Original Article

Development of a Comprehensive Antenatal Risk Assessment Tool to Predict Adverse Maternal and Perinatal Outcomes in Rural Areas: An Exploratory Study

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Abstract

Objective: To develop a comprehensive antenatal risk assessment tool to predict adverse maternal and early perinatal outcomes in a rural setting.

Materials and methods: Cross-sectional study among women admitted for delivery in a rural maternity hospital, south India. Risk factors from Rotterdam Reproductive Risk Reduction (R4U) scorecard and social factors relevant to Indian rural context were included in questionnaire. Maternal and perinatal outcomes were obtained from in-patient records. Logistic regression of risk factors associated with adverse outcomes and weighted scores assigned using beta-coefficients. Cut-off score to predict adverse outcome was derived using Receiver Operator Characteristic Curve (ROC Curve) and Likelihood ratios.

Results: Adjusted odds for adverse outcome highest for small for gestational age by ultrasound scan [OR=7.4 (1.4-36.5)], tobacco chewing [OR=5.6 (1.8–28.5)] and hypertensive disorders of pregnancy [OR=3.5 (1.9-9.6)]. After assigning weighted scores, the 74-item antenatal risk assessment tool had a maximum possible score of 86. Risk score was calculated for all subjects. Cut-off score to predict adverse outcome was 4, using ROC curve, with a sensitivity of 98%, a specificity of 21% and positive likelihood ratio of 1.23 (1.10-1.37).

Conclusion: This comprehensive antenatal risk assessment tool is easy to administer, specific to rural areas and can help community-level workers to screen, monitor, and refer high risk pregnancies for further management to prevent adverse maternal and perinatal outcomes. This may be considered a prototype towards developing more robust antenatal risk screening and outcome prediction in rural settings.

Keywords: Score Card; Risk Prediction; Pregnancy; Perinatal Outcomes

Introduction

Maternal mortality and morbidity continue to be a major public health problem in India, where a woman's lifetime risk of maternal death is 1 in 290 (1).While Sustainable Development Goal is to reduce the global Maternal Mortality Ratio (MMR) to less than 70 per 100,000 live births by 2030 (2), recent Sample Registration System (SRS) data pegs MMR in India at 122 maternal deaths for every 100,000 live births (3). The main causes of maternal deaths are haemorrhage, sepsis, obstructed labour and

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hypertensive disorders of pregnancy (4). Perinatal mortality (stillbirth and death of new-born within 7 days of life), accounts for more than half of all childhood mortality (5), commonly caused by prematurity, birth asphyxia, low birth weight and neonatal infections. Perinatal deaths are a reflection of the quality of maternal, intra-natal and early neonatal care (6).

Causes of maternal and perinatal mortality and morbidity are well-documented; however, gaps in medical literature exist when it comes to objective methods of predicting adverse maternal and perinatal outcomes. Assessing pregnant women for high risk is part of routine and essential obstetric care, but not enough attention is paid to socio-cultural factors that may increase the risk of adverse maternal and perinatal outcomes. While risk prediction models for maternal mortality are in existence, for example Collaborative Integrated Pregnancy High-dependency Estimate of Risk (CIPHER) model and the Maternal Severity Index (MSI), the former applies only to critically ill obstetric patients and later applies to hospitalized obstetric patients (7).

The Rotterdam Reproductive Risk Reduction (R4U) (8) score card is one of the few instruments for use in routine antenatal care, that takes into account social, ethnic and lifestyle factors to predict adverse maternal and neonatal outcomes. However, it has been developed for use in the Netherlands and is not entirely suitable for use in a rural Indian setting. There is a need to have a comprehensive risk assessment tool for pregnant women during routine antenatal care which could be used to predict adverse maternal and perinatal outcomes, within the prevailing socio-cultural context, which would include social, environmental and behavioural factors unique to the Indian rural context. With two-thirds of our population residing in rural areas, this study was conducted with the primary objective to develop a culturally specific, comprehensive risk assessment tool that would be an easy to use and non-invasive method to assess risk among antenatal women in rural areas. The secondary objective of this study was to estimate cut-off scores for predicting an adverse maternal or perinatal outcome, using this risk assessment tool.

Materials and methods

The Institutional Ethical Review Board gave the approval for the study. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Study Setting: An exploratory study using a cross sectional study design was conducted among women who were admitted for delivery in a rural secondary-level maternity hospital in Ramnagara District, 50 km from Bangalore city in Karnataka, India over a two-month period in 2017.

Sample Size Estimation: Sample size was calculated based on the adverse maternal or early neonatal outcome with the highest prevalence, which was 11% prevalence of low birth weight among babies born to rural mothers in a similar study setting to ours (9). With 5% absolute precision and 95% confidence limits, sample size was estimated to be 150.

Sampling Method: Consecutive sampling was used for recruiting mothers for this study.

Inclusion Criteria: Women who were admitted to the hospital for delivery.

Exclusion criteria: Women who were referred out to a tertiary centre before the delivery.

Ethical Considerations: Approval from Institutional Ethics Committee was obtained along with permission from the hospital authorities. Written informed consent was taken from the participants before enrolment.

Study Instrument: A questionnaire was administered which comprised of socio-demographic details and questions to document antenatal risk factors. This questionnaire included those risk factors from the R4U score card (8) which were relevant to the Indian rural context as well as additional lifestyle and social factors in a rural setting which are direct or indirect risk factors for adverse pregnancy outcomes, based on an extensive review of literature. The antenatal risk factors comprised 74 questions, all of which had Yes / No response, across five domains- 1) current pregnancy risk factors 2) antenatal care factors 3) previous obstetric history 4) social factors 5) lifestyle factors. The questionnaire was face-validated by two experts in the field of maternal and child health and pilot tested prior to use in the study. After the delivery, when the mother was shifted to the postnatal ward, delivery details and adverse maternal and perinatal outcomes were recorded from the labor room records and in-patient records. Adverse maternal outcomes assessed were assisted delivery (vacuum extraction or forceps), caesarean section, manual removal of placenta, post-partum

haemorrhage, post-partum eclampsia, puerperal sepsis (fever and foul-smelling lochia / sub-involuted uterus/local infection) and puerperal pyrexia (fever). Adverse perinatal outcomes assessed were low birth weight (birthweight < 2500g), preterm (< 37 weeks gestation), APGAR score < 7 (to assess birth asphyxia), congenital anomalies, stillbirth and neonatal death (death of the new-born prior to discharge from hospital).

Informed Consent: Informed consent was obtained from all individual participants included in the study. If identifying information about participants is available in the article, additional informed consent was obtained from the individual participants.

Data Analysis: Data was entered in Microsoft Excel and analyzed with IBM SPSS version 20.0. Study variables were described using frequencies and proportions, mean and standard deviation wherever applicable. The outcome variable was 'adverse outcome', which was taken to be the occurrence of *any one* of the adverse maternal or perinatal outcomes. Bivariate analysis was done using Chi-square test, or Fischer's Exact test where applicable, to look for association between the outcome variable (any adverse outcome) and each antenatal risk factor separately. The risk factors which were significantly associated with the outcome variable (p value <0.05) as well as those risk factors with a p value <0.2 were then entered into a logistic regression model. After regression analysis, the significantly associated variables (where the 95% confidence intervals of the Odds Ratio did not include '1' were then assigned weighted scores based on beta coefficients from the regression model. Each beta-coefficient was divided by the smallest beta coefficient in the model and rounded off to the nearest whole number to create a weighted score. All the other antenatal risk factors in the questionnaire which were not significantly associated with adverse outcomes in our study were given a score of one. Thus, a comprehensive antenatal risk assessment tool was generated with 74-items and a maximum possible total score of 87. To arrive to an antenatal risk assessment cutoff-score that could accurately predict adverse maternal and perinatal outcomes, the total antenatal risk assessment score was calculated for each study subject based on this scoring system and analyzed using a Receiver Operator Characteristic Curve (ROC Curve) and likelihood ratios. The flowchart depicting creation of a Comprehensive Antenatal Risk Assessment Tool is summarized in Figure 1.

Results

Demography: A total of 150 newly delivered mothers participated in the study. Majority of the women were between 20-25 years of age with a mean + SD age of 22.95±3.16 years. Almost all of them were Hindu by religion. Only 45 (30%) women had studied till 12th standard and 146 women were home makers (97.3%).

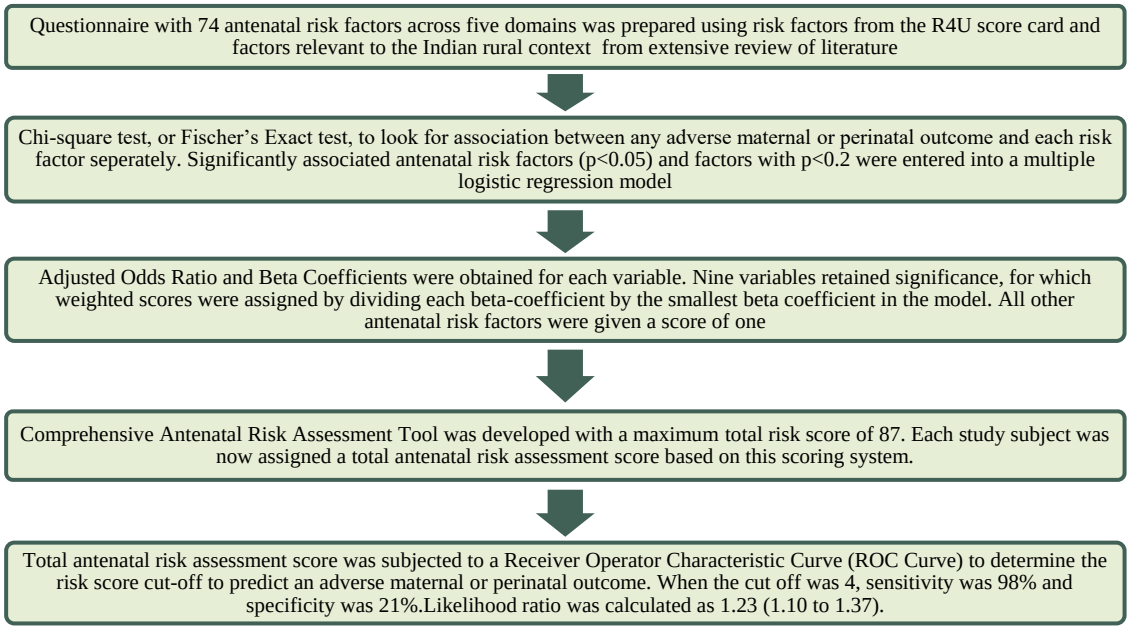

Figure 1: Flowchart depicting creation of a Comprehensive Antenatal Risk Assessment Tool

Home makers are women who are not gainfully employed but take care of the household, the family members and other domestic responsibilities. More than half of the husbands 86 (57.3%) of the study group belonged to agricultural occupations and 107 (71%) of the study population belonged to joint families.

Current Pregnancy Risk factors: Of all the pregnancies, 132 (88%) were unplanned; with only one reported unwanted pregnancy and 8 (5%) were teenage pregnancies. Anaemia (with Haemoglobin levels less than 11.0 mg/dl) was present in 19 (12.7%) women and pre-eclampsia in 11 (7%) but no one was found to have gestational diabetes mellitus, antepartum haemorrhage or twin gestation. There were no subjects with sexually transmitted diseases or any psychiatric illnesses. Everyone had at least one ultrasound scan done, none of them had any foetal abnormalities detected via ultrasound, but two subjects were diagnosed with small for gestational age foetus.

Antenatal care factors: Among the study population, 9 (6%) women did not have a Mother and Child Protection card (MCP Card) and 53 (35%) registered their pregnancy after 12 weeks of gestation. An MCP card is a small booklet with unique number and barcode assigned to a pregnant woman when she registers her pregnancy. This booklet has details of all antenatal check-ups, anthropometry, and health education for pregnant woman, immunization and growth charts or the child after the birth. Antenatal care services were well-utilised with 147 (98%) subjects reporting of having consumed at least 100 Iron and Folic acid tablets and had at least four antenatal visits. All subjects had complete course of Tetanus toxoid injections and routine blood investigations.

Previous Obstetric History: It was the first delivery for 100 (75%) women. Previous abortions were reported by 30 (20%) subjects and 3 (2%) had previous infant deaths. There were no recurrent abortions, no previous history of preterm births, low birth weight babies, birth asphyxia, congenital anomalies, stillbirths, antepartum or postpartum haemorrhage, gestational diabetes or puerperal sepsis. One subject reported a previous instrumental delivery, one had a previous caesarean section and three had history of Rh incompatibility.

Social Factors: According to the Standard of Living Index (SLI) (10), 132 (88%) belonged to lower class. The mean age at which the women in the study were married was 20.1± 2.6 years. There were 5 (3.3%) consanguineous marriages. There were no single mothers and there was no report of domestic violence even though 11 (7%) husbands consumed alcohol. Most subjects were homemakers, 9 (6%) women were involved in occupation with standing labour (work that involved standing for long periods of time, for e.g. working on agricultural farm) and 9 (6%) worked beyond 32 weeks of gestation. About 30 (20%) women had family debts. On assessing the housing conditions, 90 (60%) had a pucca house (roof, walls and floor are all made of impervious material) and 51 (32%) were living in semi-pucca house (either roof, walls or floor is made of pervious material). Overcrowding was present in 33 (22%) houses.

Lifestyle factors: Tobacco chewing was reported among 9 (6%) subjects during pregnancy, however there was no report of smoking, alcohol consumption or drug abuse during pregnancy. Almost all mothers slept for >8 hours a day. None of the mothers had a BMI >30 kg/m^2 at first visit.

Adverse Outcomes: The adverse maternal and perinatal outcomes documented in the study are summarised in Table 1. Some subjects had an adverse maternal as well as an adverse early neonatal outcome. The outcomes were combined into a single binomial variable of presence or absence of any one adverse outcome. 35 participants (23.3%) had an adverse outcome (either maternal or perinatal or both).

Table 1: Adverse maternal and perinatal outcomes in the study population (n=150)

Adverse Maternal Outcomes	n (%)	Adverse Perinatal Outcomes	n (%)
Assisted delivery	12 (8)	Low birth weight	18 (12)
C section	15 (10)	APGAR<7 (1min)	16 (10.7)
Puerperal pyrexia	30(20)	APGAR <7 (5min)	2 (1.3)
Post-partum haemorrhage	1 (0.7)	Congenital anomalies	0
Manual removal of placenta	0	Preterm	0
Puerperal sepsis	0	Stillbirth	0
Post-partum eclampsia	0	Neonatal death	0

Antenatal Risk Assessment Scoring: Among the 74 known risk factors for adverse pregnancy outcomes across 5 domains, the factors which had statistically significant association with adverse maternal or perinatal outcome were: small for gestational age by scan (p=0.002), maternal anemia (p=0.04), occupation with standing labor (p=0.029), working beyond 32 week gestation (p=0.029), and tobacco chewing (p=0.025) (Table 2).

Table 2: Risk factors significantly associated with adverse outcomes (n=150)

Risk Factor		Adverse Outcome N (%)		p value
		Present [35 (23.3)]	Absent [115 (76.7)]	
Unplanned pregnancy	Yes	28 (21.2)	104 (78.8)	0.10 ‡
	No	7 (38.9)	11 (61.1)	
Maternal Anemia	Yes	8 (42.1)	11 (57.9)	0.04 *
	No	27 (20.6)	104 (79.4)	
Hypertensive disorders in pregnancy	Yes	5 (45.5)	6 (54.5)	0.08 ‡
	No	30 (21.6)	109 (78.4)	
Small for gestational age by ultrasound	Yes	2 (100)	0 (0)	0.06 †
	No	33 (22.3)	115 (77.7)	
Does not have MCP card	Yes	4 (44.4)	5 (55.6)	0.136 †
	No	31 (22.0)	110 (78.0)	
Less than 4 Antenatal checkups	Yes	1 (50.0)	1 (50.0)	0.18 †
	No	33 (22.3)	115 (77.7)	
Occupation with standing labor	Yes	5 (55.6)	4 (44.4)	0.029 *†
	No	30 (21.3)	111 (78.7)	
Working >32-week gestation	Yes	5 (55.6)	4 (44.4)	0.029 †
	No	30 (21.3)	111 (78.7)	
Socio-Economic Class	Low	33 (25.0)	99 (75.0)	0.20 ‡
	Middle / High	2 (11.1)	16 (88.9)	
Not living in a pucca house	Yes	18 (30.5)	41 (69.5)	0.097 ‡
	No	17 (18.7)	74 (81.3)	
Tobacco chewing	Yes	4 (66.7)	2 (33.3)	0.025 *†
	No	31 (21.5)	113 (78.5)	

All numbers in parentheses are row percentages.
*statistically significant at p<0.05 † Fisher's exact test ‡ Chi-square test

These were included in a multiple logistic regression model along with factors which had a p value of <0.2; not living in a pucca house, does not have Mother and Child Protection (MCP) card, unplanned pregnancy, hypertensive disorders in pregnancy, less than four antenatal checkups and low socio-economic class.

Not living in a pucca house and unplanned pregnancy lost their significance after regression analysis. The adjusted odds ratios were highest for small for gestational age by ultrasound scan [OR= 7.4 (1.41 – 36.51)], tobacco chewing [OR= 5.6 (1.8 – 28.53)] and hypertensive disorders of pregnancy [OR= 3.5 (1.85-9.56)] Weighted scores were assigned for the nine significantly associated factors, computed from the beta-coefficients (Table 3). Thus, a comprehensive antenatal risk assessment tool was generated with 74-items and a maximum possible total score of 87 (Table 4). The mean total risk score of the study population was 8.11 (SD: 2.91) with a range of 2 to 19.

Table 3: Logistic Regression of risk factors associated with adverse outcome.

Factor	Beta Coefficient	Odds Ratio with 95%CI	p value	Weighted score *
Unplanned pregnancy	1.3	1.5 (0.25 – 1.85)	0.257	1
Maternal Anemia	2.7	2.1 (1.25 – 7.67)	0.042	2
Hypertensive disorders in pregnancy	4.6	3.5 (1.85 – 9.56)	0.009	4
Small for gestational age by scan	5.2	7.4 (1.41 – 36.51)	0.002	4
Does not have MCP card	2.2	1.6 (1.19 – 8.67)	0.032	2
Less than 4 Antenatal checkups	2.9	3.1 (1.12 – 23.24)	0.035	2
Occupation with standing labor	2.8	1.8 (1.03 - 13.57)	0.048	2
Working beyond 32 weeks gestation	2.7	2.4 (1.8 3- 13.42)	0.032	2
Low Socio-Economic Status	2.8	2.2 (1.32 – 22.69)	0.026	2
Not living in a pucca house	1.4	1.2 (0.82 - 9.4)	0.581	1
Tobacco chewing	3.1	5.6 (1.8 – 28.53)	0.006	2

*Weighted scores obtained by dividing the Beta coefficients with 1.3 which is the smallest coefficient in the model

Table 4: Comprehensive antenatal risk assessment score card

	1. Current Pregnancy Risk Factors	Score		2. Antenatal Care Factors	Score		4. Social Factors	Score
1	Primigravida	1	27	Does not have MCP card	2	50	Single mother	1
2	Unwanted pregnancy	1	28	Registration of pregnancy >12 weeks	1	51	Teenage marriage	1
3	Unplanned pregnancy	1	29	No pre-conceptional folic acid taken	1	52	Consanguineous marriage	1
4	Teenage pregnancy(<19years)	1	30	< 4 ANCs in pregnancy	2	53	Domestic violence	1
5	Maternal age (>35 years)	1	31	< 100 IFAs consumed in pregnancy	1	54	Alcohol consumption by husband	1
6	Grand multipara	1	32	< 2 doses / No booster of TT injection	1	55	No personal income	1
7	Conceived by assisted reproduction	1	33	Routine blood investigations not done	1	56	Occupation with standing labor	2
8	Maternal anaemia (<11 g%)	2	34	Obstetric ultrasound not done	1	57	Working >32 weeks gestation	2
9	Gestational diabetes	1				58	Low socio-economic status	2
10	Hypertensive disorders	4		**3. Previous obstetric History**		59	Family has debts	1
11	Antepartum haemorrhage	1	35	Last childbirth less than 3 years ago	1	60	Unemployed partner	1
12	Hypo/hyperthyroid	1	36	Recurrent miscarriages (≥2)	1	61	Illiterate or no formal education	1
13	STI/RTI	1	37	Previous child with congenital anomaly	1	62	Semi pucca or kuchcha housing	1
14	Any TORCH infection	1	38	History of preterm birth (<37 weeks)	1	63	Overcrowding	1
15	Heart disease in pregnancy	1	39	History of birth asphyxia	1	64	Lack of separate kitchen	1
16	TB in pregnancy	1	40	History of low birth weight babies	1	65	Lack of sanitary latrine	1
17	Current psychiatric illness	1	41	History of stillbirths/intrauterine death	1	66	Lack of safe drinking water	1
18	Self-medication in 1st trimester	1	42	History of instrumental delivery	1			
19	Short stature (<140 cm)	1	43	History of Caesarean section	1		**5. Lifestyle Factors**	
20	Weight gain of >500g /week	1	44	History of gestational diabetes	1	67	Chewing tobacco during pregnancy	2
21	Mal presentation of the foetus	1	45	History of PIH/(pre)eclampsia/ HELLP	1	68	Smoking during pregnancy	1
22	Multiple gestation	1	46	History of Antepartum haemorrhage	1	69	Passive smoking in pregnancy	1
23	Small for gestational age by scan	4	47	History of MRP/PPH	1	70	Alcohol consumption during pregnancy	1
24	Structural abnormalities seen in scan	1	48	Rh incompatibility	1	71	Sleep for <8 hours a day	1
25	Organ abnormality detected by scan	1	49	History of puerperal sepsis	1	72	BMI <18 kg/m^2 (at first visit)	1
26	Polyhydramnios/Oligohydramnios	1				73	BMI >30 kg/m^2 (at first visit)	1
	TOTAL ANTENATAL RISK ASSESSMENT SCORE = (Score of 4 or higher indicates High Risk Pregnancy)					74	Multiple sexual partners	1

***Antenatal risk cut-off score to predict adverse outcome*:** To determine the cut-off score for prediction of an adverse outcome, the total antenatal risk assessment score was then calculated for each study subject. The ROC Curve (Figure 2) indicates that a cut-off score of 4 gives a sensitivity of 98%, specificity of 21% along with 78% area under the curve. A score with very high sensitivity was chosen to minimize false negatives, at the cost of lowered specificity. At the cut-off score of ≥4, the likelihood ratio was found to be 1.23 (1.10-1.37) with p = 0.001.

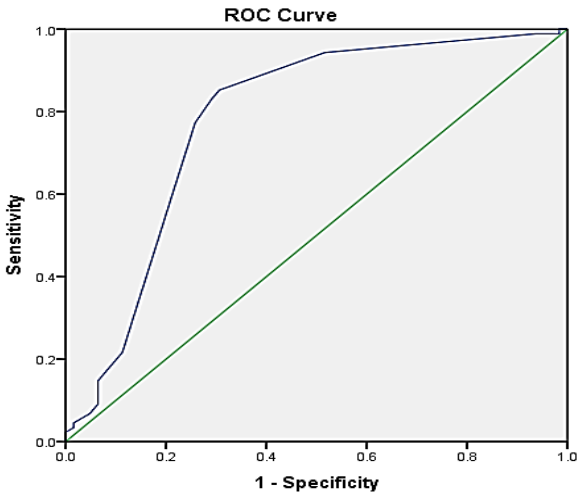

Figure 2: ROC curve showing maximum area under the curve (0.78) at the cut off of 4 with sensitivity of 98% and specificity of 21% for predicting adverse outcomes.

Discussion

The demographics of our study population is reflective of rural areas of India, where women are typically married at the age of 18 to 20 years and their first and second pregnancies occur between 20 and 25 years, with lower education and economic status, and an unsurprising lack of single mothers in this socio-cultural setting. The traditional family structure and culture in a rural area prevents most of the women from holding a job of their own, unless it is to assist their families in farming and also prevents women from making an informed choice about when and how many children they wish to have, as evident by the large majority of unplanned pregnancies in this study. In our study, more than a third of women did not live in a pucca house, which is in line with the 2011 census data (11).

From all the 74 possible risk factors listed in the risk assessment tool, there were nine factors that were found to have increased odds of an adverse maternal or perinatal outcome. These factors were found to have twice the risk of an adverse outcome in our study and have been shown to be predictors of adverse outcomes similarly in other studies; women with maternal anemia (12, 13), occupation with standing labor (14, 15), working beyond 32 weeks of gestation (15), not in possession of an MCP card (16) and of low socio-economic status (17, 18). Risk factors which were thrice more likely to have an adverse outcome in our study and have similarly been identified as predictors of adverse outcomes in other studies were women with hypertensive disorders of pregnancy (19) and those with less than four antenatal visits (20, 21). The highest odds of an adverse outcome were calculated for two risk factors which have also been demonstrated in other research: women who were diagnosed with a small-for-gestational age fetus by ultrasound (22) and those who chewed tobacco (23).

Prevalence of anemia in pregnancy was low in our study (12.7%) as compared to national prevalence of 50.4% (24) and Karnataka state prevalence of 45.4% (25). This may be due to the fact that nearly all our study subjects had adequate antenatal checkups and had consumed the recommended iron and folic acid tablets. This may have been augmented by dietary practices in this locality, where ragi (iron-rich millets) and green leafy vegetables are a staple diet. Cultural norms and practices may have also been the key in the low prevalence of alcohol, smoking and drug abuse among our subjects, habits that usually do not find takers among rural women in our study setting, much less during pregnancy.

One in ten women who delivered had a caesarean-sections, which was lower than the caesarean rate for both India (24) and Karnataka (25) state. This was due to the referral policy in the study hospital where complicated cases were referred to a tertiary hospital. The low birth weight proportion too was lower (12%) as compared to 18% for India (NFHS-4) (24). Our antenatal risk assessment tool can be compared with the R4U score which takes into account the local socio-cultural factors in Netherlands (8) created on the basis of a conceptual framework of multifactorial causation. This was used in further studies to prove that early deduction of risk leads to channeled interventions to prevent adverse events (26).

The rural-specific antenatal risk assessment that we have created takes into account social, environmental, economic and lifestyle factors like

overcrowding, lack of safe drinking water, lack of sanitary toilet, family debts and domestic violence to name a few, which are indirect predictors of maternal and perinatal mortality, but have not been thus far included in any risk assessment tool in India. Usually for screening tests, the cut-off value is selected giving importance to both sensitivity and specificity. In our study, the low cut-off score of four meant that the sensitivity would be very high, but at the cost of specificity. In the case of pregnant women, higher sensitivity is preferable since we do not want to miss any case of high-risk pregnancy, since high risk pregnancies are strong predictors of adverse maternal and perinatal outcomes.

There has been lots of risk prediction scorecards for antenatal women like the one by Talsania and Lala (27); Bansal et al. (28); Ezz-Eldin et al. (29); Psothumus (26) and Rashmi et al. (30). Some of the studies looked at preterm as the main outcome or only the infant adverse outcomes in general. Our score card predicts both the maternal and perinatal outcomes. Also, the other score cards have looked at single aspect of the mother's health or nutrition or behavior. Our scorecard is comprehensive in its approach and inclusive of all possible factors which influences the adverse pregnancy outcomes. Also, our score card can look for risk factors which are recommended as part of the Pre-conception Care by the Centers for Disease Control (31).

Strengths of our study: This risk assessment tool is comprehensive, encompassing various social, environmental and economic risk factors across 5 domains specific to a rural setting, with weighted risk scores providing screening reliability via ROC curve. This comprehensive tool can be easily administered by community level health workers like ANM, ASHA and Anganwadi worker at routine antenatal clinics or during home visits. This tool can be an instrument for action; a score of four or higher would alert the community level worker to the need for further evaluation and management by a doctor, more frequent monitoring, home visits, birth planning and institutional delivery at a referral hospital.

Limitations: This risk assessment tool is based on data collected in a hospital setting and may not be reflective of women who are unable to access obstetric care. Being a secondary level hospital, the referral policy of this hospital for some of the high-risk cases may have reduced the detection of adverse outcomes. However, this model may be considered a prototype towards developing more robust risk screening and adverse outcome prediction in rural settings.

Conclusion

This study had resulted in the development of a comprehensive 74-item antenatal risk assessment tool for use in rural areas of India. Nine factors were found to have increased odds of an adverse maternal or perinatal outcome. Women with maternal anemia, occupation involving standing labor, working beyond 32 weeks of gestation, not in possession of an MCP card and low socio-economic status were found to have twice the risk of an adverse outcome. Women with hypertensive disorders of pregnancy and less than four antenatal visits were thrice more likely to have an adverse outcome. Women who were diagnosed with a small-for-gestational age fetus by ultrasound had seven times higher risk and those who chewed tobacco had five times higher risk. After assigning weighted scores, the tool had a maximum possible score of 86. Risk score was calculated for all subjects and the cut-off score to predict adverse outcome was determined to be four, using ROC curve, with sensitivity of 98%, specificity of 21% and positive likelihood ratio of 1.23 (1.10-1.37). This tool is easy to administer, specific to rural areas, can help community-level workers to screen, and refer high risk pregnancies for further management and may be considered a prototype towards developing robust antenatal risk screening and outcome prediction in rural settings.

Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

There is no conflict of interests among the authors.

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