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SYSTEMATIC REVIEWS/META-ANALYSIS

A Systematic Review of Antenatal Risk Scoring Systems in India to Predict Adverse Neonatal Outcomes

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Abstract

Background The purpose of antenatal care (ANC) is to identify 'at-risk' pregnant women, to provide quality care for all, and maximize the allocation of resources for those who need them the most. To address the synergistic effect of risk factors, clinicians across the globe developed antenatal scoring systems.

Objective This review aims to investigate various antenatal risk scoring systems developed and used in India to predict adverse neonatal outcome.

Methods We reviewed articles published between January 2000 and April 2020, which have either developed a scoring system or used a scoring system, among the Indian population. This systematic review is reported based on Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines. Prediction model study Risk Of Bias Assessment Tool (PROBAST) was employed for the assessment of the quality of included studies. Data sources such as Embase, MEDLINE/Pubmed, APA PsycExtra, PsycINFO, CINHAL Plus, Cochrane Library, IndMED, LILACS, Scopus, WHO Reproductive Health Library and Web of science were searched.

Results An initial search retrieved a total of 6246 articles. This systematic review identified six studies, of which one study developed an antenatal scoring system and the other five studies used two antenatal systems for predicting adverse neonatal outcome. The study which developed a risk scoring system had a high risk of bias (ROB) and concern for applicability. The overall sensitivity of the antenatal scoring system was high (77.4%), but the specificity was low (45%). Similarly, the positive predictive value is low (15.3%), and the negative predictive value is high (94.2%). A meta-analysis was not conducted due to the heterogeneity of the studies and insufficient data.

Conclusions There is a need for a systematically developed antenatal scoring system for India. Such scoring systems can be promising in public health, proposing a paradigm shift in the implementation of effective mother and child health programmes locally as well as nationally.

Keywords Antenatal risk scoring · Risk score development · High-risk pregnancy · Systematic review · India

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Background

The main objective of antenatal care (ANC) is to identify 'at-risk' pregnant women, to provide quality care for all and to maximize the allocation of resources for those who need them the most [1, 2]. A pregnancy becomes high-risk when the woman has one or more risk factors that affect the health condition of the pregnant woman, foetus or both.

The neonatal mortality rate (NMR) of India is 22.7 per 1000 live birth, and the maternal mortality ratio (MMR) is 113. Despite declining trends in neonatal mortality rate (NMR) and maternal mortality ratio (MMR) over the decades, the magnitude is high in India. The reason for such

high mortality rate can be attributed to the prevalence of high-risk pregnancy in India which ranges from 18 to 37% [3, 4].

Timely identification of high-risk pregnancy becomes crucial as a preventive strategy to avoid an adverse outcome [5]. Providing appropriate interventions for high-risk women before and after conception can yield better maternal and child care.

In clinical practice, a physician identifies a high-risk pregnancy by the presence or absence of an individual risk factor [6]. However, in reality, there are multiple risk factors which may act by interaction, and the cumulative effect of the risk factors is responsible for an adverse outcome [7]. To address the synergistic effect of risk factors, clinicians across the globe developed antenatal scoring systems. Nesbitt et al. developed the first antenatal scoring system in 1966; over time, many clinicians developed antenatal risk scorings based on their clinical experiences and individual perceptions. Given the advancements in predictive statistics, many hospitals in developed countries use such scoring systems in their routine antenatal check-ups for planning and resource allocation [8, 9].

In low-resource settings like India, such antenatal risk scoring systems are crucial to identify high-risk pregnancy in the initial days of pregnancy. In India, there is no standard definition for high-risk pregnancy; each author defines a high-risk pregnancy as per their own operational definition. A standard scoring system is, therefore, necessary to compare the progress of indicators and strategies over a period of time.

This review aims to investigate various antenatal risk scoring systems that are developed and used in India to predict adverse neonatal outcome. The objective of this study is to understand the development process of antenatal scoring systems in India, the selection process for risk factors (variables), and the predictive statistics of the antenatal risk scoring systems.

Methods

This systematic review was reported as per Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines [10].

Criteria for Considering Studies for this Review

(a) **Types of participants**

All the pregnant women attending antenatal care clinic, irrespective of the risk factors present, were considered for this review.

(b) **Types of scoring system**

Any antenatal scoring system which predicted more than one adverse neonatal outcome and scored at least once during the pregnancy was included in the review. Since the sole purpose of an antenatal scoring system is to be simple and used by community health workers in low-resource settings, scoring systems which included invasive procedures and costly investigations were excluded. Studies focusing on specific populations (e.g. application of antenatal scoring system only on pregnant women undergoing caesarean section) were also excluded.

(c) **Types of studies**

Studies published between 2000 and April 2020 which have either developed a scoring system or used a scoring system among Indian population were included. Cohort studies, case–control studies, observational studies were included in the review. RCTs, case series, case reports, reviews and editorials were excluded in the review because such studies are not the ideal study design to evaluate an antenatal scoring system. The studies were not restricted by language.

(d) **Types of outcome measures**

The outcome measures of interest for this review were neonatal death, stillbirth, preterm birth, low birth weight (LBW), Apgar score, admission to neonatal intensive care unit (NICU). A study was included if it measured two or more adverse neonatal outcomes.

Search Methods for Identification of Studies

(a) **Electronic search**

We systematically searched in Ovid electronic databases including Embase, MEDLINE/PubMed, APA PsycExtra, PsycINFO, CINHAL Plus, Cochrane Library, IndMED, LILACS, Scopus, WHO Reproductive Health Library and Web of Science for eligible studies. The search strategies contained three sets of terms reflecting the research questions such as the model (risk scoring system), target (adverse neonatal outcome) and patient population (antenatal pregnant women in India). The search was carried out for the period 2000 to April 13, 2020. The search strategy for the Ovid database is listed in appendix 1 (Search strategy).

(b) **Searching other resources**

Studies were also identified by manually searching relevant journals and from reference lists of review articles and eligible studies.

Data Collection and Analysis

(a) **Selection of studies**

Two researchers (DRP and SK) independently assessed titles and abstracts for eligibility using Rayyan Desktop tool [11]. Articles that fulfilled the inclusion criteria were selected. If articles contained insufficient information, the authors were contacted to get the full text. A copy of the full text for all included articles that were available was obtained. Disagreements were resolved by discussion with a third reviewer (VBB) if needed.

(b) **Data extraction and management**

Data extraction forms were developed in MS Excel to collect the information and piloted before use. Each included study was described by general information (author name, year of publication, and study design), descriptors (sample size, place of study, neonatal outcome studied) and reference information (sensitivity, specificity, positive predictive value [PPV], negative predictive value [NPV]). Each included study was assessed and double-checked independently by two researchers (DRP and SK). In case of discrepancies, it was resolved through discussion with a third reviewer (VBB).

The antenatal risk scoring systems were described by their development information (name of the antenatal risk scoring system, origin of the scoring system, country and year of development, development process, the total number of variables in the scoring system, subcategories, risk categories and the scores assigned to it. Meta-analysis was done if three or more studies were reporting the same adverse neonatal outcome using a similar antenatal scoring system.

(c) **Assessment of methodological quality in included studies**

Prediction model study Risk Of Bias Assessment Tool (PROBAST) for the assessment of the quality of included studies was employed [12].

Results

An initial search retrieved a total of 6246 articles. Through the reference lists and citations, additional twelve articles were identified. After removing duplicates, 6205 titles and abstracts were screened, and 21 relevant articles were found. The full manuscript text of these 21 articles was assessed for eligibility. Finally, six studies using three scoring systems met the inclusion criteria [13–18]. Figure 1 details the flow chart of the study selection process adapted from PRISMA statement [10].

(a) Study type and settings

Most of the included studies were conducted prospectively, and only one study was designed as a case–control study [14]. Similarly, only one study was conducted in community setting, and the rest were conducted in the hospital [15]. The sample size of the included studies ranged from 200 to 999 pregnant women. Only two out of six studies were scored at first ANC visit. Two studies were conducted in South India, and the rest were from North India. The details of the included studies are provided in Table 1.

(b) Risk of bias (ROB) in included studies

We could apply the PROBAST tool to one study only, i.e. Bhavna Anand et al. which has developed a multivariable prediction model aiming to make individualized predictions of a diagnostic outcome (Table 2).

This study has high overall ROB and concern for applicability. Following are the shortcomings for downgrading the study to high ROB and concern for applicability of the scoring system (i) lack of external validation of the prediction model, (ii) lack of justification of selection of predictors, i.e. risk factors, and (iii) lack of statistical analysis methods.

(iii) Outcomes

(i) Antenatal risk scoring systems

In total, three antenatal risk factors were used among the included studies. Bhavna Anand et al. [16] developed their own scoring system, and the remaining five studies used scoring systems developed earlier.

Bhavna Anand et al. did not explain the process of development and the selection of risk factors for antenatal risk scoring system in their study. However, the scoring system is an elaborate modification of Coopland antenatal scoring system developed in 1977. The numerical scores in this scoring systems were assigned based on the severity and its implication on maternal and perinatal outcome.

Datta & Das antenatal scoring system is the most commonly used tool for antenatal scoring system in India [14, 17, 18]. They developed the antenatal scoring system by modifying the Prenatal Scoring System by Morrison & Olsen [19]. Morrison and Olsen developed their model in 1979 based on Goodwin et al. 's scoring system, and these two scoring systems were developed in Canada based on clinical experience (accepted risk factors) and arbitrary values [19, 20].

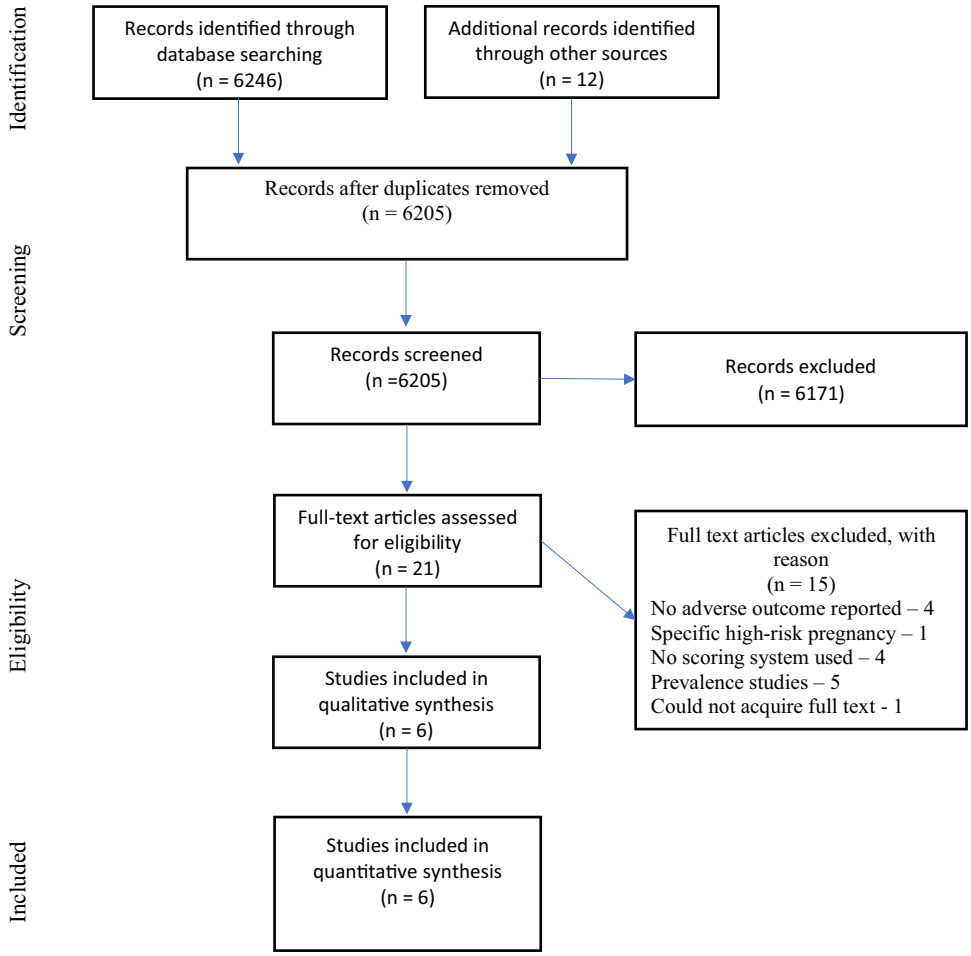

Fig. 1 PRISMA flow chart

Indian Council of Medical Research (ICMR) antenatal scoring system is reported to be from written communication from ICMR in 1986 [21]. Despite three written communications to ICMR, we could not obtain the article on the development process of the ICMR antenatal scoring system. The details of the three antenatal scoring systems are explained in Table 3.

(ii) List of antenatal risk factors

Broadly, risk factors in the three antenatal scoring systems were categorized into i) maternal factors such as age, parity, height, weight ii) past obstetrical factors, iii) present pregnancy factors, and vi) diagnosed associated disease/medical factors.

A total of 75 variables were identified, out of which 31 (41%) variables were unique to scoring system developed by Bhavna Anand et al. Fourteen (18%) variables and four (5%) variables are unique to Datta & Das antenatal scoring system and ICMR antenatal scoring system, respectively. Only 13 (17%) variables were included in all the three scoring systems.

None of the variables was subjective in nature, but eight variables (10.6%) could be answered only after an ultrasound examination. Moreover, the Datta & Das antenatal scoring system has differences in the prediction of risk factors among the three studies. The list of antenatal risk factors is described in Table 4.

(iii) Predictive statistics

Since the primary purpose of the scoring system is to identify at-risk pregnancy, we clubbed any level of risk above low risk as at-risk pregnancy to calculate predictive statistics.

The common outcome measured in the included studies is LBW, preterm, neonatal mortality, neonatal morbidity and stillbirth. There was no uniform predictive performance measure found in the included studies. Therefore, from the available data, we calculated sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV)

Table 1 Profile of included study

Author name (year of publication)	Time of scoring	Study design	Place of study	Sample size	Neonatal outcome studies
Bhavna Anand et al. antenatal scoring system					
Bhavna Anand et al. (2015)	First antenatal visit	Hospital-based prospective study	New Delhi, India (North India)	999	Apgar < 8 Early preterm Extreme LBW LBW NICU admission Observational hospital stay Perinatal mortality Preterm
Datta & Das antenatal scoring system					
Samiya M, Samina M (2008)	Third trimester	Hospital-based case–control study	Kashmir, India (North India)	400	Apgar < 8 LBW Perinatal mortality Preterm
Vasavi Kolluru, Anantha Reddy (2016)	Third trimester	Hospital-based prospective study	Telangana, India (South India)	200	Birth asphyxia LBW Perinatal mortality
Lipi Mondal et al. (2019)	Third trimester	Hospital-based prospective study	Puducherry, India (South India)	372	Congenital anomaly LBW Preterm Respiratory distress
ICMR antenatal scoring system					
Mrudula K. Lala, N.J. Talsania (2001)	First trimester	Hospital-based prospective study	Ahmedabad, India (North India)	687	LBW Neonatal mortality Neonatal morbidity
Kiran Bala et al. (2012)	Third trimester	Community-based prospective study	Jammu, India (North India)	303	Early neonatal death Neonatal mortality Stillbirth

Table 2 Tabular presentation OF PROBAST Results * Critical appraisal of the selected prediction modelling studies based on the PROBAST checklist

Study	ROB				Applicability			Overall	
	Participants	Predictors	Outcome	Analysis	Participants	Predictors	Outcome	ROB	Applicability
Bhavna Anand et al. (2015)	+	+	+	–	+	?	?	–	–

PROBAST = Prediction model Risk Of Bias ASsessment Tool; ROB = risk of bias

* + indicates low ROB/low concern regarding applicability; – indicates high ROB/high concern regarding applicability; and ? indicates unclear ROB/unclear concern regarding applicability

for each outcome measured in the study. The average sensitivity is 77.4%, and specificity is 45.0%. Similarly, the average PPV is 15.3%, and NPV is 94.2%. The details of the predictive statistics are provided in Table 5.

Among the included studies, only one adverse neonatal outcome, i.e. low birth weight, was predicted using the same antenatal scoring system, i.e. Datta & Das antenatal scoring system in more than two studies. However, due to insufficient information, a meta-analysis could not be conducted.

Discussion

Main Findings

This systematic review identified six studies, of which one study developed an antenatal scoring system and the other five studies used two antenatal systems for predicting adverse neonatal outcome. The study which developed a risk scoring system had a high ROB and concern for applicability. The other two scoring systems have their origin from Canada.

Table 3 Profile of the antenatal scoring systems used in India

Antenatal scoring system	Source of scoring system	Year of development/country of origin	Development process	No. of variables used	Subsections	Risk label (and scores)
Bhavna Anand et al.	Own scoring system (elaborate modification from Coopland prenatal scoring system – 1977)	2017, India	No information on the development process	54	Medical factors, Past obstetrical factors, Present obstetrical factors	Low (0 to 3), High (4 to 7), Extremely high (> 7)
ICMR antenatal scoring system	No information*	1986, first study reported in 1988 (22), No information	No information*	22	Maternal factors, Present pregnancy factors, Past pregnancy	Mild (1 to 3), Moderate (4 to 6), Severe (> 7)
Datta & Das antenatal scoring system	Morrison & Olsen's prenatal scoring system -1979	1989, Canada	Based on series of accepted risk factors to which arbitrary values were assigned	32	Reproductive history factors, Past obstetrical history, Present pregnancy factors, Associated disease	Low risk (1 to 2), Moderate (3–5), High risk (≥ 6)

*No information even after three written communication

Assessment of methodological quality revealed various shortcomings for building the antenatal scoring system resulting in a low quality of the reviewed scoring systems. Most importantly, none of the studies were externally validated, and the number of events per variable was fewer than the commonly recommended value of 10 events per predictor [23].

The high sensitivity and low specificity of antenatal scoring systems in India are similar across other studies. Even among the Indian studies which used an antenatal scoring system for one adverse neonatal outcome, the trend is the same. Hence, we can understand that an antenatal scoring system is an effective tool for clinical prediction. An ideal prediction model should have high specificity and sensitivity, and this can be possible using data from a larger sample group. Meta-analysis was not conducted due to the heterogeneity of the studies and lack of sufficient data.

Selection of Risk Factors

Selection of risk factors or model predictors is an important step in the development of a risk scoring system. They should be picked from studies conducted in the same geographical region where the scoring system will be used [24]. A systematic review should be conducted to identify all the associated risk factors for adverse neonatal outcome. The consensus from local experts should be made through a modified Delphi method to identify clinically relevant, most important and objective predictors to add in the risk scoring system.

More number of risk factors in the scoring system increases the predictive accuracy [24]. However, the acceptability of the scoring system also depends on the simplicity of the scoring system [25]. Hence, it is important to identify the risk factors which are most related to the outcome and to include those minimal number of risk factors, so that the predictive accuracy is good and appropriate.

Need for Periodic Revision and Updating

The pattern and prevalence of risk factors modify over time and differs in each population; hence, selection of predictors should be based on the risk factors prevalent or burden of specific risk factor observed in each community. Similarly, the prevalence of adverse neonatal outcome also differs in each population, which critically affects the sensitivity and specificity of the scoring system [26, 27]. This emphasizes the need to develop an antenatal scoring system for each population where it will be used and also the need for updating or revising the antenatal scoring system periodically [26].

Table 4 List of variables in antenatal scoring systems

Variables	Antenatal risk scoring system		
	ICMR	Datta & Das	Bhavna Anand et al
Maternal Factors			
Age	+	+	+
Maternal height	+		+
Maternal weight	+		+
Parity	+	+	+
Present pregnancy			
Abnormal presentation (breech or malpresentation)	+	+	+
Abnormal umbilical artery Doppler*			+
Absent or reverse diastolic flows*			+
Albuminuria		■	
Anaemia/pallor	◆	+	+
Antepartum haemorrhage	+	+	+
Breathlessness	+		
Eclampsia			+
Foetal malformation			+
Gestational diabetes			+
Gestational hypertension			+
Hypertension/blood pressure	◆	+	+
Hypertension with albuminuria		●	
Intrauterine growth restriction*			+
Intrahepatic cholestasis of pregnancy*			+
Morbid adherent placenta*			+
Multiple pregnancy		+	
Oedema	◆	■	
Oligohydramnios*		●	+
Placenta previa			+
Polyhydramnios*		+	+
Preeclampsia/history of fits during pregnancy	+		+
Premature rupture of membranes		+	+
Preterm labour pains			+
Prolonged labour		■	
Prolonged pregnancy		●	
Rh isoimmunization	◆	+	+
Small foetus/small for dates*		+	
Tetanus immunization	◆	◆	
WR/VDRL	◆		
Past pregnancy (s)			
Abortions	+	+	+
Antepartum haemorrhage	+		
Assisted reproductive technique (ART) conception			+
Big baby		+	
Family history of recurrent abortions			+
Foetal anomaly (with or without heritable genetic cause)			+
Gynaecological diseases like fibroids, synechiae, ovarian			+
Hours of abnormal presentation	+		
Hypertension/preeclampsia			+
Infertility		+	
Low birth baby		■	

Table 4 (continued)

Variables	Antenatal risk scoring system		
	ICMR	Datta & Das	Bhavna Anand et al
Neonatal death	+	+	+
No. of operative deliveries/previous caesarean section	+	+	+
Post-partum haemorrhage/manual removal of placenta	+	+	+
Pregnancy-induced hypertension		+	
Preterm births	+		+
Prolonged labour/difficult labour	+	+	+
Radioiodine ablation within past six months			+
Stillbirths	+	+	+
Uterine malformation			+
Associated diseases			
Active bacterial, viral, fungal or protozoal infection			+
Active immunological disease			+
Brain tumour/carcinoma			+
Cardiac disease		+	+
Chronic disease like HIV			+
Chronic renal disease		+	+
Diabetes		+	+
Epilepsy			+
Hypertension			+
Icterus increasing or decreasing			+
Immunological disease			+
Infective hepatitis		+	
Other diseases according to severity		+	
Positive serology for infections			+
Previous gynaecological surgery		+	
Pulmonary disease			+
Pulmonary tuberculosis		+	+
Under-nutrition		+	
Urinary tract infection			+
Lifestyle			
Smoking			+
Alcohol use			+

■ Variable included only in study by Samiya M, Samina M (14)

● Variable not included in the study by Samiya M, Samina M (14)

♦ Not clear if the variable should be considered in past pregnancy or present pregnancy

* Requires an ultrasound investigation

Use of Statistics

Predictive statistics has seen exponential growth in recent decades. All the scoring systems used or developed in India might have used weightage based on the clinicians' opinion. It is now known that statistical weightage decreases the number of risk factors and has an edge over clinical weightage [24]. When statistical methods are used, it increases the predictive values and decreases the number of risk factors which make the scoring system simple to use in antenatal clinics or hospitals [24].

Usefulness of Such Risk Scoring System in Neonatology

An estimate of the risk of an adverse neonatal outcome can provide important information to obstetricians and neonatologists and provide appropriate care for both mother and child [28, 29]. In low-resource setting where there is a lack

Table 5 Predictive performance of antenatal risk scores of included studies

References	Neonatal outcome	Sample size	Prevalence	TP	FP	FN	TN	Sensitivity	Specificity	PPV	NPV
Bhavna Anand et al. *antenatal scoring system*											
Bhavna Anand et al. 2015	Apgar < 8	999	13.1	65	292	66	576	49.6	66.4	18.2	89.7
	Early preterm	859	7.1	43	248	18	550	70.5	68.9	14.8	96.8
	EXTREME LBW	817	4.8	29	232	10	546	74.4	70.2	11.1	98.2
	LBW	960	19.0	96	232	86	546	52.7	70.2	29.3	86.4
	NICU admission	999	12.5	65	292	60	582	52.0	66.6	18.2	90.7
	Observational hospital Stay	999	0.8	0	357	8	634	0.0	64.0	0.0	98.8
	Perinatal mortality	999	0.8	6	351	2	640	75.0	64.6	1.7	99.7
	Preterm	999	20.1	109	248	92	550	54.2	68.9	30.5	85.7
ICMR antenatal scoring system											
Kiran Bala et al. 2012	Early neonatal death	303	1.3	4	259	0	40	100.0	13.4	1.5	100.0
	Neonatal mortality	303	19.5	53	210	6	34	89.8	13.9	20.2	85.0
	Stillbirth	303	2.3	7	256	0	40	100.0	13.5	2.7	100.0
	Total	303	23.1	66	197	4	36	94.3	15.5	25.1	90.0
Mrudula K. Lala, N.J. Talsania 2001	LBW	696	21.6	140	430	10	116	93.3	21.2	24.6	92.1
	Neonatal morbidity	696	11.2	75	495	3	123	96.2	19.9	13.2	97.6
	Neonatal mortality	696	4.5	30	540	1	125	96.8	18.8	5.3	99.2
Datta & Das antenatal scoring system											
Lipi Mondal et al. 2019	Congenital anomaly	372	3.2	8	238	4	122	66.7	33.9	3.3	96.8
	LBW	372	23.1	68	178	18	108	79.1	37.8	27.6	85.7
	Preterm	372	4.8	12	234	6	120	66.7	33.9	4.9	95.2
	Respiratory distress	372	16.1	47	199	13	113	78.3	36.2	19.1	89.7
Samiya M, Samina M 2008	Apgar < 8	408	11.3	44	164	2	198	95.7	54.7	21.2	99.0
	LBW	408	12.0	43	165	3	197	93.5	54.4	20.7	98.5
	Perinatal mortality	408	4.4	17	191	1	199	94.4	51.0	8.2	99.5
	Preterm	408	9.1	33	175	4	196	89.2	52.8	15.9	98.0
Vasavi Kolluru, Anantha Reddy 2016	Birth asphyxia	200	13.5	22	83	5	90	81.5	52.0	21.0	94.7
	LBW	200	10.0	14	91	6	89	70.0	49.4	13.3	93.7
	Perinatal mortality	200	2.0	4	101	0	95	100.0	48.5	3.8	100.0
	Total	200	25.5	40	65	11	84	78.4	56.4	38.1	88.4

TP true positive, *FP* false positive, *FN* false negative; *TN* true negative, *PPV* positive predictive value; *NPV* negative predictive value

of manpower such a score can help understand and evaluate the risk of a pregnant woman. A scoring system could offer a standardization of the classification process [29]. However, vigilance should not be relaxed merely because a woman has one major risk factor. She should not be neglected as she is at low risk [30]. To the best of the knowledge of authors, it is the first of its kind to analyse the methodological robustness and risk of bias of antenatal risk scoring systems in India.

Strengths and Limitations

This systematic review is the first of its kind to summarize evidence on antenatal scoring systems in India. This review emphasizes the need for the development of scientifically sound antenatal scoring systems in Indian context. The findings from the review will help the programmers or clinicians to develop a simple and robust scoring system and thus help in the application of health care delivery system, which is cost-effective. It will also help in follow-up or intervention research among antenatal mothers in case of the presence of antenatal risk factors and adverse outcomes. Meta-analysis was not conducted due to the heterogeneity of the studies and lack of sufficient data.

Implications for Practice, Research and Policy

In light of the few studies and the variations in the risk factors used, it is not possible to generalize the finding from the included studies to the entire country. Predictive studies with larger sample size having good accuracy level will help to generalize the study findings. In the twenty-first century, use of computer models can make the scoring systems a promising and useful predictive tool. Such scoring systems can be used in public health, proposing a paradigmatic shift in mother and child care [29].

Conclusion

Because of the lack of evidence on the standard antenatal scoring system in India, it is imperative that more efforts be directed towards developing an antenatal risk scoring system based on the current evidence available and knowledge in statistics. Although there were some efforts, it is important to standardize the scoring system in India and use it widely in public health systems.

From this systematic review, we understand that there is a need for a systematically developed antenatal scoring system for India. Now that we know the strengths of using predictive statistics, a population relevant antenatal risk scoring system should be developed for India.

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Authors' contribution All the authors conceived and designed the study. DRP, SK and SKK developed the search strategy. DRP and SKK conducted the search strategy. DRP and SK independently assessed titles and abstracts for eligibility and extracted relevant data. VBB was the third reviewer to resolve any disagreements. DRP and VBB drafted the manuscript. All the authors reviewed, gave feedback and approved the final version of the manuscript.

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