Journal of Psychosomatic Research 75 (2013) 299–304

Contents lists available at ScienceDirect

Journal of Psychosomatic Research

Predicting birth outcomes: Together, mother and health care provider know best

Dolores Cannella, Melissa Auerbach, Marci Lobel *

Department of Psychology, Stony Brook University, United States

ARTICLE INFO

Article history:
Received 27 February 2013
Received in revised form 16 July 2013
Accepted 4 August 2013

Keywords:
Birth outcomes
Birth weight
Obstetric risk
Perceived risk
Pregnancy
Prenatal stress

ABSTRACT

Objective: To examine contributors to perceived risk in pregnancy and its utility in predicting lower birth weight and earlier delivery in conjunction with health care providers' assessment of obstetric risk.
Methods: 165 pregnant women at high ($n = 34$) or low ($n = 131$) obstetric risk completed assessments of perceived risk, stress, optimism, and health behaviors using well-validated instruments and measures designed for this study. Medical charts were abstracted for gestational age at delivery and birth weight.
Results: 40% of the sample perceived their risk status differently than their health care provider. Stress, poor reproductive history, provider assigned risk, and unhealthful behaviors were significant, independent predictors of perceived risk ($R^2 = .37$). The greatest difference in birth weight ($p = .003$) and gestational age ($p = .05$) was between women considered at low risk by both self and provider and women considered at high risk by both. Perceived risk improved prediction of adverse birth outcomes, especially lower birth weight, in women considered by providers to be at low risk.
Conclusion: Women's perceptions of risk are an important contributor to prediction of birth outcomes, but the combination of information from both a woman and her health care provider is superior. Incorporating women's perceptions into obstetric risk determination may help to reduce the number of women identified as high risk who subsequently have a normal birth outcome (false positives), and more importantly, the number of women considered to be at low risk who ultimately experience an adverse outcome (false negatives).

Introduction

Despite advances over the past several decades that have substantially improved birth outcomes, the United States still has alarmingly high rates of preterm delivery and low birth weight [1] even when compared to other industrialized nations [2]. Identification of pregnancies at greater than average risk for such outcomes can enable careful monitoring and appropriate interventions where possible [3–6]. Risk measures that take into account factors such as chronic medical conditions, prior obstetrical problems, or current complications have been developed to determine obstetric risk [7–10]. Often, however, obstetric risk is not directly assessed using such measures. Instead, particular groups of women, such as those with diabetes, hypertension, or pre-term labor [11,12], are typically considered at high risk in clinical practice. Studies of high risk pregnancy often identify high risk participants simply as women "receiving high risk care" (e.g., [13,14]) or those who develop medical conditions during pregnancy (e.g., [15,16]). Because there are not agreed upon guidelines for identifying risk nor a uniformly accepted definition of high risk [6,17], estimates of the prevalence of high risk pregnancies in the U.S. vary widely, ranging from 6 to 8% [18] to 20% of all pregnancies [19].

Furthermore, existing measures of risk have been generally unreliable in predicting birth outcomes [4,6,16,20–22], with many false positives (women identified as high risk who subsequently have a normal pregnancy and birth outcome) and more problematically, many false negatives (women considered to be at low risk who develop serious complications or experience adverse outcomes). As Jordan and Murphy [6] note, misidentifying women's risk can result in faulty decisions about the medical management of their pregnancy.

Often, the determination of whether a woman is at high risk is based on the clinical judgment of the health care provider [23,24]. Clinical judgments may be faulty for a variety of reasons including the provider's limited access to relevant or accurate information and the impact of perceptual biases. Garb's work [25] calls attention to the influence of patient variables including race, gender, age, and socioeconomic status on the use of diagnostic criteria. For example, because people of lower socioeconomic status tend to be at higher risk than other groups, clinicians are more likely to identify any person of lower socioeconomic status as high risk, despite their actual status [25]. Another increasingly important influence on clinician determinations of obstetric risk is concern about malpractice litigation [6]. To reduce the likelihood of litigation, physicians commonly practice "defensive medicine," conducting frequent monitoring and technologically-aided surveillance of patient conditions. This may result in a greater number of pregnant women being labeled high risk. Legal issues are of particular concern in obstetrics because the number of malpractice lawsuits against obstetricians is substantially higher than for other physicians and the high cost of

* Corresponding author at: Department of Psychology, Stony Brook University, Stony Brook, NY 11794-2500, United States. Tel.: +1 631 632 7651; fax: +1 631 632 7876.
E-mail address: marci.lobel@stonybrook.edu (M. Lobel).

0022-3999/$ – see front matter
http://dx.doi.org/10.1016/j.jpsychores.2013.08.004

malpractice insurance has led some to leave this medical specialty or to refuse care for high risk patients [26,27].

Pregnant women also make appraisals about their risk. These self-perceptions of risk are sometimes not consistent with their provider's assessment [11,15] (see review by Lee et al. [17]). One reason is that women may define or interpret the concept of risk differently from their provider and may base their perception of risk on different factors than a provider [17,28,29]. Tversky and Kahnemann [30] suggest that people make inferences about their risk based on a range of factors or "rules of thumb" rather than on known probabilities. Pregnant women's perceptions of their risk may also be influenced by information that they have not revealed to their provider, including unhealthful behaviors such as cigarette smoking, behaviors which women understand do elevate their risk for adverse birth outcomes [31]. Psychosocial factors such as stress may also influence perceived risk status [32–34]. Lee et al. [17] found a consistent association between anxious emotional states and perceived risk among pregnant women in their systematic review of research on risk perception. Several reasons may explain why perceived stress or anxiety is associated with obstetric risk perception. One is that both types of perception may originate from underlying dispositions or traits, such as a pessimistic outlook [35]. A second explanation is that some people believe that stress affects health [36] and there is evidence that stress, negative mood, and related psychological factors are associated with perceived vulnerability to health problems and to self-assessments of health [37]. Keller's [36] analysis of data from the 1998 National Health Interview Study of American adults revealed that perceived stress and the belief that stress affects health independently and interactively predict poorer health, substantiating the veridicality of these beliefs.

The purpose of the present study was to examine perceived risk in pregnancy and its utility in predicting birth outcomes, specifically lower birth weight and earlier delivery. Based on the research described above, we predicted that pregnant women's perceptions of risk would be associated with poorer reproductive history, psychosocial factors including lower dispositional optimism and greater perceived stress, and unhealthful behaviors such as cigarette smoking. In addition, we examined whether women's risk perceptions were congruent with their provider's assessment of risk and we examined the value of combining self and provider assessments in predicting birth outcomes, a topic which has received almost no attention previously.

Method

Participants and procedures

The sample consisted of 165 women recruited from a university hospital-affiliated prenatal facility. To be eligible for the study, women had to understand English, be at least 18 years old, with a singleton pregnancy. Participants provided written informed consent and completed the study questionnaire while waiting for their prenatal care appointment. The questionnaire took approximately 20 min to complete. A raffle for a $50 gift card to a local department store was provided as a participation incentive. The research was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki).

Measures

Provider assigned risk

Participants were identified as low or high risk by their health care provider. Reasons for each individual's risk status were not specified, but as a group, high risk determination was based on the presence of conditions such as hypertension, diabetes, autoimmune diseases, and blood clotting disorders that are associated with poorer birth outcomes [38].

Perceived risk

Participants were asked, "Taking into consideration your family history, your health, and previous pregnancies, do you feel you are at risk of having [pregnancy complications/labor and delivery complications/a premature or low birth weight baby/problems with your health]?" (four items). Responses (0 = not at all to 2 = a lot) were summed to create a total score. The perceived risk measure appears in Appendix A.

Unhealthful behaviors

The Prenatal Health Behavior Scale (PHBS) has been shown to have good reliability and validity [39–41] as a measure of self-reported healthful and unhealthful behaviors in pregnancy. Based on their significant inverse correlations with birth weight, three items were selected from the PHBS: cigarette smoking, skipping meals, and physical overexertion. Participants reported frequency of these behaviors over the past two weeks on a 5-point scale, from 1 (never) to 5 (very often). Internal consistency was acceptable ($\alpha = .43$) given the small number of items and the lack of expected co-occurrence of these behaviors. A total score for each participant was calculated.

Optimism

Dispositional optimism was assessed with the widely-used and well-validated 10-item Revised Life Orientation Test [42]. Responses were from 1 (strongly disagree) to 5 (strongly agree). Four items are fillers and are not scored.

Perceived stress

The Revised Prenatal Distress Questionnaire (NuPDQ; [31]) was used to measure perceptions of stress associated with pregnancy-specific circumstances including physical symptoms, bodily changes, and the infant's health. Women report how "bothered, upset, or worried" they are about each of the 17 items on a scale from 0 (not at all) to 2 (very much). The measure has excellent psychometric properties [43].

Reproductive history

Participants reported whether they had ever experienced a miscarriage or complications with a previous pregnancy. Dichotomous responses on these two items were combined to create a measure of poor reproductive history, ranging from 0 (no previous miscarriage or complicated pregnancy) to 2 (both previous miscarriage and complicated pregnancy).

Birth outcomes

Both continuous and clinically relevant dichotomous outcome variables were coded from medical charts: gestational age at delivery in weeks and preterm/full term birth (<37/37+ wks); birth weight in grams and low/normal birth weight (<2500/2500+ g).

Results

Sample description

Age ranged from 18 to 45 ($M = 29.9$, $SD = 5.9$). Participants were representative of the patient population at the prenatal facility. Approximately 68% were White, 12% Black, 10% Latina, 6% Asian, and 4% multi-ethnic. Median annual household income was $45,000–60,000. A majority (92%) had completed high school; 42% held college or advanced degrees. Approximately three-quarters (76%) were married or partnered. At the time of the study, 51% were in their third trimester of pregnancy, 36% in their second trimester, and 13% in their first trimester. One-third (32%) were primiparas. Body mass index (BMI), calculated from height and pre-pregnant weight listed in medical records, indicates that approximately half (48%) were of normal pre-pregnant weight, 24% were overweight, and 28% were obese (BMI $M = 27.7$, $SD = 7.5$). Thirty percent of participants reported having miscarried and 36% reported having a prior complicated pregnancy.

Means and correlations of study variables are displayed in Table 1. Average gestational age at delivery for the sample was 38.7 weeks ($SD = 1.9$); 15 participants (9%) delivered preterm. Average birth weight was 3252 g ($SD = 566$); 9% were low birth weight. Table 2 displays birth weight and gestational age for study participants as a function of their provider assigned and perceived risk status. It shows that birth weight (3344 g) and gestational age (39.2 wks) were highest for women considered at low risk by both

Table 1
Correlations of study variables

Variable name	1	2	3	4	5	6	7	8	9
1. Provider risk (0 = low, 1 = high)	–								
2. Perceived risk (continuous)	.27**	–							
3. Unhealthful behaviors	.18*	.32**	–						
4. Poor reproductive history	.03	.34**	.06	–					
5. BMI	.20**	.16**	−.01	.04	–				
6. Perceived stress	.20**	.44**	.32**	−.04	.14	–			
7. Optimism	−.25**	−.27**	−.29**	−.16*	−.17*	−.45**	–		
8. Gestational age at delivery (wks)	−.26**	−.31**	−.22**	−.28**	−.07	−.20*	.13	–	
9. Birth weight (g)	−.15	−.17*	−.25**	−.06	.01	−.08	.17*	.51**	–
Mean	.21	2.5	5.7	.67	27.7	11.0	20.9	38.7	3252
SD	.41	2.4	2.2	.81	7.5	7.1	4.6	1.9	566
Cronbach's alpha		.86	.43			.88	.82		

* $p < .05$.
** $p < .01$.

assessments and lowest for women considered at high risk by both assessments (3092 g and 37.7 wks, respectively).

Most participants assessed their risk at the lower end of the scale ($M = 2.5$, $SD = 2.4$). Those in the third trimester of pregnancy viewed themselves at significantly lower risk ($M = 1.8$, $SD = 1.9$) than women in their first ($M = 3.1$; $SD = 2.4$) or second trimester ($M = 3.3, SD = 2.7$), $F(2, 162) = 8.56, p < .001$. We used a median split to divide the sample into those who perceived themselves to be at high risk (score > 2.0; $n = 74$, or 45%) and those who perceived themselves to be at low risk (score ≤ 2.0; $n = 91$, or 55%). Of the 34 women (21%) considered at high risk by their health care provider, 23 women (68%) concurred. Of the remaining 131 considered at low risk by their health care provider, 80 women (61%) concurred. Thus, a total of 62 women, or 38% of the sample, perceived their risk status differently than their health care provider, with most of these cases involving women considered by their provider to be at low risk but who viewed themselves at high risk.

Correlates of risk perceptions

As shown in Table 1, women who were less optimistic and those who reported greater stress perceived themselves to be at greater risk. Perceived risk was also correlated with poorer reproductive history, unhealthful behavioral practices, and higher BMI.

We conducted hierarchical multiple regression analysis to determine the unique associations of these variables with continuously coded perceived risk. Multicollinearity was examined and was found not to be an issue (all VIF's <2). Provider assigned risk was entered into the model first (step 1) and accounted for 7% of the variance in perceived risk. Poor reproductive history and the number of times pregnant were entered on step 2, followed by diabetes, hypertension, and BMI (step 3), optimism and stress (step 4), and unhealthful behaviors (step 5). At each step, non-significant variables were removed from further analyses. In the final model, perceived stress ($\beta = .38$), poor reproductive history ($\beta = .34$), provider assigned risk ($\beta = .15$), and unhealthful behaviors ($\beta = .15$) were significant, independent predictors of perceived risk (all p's < .05), accounting for 37% of its variance.

Predicting continuous birth outcomes

To examine gestational age and birth weight as a function of both provider assigned and perceived risk status (dichotomized), we created four groups of women, those with: 1) provider assigned LOW risk and perceived LOW risk; 2) provider assigned LOW risk and perceived HIGH risk; 3) provider assigned HIGH risk and perceived LOW risk; and 4) provider assigned HIGH risk and perceived HIGH risk. Values of gestational age and birth weight for the four groups of women appear in Table 2. Because timing of delivery and birth weight may have been confounded by having a scheduled cesarean, in these analyses we included only participants who delivered vaginally ($n = 104$, or 63% of the sample). One-way ANOVA results indicate that risk status group significantly predicted both birth weight ($F(3100) = 5.38$, $p = .002$) and gestational age at delivery ($F(3100) = 3.96$, $p = .01$). Post hoc comparisons (Tukey HSD) reveal significant differences between the LOW/LOW and HIGH/HIGH groups for birth weight ($p = .003$) and gestational age ($p = .05$). Two-way ANOVAs were then conducted to examine interactive and independent associations of provider assigned risk and perceived risk. There were no interactive effects of risk (provider assigned X perceived) on birth outcomes. However, both provider assigned risk and perceived risk (to a lesser extent) predicted birth weight, $F(1100) = 5.74$, $p = .02$ and $F(1100) = 3.65$, $p = .06$, respectively. For gestational age, only provider assigned risk was a predictor, $F(1100) = 4.87$, $p = .03$.

Predicting dichotomous birth outcomes

We compared the number of cases of clinically-defined preterm delivery and low birth weight in each of the four groups determined by provider assigned and perceived risk status among the 104 women who delivered vaginally (see bottom half of Table 2). Given the size of this subsample, the prevalence of preterm and low birth weight cases was predictably very low ($n = 7$ and $n = 8$, respectively), and therefore comparisons should be interpreted cautiously.

Four of the 7 cases of preterm delivery occurred among women who viewed themselves at high risk, whereas only 1 of the 7 cases of preterm delivery was among women identified by provider assigned high risk status. In addition, there are no cases of preterm delivery among women who viewed themselves at low risk despite being considered high risk by their providers (the HIGH/LOW group), and 6 of the 7 cases of preterm delivery occurred among women who were considered to be at low risk by their provider. However, the difference in distribution of preterm delivery across the four risk status groups did not achieve statistical significance, $X^2(3, N = 104) = 1.128$, $p = .77$.

Parallel analyses were conducted for low birth weight; 6 of the 8 cases of low birth weight were among women who perceived themselves to be at high risk. In addition, there was only one case of low birth weight among women who viewed themselves at

Table 2
Provider assigned and perceived risk groups

Provider assigned risk status/perceived risk (dichotomized) for $N = 165$ total sample					
	LOW/LOW	LOW/HIGH	HIGH/LOW	HIGH/HIGH	Total (%) or *M* (*SD*)
Frequency (% of sample)	80 (48)	51 (31)	11 (7)	23 (14)	165 (100%)
Birth weight g. *M* (*SD*)	3344 (462)	3194 (448)	3192 (1130)	3092 (721)	3252 (566)
LBW frequency	3	3	2	7	15 (9.1%)
Gestational age wks. *M* (*SD*)	39.2 (1.6)	38.5 (1.4)	37.7 (3.7)	37.7 (2.0)	38.7 (1.9)
Preterm delivery frequency	4	5	1	5	15 (9.1%)
Provider assigned risk status/perceived risk (dichotomized) for $N = 104$ vaginal deliveries					
	LOW/LOW	LOW/HIGH	HIGH/LOW	HIGH/HIGH	Total (%) or *M* (*SD*)
Frequency (% of 104)	56 (54)	31 (30)	6 (6)	11 (11)	104 (100%)
Birth weight g. *M* (*SD*)	3387 (382)	3166 (418)	3109 (558)	2885 (536)	3251 (446)
LBW frequency	1	2	1	4	8 (7.7%)
Gestational age wks. *M* (*SD*)	39.4 (1.5)	38.7 (1.5)	38.2 (1.0)	38.2 (1.3)	39.0 (1.5)
Preterm delivery frequency	3	3	0	1	7 (6.7%)

low risk despite being considered high risk by their providers (the HIGH/LOW group). The distribution of low birth weight differed significantly across the four risk status groups, X^2 (3, N = 104) = 16.23, p = .001. Both provider assigned risk (X^2 (1, N =104) = 13.50, p = .003) and perceived risk (X^2 (1, N = 104) = 4.31, p = .05) predicted low birth weight.

Because of the limited sample size examining vaginal births only, we repeated these comparisons among the full sample. Group differences corroborate the patterns seen for the subsample who delivered vaginally. As displayed in the top half of Table 2, of the 15 cases of preterm delivery in the sample, the largest number (n = 5) occurred in each of the two groups involving women who perceived their risk to be high, regardless of provider assigned risk; the lowest occurrence (n = 1) was in the group of women whose perceived risk was low but whose providers considered them to be at high risk (the HIGH/LOW group). Chi-square analysis indicates that overall, differences in the number of preterm deliveries across the four risk status groups approached marginal statistical significance, X^2 (3, N = 165) = 6.10, p = .11. The number of cases of preterm delivery by provider assigned high and low risk was marginally different, X^2 (1164) = 3.79, p = .06, as was the number of cases by perceived risk, X^2 (1, N = 165) = 3.18, p = .07. Stronger contrasts in the distribution of cases across the four risk status groups were observed for cases of low birth weight, X^2 (3, N = 165) = 17.18, p = .001, with significant differences by provider assigned risk, X^2 (1, N = 165) = 15.65, p = .001, and marginally significant differences by perceived risk, X^2 (1, N = 165) = 3.18, p = .07.

Discussion

As predicted, pregnant women's perceptions of risk were associated with poorer reproductive history and with unhealthful conditions and behaviors such as obesity and cigarette smoking. These findings suggest that women perceive themselves as vulnerable in part because of health conditions and behaviors that they know to be associated with poorer birth outcomes. Presumably, a woman's health care providers are aware of her major health conditions and her prior history, but pregnant women may not always reveal that they are doing ill-advised things such as skipping meals or smoking cigarettes. This may explain why these behaviors appear to be more strongly associated with women's perceptions of risk than with provider assigned risk.

Psychosocial factors, namely lower optimism and greater perceived stress, were also associated with women's perceptions of their risk. The association of negative psychosocial states with risk is likely to be bidirectional and may be mediated by health behaviors. That is, expecting a poor outcome predictably elevates stress and reinforces a negative outlook, but in addition, pregnant women under stress and those who are less optimistic have been shown to take poorer care of themselves [40,41] and thereby may increase their actual risk. Such cyclic associations among perceived risk, negative psychosocial states, and unhealthful behaviors may result in a self-fulfilling prophecy, whereby a poor outcome is virtually ensured.

Interestingly, provider assigned risk was also associated with women's perceptions of stress and low optimism. Prior research indicates that merely being labeled as high risk heightens stress and negative mood [4,6,44,45]. Enkin [4] warns that in some cases, the high risk label may increase women's distress without improving outcomes, particularly when medical interventions and women themselves cannot alleviate the factors contributing to their risk.

In a sizeable portion of cases, nearly 40%, women viewed their risk differently than their health care provider. Most were women considered by the provider to be at low risk but who viewed themselves at high risk, reinforcing the possibility noted above that these women were reflecting upon behaviors or conditions that they had not disclosed. Another explanation for the discrepancy between perceptions of risk and provider assigned risk is that both objective and subjective appraisals of risk may change over the course of pregnancy, but we assessed these at a single time point only.

Women's perceptions of risk, even when these differed from provider considerations, proved to be an important contributor to prediction of birth outcomes, especially of birth weight. Among women labeled low risk by providers but who perceived themselves as high risk, birth weight was 150 g (for the full sample) to 220 g (for vaginal deliveries only) lower than for women whose risk was considered low by both sources. In addition, among women labeled high risk by providers but who perceived their risk as low, birth weight was 100 g (full sample) to 220 g (vaginal deliveries) greater than for those whose risk was considered high by both. These findings suggest that prediction of birth weight might have been enhanced by taking women's perceptions into account. ANOVA results corroborate this possibility, in that the largest contrast in birth weight was between women in the LOW/LOW and HIGH/HIGH groups, groups where both women and their providers agreed on risk status. It appears that the combination of information from both a woman and her health care provider may be best in predicting birth weight.

Group comparisons of gestational age by the four risk status combinations indicate that women's perceptions of risk may not be as consequential for prediction of gestational age as for birth weight. Among those considered by their providers to be at high risk, timing of delivery was equivalent whether or not a woman perceived herself to be at high risk. However, among those considered by providers to be at low risk, women's perceptions did seem to matter, given that those who perceived themselves at high risk delivered almost a week earlier than those who perceived themselves at low risk. ANOVA results also indicate that perceived risk is a better predictor of birth weight than of gestational age.

Examination of clinically-defined adverse birth outcomes in the four risk status groups further underscores the value of incorporating women's perceptions into risk assessment, with recognition that the small number of these outcomes (although at the rate expected) reduces the reliability of comparisons. Nevertheless, group comparisons suggest that incorporating perceived risk may help to reduce the number of false positives – women identified as high risk but who subsequently have a normal birth outcome – and more importantly, it may reduce the number of false negatives, women considered to be at low risk who ultimately experience an adverse outcome. Our findings suggest that taking women's perceptions into account might have helped identify an additional three cases of low birth weight and five cases of preterm delivery in the full sample beyond considering provider assigned risk alone. We can also conjecture that incorporating self-perceptions into risk assessment might improve medical management and thereby facilitate interventions to improve outcomes. Such a possibility certainly warrants further investigation. However, this possibility calls attention to an important paradox that can complicate evaluation of the benefits of obstetric risk identification: Successful high risk identification, and resulting interventions, may produce better birth outcomes, making it appear that the predictive validity of risk identification is poor, when in fact the opposite is true. Only longitudinal studies with repeated assessments of obstetric risk and of medical management procedures can ascertain the dynamic and unfolding process linking risk identification, interventions, and birth outcomes. Results of the current study offer a foundation for research of this sort and provide empirical justification for including self-perceptions in the assessments of obstetric risk.

Limitations

Several caveats apply to our interpretation of study results. Foremost is the limited sample size, as elaborated already. For some analyses, we excluded cesarean deliveries, as information regarding secondary cesarean and induction of labor was not available and these factors can influence the timing of delivery. Larger studies are needed to confirm the validity of findings for cases of low birth weight and preterm delivery. Another limitation is that the sample was predominantly well-educated, partnered, and White, and we do not know whether results are generalizable to different groups of women, although we did not find correlations of perceived risk with education, marital status, or race. Also, we employed a median split of perceived risk to divide the sample into “low” and “high” risk groups, without ascertaining that women viewed themselves in this manner. Nevertheless, the score used to divide the sample, a 2 on the 0 to 8 scale, does fall at the

low end of the continuous perceived risk scale and is close to the mean scale score.

We also emphasized continuous outcome variables in this study because of the small numbers of clinically-defined dichotomous outcomes in a sample of this size. Nevertheless, there is evidence that some child and adult health outcomes are influenced by small variations even within normal ranges of gestational age and especially birth weight (e.g., [46,47]).

Finally, as noted earlier, being labeled high risk or perceiving oneself as high risk can elevate stress, which itself has been shown to contribute to poorer birth outcomes (see reviews by [48,49]). Because our data were collected at a single time point, we could not determine the extent to which stress may have mediated the association of risk with birth outcomes, but longitudinal studies could profitably examine this and other more complex multivariate models of obstetric risk and birth outcome.

Conclusions and implications

Study findings highlight the value of combining self and provider assessments in predicting birth outcomes, a topic which has received little attention previously. Pregnant women's perceptions of their own risk do appear to enhance prediction of adverse birth outcomes. Incorporating these perceptions with provider assessments of obstetric risk may improve medical management of pregnancy and enable more comprehensive and accurate determinations of risk for adverse birth outcomes [14,50]. Subjective perceptions of risk are also important to assess because they may affect whether women adhere to recommended treatment regimens or modify their health behaviors [17,28,51], and there is related evidence that perceived risk influences women's uptake of available prenatal screening [52,53] and preparation for childbirth [15]. Thus, in determining risk, and presumably in many other aspects of obstetric care, a collaborative relationship between each woman and her health care provider, utilizing the knowledge and judgment of both, may offer the best promise for a healthier birth outcome.

Conflict of interest

The authors have no competing interests to report.

Acknowledgments

Some funding for this research was provided by the Stony Brook University Department of Psychology. We are grateful to Alan Monheit for his assistance with this project.

Appendix A. Perceived risk measure

Taking into consideration your family history, your heath, and previous pregnancies, do you feel you are at risk of having …	Not at all	A little	A lot
1) … pregnancy complications?	0	1	2
2) … labor and delivery complications?	0	1	2
3) … a premature or low birth weight baby?	0	1	2
4) … problems with your health?	0	1	2
Taking into consideration your family history, your heath, and previous pregnancies, do you feel you are at risk of having …	Not at all	A little	A lot
1) … pregnancy complications?	0	1	2
2) … labor and delivery complications?	0	1	2
3) … a premature or low birth weight baby?	0	1	2
4) … problems with your health?	0	1	2

References

[1] Hamilton BE, Martin JA, Ventura SJ. Births: preliminary data for 2011. Nat Vital Stat Rep, 61. Hyattsville, Maryland: National Center for Health Statistics; 2012 .
[2] [Internet]World Health Organization. Geneva: Born too soon: The global action report on preterm birth. [cited 2013 Feb 25]. Available from: http://www.who.int/pmnch/media/news/2012/201204_borntoosoon-report.pdf; 2012.
[3] Enkin MW. Risk in pregnancy. The reality, the perception, and the concept. Birth 1994;21:131–4.
[4] Enkin MW, Keirse M, Neilson J, Crowther C, Duley L, Hodnett E, et al. Effective care in pregnancy and childbirth: a synopsis. Birth 2001;28:41–51.
[5] Crawford R. Risk ritual and the management of control and anxiety in medical culture. Health 2004;8:505–28.
[6] Jordan RG, Murphy PA. Risk assessment and risk distortion: finding the balance. J Midwifery Womens Health 2009;54:191–200.
[7] Hall P. Rethinking risk. Can Fam Physician 1994;40:1239–44.
[8] James DK, Steer PJ, Weiner CP, Gonik B. High risk pregnancy: management options–expert consult. St. Louis: Saunders; 2010 .
[9] Kringeland T, Möller A. Risk and security in childbirth. J Psychosom Obstet Gynecol 2006;27:185–91.
[10] Waldenström U. Normal childbirth and evidence based practice. Women Birth 2007;20:175–80.
[11] Gray BA. Hospitalization history and differences in self-rated pregnancy risk. West J Nurs Res 2006;28:216–29.
[12] Papiernik E, Tafforeau J, Richard A, Pons JC, Keith LG. Perception of risk, choice of maternity site, and socio economic level of twin mothers. J Perinat Med 1997;25:139–45.
[13] Headley AJ, Harrigan J. Using the pregnancy perception of risk questionnaire to assess health care literacy gaps in maternal perception of prenatal risk. J Natl Med Assoc 2009;101:1041–5.
[14] White O, McCorry NK, Scott-Hetes G, Dempster M, Manderson J. Maternal appraisals of risk, coping and prenatal attachment among women hospitalised with pregnancy complications. J Reprod Infant Psychol 2008;26:74–85.
[15] Heaman MI, Beaton J, Gupton AL, Sloan J. A comparison of childbirth expectations in high-risk and low-risk pregnant women. Clin Nurs Res 1992;1:252–65.
[16] Heaman MI, Gupton AL. Psychometric testing of the perception of pregnancy risk questionnaire. Res Nurs Health 2009;32:493–503.
[17] Lee S, Ayers S, Holden D. Risk perception of women during high risk pregnancy: a systematic review. Health Risk Soc 2012;14:511–31.
[18] [Internet]UCSF Medical Center. High Risk Pregnancy. [cited 2013 Feb 25]. Available from: http://www.ucsfhealth.org/conditions/highrisk_pregnancy/; 2012–2013.
[19] Hatmaker DD, Kemp VH. Perception of threat and subjective well-being in low-risk and high-risk pregnant women. J Perinat Neonatal Nurs 1998;12:1–10.
[20] Berglund A, Lindmark G. The usefulness of initial risk assessment as a predictor of pregnancy complications and premature delivery. Acta Obstet Gynecol Scand 1999;78:871–6.
[21] Honest H, Bachmann LM, Sundaram R, Gupta JK, Kleijnen J, Khan KS. The accuracy of risk scores in predicting preterm birth — a systematic review. J Obstet Gynecol 2004;24:343–59.
[22] MacKenzie BH, van Teijlingen E. Risk, theory, social and medical models: a critical analysis of the concept of risk in maternity care. Midwifery 2010;26:488–96.
[23] Handwerker L. Medical risk: implicating poor pregnant women. Soc Sci Med 1994;38:665–75.
[24] Smith V, Devane D, Murphy-Lawless J. Risk in maternity care: a concept analysis. Int J Childbirth 2012;2:126–35.
[25] Garb HN. Psychodiagnosis. Washington DC: American Psychological Association; 1998 .
[26] Penna L, Arulkumaran S. Cesarean section for non-medical reasons. Int J Gynecol Obstet 2003;82:399–409.
[27] Hale R. Legal issues impacting women's access to care in the United States — the malpractice insurance crisis. Int J Gynecol Obstet 2006;94:382–5.
[28] Heaman MI, Gupton AL, Gregory D. Factors influencing pregnant women's perceptions of risk. MCN Am J Matern Child Nurs 2004;29:111–6.
[29] Chuang CH, Velott DL, Weisman CS. Exploring knowledge and attitudes related to pregnancy and preconception health in women with chronic medical conditions. Matern Child Health J 2010;4:713–9.
[30] Tversky A, Kahneman D. Judgment under uncertainty: heuristics and biases. Science 1974;185:1124–31.
[31] Lobel M, Hamilton JG, Cannella DT. Psychosocial perspectives on pregnancy: prenatal maternal stress and coping. Soc Personal Psychol Compass 2008;2:1600–23.
[32] Lobel M. Conceptualizations, measurement, and effects of prenatal maternal stress on birth outcomes. J Behav Med 1994;17:225–72.
[33] Mercer RT, May KA, Ferketich A, DeJoseph J. Theoretical models for studying the effect of antepartum stress on the family. Nurs Res 1986;35:339–46.
[34] Gupton A, Heaman M, Cheung LWK. Complicated and uncomplicated pregnancies: women's perception of risk. JOGN Nurs 2006;30:192–201.
[35] Carver CS, Scheier MF, Segerstrom SC. Optimism. Clin Psychol Rev 2010;30:879–89.
[36] Keller A, Litzelman K, Wisk L, Maddox T, Cheng ER, Creswell PD, et al. Does the perception that stress affects health matter? The association with health and mortality. Health Psychol 2012;31:677–84.
[37] Andersen M, Lobel M. Predictors of health self-appraisal: what's involved in feeling healthy? Basic Appl Soc Psychol 1995;16:121–36.
[38] [Internet]The Society for Maternal–Fetal Medicine. Washington DC: High-Risk pregnancy care, research, and education. [cited 2013 Feb 25] Available from: https://www.smfm.org/attachedfiles/SMFMMonograph3.1pt.pdf.

[39] DeLuca RS, Lobel M. Conception, commitment, and health behavior practices in medically high-risk pregnant women. Womens Health 1995;1:257–71.
[40] Lobel M, DeVincent CJ, Kaminer A, Meyer BA. The impact of prenatal maternal stress and optimistic disposition on birth outcomes in medically high-risk women. Health Psychol 2000;19:544–53.
[41] Lobel M, Cannella DL, Graham JE, DeVincent C, Schneider J, Meyer BA. Pregnancy-specific stress, prenatal health behaviors, and birth outcomes. Health Psychol 2008;27:604–15.
[42] Scheier MF, Carver CS, Bridges MW. Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): a reevaluation of the Life Orientation Test. J Pers Soc Psychol 1994;67:1063–78.
[43] Alderdice F, Lynn F, Lobel M. A review and psychometric evaluation of pregnancy-specific stress measures. J Psychosom Obstet Gynecol 2012;33:62–77.
[44] Tracey S. Risk: theoretical or actual. In: Page LA, McCandlish R, editors. The new midwifery: science & sensitivity in practice. London: Churchill Livingstone; 2000. p. 227–50.
[45] Stahl K, Hundley V. Risk and risk assessment in pregnancy — do we scare because we care? Midwifery 2003;19:298–309.
[46] Matte TD, Bresnahan M, Begg M, Susser E. Influence of variation in birth weight within normal range and within sibships on IQ at age 7 years: cohort study. BMJ 2001;323:310–4.
[47] Richards M, Hardy R, Kuh D, Wadsworth MEJ. Birth weight and cognitive function in the British 1946 birth cohort: longitudinal population based study. BMJ 2001;322:199–203.
[48] Dunkel-Schetter C, Glynn L. Stress in pregnancy: empirical evidence and theoretical issues to guide interdisciplinary researchers. In: Contrada R, Baum A, editors. Handbook of stress. 2nd ed. New York: Springer; 2010. p. 321–43.
[49] Dunkel-Schetter C, Lobel M. Pregnancy and birth outcomes: a multi-level analysis of prenatal stress and birth weight. In: Baum A, Revenson TA, Singer J, editors. Handbook of health psychology. 2nd ed. Psychology Press; 2012. p. 431–63.
[50] Heaman M, Gupton A. Perceptions of bed rest by women with high-risk pregnancies: a comparison between home and hospital. Birth 2002;25:252–8.
[51] Coster-Schulz MA, Mackey MC. The preterm labor experience: a balancing act. Clin Nurs Res 1998;7:335–59.
[52] Markens S, Browner CH, Press N. Because of the risks: how US pregnant women account for refusing prenatal screening. Soc Sci Med 1999;49:359–69.
[53] Lobel M, Dias L, Meyer BA. Distress associated with prenatal screening for fetal abnormality. J Behav Med 2005;28:65–76.