Obstetric Risk Assessment in Rural Practice

Michael LeFevre, MD, MSPH, Harold A. Williamson, MD, MSPH, and Melvin Hector, Jr., MD
Columbia, Missouri, and Tucson, Arizona

A study was undertaken to evaluate Coopland's obstetric risk index in a rural primary care setting. Information on 635 pregnant women cared for in a rural practice was collected prospectively. Adverse outcome was defined as perinatal death, birthweight less than 2500 g, 5-minute Apgar score less than 7, or newborn transferred to a level 2 or level 3 nursery. Forty-seven pregnancies (8.3%) had an adverse outcome. There was a clear relationship between risk score and probability of adverse outcome. Good sensitivity could be achieved only at the expense of a very high false-positive rate, however. The index can be used to identify a subgroup of women at relatively high risk for adverse outcome, but the majority of adverse outcomes will occur in women identified as low risk. The risk-scoring system in this population was no more effective than a policy that would refer all women with standard obstetric risk factors.

Research into obstetric risk has received increasing attention over the past 15 to 20 years, with most of the effort expended to identify factors associated with adverse perinatal outcome.[1–5] The advantage of identifying such factors is twofold. First, recognizing factors associated with adverse perinatal outcome is the initial step toward understanding the underlying abnormal function that causes adverse perinatal outcome. Interventions will be more likely to be effective if the mechanism by which the risk factor exerts its effect is known. Second, these factors can be used to predict the likelihood of adverse perinatal outcome for a particular patient. Appropriate attention to perinatal risk factors is the basis for the management of high-risk pregnancies. Obstetric interventions are selectively applied to high-risk pregnancies to increase the likelihood of a favorable outcome.

A number of high-risk conditions are well delineated. For example, Rh isoimmunization, diabetes, hypertension, preeclampsia, and renal disease are known to be associated with a higher incidence of adverse outcome. These conditions are unusual, however, and explain only a small minority of adverse outcomes. To account for the cumulative effect of many minor risk factors, a number of additive risk indices were created and became popular.[6–13] All such indices have in common the following principles:

1. Some number of obstetric risk factors are identifiable at a point prior to delivery.
2. These risk factors are quantifiable.
3. These quantifiable risk factors are additive, with the sum of the values for each individual factor representing the overall level of obstetric risk.

Virtually all risk scores created were demonstrated to correlate with adverse perinatal outcome.[6–13]

In an effort to improve perinatal care and outcome, regionalization of perinatal services has also become popular within the past 15 years.[14–20] For any regionalization effort to work, high-risk pregnancies must be identified and referred to appropriate high-risk centers. The ability to identify high-risk pregnancies would be most advantageous in a rural practice, where physicians must not only decide how to manage the pregnancy, labor, and delivery, but also where. A clinically useful obstetric risk index that could be applied in rural practice could facilitate regionalized care.

Several problems currently preclude the meaningful application of available risk indices to rural practice. First, virtually all of these indices have been developed and tested in tertiary care obstetric centers. The patient populations served in rural settings differ significantly from those served by the centers testing the risk indices. This limits the generalizability of their results to the rural setting. Second, such indices usually have incorporated many traditional biomedical factors but have often neglected

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From the Department of Family and Community Medicine, University of Missouri-Columbia, Columbia, Missouri. Requests for reprints should be addressed to Dr. Michael LeFevre, Department of Family and Community Medicine, MA 303 Health Sciences Center, University of Missouri, Columbia, MO 65212.

TABLE 1. OBSTETRIC RISK INDEX*

Reproductive History	Score	Associated Conditions	Score	Present/Past Pregnancy	Score
Age (yr)				Bleeding	
<16	1	Previous gynecological surgery	1	<20 weeks	1
16-35	0	Chronic renal disease	2	>20 weeks	3
35	2				
Parity					
0	1	Gestational diabetes	1	Anemia <10 g%	1
1-4	0	Diabetes mellitus	3	Prolonged	
5+	2	Cardiac disease	3	pregnancy (42 wk)	1
Habitual abortion/infertility	1	Other medical disorders (chronic		Hypertension	2
PPH/Manual removal	1	bronchitis, lupus, etc). Score		Premature rupture of membranes	2
Baby >9 lbs (4082 g)	1	according to severity	1-3	Polyhyramnios	2
Baby <5.5 lbs (2500 g)	1			Small for dates	3
Previous cesarean	2			Multiple pregnancy, breech,	
Stillbirth or neonatal death	3			malpresentation	3
Prolonged labor or difficult delivery	1			Rh isoimmunization	3

**Created by Goodwin et al[7] and modified by Coopland et al[8].*

socioeconomic or psychosocial factors. Since traditional biomedical risk factors are less common in a primary care setting, it may be that socioeconomic or psychosocial factors are of relatively more value in this setting.

The purpose of the present study was to evaluate an existing risk index in the rural practice setting. In addition to determining whether the risk score could be correlated with adverse outcome, the sensitivity and predictive value of the index was determined for this setting.

METHODS

The study population was made up of pregnant women from four rural Missouri counties. The sample was obtained by enrolling patients accepted for care in four practices, one in each county. Two of these practices were training sites for residents in family practice. The other two sites were small group practices of family physicians. Patients who were enrolled in the study, but were subsequently referred because they developed high-risk conditions, were included in the analysis. Data collected included demographic information, obstetric and medical history, and an assessment of particular obstetric complications both prior to 20 weeks' and again at 32 to 36 weeks' gestation. The total risk score was calculated on the basis of information collected at 32 to 36 weeks unless the patient had already given birth, in which case information at 20 weeks' gestation was used.

To determine whether the study sample was representative of the county population, selected characteristics of women residing in these four counties who gave birth in 1985 were obtained from Missouri vital statistics. The majority of women in the sample had their babies in 1985. Demographic and obstetric factors from the sample and population were compared.

The risk index selected for evaluation was that created by Goodwin et al[7] and modified by Coopland et al[8] (Table 1). The index is brief and easily completed using information regularly obtained in the course of prenatal care, thus enhancing application to the practice setting. In addition, the risk index includes no intrapartum items. Since it is preferable to identify and refer high-risk rural patients prior to labor, intrapartum scoring is of limited value. In a review of several risk indices, Coopland's index was found to have the highest sensitivity and specificity for perinatal mortality and depressed Apgar score.[21] In a recent comparison[22] of this index with those of Halliday and Hobel in a family practice setting, the Goodwin system performed better overall.

A composite measure of adverse perinatal outcome was used because the incidences of individual adverse outcomes were not high enough to allow valid statistical comparisons in this setting. Adverse perinatal outcome was prospectively defined as the presence of any one of the following: perinatal death, birthweight less than 2500 g, 5-minute Apgar score less than 7, or newborn transferred to a level 2 or level 3 nursery.

Statistical analysis with the risk score as the independent variable and the adverse perinatal outcome as the dependent variable was conducted in two ways. First, three categories of risk were defined, and chi-square analysis was used. Second, to allow the risk score to be treated as a continuous variable, logistic regression was used. Individual risk factors included in the index, as well as other common biomedical and sociodemographic factors, were examined in univariate analyses with chi-square analyses.

RESULTS

Of the 646 women enrolled in the study, completed information on 635 was available for analysis. Selected characteristics of the women with completed information

TABLE 2. SELECTED CHARACTERISTICS (in percent) OF STUDY SAMPLE AND POPULATION

Characteristics	Sample	Population*
White	95.5	97.2
Married	86.7	85.9
Education <12 yr	19.9	22.3
Age (yr)		
<20	15.3	13.8
20-34	81.0	80.8
≥35	3.7	5.4
Nulliparous	38.2	40.0
Smoker	26.5	30.3
Birthweight <2500 g	3.2	5.9
Apgar <8	5.6	4.3

**1985 vital statistics data for four counties included in the study*

and of all women residing in the four counties who gave birth during the midpoint of the study are displayed in Table 2. The sample characteristics were very similar to the combined county populations, though low birthweight was slightly less common in the sample.

Forty-seven pregnancies had an adverse outcome. Seven pregnancies (1.1%) resulted in a perinatal death, an additional 18 (2.8%) resulted in a low-birthweight baby, 13 (2%) more had a 5-minute Apgar less than 7, and nine babies (1.4%) seemed well at birth but were subsequently transferred to a level 2 or level 3 nursery. The majority of babies with low Apgar scores or low birthweight also required intensive care.

Univariate analysis of the risk factors included in Coopland's index revealed an increased incidence of adverse outcome for most risk factors examined. As the incidences of individual risk factors were quite low, a relative risk could not be computed precisely, and none of the individual comparisons reached statistical significance. Univariate analysis of other demographic and common biomedical variables produced no statistically significant results, although the trends were consistently in the direction expected. It is important to note that many traditional high-risk obstetric conditions were not present at all in this sample. For example, there were no women with diabetes, heart disease, renal disease, or Rh sensitization.

The total risk score was initially examined using three categories of risk as defined by Coopland: (1) low risk, 0 to 2; (2) high risk, 3 to 6; and (3) extreme risk, >6. A clear increase in the frequency of adverse outcome with high-risk pregnancies was found (Table 3).

Logistic regression was used to model the relationship between the risk score as a continuous variable and the probabilty of an adverse outcome. The progressive increase in probability of adverse outcomes with higher risk scores is shown in Figure 1.

Although a clear relationship between the frequency of adverse outcomes and risk score can be demonstrated with these data, the clinical utility of a risk index, especially in a rural setting, is contingent upon the relationship between the sensitivity of the index and the predictive value of

TABLE 3. RISK CATEGORY AND ADVERSE OUTCOME

Risk Category (Score)	Number	Adverse Outcome No. (%)
Low (0-2)	474	28 (5.9)
High (3-6)	149	14 (9.4)
Extreme (>6)	11	5 (45.5)

$X^2 = 17.5$, $P < .001$

being labeled high risk. The performance of this index in the sample studied is shown in Table 4. If a score of 6 was used as the cutoff for high risk and consequent prenatal referral, then only 1.7% of the population would have been considered to be at high risk. The predictive value would have been 45%, that is, 45% of those so identified as being at high risk experienced a bad outcome. Only 11% of patients who experienced bad outcomes would have been identified at this cutoff point, however. To identify and refer a majority of patients with adverse outcomes would have required the high-risk point be set at 1, which would have resulted in referral of 39% of the patients of whom only 11% experienced a bad outcome.

A formalized system of risk scoring is of value only if it augments clinical judgment. Although individual high-risk conditions did not occur often enough to examine individually, some general observations can be made. Chronic hypertension, diabetes mellitus (including gestational diabetes), twins, and preeclampsia are well-accepted risk factors in obstetrics. In addition, many rural hospital units are not well equipped to handle the problems uniquely associated with preterm infants. A policy requiring referral of all pregnant women with hypertension, diabetes, twins, and preeclampsia, as well as transfer of women in labor prior to 37 weeks' gestation, would have resulted in referral of 97 of the 635 women (15%), with 20 experiencing poor outcomes. With this approach, 15% would be identified as high risk, similar to the 14% noted in Table 4 for a score >3. The sensitivity would be 57% and predictive value 21%, both improvements over formalized risk scoring. This system, however, would not accomplish referral of most preterm births before labor.

DISCUSSION

The purpose of this study was to test the utility of a previously published risk index for predicting adverse outcomes in a primary care population in rural practice. A clear relationship between the score on a risk index and the frequency of adverse outcomes was demonstrated. In addition, the risk index could have been used to identify and refer a small number of patients before labor who had a relatively high probability of an adverse outcome. If a high-risk cutoff of 4 were established, only 5% of all patients would have needed to be referred, with 29% of these women experiencing adverse outcome. The major problem

TABLE 4. SELECTION OF HIGH-RISK POINT (percent)

Score	High Risk	Sensitivity	Predictive Value
>6	1.7	11	45
>5	3.4	19	41
>4	5	21	29
>3	14	34	18
>2	25	40	12
>1	39	57	11
>0	76	87	8

associated with the use of the index in this manner is its low sensitivity. The majority (79%) of adverse outcomes would occur in women considered to be at low risk.

It is unlikely that any other existing risk index would perform substantially better in this setting. Almost all indices consider similar risk factors, and univariate analysis failed to identify any factors that would have enhanced the sensitivity or predictive value in this study.

As noted by other authors, it is important to validate a risk index in the setting in which it is to be used.[23] In this setting, a good sensitivity could be achieved only at the expense of a high false-positive rate. The formalized system of risk scoring seemed to offer no advantage over clinical judgment. Much of the perinatal morbidity and mortality in this study was associated with prematurity. Whether premature labor in these patients could have been prevented by early transfer of care is debatable, but it is unlikely, given the current state of knowledge regarding the causes of premature labor. Aggressive tocolysis and delivery at an appropriate high-risk facility is the best approach, which can be initiated in the rural setting. Referral of patients with other accepted obstetric high-risk conditions would eliminate a few more adverse outcomes from the rural setting. This approach still leaves the rural hospital with the majority of the adverse outcomes, a result not improved on by the use of risk scoring.

There are some limitations on the generalizability of these results. The population studied may not be representative of other rural populations. The lower incidence of low birthweight in this sample relative to the county population suggests some self-referral of high-risk women prior to establishing care. This self-referral may also occur in other rural settings.

It is important to note that risk scoring cannot eliminate adverse outcomes from any practice setting. Rural hospitals and regionalized systems of care must be prepared to care for the sick newborn before and during transport to appropriate facilities.

In summary, risk scoring using the index proposed by Coopland may be of value in a rural setting to identify women at relatively high risk for adverse outcome. It seems to offer no advantage, however, over a policy that would refer pregnant women with standard and easily identified risk factors (preeclampsia or preterm labor, for example). It is important to note that until other factors associated

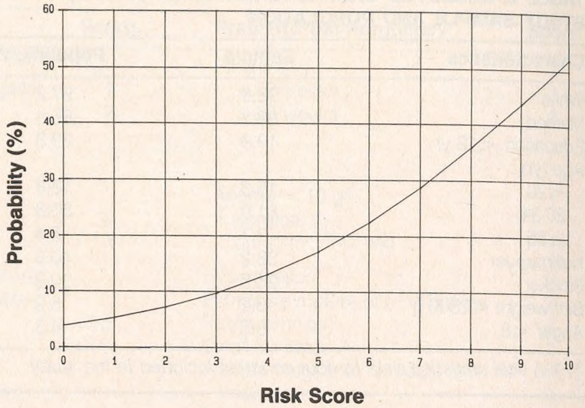

Figure 1. Logistic regression model showing relationship between the risk score as a continuous variable and the probability of an adverse outcome. ln $(P/1\text{-}P) = 3.22 + 6.33 + \text{risk}$ ($P = .001$)

with adverse outcome are identified, the majority of adverse outcomes will occur in patients identified as low risk.

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Commentary

Thomas S. Nesbitt, MD, MPH
Sacramento, California

In an age of genetic engineering and fetal surgery, it is difficult to believe that the ability to predict basic pregnancy outcomes accurately still eludes us. Since the development of the first formal prenatal risk-scoring system 20 years ago,[1] many new or modified instruments with the same purpose have appeared in the literature[2]—confirming that no single system is considered ideal. That these instruments continue to be developed, modified, and tested, however, is evidence of their perceived potential value.

The role of risk-scoring indices in perinatal health care has been the subject of considerable debate, including some that has appeared in this journal.[2–4] There are conflicting data regarding the reliability of these systems, and disagreement as to their role in the management of obstetric patients. As LeFevre and his colleagues point out, in few other areas is the resolution of these issues as important as in rural perinatal practice.

Assessing the usefulness of prenatal risk-scoring systems specifically for rural populations has been nearly impossible, as few studies on rural populations have been reported.[5–7] LeFevre et al are virtually the only researchers to study an objective antepartum risk-scoring instrument primarily in a rural setting. Goodwin,[8] one of the original authors on the subject, developed a profile of the hypothetical extremely high-risk patient. This "horror," as he called her, was from an "isolated" community. Despite this apparent recognition of the potential differences between urban and rural patients, he, like those who followed, failed to address this factor directly, either in the instrument itself or in the discussion of its applicability to such populations.

The preceding paper points to one of the most important potential functions of prenatal risk-scoring indices: timely identification of the true high-risk patient so that intrapartum care can occur in a facility with the equipment and personnel appropriate for the sick or premature neonate. With the advent of regionalization, improved access to specialized care has become increasingly available to patients in isolated communities. In a regionalized system, local rural providers are responsible for deciding when a patient should be referred to the next tier of care. As LeFevre et al noted, this decision involves altering not only the intensity of care, but also (in most cases) the provider and site of that care. The psychological and economic consequences of these disruptions in care are likely to be more significant for rural obstetric patients than for their urban counterparts because of the distances involved and the lower percentage of insured patients in the rural population.

Of course, if one predicts accurately those births requiring higher levels of care, transfer of these patients before delivery does improve birth outcomes.[9,10] If the rate of transfer results in overreferral, however, then the net improvement to birth outcomes of one's patient population may be diminished. As Rosenblatt et al[11] have demonstrated, low-risk obstetric patients appear to have superior outcomes in small local maternity units.

Another and possibly more important use for prenatal risk scoring is to identify those patients whose risks may be modifiable and thereby possibly avert an adverse outcome. Unfortunately, the method used by LeFevre et al does not allow for the identification of those cases. In their study, those patients identified as being at high risk and whose outcomes had been successfully modified would simply be identified as false positives, lowering the positive predictive value of the screening instrument.

Although the above argument suggests that this risk-scoring instrument may have performed marginally better than the results of the LeFevre et al study actually indicate, it is doubtful that the instrument performed well enough to change the assessment of its usefulness in this population. As Wall[2] noted in his review of obstetric risk-scoring systems, in nearly all but Goodwin's original paper, these instruments had relatively poor predictive values. Further, in a study on a mostly rural population, Akhtar and Sehgal[5] tested an antepartum risk-scoring form similar to that used by LeFevre et al. Although the incidence of perinatal mortality increased as risk category increased, their calculated predictive values were quite low.[2,5] The paper by LeFevre et al confirms this finding.

It is not surprising that risk-scoring instruments with relatively low predictive values for the populations on which they were developed performed no better on sociodemographically different populations. LeFevre et al reference work by Baruffi et al,[12] which has further shown that the same risk-scoring instrument may perform differently in different locations, even in two populations that are similar in socioeconomic backgrounds.

The variable performance of prenatal risk-scoring indices in different populations in different settings should be expected. As other authors have noted, most factors used in risk-assessment indices are not causative and are only frequently associated with true pathophysiology.[13] Many of these factors are socioeconomic, and therefore may not have the same associated pathophysiology in a different sociodemographic population. Further, biomedical risk factors may have differential cumulative effects when combined with various socioeconomic and demographic factors. Psychological factors, often difficult to measure, have also been shown to have a significant impact on fetal well-being.[14] All these factors, combined with different genetic predispositions, individual variations of health beliefs, and cultural practices, make precise prenatal risk scoring extremely difficult.

Although the current level of understanding of factors leading to gestational and intrapartum pathophysiology makes a completely accurate prenatal risking instrument unlikely, these current risk-scoring systems still serve a purpose. They are rough screening tools for identifying those patients requiring further evaluation and treatment during prenatal care, and as such can, in combination with other factors, play a role in deciding the intensity of intrapartum care. These risk-scoring systems also function as reminders of the relative importance of various risk factors identified, as educational tools for less experienced providers, and as potential medicolegal tools as well. Further, these systems may help to establish a semi-objective basis for planning labor and for patient expectations, factors correlated with patient satisfaction with obstetric care.[15,16]

In rural settings in particular, intrapartum risk scoring may be a valuable adjunct to antepartum risk assessment. In a rural community hospital setting, Smith and colleagues[6,7] demonstrated the usefulness of an intrapartum instrument in predicting low Apgar score and the need for neonatal resuscitation teams. The ability to predict the need for specialized personnel, who may not always be readily available in small rural community settings, is invaluable and undoubtedly has an impact on outcomes.

For future work in prenatal risk assessment to have the maximum benefit for rural obstetric patients, it must focus on factors associated with major sources of potentially preventable infant mortality and morbidity in rural populations rather than just attempt to predict "bad" outcomes in general. These associations should then be evaluated specifically in a rural setting. For instance, in the preceding paper a major contributor of perinatal mortality and morbidity was prematurity. A valuable project, requiring a larger sample size, might involve taking proven factors predictive of an increased incidence of prematurity and evaluating them in a rural setting. In addition, the cumulative effect of other factors specific to rural areas, such as travel time to care and specific occupational exposures, could be evaluated. From this investigation a more useful instrument might be developed.

The continued study and modification of risk-assessment instruments gives us access to the cumulative clinical judgment of others in a quantitative form. This information is particularly valuable to the more isolated obstetric provider. Given the inconstant nature of pregnancy in a diverse and changing society, however, it is doubtful that precise risk assessment will be achieved in the near future. The role of these systems will continue to be only a component of a variety of factors used in clinical decision making in this rewarding, yet challenging, area of practice.

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Dr. Thomas Nesbitt is Assistant Professor of Clinical Family Practice, Department of Family Practice, University of California, Davis, Sacramento, California.