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ORIGINAL RESEARCH

Evaluation of Risk Factor Screening Using the Ministry of Health's Scoring System for the Incidence of Early-Onset Preeclampsia in Primary Health Service

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Background: Early onset preeclampsia (E) causes severe complications that lead to morbidity and mortality in women. Various screening methods have been implemented, including the Ministry of Health's scoring system and eoPEE prevention programs implemented in primary health care in Indonesia.

Purpose: The objectives of this study were: 1) To determine the results of screening for eoPE risk factors using the Ministry of Health's scoring system, 2) To evaluate the accuracy of the Ministry of Health's scoring system in predicting the occurrence of eoPE.

Patients and Methods: This prospective cohort design study was conducted from October 2021 to September 2022 in 38 primary health centers in Banyumas Regency, Central Java Province, Indonesia. A purposive sampling technique was utilized. The pregnant women with a gestational age of <20 weeks who were screened for eoPE risk factors using the Ministry of Health's scoring system at the first pregnancy visit were included as research participants. Data were processed using SPSS version 29, and a 95% confidence interval was used to determine the significance level.

Results: The results revealed that 563 (13.9%) were classified as high risk for developing eoPE. The incidence of eoPE among those pregnancy screened was 2.5%. The most common maternal risk factors associated with eoPE were mean arterial pressure (24.8%), age ≥35 years (18.6%), and pre-pregnancy obesity (7.5%). The sensitivity, specificity, positive predictive value, and negative predictive value of the scoring system for eoPE were 52%, 87.1%, 9.6%, and 98.6%, respectively.

Conclusion: It is concluded that the scoring performance test requires modification or other approaches to increase its sensitivity and positive predictive value. Modification of this system requires an approach that is easy, inexpensive, and feasible to be carried out in developing countries.

Keywords: early-onset preeclampsia, risk factors, scoring system, screening

Introduction

Preeclampsia (PE) is an important public health issue, affecting ~5%–8% of all pregnant women.[1] In normal pregnancy, uterine artery diameter doubles and placental perfusion increases >20-fold. This morphology is based on increased cardiac output and trophoblastic changes in the uterine spiral arteries. In preeclampsia, there is a failure of the normative process in trophoblast stem cells to become high-flow vessels. Failure of trophoblasts to transform maternal spiral arteries results in maladaptive remodeling, impaired blood flow and ischemia.[2] This disease is also the leading cause of one-sixth of all preterm births, and women who develop preeclampsia have a significantly increased risk of hypertension and cardiovascular disease later in life.[3] PE is particularly common in low- or middle-income countries,[4] including Indonesia.

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There is a consensus that specific maternal trophoblast defects or metabolic abnormalities trigger PE. Since the late 1970s and early 1980s, several studies have categorized PE in two distinct subtypes based on the onset of clinical signs and symptoms. Early onset preeclampsia (eoPE) is characterized by the emergence of clinical signs and symptoms before 34 weeks of gestation, with a pathomechanism involving failure of spiral artery remodeling.[5,6] In contrast, late-onset preeclampsia (loPE), which manifests after 34 weeks of gestation, is based on a pathomechanism of mismatch between the metabolic needs of the fetus and maternal supply.[5,7,8] Although these two types represent different disease entities, they exhibit similar clinical manifestations.[9] While this classification relies on identifying the onset of clinical signs and symptoms, which can be challenging in pregnant women, time of delivery is commonly used to distinguish PE subtypes.

Early-onset preeclampsia contributes to higher maternal and neonatal morbidity and mortality than loPE.[10–12] Neonates born to mothers with eoPE face an increased risk of respiratory distress, asphyxia, and prolonged hospital stays compared to late-onset preeclampsia.[10,13–15] Women with eoPE are also more likely to experience severe complications, such as HELLP syndrome (Hemolysis, Elevated Liver Enzymes, Low Platelet Count), antepartum hemorrhage, cardiovascular disease, and organ dysfunction. Conversely, mothers with late-onset preeclampsia are more likely to experience prolonged hospitalization due to complications.[13,16]

Proper identification of high-risk individuals, along with effective prevention strategies, remains a priority in health care and research.[17,18] Risk factors that fail to differentiate between eoPE and loPE may overlook risk factors that specifically contribute to eoPEE, as loPE is far more common.[19] In Indonesia, where the incidence of PE ranges from 12 to 21%, eoPE risk factor screening has been implemented as part of PE prevention efforts.[20–23] Maternal risk factor screening is carried out using a scoring system in the Maternal and Child Health handbook, developed by the Ministry of Health, and applied in primary health care services. The screening of PE risk factors is based on guidelines from the National Institute for Health and Care Excellence (NICE). However, the effectiveness of this scoring system in predicting the occurrence of eoPE has never been formally evaluated, contributing to persistently high eoPE incidence rates. Additionally, the Ministry of Health's scoring system does not differentiate between risk factors of eoPE and loPE.[24,25] This study aimed to evaluate the effect of risk factor screening using the Ministry of Health scoring system and the effectiveness of the scoring system on the incidence of eoPE.

Materials and Methods

Study Setting, Design and Period

This was an observational analytic study with a prospective cohort design conducted from October 2021 to September 2022.The study was conducted in the health centre area of Banyumas Regency, Central Java, Indonesia. There are 38 main and auxiliary health centres in this area.

Population of the Study, Sample and Inclusion Criteria

The population in this study comprised all pregnant women living in the Banyumas Regency area, Central Java, Indonesia. The inclusion criteria in this study were pregnant women with a gestational age of <20 weeks, no comorbidities, able to communicate well, and willing to be involved in the study (up to 34 weeks of pregnancy). The exclusion criteria for the study included the presence of comorbidities that appeared before or during the study, communication disorders, and unwillingness to be involved in the study. Preeclampsia was categorized as early- and late-onset, defined as onset of preeclampsia or delivery with preeclampsia before or after 34 gestational weeks, respectively. Informed consent was obtained from all participants.

Data Collection Instrument and Techniques

Thirty-eight coordinating midwives and three hundred fifty village midwives and laboratory personnel at the 38 health centers were involved in collecting data and monitoring pregnancies. The coordinating midwife oversaw data collection and monitoring activities based on the division of the health center area. The village midwife collected and monitored data on each pregnant woman in the village while the laboratory technical staff checked urinary protein levels at the health center. Data collectors were trained over two days to ensure standardization.

Midwives conducted data collection through interviews, physical examinations, and simple laboratory tests performed by laboratory technicians during pregnancy visits at the health center. The physical examination consisted of height, weight, and blood pressure measurements. A simple laboratory examination was performed to assess urinary protein levels. Data were collected through an information system adopting the PE risk factor scoring system from the Ministry of Health's Maternal and Child Health Book 2021 (Table 1).

The maternal health scoring system included 16 risk factors as follows: multipara with new partner pregnancy, pregnancy with assisted reproductive technology (IVF and ovulation induction drugs), age ≥35 years, nullipara, multipara with a previous pregnancy interval of >10 years apart, a history of preeclampsia in the mother or sister, obesity before pregnancy (BMI >30 kg/m2), multipara with a previous history of PE, multiple pregnancy, diabetes in pregnancy, chronic hypertension, renal disease, autoimmune disease, systemic lupus erythematosus (SLE), anti-phospholipid syndrome (APS), MAP ≥90 mmHg, and proteinuria.

Screening results were categorized into two groups: moderate risk and high risk. A moderate-risk category was assigned if less than two moderate risk factors were found, while a high-risk category was assigned if one high-risk factor was present or if two moderate risk factors or more were found. Data were observed until 34 weeks of gestation to determine the incidence of eoPEE, characterized by an increase in systolic blood pressure to 140 mmHg and diastolic pressure to 90 mmHg with proteinuria (urine dip >+1 at two examinations 6 hours apart or an immediate quantitative measurement of 300 mg/24 hours) occurring at more than 20 weeks of gestation but less than 34 weeks.

Table 1 Scoring System Algorithm for Detection PE Risk Factor

	Moderate Risk	High Risk
Anamnesis		
Multipara through pregnancy with a new partner.	+	
Pregnancy through reproductive technology (IVF or ovulation induction drugs)	+	
Age ≥ 35 years	+	
Nullipara	+	
Multipara with previous pregnancy interval >10 years	+	
History of preeclampsia in mother or sister	+	
Obesity before pregnancy (BMI > 30kg/m^2)	+	
History of pregnancy with preeclampsia		+
Multiple pregnancy		+
Diabetes in pregnancy		+
Chronic hypertension		+
Kidney disease		+
Autoimmune disease		+
Antiphospholipid syndrome		+
Physical Examination		
Mean arterial pressure ≥90 mmHg	+	
Proteinuria (urine dipstick value > 1 of two examinations at 6-hour intervals or quantitatively > 300 mg/24 hours)	+	

Note: Pregnant women are referred to hospital if 2 moderate risks and/or 1 high risk are found.

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Data Processing and Analysis

Descriptive statistics, such as frequency and percentage, were used to describe the incidence of risk factors among subjects and the results of screening classifications based on the scoring system. To determine the proportion and relative risk of risk factors and screening results, the incidence of early-onset preeclampsia was analyzed using the chi-square test. The effectiveness of the scoring system was assessed based on its sensitivity, specificity, and positive predictive value.

Ethical Considerations

This study was performed according to the principles of the Declaration of Helsinki of the World Medical Association regarding the application made to the research ethics committee of Padjadjaran University (No 874/UN6.KEP/EC/2021), which works under the Ministry of Health (11/102,021).

Results

In this study, 4053 pregnant women who underwent pregnancy check-ups at <20 weeks of gestation at the health centre were screened using the Ministry of Health scoring system. Maternal risk factors captured based on the number of consecutive events were MAP (24.77%), age ≥35 years (18.55%), and obesity before pregnancy (7.45%) (Table 2).

The screening results using the Ministry of Health scoring system revealed that 563 (13.9%) pregnant women were included in the high-risk category for eoPE (Table 3).

The results of risk factor screening using the Ministry of Health scoring system with a high-risk category determined based on a cut-off score of >2 developed into eoPE in 9.6% (p <0.001; RR: 6.7; 4.6–9.8 CI 95%) (Table 4).

Table 2 Frequency Distribution of Maternal Risk Factors in Pregnant Women in Banyumas Regency (n=4053)

Risk Factors	Occurrence of Risk (N=4053)	
	f	%
MAP ≥90 mmHg	1004	24.8
Age ≥35 years old	752	18.6
Pre-pregnancy obesity (BMI>30kg/m2)	302	7.5
Nullipara	80	2.0
Multiparous whose previous pregnancy interval >10 years	78	1.9
Recurrent pregnancy loss	71	1.8

Table 3 Cluster Screening Maternal Risk Factors in Pregnant Women in Banyumas Regency (n=4053)

Cluster Screening	f	%
High risk	563	13.9
Moderate risk	3490	86.1
Total	**4053**	**100**

Table 4 Relationship Between Risk Factors and eoPE Incidence (n=3929)

Ministry of Health's Scoring System	eoPE		No eoPE		RR	p Value
	N	%	N	%		
High risk	52	9.6	492	90.4	6.7 (4.6–9.9; CI 95%)	<0.001*
Moderate risk	48	1.4	3337	98.6		
Total	**100**	**2.5**	**3829**	**97.5**		

Note: *Statistically significant.

Table 5 The Effectiveness of the Scoring System on eoPE Incidence

	eoPE Incidence (2.5%)					
	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	LR+	LR-
Ministry of Health's scoring system	52	87.1	9.6	98.6	4.0	0.5

Abbreviations: PPV, positive predictive value; NPV, negative predictive value.

By implementing the Ministry of Health scoring system at an incidence of 2.5%, we can predict eoPE with a sensitivity of 52%, a specificity of 87.1%, a PPV of 9.6%, and a NPV of 98.6% (Table 5). Overall, this Ministry of Health scoring system provides simple predictive effectiveness as it only uses maternal factors to predict the occurrence of eoPE.

Discussion

Various studies have been conducted to reveal the structure of health behavior at the research locations we have determined. Several studies showed that women in Banyumas discovered that 60% of female adolescents have poor dietary behavior, rarely eat fruit, and rarely exercise.[26] This poor dietary behavior causes pregnant women in Banyumas to have an incidence of chronic energy deficiency.[27] In addition, it has been proven that cultural factors in the Banyumas population also have the potential to influence disease treatment.[28] All of these specific local factors, the hypothesis support the emergence of the quantity and quality of eoPE risk factors.

eoPE and loPE are pure maternal syndromes associated with different clinical features, biochemical markers, genetic risk factors, and heritability. However, both have the same maternal features, signs, and symptoms of preeclampsia. In this study, we evaluated moderate and high-risk factors in 4053 pregnant women. For moderate risk group, the most common were MAP > 90 mmHg (24.77%) and age > 35 years (18.55%). For high-risk group, the two most common risks were antiphospholipid syndrome (1.75%) and chronic hypertension (1.46%). The relationship between MAP and the pathology of preeclampsia involves endothelin-1. In previous studies in Indonesia, a positive correlation between MAP and endothelin-1 was demonstrated.[29] ET-1 is a vasoconstrictor that regulates vascular tone. Although MAP in the first trimester is strongly correlated, MAP is unable to distinguish which will develop into the disease and which will not.[30] MAP is an important biophysical marker with inconsistent performance of prediction models due to differences in measurement methods.[31–33] A case-cohort study concluded that MAP assessed by automated devices was better at identifying high risk of preeclampsia than manual devices.[34] Another study demonstrated that first-trimester MAP is a strong predictor in nulliparous women.[35]

In this study, the second most common moderate risk factor was maternal age >35 years. Age is a single risk factor for chronic diseases. Women are disproportionately affected by age-related diseases. It has been shown that age alone is a risk factor for the development of gestational hypertension and preeclampsia.[35] Studies in monkeys have shown that there is an increase in blood pressure in the third trimester in older mothers even though they live in controlled environmental conditions.[36–38] The risk of preeclampsia shows a J-shaped relationship with maternal age, which is

higher at the extremes of reproductive age. Other studies have also determined that age is a component in the risk stratification of developing preeclampsia.[39,40]

In this study, we found a high risk of eoPE of 13.9%. This finding is lower than that of studies in China and India (28% and 49.4%).[41,42] The results of risk factor screening using the Ministry of Health scoring system with a high-risk category determined based on a cut-off score of >2 developed into eoPE in 9.6% ($p < 0.001$; RR: 6.7; 4.6–9.8 CI 95%). It shows that individuals with high-risk factors have a 6.7-fold greater chance of developing eoPE compared to individuals with moderate risk factors.

Overall, with the implementation of this scoring system at an incidence of 2.5%, we can predict eoPE with a sensitivity of 52%, a specificity of 87.1%, a PPV of 9.6%, and an NPV of 98.6%. It shows that the possibility of this scoring tool being positive when the patient later develops the disease is 52%. This means that the ability of this scoring tool to show positive results when the disease appears is still low. It indicates that this scoring system must be evaluated or given additional markers so that its sensitivity value increases. For specificity, the ability of this scoring system to be negative if there is no disease is quite high, namely 87.1%. It shows that this scoring system as a group detection tool does not work quite well. When this scoring system is compared with guidelines in England and Australia, a higher sensitivity value is obtained.[43,44] When compared with a score that assesses age and various serum biomarkers combined, our scoring sensitivity is lower, but our specificity is higher.[40] This may be a direction for future studies to combine with serum biomarkers to increase its sensitivity. Even when placental factors are added, the value will be higher.[45] Another factor to consider is the pragmatism of the system for implementation in limited resources.[46]

For the positive predictive value of only 9.6%, it means that this scoring ability has low accuracy in detecting individuals who will later develop into eoPE. Meanwhile, the negative predictive value of 98.6% means that this scoring system in detecting individuals who will later not become eoPE is very accurate.

Conclusion

It is concluded that the scoring performance test requires modification or other approaches to increase its sensitivity and positive predictive value. Modification of this system requires an approach that is easy, inexpensive, and feasible to be carried out in developing countries.

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Disclosure

The authors report no conflicts of interest in this work.

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