

The determination of high-risk pregnancy: the use of antenatal scoring system

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Summary

Aims: A standardized antenatal scoring system is not available in order to detect high-risk pregnancies at primary health care units in Turkey. The authors aimed to evaluate the applicability of the “Knox scoring system” in Turkey. **Materials and Methods:** One hundred and twenty-nine pregnant women were included in study. They were assessed upon admission and then the same women were reassessed at the onset of labor by Knox scoring system. **Results:** The Knox scoring system identified 65 pregnant women (50.4%) as high-risk upon admission while 22 pregnant women (17.1%) as high-risk at the onset of labor. Twelve pregnant women (9.3%) (one case of perinatal death and 11 cases of perinatal morbidity) had poor perinatal outcomes during the study period. The Knox scoring form administered upon admission yielded 58% sensitivity, 50% specificity, and 10% positive predictive value, while 91% sensitivity, 90% specificity, and 50% positive predictive value at the onset of labor. The diagnostic value of the Knox scoring system for determining high-risk pregnancies was not found statistically significant regarding admission (ROC value: 0.655; $p > 0.05$), while statistically significant regarding the onset of labor (ROC value: 0.946; $p < 0.05$). **Conclusions:** The use of the Knox scoring system for determining high-risk pregnancies seems to be effective at the onset of labor.

Key words: Antenatal scoring system; High-risk pregnancy; Knox scoring system.

Introduction

Physiological changes that occur during pregnancy may narrow the line between health and disease. Due to maternal and fetal diseases and anomalies, some complications may develop during pregnancy and at labor. Pregnancy-related deaths occurring among women in the antepartum and peripartum periods are an important health problem in developing countries [1]. First pregnancy, high parity, interpregnancy intervals shorter than two years, advanced maternal age, short maternal stature, low body mass index (BMI), inappropriate weight gain during pregnancy, poor obstetric history, anemia, smoking during pregnancy, history of stillbirth, and malnutrition are some of the worldwide accepted risk factors [1, 2]. Turkey Demographic and Health Survey (TDHS) demonstrated that 69.4% of the pregnancies in the country were classified under the risk category [3]. Accordingly, high-risk pregnancies remain a significant problem in Turkey [4]. Early identification of risk factors associated with pregnancy and providing relevant and timely treatment may reduce maternal and fetal mortality rates, and improve pregnancy outcomes. Hence, high-risk pregnancies should be identified and deliveries should be carried out in the referring hospital [5, 6].

The factors of antenatal risk can be estimated in several ways. The informal (clinical) antenatal risk assessment was classified by Hobel *et al.* [7] as level 1 obstetric risk assessment. The accuracy of level 1 assessment depends on the experience of healthcare professionals. Level 2 risk assessment uses the presence or absence of single risk

factors to decide whether a person is at risk. In this level 2 assessment, a large number of women will be considered high-risk and all risk factors are considered to have an equal effect on outcome. Level 3 assessment assigns each factor a statistical weighting to reflect the fact that different risk factors have differing levels of effect. The use of statistical weighting is potentially more effective than clinical weighting because it excludes experimental bias.

The risk scoring system is one of the available methods for predicting situations at risk associated with pregnancy in the prenatal period. Hence, a wide range of risk scoring systems diversely evaluating these risks are available in the literature [8-12]. Among these, the scoring system developed by Knox *et al.* in 1993 in New Zealand, is one of the methods exhibiting the highest predictive value [11].

In Turkey, pregnancies at risk are roughly determined according to the patient's history at the prenatal period without using a standardized risk scoring system in primary health care units. This current study aimed to evaluate the applicability of the “Knox Scoring System”, which has been developed to identify pregnant women at risk according to the circumstances in Turkey.

Materials and Methods

In this study the Knox scoring system was used to determine pregnancy-related risks by using 27 significant antenatal variables. The Knox scoring system was applied upon admission and at the onset of labor at the level III hospital in Izmir, Turkey. The pregnant women in this study were 159 and recently diagnosed before 20 weeks of gestation and filled out a scoring form. Within the next few days, 11 cases resulted in abortion, while 19 pregnant women were lost at follow-up. When the remaining 129 pregnant women applied to the same hospital to give birth,

they filled out the scoring form again. The study was approved by the local ethics committee. Oral and written informed consent was taken from each participant.

During the first questioning, variables that could be detected at the beginning of the pregnancy were asked (minimum 14, maximum 25 inquiries). The purpose of this survey was to determine the prenatal care plan (frequency of routine follow-up) of the pregnant woman according to her risk status, furthermore, determining the relevant patient care unit. During the second questioning, the Knox scoring system was entirely administered at the onset of labor. It was intended to re-evaluate the degree of risk and refer high-risk pregnancies requiring a higher level of care to specialized units.

The Knox scoring form, is a statistically-weighted risk scoring system using data on 27 pregnancy-specific significant risk factors. It consists of six sections covering socio-demographic data, individual characteristics, previous obstetric, gynecological and medical history, any health problems experienced during pregnancy (gestational diabetes, etc.), and gestational week at birth. Considering the social structure of the country, ethnicity was excluded from socio-demographic variables, and the validity of the Knox scoring form was evaluated via 26 items. A high-risk pregnancy was identified using the exact sum of logistic coefficients used by the Knox score (> 0.4 upon admission and > 2.75 at the onset of labor). A poor outcome in this analysis was defined as perinatal mortality (any death after 20 weeks of pregnancy or during the first week of life) or perinatal morbidity (defined as a stay of longer than five days in a neonatal unit).

Receiver-Operating Characteristic (ROC) analysis was performed with the construction of ROC curves to identify the cut-off values.

Results

The Knox scoring system identified 65 pregnant women (50.4%) as high-risk and 64 (49.6) as low-risk during the admission visit. At the onset of labor, the Knox scoring system identified 22 pregnant women (17.1%) as high-risk and 107 (82.9%) as low-risk.

Twelve pregnant women (9.3%) (one case of perinatal death and eleven cases of perinatal morbidity) had poor perinatal outcomes during the study period. Seven of these cases upon admission and 11 of these cases at the onset of labor were predicted by the Knox scoring system with positive predictive values of 10.8% (7/65) and 50% (11/22), respectively.

According to these results, the Knox scoring form administered upon admission yielded 58% sensitivity, 50% specificity, and 10% positive predictive values, while 91% sensitivity, 90% specificity, and 50% positive predictive values at the onset of labor (Tables 1 and 2). Of the pregnant women enrolled in the study 59.7% achieved normal vaginal deliveries, whereas 40.3% had cesarean section. No significant maternal morbidity was noted by the participants.

The diagnostic value of the Knox scoring system for determining high-risk pregnancies was not found to be statistically significant regarding admission (ROC value: 0.655; $p > 0.05$), while statistically significant regarding the onset of labor (ROC value: 0.946; $p < 0.05$).

Table 1. — *Perinatal outcome according to the Knox scoring system upon admission.*

	Poor perinatal outcome	Good perinatal outcome	Total
High-risk	7	58	65
Low-risk	5	59	64
Total	12	117	129

Sensitivity: 7 / 12 (58%), Specificity: 59 / 117 (50%), Positive predictive value: 7 / 65 (10%).

Table 2. — *Perinatal outcome according to the Knox scoring system at the onset of labor.*

	Poor perinatal outcome	Good perinatal outcome	Total
High-risk	11	11	22
Low-risk	1	106	107
Total	12	117	129

Sensitivity: 11 / 12 (91%), Specificity: 106 / 117 (90%), Positive predictive value: 11 / 22 (50%).

Discussion

The identification of pregnancies at risk is one of the most important components concerning prenatal care and moreover, considered very helpful both for the patient and for the general health system [8]. Through such an assessment, high-cost medical examinations and treatments would be reserved for high-risk pregnancies, while low-risk pregnancies can be managed with minimal interferences in normal delivery rooms [11, 13].

According to the Knox scoring data obtained upon admission, half of the pregnant women were at high-risk (65 high-risk / 64 low-risk); therefore, the validity of the Knox scoring system was not found statistically significant. This could be explained with some distinctive data regarding the Knox scoring variables in that of the pregnant women enrolled in this study group, 67% displayed primary school or a lower education status, 14% had less than 50 kg body weight, 17.8% smoked during pregnancy, 15.5% noted shorter than one year interpregnancy interval, and 9.3% had Rh- blood group. In addition, poor obstetric outcomes with respect to previous pregnancies were frequently reported. Moreover, this study was conducted in a level III hospital, where high-risk pregnancies were commonly referred for early diagnosis and treatment, as well as for follow-up.

The sensitivity, specificity, and positive predictive values the authors obtained from the Knox scoring form administered at the onset of labor, were similar to the data reported by Knox *et al.* [11] in New Zeland (sensitivity 90%, specificity 87%, positive predictive value 42%).

The positive predictive value obtained by Knox *et al.* [11] in the scoring form administered at the onset of the labor was reported as the highest to date. In this present study, the positive predictive value obtained upon admission was similar to the value of Knox *et al.*

Mohamed *et al.* [12] compared the data of Knox scoring system administered both upon admission and at late pregnancy (36 weeks gestation) with data of the scoring system they used in England. Upon admission, Knox scored 11.7% of women as high-risk, while their system scored 48.9%. At 36 weeks gestation, Knox scored 1.4% of the same pregnant women as high-risk, while their scoring system iden-

Table 3. — The result of antenatal scoring systems.

	Gestation at scoring	% in risk group	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Number of items in score	Prevalence of poor outcomes
Knox <i>et al.</i>	Booking	31	63	72	16	15	7.6
	Onset of labor	16	87	90	42	27	7.6
Mohamed <i>et al.</i>	Knox scoring system	Booking	30	90	17.6	27	6.8
	36. gestational weeks	1.4				27	6.8
	Their current system	Booking	90	54	12.1	50	6.8
	36.gestational weeks	38				50	6.8
Current study	Booking	11	58	50	10	14	9.3
	Onset of labor	50	91	90	50	26	9.3

tified 37.9%. The positive predictive value they found with the Knox scoring system (18%) was very close to the value reported by Knox *et al.* [11] (16%), but higher than the value of their scoring system (12%). However, sensitivity was determined higher with their scoring system (90%) compared to the Knox scoring system (30%), and both were rather different than the value reported by Knox *et al.* [11] (62%). In the present study, sensitivity was 58% and positive predictive value was 10% upon admission, which were rather low compared to the values reported by Knox *et al.* [11]. The significant difference in the findings of two groups may be correlated with the majority of the high-risk pregnancy in this study group. Additionally, as stated by Mohamed *et al.* [12], it is probable that the predictive accuracy of any score can be altered by the frequency of poor outcome in the population tested. The results of previously studies are summarized in Table 3.

Low-risk pregnant women were almost half of this study group upon admission (49.6%), while 82.9% at the onset of labor. Mohammed *et al.* [12] also reported low-risk in half of their pregnancy cases, both with Knox scoring system and also with their own scoring system. Recognition of the low-risk pregnancies is also important. Comparison of midwife/general practitioner-managed care vs obstetrician/gynaecologist shared care showed similar clinical efficacy [1, 14].

Pregnancies at risk should be differentiated from normal pregnancy cases through antenatal care. These should be monitored frequently in appropriate conditions. However, there is no perfect system for predicting pregnancy complications, which can develop at any stage. Therefore, beginning from the antenatal period, risk assessment should be performed on a regular basis with certain periods throughout pregnancy, and repeated at the onset of labor.

The authors did not achieve statistically significant validity with the data of Knox scoring system administered upon admission. This could be explained as the study was conducted in a level III hospital, where high-risk pregnancies were commonly referred for early diagnosis and treatment, as well as to follow-up. This situation was a limitation in the present study. The positive predictive value reported by Knox *et al.* was higher compared to data of all the other studies conducted. The authors found a similar positive predictive value when applied at the onset of labor. The results obtained at the onset of labor demonstrated that more accurate evaluation of the pregnant women could be managed with this scoring system, thus unnecessary referral to level III hospitals could be reduced.

In Turkey, a standardized scoring system is not available

in order to detect high-risk pregnancies. Randomized controlled studies with larger sampling size are required to be conducted especially in primary health care units. In the light of these data, new scoring systems relevant to the conditions in this country, can be further developed.

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