than 80%). The average discrepancy of all women in the reporting class was then used to adjust maternal self-reports of smoking for the trimester. This approach limited the influence of individual variations in nicotine metabolism and timing of urination on adjusted smoking estimates (Dukic et al., 2007).

Measures of stressful context

Intimate social context. We were interested in assessing intimate relationship stress as measured via

<table>
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<tr>
<th>Table 1. Demographic characteristics of the sample.</th>
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<tbody>
<tr>
<td>Characteristic</td>
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<tr>
<td>----------------</td>
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<tr>
<td>Ethnicity, number of subjects (percent)</td>
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<tr>
<td>White, non-Hispanic</td>
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<tr>
<td>Hispanic</td>
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<tr>
<td>Multiple ethnicities or “other”</td>
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<tr>
<td>Mean age, years (SD)</td>
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<td>Education, number of subjects (percent)</td>
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<tr>
<td>High school</td>
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<td>High school or equivalency</td>
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<td>Household income, number of subjects (percent)</td>
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<td>US$0–$30,000</td>
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<tr>
<td>$30,000–$60,000</td>
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<tr>
<td>$60,000–$90,000</td>
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<tr>
<td>Relationship status, number of subjects (percent)</td>
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<tr>
<td>Married</td>
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<tr>
<td>Not married, cohabitating</td>
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<tr>
<td>Not in a partner relationship</td>
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<tr>
<td>First pregnancy, number of subjects (percent)</td>
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<tr>
<td>Smoked at least 100 cigarettes in lifetime, number of subjects (percent)</td>
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<tr>
<td>One or more smokers living in the household, number of subjects (percent)</td>
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<tr>
<td>Persistent pregnancy smokers</td>
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<tr>
<td>Nonsmokers/quitters</td>
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<tr>
<td>First cigarette within 30 min of waking (smokers only), number of subjects (percent)</td>
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harsh conflict, and level of support as measured via closeness and affection between the partners. Harsh conflict was assessed using the psychological aggression and physical assault subscales of the Conflict Tactic Scale (Straus, Hamby, Boney-McCoy, & Sugarman, 1996). Because self- and partner ratings of these two types of behaviors were highly correlated ($r=.72$ for physical assault and $r=.84$ for psychological aggression), we used the annual prevalence scoring system, which sums the number of acts displayed by either partner within the past year, without regard to frequency.

We also used the Dyadic Adjustment Scale (Spanier, 1976) to assess the quality of the partner relationship. This widely-used scale assesses dyadic satisfaction, dyadic consensus, dyadic cohesion, and affectional expression. The total Dyadic Adjustment $t$ score was used in the present analyses and was reverse coded, so that higher scores indicated poorer adjustment. The internal consistency of the measure was high in this sample (Cronbach’s alpha = .87). Because this was a pregnancy sample, only three women reported that they were not currently in a partnered relationship. These women were asked to fill out the intimate social context measures, thinking about their partner during the past year.

**Broader social context.** This latent construct was composed of three indicators assessing chronic stressors, social support, and community resources. We used the Difficult Life Circumstances Scale (Booth, Mitchell, Barnard, & Spieker, 1989) to assess the presence of chronic stressful life events such as debt, housing problems, medical illness, and child-related problems. Items assessing partner conflict, physical abuse, and emotional abuse were not included in the total score used in this study to avoid tapping into constructs assessed in the intimate social context latent variable. The Community Life Skills Scale (Booth et al., 1989) assessed maternal use of community resources in the domains of transportation, budgeting, support services, support-involvement, interests and hobbies, and regularity of routines using binary items. We reverse coded the total score for the scale so that greater scores indicated fewer resources. Maternal satisfaction with social support was assessed by summing the satisfaction items from the community, friends, and family subscales of the measure used by Crnic and colleagues (Crnic, Greenberg, Ragozin, Robinson, & Basham, 1983). The scale was reverse coded, so that higher scores indicated less social support. Internal consistency for the calculated summary score was adequate (Cronbach’s alpha = .69).

**Socioeconomic context.** Income and maternal education measured during the first trimester comprised the socioeconomic context latent variable. We assessed yearly household income using an eight-category ordinal scale ranging from $0$–$15,000 to $105,000+. We asked women to report the highest school grade they completed and asked clarifying questions regarding high school equivalency and college education. Both items were reverse coded, so that higher scores represented potentially greater stress and less socioeconomic resources.

**Data analyses**

Mplus version 3.0 was used for all analyses. This program allowed us to include related dichotomous and continuous outcomes in the same model and to use all available data. First, we tested the adequacy of the three-factor contextual model using confirmatory factor analysis with full information maximum likelihood estimation. Next, we used a two-step structural equation modeling approach that simultaneously assessed the influence of the stressful context measurement model on the binary outcome (persistent pregnancy smoking) with a probit regression, while also considering the continuous outcome (amount smoked during the third trimester). As recommended by Muthén and Muthén (2001) for models including at least one binary outcome, we used WLSMV estimation for the full model. This approach is based on a diagonal weight matrix for estimation (but with standard errors and mean- and variance-adjusted chi-square test statistics based on a full weight matrix) and produces probit coefficients.
for the binary outcome. These coefficients can be interpreted as the change in the cumulative normal probability distribution (or z score) associated with a one-unit increase in the predictor. This estimator allowed us to use cases with missing data on one or more of the model variables. Fit was assessed according to the guidelines of Yu (2002). In general, a non-significant chi-square, CFI ≥ .95, RMSEA ≤ .06, and WRMR ≤ .95 were considered to be indicative of good fit. CFI and RMSEA appear to be less sensitive to sample size than other fit indices (Fan, Thompson, & Wang, 1999), and WRMR is appropriate for models with binary outcomes (Muthén & Muthén, 2001).

Results

Pregnancy smoking

Our best estimate, combining self-report and cotinine data, indicates that 45% (n=45) of the women with smoking data available for at least two trimesters were persistent pregnancy smokers. Five of these women reported quitting during or immediately prior to pregnancy and the rest reported regular smoking during their first prenatal assessment. On average, these women reported smoking 9.4 (SD=6.8), 8.6 (SD=6.3), and 8.4 (SD=6.3) cigarettes/day for the first, second, and third trimesters, respectively. Means and standard deviations of the corrected estimates based on the deterministic modeling approach were 15.2 (9.5), 13.3 (8.1), and 12.8 (8.3) cigarettes/day, respectively. For third trimester corrected estimates, 34% of the smokers had an adjustment of two or less cigarettes, 29% had an adjustment of between two and six cigarettes, and 37% had an adjustment of six or more cigarettes.

Confirmatory factor analysis

We first tested the adequacy of the three-factor contextual model using confirmatory factor analysis with three indicators for intimate social context, three indicators for broader social context, and two indicators for socioeconomic context. Table 3 shows indicator variances and intercorrelations. The model was a good fit for the data, \( \chi^2(17) = 16.45, p = .49; \) CFI=1.00; RMSEA=.00, and no modifications were made. The factor loadings were statistically significant for all indicators. Latent variables were allowed to freely correlate with intercorrelations ranging from .40 to .58 (all p values <.05).

Smoking outcomes

To examine the relationship between levels of context and pregnancy smoking, we tested a model that simultaneously regressed persistent pregnancy smoking and third trimester smoking intensity on the three-factor contextual model. Women who were not classified as persistent pregnancy smokers had missing data on the smoking intensity variable. The two-part outcome model allowed us to examine two linked variables: “Is a woman a persistent pregnancy smoker?” and “If so, how much did she smoke in the third trimester?” As in the confirmatory factor analysis model, the three latent factors were allowed to freely correlate, as were the two smoking outcomes. The model was a good fit for the data, \( \chi^2(15) = 19.14, p = .21; \) CFI=.94; RMSEA=.05; WRMR=.462, and no modifications were made. The final model, shown in Figure 1, explained substantial variance in amount smoked during the third trimester (62%). We also ran the final model replacing the smoking estimate with third trimester self-reported smoking intensity as the outcome. Results were similar to the reported estimates.

Strikingly, different levels of stressful life context predicted the two smoking outcomes. Socioeconomic stress was the only statistically significant predictor of persistent pregnancy smoking in the comprehensive model. That is, as stress associated with low levels of education and income increased, the probability of being a pregnancy smoker increased (probit regression coefficient=.70, p<.05). Figure 2 contains a plot of predicted probabilities by values of the standardized latent socioeconomic variable. In contrast, neither intimate (probit regression coefficient=-.24, p>.05) nor broader (probit regression coefficient=.18, p>.05) social stress were significant predictors of smoking status. An estimate of the odds ratio can be obtained by multiplying the probit coefficient by 1.8 to obtain an estimated logit and then exponentiating (Long, 1997). For every one standard deviation increase in stressful socioeconomic context, women were 3.5 times more likely to be a pregnancy smoker. Odds ratios for intimate and broader social context were 0.7 and 1.4, respectively.

For those women who smoked during pregnancy, broader social context was the only significant contextual predictor of smoking intensity during the third trimester. That is, a broader social context that includes less community and support resources and more stressful life events was associated with increased intensity of smoking (standardized regression coefficient=.81, p<.05). Neither intimate nor socioeconomic context were significant predictors of smoking intensity, controlling for the other levels of context.

Discussion

Results suggest that pregnancy smoking is a complex phenomenon that may be influenced by psychosocial
context at several levels. As suggested by the observed differences in pregnancy smoking prevalence across social classes, socioeconomic context (as defined by maternal education and household income) was the only significant contextual predictor of whether a woman persistently smokes during pregnancy. Among pregnancy smokers, broader social context, including measures of stressful life events, social support, and utilization of community resources, predicted how many cigarettes were smoked per day during the third trimester. Intimate social context was not a significant predictor of either smoking outcome in the comprehensive model.

Our conceptualization of socioeconomic status as one level in a multilevel model of stress may help explain why sociodemographic characteristics distinguished pregnancy smokers from pregnancy quitters and nonsmokers, even when approximately 70% of the sample had a smoking history. Interestingly, even though socioeconomic differences were limited by sociodemographic matching at recruitment, relatively small differences (e.g., approximately 1 additional year of education and $15,000 annual income) continued to distinguish smokers from quitters and nonsmokers. This finding suggests that even relatively small increases in available resources may be important. Income and education can be thought of as proxies for sources of stress (e.g., financial worries, under-employment) and resources available to help manage stress. In addition, social norms regarding the acceptability of smoking during pregnancy may vary within socioeconomic strata.

Table 3. Variable intercorrelations and variances.

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<tr>
<th></th>
<th>CLS</th>
<th>DLC</th>
<th>Support</th>
<th>CTS Psych</th>
<th>CTS Phys</th>
<th>DAS</th>
<th>Edu</th>
<th>Income</th>
<th>Smoking (yes/no)</th>
<th>Smoking intensity</th>
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<tr>
<td>CTS-Psych</td>
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<td>.21</td>
<td>4.19</td>
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<tr>
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<td>.28</td>
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<tr>
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<td>.32</td>
<td>.33</td>
<td>.87</td>
<td>.38</td>
<td>.69.57</td>
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Note. CLS=Community Life Skills scale. DLC=Difficult Life Circumstances Scale. Support=maternal perceived social support. CTS-Psych=Conflict Tactics Scale–Psychological Aggression subscale. CTS-Phys=Conflict Tactics Scale–Physical Assault subscale. DAS=Dyadic Adjustment Scale. Edu=education in years. Variable intercorrelations with variances on the diagonal. The proportion of participants designated as persistent pregnancy smokers is listed on the diagonal for the dichotomous smoking variable.

Figure 1. CLS=Community Life Skills Scale. CTS-Psych=Conflict Tactics Scale–Psychological. CTS-Phys=Conflict Tactics Scale–Physical. DAS=Dyadic Adjustment Scale. DLC=Difficult Life Circumstances Scale. Probit regression coefficients are shown for the paths to persistent pregnancy smoking. Standardized parameter estimates are shown for all remaining paths. Latent variables were allowed to freely correlate with intercorrelations ranging from .42 to .62 (all p values <.05). *p<.05.

Figure 2. Predicted probabilities of being a persistent pregnancy smoker by stressful socioeconomic context. Socioeconomic context is shown as standardized units with a mean of .02 and a standard deviation equal to .79. Intimate and broader social context latent predictors were held constant at their mean values.
and have a strong controlling influence on this behavior during pregnancy. Cultural beliefs about the benefits of smoking during pregnancy (e.g., smaller babies) may vary greatly by social class. The importance of social context in understanding this health-compromising behavior was demonstrated by Pickett and colleagues (2002), who found in a study of 878 pregnant women that pregnancy smoking was significantly associated with living in a predominately working class neighborhood, even after controlling for the woman's own socioeconomic characteristics.

The finding that increased stressful life events and fewer resources available to manage stressors are associated with greater smoking intensity is consistent with previous research linking stress and smoking in pregnant women. Although for many women pregnancy is a time of happy anticipation, it can also be a time of increased stress associated with a major life transition. Among the many concerns that pregnant women may face are anxiety about physical well-being, emotional concerns relating to motherhood or the future, and financial worries. Increased stress during pregnancy could interfere with a pregnant woman's attempts to quit or reduce smoking. It is possible that the relationship between stress and smoking may be bidirectional (i.e., stress may lead to increased smoking, and pregnant women may feel stressed because they are smoking). The longitudinal analysis of stress and smoking in the present study provides support for the first pathway, but increased stress associated with the discrepancy between actual and desired behavior may result in a feedback loop, further reinforcing smoking behaviors during pregnancy.

Intimate social context was not related to either persistent pregnancy smoking or third trimester smoking intensity. The inclusion of pregnancy quitters in the nonsmoking group might have diluted differences between never-smokers and smokers, which has been observed in other studies (Bullock et al., 2001; Song & Fish, 2006). In addition, the present study did not measure smoking-specific support, so we do not know what type of messages women were getting about smoking from their partners and family members. The vast majority of persistent pregnancy smokers in this study lived in a household with at least one other smoker. Future studies are needed to understand the influence of this contextual variable and how it may interact with stressful life context to influence pregnancy smoking. Research suggests that partner smoking status may influence the provision of smoking cessation support and the perceived helpfulness of this support (Pollack, Baucom, Peterson, Stanton, & McBride, 2006).

These results may have important implications for smoking cessation and reduction efforts targeted at pregnant women. In this sample of predominately non-Hispanic, White women, the majority of whom had a smoking history, pregnant mothers with lower incomes and less education were more likely to smoke throughout their pregnancy. This finding suggests that cessation efforts should continue to be targeted toward these high-risk women. Although harm reduction is controversial with this population of hard-core smokers, some studies have shown dose-response relationships between nicotine levels and adverse perinatal outcomes (Horta et al., 1997). Thus, reductions in cigarette use could be beneficial to the offspring of pregnant smokers (Li, Windsor, Perkins, Goldenberg, & Lowe, 1993). The results from the present study suggest that interventions that decrease perceptions of life stressfulness and increase coping efficacy may be useful in helping women reduce their smoking. Interventions such as cognitive-behavioral stress management, coping skills training, and social support utilization may help women reduce their risk of adverse perinatal outcomes if they are unable to quit smoking entirely.

Strengths of this study include the intensive measurement of both smoking and stressful life context prospectively. Smoking was measured throughout pregnancy using both self-report and biological methods. Stress and resources were measured using multiple, well validated measures. The use of sophisticated data analytic techniques allowed us to utilize all available data and to model both smoking outcomes simultaneously, resulting in increased efficiency.

The primary limitation of this study is the relatively small sample size. Future studies are needed to confirm the observed relationships. In addition, we combined nonsmokers and pregnancy quitters to obtain an adequate sample size for statistical testing. Studies examining nonsmokers, pregnancy quitters, and persistent pregnancy smokers separately would better allow us to understand how social and behavioral characteristics are distributed across groups. Our previous preliminary work suggests that pregnancy quitters may be more similar to nonsmokers than to persistent smokers on key sociodemographic and psychosocial variables (Wakschlag et al., 2003). Our sample was recruited at prenatal care clinics and may not have been representative of the larger population of pregnant smokers because of the commitment required of participants (completion of multiple intensive assessments during a 3-year period). The small numbers of Black and Hispanic women in this study did not allow us to examine the possible moderating effect of ethnicity. In addition, due to sample size limitations we could not examine possible interactions between intimate social context and variables such as partner smoking.
Results suggest that it is important to examine sources of stress and available resources at several contextual levels when investigating smoking behavior during pregnancy. Increased educational and financial resources are negatively associated with the probability of being a persistent pregnancy smoker. Among pregnancy smokers, increased stressful life events and decreased support and coping resources are positively associated with amount smoked the third trimester. Further research is needed to confirm these relationships in other populations and to further elucidate the complex context of pregnancy smoking.

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