

## The development of an index of high-risk pregnancy

JUDITH A. FORTNEY, Ph.D.

EDWARD W. WHITEHORNE, A.M.

*Research Triangle Park, North Carolina*

Presented is a scheme by which an index of high-risk pregnancy can be evaluated. The proposed scheme is applied to a risk index developed for the purpose of illustration. The usefulness of risk indices (or any other predictive measure) can be judged in clear statistical terms. The illustrative model developed here behaves similarly with each of the two sets of data on which it is tested, except to the extent that it is influenced by the incidence in the test population of the outcome to be predicted. The conclusion reached is that unreasonable demands are made of high-risk indices, that no index can satisfy all requirements. However, if the requirements are reasonably stated in advance, indices of high-risk pregnancy can be extremely useful. (AM. J. OBSTET. GYNECOL. 143:501, 1982.)

THE CONCEPT of the high-risk pregnancy is important in obstetrics. The ability to predict the birth of a jeopardized infant before its delivery means that decisions about the optimal management of the pregnancy can be made, and the chances of a favorable outcome can be increased. Anderson and colleagues<sup>1</sup> have shown, for example, that neonatal morbidity is significantly reduced (and the cost of hospitalization approximately halved) if patients are referred before delivery rather than after.

Because this is so important, many attempts have been made to develop an index or score for classifying high-risk pregnancies. None of these, however, has been entirely satisfactory, and it is questionable whether any real progress has been made in this area.<sup>17</sup>

High-risk indices are most often developed on a rather arbitrary basis, variables are selected for inclusion on the basis of clinical judgment, and the weights are assigned to the variables in a similar fashion. Indices based on appropriate statistical analysis of a large number of births are free of the arbitrariness, but tend to be excessively complicated to administer (e.g., the index of Donahue and Wan<sup>5</sup>).

*From the International Fertility Research Program.*

*Supported in part by the International Fertility Research Program with funds from the Agency for International Development.*

*Received for publication September 29, 1981.*

*Revised January 21, 1982.*

*Accepted January 26, 1982.*

*Reprint requests: Judith A. Fortney, Ph.D., International Fertility Research Program, 1 Triangle Dr., Research Triangle Park, North Carolina 27709.*

At the present time, it appears that a significant proportion of pregnancies remains for which a poor outcome occurs unpredictably. Rayburn and colleagues<sup>21</sup> found that two thirds of distressed infants born at term were not predictable, and Lesinski<sup>17</sup> refers to the "big unknown," i.e., the genetic factors of both parents and the fetus that make prediction difficult, if not impossible. Goodwin and associates<sup>11</sup> found that half of the deaths in the low-risk group were attributable to congenital malformations that are often difficult to predict.

A high-risk index is not useful if a significant proportion of high-risk patients are not diagnosed as such (false negative), or if a significant proportion of patients are defined as being at high risk when they are not (false positive).

In evaluating the usefulness of any diagnostic tool, the consequences of misdiagnosis must be considered. Often, this depends on what kind of action is to be taken as a result of the diagnosis. Let us examine the consequences of error in classifying a patient.

The consequences of false negative results (i.e., high-risk patients who are mistakenly classified as being at low risk) may be that a patient who needs special care does not receive it, which may result in increased mortality or morbidity for the mother and/or the baby. The consequences of a false positive assessment are that a patient who does not require additional care receives it, perhaps with the use of scarce resources that could be better used elsewhere; the patient may be referred to another hospital unnecessarily and be subjected to unnecessary intervention. All of these consequences can be costly.

However, if the hospital is well equipped, if anesthesiologists and pediatricians are routinely standing

**Table I.** Definitions of the five criteria of evaluation

Actual	Diagnosis		Total
	At risk	Not at risk	
At risk	A	B	G
Not at risk	C	D	H
Total	E	F	

Sensitivity =  $A/G$ . Specificity =  $D/H$ . False positive =  $C/E$ .  
False negative =  $B/E$ . Rate =  $A/E$ .

by, then the additional cost to both the patient and the hospital is minimal. If the patient would remain in the same hospital regardless of whether she is considered to be at high or low risk, then the inconvenience to the patient is minimal. If resources are abundant, use of them unnecessarily on a misclassified patient does not mean that they will not be available later for a correctly classified patient. However, in all of these situations, the possibility of unnecessary intervention remains.

Any diagnostic tool can be analytically evaluated in terms of five characteristics. These characteristics are defined mathematically in Table I.

False positive refers to the situation in which patients are defined as having the condition when, in fact, they do not have it (i.e., the obstetric patient who is classified as high risk, when she is not at risk).

False negative refers to the situation in which patients with the condition are defined as being free from the condition (i.e., the high-risk obstetric patient is misclassified as being at low risk).

Sensitivity refers to the ability of the test to find the condition in patients who are at high risk (i.e., the percentage of high-risk patients who are defined as being at high risk).

Specificity refers to the ability of a test to define risk only when risk exists (i.e., the percentage of low-risk patients who are classified as being at low risk).

The rate is that at which the predicted event occurs in patients classified as being at risk. (What percentage of obstetric patients classified as being at high risk actually have an adverse outcome of pregnancy?)

An improvement in any one of the factors necessarily occurs only at the expense of one or more of the others. For example, as the sensitivity increases, so does the rate of false positives; as the specificity increases (i.e., improves), so does the rate of false negatives. Thus, a factor in deciding the most appropriate cutpoint is an evaluation of the consequences of the different kinds of error. The physician or the hospital should decide in advance the negative consequences, in the partic-

ular situation, of the false positives and of the false negatives.

Administrative preference might be to decrease the percentage of patients defined as being at risk (i.e., lower the sensitivity and false positives and increase the specificity and false negatives by raising the cutoff point), whereas a clinician might prefer to lower the cutoff point, thus increasing the sensitivity and false positives and reducing the specificity and false negatives. Clearly, neither response is "correct," and a trade-off must be made to arrive at the best judgment on balance.

As Table II shows, most risk assessment scores classify a rather high percentage of patients as being at risk. Sensitivity tends to be quite high and the number of false negatives tends to be low. Specificity, on the other hand, is rather low and the number of false positives is remarkably high—up to 96%. This is a conservative approach from the clinical point of view. Several of the high-risk scores shown in Table II are classified into three groups—high, medium, and low risk. The appropriate evaluation criteria are calculated with the medium group included among the high-risk patients and with the medium-risk patients included among the low-risk patients. The second situation, of course, corresponds to raising the cutoff point, thereby improving specificity at the expense of sensitivity. Table II includes only those articles in the list of references from which the calculations could be made. A surprisingly large number of articles on this subject not only do not give the sensitivity, specificity, or the percentage of misclassified cases but also do not provide the reader with sufficient information to make those calculations.

The rather high rate of false positives brings us to a major problem inherent in the development of risk assessment scores. If the physician reacts appropriately to a high-risk assessment and manages the patient skillfully, then an unsatisfactory outcome of pregnancy is avoided and the case is subsequently recorded as a misclassification (i.e., a false positive). Theoretically, this would be most true if the outcome variable of interest is perinatal mortality, less true if a depressed Apgar score is the outcome of interest, and least true if either low birth weight or low gestation is the outcome of interest since the physician is more easily able to influence survival than either weight or gestation.

In addition to its predictive ability, a high-risk score should be simple to administer. The index developed by Donahue and Wan<sup>7</sup> involved only nine variables, but each was given a "factor value" to two decimal places and a "weighting factor" to two decimal places that are then multiplied; the scores for the nine variables are

**Table II.** Performance of various risk assessment scores in predicting perinatal outcome

	<i>Percentage assessed at risk</i>	<i>Sensitivity</i>	<i>Specificity</i>	<i>False positive</i>	<i>False negative</i>
Dependent variable = perinatal mortality:					
Goodwin et al. <sup>11</sup>	14	77.8	97.1	17.0	4.0
Morrison and Olsen <sup>12</sup>	19	69.7	82.0	93.0	0.7
Akhtar and Sehgal <sup>3</sup>					
High and medium risk	26	70.0	n.a.	n.a.	n.a.
Hobel et al. <sup>13, 15</sup>	34	50.4	68.5	77.2	11.8
Edwards et al. <sup>7</sup>	47	88.6	54.5	93.7	0.7
Sokol et al. <sup>16</sup>	49	84.2	52.1	94.9	0.9
Halliday et al. <sup>17</sup>					
High and medium risk	62	96.8	38.5	96.2	0.2
High risk only	16	67.7	75.0	93.6	1.1
Dependent variable = preterm birth:					
Akhtar and Sehgal <sup>3*</sup>					
High and medium risk	26	43.6	76.7	79.4	9.2
High risk only	12	25.5	89.9	74.1	10.3
Creasey et al. <sup>18</sup>					
High and medium risk	32	79.7	70.9	84.9	1.8
High risk only	13	64.4	90.4	69.6	2.5
Nesbitt and Aubry <sup>19</sup>					
High and medium risk	69	78.1	31.5	92.6	4.6
High risk only	30	46.9	71.3	89.8	5.0
Dependent variable = low birth weight <sup>§</sup>					
Akhtar and Sehgal <sup>3</sup>					
High and medium risk	26	38.7	76.2	80.0	11.0
High risk only	12	25.1	90.0	72.1	11.3
Nesbitt and Aubry <sup>19</sup>					
High and medium risk	69	76.5	32.6	85.2	10.0
High risk only	30	43.2	72.8	80.4	10.6
Dependent variable = depressed 5-minute Apgar score:					
Goodwin et al. <sup>11</sup>	14	67.3	97.9	19.5	4.1
Akhtar and Sehgal <sup>4</sup>					
High and medium risk	26	55.2	76.5	84.8	4.3
High risk only	12	35.6	89.8	78.9	5.2

\*Using Hobel's scoring system.

†Less than 37 weeks.

‡Less than 36 weeks.

§Less than 2,500 gm.

|| Less than 4.

¶ Less than 7.

added, and give a score with four decimal places. Hobel's score involves 51 prenatal factors and 40 intrapartum factors, each of which are scored 1 to 10.<sup>13, 15</sup> It is not possible to calculate sensitivity or specificity from Donahue and Wan's<sup>7</sup> published data; in the case of Hobel and associates' data, they are not particularly good (see Table II). Thus, complexity does not necessarily contribute to accuracy of prediction. The method developed by Adelstein and Fedrick<sup>1</sup> uses 10 risk factors, with scores on each factor ranging from 0.1 to 5.9 (not the same for each factor), and the individual scores are multiplied. Not enough information is given to calculate false negative and positives, or specificity, but sensitivity appears to be a satisfactory 60% when 12% of the population is identified as being at high risk.

The most useful of the indices developed to date appears to be that of Goodwin and colleagues.<sup>11</sup> Twenty-seven factors are grouped into three categories; each of the three categories receives a score, and the sum of the three ranges from 0 to 10. Although synergism is recognized by scoring 1 for a factor alone but 2 if the factor occurs simultaneously with another, the index does not permit recording more than two factors within a single category. The great value of Goodwin's index is that, with the test population used, only 14% of the population was defined as being at risk, which accounted for 77.8% of the perinatal deaths and 67.3% of the depressed Apgar scores (i.e., high sensitivity).

Much of the published work on the development of

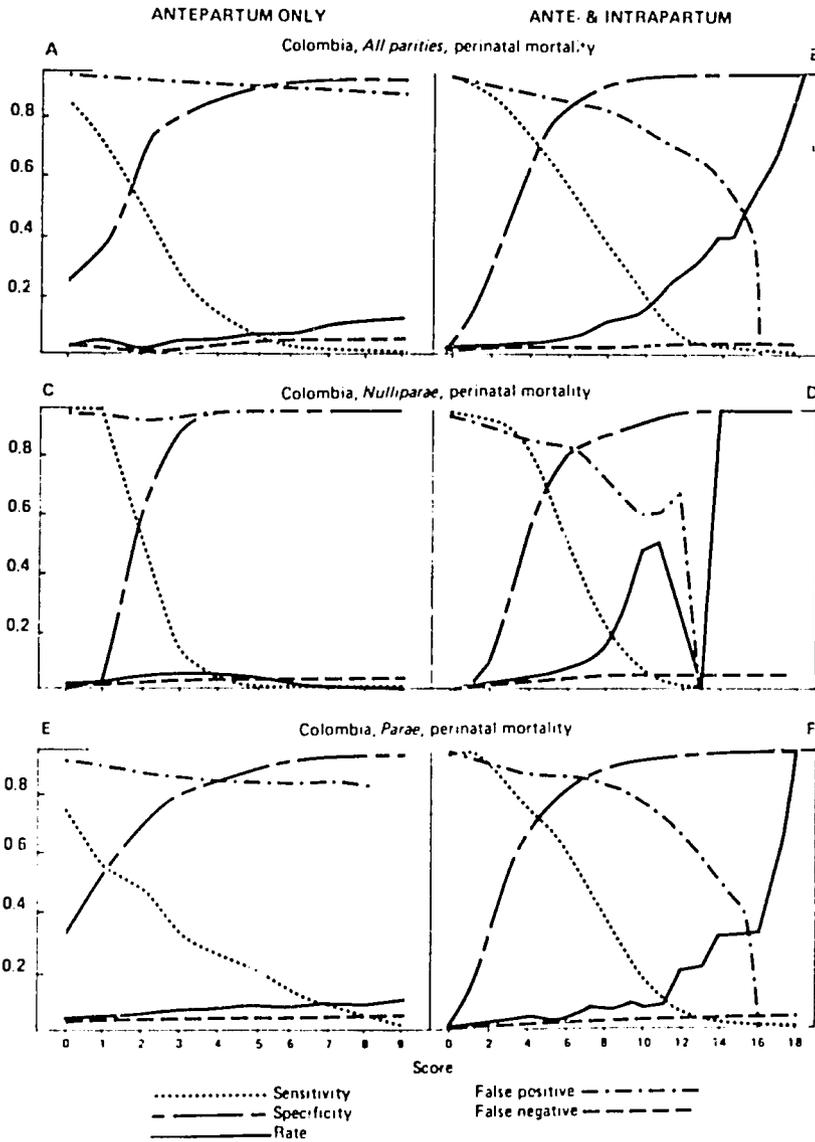


Fig. 1. Five statistical criteria used to evaluate an antepartum index and an antepartum and intrapartum index of high risk of perinatal mortality before hospital discharge. Data from Colombia.

risk scores is conceptually confused (and confusing). The relevant outcome variables are often not clearly stated and sometimes appear to be a combination of low birth weight, perinatal death, depressed Apgar score, and even maternal complications. Usually, the criteria by which the score will be judged are not clear; the most commonly used is the percentage of all perinatal deaths (or whatever the outcome variable is defined to be) that were defined as high risk.

Another source of confusion is the time at which the assessment is made. It is not useful to predict a poor outcome at a time when it is too late to change the treatment. A condition discovered intrapartum will not change the management of the pregnancy, although it

may change the method of delivery. In some of the material published on this subject, the writers do not specify the time at which the assessment should be made, and even include some postpartum factors.

With these desirable characteristics in mind, we developed a model for a high-risk index and tested this index on two large sets of data. The model was developed with the use of data collected from a random sample of hospitals in Colombia. The variables were selected for inclusion by a multiple discriminant analysis, and the weights were assigned to these variables by determining the relationship among the variables and scaling the proportions to integer weights. Finally, curves were plotted which showed the relationship

among sensitivity and specificity, false positives and false negatives, and the rate of adverse outcome.

The adverse outcomes that we selected for the model were (1) stillbirth or neonatal death before mother's discharge from the hospital and (2) low birth weight (2,500 gms or less).

Nine factors in two categories were selected for inclusion in the score. The first five factors can be ascertained at any point during the pregnancy and require no tests and no clinical judgment to be made. These antepartum factors and their weights are as follows.

1. Mother's age: Less than 16 years = 2, 16 to 17 years = 1, 18 to 29 years = 0, 30 to 34 years = 1, and 35+ years = 2.

2. Parity: Nulliparity = 1, parity 1 to 3 = 0, parity 4 to 6 = 1, and parity 7+ = 2. (Parity is defined as deliveries at 20 weeks or more, whether live or stillborn.)

3. Gravidity: Nulligravidity = 1, gravidity 1 to 3 = 0, gravidity 4 to 6 = 1, and gravidity 7+ = 2. (Gravidity is defined as live births, stillbirths, spontaneous and induced abortions.)

4. Bad obstetric history: The numbers of previous stillbirths, spontaneous abortions, and cesarean sections are added together; if the resulting sum is none, the score = 0, if one, the score = 1, if more than one, the score = 2.

5. Antepartum condition: No pathologic condition during pregnancy is scored 0; any condition is scored 1.

The other four factors are determined when the patient is admitted into the hospital for delivery, i.e., labor has already started. Again, none of the four factors requires that any tests be made; although clinical judgment is called for, the scores can easily be assigned by a midwife. The four intrapartum factors are as follows.

6. Number of antenatal visits made: None or 1 visit = 2, 2 to 5 visits = 1, 6+ visits = 0.

7. Presentation: If the presentation is vertex, occipitoanterior, or transverse, score = 0; any other presentation is scored 1.

8. Duration of labor: No labor (i.e., elective cesarean section or precipitate labor) is scored 1, up to 18 hours is scored 0, more than 18 hours is scored 1.

9. Estimated gestation: 20 to 27 weeks = 5, 28 to 35 weeks = 1, 36 to 39 weeks = 1, 40 to 42 weeks = 0, 43 weeks or more = 1.

Adding the scores of the individual factors produces an index that ranges from 0 to 9 when the antepartum factors alone are added, and from 0 to 18 when the combined antepartum and intrapartum factors are added. Multiplying the scores (which would give added weight to factors held in combination by permitting interaction between two or more factors) did not produce a better index in terms of predictive value.

The combined antepartum and intrapartum factors produced a better index in terms of predictive value than did the antepartum factors alone.

Fig. 1 (*A* to *F*) shows the five criteria by which the index is evaluated, for the antepartum index alone, and for the antepartum and intrapartum parts combined. Since other authors (Donahue and Wan<sup>7</sup>) have found that it is more difficult to identify high risk among nulliparous women than among parous women, Fig. 1 also shows the two indices for nulliparous women (*C* and *D*) and for multiparous women (*E* and *F*) separately. In Fig. 1, the outcome of interest is perinatal death before hospital discharge; the data are from Colombia. Tables that show the data which were used to generate the graphs may be obtained by writing to us.

Fig. 1, *A* shows the antepartum part of the index. This part of the index alone does not predict well: the death rate at the higher scores is close to zero, and is highest at the middle scores. False positives remain high at all levels of the score, and the sensitivity is quite poor. Adding in the intrapartum part of the index produces much better results (*B*); the correspondence between increasing death rate and increasing score on the index is good and achieves 100% at the highest score. The false positives decline, particularly after a score of 8. Since the death rate before discharge is a low 2.8%, it is inevitable that false negatives remain low at all levels of the score. Sensitivity and specificity are optimal at a score of 5.

Suppose, after examining Fig. 1, *B*, we decided that a score of 5 is an appropriate cutoff at which to define patients as being at high risk, i.e., if a woman has a score of 6 or higher, she will receive some kind of special attention. This would mean that 38.1% of all women would be classified as being at high risk, and that 68.9% of all the deaths before discharge would have been predicted (sensitivity). However, 91.6% of those classified as being at high risk would not have had an adverse outcome of pregnancy (false positives). On the other hand, 77.6% of the low-risk patients would have been correctly identified (specificity). By raising the cutoff just one point (i.e., 7 or higher is high risk), and by classifying less than a fourth (23.8%) of the women as being at high risk, we can still account for more than 1/2 (56.1%) of all deaths (sensitivity). False positives are lowered to 88.8% (which is still high), and false negatives increase only to 1.5%; 86.7% of the low-risk women are correctly identified (specificity).

Comparing the results for the parous and the nulliparous women for the combined antepartum and intrapartum index (Fig. 1, *D* and *F*), we find that there is remarkably little difference in the predictive value of the index for the two groups of women. The curves in

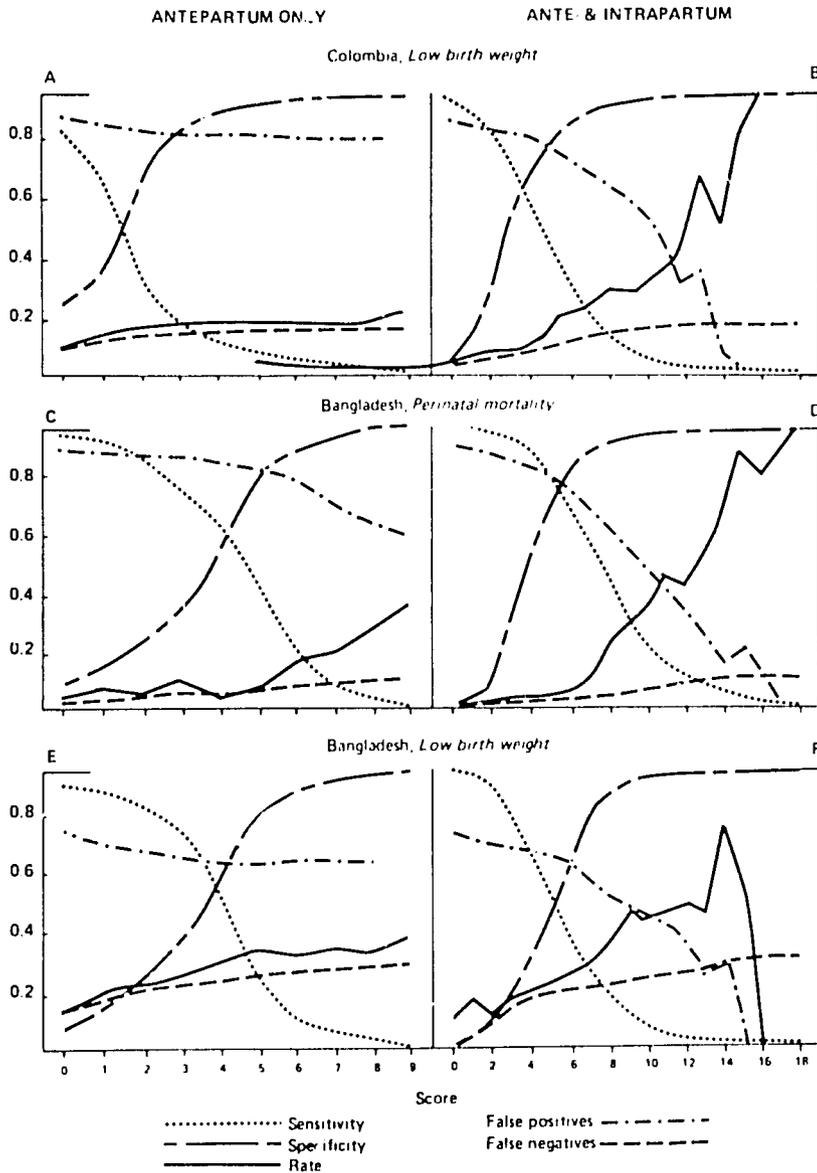


Fig. 2. Five statistical criteria used to evaluate an antepartum and an antepartum and intrapartum index of high risk of perinatal mortality before hospital discharge and high risk of low birth weight. Data from Colombia and Bangladesh.

Fig. 1, *D* and *F* are quite similar, except that they become erratic at the higher scores for nulliparous women, primarily because the numbers are small. Taking the same cutoff point of 5, we find that the sensitivity is 66.9% for nulliparous women and 69.9% for parous women; specificity is 78.6% for nulliparous women and 76.9% for parous women; false positives are 92.6% and 91.0%, respectively; and false negatives are 1.1% and 1.3%, respectively. Even the percentages of women classified as being at high risk in the two groups—22.5% of nulliparous women and 21.6% of parous women—are very similar.

Fig. 2 shows the antepartum-only index and the combined antepartum and intrapartum index for all women in which the outcome of interest is birth weight (i.e., the probability of weight being 2,500 gm or less). Fig. 2, *A* and *B* shows data for Colombia, whereas the other four panels show for Bangladesh the equivalents of Fig. 1, *A* and *B* and Fig. 2, *A* and *B*.

In a general way, perhaps the most apparent fact in Fig. 1 is that in the three graphs on the right (i.e., those for the combined antepartum and intrapartum scores) the line that represents the proportion with the outcome of interest shows a much more pronounced up-

ward trend than is the case with the antepartum index alone. This confirms our conclusion from Fig. 1 that the combined score is a much better predictor than the antepartum score alone. The next important fact to notice is that only with the combined index does the curve that represents false positives decline very substantially. This confirms the statement by Rayburn and colleagues that it is difficult to predict which infants are threatened until labor has begun.

The similarities between the results for the two countries are quite surprising, given how different the two settings are. If we take perinatal death before maternal discharge as an example, in Colombia, 2.9% of babies died before maternal discharge; in Bangladesh, the percentage was 8.1%. Sensitivity and specificity were optimized at a score of 5 in Colombia and 6 in Bangladesh; at that score, sensitivity and specificity averaged 73.2% in Colombia and 76.5% in Bangladesh; and at that point, 23.8% of the Colombian women and 23.3% of the Bangladeshi women were classified as being at high risk. If we look at low birth weight instead of perinatal death, 12.1% of the Colombian babies weighed 2,500 gm or less compared with 23.6% of the Bangladeshi babies; sensitivity and specificity were optimized at 4 in Colombia and at 5 in Bangladesh (both one point lower than the optimal score for perinatal death), and at that point, sensitivity and specificity averaged 62.1% in Colombia and 60.0% in Bangladesh, and 38.1% of the women were classified as being at high risk in Colombia and 37.0% in Bangladesh.

The five statistical criteria are affected by the incidence of the outcome variable in the population. In Bangladesh, for example, 8.1% of the infants died before maternal discharge, and 23.6% of the infants weighed 2,500 gm or less. Sensitivity is much higher at

all scores for death than it is for low birth weight; specificity, on the other hand, is almost identical at each score. False positives are higher with the rarer outcome (death), and false negatives are lower at each level of the score. The incidence at each score is obviously higher, the higher the overall incidence.

### Comment

Although many high-risk indices have been developed, a great deal of work remains to be done. Also it may be true that we are asking too much of the high-risk index: there are too many conflicting demands. It is impossible to keep both false positives and false negatives low, since, as specificity increases, sensitivity inevitably decreases. It is impossible to keep small the percentage classified as being at high risk and at the same time predict a large percentage of the jeopardized babies.

Nevertheless, it is possible to make a sensible classification of obstetric patients based on the score of a high-risk index as long as consideration has been given to expected rates of error and the consequences of error. It must be accepted that error is inevitable; therefore, decisions need to be made as to the most acceptable type of error that allows for maximum use of available resources. Risk indices can contribute greatly to the overall management of a high-risk pregnancy by providing a mechanism for coarse screening. Finer screening by clinical testing can then be used to maximize the allocation of often scarce resources and positively influence the outcome of the pregnancy.

We acknowledge the Programa Regional de Investigaciones en Fecundidad, Bogota, Colombia, and the Bangladesh Fertility Research Program, Dacca, Bangladesh, for providing the data.

### REFERENCES

1. Adelman, P., and Fedrick, J.: Antenatal identification of women at increased risk of being delivered of a low birth weight infant at term. *Br. J. Obstet. Gynaecol.* **85**:8, 1978.
2. Akhtar, J., and Seligal, N. N.: Prognostic value of a prepartum and intrapartum risk-scoring method. *South. Med. J.* **73**:111, 1980.
3. Anderson, C. L., Aladjem, S., Avuste, O., Caldwell, C., and Ismail, M.: An analysis of maternal transport within a suburban metropolitan region. *Am. J. Obstet. Gynecol.* **140**:499, 1981.
4. Aubry, R. H., and Pennington, J. C.: Identification and evaluation of high-risk pregnancy: The perinatal concept. *Clin. Obstet. Gynecol.* **16**:3, 1973.
5. Coopland, A. L., Peidle, L. J., Baskett, F. E., et al.: A simplified antepartum high-risk pregnancy scoring form. *Can. Med. Assoc. J.* **116**:999, 1977.
6. Creasey, R. K., Gummer, B. A., and Higgins, G. C.: System for predicting spontaneous preterm birth. *Obstet. Gynecol.* **55**:692, 1980.
7. Donahue, C. L., and Wan, T. F. H.: Measuring obstetric risks of prematurity: A preliminary analysis of neonatal death. *Am. J. Obstet. Gynecol.* **116**:911, 1973.
8. Edwards, L. E., Barrada, L., Latreau, R. W., and Hakanson, E. Y.: A simplified antepartum risk scoring system. *Obstet. Gynecol.* **54**:237, 1979.
9. Foy, J. E., and Backes, C. R.: A study of the relationship between Goodwin's high-risk scoring system and fetal outcome. *JAOA* **78**:113, 1978.
10. Fedrick, J.: Antenatal identification of women at risk of spontaneous preterm birth. *Br. J. Obstet. Gynaecol.* **83**:351, 1976.
11. Goodwin, J. W., Dunne, J. L., and Thomas, B. W.: Antepartum identification of the fetus at risk. *Can. Med. Assoc. J.* **101**:57, 1969.
12. Haeri, A. D., South, J., and Naldrett, J.: A scoring system for identifying patients with a high risk of perinatal mortality. *J. Obstet. Gynaecol. Br. Commonw.* **81**:535, 1974.
13. Halliday, H. L., Jones, P. K., and Jones, S. L.: Method of

- screening obstetric patients to prevent reproductive wastage, *Obstet. Gynecol.* **55**:656, 1980.
14. Hobel, C. J., Hyvarinen, M. A., Okada, D. M., and Oh, W.: Prenatal and intrapartum high-risk screening, *Am. J. OBSTET. GYNECOL.* **117**:1, 1973.
  15. Hobel, C. J.: Risk assessment in perinatal medicine, in Makowski, E. L., editor: *Clinical Obstetrics and Gynecology. High-risk Obstetrics*, New York, 1978, Harper & Row, Publishers, Inc., pp. 287-294.
  16. Jones, P. K., Halliday, J. L., and Jones, S. L.: Prediction of neonatal deaths or need for interhospital transfer by prenatal risk characteristics of mother, *Med. Care* **17**:796, 1979.
  17. Lesinski, J.: High risk pregnancy: Unresolved problems of screening, management and prognosis, *Obstet. Gynecol.* **45**:599, 1975.
  18. Morrison, L., and Olsen, J.: Perinatal mortality and antepartum risk scoring, *Obstet. Gynecol.* **53**:362, 1979.
  19. Nesbitt, R. E. L., Jr., and Aubry, R. H.: High risk obstetrics. II. Value of semiojective grading system in identifying the vulnerable groups, *Am. J. OBSTET. GYNECOL.* **103**:972, 1969.
  20. Pavelka, E., Riss, P., Parschalk, O., and Reinold, E.: Practical experiences in the prevention of prematurity using Thalhammer's score, *J. Perinat. Med.* **8**:100, 1980.
  21. Rayburn, W. F., Anderson, C. W., O'Shaughnessy, R. W., and Rickman, W. P.: Predictability of the distressed term infant, *Am. J. OBSTET. GYNECOL.* **140**:489, 1981.
  22. Sokol, R. J., Rosen, M. G., Stojkoy, J., and Chik, L.: Clinical application of high risk scoring on an obstetric service, *Am. J. OBSTET. GYNECOL.* **128**:652, 1977.
  23. Sogbamu, M. O.: Perinatal mortality and maternal mortality in General Hospital, Ondo, Nigeria. Use of high-risk pregnancy predictive scoring index, *Niger. Med. J.* **9**:123, 1979.

do not calculate  
APPT  
R. J. J.